2040

The Netherlands of 2040

Bas ter Weel
Albert van der Horst
George Gelauff

cpb

No 88
June, 2010

The Netherlands of 2040

Bas ter Weel, Albert van der Horst, George Gelauff

CPB Netherlands Bureau for Economic Policy Analysis
Van Stolkweg 14
P.O. Box 80510
2508 GM The Hague, the Netherlands

Telephone +31 70 338 33 80
Telefax +31 70 338 33 50
Internet www.cpb.nl

ISBN 978-90-5833-461-9

Contents

Preface		7
Summary		9
Part I	Towards 2040	25
1	Imagining the future	27
1.1	How to approach the future?	27
1.2	CPB approach to investigating the long-term future: Scenario studies	30
1.3	How long is a period of thirty years?	31
1.4	Economic developments in thirty years	34
1.5	Policy changes in thirty years	42
1.6	Lessons	43
2	The past: Building blocks	45
2.1	The very long run	45
2.2	Cities	47
2.3	Human capital	49
2.4	Wrapping up: Cities and human capital	51
2.5	Conclusion	53
3	The present: Stylised facts	55
3.1	Cities and human capital	55
3.2	Global developments	65
3.3	Policy awareness	74
4	The future: Trends and counter forces	75
4.1	Technological change	75
4.2	World economy	78
4.3	The division of labour and organisation of work	81
4.4	Cities as the place of business	86
4.5	What have we learnt?	90

Part II Unfolding 93

5 Production technology: Workers and the task economy 95

5.1 Main argument and example 95
5.2 The division of labour 101
5.3 The new division of labour 102
5.4 The new division at work 104
5.5 Consequences and summary 112

6 Spatial development: Cities and economic geography 115

6.1 Why cities exist and why they have limits 115
6.2 A basic model of the location of production 116
6.3 Mobility determines concentration and scattering 119
6.4 Mobility of ideas 123
6.5 Mobility of multinational firms and foreign direct investment 125
6.6 The determinants of economic geography 127

7 Composing the scenarios 129

7.1 Coordinate system 129
7.2 Four scenarios 132
7.3 Scenario drivers 134
7.4 Illustration 136
7.5 Cappuccino 138

8 Unfolding the scenarios 141

8.1 Talent Towns (TT) 141
8.2 Cosmopolitan Centres (CC) 147
8.3 Egalitarian Ecologies (EE) 152
8.4 Metropolitan Markets (MM) 156
8.5 Summary 161

Part III Policies for the future 165

9 Place of business 167

9.1 Mobile factors and attractors 169
9.2 Infrastructure 171
9.3 Regulation 176

10 Knowledge economy 179

10.1 Ideas and people 181
10.2 Education policy 182
10.3 Science policy 187
10.4 Innovation policy 192

11 Labour market 199

11.1 Workers' response to labour-market shocks 201
11.2 Risk sharing and government intervention 204
11.3 Redistribution 209
11.4 Housing market 210

12 Strategic policymaking 211

12.1 Scenarios: A way to effectively deal with uncertainty 211
12.2 The magic circle of strategic policymaking 213
12.3 Other applications 214

References 217

Preface

The Netherlands of 2040 develops four scenarios to increase our understanding of the long-term economic future of the Netherlands.

This work builds on the shoulders of giants. Already in 1955, CPB published its first long-run study. Since this early study, the focus at CPB has been on building a number of scenarios for policy analysis. Two landmark CPB scenario studies in this respect are *Scanning the Future* (1992) and *Four Futures of Europe* (2003). They developed long-term scenarios for the world economy based on trends and comparative advantage. The present work extends the tradition with a focus on how the Dutch economy may be expected to perform in different scenarios.

The main question of the present study is: How will we earn our money in 2040? It is, of course, impossible to give a correct answer to this question—because CPB is not an oracle to be consulted for future predictions. Yet, a look at the future of production in the Netherlands as far as 2040 is crucial. The traditional approach would be to "predict" what types of industries will soar in the next couple of decades. The avenue chosen in this study is not related to industries, however, but is concerned with location and people. So, earning money involves two crucial ingredients: *who* is producing, and *where* does this take place? The first question is about the division of work. Dutch workers increasingly compete and cooperate with workers all over the world. What will be the future tasks carried out by these workers—and will they earn a decent income? The second question is about geography. Cities perform a crucial role in bringing together knowledge and production. These cities can become larger or smaller, depending on the use that firms make of clustering, in terms of reaping the benefits of sharing knowledge. What will be the future of Dutch cities as places of production? This study reveals the implications of the different answers to these questions for policies related to the Dutch place of business, the structure of the knowledge economy and the labour market.

The Netherlands of 2040 was written by Bas ter Weel, Albert van der Horst and George Gelauff. The research has benefited from the inputs of many, whose efforts have improved the work. In particular, Ellen Boelema and Suzanne Kok deserve credit. Ellen served as a superb project manager and provided excellent research assistance during the entire project. Suzanne conducted first-rate work in the research documented in the first two parts of the project. Together, these five researchers formed the project team developing this study and the complementary website http://www.nl2040.nl. In addition, several CPB colleagues have been very helpful in providing input, knowledge and feedback and support over the course of this project. Finally, the many conversations the team has had with academics, business people and policymakers have been useful in getting a grip on the challenges for the Dutch economy in the next three decades. On the website, background information has been posted and a Dutch summary is available for downloading.

Coen Teulings
Director

Summary

This study develops four scenarios that can be used to think about the future of the Dutch economy in 2040. The study addresses the question of *how we will earn our money in 2040* by looking at people and cities. It is hard to predict how the Dutch economy will evolve in the next five years, or even in the next one or two years—let alone thirty years ahead. Yet, policymakers have to take decisions today that have long-lasting consequences—about infrastructure projects, investments in education and science and welfare state reforms, for example. How should policymakers deal with the uncertainty about the future—as far as 2040—when taking such strategically important decisions?

Decisions have to be made today based on current knowledge, and cannot be made conditional on future events. For policies that can be changed fairly rapidly, it is feasible to take action immediately and adjust the policy when it turns out to be the wrong one or when more knowledge about outcomes becomes available. It becomes quite another matter when policies have a long lead-time and/or when they involve investments with large sunk costs. In such circumstances, policymakers have to trade off the benefits of waiting (with the chance of amassing more knowledge and learning about the direction of future developments) against the costs of delay.

A fruitful approach to help answer our main question is to develop scenarios for the future Dutch economy in 2040. Scenarios provide different pictures against which policymakers are able to consider and reconsider decisions and their long-term implications. Scenarios bundle historical developments, current stylised facts and trends towards the future into consistent stories for the future. They compel assist policymakers in thinking through all possible outcomes of their decisions.

People and cities

People and cities are at the foundations of the scenarios. The scenarios explore the questions of *who* earns the money and *where* the money is earned in 2040. People are considered in their role as workers, and each scenario has a different perspective as to their knowledge and the way the tasks they perform are divided: thus, what does the future hold for workers in the Netherlands? Cities are viewed in each scenario according to the type of production that occurs in them, and the connections that exist within and between cities: thus, what will the future bring for cities in the Netherlands? But first, why has this study chosen to focus on people and cities?

People matter …

Human capital is an essential input in innovation and production. Specifically, human capital is crucial for economic development. Education not only improves skills, but also generates various positive feedbacks. Investments in human capital affect social relations and the social

climate in communities, neighbourhoods and cities. This leads to higher levels of trust among citizens, which boosts the attractiveness of a country as a place of business and promotes further investment in education and innovation.

All over the world, firms are expressing high demand for skilled workers. Over the last decades the educational level of the world's labour force has risen substantially. Yet, in many countries the wages of high-educated workers have also risen, which indicates that demand for skills has thus far outpaced supply.

The way in which human capital is used in production is changing profoundly. Around 1980, less than 20 percent of all workers operated some sort of computerised equipment at work; by 2005, this had risen to over 80 percent. Computers change the way we work (who still totals up an account on a piece of paper?) and the way we communicate (who hasn't sent an email today, or perhaps even twittered his latest thoughts?). As a result, jobs are split up into different tasks, and trade in tasks replaces trade in final products. Increasingly, firms participate in complex global supply chains in which the many tasks required to manufacture a good are performed in different locations, often offshore.

… and cities matter ...

Cities flourish and deteriorate. Housing prices in Amsterdam tripled over a period of about 150 years in the golden age (from 1630 to about 1780), and fell to one-quarter of the 1780 price in the period up to 1816. This corresponds with the rapid urbanisation of the western part of the Netherlands (and especially Amsterdam), followed by a decline in economic prosperity when Britain took over Dutch leadership in trade. Only in the second half of the nineteenth century did the index rise again, which is consistent with the developments in the second half of the Industrial Revolution. More recently, after World War II, Dutch cities faced a difficult time, with de-urbanisation of economic activity, and social problems and racial tensions increasing. Stimulated by the development of the service economy and the emergence of the knowledge economy, cities have begun to flourish once again in developed economies. In the Netherlands, for instance, several large companies moved their headquarters to Amsterdam. This development has gone hand-in-hand with rising land rents in the densest areas relative to comparatively rural areas.

Cities bring together people who benefit from each other. Cities are the places where new technologies are being developed. At the beginning of the twentieth century, manufacturing firms settled near each other in order to benefit from knowledge spillovers in the development of electricity. Later on, in 1970-2000, ICT emerged and strongly affected services that concentrated in space. Cities are the places where high-educated people cluster, where start-ups flourish and face-to-face interactions increase productivity. As a result, cities are the places where productivity grows.

The ability of cities to change or even to re-invent themselves is a predictor for economic success. The evolution of the four biggest cities in the Netherlands illustrates this assertion. Amsterdam, Rotterdam, The Hague and Utrecht have led the city rankings in the Netherlands

for centuries. Meanwhile, their industry structure has changed dramatically. Other Western countries have experienced similar developments.

… and together they matter even more

One of the most persistent predictors of urban growth over the last century is the skill level of a city. Cities with a high-skilled labour force have done well. Boston is a case in point. Based on its historically deeply rooted top-level universities (Harvard, MIT) Boston excels in high technology, higher education and financial services. How should the scenarios deal with the notion that people and cities matter—and that together they matter even more? The answer requires a view on possible future technological change and its direction.

Technology and globalisation

How do firms divide tasks among workers, and what will be the main characteristics of workers in 2040? What determines the size and structure of cities in 2040? Basically, the answer to both questions depends on the development of technology, which is the fundamental driver of future economic development. Technological developments are largely exogenous, uncertain and pervasive. This means that they can hardly be influenced by policymakers, and barely be predicted. Rather, policymakers have to be aware of the power of technology and deal with its development to the best of their ability.

General-purpose technologies (GPTs) drive technological change in the long run (that is, over periods of several decades). The arrival of these GPTs is unknown, but when they arrive society changes fundamentally. They affect the production of goods and services, the innovation of new products, the organisation of firms and the lifestyles of consumers. Previous examples include the steam engine, which took off around 1850, and electricity, which started to replace steam power around 1910. Information and communication technology (ICT) is the current GPT affecting a broad range of developments in society at large. Its development started to take off in the 1960s, with its societal impact kicking in with the introduction of the personal computer and, later on, the Internet.

Technology steers people ...

ICT changes the division of tasks among workers through two main channels: communication and information. The communication technology (CT) part of ICT facilitates transmission of ideas and information, and enables people to quickly check and confirm their validity. At present, the speed of communication is so fast that sending and receiving messages occurs nearly simultaneously, which greatly improves the opportunity to check and double check whether the information has been rightly interpreted. Consequently, tasks that used to be highly integrated can now be disconnected and executed by different persons in different places. Workers specialise. For example, Texas Instruments' telecommunications chip looks like any other semiconductor. But it is the product of worldwide effort. Conceived by engineers from

Ericsson in Sweden, it was designed in France with software tools the company developed in Houston. The chip rolls off production lines in Japan and the United States, gets tested in Taiwan, and is put into phone systems in Sweden, the US, Mexico and Australia.

The information technology (IT) part of ICT improves the way workers process information. Many routine tasks have been taken over by computers and expert systems; they will never become tired of doing the same job repeatedly and endlessly. People are still needed to manage and operate the computer, however, and to add creativity and interpersonal contacts. The key strength of computers lies in the interconnection of routine tasks. Systems that link up with each other process larger and more complex types of information. This broadens the scope of work processes. No longer does a team of workers execute all routine tasks; with the aid of a computer a single worker can perform a range of tasks autonomously. Workers generalise and become jacks-of-all-trades. This process has been going on in banks and insurance companies, for example. While automated back offices produce files about clients, products and processes in an enterprise resource planning (ERP) system, the customer communicates with a single person about all of his insurance needs. The advisor is able to recommend a complete package for each customer using the company's ERP system.

Further improvements in ICT may emphasize either CT or IT. This uncertainty influences the division of labour and tasks in the scenarios. Better CT reduces the costs of coordination and communication, and leads to further specialisation of work. The limit to specialisation is the cost of coordinating the different tasks. In contrast, improvements in IT reduce the need to ask for specialist help and input. Workers become less dependent on fellow workers, in terms of both tasks and face-to-face interactions. The limit to generalisation is that workers have to divide attention over many tasks, which may lead to productivity losses when workers have to carry out tasks they are not so well equipped for.

... and cities towards 2040

Will a new GPT arrive over the next 30 years? How that question is answered implies certain shifts in city size in the scenarios. In its early phases, the development of a GPT strongly depends on face-to-face contacts. Researchers, innovators, designers and managers all benefit from close personal interaction in order to exchange knowledge—not only about the contents of the new technology, but also about the highly qualified experts in the field, the most promising new applications of the GPT, adjustment of organisations to the new technology, and so on.

Information and communication technology, the current GPT, has reached an advanced phase. As a result, the current trend in ICT makes physical presence less important, because a lot of modern communication is virtual in nature, and modern production involves knowledge displayed through firms' Intranets. This opens possibilities for production to take place independently of location and time. Cities will become smaller because of advanced ICT substituting for face-to-face contact. The internationalisation of production teams, the rise of international collaborations in science and the increasing number of production locations of multinationals are consistent with this trend. Take Boeing as an example: coordinated from

Boeing's headquarters in Chicago, 70 percent of the Boeing 787 Dreamliner is built by 43 firms in 135 production locations across the world. Only about a third of the activities are directly performed by Boeing.

Bio- and nanotechnology are the foremost candidates for a new GPT in the future. The presence of these technologies is already being felt in many areas of research, similar to the presence of computer technology in "number crunching" in the 1960s. When a new GPT emerges in the coming decades, it will require face-to-face contacts together with extensive laboratories and test sites to innovate in the new technological fields. This will initiate a shift towards larger cities. Economic activity will become more clustered and cities will become more important. Since the future arrival of a new GPT represents a major uncertainty, cities may either shrink or expand over the coming 30 years.

What about globalisation?

Besides its direct impact on people and cities, technology also affects workers and cities through globalisation. The integration of economies, leading to trade in goods and services, exchange of knowledge and the migration of workers, is known as globalisation. To a great extent, globalisation is the result of technological change. A technology such as the steam engine (and beyond) boosted trade in goods; the current wave of ICT facilitates the division of the production chain in many pieces, and its distribution across many countries.

The implications of globalisation and technological change are far-reaching. First, the world income distribution has narrowed. The incomes of the majority of the world's citizens have increased since 1970. With an increasingly better-educated worldwide labour force, emerging economies take part in world trade and shift their comparative advantage more and more from raw materials to intermediates and final products. Foreign competitors challenge Dutch firms on domestic and world markets.

However, full equalisation of per capita incomes is unlikely to occur in the next decades. Much of the differences in income are due to the fact that the Western economies are performing tasks that are quite different from those performed by the economies of developing countries. Equalisation can only take place between identical tasks, and the Western economies have an advantage of specialising in the more-advanced tasks. Western economies increasingly specialise in high-end manufacturing and tradable services. Globalisation creates abundant opportunities, but to exploit the comparative advantage of the Dutch economy, an excellent educated workforce becomes ever more decisive.

Second, trade in tasks replaces trade in goods. The former means that production chains are split up in many pieces, in many tasks, which are operated in different countries. For instance, trade in intermediate inputs has grown substantially in recent decades: currently, intermediates represent 73 percent of trade in services.

Third, location becomes more important. With increased capital and labour mobility, economic activity is more footloose than it was thirty years ago. This implies that the quality of cities and the connections between them become more important than ever. A successful city is

able to attract high-quality production and to lock it in for a long time, whereas other cities fail to do so. The combination of tasks and cities is crucial. For example, the film industry can produce anywhere, but has chosen Hollywood as the main location for producing movies. Hollywood attracts top actors and producers from all over the world. Would it be possible to relocate (parts of) the Hollywood movie industry away from Los Angeles? It may happen, just like Detroit lost its competitive edge in producing cars. Whether it happens depends on the contestability of tasks and cities, which is determined by how easy it is to perform tasks elsewhere, and how easy it is to reproduce the infrastructure elsewhere.

The future of people and cities

This results in three major lessons, which set the stage for the development of the four scenarios. First, knowledge is and will be the key to success for the Netherlands. Human capital and knowledge are essential for participation in technological progress and for maintaining a competitive edge in a globalising world. Second, jobs will be based more and more on a collection of tasks. Third, economic activity will cluster in cities. Cities attract skilled workers who benefit from face-to-face interactions. In addition, cities are the main hubs in the economy, replacing to some extent the role of countries as economic engines. This demands a novel view on the division of work and the location of production in the future.

Four scenarios

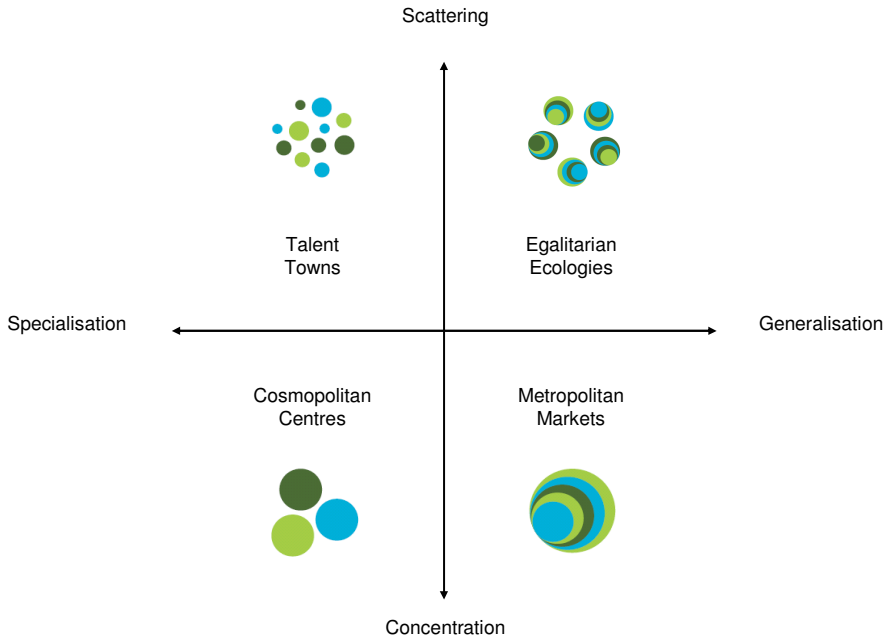
The power of imagination is crucial in creating scenarios because imagination makes it possible to draw pictures about possible future states of the world. People that are better able to deal with different future states will be more successful because they are better able to prepare for unforeseen contingencies. The scenarios in this study are four consistent stories for such contingencies. They deal with two basic uncertainties: (i) the future division of tasks among workers—will it occur anywhere in the world or will production occur more locally and (ii) whether the size of cities will become larger or smaller. Together, these two uncertainties lead to the four scenarios presented in the figure below.

The horizontal axis presents the options for the division of tasks, the vertical axis shows the possibilities for city size. The scenarios are labelled such that the first term reflects the characterisation of people and the second informs about the type of location. For example, the scenario in which workers specialise and city size is relatively small is labelled *Talent Towns*.

The economy is moving towards a task economy in which workers perform one or many tasks rather than producing one or a few products. This implies a new division of work. There are two possible directions. First, workers specialise and excel in one or a few tasks. They produce in teams of similar specialists, which may be virtual and of an international nature. The cost of coordinating tasks determines how specialised firms and cities become. Examples of specialised cities are Detroit, which has specialised in producing cars, and the city of Eindhoven, known for its consumer electronics. Second, workers are jacks-of-all trades and

mainly produce for the local market. The generalist worker is employed easily in many occupations. He uses inputs from the world's knowledge stock and imports intermediate goods. Once again, the generalisation of work extends to firms and cities. Examples of generalised cities are New York, London, Paris and also Amsterdam.

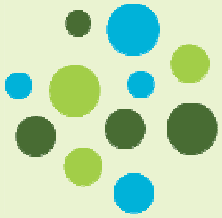
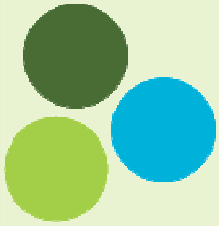
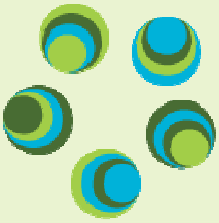
Four scenarios for the Netherlands of 2040



The uncertainty about cities is not about cities becoming more important, since in all scenarios they will become more important. The question is about their size: large or small. The first possibility is that cities become relatively small (with 100,000 to 500,000 citizens) and are scattered across space. They serve as small economic and urban spikes. In this world, the reasons for economic activity to cluster are limited. Cities are formed because they offer a minimum scale to provide local goods and services. In such a world, firms exploit the connections between cities rather than benefiting from interactions within cities. A second option has economic activity becoming highly concentrated in a limited number of large cities. The cities are populated by several millions of people (or attract these numbers by day-to-day commuting). The cities are the meeting places of people for the purpose of trade, for the exchange of ideas, for the development of new technologies and to optimise the matching between workers and firms and between producers and consumers. The geographical area of demand for commodities or services, and the available supply of or potential demand for specified goods or services is large. The cities are magnets, or may even become black holes, absorbing most of the economic activity in the region, or even country, leaving the hinterland empty.

What are the main characteristics of each of the four scenarios, and what are the main differences that are relevant for policymaking? The table 'Main scenario characteristics' presents a summary.

Main scenario characteristics

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
				
City size, in population	100k – 200k	2 – 8 m	100k – 500k	> 10 m
Technology, knowledge				
Direction ICT	Communication	Communication	Information	Information
New GPT	None	Research-oriented	None	Application-oriented
Innovation	Direct applications, strong competition	Radical, firm – university links	Applied and incremental	Fundamental and applied, within firms
World economy				
BRICs	Manufacturing	Manufacturing hubs	Inward orientation	Some metropolises
United States	Top-end innovation and design	GPT, services	IT products and local varieties	Many metropolises
EU (including the Netherlands)	Business services	High-end services	Local varieties	Few, autonomous metropolises
Trade	Global market, high trust, strong trade agreements	Global market, trade in intermediaries	In final products	Limited
Place of business				
Agglomeration	Scattered	Concentrated	Medium city size, local varieties	Highly concentrated
Infrastructure	Virtual + air connections	Between and within cities, high quality	Regional	Locally, high quality
People				
High-skilled workers	Talent is rewarded	Talent is highly rewarded and benefits from interactions	Moderate wages	High wages due to benefits from interactions
Income inequality	High due to specialisation	Very high due to size and specialisation	Low due to absence size of specialisation	High due to size
Vulnerability to shocks	High – specific human capital and city output	High – specific human capital and large city output	Limited	Low

Talent Towns (TT)

Imagine a world with relatively small cities (100,000 - 200,000 inhabitants) and specialised workers and firms. Communication technology (CT) enables specialist workers to co-operate in virtual teams, particularly in service industries. People do not have to meet in person all of the time in order to successfully design new products, improve upon production processes or devise marketing campaigns. Consequently, firms employ specialists from all over the world. Specialist workers gain from personal interaction with their fellow specialists, which determines their location choice. Meeting in person provides the opportunity to monitor the developments in their field, exchange ideas or discuss reputations. In addition, they select their place of residence on the basis of the attractiveness of the living environment and the availability and quality of consumption amenities such as restaurants, theatres, childcare centres, schools and so forth.

The comparative advantage of the Netherlands and other European countries lies with business services. In the coming years, manufacturing activities move for the most part to Asia, because manufacturing knowledge increasingly becomes generally available and because trade facilitates the global transfer of final goods and intermediates. Knowledge of business services becomes the distinctive comparative advantage of the Netherlands. Dutch consultants, financial specialists, designers and publicity experts operate worldwide. In this highly competitive world, exports of business services enable the Netherlands to increase imports of manufacturing products. Since intense competition perpetually creates new winners and losers, there always is a chance that interest groups lobby for protectionism. If some government gives in, then a cascade of retaliation may undermine the sources of wealth.

TT is a very dynamic world with excellent opportunities, but also major challenges. The strongly competitive environment enables high-skilled specialists to earn high incomes. However, the rising top performer of tomorrow can overtake the top performer of today, and when a certain specialisation becomes obsolete, an entire TT may lose its livelihood. Moreover, the wages of low-skilled workers suffer downward pressure due to global competition. The TT world faces the paradox of high demand for protection and redistribution, but limited supply. The high mobility of labour, capital and tasks puts bounds on redistribution. An elaborate social insurance system would urge high-skilled people with a small risk of becoming unemployed to move abroad, thereby eroding the premium base. Hence, substantial vulnerability and inequality together with low solidarity characterise TT.

Cosmopolitan Centres

Envision a world of large cities (each of 2 to 8 million inhabitants) with global connections hosting specialised workers and firms. In a CC city, many specialists from all over the world combine their efforts in the design and production of toys and cars, games and business software, but also a range of new products and services. Some firms and workers specialise in design, financial services or transport, others in electrical engineering or packaging. Companies acquire intermediary products and support services from all over the world. This global division

of tasks relies above all on efficient and relatively cheap communication technologies, which facilitate intensive coordination between all steps in the production process. The second characteristic of this piecemeal production process is just-in-time trade in intermediate products and services, for which a stable international environment is crucial.

Cities develop into clusters of these specialised activities. The largely science-driven expansion of bio- and nanotechnology demands close cooperation between researchers in universities and firms. Also in other fields specialist workers substantially benefit from grouping together. Working on complex tasks in a common location, specialists disseminate knowledge, exchange ideas, share common facilities and establish a reputation among their peers. A cosmopolitan centre of biotech R&D arises at one location, another location develops into a logistics centre, and so on.

The Netherlands may host a few of these clusters in which it has a comparative advantage (stemming from our location and connections with the major economic regions in Europe and the rest of the world, from the educational level of the population and from our international orientation). In addition, our strength in the past may develop in the future, and the Dutch CC cities may specialise in, for instance, company headquarters, water management and engineering, biomass technology, medical engineering, creative activities or logistics services. The prosperity of these cities might be threatened if other cities contest or take over that comparative advantage. Therefore, income levels may differ substantially between centres and between a particular centre and its hinterland. Substantial income inequality also exists within cities, because the large CCs attract a broad range of supporting tasks.

Egalitarian Ecologies

Variety and dispersion characterise egalitarian ecologies. Economic activity spreads out over medium-sized cities (100,000 - 500,000 inhabitants) that host medium-sized firms. Medium-sized cities in the east and south of the Netherlands flourish, building on their strengths in fields such as creative industries, agricultural services, healthcare products, fashion and design. Economic activity in the Randstad keeps pace, because the Netherlands retains its position in the transport of final goods all over Europe. Knowledge resides largely in the minds of the country's generalist employees in combination with the databases and other IT-applications of firms. The IT systems enable firms to produce differentiated products that cater to differences in local demand.

Living and working activities spread out over space. Due to in-house production and meagre inter-firm knowledge flows, firms benefit little from being located near each other. Firms turn away from large cities and settle in medium-sized cities, which offer high-quality non-tradable private and public services, and which provide agreeable living conditions for their employees. Successful cities are hotbeds of high-quality production, and offer opportunities for creative cooperation on a small scale. However, in the longer term cities also face the risk of stagnation. Workers and plants can become locked-in, with limited opportunities inside the city, limited opportunities for learning from outside companies and limited outside options.

EE represents a world with little income growth and modest income differentials. Because technological progress levels off and considerable wealth flows to suppliers of raw materials, disposable income grows only moderately. The relatively equal income distribution fits with the preference for equity in the Dutch society. However, social relations may come under pressure from the considerable migration of low- and medium-skilled workers, which also poses a challenge to the Dutch education- and vocational training system.

Metropolitan Markets

Think of a few very large metropolises with more than 10 million inhabitants dominating the world. Large factories, huge office buildings and sky-high apartment blocks characterise these cities. Economic activity is concentrated in dense areas, where economies of scale and scope are optimally exploited. The hinterland and smaller cities face bleak prospects, talented workers leave and sufficient production size may never be reached. Metropolitan Markets is a world in which the winning cities take all.

In MM, bio- and nanotechnology break through. Their sheer complexity requires extensive research facilities and a high degree of tacit knowledge exchange within large firms to create sufficient potential for developing marketable applications. IT expert systems enable managers to delegate decision-making power. Still, managers need face-to-face contacts with experts in order to assess the technological potential of the firm's product portfolio. Hence, managers have the potential to run a large firm, as long as the various departments of the firm are situated in close vicinity to each other.

Metropolises attract firms and people. In metropolises, firms find trusted business partners, knowledge centres, a large supply of generalist workers and many consumers. People move to a MM city to select the best job, to build interesting relationships and to benefit from an appealing supply of cultural and recreational services. In addition, the scale of the community reduces uncertainty. Thus, if one's job doesn't satisfy, many other job options can be found.

Where the metropolis thrives, the hinterland lags behind. The metropolis attracts all of the highly productive firms and higher-qualified people. Income inequality is large—both within the metropolis and between the metropolis and the hinterland. This may pose serious social problems for a country with a preference for equity, such as the Netherlands. An even deeper problem arises if the Netherlands fails to host a local metropolis; given the scale and scope of MM cities there is a chance that this is impossible. In that case, the Netherlands as a whole becomes a hinterland. Neighbouring European metropolises would attract all company headquarters, research centres and talented people.

Policy

How can this study, with four distinct scenarios, be used for strategic thinking about the future? The relatively broad scope of the study—using developments of cities, human capital and the world economy at large—has the advantage that it can be used as a background for and input into many different subjects that require a long-term perspective. It also means that to analyse other policy areas of interest a further elaboration of the framework will be needed.

Policy environment

Technology determines the allocation of future production. This limits the scope for the government to intervene, but doesn't make its policies ineffective. The scope may be reduced, but the impact will rise. For example, it is important that government and business jointly develop and nurture specialisation in CC. Once the type of specialisation is given, there is a risk of others overtaking the successful place of business. An example is Detroit, which became a place of vast vertically integrated car companies that employed thousands of workers. The result was a massive growth of the city and economic prosperity. However, this model was unstable in the face of the increasing dominance of Japanese car producers, which eventually took over, leaving Detroit behind. In the Netherlands, cities such as Enschede and Tilburg were once known as wealthy textile cities, but suffered once production was taken over by cheaper places. Only after a while did these cities recover and flourish again. The task to monitor—and if necessary, reinvent—cities is one for both business and policy. Yet, the government has to swim with the tide and respond to the development of one of the four scenarios.

Policy should prepare for the future, which is impossible without imagining future developments. The scenarios reveal that uncertainties in future production mainly involve uncertainty about the division of labour and about its distribution across space. This sheds important light on today's choices. Investments in infrastructure should not only solve today's traffic jams, but should also take some account of possible future growth (or decline) of cities and the connections within and between cities. Public institutions for education, science and innovation have to look beyond today's questions and consider the possibility that specialisation becomes crucial. Finally, labour-market institutions were designed in the past, but should anticipate future problems in the best possible way. What should employment protection look like if workers and firms scatter, and people are expected to excel in highly specialised jobs?

Common trends and policies

The scenarios have important implications for thinking about the future of the Netherlands as an attractive place of business, characterised by the emergence of a strong knowledge economy and a flexible labour market. Some of the key challenges for policy are the following:

- Technology drives long-run economic development. Firms located in the Netherlands should be able to at least apply leading technologies. Preferably, Dutch workers, universities and research departments operate at the frontier and help in pushing it forward. The challenge for policy is to design research institutions able to deal with the uncertain future—where progress stems either from improving specialised knowledge or from the integration of several knowledge areas. To accomplish this, two policy measures are of direct relevance in all scenarios. The emergence of the European Research Area (ERA) stimulates knowledge flows by facilitating transfer of researchers across borders. In addition, the move towards a European patent system will help make knowledge more easily accessible and applicable. This will benefit the growth and application of the knowledge stock.
- Production processes are unbundled. Improvements in ICT, together with reliable international relations, facilitate the unbundling of the production process, where each part of the production chain is processed elsewhere. The current strength of the Dutch economy might not be its future strength—but predicting future specialisations is hard, if not impossible. The old paradigm of investigating comparative advantages based on a sector decomposition of the economy does not work any longer, as production processes within and between sectors become unbundled. What remains similar is that free trade is important for a small open economy. Regardless of the scenarios, this is a sound policy. The challenge for policy is to protect workers against frequent shocks and at the same time support them in seizing their opportunities. What kind of glue will connect workers, tasks and cities in the different worlds? What policies lead to the best glue?
- Jobs change—in terms of both the degree of specialisation and their distribution across space. This demands flexibility and security, from the perspective of the welfare state. The challenge is that the provision of social security is likely to fail in scenarios where workers would need it most. To increase flexibility, policymakers should optimally invest in human capital. In addition, making the labour and housing markets more flexible is a no-regret policy. A higher educated workforce is more flexible and skill begets skill. In all scenarios this means that investing in the young instead of repairing deficiencies later is the optimal policy response. A flexible housing market is important to absorb shocks that would otherwise force people to move to other places.
- Cities flourish. Cities are the local networks for face-to-face connections in the development of knowledge and in matching firms and workers. They are also nodes in the global network of cities, and determine the division of production across space. The government has to develop cities, deal with congestion problems, and take care of healthy cities and good connections. The challenge for policy is to deal with uncertainty about urban development: Should we prepare for a world with large-sized cities or would we benefit from scattered cities in a world where location hardly matters? In all scenarios, cities become increasingly important, so regulation should be reoriented towards the city level.

Policies for the future

In each of the four scenarios, policymaking shows a comprehensive and consistent package of successful measures.

In Talent Towns, flexibility and excellence rule the world. An excellent network of connections between cities is very important, with relations between people and place changing rapidly. Cities and workers have to be able to adjust to changing economic conditions, and produce some parts of computer games today, but switch to ICT security tomorrow. The new assignment involves the same tasks but probably a different way of dealing with producers, consumers and intermediate goods. This demands a lot of flexibility from the Dutch labour force, and workers can meet this flexibility only if they are highly educated and specialised in a certain field. They have to be able to both excel in their specialisation and switch jobs easily. The education system should prepare workers for their specialised jobs. Universities should be specialised, and science in general should focus on the utilisation of specialist knowledge. The incentives in the welfare state should favour frequent job-to-job changes and retraining. However, given the fact that workers frequently cross national borders, the means for a nationally organised welfare state to provide these incentives are limited. Talent Towns is a world of chances, which should be seized by workers, firms and government alike.

In Cosmopolitan Centres, large-scale specialisation dominates. Both connections between cities and high urban quality are needed to develop and sustain successful cities in this scenario. Cooperation between government and business is crucial to develop these large specialised cities. This cooperation would help to create an attractive place of business and in sustaining a highly-rated knowledge economy. Early selection and a focus on excellence in education are required to train specialised workers. The downside of specialisation is uncertainty and the cost of switching to another field. These downside risks are rare but far-reaching: a complete city will be hit once its specialisation fails, leading to very high unemployment rates and a substantial drop in housing values. Both the labour market and the housing market should be prepared. Strengthening the rental market should be seriously considered in this respect. CC is a world of extremes, where high prosperity and deep recessions take turns.

In Egalitarian Ecologies, small is beautiful. Medium-sized cities perform a variety of tasks. The labour force is well prepared to deal with negative shocks because workers are able to change jobs quickly. The downside of this generalisation is that although mean performance is reasonable, and volatility is relatively low, EE cities don't benefit to the full extent from new technological developments. The main challenge for the welfare state is not to provide security, but to create incentives. The education system should be geared towards training in general skills and by preparing workers to perform a variety of jobs. In particular, workers should be able to collect information from many sources and apply this in their productive activities. Science, too, should be directed towards the application of globally available knowledge. EE is a world of stability and moderate prosperity.

In Metropolitan Markets, size matters. Firms, workers and their activities will concentrate in a few extremely large cities. The opportunities for small-sized cities in the hinterland are

limited because all economic activity is attracted by the MM city. One of the challenges for the welfare state is to redistribute between the mega-city and its surroundings. Public infrastructure has to support the development of these cities, by developing public transport and local facilities (such as office parks). Science benefits from size and will be able to develop a new general-purpose technology, like bio- or nanotechnology. This will mainly take place within companies, with a focus on the application of the new technology in the production process and in the development of goods and services. Firms have to compete with other local firms, with limited international competition at hand. MM is a world of prosperity for the winners, but despair for regions that lag behind.

Scenarios: from imagination to strategic policymaking

Young people choosing to invest in schooling, firms setting up a new business, workers deciding where to pursue their careers, and governments aiming at strategic policymaking all have to make decisions about an uncertain future. Scenarios help to visualise the consequences of their choices against a set of possible futures. And visualising scenario making helps to get a grip on the scenario outcomes and their policy implications. For that purpose the introductions to Part I, II and III of this study all start with a picture by J.W. Waterhouse.

In Part I *Echo and Narcissus* shows that scenario making is all about combining imagination and reality. Part I uses imagination to depart from a more conventional approach based on sectors and countries. It adds a large body of empirical evidence from reality, to argue that cities, people and their human capital play a central role in the future of the Dutch economy.

In Part II *Consulting the Oracle* acts as a mirror to show that scenarios do not predict the future, but instead tell different stories to underscore the fundamental uncertainties of the future. Building on the evidence from Part I, Part II develops four scenarios from two basic uncertainties: specialisation versus generalisation of workers and increase versus decrease of city size.

In Part III *The Magic Circle* illustrates both the importance of policy and the limits to policymaking. The influence circle of national governments shrinks, but the impact of their actions increases. This implies that governments both have to move with the tide of all-encompassing trends and have to respond to uncertain future developments. Often policy makers have to trade off the benefits of waiting against the costs of delay. When decisions have to be made, scenarios help to assess which policy options are robust to future uncertainties and which options are sensitive to changing circumstances and thus have to be closely monitored.

And ultimately, returning to *Echo and Narcissus*, it is of course to the reader to judge if this study really succeeds in squaring imagination with reality.

Part I Towards 2040

'Change is the law of life. And those who look only to the past or present are certain to miss the future.'
John F. Kennedy, President of the United States.

In his 1903 painting *Echo and Narcissus,* the British painter J.W. Waterhouse (1849-1917) presents a young woman looking over her shoulder at a handsome young man who is lying on the ground bending over a pool.[1] She is the nymph Echo, who can only repeat the words of others; he is Narcissus, so fascinated by his own reflection that he falls in love with it. Echo tries to establish contact with Narcissus by repeating the words he says to his reflection, but he thinks that his reflection is answering him. The gods finally turn him into a flower, the narcissus, the head of which bends to the ground, while Echo pines away until nothing but her voice remains, forever repeating other people's words.

Echo and Narcissus

This painting has at least three lessons for the present study about the future of the Dutch economy until 2040. First, it teaches us to step outside our own world of thinking and let go of our perceptions and beliefs and try to imagine the future in a broad perspective. Narcissus is so obsessed with his own reflection that he fails to observe what is happening around him, which blurs his opportunities to meet with Echo. Our current fascination and concern with the economic downturn could trap us here because we run the risk of neglecting to focus on the fundamentals shaping the future. Second, while echoing what others have told and taught us

[1] The picture of *Echo and Narcissus* can be seen in the Walker Art Gallery in Liverpool or at www.johnwilliamwaterhouse.com.

with the benefit of hindsight is very useful in emphasising the past and present, it fails to yield a picture of the future. The metaphor of Echo, fading away until only her voice remains, cursed to repeat others forever, is tempting in this respect. Our study will be forward-looking by emphasising the challenges ahead, building on the foundations of the past and present. Finally, if this study is to make any sense, it must combine imagination with a sufficient grasp on reality, to be comprehensive. *Echo and Narcissus* is painted in the tradition of the Pre-Raphaelites, who found their inspiration in the Middle Ages and classical antiquity, through British literature (e.g., William Shakespeare) and Romantic poets of the Nineteenth century (e.g., John Keats). Characteristic of this style of Victorian painting are the depictions of classical antiquity, which combine the aura of mythological figures with real symbols. This style made the paintings of the Pre-Raphaelites accessible to a broad public. Our study presents a view about the future that is accompanied by an important look at real trends and tangible strategies to focus on the most important trade-offs for policy.

Part I of this study deals with the question of how to imagine the future. There are several approaches that can be taken to conduct this kind of research. We have chosen for a scenario study, in which we imagine the economic state of affairs in the Netherlands over the course of the next thirty years. Chapter 1 provides a brief and selective review of the many possible approaches that can be taken and have been taken by others. We explore what the implications are of using the length of time of 30 years, what kinds of change we might expect within this period, as well as what lessons might be drawn. Chapter 2 discusses the ingredients underlying our historical and current economic situation. Modern economies are built on two pillars: people and cities. A discussion of the importance of these pillars is followed by a brief history of what is typical for the Netherlands. Chapter 3 uses the fundamentals to present ten stylised facts about current economic relationships that characterise the world as it is right now. These facts also colour future developments. Chapter 4 presents the future trends and the uncertainty around these trends for the next three decades until 2040.

1 Imagining the future

'You see things; and you say, Why? But I dream things that never were; and I say, Why not?'
George Bernard Shaw, Irish playwright and Nobel Prize winner.

At the opening of the 1900 *Exposition Universelle* in Paris, people were asked to envision Paris in the year 2000. The images were mostly constrained to big iron bridges crossing the river Seine, comfortable air taxis and trains that transported ladies with parasols and gentlemen with bowlers. One visitor was very practical: the streets would be cleaned from horse faeces by big sweeping machines. Although none of these predictions became true (the faeces did disappear, though), simply asking people about the future is a useful starting point from which to imagine what the future will look like.

We asked about 100 pupils from a secondary school in The Hague to envision their future and what the Netherlands will look like in 2040. These kids – all between 16 and 18 years old and studying at the highest level of secondary education (*VWO*) – are the workforce of the future. In addition, beliefs about the world are formed in late childhood and seem to change only slowly past this critical period of mental development. Hence, their views and beliefs about the future are likely to be a nice illustration of future outcomes. At http://www.nl2040.nl some of the most salient results of our short survey can be found.

1.1 How to approach the future?

Sketching future worlds contains a strong element of storytelling, which is essential when investigating the future. Well known is *1984* by George Orwell (Orwell, 1949). The book focuses on a repressive and totalitarian regime by following the life of Winston Smith. Smith is a civil servant assigned the task of falsifying records and political literature, and who is growing so disillusioned with his own life that he starts a rebellion against the system. The book has become famous for its portrayal of surveillance ("big brother is watching you") and society's increasing encroachment on the rights of the individual. The book, written during the period of rapid change after World War II, is concerned with what a possible regime change will bring about. Orwell's prediction is that it will bring us a world of strict control and only little individual freedom – with no latitude for creativity and innovative thinking. Essentially, *1984* explores pushing a trend to its limit and exposes the fear and uncomfortable feelings in society at large about the present state of affairs.

Portraying the ideal world or simulating realities is one way to envision the future state of the world. Thomas More's *De Optimo Reipublicae Statu deque Nova Insula Utopia* (1516) sketches the ideal world, where a country is pictured with a perfect socioeconomic system. Plato's *The Republic* presents the perfect political system. Realities are simulated in movies such as *The Matrix*, in which the future perceived by humans is actually a simulated reality, or

The Truman Show, in which a character named Truman lives in a constructed reality for the fun of those outside.

These examples seek to understand what is likely to continue, what is likely to change, and what is novel. The exercise is a practice of postulating outcomes about future states and rejecting possible myths that underlie these states. In the social sciences, there are many techniques to try to understand future states of the world. These include anticipatory thinking protocols, back casting, and modelling, simulation and trend analysis.

The aim of *anticipatory thinking* is to develop a rich and detailed portrait of a plausible future world, including the challenges and opportunities that such an environment would present. Examples are the Delphi method (expert panels) and scenario planning. RAND Corporation is one of the most prominent institutes publishing studies about the future. The classic work *Habitable Planets for Man* by Stephen H. Dole, about finding other planets where humans could survive after a major catastrophe on earth, and how to deal with an increasing world population, is one of their most provocative studies around (Dole, 1964).[1] This study is based on probability and correlations. In the 1960s, the space race between the Soviet Union and the US was intense, and this work presents the characteristics of a planet that could provide an acceptable environment for mankind, itemises the stars nearest the earth most likely to possess habitable planets based on correlations between several chemical processes, and discusses how to search for habitable planets. Another classic long-term projection of the future was made by the Club of Rome in 1972, when it published its report *Limits to Growth*. The analysis in the report predicts that economic growth cannot continue indefinitely because of the limited availability of natural resources. This study was mainly based on (linear) projections of trends into the future, and was criticised for its lack of modelling interrelations and behavioural responses. Both studies have in common that they are provocative, tackle and address relevant questions and contain clear plans or warnings for policymakers by offering a palette of alternatives.

Back casting is a technique to identify a particular scenario and trace its origins back to the present. A project in which this method was applied is the Georgia Basin Futures Project in Vancouver, Canada. The identified goal is a "sustainable city by 2040". In order to achieve the desired outcome, this goal was communicated to the public and science. The information obtained through this process would be included in a model that projects several ideas into the future to see whether they are consistent with reaching a sustainable Vancouver in 2040 and what actions need to be taken underway.

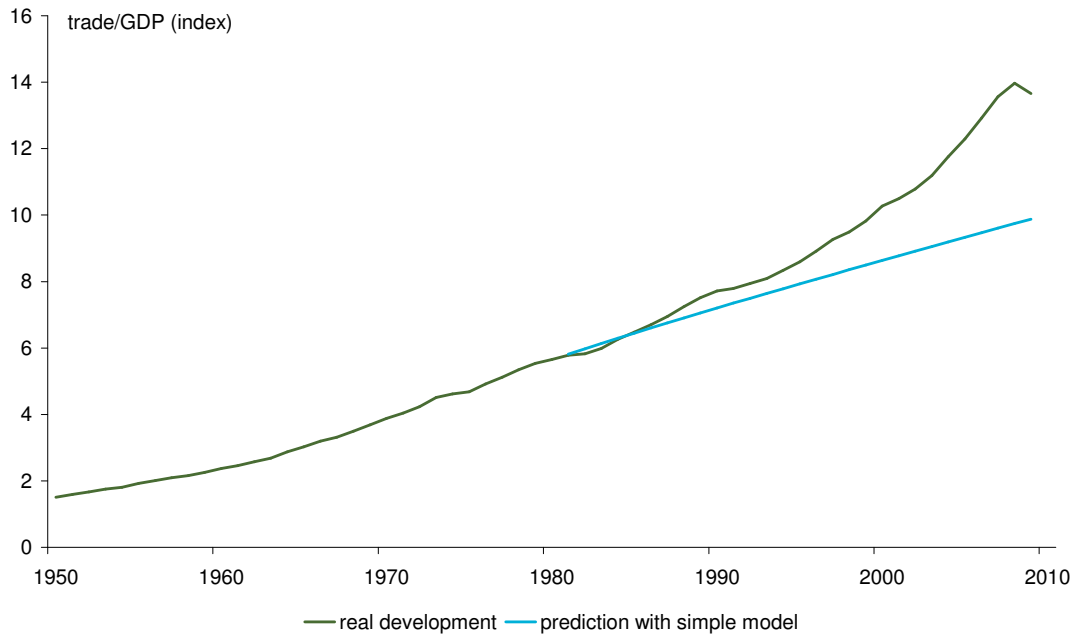
A last way of forecasting the future is the use of models and trend analysis to project historical data flows to future outcomes in a statistical way. This approach fosters an understanding of the connections between important factors and events. Models examine

[1] Dole (1964, p.3): "As it is now, our planet Earth supports the entire human race. It is possible that one catastrophe could completely destroy our form of life. But if the human race were living on a number of planets scattered around the Galaxy, its immortality would be virtually assured. One of the most important facets of life on the Earth today is the rapidly increasing number of human beings. As population pressures increase, there will be ever-increasing incentives for pioneers to migrate to the next frontier."

dynamics, while simulations are able to deal with changes to these models. Extrapolation with correlations is a conceptually straightforward method of predicting economic quantities such as GDP, unemployment or inflation from historical data of the same quantity. The assumption is that the historical data contain information that has predictive power. The simplest way of extrapolating is to "draw a line" through the past data, and extend this line to the future. It is possible to improve on this method, however, since often the time-evolution of macroeconomic quantities shows considerable correlation: if unemployment is high in a particular year, it is likely to be high the next year as well, and the year after, until after a number of years it "forgets" its dependence on the situation in the initial year and becomes independent of it. One way of efficiently capturing the correlations is by means of simple time-series models, such as ARIMA models.[2] These models have two parameters, one accounting for the persistence of the correlation (for example, five or ten years), and one capturing the strength of the correlation.

Figure 1.1 illustrates the use of such a model to predict the development of trade (normalised by GDP), pretending that we are living in 1980, and then compares the prediction to the actual path taken by these quantities. In the first step, we estimate the two parameters of the model based on data from 1950-1980. We do not consider data before 1950, in order to avoid the shock of WOII. We find a long correlation time of the order of 13 years for trade. The estimated model predicts that trade will continue to grow despite the temporary drop of trade in 1980, but the model underestimates the actual growth of trade since 1980. Figure 1.1 shows that there is considerable divergence from the actual development of trade after about ten years. In the case of trade, extrapolation with a time-series model is a reasonable approach, but no more than that.

Figure 1.1 Predicting international trade using a simple time-series model



[2] ARIMA is short for AutoRegressive Integrated Moving Average.

1.2 CPB approach to investigating the long-term future: Scenario studies

Scenarios provide a useful tool in a world that is uncertain and unpredictable. Some things we have been able to foresee in our scenarios, but many others have altered quite a lot in thirty years. To learn how to develop better scenarios, we continuously look at the efforts of not only some forward-looking companies and institutions, but also our own organisation.

A business company well known for its future studies is Shell, which has a 30-year history of looking ahead and learning about the future of energy. The relevance of doing so is summarised on their website as recognising "that people hold beliefs and make choices that can lead down different paths. They reveal different possible futures that are plausible and challenging." Shell has benefited from these scenario studies in situations where there is a desire to put challenges on the agenda and where changes in the global business environment are recognised but not well understood. An interesting feature of their scenarios is that they reveal information about the time at which they were published. Shell's global scenario for 1992-2020 was centred on the fall of the Berlin Wall and the forces of liberalisation and globalisation. Their subsequent studies sketched a picture of strong and global market forces that seemed to be irresistible, with the only action being to go with this flow. At the turn of the century, the focus was enriched. The 2001-2020 study adds social elements to the economic and the political dimensions, and explores the importance of people and connections to be powerful and influential in shaping the future.[3]

Unilever also structurally investigates the future. Their strategy department builds scenarios for the future prospects of their business. Unilever's 2008 study starts as follows: "This report imagines the world in 2020 through four scenarios. These were chosen for their plausibility and their importance to Unilever. Although we cannot say what the Unilever of 2020 will look like, we have taken, as a working assumption, our current commitment to vitality, though we have interpreted it more widely to cover what would be needed to deliver a true vitality promise in 2020." Unilever's strategy is to focus on a plausible future world and work towards the most efficient and effective ways to build this future for the company.

Delta Lloyd is another company that has invested in developing scenarios about the future of their business.[4] Their newest scenarios for the period up to 2025 point to new balances for the world economy to scattering. The *New balances* extreme points to sustainability and a large role for governments to structure the economy, while the *Scattering* extreme points to turmoil and economic stagnation. The scenarios are to a large extent driven and influenced by the current economic crisis.

Governmental bodies also construct scenarios for gaining insight into possible future challenges and choices. In 1977, the WRR published a report on the next 25 years (WRR, 1977). This study was meant not so much to give a view on policy analysis, but to inform policymakers and to encourage preparation of long-term policies. The WRR foresaw an

[3] See http://www.shell.com for more information and the latest scenario study for energy use up to 2050.
[4] http://www.deltalloyd.nl/dlnl/downloads/flippingbook/scenarioboeknl/index.html

increase of the services sector, combined with a tendency towards individualisation of higher-educated people. Functional networks would replace hierarchies, and the government would be more involved—but as a partner instead of a sovereign body. Furthermore, the WRR foresaw a problem with spatial developments. Suburbanisation and expansion of infrastructure and industry would erode the quality of (rural) areas.

CPB has a long tradition of developing scenario studies for policy analysis. Already in 1955, CPB published *Een Verkenning der Economische Toekomstmogelijkheden van Nederland 1950-1970* (CPB, 1955), with the expressed aim of quantifying possible futures of the Dutch economy. The CPB study was in line with studies about the future of the US and France, but added a scenario element presenting the borders of the intervals of likely developments of the Dutch economy. The aim of the 1955 study is very much in line with the present study, as it explored future options for the Dutch economy to generate income. At that time, competition from abroad was already a concern in relation to the relatively high Dutch wages and in relation to what options were open to workers when their jobs were taken by others from abroad. The current globalisation debate seems to be remarkably similar. More scenario studies have followed the 1955 study; these can be downloaded from http://www.nl2040.nl/.

This study builds on the CPB tradition of presenting scenarios for the future. We follow the trend that quantifying the future becomes less important whereas developing scenarios about possible future images of the world gains weight. Forecasting future income growth is gradually replaced by presenting consistent and plausible pictures for future worlds. Our work continues this development and sketches the most important trends, the uncertainties around these trends, and the trade-offs policymakers face when trying to solve market failures.

1.3 How long is a period of thirty years?

To come to grips with a period of thirty years ahead, we first have to understand the scope of such a period of time. We look thirty years ahead to 2040—but it is hard (if not impossible) to imagine what can happen in such a period of time. To gain insight into the length of the time period, imagine the following leap back in time: Today is not somewhere in summer 2010; rather, it is the summer of 1980. Now return to the past and ponder how you think we will earn our money in 2010.

In the historical novel *De Eeuw van mijn Vader,* Geert Mak starts his review of the 1970s in the Netherlands by putting it into the perspective of the 1950s and 1960s (Mak, 1999). The 1950s and 1960s were focused on the future and were strongly forward-looking. The recovery of the country after World War II was completed, and it was time to reap the fruits of increasing family income and wages, advances in technology, improvements in the welfare state and social insurance and increases in leisure time. When in 1959 the natural gas fields in Groningen (and later on, in the North Sea) were discovered, a part of it was invested in new roads, which improved the infrastructure of the Netherlands dramatically. The first moon-landing in 1969 raised speculations about humans affecting various future states: would there be human cities

on other planets; what about artificial life; would we ever be able to affect where and when rain falls; would nuclear power from small motors ever be used to drive cars; and would the sea be used for electricity?[5] Daily life changed dramatically with the introduction and adoption of television, telephone, cars and an array of household technologies (for example, washing machines and vacuum cleaners). The Netherlands faced a range of favourable technological changes, which were complemented by large investments in infrastructure and housing.

To get a feeling for the atmosphere in the 1980s and the important events that influenced the way that we make money today, we will examine the political situation first. The Cold War is intense, and the oil crisis aftermath is visible in lower growth rates. In the US, the UK and the Netherlands, new governments come into office with a different view on the economy. Keynesian policies to stimulate demand do not seem to work and have resulted in huge budget deficits. Ronald Reagan, Margaret Thatcher and Ruud Lubbers start their terms of office and take strong measures to cut budget deficits, force labour unions to liberalise the labour market, introduce a market-oriented approach in which privatisation of nationally-owned firms is stimulated, and cut tax rates. 1980 seems to be a year of turnaround. The sense of urgency to change the world is clear, and the Dutch annual review of the news of 1980 (*Het Aanzien van 1980*) puts Ronald Reagan on the cover. In his inaugural address on January 20, 1981, Reagan addresses the US economic malaise, arguing: "Government is not the solution to our problems; government is the problem."[6] Supply-side economics becomes very influential in all Western economies and opens up markets and stimulates free trade all around the world. In this period of change, Milton Friedman publishes his book and is featured in a television programme, *Free to Choose,* about how markets work and how government spending has gotten out of hand. Stagflation is one of the main arguments used by Friedman (1980) to argue that governments should reduce their spending and give room to the free market.

The situation in the Netherlands was not very favourable in 1980; in fact, it was much worse than it is today, despite the economic crisis we are now experiencing. CPB's short-term views (*Centraal Economisch Plan* (CEP) and *Macro Economische Verkenning* (MEV)) of that time present grim pictures, and the forewords by the ministers of economic affairs sound worried and bleak. The macroeconomic variables look bad. Unemployment is high, and inflation is simultaneously above the 10 percent level. Belief in the trade-off between unemployment and inflation (the so-called Philips curve) fades away, and stagflation rears its head.

[5] Most of these dreams did not come true, although *Second Life* has made it possible for people to have some artificial imaginative life on the Internet. The steering of clouds and even thunderstorms is by and large impossible, although it is possible to create clouds and squalls. Mostly these squalls appear to be unexpected side effects of the building of large cities. For example, the city of Atlanta (Georgia) is responsible for heating up the environment. As a result thunderstorms form.

[6] In 2008, US President Obama was *Time Magazine's* "Person of the Year". It seems that economic sentiments today are remarkably similar to those in society 30 years ago, with a high sense of urgency for change. The economic crisis has led to discussions about the way in which the economy is designed, the role of the government and the need for supervision of markets to guide the invisible hand. Barack Obama, the 44th President of the United States, put it in his inaugural speech (on 20 January 2009) as follows: "Our economy is badly weakened, a consequence of greed and irresponsibility on the part of some, but also our collective failure to make hard choices and prepare the nation for a new age".

At the same time, the second oil crisis makes things worse. Due to social unrest in Iran, and the subsequent change of power there, the supply of oil is restricted and prices escalate. OPEC countries make record profits, but Western economies are suffering. Most dramatically, the oil price increased almost tenfold between 1971 and 1981. Government debt rose from 45 percent of GDP in 1980 to more than 75 percent in the early 1990s. In the 1970s, the Netherlands became entangled in a wage-price spiral—with annual wage increases ranging between 5 and 15 percent. At the same time, unemployment was dramatically on the rise.

During the summer of 1980, trade unions began to mobilise their members to demonstrate against government decisions involving wage standstills. A crowd of around 70,000 people demonstrated at the Dam Square in Amsterdam against the plans, and workers in Rotterdam marched in the streets. Around 400,000 people were involved in strikes throughout the country. In November 1980, the cabinet took over the negotiations when the pay consultation between the social partners seemed to have failed. The most painful measures were softened a little, and compensated with tax reductions to prevent income losses.

What else happened in 1980?

The following are events that occurred in 1980, or facts of that time, which shows how much (or how little) our lives have changed or how much the world around us was changing:

- The EU consists of nine countries
- Intensified Cold War with invasion in Afghanistan and Brezhnev-Reagan disputes
- Army grasps power in Turkey
- Iran attacks Iraq
- Free elections in Iraq (Saddam Hussein) and Zimbabwe (Robert Mugabe)
- The Gotthard tunnel opens
- Beatrix becomes Queen of the Netherlands
- Political party CDA arises from ARP, CHU, KVP
- The Florin cent was abolished
- Almere welcomes its first inhabitants
- First personal computer, video recorder, CD, walkman and microwave
- Start of the Dutch entertainment industry (Joop van den Ende, John de Mol)
- Nobel prize in economics awarded to Lawrence R. Klein for the analysis of economic fluctuations and policies

The coalition agreement of the first Lubbers cabinet (1982-1986), formed by CDA and VVD, was aimed at cutting back the deficits, which had widened to record levels. In addition, about two-thirds of GDP was spent or redistributed by the government, and taxation and social security contributions accounted for about half of GDP. At the same time, business profitability and investment had plummeted dramatically, and for every ten employed persons there were about eight persons on social benefits. Both the unfavourable economic climate and the spending of the previous cabinets presented enormous challenges to the economy and policymakers. The main aim of the cabinet was to cut government spending and to start with

privatising government-owned companies, which was perfectly in line with the developments in the US and the UK. “Lubbers-1” continued in a more rigorous way the policies that had been initiated by the Van Agt-Wiegel cabinet, and ultimately quit the Keynesian view of the 1970s. Only in the 1990s did this policy seem to have reached fruition, with government debt under control.

1.4 Economic developments in thirty years

The most important economic developments since 1980 include key changes in the economic integration of Europe and globalisation, the computerisation of work, the rise and revival of cities, the growth of a service economy and the emergence of the knowledge economy.

1.4.1 Economic integration

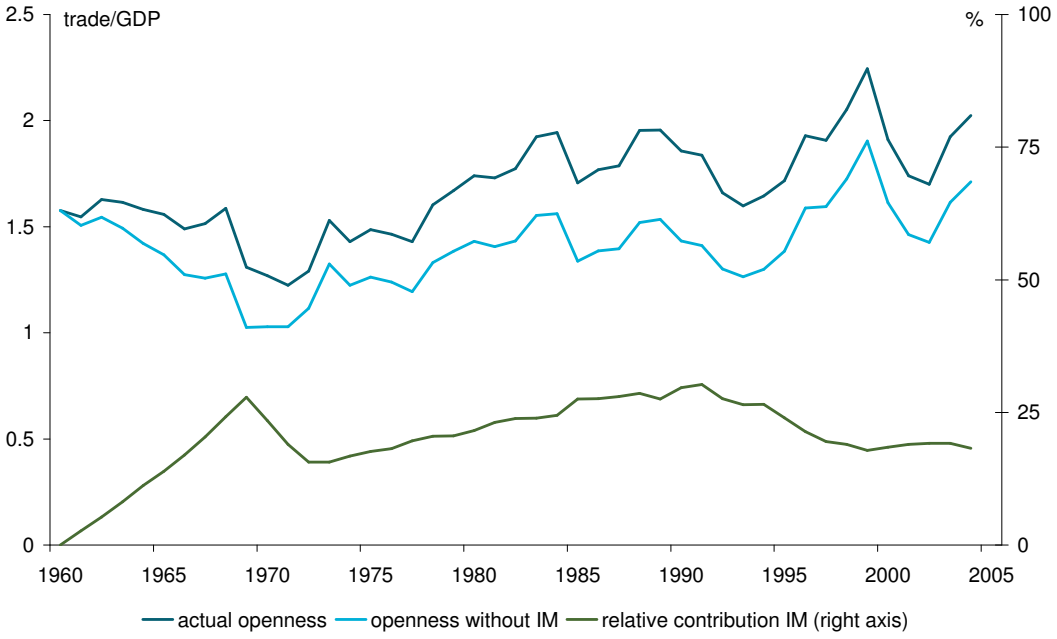
With more trade, comparative advantages of different countries and areas are better exploited. Globalisation has taken off, to the great benefit of the Dutch economy. At the same time, the EU Internal Market has taken huge steps in both scale and scope, which has increased our welfare. The fall of the Berlin Wall in 1989 and the subsequent German unification have removed the threat of war in our backyard. The market has expanded and competition enlarged. The introduction of the euro even hastened this process of European integration in economic terms. Straathof et al. (2008) show that 8 percent of the exports and imports of goods can be attributed to the Internal Market. For services trade, the effects are somewhat smaller: about 5 percent of EU members’ services trade. For the Netherlands, the Internal Market has about twice as large an effect on trade in goods, compared to the results for the EU. For services trade, the effects are in line with the results for the EU. Second, the authors estimate the trade-enhancing effect of the Internal Market on GDP. For 2005, the Internal Market integration of goods markets yielded 2 to 3 percent higher per capita income in the EU, and about 4 to 6 percent higher income per capita in the Netherlands.

Figure 1.2 illustrates the benefits of the European Internal Market for the Netherlands. The figure shows how the openness of the Dutch economy evolved—and how it would have evolved had there been no European Internal Market. The horizontal axis measures the period 1960-2005. The left axis measures openness of the EU-15 countries as total trade (sum of exports and imports) divided by GDP. The line on top shows actual openness of the EU-15, measured as the sum of exports and imports divided by GDP. The line immediately below refers to openness computed using counterfactual trade flows. The line at the bottom is the relative difference between the two lines (measured on the right axis) in percentages (see Straathof et al., 2008, for more details). The abolishment of internal tariffs contributed substantially to the openness of the Dutch economy and has bolstered our national income.

During the 1980s and early 1990s many people still considered the prospects for the Former Soviet Union good. President Gorbatsjov started a fundamental reform, politically as well as economically. This was the period of Perestroika and Glasnost that was instrumental in ending

the Cold War. It also resulted in the fall of the Berlin Wall in 1989. The developments in the Former Soviet Union were deemed positive by many Western commentators. They heavily advocated structural reforms of the economy. Best-known among them is probably Jeffrey Sachs, who strongly advocated big-bang policies as opposed to policies of gradualism, which were practiced most notably in the People's Republic of China.[7] Further, Gaidar's *shock therapy* in 1992 resulted in, among other things, abolition of price regulation by the state and the official authorisation of the market economy in Russia.

Figure 1.2 The benefits of the Internal Market for the Netherlands, 1961-2005



Source: Straathof et al. (2008).

The development since the early 1990s marks a dramatic change in fortune. With hindsight, the policy of gradualism that has been followed in China has (at least thus far) brought economic prosperity at an unprecedented rate and for a historically unique long period of time (see Suyker and De Groot, 2006, for a brief account of China's history). In contrast, Russia deteriorated in all relevant dimensions. Considering the specific implications for the Dutch economy, it is interesting to look in particular at trade patterns with the main trade partners. Trade with China has increased substantially, which is to a large extent re-exports underlining the important role of the Netherlands as a gateway to Europe. In terms of imports, China is now third (behind Germany and Belgium, and just before the US and the UK), with an annual import share of about nine percent. However, despite the impressive economic developments in most notably China, Europe remains by far the most important trading partner for the Netherlands. Creusen and Lejour (2009) confirm the importance of the integration of the EU for Dutch trade by

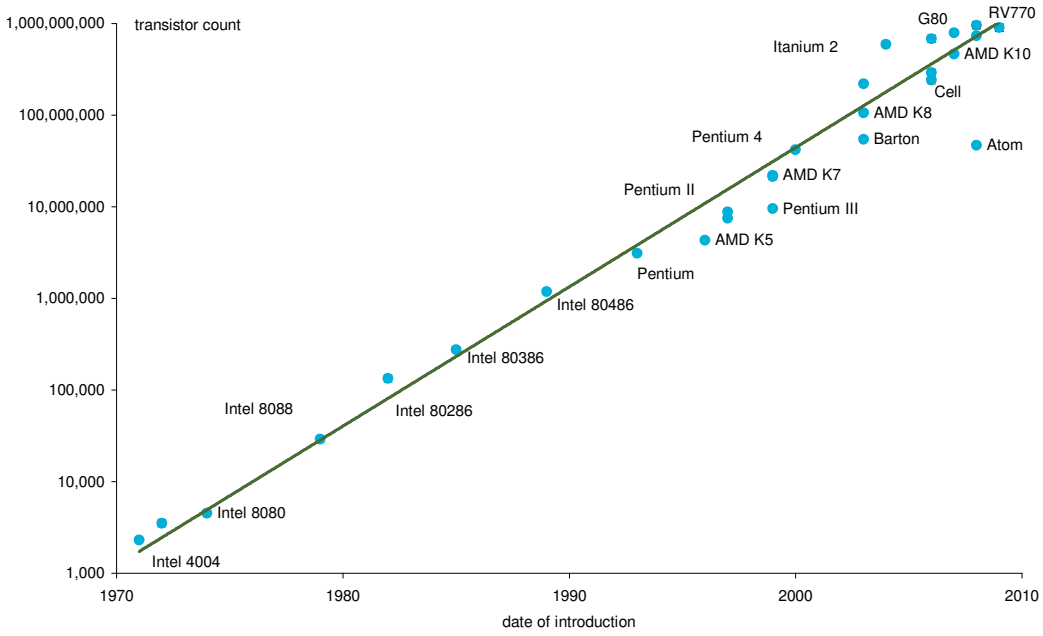
[7] The shock therapy was also heavily advocated by the US and the IMF. Looking back, the policy resulted in a serious economic recession with hyperinflation, a deep financial crisis, and an increase in poverty, corruption and crime.

showing that the contribution of trade outside the EU to GDP per capita in the Netherlands is only about one-fifth of the total contribution to GDP.

1.4.2 Computerisation

Technological change has been driven by advances in computer technology. This general-purpose technology (GPT) has dramatically changed the world in terms of production and connectivity—a development predicted by few people in 1980. Figure 1.3 illustrates the rapid development of computing power. It plots Moore's law, which documents that since the invention of the integrated circuit in 1958, the number of transistors that can be placed on an integrated circuit doubles every two years. This trend is continuing.

Figure 1.3 Moore's law for transistor counts for integrated circuits, 1970-2010



Note: Adapted from http://en.wikipedia.org/wiki/Transistor_count.

Today, most economic transactions involve computer technology. Sometimes the computer takes the form of a cash register, sometimes it is part of a sophisticated point of sale systems, and sometimes it is a website. In each of these cases, the computer creates a record of the transaction. The record-keeping role was the original motivation for adding the computer to the transaction. Creating a record of transactions is the first step in building an accounting system, thereby enabling a firm to understand how its business is doing. Modern transactions in the production process facilitated by computer technology are new ways to write contracts between firms at different stages in the production process, a more efficient monitoring of workers and easier transactions between workers (Varian, 2010).

So, computer technology has changed the way we work. Between the early 1960s and the present, computer use at work has increased dramatically. Around 1980, less than 20 percent of

all workers operated some sort of computerised equipment at work; by 2005, this had risen to over 80 percent (see Borghans and Ter Weel, 2005, and Soete and Ter Weel, 2005, for an overview). The rise in the use of computer technology at work is mainly the result of the introduction of the personal computer in the workplace from 1980 onwards. An essential characteristic of computer technology is that it supports workers in their activities. These developments have also hugely impacted the way we work, amplifying the importance of a highly educated and competitive workforce, and radically altering the income distribution.

One of the most important features of computer technology is that it complements our work. It has reduced the costs of many kinds of interactions by making a great many processes operate more efficiently, and it has made it possible to engage in new interactions that have become cost effective. Computer technology truly falls into the category of revolutionary technology. Revolutionary technologies, at first, are implemented in a rather mechanical way—to make it less costly to produce the same level of output. The main reason for Charles Babbage to manufacture and use a "computer" was to deal more accurately and efficiently with information (Babbage, 1832). These "number crunchers", as they were called, were used until the late 1960s mainly to carry out mathematical and statistical procedures, mass-integrated data processing and simulations of decision-making processes. Over time, this revolutionary technology changed and underwent amendment (in an endogenous or co-invention manner) to do entirely new things—to change the way in which markets function and are structured, to alter how demand and supply are brought together, or restructure the way in which a firm is organised and influence the way in which innovation activities are pursued. These more incremental changes or innovations are the result of computers being a general-purpose technology influencing society and production at large (Bresnahan and Trajtenberg, 1995). These latter consequences of new technologies are often hard to predict.

An example of how difficult it may be to predict technological changes can be found in a study of Klahr and Leavitt (1967). They acknowledged that computer technology used in firms in the mid-1960s was being complemented by communication technology, but they could not forecast the way in which computer technology would change decision-making within firms: "Presumably the organisational impact of this wave [of computer technology] may be broader and may move into somewhat higher levels of the organisational pyramid. One effect of this new thrust seems to be the binding together of several subparts of the total structure, often severely modifying some in the process. Another is to move the locus of large amounts of information to some central point; and, in some cases, to change the locus of certain decisions from one part of the structure to another. The still speculative part of real-time information systems forecasts the provision of instantaneous information to top executives at their will – though no one is quite sure what they should will, or how such innovations will affect present structures." (p. 108). Another interesting quote comes from the WRR (1977): "Er zijn weinig technische innovaties te verwachten die de jeugd kunnen boeien. Huiskamertoepassingen van visuele media zullen het doen en laten van de jeugd niet in sterke mate beïnvloeden." [We don't

expect there to be any future technological innovations that will really interest the young. Living room applications of visual media will not be highly influential for their daily lives].

This view on computers describes the developments until the mid-1980s fairly well, because mainframe computers were in heavy use, and companies such as IBM and Computer Associates were big players in the market for hardware and software.

Sweeping changes took place in the early 1990s, when smaller, more mobile and networked computer technology became available. This client-server type of computing gave companies more flexibility in applying information technologies without losing computing power. The compatibility of different types of software and hardware has increased substantially, moreover, impacting the way in which agents work together within organisations and "meet" suppliers in consumer markets. Client-server computing puts the power of the mainframe computer into a server, and networks permit a business system to run on less powerful and more mobile clients.

1.4.3 The rise of cities

The Netherlands was the first urbanised country in the world, and since the 1980s its cities have begun to flourish again. After World War II, Dutch cities faced a difficult time, with de-urbanisation of economic activity, and social problems and racial tensions increasing. Although in the Netherlands the number of people living in the G5 (Amsterdam, Rotterdam, The Hague, Utrecht and Eindhoven) has declined since 1960, GDP per capita in the G5 has increased compared to the hinterland. Recently, there has been an upswing in the number of people living in the G5. Table 1.1 shows this development over the period 1980-2010. This rise has been mainly due to skilled workers moving to large cities.

Cities are places where creativity is born and can best be exploited. However, cities like Amsterdam also have their drawbacks. Space is limited and pollution has become a serious problem. Thirty years ago saw the city of Almere being established as a suburb for people working in Amsterdam. People were looking for more space but they wanted to be closely connected to their work as well. Furthermore, the government had a main port strategy, with Schiphol and Rotterdam as drivers behind the Randstad (the collective area comprised of Amsterdam, Utrecht and Rotterdam), with a focus on logistics and international connections. Nevertheless, the top-ten largest cities are rather persistent, with the Randstad being the most populated area. Table 1.1 shows the ten largest cities in 1980 and 2010. Very little change has occurred—either in the order of the cities or in the top-ten itself. Interestingly, the three largest cities were already the largest in the Golden Age. Chapter 2 elaborates further on the persistence of economic activity in cities.

The movement of several large companies to the Amsterdam area further emphasised the increasing importance of cities (and the Randstad, in particular). Philips, Ahold and Akzo Nobel all moved their headquarters to Amsterdam. In 1998, Philips CEO Cor Boonstra decided to move the Philips headquarters to Amsterdam, because of the proximity to Schiphol airport and the knowledge about marketing, financial markets and legal issues centred there. The concentration of economic activities also led Ahold (in 2005) and Akzo (in 2007) to take

advantage of the Amsterdam agglomeration and concentration of economic activities by moving their headquarters.

Table 1.1 The ten largest Dutch cities in 1980 and 2010 (x1,000)

1980	Population	2010	Population
Amsterdam	717	Amsterdam	767
Rotterdam	579	Rotterdam	590
The Hague	457	The Hague	489
Utrecht	237	Utrecht	307
Eindhoven	194	Eindhoven	214
Groningen	161	Tilburg	205
Haarlem	158	Almere	188
Tilburg	152	Groningen	187
Nijmegen	148	Breda	173
Enschede	143	Nijmegen	163

The agglomeration of headquarters around Amsterdam fits into a worldwide trend. Headquarters seem to choose to locate in metropolitan areas comprised of a wide variety of business service suppliers (Duranton and Puga, 2005). Firms need information, advice and services from specialists in law, marketing and finance, which was the main reason for Philips to move its headquarters to Amsterdam. Acquiring such information and services involves repeated face-to-face interactions and close spatial proximity between buyers and sellers. So, unsurprisingly, service firms are disproportionately concentrated in Amsterdam. Firms will choose to locate their headquarters in these service cities away from smaller production-oriented cities (e.g., Eindhoven and Arnhem), because they benefit from the variety of differentiated suppliers.

Another explanation is that headquarters cluster together to exchange information among themselves and to acquire information about market conditions. This exchange (through formal and informal exchange of information, trades between firms and knowledge spillovers) provides feedback to headquarters about production, input and technology choices for their plants, which can be located at other places. In the small open economy of the Netherlands, multinationals need to export a large fraction of production, which implies a market for difficult-to-acquire information about exporting markets. Indeed, Lovely et al. (2005) find that the headquarter activity of exporters is more agglomerated than other headquarter activity.

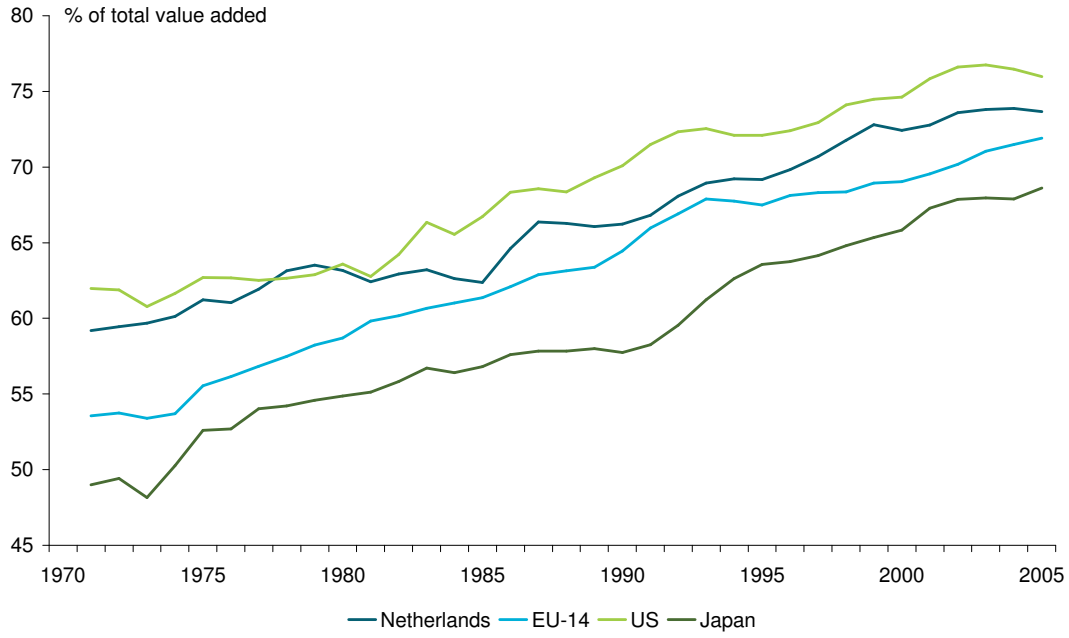
Finally, the revival of cities since the 1980s has been stimulated by the development of the service economy and the emergence of the knowledge economy, which have led to a movement away from industrial production in Western economies. Desmet and Rossi-Hansberg (2009) show that in the early stages of such developments spatial knowledge spillovers are important contributors to increasing productivity. These spillovers yield incentives to cluster together in cities with the right conditions in terms of location and people. When the development matures, the diffusion of new technologies dominates, leading to scattering of economic activity across space. Chapters 3 and 4 discuss these developments in depth.

1.4.4 Towards a service economy

The Netherlands has never been a real industrial country, with historically more people working in the service sector, but the increase in employment and value added of services is quite large. Currently, over 70 percent of all employees work in the service sector, compared to less than a quarter in manufacturing. Furthermore, services create almost 75 percent of total value added right now, compared to 60 percent in the early 1970s. Of the major Western economies, only the US has a larger share of service in value added. Figure 1.4 shows this transition towards a service economy over the period 1971-2005.

The change towards a service economy can also be seen in terms of employment shares of occupations in the Dutch economy. Whereas in the 1960s and 1970s industry and agricultural jobs are ranked among the top-ten in terms of employment shares, the top-ten of the largest occupations in 2007 is dominated by sales, transport and caring jobs.

Figure 1.4 The share of value added created by the service sector, 1971-2005



Source: World Bank Development Indicators.

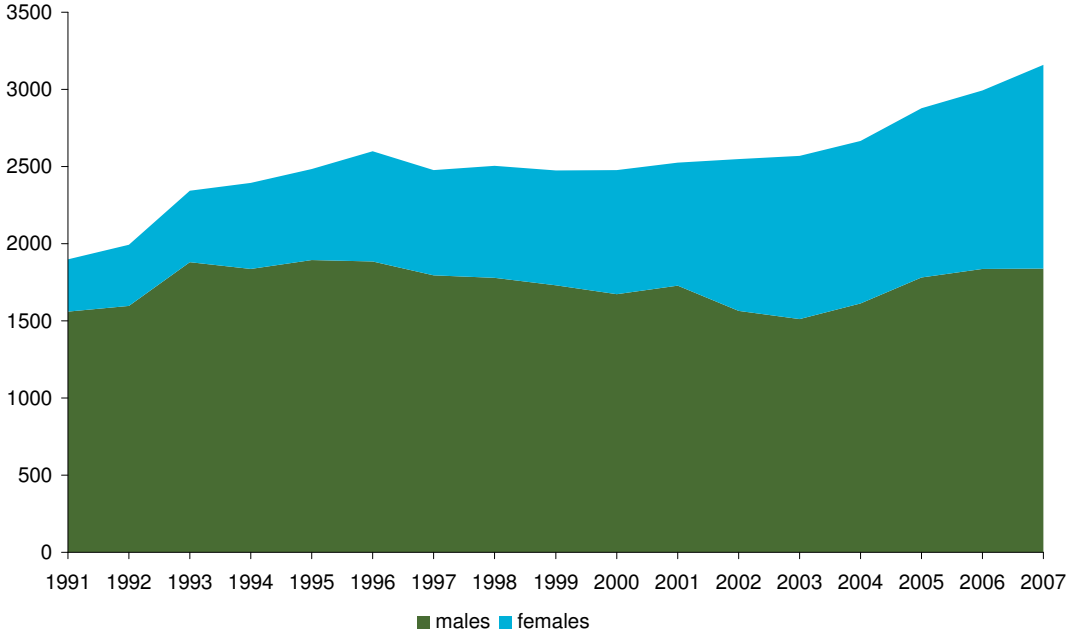
Services trade also increased rapidly in the 1980s. Trade in services merits special attention because the service sector employs about three times as many workers as the goods-producing industries. Second, the service sector contains a relatively large share of highly educated workers. These two observations, together with the fact that educational levels throughout the world are on the rise, imply a widening range of workers potentially facing competition from abroad. Finally, computerisation has increased the possibilities of trading services. Since many services involve idea transmission, improved communication technologies makes this process smoother. Head et al. (2009) find for a panel of OECD countries that distance costs are high but are declining over time. Their estimates suggest that delivery costs still create substantial

advantage for local workers, relative to competing workers in distant countries, but that the advantage seems to be waning. See also Griffith et al. (2007) for econometric evidence of the diminishing importance of geographical localisation of knowledge spillovers.

1.4.5 The emergence of the knowledge economy

The role of knowledge in production has been increasing since the early 1980s. With the advent of computers as a new general-purpose technology, the increasing economic integration of the world, and organisational changes within the production models of firms, relatively simple production stages have been outsourced. At the same time, knowledge-intensive production is increasingly concentrated in advanced economies.

Figure 1.5 Number of PhD graduates in the Netherlands, 1991-2007



Drucker (1969) and Machlup (1962) introduced the term “knowledge economy” during the 1960s. In 1999, the concept was added to the dictionary for the first time, being ‘an economy in which the production factors labour and capital are aimed on the development and application of new technologies’. The pillars of a knowledge economy are education and innovation. In 1999, an additional year of education increased the average Dutch worker’s wage by about 8.5 percent (net present value over the lifecycle). This return on education has been increasing since the early 1980s, from about seven percent in 1985 to almost nine percent in 2005 (see CPB, 2002 for an overview). In light of increased participation in education (increasing the supply of highly educated workers), a rising return points towards demand in excess of supply. Innovation is created by scientific investments and by R&D efforts. A trend has been observed in science—towards incentives for researchers to increase their output and the quality of research, increasing

levels of international mobility of researchers and less room for national science policies in Europe.

Figure 1.5 plots the number of people getting a PhD in any field from 1991 onwards. It increases from around 1,900 in 1991 to 3,160 in 2007: an increase of about 40 percent. Note that the share of women increased from 18 to 43 percent over this period of time. This development stresses the importance of knowledge as an input of production.

1.5 Policy changes in thirty years

These economic developments have been accompanied by a number of policy changes. This section reviews the most important policy changes since 1980.

As stated before, in the 1970s the Netherlands became entangled in a wage-price spiral, with annual wage increases ranging between 5 and 15 percent. The government (cabinet Van Agt-Wiegel) decided to try to reduce wage increases. The unfavourable economic prospects eventually led to the Wassenaar Agreement (*Akkoord van Wassenaar*) in 1982. Employers' organisations and trade unions signed this agreement, which combined wage moderation with a redistribution of labour to combat (youth) unemployment and enhance competitive power. The Wassenaar Agreement had a huge impact on the labour market and laid the foundations for recovery.

Initially, wage moderation drove the policies initiated by the first Lubbers administration. At first, the main factor behind wage moderation was the weak bargaining position of labour unions due to rapidly increasing unemployment (from 6 percent in 1981 to over 12 percent in 1984). Later on, the positive results of wage moderation changed the relationship between the government and the social partners from negotiating to developing common policy goals. This had a positive effect on the Dutch economy because the reform process started earlier in the Netherlands compared to other EU countries.

More specifically, three policy areas stand out. First, the Netherlands has become a more competitive economy by bidding farewell to collusion and monopolies. Competition policy initiated at both the EU- and national level has made many markets much more competitive and open. The most important changes have been the completion of the Internal Market and the liberalisation of the telecom industry. In addition, the Dutch place of business has been an important area of focus for policymakers. Attracting headquarters and high-end economic activity, and serving as a transport hub for both goods and people have been on top of the policy agenda. Two important measures include the development of railways and the extension of the Maasvlakte in Rotterdam harbour. Second, knowledge has become a crucial input into production, and policies to foster innovation and education have been at the top of the policy agenda. CPB (2002) presented an elaborate overview of the policy challenges for the knowledge economy, and concluded that education policies and policies to foster innovation have been most important. Incentives to improve the quality and quantity of education and the stimulation of R&D by all kinds of tax credits and subsidies have been important policy tools

over the past 20 years. Finally, globalisation has affected not only product markets, but also the labour market and, more broadly speaking, the welfare state. Tighter fiscal policy, leaner social insurance and a more flexible labour market have been initiated to increase competitiveness. Again, the bottom line of these policies has been to increase incentives and to make people more responsible for earning their own income.

1.6 Lessons

What lessons can be drawn from this review of previous studies? First, big events have a tendency to be interpreted as generic and as trend-breaking phenomena. The oil crisis of the 1970s and the economic downturn in the 1980s colour much of the studies of that time. Of course, these events had a very serious impact on people who were unemployed; they were labelled at the time 'the lost generation'. This shaped economic and social policies for about twenty years, but has not been the main (let alone the single) driving force of the last thirty years. Currently, it is tempting to draw a parallel with the present economic crisis, which is the most severe economic crisis since the 1930s.

Second, studies that have focused on more general socioeconomic and technological trends have fared much better than studies weighing contemporary events heavily. In 1977, the Dutch Scientific Council for Government Policy (WRR) released the publication *De Komende Vijfentwintig Jaar. Een Toekomstverkenning voor Nederland*. This study was characterised by ongoing economic growth, on the one hand, and stagnation, on the other. These options were the plausible upper- and lower boundaries for economic development. Twenty-five years later, in 2004, the institute published a review. What actually happened in the Netherlands—and what can be said about the projections of the future made in 1977? A first impression is that less speculative and more straightforward extrapolations have a higher 'true value' than more constructed and speculative propositions. A second impression is that the developments with much attention for scientific discourse are better forecasted than less discussed items. A final notion is that phenomena with a long history are more easily extrapolated than relative new developments are. One lesson the WRR draws is that the studies themselves have developed over time. Predictive studies have made way for more-explorative studies of possible futures that are less verifiable and more conditional. Every study is a child of its time, and the 1970s was a time in which the people wanted to grasp the long-term future.

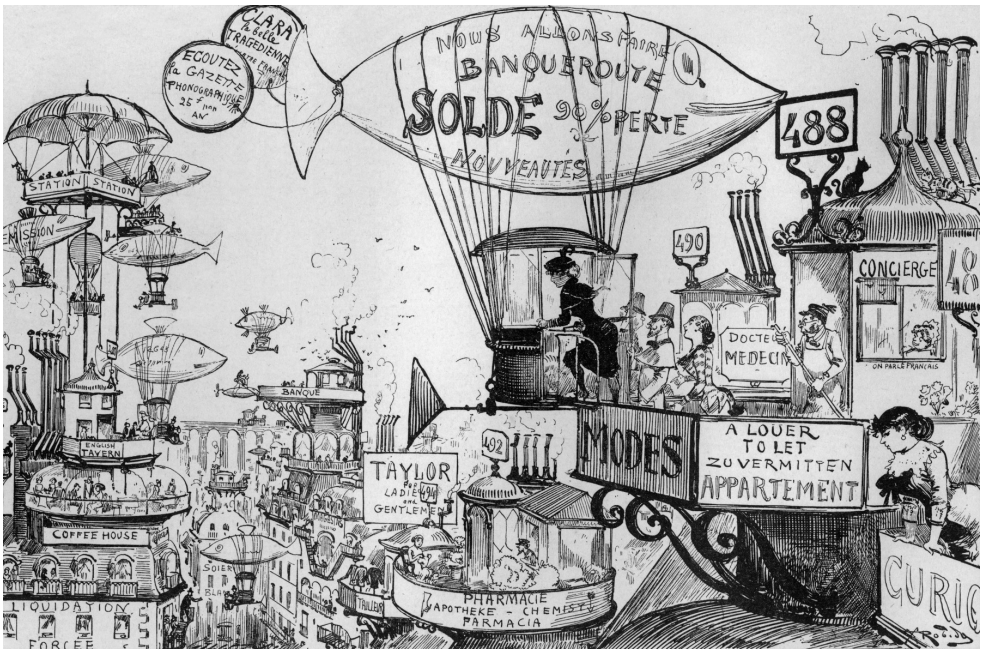
Third, new developments with huge potential tend to be overlooked. As in *Echo and Narcissus,* the past and present carry so much weight that new and potentially huge-impact development may be overlooked. One prominent example has been the impact of computer technology. At first, revolutionary technologies are implemented in a rather mechanical manner to make it less costly to produce the same level of output. The main reason for the manufacturing of the first computer by Charles Babbage was to deal more accurately with information, and until the 1970s computers were mainly used to carry out mathematical and statistical procedures. Over time, revolutionary technologies change and amend to do entirely

new things. Computer technology and the complementary development of the Internet and other forms of communication technology have changed the way in which markets are functioning, firms are organised and innovation activities are pursued. Especially these latter consequences of new technologies are extremely hard to predict and account for, at first sight.

Fourth, although some things have emerged and changed our lives rapidly, most trends have only changed modestly and gradually. In that sense, a period of thirty years is sufficiently long to experience fundamental changes—but it is also sufficiently short to keep most things relatively stable, and perhaps to some extent predictable. Examples of the former are general-purpose technologies, such as ICT, which were not predicted very well in the early 1980s. An example of the latter is the ageing of the Dutch population. Already in 1980 researchers were involved in analysing the consequences of ageing and the sustainability of the welfare state.

Finally, the power of imagination is crucial. Imagination is the ability to create pictures about possible future states. People and countries that are better able to predict these future states are more successful in life because they are better able to prepare for unforeseen contingencies. Albert Einstein said that knowledge defines all that we currently know and apprehend, but imagination points to all that we might yet discover and learn. Illustrator and novelist Albert Robida made a trilogy of futuristic works. In the first book he painted a future of the twentieth century in which he predicted transport by balloons and trade from the roofs of buildings. Figure 1.6 shows his 1883 painting of the twentieth century.

Figure 1.6 **Trade in the twentieth century according to Albert Robida (1883)**



2 The past: Building blocks

'The rural world, a world of peasants; the urban world, a world of craftsmen. Certainly this distinction is mainly accurate. The differentiation between the activities normally carried out in cities and those normally carried out in the country, particularly as concerns the non-production of food by city dwellers, is the essence of urbanisation.'
Paul Bairoch, 1988, *Cities and Economic Development*, p. 15.

What are the most important building blocks of the current Dutch (and Western) economy? This chapter argues that cities, human capital and property rights are crucial in explaining past- and present economic activity and success. They are complementary, in the sense that skilled people benefit from clustering together and cities rise because of the presence of skilled people. Property rights are crucial for fostering investments in both human capital and city infrastructure. This chapter investigates a number of long-run facts explaining the point of departure of the Dutch economy towards 2040. To do so, the discussion focuses on the development of human capital and cities, taking property rights as given.

2.1 The very long run

The rise in population density, the domestication of animals, and the increase in work effort in the course of the Neolithic Revolution (around 10,000 BC) triggered the development of modern economies (see Galor, 2005, for an excellent overview of the economic and historical literature). The Neolithic Revolution brought agriculture, which made denser human populations possible, thereby supporting city development (Bairoch, 1988). Note that transport technology remained the same, but that production technology changed. Increased population density, resulting from the increased output of food per unit of land, created conditions that seem to be the roots of the birth and development of cities. During the initial process of European city formation, the percentage of the urban population increased six-fold— from about 3 percent in 1520 to nearly 18 percent in 1750 (De Vries, 1984).

Until about 1600, much of the world was stuck in a Malthusian equilibrium with subsistence consumption constraints, a positive effect of income on population growth and stationary output per capita. Basically, the population grew together with income. During the first part of the Industrial Revolution, manual labour and animal-based production were replaced by machine-based manufacturing. It started with the mechanisation of the textile industries, the development of iron-making techniques and the increased use of refined coal. Trade expansion was enabled by the introduction of canals, improved roads and railways. The introduction of steam power fuelled primarily by coal, wider utilisation of water wheels and powered machinery (mainly in textile manufacturing) underpinned the dramatic increases in production capacity. The development of all-metal machine tools in the first two decades of the nineteenth century facilitated the manufacture of more production machines for manufacturing in other industries.

The effects spread throughout Western Europe and North America. During this process, population size positively affected technological progress via the supply of and demand for innovations, the diffusion of knowledge, the division of labour and the extent of trade. Urbanised countries benefited more from the industrial revolution because the development of new technologies is easier in densely populated areas, the main reason being that knowledge spreads more easily in cities, the division of labour is easier in thick labour markets and exchange and trade are more easily established. This is still true today, as Glaeser et al. (1992) demonstrated for US cities.

During the second part of the Industrial Revolution, the importance of human capital for technological development and subsequent technology diffusion became more important. Human capital positively affected technological progress, and educated individuals had a comparative advantage in adopting and advancing new technologies (Acemoglu, 2002). Population scale was still beneficial. From 1850 onwards, output grew faster than the population. The increase in the rate of technological progress, in turn, increased the demand for human capital—and human capital is what permits individuals to better cope with changes in the technological environment (Nelson and Phelps, 1966). The introduction of new technologies is therefore skill-biased in the short-run, and the nature of the technology is skill-biased or skill-saving in the long run. Acemoglu (2009, p. 870) argues that "the first phase of the Industrial Revolution was followed by the production of yet newer technologies, more complex organisations, greater reliance on skills and human capital in the production process, and increasing globalisation of the world economy. By the second half of the nineteenth century, Western Europe had reached unprecedented growth levels."

The rise in demand for human capital in the second phase of industrialisation induced parents to get less children but pay more attention to them (Mokyr, 1993). The rise in income along with the rise in the potential return to human capital generated an income and substitution effect. The income effect tells us that there is more income to spend on children, which increases the quality and length of the investment. The substitution effect implies that the opportunity cost of raising children increases, and that the potential return to investment in children's human capital increases. The substitution effect dominates from about 1900 onwards, and fertility rates decline permanently. The economy converged to a steady state in which output per capita could grow at a positive rate, and population growth was only moderate (Kremer, 1993).

When around 1900 electricity arrived as the new general-purpose technology (GPT), smart people clustered in cities to gain from spatial knowledge spillovers in developing new applications. The concentration of economic activity in large industrial cities continued until about World War II, after which technology diffusion dominated the gains from spillovers, and the absorption and use of the technology led to scattering of economic activity. Industrial plants were moved outside cities to battle the cost of congestion in urban areas. This accompanied the increased use of road traffic instead of transportation using water and railways. Using trucks instead of boats and trains reduced the need for locating in a city centre, where expensive

infrastructure is located. In the 1960s cities were declining, and only in the late 1970s, with the arrival of the new cluster of information and communication technology (ICT), did cities regain economic importance (Desmet and Rossi-Hansberg, 2009). Currently, spatial knowledge spillovers to develop computer technology further concentrate economic activity in large cities with abundant human capital, but there seems also a trend (strengthened by communication technology) to spread economic activity across space. Clearly this tendency to concentrate or spread depends on the way in which ICT is used. Technology development is dominant in large agglomerations, while application of the technology is more important when scattering across space is observed (Ioannides et al., 2008).

Note also that human capital clustering in cities is no coincidence. Even after huge shocks, economic activity tends to cluster again at the same location. Davis and Weinstein (2002) and Brakman et al. (2004) show that cities that were heavily bombed in World War II went through a negative shock in size and economic growth. This shock turns out to be only temporary in nature, since Japanese and German cities were rebuilt and back on their pre-war growth path quite quickly. This recovery was due to both first nature advantages (such as waterways and fertile soil) and increasing returns. Especially for Japan, Davis and Weinstein (2002) find that specific economic activity returned to the cities in which they were situated before the war.

2.2 Cities

From 1500 onward, a very rapid development of cities took place in the Netherlands. Around 1500, the level of urbanisation in the Netherlands was close to the European average; by 1700, however, the Netherlands was the most heavily urbanised country in Europe, some 45 (29) percent of its population living in cities with over 5,000 (20,000) citizens (Bairoch, 1988). After that, it fluctuates around this figure until 1860. This early urbanisation and its persistence were driven mainly by the development of Amsterdam, Rotterdam, Leiden and (to a lesser extent) the Hague, which together grew from 15,000 people in 1500 to as many as 300,000 inhabitants (120,000 of which resided in Amsterdam) by 1700. Until 1700, the urban population in the Netherlands was equal to the urban population in the UK, despite the fact that the population of the UK was three times as large. This early urbanisation in the western part of the country masks the decline of several other cities in the period 1700-1850, when Amsterdam saw its population rise to 220,000 in 1800. Economic activity concentrated around Amsterdam, Rotterdam and Leiden (De Vries, 1984).

The rapid growth of these cities could be attributed greatly to the role of the Netherlands as traders and intermediaries for Europe, carrying out a substantial part of European trade. The limits of Dutch city growth were mainly caused by the Dutch East India Company, which recruited young men from especially Amsterdam and Rotterdam, many of whom died during their trips to the East. Part of this trend was countered by immigration and recruitment of young men from the countryside. Another hindrance to the growth of Dutch cities can be attributed to

Britain's taking over the role of world leader, which adversely affected economic development in the Netherlands. Only from 1850 onwards did urbanisation increase, to 45 percent in 1900.

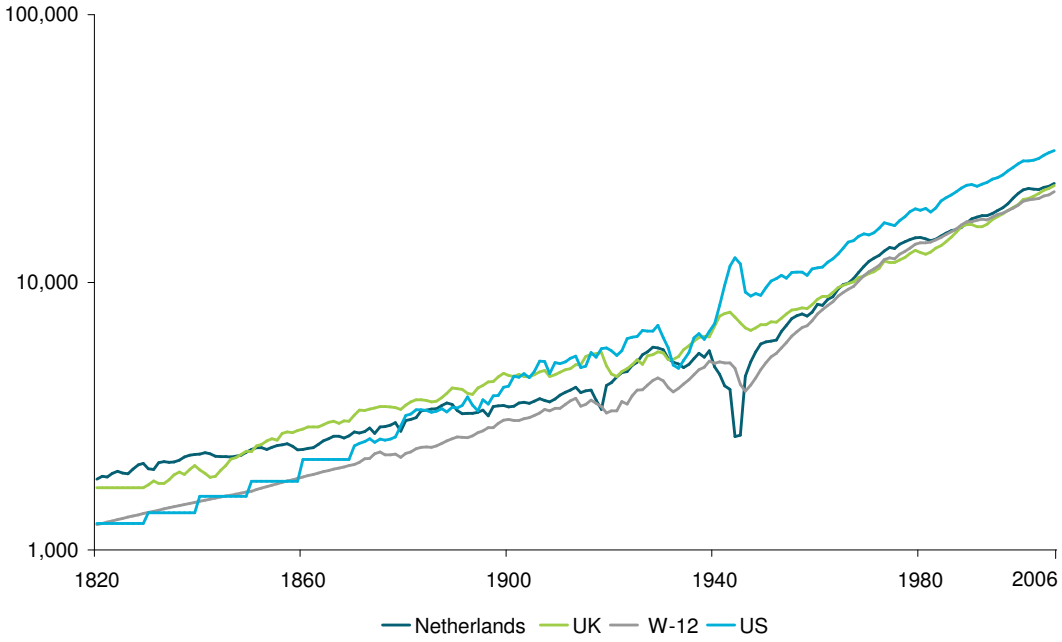
The Netherlands was the first European country to increase output per capita. The main reason, according to Bradford De Long and Shleifer (1993), is that the Netherlands had been a free country with either a feudal, constitutional or republican regime before the Industrial Revolution. They argue that "England and the Netherlands made revolutions, threw off proto-absolutisms, and under their constitutional and limited governments dominated the European economy in the century before the industrial revolution". By 1700, Dutch income per capita was 70 percent higher than that of the UK (number two on the list of then-advanced countries). Already 60 percent of the population was employed in manufacturing and services. Even the agricultural sector was highly specialised and internationally oriented. The textile industry was a significant source of income, together with the dairy product industry, sugar refining, shipbuilding and fisheries. The service sector had developed large-scale international transactions in banking, insurance, shipping and warehousing.[8]

Rapid technological progress, military power (especially a strong navy) and favourable institutions made it possible for the British to take over and monopolise dominance in world trade. By 1890, leadership went to the US as a result of technological advancements, major investment efforts, rapid population growth (both fertility and immigration) and the creation of a vast internal market economy. The early development in the Netherlands can be attributed to the independence of the local populations, which acted rather autonomously and were wealthy. This kept the Netherlands from falling into the reign of absolutism that struck the rest of Europe with the Habsburgs and Bourbons, devastating the development of human capital and economic performance. The Dutch revolt of the sixteenth century preceded the explosion of economic growth in the Netherlands in the seventeenth century. A substantial part of the skilled population of Antwerp fled to Amsterdam to escape the Spanish taxation and the Inquisition.

Figure 2.1 shows GDP per capita in the period 1820-2006 in the Netherlands, the UK and the US. Since 1870, a line representing the average of the GDPs per capita for Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland and the UK has been added (W-12). The figure shows that, until 1850, GDP per capita was highest in the Netherlands, followed by a fifty-year dominance of the UK. From the turn of the century onwards, the US took over the lead in terms of GDP per capita. Its leadership has been undisputed since World War II, although the gap with the Western European countries including the Netherlands has been partly closed; in 1950, Dutch GDP per capita was about 50 percent of US GDP per capita; since 1970, it is stable at about 75 percent. Although the UK and the US took leadership over from the Dutch as world traders, GDP per capita in the Netherlands has persistently been in the worldwide top-15, regardless of the different measurement issues involved in documenting income.

[8] *De Economist*, vol. 148, no.4 provides an excellent historical overview of the economic development of the Netherlands.

Figure 2.1 The development of income per capita, 1820-2006



Source: Groningen Growth and Development Centre (http://www.ggdc.net).

2.3 Human capital

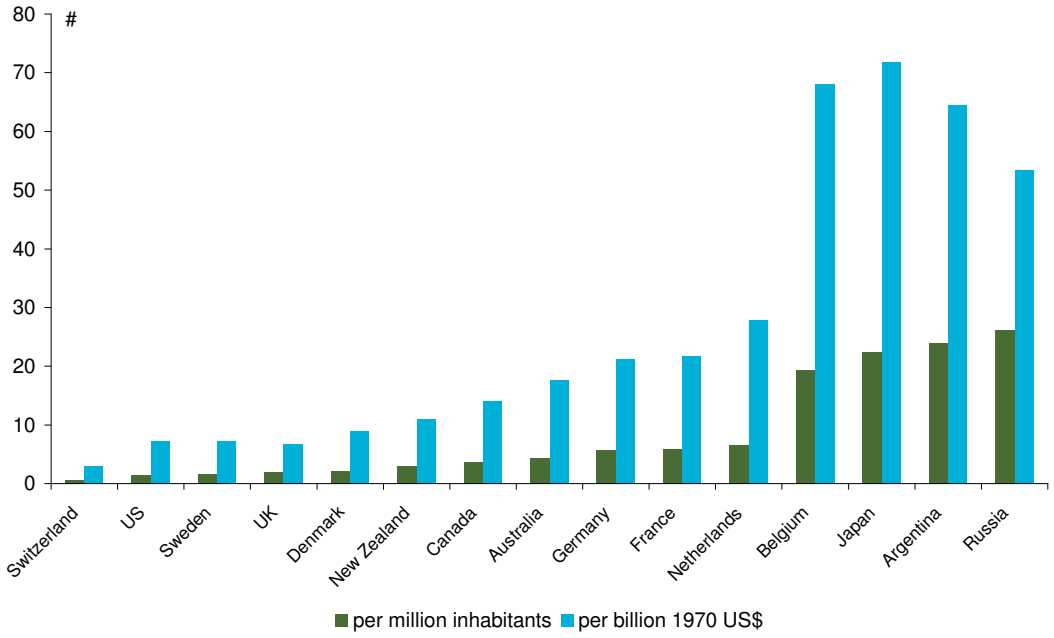
Human capital is crucial for economic development. By 1850, literacy rates in the Netherlands were already as high as 89 percent. A comparison of literacy rates across 102 EU regions at that time reveals that the average literacy rate in Europe was only 63 percent. Early investments in human capital (expressed by higher education outcomes of the average person in a group or community) have also had an impact on current social relations and social climate in communities, neighbourhoods and cities. This has led to higher levels of trust among citizens, which boosts the attractiveness of the Dutch place of business and investments in education and innovation (see Akçomak and Ter Weel, 2009 and Akçomak et al., 2010).

Ever since the invention of the microscope in 1595, the Netherlands has a long history in science. The average age of the five oldest Dutch universities is higher than that of other regions in Europe: over 400 years, compared to approximately 350 years for Europe. In terms of top scientists, the Netherlands has done relatively well. Figure 2.2 shows the number of Nobel Prizes in any field after 1950 per million inhabitants in 1970 and relative to GDP in 1970.[9] On both scales the Netherlands ranks 11th, which positions the Netherlands nicely within the foremost group of research countries. Figure 2.3 first shows the world rankings of Dutch researchers in 19 academic fields of study (blue dots). The green dots present the share of citations to Dutch researchers in any of these fields. The information provides an impression of the scientific areas of comparative advantage of the Netherlands. It turns out that in 12 of the 19

[9] The information in Figures 2.2 and 2.3 was generously shared by Bruce Weinberg from Ohio State University. See Weinberg and Galenson (2007) for an analysis of the economic profession and Galenson and Weinberg (2000) for artists.

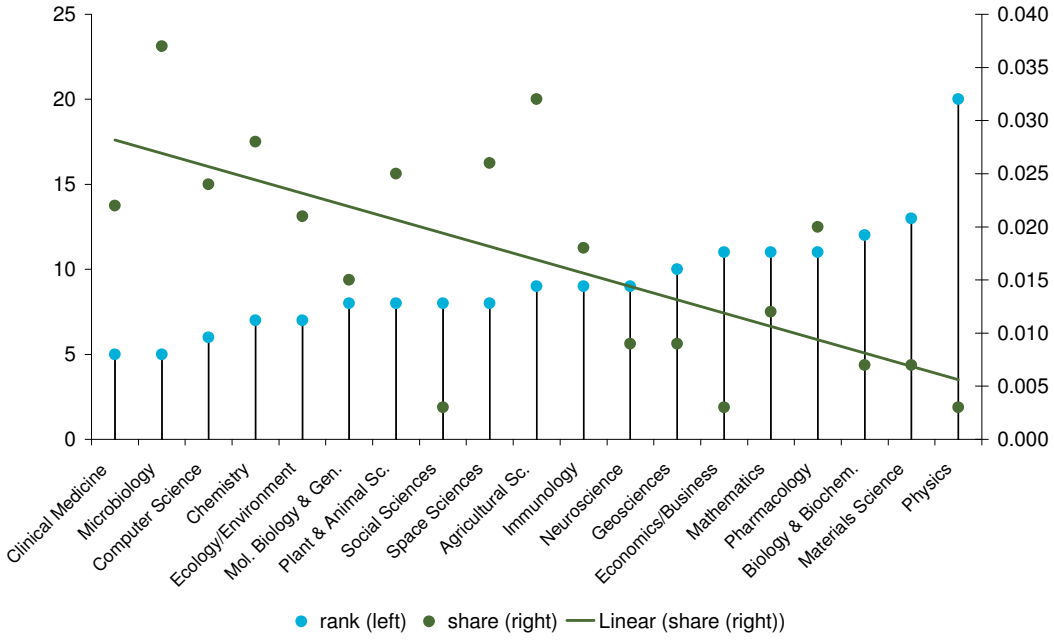
fields, the Netherlands is present in the top-ten. In clinical medicine and microbiology, the Netherlands even ranks fifth. The pattern is similar in terms of the share of citations, as indicated by the trend line: the higher the rank, the higher the share of Dutch contributions.

Figure 2.2 **Nobel Prizes since 1950**



Source: Made available by Bruce A. Weinberg, Ohio State University.

Figure 2.3 **Scientific performance in the Netherlands, ranking (1=best) and share of citation of Dutch scientists**



Source: Made available by Bruce A. Weinberg, Ohio State University.

Another reason why human capital is important for development is that it lowers a population's discount rates. Generally, skilled workers live longer and have longer time horizons than absolutist dictators. This longer time horizon demands increasing security to property and business activities. Such security is likely to be stronger in the absence of an absolutist regime. Already in the seventeenth century the Netherlands installed bodies to control property rights in order to check the power of the executive to tax away property and profits (North, 1981).

For a nation of traders, property rights also meant possibilities for trading with other countries. When contracts can be written, trade takes off. In this respect the Netherlands benefited from having a diffuse workforce structure of relatively well-educated people. This fosters creativity and inventiveness, which helps a country become a technological leader and specialise in skill-intensive products. Basically, this situation led to specialisation and trading patterns along the lines of the standard Heckscher-Ohlin framework. In addition, openness has helped to make a faster demographic transition towards investing more in human capital and maintaining the pattern of comparative advantage.

2.4 Wrapping up: Cities and human capital

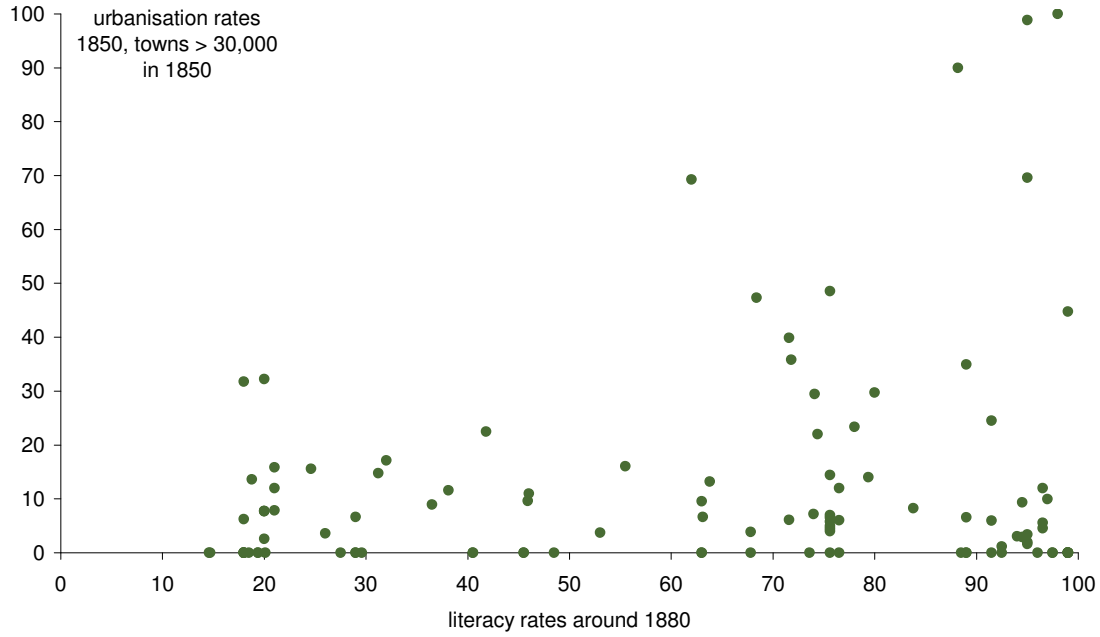
Cities bring together people who benefit from each other. This leads to four main insights for our work.

First, economists and historians have argued that most innovation—and hence economic growth—takes place in cities (Glaeser et al., 1992). Knowledge creation is strongly determined by location. Jacobs (1969) argues that interactions between people in cities help them to pick up and develop ideas and innovate. In fact, without an opportunity to learn from others and thus improve one's own productivity, there would be little reason for people to pay high rents just to work in a city. The easy flow of ideas explains to a great extent how cities survive despite the high rents. Pred (1966) was among the first studies to show the relation between city growth and innovation. He found a positive relation between the number of patents and the population size of the thirty-five largest American cities from 1860 to 1910. Bairoch (1988) showed that higher population density facilitates interpersonal interactions, and that population diversity encourages technological change. He also showed that cities are able to bundle educational activities and foster human capital development.

Second, the attractiveness of a place of business is determined by the attractiveness of cities. Good governance is important for a place of business. Good governance can be measured with data collected by the World Bank on executive constraints. This measure captures institutionalised constraints on the decision-making powers of chief executives. It ranges from unlimited authority (whereby governments behave flexibly in changing rules and legislation) to executive parity (essentially, a parliamentary democracy). Correlations between several historical measures of executive constraints and the extent to which people trust government institutions and other people in their neighbourhood are strongly positive and significant (Akçomak and Ter Weel, 2009).

Third, the creation of human capital through sound education and the utilisation of human capital in production are crucial for economic success. In this sense there is also a connection between urban development and human capital formation. For European regions, there is a significant correlation between the literacy of the population and the rate of urbanisation in the 1850s. Figure 2.4 plots this relationship for 102 European regions. The horizontal axis measures the literacy rates of the population in a region in percentages; the vertical axis measures the percentage of the population living in cities over 30,000 inhabitants. Regression analysis using country fixed effects reveals a positive and significant correlation between these two variables. For the same regions in Europe there is also a strong and positive correlation between the number and establishment date of universities and urbanisation.

Figure 2.4 Human capital formation and urban development in European regions



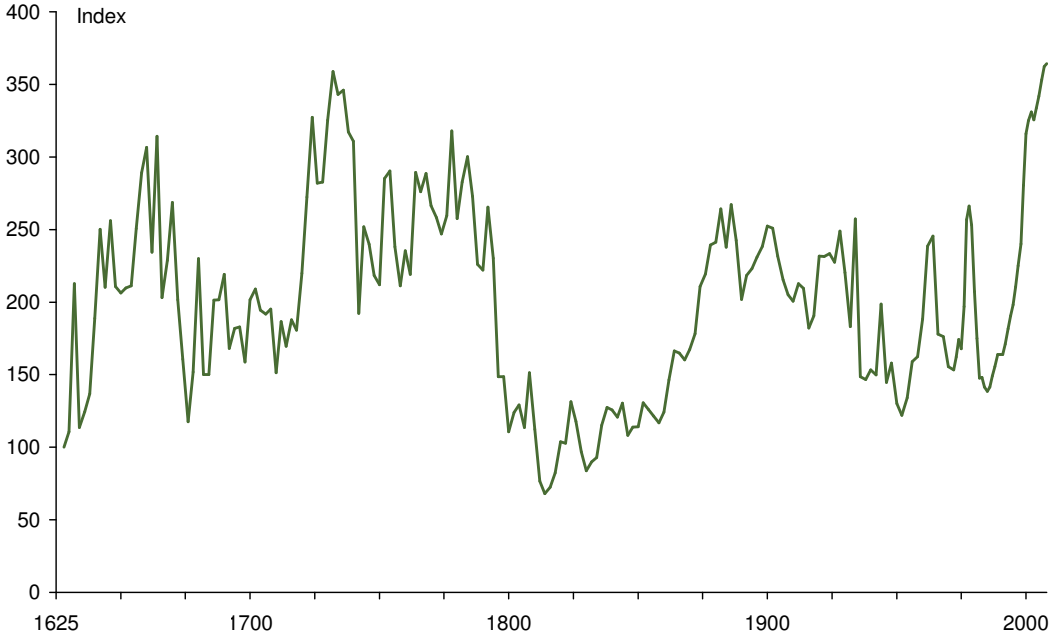
Source: Akçomak and Ter Weel (2009).

Finally, it is important to note that cities flourish and deteriorate over time. For Amsterdam, this is nicely illustrated by the index based on the transactions of the buildings on the Herengracht, one of the main canals in Amsterdam. Since its development, the quality of the buildings on this canal has been on a constant, high level, which makes the Herengracht a unique sample upon which to base a long-run house price index. Eichholtz (1997) presents this hedonic price index, and Figure 2.5 plots a three-year moving average of the index from 1630 onwards. 1629 is set at 100, and the starting point 1630 is the moving average of the period 1629-1631.

Figure 2.5 shows an increase of housing prices for about 150 years from 1630 to about 1780. This corresponds with the rapid urbanisation of the western part of the Netherlands and especially Amsterdam, which saw its number of inhabitants rise to over 200,000 by 1800. When Britain took over Dutch leadership in trade, economic prosperity went down and so did the

index (falling from 285 in 1785 to 74 in 1816). Only in the second half of the nineteenth century did the index rise again, which is consistent with the developments in the second half of the Industrial Revolution. The first half of the twentieth century was a period characterised by crises and wars, which led to a fall of the index. But with the advent of ICT from the 1980s onwards, the index rose in 2007 to an all-time maximum of 360. The index thus reveals that when economic revolutions take place and/or new technologies evolve (Dutch leadership, Industrial Revolution and the ICT revolution), the city of Amsterdam often flourished.

Figure 2.5 Housing prices in Amsterdam over time: The Herengracht index 1629-2007



Source: Eichholtz (1997).

2.5 Conclusion

This chapter has argued that human capital and cities, complemented with sound institutions, are crucial for the past economic development of the Dutch economy. Human capital levels have been high throughout history and science and technology have had a chance to flourish. The Netherlands was the first country in Europe to urbanise, with the city of Amsterdam being the point of departure for international trade.

The next step is to explore the importance of human capital and cities in the present world by investigating the relationship between human capital and cities throughout the Western world.

3 The present: Stylised facts

'If we could say today what new thing we'll know tomorrow, then we'd already know them today and they wouldn't be new tomorrow. For the purpose of prediction, the fact that we will have for example a computer fifty times more powerful is more important than the question of how exactly we'll make them.'
Robert Wright, 2000, *Nonzero: The logic of human destiny*, p. 195.

To build scenarios for the future earnings capacity of the Netherlands, we first need to determine the critical economic relationships behind success. This chapter presents ten stylised facts on which we build our scenarios. These relate to the three themes we have identified. The first theme has to do with facts about and correlations between cities and human capital, because this is core to the scenarios developed in Part II and it follows directly from the past drivers of economic success as discussed in Chapter 2. The second theme focuses on facts about the world economy that influence the Dutch economy: Globalisation and the effects of developments in other countries are increasingly influencing the Dutch economy. Finally, our third theme wraps things up, recognising that policy awareness in such an integrated world is crucial and that policy actions and room for manoeuvring are different than ever before.

3.1 Cities and human capital

History has taught us that economic activity is concentrated in cities and that human capital is important for economic success. The complementarity between cities and human capital enters economic analysis in several ways. To understand the present relationship between cities and human capital, we first document the effects of ICT for the economy—for this is the most prominent change over the last decades.

Fact 1: ICT has changed the way we work

Around 1980, the jobs of secretaries were described in the *Occupational Outlook* as "relieving their employers of routine duties so they can work on more important matters. Although most secretaries type, take shorthand, and deal with callers, the time spent on these duties varies." The latest version of the *Occupational Outlook* includes the following description: "As technology continues to expand, the role of the secretary has evolved. Office automation and organisational restructuring have led secretaries to assume a wide range of new responsibilities once reserved for managerial and professional staff. Many secretaries now provide training and orientation to new staff, conduct research on the Internet, and learn to operate new office technologies. However, their core responsibilities have remained much the same – performing and coordinating an office's administrative activities and ensuring that information is disseminated to staff and clients."

The driving force behind computerisation is Moore's law. Since the invention of the integrated circuit in 1958, the number of transistors that can be placed on an integrated circuit has increased exponentially, doubling approximately every two years. This trend is continuing. Several versions of this law hold, with the result that computers provide a complement to, and substitute for, certain job tasks. This change is not only true for secretaries but for many jobs. In general, computers seem to have accomplished two things: increased information processing (information technology) and improved communication possibilities (communication technology). Varian (2010) provides a nice overview of the impact of computer mediated transactions. He argues that transaction costs have gone down and that different types of transactions are possible now. The latest development seems to be cloud computing: "Now there is a single master copy that can be viewed and edited by all relevant parties, with version control, check points and document restore built in. All sorts of collaboration, including collaboration across time and space, have become far easier. Instead of carrying the document around from collaborator to collaborator, a single master copy of the document can be edited by all interested parties. By allowing workflow to be reorganized, cloud computing changes knowledge worker productivity the same way that electricity changed the productivity of physical labor." (Varian, 2010, p. 7). Such developments have important consequences for the division of labour.

Information technology (IT) has changed the way in which processes are organised. Many routine tasks have been taken over by computers and machines; they will never become tired of doing the same job repeatedly and endlessly. People are still needed to manage and operate the computer. The human touch is still needed for creativity and interpersonal contacts. The key strength of computers lies in the interconnection of these routine tasks. Systems that link up with each other perfectly can be made much larger and complex. This broadens the scope of the worker in this process. He does not have to execute all routine tasks; with the aid of the computer he can execute several tasks simultaneously and is able to run a relatively long production chain efficiently and autonomously.[1] Hence, workers generalise and become jacks-of-all-trade when they benefit from IT and become more autonomous.

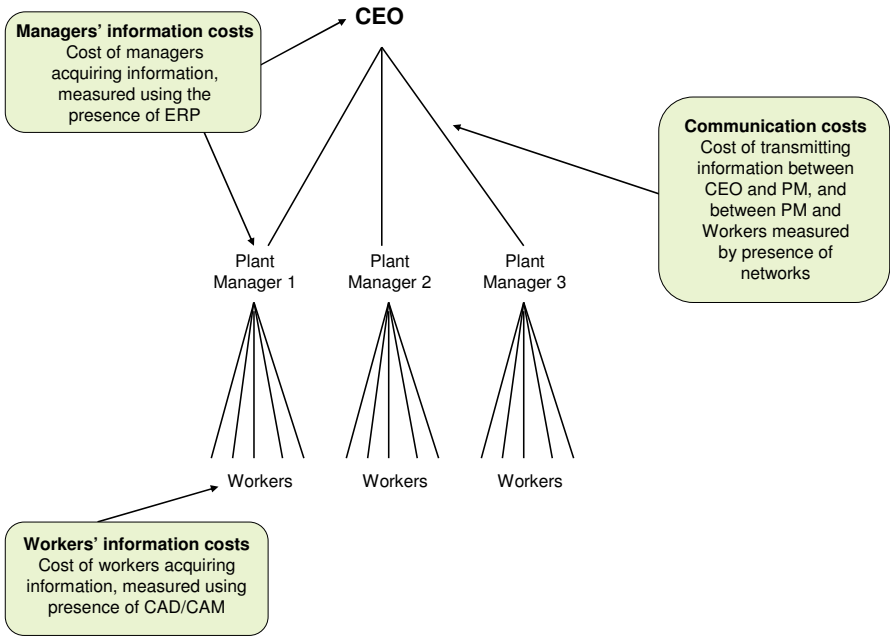
Communication technology (CT) facilitates information transmission and improves the right interpretation of this information. At present, the speed of communication is so fast that sending and receiving messages occurs nearly simultaneously, which greatly improves the opportunity to check and double check whether the information is rightly interpreted. Tasks that used to be highly integrated can now be disconnected and executed by different persons in different places. For example, the production of cars is cut into pieces, which are executed in many places. This will produce a very good car only if all activities are neatly geared to one another. This has changed the way we work in two ways. First, the isolated part of the production process can be

[1] Another example: Airplanes used to be mechanical machines, with the pilot in charge. Today, the pilot may sit and watch how the computer executes the whole flight. But even this control function is challenged. The operating system of the airplane is so complex that it is debatable whether the pilot or the computer is better able to cope with crisis events. Still, the decision whether or not to fly is taken by human beings.

executed precisely and efficiently. Secondly, the worker has to communicate much more intensively, which likely consumes a larger share of his working time. Hence, workers specialise, with specialisation bound by the cost of communication.

Duranton and Puga (2005) show that changes in production have moved from having a sectoral orientation to having a functional organisation. From 1977 to 1997, sectoral specialisation patterns declined in the US, while functional specialisation appeared to be on the rise. It turns out that while in the 1970s headquarters and production plants were situated together in the same city, this pattern had changed by the end of the 1990s. In 1997, larger cities had become specialised in management functions, whereas smaller cities had become specialised in production. A crucial component of the rise of multi-location firms has been the growing importance of separate establishments acting as headquarters. The number of stand-alone headquarters and their employment rose by almost 80 percent between 1960 and 1990. This trend is consistent with developments in the Netherlands. Many headquarters have been moving to Amsterdam over the last thirty years, as documented in Chapter 1.

Figure 3.1 Information and communication technology



Source: Bloom et al. (2009).

These changes in organising work are related to the presence of human capital in cities, but also are a consequence of ICT. Bloom et al. (2009) show that the organisation of work is determined by the cost of information acquisition and communication. Figure 3.1 shows their model of information and communication flows within an organisation of three plants. The CEO on top of the pyramid has to obtain information from his plant managers. To do this, he uses IT systems, such as Enterprise Resource Planning (ERP). The workers use computer equipment (CAD/CAM) to get the relevant information for production. The more advanced the IT system

works, the more autonomously the plant managers and workers can operate. They obtain all information in the form of codified instructions. This reduces the need to cluster headquarters (i.e., CEOs in this figure) next to the plant where production takes place.

The CEO also has to communicate with plant managers and workers. If communication networks are advanced, plants become more specialised. The costs of communication constrain the gains of specialisation (Becker and Murphy, 1992). The more specialised plants and workers become, the stricter the hierarchy will be, because the CEO is now able to give instructions all the way down to the level of the worker. With sound communication networks, economic activity can be spread across space. Overall, this reveals the interplay between the organisation of work and the location of economic activity across space.

Fact 2: ICT has changed urban structure

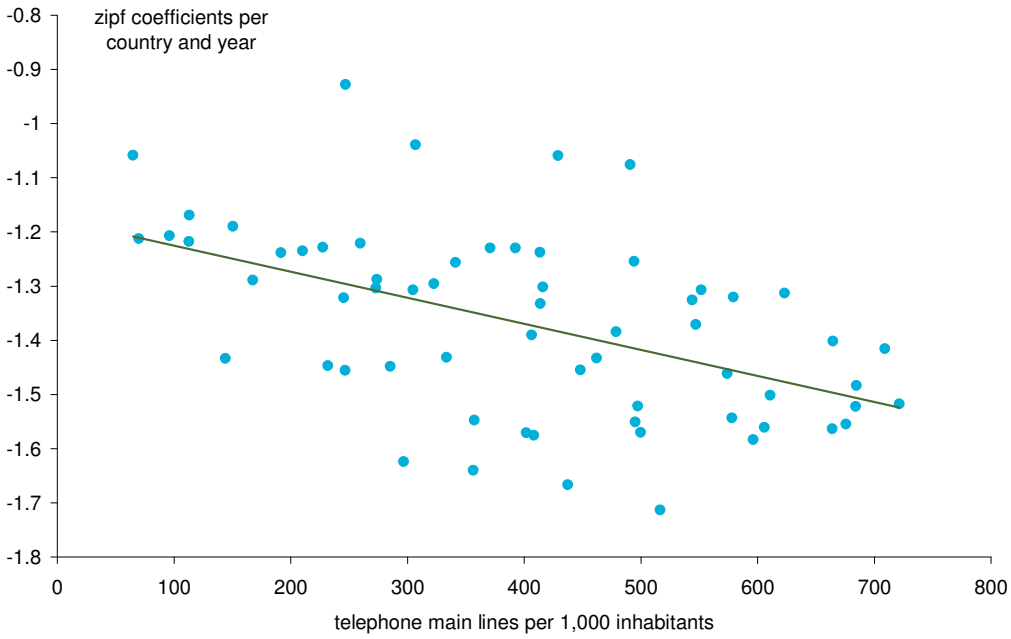
ICT can have a number of distinct effects on the distribution of economic activity in space. On the one hand, IT can increase the spatial scope of knowledge spillovers because it is easier for workers to acquire context that helps them assess information and knowledge from other firms or about intermediate inputs. This means that IT leads to less demand for face-to-face interactions in order to complete tasks. This is in line with generalisation of work. Simultaneously, when CT improves, face-to-face interactions are substituted for virtual interactions. CT accomplishes this in two ways: it makes distance less of an issue for current production structures and it strengthens knowledge spillovers among individuals who are located further apart. This enhances specialisation of work, because tasks can be completed and communicated more easily. Also the matching of tasks to workers becomes easier. The net effect of ICT is that local increasing returns, which are important for concentration of economic activity in space, become less localised when more people across an entire country or across countries can work on their own or smoothly interact with each other by using new technologies. This leads to reduced coordination and commuting costs.

Ioannides et al. (2008)—building on the notion that agglomeration effects are the result of an externality generated by the amount of human capital and labour employed in the city (Rossi-Hansberg and Wright, 2007)—show that this effect of ICT implies that local urban agglomeration effects become less important. ICT leads to less concentration of people and jobs in a few successful (and larger) cities or urban agglomerations and to more scattering of economic activity across space. Agents and firms obtain smaller benefits from locating close to each other, and so they locate more evenly in space in order to economise on land rents (and other congestion costs). Suggestive cross-country empirical evidence supporting this model comes from the correlation between Zipf coefficients and a measure of ICT diffusion, in the case study of Ioannides et al. (2008) using the number of telephone lines per 1,000 inhabitants as a measure of ICT diffusion. According to Zipf's law, the growth pattern of cities almost everywhere follows the power law—the number of cities with populations greater than S is proportional to $1/S$. If cities are plotted according to the log of their population sizes and the log

of their ranks, a straight line should appear with slope −1. If the slope exceeds 1, cities are more dispersed than predicted, whereas if the slope is below 1, cities are more even-sized than the prediction.

Figure 3.2 shows the relationship between Zipf coefficients and ICT diffusion. First, the negative correlation suggests that the more telephone lines a country has, the more even its city-size distribution is. This is consistent with the notion of Rossi-Hansberg and Wright (2007) that improvements in ICT (indicated by the diffusion of telephone lines) lead to smaller local external effects—and via that channel to smaller cities. Second, the Zipf coefficients range from –0.9 to –1.7, which implies that city sizes are more dispersed than we should expect according to Zipf's law. This holds in particular for countries like Belgium and the Netherlands with Zipf-coefficients of respectively –1.7 and –1.6.

Figure 3.2 Zipf coefficients and telephone main lines per 1,000 inhabitants for country-year pairs



Source: Ioannides et al. (2008). A lower Zipf-coefficient implies that city sizes are more similar in a country.

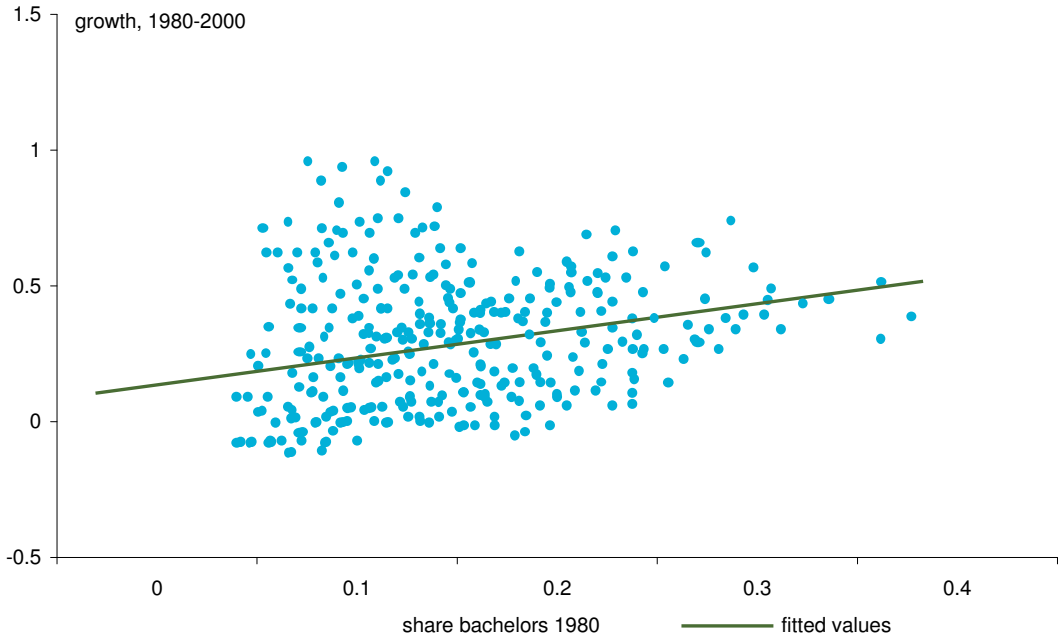
Fact 3: Human capital drives long-run urban success

One of the most persistent predictors of urban growth over the last century is the skill level of a city (Simon and Nardinelli, 2002; Glaeser et al., 1995). Glaeser (2005b) shows the relationship between percent of the population that is college educated in 1980 and the population growth between 1980 and 2000 among 150 US metropolitan areas with more than 100,000 residents in 1980. He finds that skills are the best predictor of urban growth over this period. The correlation coefficient between share of college graduates in 1980 and growth between 1980 and 2000 is 54 percent, which suggests that as the share of the population with college degrees rises by one percent, the urban growth rate between 1980 and 2000 rises by 1.9 percent. Figure 3.3 shows

this relationship. The horizontal axis measures the share of college graduates in 1980; the vertical axis the urban growth rate, 1980-2000.

Glaeser (2005b) describes the relationship between urban success and human capital more specifically to explain the success of Boston: "The source of Boston's recent success is not unknown. Most skilled cities have done well over the past two decades, and Boston in 1980 had a strong skill base relative to its rustbelt peers like Syracuse and Detroit. Today, Boston is one of the most educated metropolitan areas of the country. This skill base, which is most strongly related to the educational history of the region, enabled Boston to become a successful city in the information age. The Boston region's dominant industries are now high technology, higher education and financial services. These industries have done extremely well over the past 20 years and have strengthened Boston's economy, but Boston's ability to be a centre for these sectors was itself a result of its historic commitment to skills."

Figure 3.3 Urban growth and human capital in the US, 1980-2000



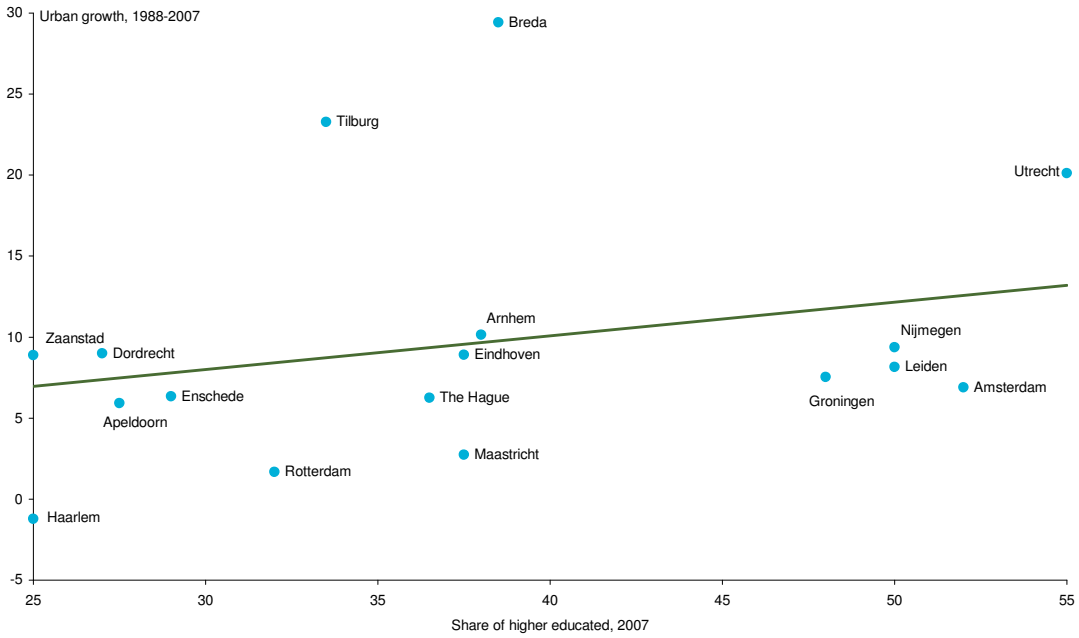
Source: Glaeser (2005b).

For the Netherlands, there is also a correlation between human capital and urbanisation. Figure 3.4 plots the correlation between the percentage higher-educated workers in 2007 (horizontal axis) and the growth of the cities with more than 100,000 inhabitants in the period 1988-2007 (vertical axis). This correlation is positive and significant.

Production is also clustered in space. Most firms are located in cities, often next to competitors. The relationship between firm density and population density is positive and significant. Figure 3.5 plots this for the Netherlands in 2009. Population density is defined as the number of people per square kilometre for a municipality, and firm density as the number of firms per square kilometre. Figure 3.5 shows the firm- and population density for each

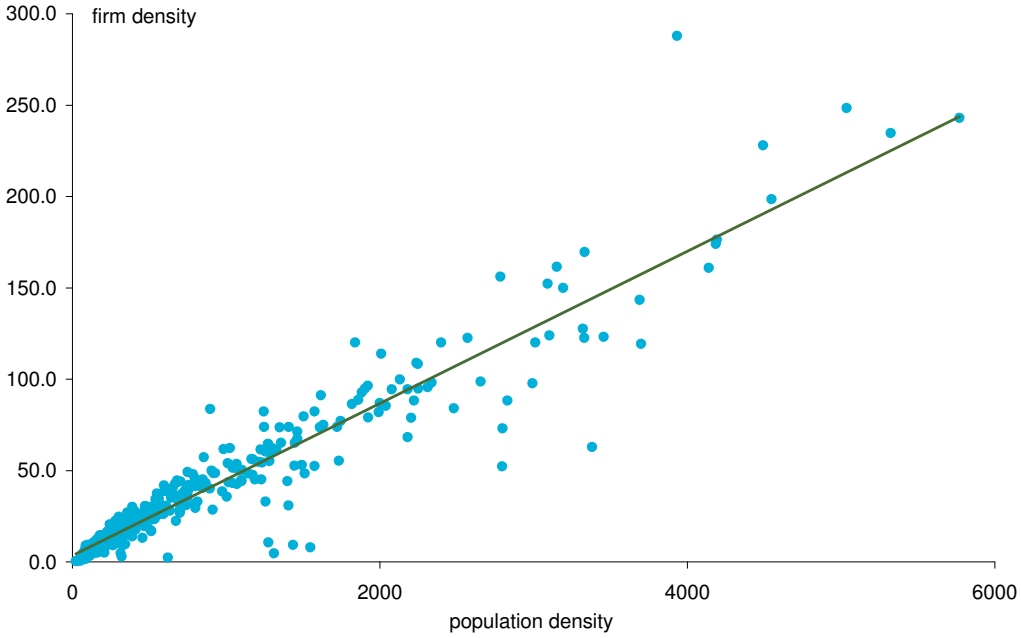
municipality in the Netherlands. In addition, the ten biggest cities contain one-fifth of the inhabitants and are located on only three percent of the area. Duranton (2007) shows for the US and France that economic activity is more unevenly distributed over space than population.

Figure 3.4 Urban growth and human capital in the Netherlands in cities with more than 100,000 inhabitants, 1988-2007



Source: CBS *Statline* for urban growth and *Enquête Beroepsbevolking* (EBB) for the share of higher-educated workers.

Figure 3.5 Firm and population density in the Netherlands, 2009



Source: CBS Regionale Kerncijfers Nederland. Density is defined as the number of people or firms per square kilometre.

Fact 4: New technologies are developed in cities

Related to the ability of a city to reinvent itself —as described by the quote from Glaeser (2005b) above for reinventing Boston—is the fact that relatively young and new economic activities are found in densely populated areas. The reason is that early in the life cycle of a city, research and development (R&D) is important for take-off. R&D is more effective when people meet and interact because of face-to-face knowledge spillovers. More mature activities move away from dense areas because all of the benefits from knowledge spillovers have been explored and it becomes too expensive to locate in dense areas with high land prices. Desmet and Rossi-Hansberg (2009) show that in the beginning of the twentieth century manufacturing firms settled together in order to benefit from knowledge spillovers in the development of the young electricity general-purpose technology (GPT).[2] Later on, in the period 1970-2000, electricity matured and manufacturing spread over space. In that period, ICT emerged as a GPT, which strongly affected services and service activities concentrated in space. Hence, driven by face-to-face knowledge exchange about ICT, services show agglomeration patterns comparable to those demonstrated by manufacturing when electricity technology was on the rise.

Next to city size, the ability of cities to change is a predictor for economic success. The most important Dutch cities have been able to cope with challenges, with a changing economic environment. The evolution of the four biggest cities in the Netherlands supports this assertion. These cities—Amsterdam, Rotterdam, The Hague and Utrecht—have led the city rankings in the Netherlands for centuries. Meanwhile, their industry structure has changed dramatically. Quite recently, the dominant industry in these cities changed from manufacturing and public utilities (in 1970) into commercial services (nowadays). Similar evidence was collected by Duranton and Puga (2001) for US and French cities. They distinguish between fast and slow changes, with rapid location changes of industries across cities (fast), but with cities moving slowly up and down the urban hierarchy (slow).

As an illustration, Table 3.1 shows the growth of employment in Amsterdam and the rest of the Netherlands, distinguishing different types of employment. Total employment growth in both Amsterdam and the Netherlands equals 27 percent between 1993 and 2005. However, during this period the share of manufacturing in Amsterdam declined by almost 50 percent, from 12.2 to 7.1 percent, while the share of services rose to 92.8 percent in 2005. For the Netherlands as a whole, the share of the service sector increased to some 80 percent. This illustration suggests that relatively new economic activities cluster in cities. Interestingly, the growth of the service sector in Amsterdam is lower than for the rest of the Netherlands. This is because it approaches 100 percent, but also because services are increasingly moving to the city's periphery. The growth of offices is negative in the city centre, while strongly positive in

[2] An important additional reason for economic activity to concentrate in cities during the rise of manufacturing was the need for inputs. Larger cities have harbours and more advanced railway connections. This is important for bringing in raw materials and intermediate inputs that are relatively expensive to transport. In the absence of modern trucks, the result is concentration.

the suburbs. This suggests that as the services sector becomes mature, the importance of face-to-face interactions drops.

Table 3.1 Employment growth and sector shares in Amsterdam and the Netherlands (%)

	Amsterdam	The Netherlands
Employment growth	27.2	26.6
Share of manufacturing in 1993	12.2	24.9
Share of manufacturing in 2005	7.1	17.8
Share of services in 1993	87.1	73.3
Share of services in 2005	92.8	80.8

Duranton and Puga (2001) develop the concept of nursery cities. Firms learn about their ideal production process by trial and error. This process of innovation benefits from generalist workers and diversified workers which both are drawn to cities. They combine and borrow inputs and knowledge from different activities and sources. Once an innovation proves successful, production switches to mass production. For mass production, knowledge spillovers are less important, so firms relocate to specialised cities where production costs are lower. Their model and estimates for France show that knowledge flows are not limited by sectors or industries but spatially bound and brought together in cities. Indeed, Glaeser et al. (1992) show that knowledge spillovers are not restricted by industry boundaries. Consistent with Jacobs (1961), they find for 170 relatively large US cities that the most important sources of knowledge spillovers are external to industries and that cities provide the source of innovation and growth. In addition, differences in human capital explain differences in outcomes between cities (Glaeser, 2005a). Gorter and Kok (2009) find similar evidence for a set of Dutch regions.

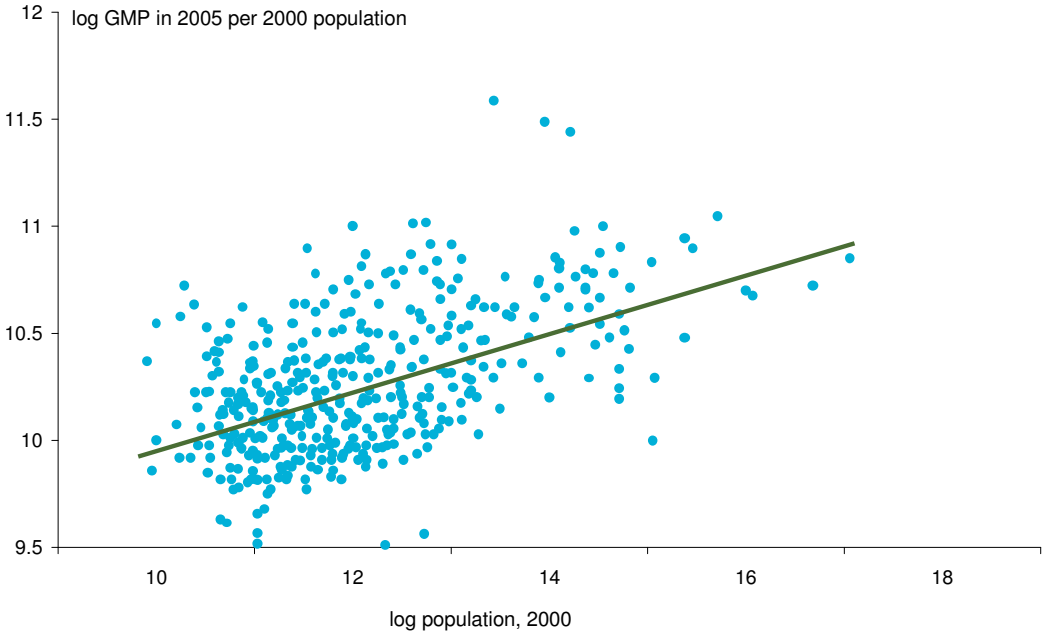
Glaeser et al. (1992) and Feldman and Audretsch (1999) also address whether specialisation or generalisation fosters innovation and technology development. It is basically a question of whether the rate of exchange is enhanced in production environments that are diverse (e.g., New York, Amsterdam, London or Tokyo) or in those that are more specialised (e.g., Silicon Valley, Boston or Eindhoven). Feldman and Audretsch's study focuses on productive activity for some industries in relatively large US cities. They find less industry-specific innovation in cities that are specialised. Glaeser et al. (1992) support this finding by showing that employment growth has been higher in diversified areas. On the other hand, cities foster human capital accumulation and excellence (Glaeser and Maré, 2001, and Fact 3 above), which increases the gains from specialisation (Fact 1).

Fact 5: Cities are drivers of productivity growth

The unevenness of the distribution of production over space is not a coincidence, as was shown above. Dense areas are more productive. There is a clear relation between productivity and urbanisation rates, as can be seen in Figure 3.6. The figure plots the population against the

Gross Metropolitan Product for the US. There is a positive and significant correlation between these two variables. Successful companies are located in big cities. For example, high rents are paid for locations in the heart of Manhattan or Amsterdam. High rents are accompanied by high productivity. Also start-ups flourish in big cities and develop more easily into successful companies.

Figure 3.6 Productivity and city size in the US, 2000-2005



Source: Glaeser and Gottlieb (2009); GMP is Gross Metropolitan Product

This evidence shows that larger cities promote interactions that increase productivity (see also Combes et al., 2009). This is an important finding, since it stresses the importance of cities in bundling economic activity and stimulating growth. Glaeser and Saiz (2004) show that educated cities grow faster than comparable cities with less human capital, which underlines the importance of cities in economic development (see fact 3 above). They show for the US that these cities grow faster because they are more productive and able to combine knowledge and create new ideas. One piece of supportive evidence is that education levels have a positive impact on future wage- and housing price growth. Workers are only willing to pay more for their houses if they earn higher wages in educated cities. And firms are willing to pay higher wages only if their employees are indeed more productive. Note that Florida (2002), indicating the role of creativity and human capital for economic development, basically points to the same issue: it is new ideas that matter, and these ideas are mainly developed by creative and educated people.[3]

[3] This role of creativity is overemphasised by Florida. Glaeser (2004) concludes that human capital is more important than creativity. Marlet and Van Woerkens (2007) confirm Glaeser's findings for an analysis of the Netherlands.

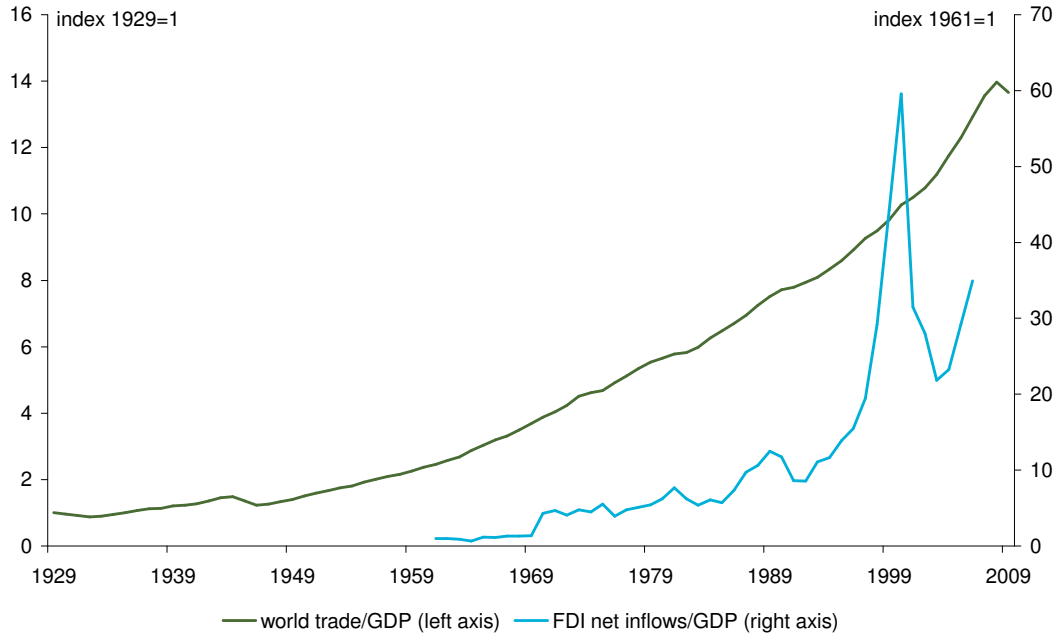
3.2 Global developments

There are also developments at the global level that influence the Dutch economy. Here we discuss the five most prominent facts. The common denominator in these global developments is that competition has increased over the last several decades. This is due both to new technological developments and the economic development of new large economies, and to global political changes moving the power away from Western dominance.

Fact 6: Globalisation increases market size

The international flow of goods, ideas, money and people has increased dramatically over the last century. People around the globe are more connected to each other than ever before. World trade as a percentage of income has increased by a factor 15 since 1930 and foreign direct investment (FDI) has increased dramatically since 1960—with an all-time high around the millennium. Figure 3.7 shows these patterns by presenting two indices. World trade over GDP is measured on the left-hand vertical axis with 1929=100. FDI net inflows over GDP are measured on the right-hand vertical with 1961=100. The key lesson from this information is that powerful incentives exist to connect as many people as possible into trading networks that make all ideas available to everyone (Jones and Romer, 2010).

Figure 3.7 World trade and foreign direct investment, 1929-2008



Source: World Development Indicators.

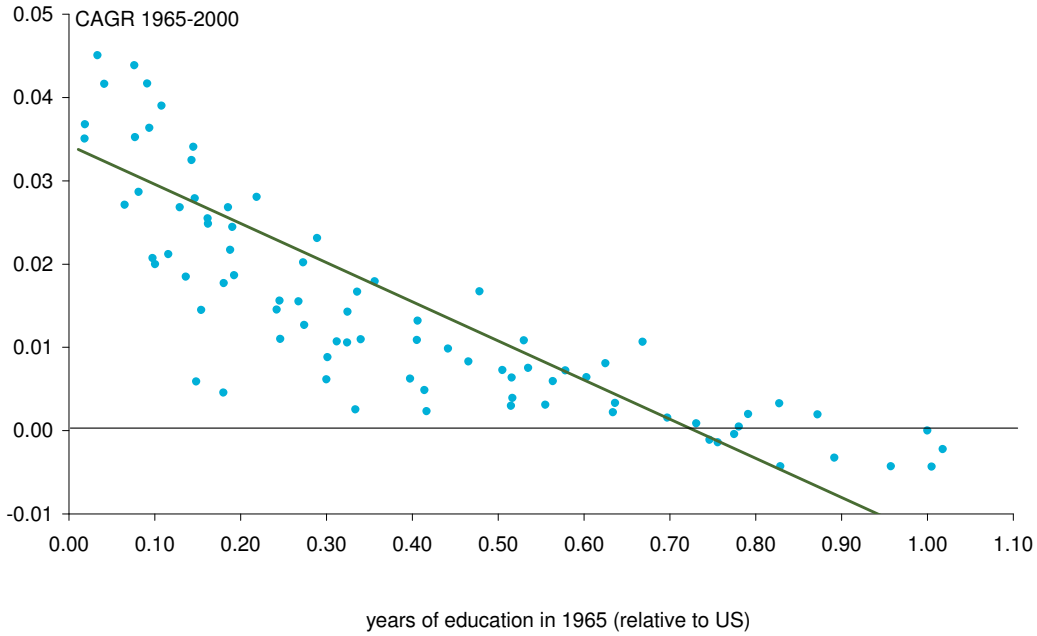
The flow of ideas has become 'globalised', with more international teams of workers exploring new ideas. Being geographically close makes transfers easier, but distance is becoming less important for the transmission of ideas. At the same time, face-to-face interactions between people have also become more important, with urbanisation worldwide growing to over 50 percent, and economic growth being realised increasingly in cities. The Internet has of course also contributed to the increasing size of markets, with information and communication flows exploding since the 1990s.

For Europe, the integration of markets has had additional stimuli, with the establishment of the European Internal Market and the introduction of the Euro (the latter making intra-European trade easier and removing exchange rate uncertainty). The net effects of globalisation and the developments in Europe have been that markets function better and that the rise in interactions has improved Dutch per capita income. For the Netherlands—a small open economy with a highly educated labour force with which to explore ideas—the benefits from increased openness are relatively large, because it exploits comparative advantages at a larger scale (Chapter 1).

Fact 7: Demand for educated workers outpaces supply

Globalisation and an increased market size have gone hand-in-hand with rising levels of education and human capital throughout the world. The average enrolment in tertiary education rose from about 18 percent in 1990 to more than 30 percent in 2007. For the OECD countries, entry rates exceeded 55 percent in 2007.

Figure 3.8 Convergence in education, position relative to US and annual growth



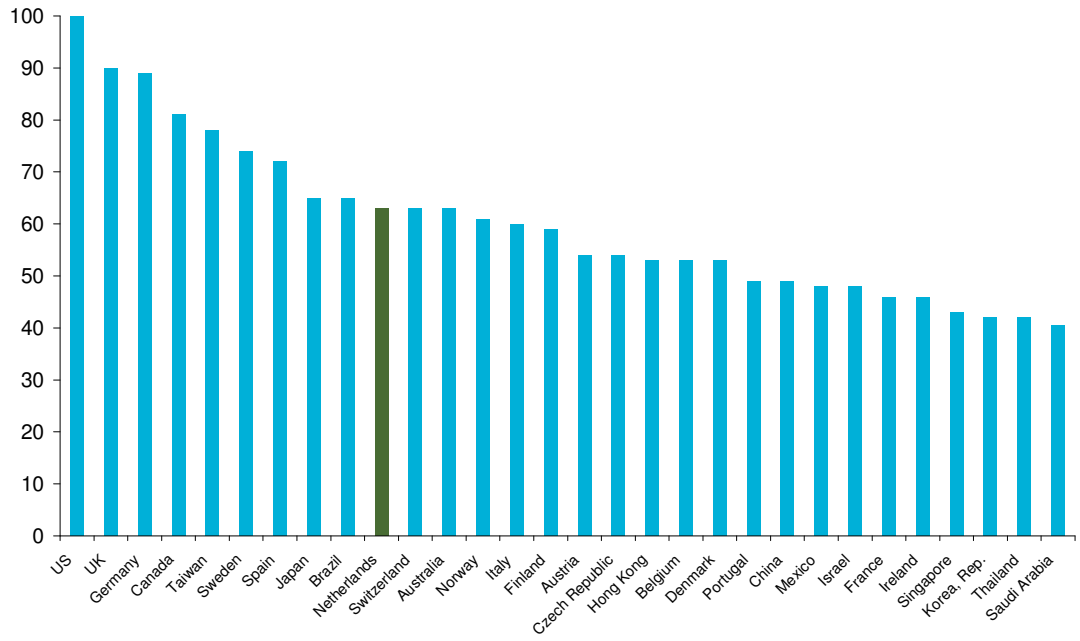
Note: Own calculations based on the Barro-Lee database.

The average years of education have also gone up dramatically over the last 50 years, with advanced economies educating their workers for about 15 years.

Figure 3.9 shows the average years of education for a panel of 90 countries in 1965 relative to the US (US=1) and the compound average growth rate of the average years of education in the period up to 2000 (US=0). The figure shows that countries with relatively low levels of years of education in 1965 grew faster in terms of educational outcomes. Human capital per worker increased and converged substantially over the last 40 years.

Higher education has also become a more global phenomenon. The Shanghai index aggregates information to rank countries according to their scientific performance. In 2003, Shanghai Jiao Tong University began publishing an "Academic Ranking of World Universities". It has become the best-known measure of university performance. Figure 3.10 documents countries by their overall rank, which is based on a number of indicators. It is clear that the US dominates science, with the top-20 universities being American and with about 70 universities among the top 100. Overall, the Netherlands is ranked 10th. What is striking is the position of China, which is outperforming countries such as France on this index. Other Asian countries are also doing well and seem to be close to the level of the Western universities.

Figure 3.9 Shanghai ranking of universities



Source: Adapted from Aghion et al. (2009) and http://www.webometrics.info/.

International trade theory (the Heckscher-Ohlin model) predicts that rising international trade—as documented in Fact 6—will lower the demand for skilled workers in countries with a comparative advantage in unskilled production. This prediction runs counter to the evidence presented in figures 3.9 and 3.10, which show that countries abounding in unskilled workers, such as China, invest a lot in human capital. Liu et al. (2010) investigate the returns to

education in six Chinese regions in the period 1990-2000. They find that the educational composition of the Urban Chinese labour force has changed considerably. Table 3.2 shows this educational composition in 1990, 1995 and 2000. From 1990, the share of workers with high levels of education almost doubled from 13.3 percent to 25.0 percent. At the same time, the shares of workers with low levels of education plummeted, while the share of workers with medium levels of education showed the least action.

Table 3.2 Educational composition of the urban Chinese labour force (shares of workers)

	1990	1995	2000
Low-level education	48.4	38.4	32.0
Medium-level education	38.3	41.5	43.0
High-level education	13.3	20.1	25.0

Source: Liu et al. (2010, Table 4).

Simultaneously, the average returns to education in China also increased. This is consistent with the worldwide rise in the supply of skilled or educated workers that has accompanied increasing returns to human capital. At present, the worldwide demand for skilled workers outpaces its supply (Goldin and Katz, 2008).[4] For China, Liu et al. (2010) conclude that institutional developments and technological change have fostered the rising returns to education. In particular, they find that the institutional transition towards a more market-oriented system has caused wages to increasingly reflect differences in productivity between workers. Moreover, Chinese workers have gained from specialising in high-rent sectors, and trade liberalisation hurt high-educated workers in the late 1990s (although this effect was compensated by technological change).

Fact 8: The world income distribution has narrowed, a bit

The world income distribution has narrowed since 1970. This fact is based on population-weighted data and within-country information about income compiled by Sala-i-Martin (2006).[5] This is a new method of measuring income distribution, whereas previous studies made use of observations by country only. The estimates of the world income distribution are based on within-country variation in income and population for a set of 139 countries. Figure 3.11 shows the world income distribution in 1970 and 2000. The distribution shifts to the right, implying

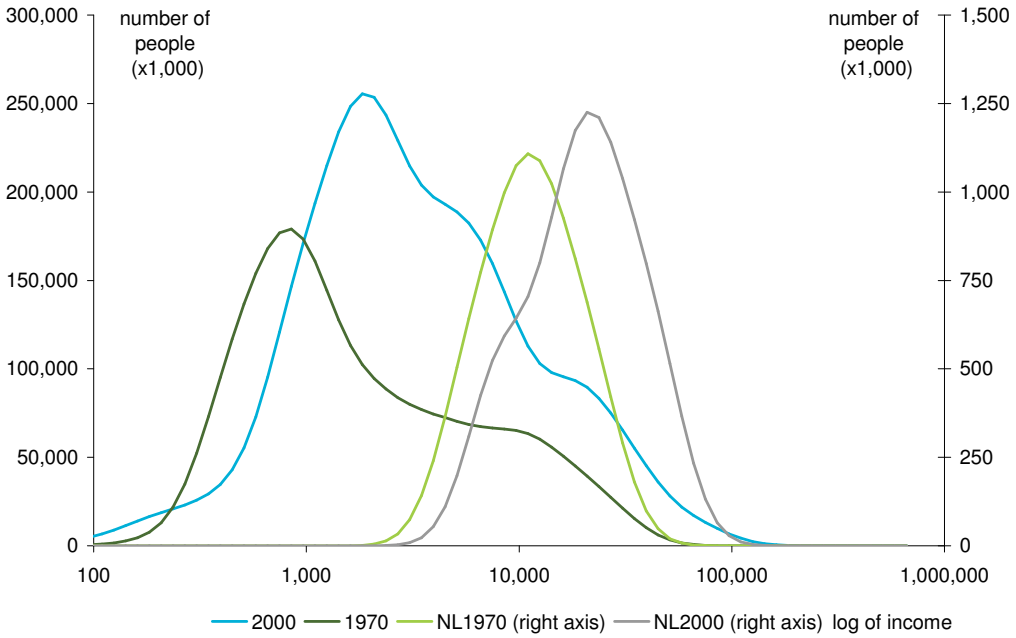
[4] Returns to human capital can be measured in two ways. The private returns are made up of the costs and benefits to the individual, and are net of any transfers from the state and any taxes paid. These private returns, estimated for a variety of Western economies, are somewhere between 5 and 15 percent, depending on the country, heterogeneity of the population, period of analysis, estimation method and control variables. The social returns to education are defined to highlight any externalities or spillover effects, and include transfers and taxes. For Western economies, the social and private returns are about equal in the short run, which implies that investments in education are more or less optimal. In the long run, an increase in the average educational level of the workforce also induces investment in new knowledge, driving up the long-run social rate of return to education above the long-run private rate.

[5] The raw data can be found at http://www.columbia.edu/~xs23/papers/worldistribution/Data/.

that the incomes of the majority of the world's citizens have increased since 1970. The horizontal axis measures the log of the income in 1970 and 2000, and the vertical axis the number of people at each level of income (×1,000). The Gini coefficient to measure inequality has decreased by 2.4 percent over this period. In addition, the 90th-10th percentile difference in the distribution of world income has come down by 9.3 percent over the same period. Hence, the rise in average prosperity has become more equally distributed over time. The conclusion that can be drawn from this development is that more and more people have become connected to the global economy and seem to benefit from it.

Countries moving up the prosperity ladder the fastest between 1970 and 2000 are almost all Asian: China, Korea, Singapore, Thailand, Malaysia and Indonesia are among the top-ten growth economies. In Europe, only Ireland (and to a lesser extent, Luxembourg and Portugal) showed a remarkable increase in GDP per capita over the same period. India and Brazil have grown at a much slower pace: on average, about two percent annually, whereas GDP per capita in China grew on average by more than seven percent annually. This is consistent with the increase in human capital and university performance in China discussed above.

Figure 3.10 The world income distribution in 1970 and 2000

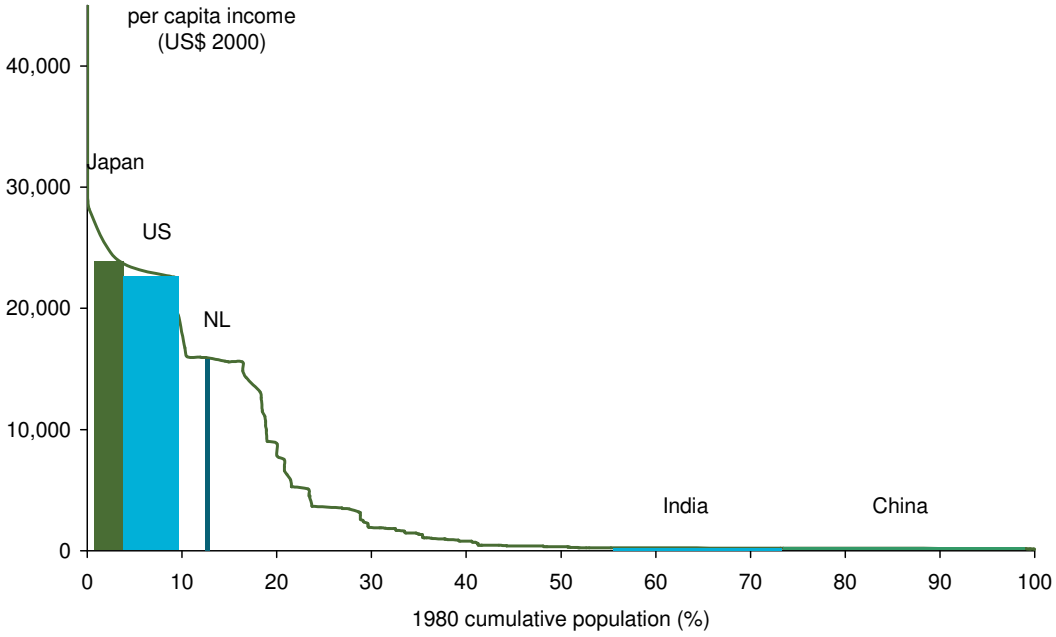


Source: Own calculations based on Sala-i-Martin (2006).

Finally, the income distribution of the Netherlands is plotted on the right-hand vertical axis of Figure 3.10. This picture shows our position in the income distribution, and reveals that we belong to the richest group of countries. Over this period of thirty years we have become richer on average, but inequality within the Netherlands seems to have increased as well.

With the rise of new economies, finding out the extent to which they will compete directly with Western economies in the next decades is highly relevant.

Figure 3.11 The global labour pool in 1980

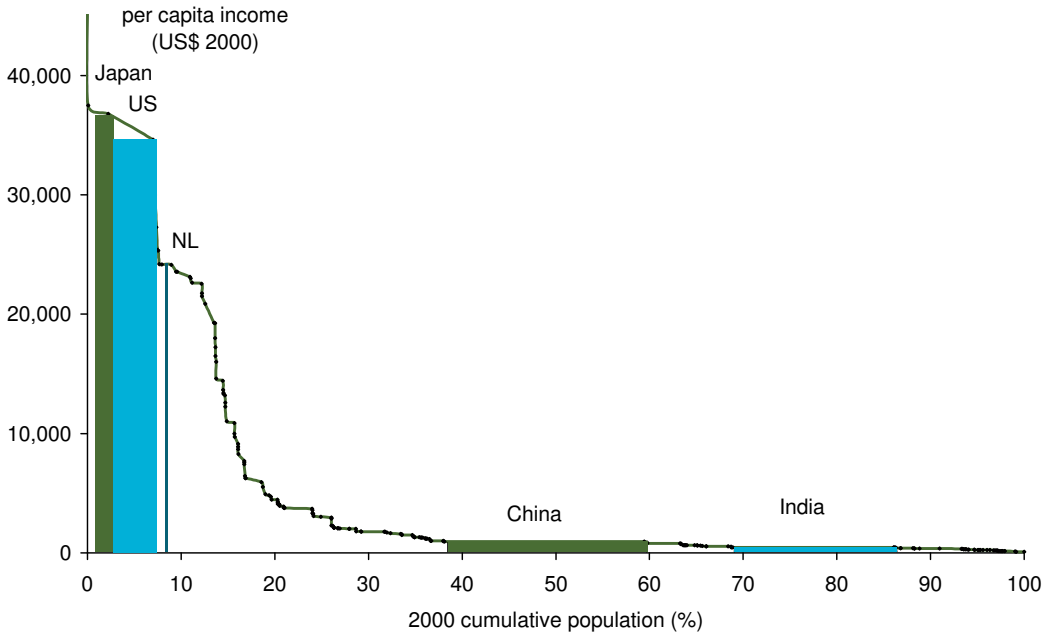


Source: Own calculations based on World Development Indicators.

Figure 3.11 plots the global income distribution in 1980, ignoring inequality within countries. Each individual is assigned the per capita income of his country. The vertical axis measures real GDP per capita in 2000 US Dollars. The horizontal axis is the fraction of the global population. Each country is presented by a rectangle with height equal to GDP per capital and width representing the fraction of the total population relative to the world's population. Countries are sorted by per capita incomes, such that the left-hand side of the picture depicts the richest countries. Five countries are highlighted: Japan and the US as the dominant contemporary economic powers; China and India as the largest upcoming economies; and the Netherlands. Japan and the US are relatively large and rich economies in 1980; China and India are large and poor at that time. Figure 3.12 plots the same series, but now for 2000. The main difference is that rich countries have grown richer and that China has made a giant leap forward in terms of per capita income. India seems to be lagging. Trade liberalisation and technological change are behind the leftward shift of China in Figure 3.12.

Leamer (2007) distils three messages from these pictures. First, full equalisation of per capita incomes is unlikely to happen in the next decades. Much of the differences in income are due to the fact that the Western economies are performing different tasks than the economies of developing countries are. Equalisation can only take place between identical tasks, and the Western economies have an advantage of specialising in the more advanced tasks. Second, trade liberalisation has increased the global pool of unskilled labour more than the pool of skilled labour. This pushes down the per capita income in developing countries because they have an advantage in unskilled labour.

Figure 3.12 The global labour pool in 2000



Source: Own calculations based on World Development Indicators.

This is true for China, even considering the massive absolute number of high-skilled workers. International trade and specialisation is about comparative advantage, not absolute advantage. Third, the mobility of ideas has led to different domains of competition or to specialisation within global supply chains. Inside manufacturing there is a segment of footloose mundane labour-intensive work, and a set of innovative and capital-intensive activities that are firmly rooted in cities and complemented by human capital. The footloose standardised products are described in blueprints, and production can be easily inspected to determine quality. This type of production is contestable and takes place in global competitive markets, which control prices and wages. The innovative work that occurs depends on location and the availability of human capital. This type of work is not contestable because the knowledge is embodied in people who benefit from direct interactions (Glaeser et al., 1992 and Griffith et al., 2007).

Fact 9: The economic and political landscape moves away from Western dominance

Developing countries have become more powerful, not only in terms of income, as we saw in Asian GDP per capita growth figures, but also politically. As an illustration, in the period 1986-1995, the number of times a veto was cast in the UN Security Council was 37, 35 of which were cast by three developed countries: Britain (8), France (3) and the US (24). In the period 1996-2008, of the 19 vetoes cast, four were cast by China, three by Russia and 12 by the US. Developing countries have organised themselves in clubs and committees outside the traditional international community of the developed world. The power of OPEC is longstanding and well

known; the influence of China has been increasing over the last decades. Other examples of the changing power of nations include the recent enlargement of the G7 to G20 to tackle the economic crisis, and the Copenhagen negotiations between the US, China, India and Brazil about measures to reduce CO_2 emissions.

In 1980, over 70 percent of world income was earned in the US, Japan and the countries of the EU-15, and only 4 percent in Brazil, India and China (also known as the BRIC countries). In twenty-five years' time, the share of BRIC countries has more than doubled to 9 percent, whereas the US, Japan and the EU-15 have lost some of their income share. Other countries are also growing, and there has been a particular focus on the development of Asia. Especially the countries in Southeast Asia are rapidly developing into modern economies. They will continue to grow because of rising labour force participation rates, the shift from low- to more productivity activities, a continued increase in the educational level of the labour force, and other improvements in the quality of their output. This makes these economies competitors and serious players in the international political and economic arena.

These changes in the economic and political spectrum could easily lead to economic conflicts. Protectionism is one outcome of such a conflict, and in the wake of the current economic crisis, many measures have been taken that violate international agreements. Measures of harmful trading patterns indicate an increase in murky protectionism.[6] Most of the measures have been taken against China and the US, which are also the countries imposing most measures on others. Still, increased globalisation is the rule rather than the exception, and changing political windows have not stopped this train. Quite the reverse, trade has increased substantially since World War II, as Figure 3.7 shows. And, even more important, from an economic point of view, economic development fosters institutional development and openness—which in turn increase competition (Leamer, 2007).

Fact 10: Western economies specialise in high-end manufacturing and services

Rich countries have a lower share of primary production in GDP. Countries with more skilled workers focus on the production of goods and services that require high-value added intermediate inputs, while countries with more unskilled workers specialise in primary production. For example, Feenstra and Wei (2009) found out that China's exports in textiles comprise about one-third of total exports. Its imports are concentrated in high-quality machinery and electronics (23 percent).

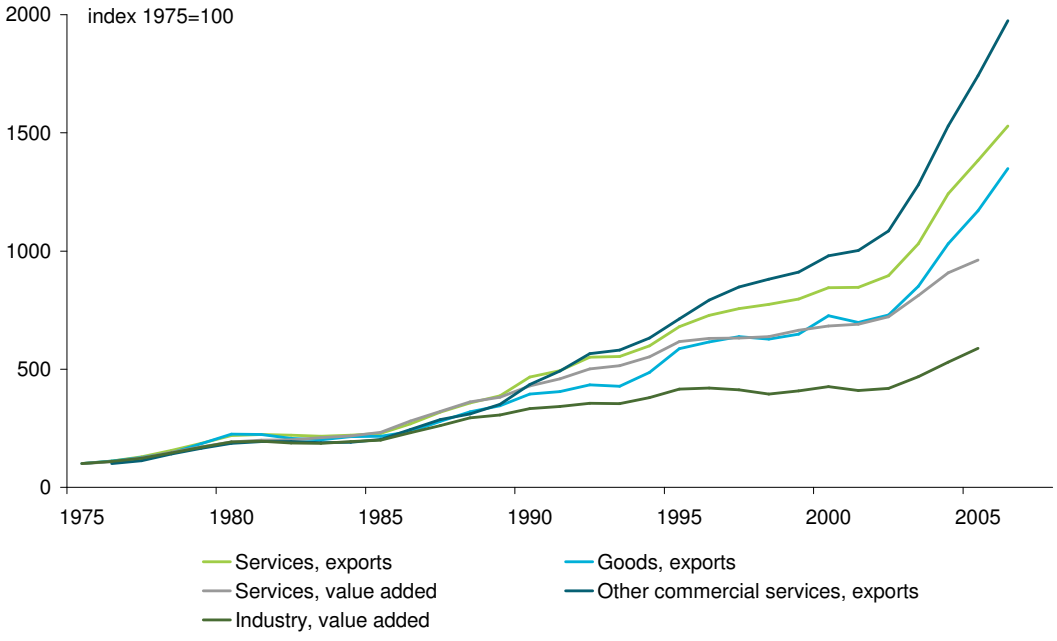
Behind this division of work are a number of developments. First, as a result of technological change, products have become more complex over time. This complexity demands more skilled workers to do the complex work. Since Western economies have a comparative advantage in skilled work, they specialise in these tasks. Second, complex work is

[6] See http://www.voxeu.org/index.php?q=node/3199 for more details.

done at the beginning of the supply chain and towards the end of it. Towards the end, production is more vulnerable to mistakes (if it goes wrong there, all previous work is obsolete). Hence, Western economies have specialised in complex processes in the beginning (design) and towards the end of the supply chain. A Dutch example is the production of Senseo, the coffee machine developed by Douwe Egberts and Philips. The technique is important, but breakthroughs were the design of the machine, the at-home one-cup-at-a-time system and the coffee with cream layer. The well-designed branding campaign made people actually buy these machines and the coffee pads. Third, complex work is hard to offshore to low-wage countries, as it is not "contestable" (Leamer, 2007, and Fact 8). As the above numbers suggest, China specialises in textiles and early-stage industrial production. In the Netherlands, the textile industry uses their inputs to make more complex products. For example, Ten Cate externalises (outsources) production and end-marketing, but keeps the innovation in technology and the cost processes internal. The company split up its value chain in order to survive in the long term.[7]

These three developments have shifted the Dutch economy away from manufacturing towards complex manufacturing and tradable services such as design, finance, sales and marketing. Figure 3.13 shows the internationalisation of the service economy. Each series is expressed as an index with 1975=100. There is rapid growth in exports, with the most growth in other commercial services (OCS) trade. The service sector has grown faster than the goods sector, and trade growth outstrips growth in value added.

Figure 3.13 Growth in trade and production of goods and services, current US$



Source: World Development Indicators.

[7] Source: http://www.tencate.com/smartsite.dws?id=4142.

Since the indexes are graphed on a log scale, the rising gap between the export and value-added index indicates that the ratio of trade to value added is rising. A natural interpretation is that both goods and services are becoming more tradable over time.

3.3 Policy awareness

Globalisation tends to make the world flat, in the sense that differences across countries are utilised to produce efficiently. Location still matters, however, and countries are unique because of institutional differences, differences in policy towards attracting economic activity, differences in labour-market policies and because of productive local knowledge spillovers. For example, a reduction of profit taxes in one country is likely to attract economic activity at the expense of the others. But, even if Ireland were to reduce its taxes to zero, few Dutch firms would shift their activities to Ireland. Apparently, being in the core of Europe and having access to a diverse and highly skilled labour market is more attractive—as firms benefit from knowledge spillovers, economies of scale and other firms in their neighbourhood. Also on the demand side there are reasons to stay in the Netherlands—because of the access to markets where the products are sold. So, the world has become flatter, but not flat. Size still matters: free trade creates opportunities to grasp the benefits from clustering and still be able to serve distant markets.

Globalisation has increased uncertainty. The world has become more unpredictable, and changes occur more suddenly. The current worldwide economic and financial crisis is a good example of, on the one hand, smoothing of risk and uncertainty leading to what some have labelled the "great moderation" (see CPB, 2009, for an overview), but on the other hand, correlated risks and contagion resulting in almost complete meltdowns of the global economy in the case of mistakes. In addition, small differences in inputs between countries could lead to large differences in outcomes because it is easier to move economic activity around the globe—with differences in human capital becoming less important, and access to worldwide networks improving.

For policymakers, this means that good policies to maintain the country's attraction as a place of business (or to create conditions leading to this) are crucial in order to compete in an integrated world. The stimulation of knowledge creation and innovation puts the Netherlands in the right part of the production chain—and fostering education- and labour-market flexibility will have a large payoff when uncertainty is higher. This also means that bad policies will be punished harshly. With increased capital and labour mobility, economic activity is more footloose than it was thirty years ago. This does not require more policy, but rather good policy measures to accommodate volatility and uncertainty.

4 The future: Trends and counter forces

'Humanity finds itself, once again, at a crossroad between a dying old order and the rise of a new age. Revolutionary new technologies are forcing a fundamental change in our spatial and temporal consciousness.'
Jeremy Rifkin, 2004, *The European Dream: How Europe's Vision of the Future is Quietly Eclipsing the American Dream*, p. 181.

This chapter explores the future. Rifkin (2004) presents the future of Europe as a dream worth living for in his book, *The European Dream: How Europe's Vision of the Future is Quietly Eclipsing the American Dream*. The Dutch side of Rifkin's European dream fits neatly into his picture of openness and interactions with people all over the world. A small open economy will benefit from new globalising technologies, such as further developments of information and communication technology (ICT), which further compress space and time. The strength of the Dutch has always been to be globally connected without a loss of their sense of cultural identity and locality. The Netherlands finds its freedom in relationships, and not so much in autonomy, which is beneficial in a network society where both physical and virtual trading relations arise. This is true because of the relatively small size of the country (which compels openness), and because of the comparative advantage of having a workforce of smart people (who long for interaction). At the same time, these smart people will cluster together in cities, where interactions lead to innovation and productivity growth.

This chapter explores the future by observing trends in how production processes take place and where and how—in the chain from raw materials to final products—money can be earned. We also show trends on the structure of the production location and how people will interact to get things done both physically and in an integrated world economy.

4.1 Technological change

Technological change in the long run (i.e., in the period of thirty years up to 2040) is best described in terms of general-purpose technologies (GPTs). The arrival of these GPTs is unknown, but when they arrive society will change fundamentally (Bresnahan and Trajtenberg, 1995 and Helpman, 1998). Here we describe the consequences of future developments in ICT (the current GPT) and what happens with the possible arrival of a new one, probably in the form of bio- and nanotechnology.

4.1.1 Further developments in ICT

ICT is the current GPT driving performance improvements in society at large. After the major improvements in the capacity of semiconductors (see the discussion of Moore's law in Chapter 1, and Facts 1 and 2 in Chapter 3), which led to a massive increase in the capacity and speed of computers to store and process data, there has been a trend towards the physical integration of

electronic functions in existing- and new equipment. This makes all kinds of equipment more handy and efficient in use, more user-friendly, and also more energy-friendly. It also opens avenues for new computer technology to develop electronic material at the sub-micron level that can interact with tiny matter and cells, even including live cells. As yet, these new developments are clearly in their infancy, and subject to a lot of research, but these mainly technologically driven developments are important because they show that the technological trajectory extends further to other areas. Cheap communication comes with developments in the field of optical fibres, which allow for the transmission of digital signals without loss of energy. At the same time, standards for communication networks will harmonise around the world to increase connectivity and create a global 24/7 economy. Combined with more powerful IT and the strong expansion of the bandwidth of communication channels, this allows for the development of a worldwide communication network in which information and communication goods can be supplied at minimal variable cost. Soete and Ter Weel (2005) present a series of papers with a more elaborate overview of the current and future developments in ICT. Varian (2010) reviews the several ways in which ICT has facilitated transactions.

The trend in ICT is such that it makes physical presence less important. Cities will become smaller because of advanced communication technology substituting for face-to-face contact. Improved information technologies make production processes and workers more autonomous. This induces the splitting up of headquarters and production plants at different locations. Concentration in dense cities becomes less important. At the same time, further improvements in ICT influence the division of labour and tasks. On the one hand, better communication technologies reduce to costs of coordination and communication, and lead to further specialisation of work. Together with the decreased need to cluster, virtual communication between specialists all over the world becomes possible. On the other hand, improvements in information technology reduce the need to ask for specialist help and input. When instructions are in one-syllable words, people can produce on their own. This increases autonomy. Together with the trend to spread, workers become less dependent on fellow workers, in terms of both tasks and face-to-face interactions.

4.1.2 The arrival of a new GPT

GPTs appear rarely, and they change society profoundly over a long period of time. They affect the production of goods and services, the innovation of new products, the organisation of firms and the lifestyles of consumers. Previous examples include the steam engine, which took off around 1850, and electricity, which started to replace steam power around 1910.

GPTs share three major characteristics.[8] First, a GPT is pervasive, because it can be found in a large variety of applications in many different parts of the economy. This characteristic explains why electricity is a GPT and a light bulb is not. Both can be found at many places, but only electricity has a large variety of applications. Second, a GPT improves substantially over

[8] See Aubert et al. (2006), Bresnahan et al. (2002), Caroli and Van Reenen (2001), Harris (1998), Helpman (1998), Hobijn and Comin (2004) and Jovanovic and Rousseau (2005).

time, which lowers its costs and contributes to its pervasiveness. The increase in computing power of the microchip is a prominent example. And thirdly, a GPT spawns many complementary technological and organisational innovations, as the evolution of the Internet shows. Helpman and Trajtenberg (1998a and 1998b) provide the economics behind the development and diffusion of GPTs in more detail.

GPTs affect the organisation of work and the agglomeration of economic activity in cities. Examples abound of the impact of a GPT on organisations. The use of electric motors meant that different engines in a plant could run independently, which increased flexibility in plant design. ICT has deeply changed logistics, factory lay out, etc. The impact on agglomeration mainly runs through the need for face-to-face contacts in the early phases of a GPT. Desmet and Rossi-Hansberg (2009) show that in the beginning of the twentieth century manufacturing firms settled together to benefit from knowledge spillovers in the development of the young electricity GPT. Later on, in 1970-2000, electricity matured and manufacturing spread over space. During that period, ICT emerged as a GPT, and strongly affected services and service activities concentrated in space. Hence, driven by face-to-face knowledge exchange about ICT, services show comparable agglomeration patterns as manufacturing did when electricity came up. Gaspar and Glaeser (1998) report a complementary relationship between ICT and face-to-face interactions in the 1970s and 1980s in the US. Venables (2001) shows that this relationship is particularly present in production processes involving skilled activities; low-skilled work is moving to cheaper places (the standardised nature of the work implies that it hardly benefits from face-to-face interactions). Glaeser (2010) addresses the paradox of the death of distance and the tendency of people to gather together in cities in his CPB lecture. His argument is that the triumph of this urban paradox is mainly the result of knowledge spillovers.

The future arrival of a new GPT represents a major uncertainty. Bio- and nanotechnology are the foremost candidates for a new GPT. Manifestation of this GPT would entail the so-called Bits, Atoms, Nano and Genes (BANG) revolution. Some preliminary empirical evidence underscores this development. Youtie et al. (2008) show that patenting characteristics of nanotechnology resemble those of information technology—and even that nanotechnology patents are significantly more general than IT patents are.

When a new GPT emerges in the coming decades, it may manifest itself in different ways. It may be primarily science-based, in the sense that universities develop new technologies, which spin off to the market. Or it may develop towards a more application-based phase, where large firms require extensive laboratories and test sites to innovate in the new technological fields. If it arrives, economic activity will become more clustered and cities become more important. However, it is also possible that the BANG revolution takes longer to occur—thus, after our thirty-year window, due to the sheer complexity of the technology and the long time needed by GPTs to mature. In that case, ICT would remain the world's dominant GPT for quite some time and economic activity is likely to scatter across space.

4.2 World economy

Traditional trade theory compares sectors across countries in order to determine the competitiveness of nations. The results of such exercises are comparative advantages of some sectors over others. This has been the standard since David Ricardo developed the concept in his *On the Principles of Political Economy and Taxation* (Ricardo, 1817). Economic predictions from such analyses worked out relatively well, and policymakers were able to identify rising and falling sectors in short- and medium-term analyses. In addition, lower trade costs as a result of better technology and the opening up of many countries after World War II exaggerated the existing patterns of comparative advantage (Baldwin, 2009). The relatively clear prediction of winners and losers has been inviting for policymakers to pick and support the winners. Sometimes these strategies of selecting firms, sectors and/or key areas have been successful. Singapore and South Korea are examples of countries in which clear development plans have put these countries on the economic map. Within countries, the selection of key areas based on computations of comparative advantage has also been a popular strategy.

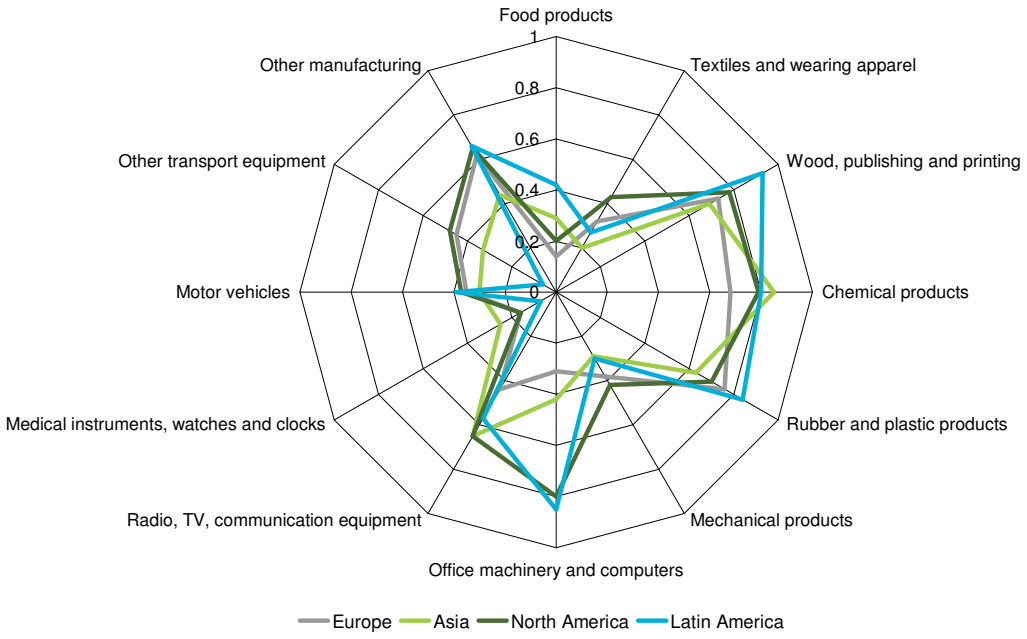
But times are changing, and this model of trade based on comparative advantages of sectors and the abundance of production factors is changing as a result of technological change in the area of ICT. Grossman and Rossi-Hansberg (2006, pp. 59-60) articulate this change as follows: "our understanding of the effects of international integration on prices, production patterns, and factor income comes primarily from analysing models in which goods – sometimes used as intermediate inputs, but often serving final consumer demand – are produced entirely in one location. But times are a-changin'. Revolutionary progress in communication and information technologies has enabled an historic (and ongoing) break-up of the production process. Countries like England and Portugal still produce some goods from start to finish, but increasingly they participate in global supply chains in which the many tasks required to manufacture complex industrial goods (or, increasingly, to provide knowledge-intensive services) are performed in several, disparate locations. To better understand the implications of these trends, we need a new paradigm for studying international trade that emphasises not only the exchange of complete goods, but also trade in specific tasks."

4.2.1 From trade in goods to trade in tasks

Measuring trade in tasks is very difficult because from the current statistics it is impossible to observe this miniaturisation. Nevertheless, an indicator of trade in tasks is trade in intermediate inputs. Grossman and Rossi-Hansberg (2006 and 2008) calculated the estimated share of imported inputs in total inputs used by all goods-producing sectors in the US and the estimated share of imported inputs in the gross output of those sectors. They show that trade in intermediate inputs has increased steadily over a period of almost three decades, with an acceleration in the last ten years. For other countries there are no detailed time series available. Trade in intermediates in both goods and services is, however, high.

Fact 6 in Chapter 3 already shows that world trade has increased dramatically. Currently, trade in intermediates represents 55 percent of trade in goods and 73 percent of trade in services in OECD countries. This suggests that world trade flows are mainly comprised of inputs rather than final consumption goods or services. Services that are intermediate inputs account for about 75 percent of total trade in services (Miroudot et al., 2009). Also shown in Fact 6 in Chapter 3, is the massive rise of foreign direct investment (FDI), as emphasised by Helpman (2006) and Bergstrand and Egger (2008). Over the last ten years, FDI has almost doubled as compared to trade, with this ratio increasing from 0.48 in 1995 to 0.86 in 2005.

Figure 4.1 Share in world intermediate goods trade in 2006



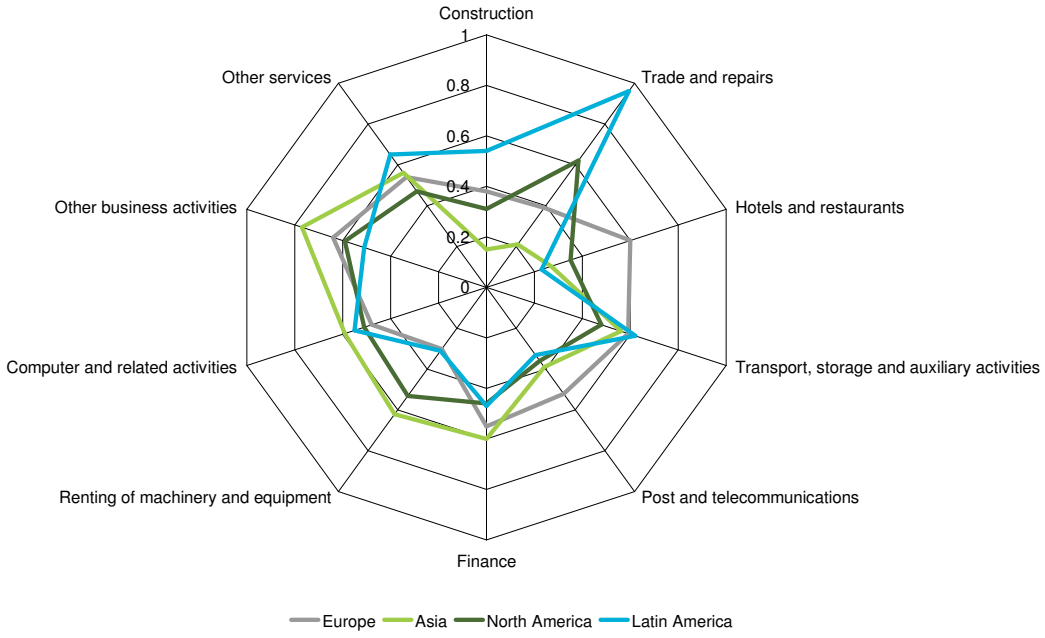
Source: Miroudot et al. (2009).

What is interesting about this development is that not only OECD countries, but also non-OECD countries, have seen a change in their patterns of trade. Figure 4.1 presents regions' shares in world intermediate trade (imports and exports) by industry. Each sector is captured by one axis on the radargram. It gives a more detailed overview of the specialisation patterns in Asia, Europe and North and Latin America. Intra-EU trade is excluded, which explains why Europe is the largest trader in intermediates in so few industries of the radargrams. The fact that stands out most is the specialisation of Asian countries in the two industries 'Radio, TV and communications equipment' and 'Chemical products'. In addition, Latin American countries trade most in 'Wood, publishing and printing' and 'Rubber and plastic products'. The high shares of Asia and Latin America, not only in exports but also in imports of intermediate goods in these industries, point to the importance of intra-regional production networks.

Figure 4.2 shows regions' shares in world intermediate services trade. Europe is the largest importer of intermediate services in almost all service industries. This process of trade in

intermediates has been enhanced by developments in ICT and trade liberalisation (Baldwin and Martin, 1999). Total trade in services increased dramatically as shown in Figure 3.13. Also Latin America and Asia seem to be trading services.

Figure 4.2 Share in world intermediate services trade in 2006



Source: Miroudot et al. (2009).

There are two possible future trends in trade in intermediates. First, it could continue, leading to worldwide specialisation of production and further increases in trade. With respect to Europe, this implies a continuation of the specialisation pattern in Figure 4.2 with an emphasis on business services and high-end services, which are traded globally. The North-American economies and Japan will combine services and manufacturing to innovate at the top end of the services and manufacturing markets. Upcoming economies in Asia and South-America (for which no data are available) specialise in manufacturing, and trade their intermediate inputs with Western countries. Improvements in communication technology will boost this process further because CT makes coordination cheaper and specialisation more efficient. Although this reduces the chance of mistakes the quality remains as high as the weakest link.

Second, this pattern of trade could become less popular because of technological change or global tensions. Upcoming economies could become more powerful and protect their own markets. In this case, European countries focus on producing local varieties in both services and high-end manufacturing. The US and Japan will do the same. Upcoming economies will produce more for their local markets, which demand less-advanced products. Patterns of regional specialisation may occur, but trade will be limited. This trend towards autonomy is boosted when complexity and liability become too high; it becomes more efficient to produce in close vicinity or even in-house. In addition, when information technologies become relatively

more efficient relative to communication technology, it pays to have one worker and one firm do many tasks.

4.2.2 Two examples

In *Barbie and the World Economy* (1996), *LA Times* journalist Rone Tempest describes the global process for producing a Barbie Doll.[9] The doll is designed in Mattel's headquarters in California. The plastic pellets that are used to produce Barbie's body are made in Taiwan, by refining oil into ethylene. Barbie's hair is made of nylon and fabricated in Japan. The cotton cloth comes from China. The moulds for the doll are made in the US, as are the paint pigments used to decorate it, and the cardboard used for packaging. Assembly takes place in Indonesia or Malaysia. Finally, quality checks, marketing and distribution are done from California.

The limit to further unbundling of the production process is best illustrated by the problems Toyota is facing. In the course of a year they have recalled over two million cars in the US with malfunctioning parts that were outsourced during production. While this has had a devastating effect on the value of the company on the stock exchange, it has—even more importantly—seriously damaged the reputation of the brand Toyota. The example shows that there is a limit to slicing up the supply chain because outsourcing means giving up direct control over the quality of the parts. The Toyota cars and reputation are as strong as their weakest link. *Financial Times* journalist Gillian Tett mentions risk as the main reason why further unbundling might reach a limit. The concentration of specialised activity in some parts of the world comes with new vulnerabilities and forms of contagion or risk because it could induce supply-chain failures. In this respect, the financial crisis also teaches us the lesson that moving credit risk around the world in complex chains has in the end not made the system safer and more efficient. Rather, it concentrated risks in certain parts of the supply chain.[10]

These two examples show that trade in intermediate goods and tasks has taken a flight in the production of dolls and cars. The manufacturing of Barbie dolls and Toyota cars has become a global process in which technology and the division of tasks across people and space are crucial.

4.3 The division of labour and organisation of work

Globalisation and the developments in ICT have led to specialisation of economic activity and to the "offshoring" and outsourcing of parts of the work (Feenstra and Hanson, 1999). The first wave of globalisation led to the spatial separation of production and consumption; the current wave leads to a spatial unbundling of jobs, firms and industries and a slicing up of the supply chain. The impact of this new wave is on jobs and tasks rather than sectors, because the costs of trading some tasks have plummeted, while others in the same sector are unaffected or might have increased in terms of trade costs. For example, truck driving is largely unaffected by

[9] See http://articles.latimes.com/1996-09-22/news/mn-46610_1_hong-kong.
[10] See http://www.ft.com/comment/columnists/gilliantett.

technological change, but call-centre services are highly affected. Until recently, these jobs could be put together geographically in say a home-PC delivery company. However, rapid advances in ICT call into question this categorisation because most call-centres have been outsourced to low-wage countries.

4.3.1 Workers, firms and countries

What is the difference between this wave of globalisation and the previous one? First, it is mainly driven by ICT. Computers determine how we organise production and divide tasks between workers. Unbundling and rebundling of tasks into jobs is the result of the advantages of specialisation or generalisation of work across people and space. It depends on the cost of communication whether or not tasks will be bundled into jobs or will be separated into different jobs. When the costs of communication are becoming lower, the probability of splitting tasks into different jobs rises.

Second, offshoring becomes a common practice for (multinational) companies. Offshoring describes the relocation by a company or a business process from one country to another. Most of the time these are operational product processes such as manufacturing, or support service processes such as accounting. The latter has been made possible because of improvements in communication technologies. Trade is mainly taking place in intermediate parts and ideas rather than packaged in some black-box production plant that delivers final goods. This means that the cost of communication and transportation of the different parts pose a limit on the gains of specialisation. This development started in East Asia, where distances are relatively short compared to the wage differences between similar workers in different countries. Japan outsourced much of its low-skilled production work to countries such as Thailand, Malaysia, Indonesia and Vietnam (and from the mid-1990s onwards also to China). This trend continued with the outsourcing of many lower end and routine office jobs from the UK and US to India, because of the common language.

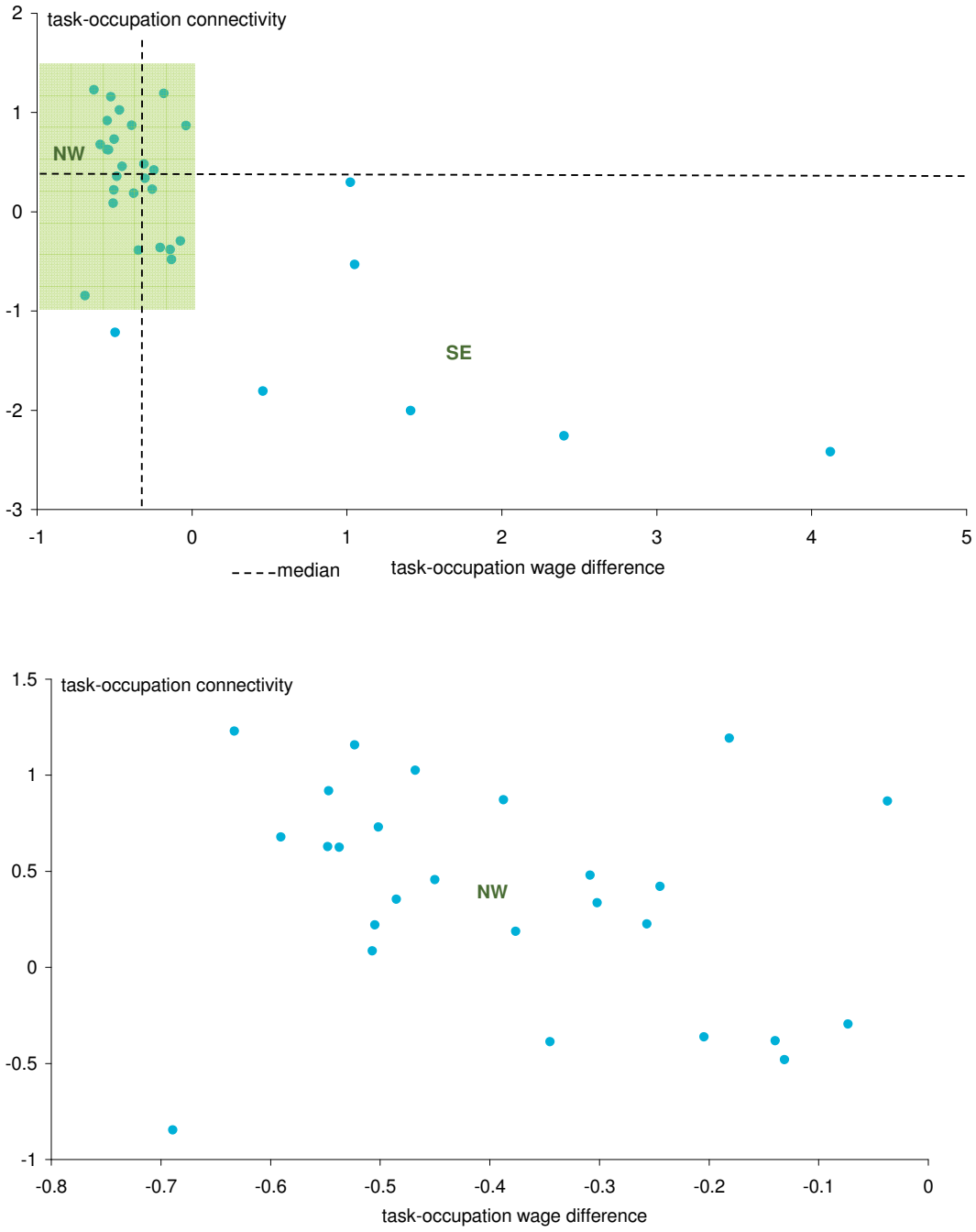
Third, the unbundling of tasks is taking place because companies organise themselves in a new way. New techniques in IT and CT change the organisation structure towards more centralisation or more empowerment at the lower levels in the hierarchy. Bloom et al. (2009) point to the different effects of information technology and communication technology. Control is the key word for the effect on employees. Better IT gives employees more autonomy and a wider span of control, while CT improvements decrease the autonomy for workers (see also Figure 3.1 and Fact 1).

4.3.2 Evidence for the Netherlands

Specialisation at the worker level occurs when it is possible to separate tasks from a job. Specialisation involves the answers to two questions. The first is about connectivity of tasks. To what extent do tasks logically belong together (or are glued together, to use Baldwin's terminology; Baldwin, 2009)? The second is about the price of different tasks. Autor et al. (2003) showed that routine tasks are increasingly automated or taken away from many jobs

because they are too expensive to maintain in the current job. So, tasks that have a higher price than the average task are likely to be separated. Acemoglu and Autor (2010) review several models to understand the modern division of labour and present evidence for the United States.

Figure 4.3 **Task-occupation connectivity and task-occupation wage differentials in the Netherlands, 1994-2008, all tasks (upper) and selection of tasks (lower)**



Source: Akçomak et al. (2010).

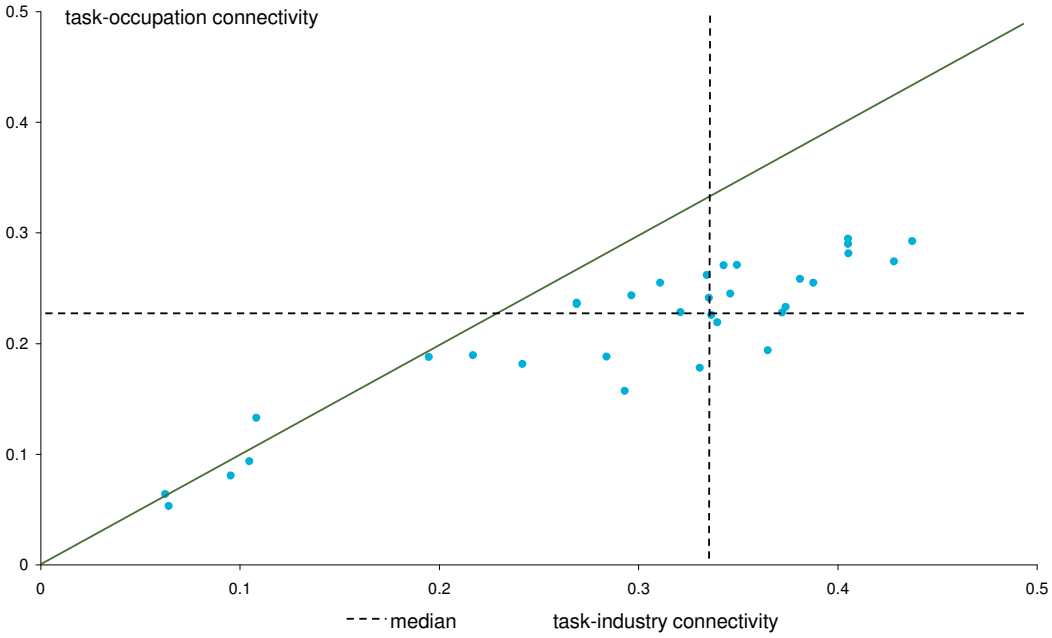
Figure 4.3 presents the relationship between task connectivity and task wage differentials for 33 job tasks for the Netherlands over the last 15 years (1994-2008). The upper frame in Figure 4.3 presents all 33 tasks, and the lower frame the northwest quadrant only—in order to make the tasks in that area more visible. The horizontal axis measures for each task the difference between the wage for the task and the wage of the occupation. The values are normalised. Higher values suggest that the difference between the occupation wage and the task wage is positive (that is, the task is worth less in terms of wages than the occupation). Hence, tasks towards the right-hand side of the horizontal axis are likely to be removed from jobs when possible. A glance at these tasks suggests that they are mainly low-skilled blue-collar tasks such as "physical strength", "working with tools," and so forth. The vertical axis measures for each task the likelihood of the presence of a task in an occupation relative to the presence of other tasks. From this correlation matrix a measure of connectivity is constructed. Higher levels of connectivity imply that it involves more communication costs to separate these tasks. Tasks such as "thinking of solutions", "analysing" and "writing" are relatively well connected, whereas tasks such as "physical strength" and "selling" are not.

The dotted lines present median values. These values were used to construct, as a rough indicator, four quadrants. The southeast quadrant included tasks that are not very well connected and have a large wage differential relative to the occupations in which they are in. These tasks are the most likely candidates to be separated and put into different jobs. In contrast, the tasks located in the northwest quadrant are relatively well connected to other tasks and are rewarded commensurately with the occupation in which they can be found. These tasks are an integral part of current Dutch jobs. These are the tasks highlighted in the lower frame of Figure 4.3.

The next step is to analyse whether a similar trend is observed within firms. If it is possible to separate tasks from a worker and assign these tasks to other workers, it is not necessarily the case that these tasks will leave the firm (or the country). An example might be something like experiencing organisational changes that have changed the division of work within firms only. In the absence of sound firm-level data for this period, we use two-digit industry-level data to investigate how task connectivity has evolved across industries/firms.

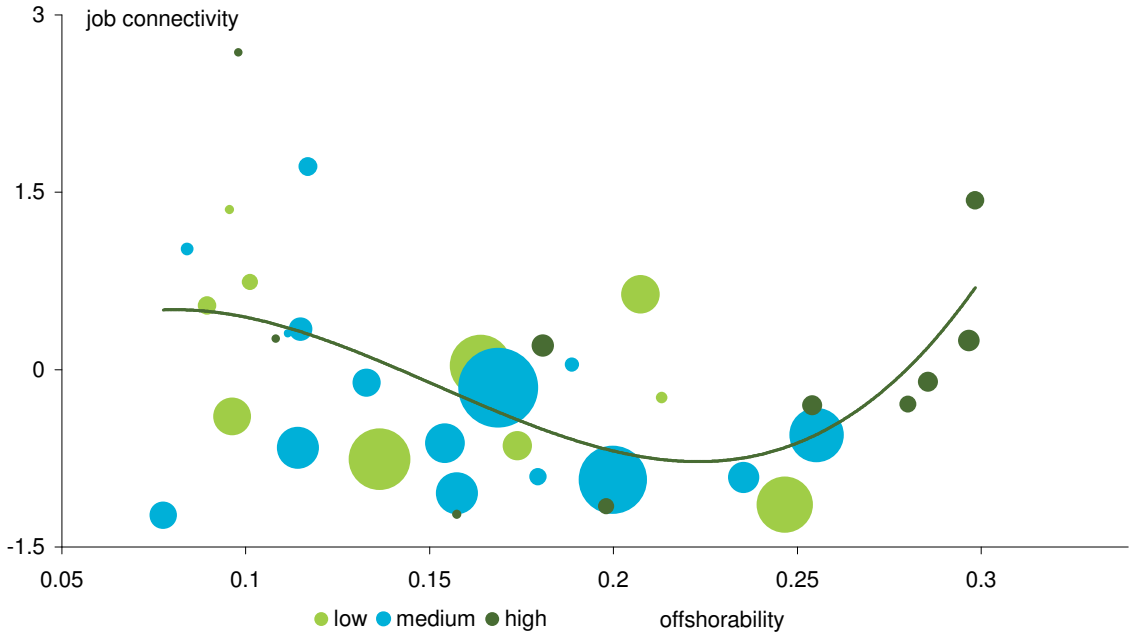
Figure 4.4 shows that correlation between task-occupation- and task-firm connectivity. It turns out that task connectivity to the firm is higher than task connectivity to the job because all observations lie below the 45-degree line. This suggests that it is easier to separate tasks from the worker than from the firm. The fact that tasks do not leave the firm so easily also implies that firms want to maintain control over their production process, which indicates that there may be some limit to outsourcing economic activity to other firms and to disintegrating the supply chain.

Figure 4.4 Correlation between task-occupation connectivity and task-industry connectivity in the Netherlands



Source: Akçomak et al. (2010).

Figure 4.5 Changes in offshorability and job connectivity in the Netherlands, 1996-2008



Source: Akçomak et al. (2010).

Finally, offshoring comes into the picture. A measure of the "offshorability" of jobs is constructed using the input-output tables for the Netherlands. This measure includes both direct and indirect imports at the two-digit industry level. Akçomak et al. (2010) explain in detail how this measure is constructed. The bottom line is that jobs scoring relatively high in terms of offshorability are more likely to be carried out outside of the Netherlands. Figure 4.5 presents a scatter plot of occupations showing the relationship between the measure of offshorability and job connectivity. The size of the dots represents the size of the occupations; different colours are used to differentiate between the levels of education across jobs. Although eyeball econometrics suggests a negative correlation between these two variables, the pattern is at first sight rather ambiguous. We expect more connected jobs to be less contestable and hence less offshorable. This prediction is generally true, except for some well-connected jobs towards the right-hand side of the horizontal axis. Closer inspection of these jobs reveals that these are high-skilled service jobs. These jobs are in industries that are heavily involved in international trade, but the tasks are attached to other tasks in the Netherlands. A regression analysis taking into account different sectors suggests a significant negative relationship between offshorability and job connectivity.

The conclusion from this early empirical evidence is that specialisation of work has occurred in the Netherlands over the last decade. The least-connected tasks and jobs have been most vulnerable to trade in tasks and to offshoring.

4.4 Cities as the place of business

Cities flourish because they allow exploitation of demand and supply linkages. Supply linkages will in particular become more important for Western economies, because they deal directly with supply chains. Firms buy many inputs from other firms and it is often cheaper to purchase such input from firms located nearby. These firms are known and trusted, culturally in close vicinity (making communication easier), and quality is assured because of similar production standards. Proximity is of importance also in terms of the development of new technologies following the ICT revolution. The size of cities differs, however. Estimating agglomeration economies has been difficult, but the trend towards concentration of people in high-income urban areas points to important agglomeration advantages (Moretti, 2010). This is increasingly true because of transport costs of goods across space, thick market advantages and knowledge spillovers. Rauch (1993) suggests that the latter is the most important in explaining the recent success of cities, and will become more important in the future. He argues that cities with higher concentrations of skilled workers pay higher wages and are more productive—and that this tendency has been rising over time. This is consistent with Facts 1-5 in Chapter 3. Skills are excellent predictors of urban success in Western countries.

4.4.1 The future of cities

One prominent force determining the type of cities is the further disintegration of global supply chains. Feenstra and Wei (2009) show that China increasingly serves as the supplier of manufacturing goods (see Fact 10). For Western countries, China represents the opportunity of a low-cost labour force. Whether the goods are simple toys, personal computers or sophisticated components for the European Airbus, a large part of Chinese exports involves contract manufacturing in China for goods that are designed elsewhere. This phenomenon is known as processing trade, and involves importing inputs into China, assembling them there and then re-exporting them. This role as contract manufacturer played by China and other upcoming economies means that Western economies import components on demand and focus increasingly on tasks nearer the beginning and end of the supply chain. Developed economies also focus more on research and development (including design and marketing) tasks. These tasks require exploiting ideas and building up knowledge.

While the costs of transmitting information to Chinese manufacturers may be invariant to distance, the costs of transmitting ideas and knowledge (especially tacit knowledge) rises with distance. Von Hippel (1994) and Gaspar and Glaeser (1998) show that tacit knowledge is even—or perhaps particularly in the ICT era—best transmitted via face-to-face interactions and through frequent contact. Proximity matters in transmitting knowledge because tacit knowledge is non-rival in nature, and knowledge developed for any particular application spills over easily (Arrow, 1962). Griliches (1992) states that such spillovers are characterised by people working on similar things and hence benefiting much from each other's research and effort. This explains why cities in Western countries have become increasingly more productive, skill-intensive and concentrated.

It also explains why it has become obsolete to speak in terms of sectors, and why cities should be the unit of observation. Knowledge flows are not limited by sectors or industries but are spatially bound and brought together in cities. Indeed, Glaeser et al. (1992) show that knowledge spillovers are not restricted by industry boundaries. Consistent with Jacobs (1961), they find for 170 relatively large US cities that the most important sources of knowledge spillovers are external to industries, and that cities are the source of innovation and growth. Moreover, differences in human capital explain differences in outcomes between cities (Glaeser, 2005a).

Globalisation increases market size, which allows for the exploitation of scale economies in production. People and firms settle in cities because of thick labour markets, the need for face-to-face interactions and knowledge spillovers (see Facts 3-5). In this way cities become the relevant players in terms of networks and places of manufacturing (Krugman and Livas Elizondo, 1996 and Ades and Glaeser, 1995). Since autarky requires production to be bundled with consumption, and complete unbundling makes location of production irrelevant, cities flourish at intermediate degrees of trade and transport costs. This is complemented by Krugman's (1980) home-market effect, where larger agglomerations get a disproportionate share of economic activity because of returns to scale and imperfect competition. But firms

would rather not all locate in the same place, as local competition is also fierce in big agglomerations.

4.4.2 Examples

Below we provide a number of examples of city development over the past decades. The examples stress the importance of cities as attractors of economic activity, the importance of human capital for urban development and the crucial impact of historically sound educational investments.

Superstar cities

Very few places have the two preconditions—restricted supply of housing and a durable anchor for robust demand—for developing successful places of business. Boston is a skilled metropolitan area, and its restricted supply of housing has led to high prices driving out the poor. But Atlanta is now a skilled metropolitan area as well. Its housing supply seems virtually unlimited, however. Why is it obvious that Boston can maintain a permanently higher price level than Atlanta?

Gyourko et al. (2006) show that differences in growth rates of house prices and income between 1950 and 2000 across metropolitan areas have led to an increasing gap in housing values and incomes between locations. They provide estimates that show growing spatial skewness in house prices and incomes, which is explained by inelastic supply of land in some attractive locations combined with an increasing number of skilled households. Scarce land leads to a bidding-up of land prices and a sorting of high-income families in so-called "superstar cities".

So, Boston is a superstar city because it restricts the number of low-educated citizens by inelastic supply of housing. This is due to the inability to expand the city. Atlanta attracts both skilled and unskilled workers, which limits sorting and eventually success. Human capital matters for urban success, but in different ways. Boston seems to benefit from self-matching of high educated workers, while Atlanta benefits from the diversity of people, leading to cross-matching of different types of workers. This has increased the degree of specialisation in Boston and has made Atlanta a place of business for all. Chapter 5 elaborates further on the importance of different types of workers sitting together.

Betting on Atlanta?

Atlanta is a clear example of a city that has attracted people and firms with thick labour markets, the possibilities of face-to-face interactions and knowledge spillovers. Should we bet on its future growth? Glaeser considers the risks and opportunities for Atlanta in an article in the *New York Times*. After years of growth, Atlanta is now in for a few rough years. It has

experienced the highest drop in the number of building permits, and its 10 percent unemployment rate reflects hard times.[11]

But on the positive side are agglomeration economies. First, Atlanta builds on its strong position in the southern region of the US and will be able to exploit its strong demand and supply linkages. Second, Atlanta clearly benefits from its business-friendly politics. Lastly, and most important, Atlanta is a high-skilled city, compared to others in the region, which is the key to success for cities today and in the future. A strong city relative to the hinterland matters for economic success because it absorbs economic activity and drives out unproductive activities.

Buenos Aires vs. Chicago

Robert E. Lucas Jr. spoke in his presidential lecture to the econometric society about a tale of two countries – the Philippines and South Korea (Lucas, 1993). In his lecture, *Making a Miracle,* he explores why the latter took off and why the former was stuck in terms of economic development. Both countries had similar "starting values" in 1960, but developed very differently. He concludes by stressing that, "the main engine of growth is the accumulation of human capital – of knowledge – and the main source of differences in living standards among nations is differences in human capital." (p. 270).

The modern version of this story is presented in Campante and Glaeser (2009). They compare the development of Chicago and Buenos Aires from the nineteenth century onwards. Both cities grew enormously over the late nineteenth century as nodes of a transportation network that brought the produce of the New World's rich, but relatively unpopulated, hinterlands to the tables of the world. Over the course of the twentieth century, the paths of the two cities have, of course, significantly diverged, just as the paths of Argentina and the US have diverged. Buenos Aires has had faster population growth, but Chicago has become much richer. There are four main reasons for this divergent development. First, the rural-urban migrants in Chicago were much better educated, reflecting the strength of the US educational system at that time. Second, because of a more-educated workforce, industrialisation took off much earlier in Chicago. Finally, a higher-educated workforce increases political stability.

These three factors are consistent with the story developed for the Netherlands in Chapter 2, and highlight the complementarity between human capital and agglomerations. Campante and Glaeser (2009, p. 33) indeed conclude: "the gap in industrial development and human capital set the stage for the 20th century. Across countries, schooling in 1900 strongly predicts success today, partially because less schooled places have had far worse political outcomes." A historically sound level of education matters for current and future success of cities. Not only the present level is important, also the past levels determine future success.

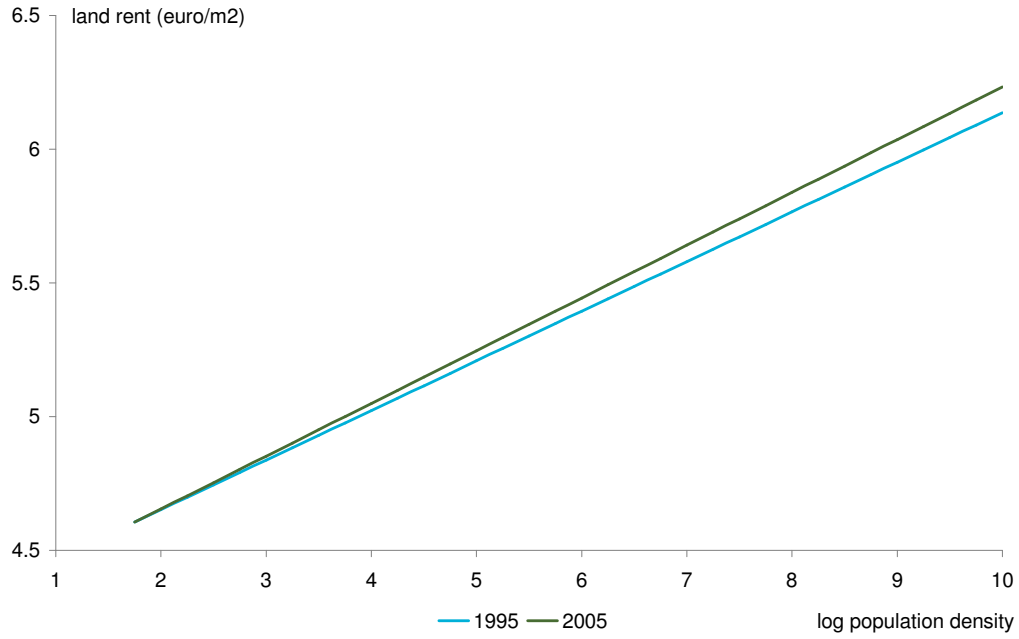
[11] See http://economix.blogs.nytimes.com/2010/03/09/betting-on-atlanta/.

Evidence from the Netherlands: Noord-Brabant

The rise of cities is also apparent in the Netherlands. Figure 4.6 shows the relationship between land rents per square meter and the log of population density in the province of Noord-Brabant in 1995 and 2005.[12]

There are two interesting observations in this picture. First, there is a positive correlation between land rents and population density. Apparently the city is an attractive place to be, which is consistent with the observation that production in cities benefits from knowledge spillovers. Second, the slope of the line is increasing in the period 1995-2005. This suggests that land rents have been increasing, making cities more important places of business over time.

Figure 4.6 The relationship between land rents and population density in Noord-Brabant, 1995, 2005



4.5 What have we learnt?

The trends and examples bring to the forefront three main lessons. First, knowledge is and will be the key to success for Western countries. Human capital and knowledge are essential for maintaining the competitive edge in a globalising world and for stimulating technological process. Second, as a result of ICT development, jobs will be increasingly based on a collection of tasks. It will become more important to focus policy on this structure, relative to the old paradigm of sectors. This demands a novel view on the division of work. Finally, economic activity clusters in cities. Cities attract skilled workers who benefit from face-to-face interactions. In addition, cities are the main hubs in the economy, replacing to some extent the role of countries as economic engines.

[12] We would like to thank Henri de Groot for computing land rents in Brabant and making this information available to us. At http://www.nl2040.nl we explain in more detail how land rents have been computed.

4.5.1 Trends

Several trends span the scenario worlds that we develop in Part II of this study. First, technology and technological change matter—especially developments in ICT and the possible arrival of a new GPT. ICT continues to improve, which has three consequences. First, ICT impacts the division of labour and the organisation of work (Fact 1 in Chapter 3). In addition, the current state of ICT is now at such a stage that its further development does not lead to further agglomeration. Knowledge spillovers become less important and economic activity will spread (Fact 2). Finally, ICT makes connections easier, which fosters knowledge exchange and global competition (Facts 6-10). A new GPT may arrive. If it does, then economic activity will be concentrated in cities because of the importance of knowledge spillovers in cities to develop the new technology (Facts 3-5). If there no new GPT arrives in the next few decades, economic activity will scatter further because of increased global competition (Facts 6-10).

Second, technology and free trade determine to what extent trade in intermediate goods and in tasks continues to develop. Technology can go either way towards emphasising more trade in intermediate products because of improved communication technology or towards more trade in final goods being put together for local markets or final goods trade. Global developments may increase or decrease free trade.

Third, cities become the new places of business: they can be large or small, depending on knowledge spillovers and other agglomeration advantages (such as thick labour and product markets) or disadvantages (such as congestion and pollution). Knowledge spillovers are particularly important with the arrival of a new GPT, whereas the further development of ICT will scatter economic activity.

Fourth, production technology is influenced by ICT. Computer technology determines to a great extent how the division of labour and the organisation of work will take shape. If information technology dominates, then generalisation and autonomy of workers and firms will increase; if, however, communication technology dominates, then fragmentation of production and specialisation will rise.

4.5.2 Economics

The future of the Dutch economy emerging from these trends can be expressed in four possible worlds, which we will develop in Part II. These will be related to how production is organised and to type of city. Regarding the former, there are two ways to organise production: by specialisation and by generalisation of work. Regarding the latter, there are also two types of cities: small cities that benefit from either virtual connections or local demand, and large cities that benefit from knowledge spillovers in production and innovation.

The combination of these two extremes creates four types of cities. The first type is a large set of small and specialised cities. These cities benefit from the many virtual connections with other cities and a global market to trade goods, services and ideas. The second type is a smaller set of large and specialised cities clustering economic activity around developing new technologies and benefiting from spillovers in production and research and development. The

third type is a world with many small and generalised cities producing local varieties and trading final goods. The fourth type features large and generalised cities with integrated supply chains producing a substantial range of goods and services and producing applied innovations. These four archetypes will be explored further in terms of scenarios in Part II.

4.5.3 Policy

Future policy challenges that may arise can be identified in terms of three main areas: cities as the place of business, the development of knowledge and human capital, and social policies. Part III of this study devotes most of its attention to these three areas of policy.

Policies in the area of the Dutch place of business demands investment in cities and infrastructure. It must take into account developments in the area of the world economy and must acknowledge the fact that responsibilities may shift away from the national level to international- and city levels.

The knowledge economy demands investments in education, science and innovation. All three are complementary and demand a consistent government strategy. Depending on the arrival of a new GPT, investments have to be more directed towards science or innovation. Investments in education are needed to keep up with global developments in knowledge creation and application.

Finally, social policy requires a flexible labour market and the ability to absorb adverse supply shocks. The ability of the economy to do so will depend on the nature of these risks and the ability to insure these risks across the different scenarios.

Part II Unfolding

'We know what we are, but know not what we may be.'
William Shakespeare, Hamlet, Part IV, v.43.

In *Consulting the Oracle* (1884), a group of women form a semicircle in front of the upright figure of a woman who motions for a silence with her hand and leans towards the dark wall. The standing woman is a priestess performing a ritual that will induce a trance in which those present will hear the head predict the future. J.W. Waterhouse paints the Teraph (a human skull) in such a way that the spectators are waiting intently and in a state of excitement for the oracle to predict their future.[1] Oriental themes were quite popular in the second half of the nineteenth century. This study is not a source of wise counsel or prophetic opinion. Neither is it a precognition of the future. The takeaway message of the painting, according to the artist, is the moment of mysteriousness. There is a brief moment of tension and silence before the Teraph predicts the future of the women present. Daylight falls through the open window exactly between the priestess and the audience, framing the gesture of her hand to pay close attention—since the unfolding of their future is imminent.

Consulting the Oracle

Part II of the study unfolds the possible future worlds of the Netherlands. Unlike the oracle in Waterhouse's painting, we are not predicting the future. CPB is not an oracle to be consulted for predicting the long-term future of our country. Rather, we sketch here four possible scenarios for the future of the Dutch economy. To do so, we use the ingredients of Part I about the

[1] *Consulting the Oracle* can be seen in Tate Britain in London or at http://www.johnwilliamwaterhouse.com/.

importance of people and location to build an analytical framework from which four scenarios can be constructed.

Scenarios serve two purposes. First, scenarios provide an instrument to deal with uncertainties about the future world. The process of thinking through different scenarios fuels the power of imagining the most important drivers that determine the possible future world in about thirty years. Scenarios focus on the most important drivers and do not incorporate all drivers. In our study this boils down to two main drivers: people and location. Scenarios do not provide a complete picture of the future world in which we will live, and our scenarios are not crystal-clear predictions of the future of the Dutch economy. The aim is not to determine the future but to prepare for it. This preparation is the main subject of Part II. Second, the scenarios can and will be used to explore strategic policy issues in the Netherlands. Part III of the study presents the contours of such policy issues. Scenarios are useful to the extent that they are acknowledged to emerge exogenously, which means that policymakers are unable to choose a particular world and work towards this world. Indeed, Dutch policymakers only have a limited impact on the trends described in Chapter 4 (in Part I, above). The table below presents the use and misuse of scenarios.

The use and misuse of scenarios

Scenarios are ...	Scenarios are not / cannot ...
... possible futures of the world	... predictions of the future
... exogenously given for the user	... be influenced by the user
... all equally plausible	... to be selected by the user
... consistent	... “visions” of the CPB
... explorations of the future under “what if ...”	... explorations of “what happens if/when ...”

Source: De Mooij and Tang (2003).

The first chapter of Part II addresses the role of people in the production process. In the language of economists, the main aim is to investigate the economics behind the division of labour between people. We label this the *production technology of the economy* (Chapter 5). Next, we focus on the role of geography as a production factor by addressing the *spatial technology of the economy* (Chapter 6). Webster’s dictionary defines technology as a manner of accomplishing a task, or the practical application of knowledge. In our case, technology is about the functions of people and space in the production process. The second reason for choosing the term technology is the frequent combination it forms with the word ‘change’: technological change. Chapter 7 brings the two together and combines the different options of people and place. Chapter 8 describes the four scenarios.

5 Production technology: Workers and the task economy

'Quantity and quality are more easily produced when a man specialises appropriately on a single job for which he is naturally fitted, and neglects all others'
Plato, Greek Philosopher in his dialogue *The Republic*.

Texas Instruments' telecommunications chip looks like any other semiconductor. But it is the product of worldwide effort. Conceived with engineers from Ericsson in Sweden, it was designed in France with software tools the company developed in Houston. The chip rolls off production lines in Japan and the United States, gets tested in Taiwan, and is put into phone systems in Sweden, the US, Mexico and Australia.[1] This division of labour sounds complicated—and it is. Rather than using factories around the world, most chip companies make most of their devices at home and ship them out by plane. Texas Instruments takes a different route, with 40 percent of its employees working outside the US in specialised companies. Similarly, ASML, the world's leading provider of lithography systems for the semiconductor industry, reports that around 90 percent of each of their systems comes from external suppliers. They argue that it is up to supply-chain engineers to determine which components are best suited for value sourcing, to draw up specifications and to identify the most qualified suppliers. To be successful, ASML maintains that it is crucial to forge strong and lasting relationships with companies who are the best in their own field.

These examples show that the division of labour between workers and firms worldwide is an important determinant of production decisions, and that the supply chain is complex in structure. What determines the division of labour? And, in the end, who carries out what activities? Why does this matter? To answer these questions, we investigate the possible production technologies and the conditions under which particular production technologies yield a particular division of labour. The outcomes of this analysis shed light on the division of labour in terms of what tasks are carried out by what workers. It also sketches the organisation of work within and between companies, which involves an analysis of the make-or-buy decision. Finally, it clarifies what the options are for integrating or disintegrating the supply chain, both domestically and abroad.

5.1 Main argument and example

The theory developed here is about the economics of scope—or, what is known as the vertical dimension of the supply chain. Essentially, it determines—based on costs and benefits—the division of work to produce output. The division of work is limited by the cost of communication. If communication costs are low, people divide the work and specialise on one

[1] See http://www.businessweek.com/archives/1995/b3436126.arc.htm for more information about Texas Instruments' strategy.

or just a few tasks. If communication costs are high, workers become jacks-of-all-trades. They conduct more tasks themselves and generalise.

The mechanism of the division of labour works at a number of levels:

- *Workers*. Workers have to decide what tasks to carry out to optimise their wages. The costs of communication (asking and telling) relative to the costs of information acquisition (knowing and doing yourself) determine the division of labour. Keeping tasks together in one person reduces coordination between workers at the expense of efficient allocation of workers to tasks.
- *Firms*. Firms have to coordinate the work and organise production to optimise profits. When coordination costs are low, decision-making is centralised, reducing the autonomy of workers relative to the upper layer of management. When information acquisition costs are low, workers need less help in solving problems and making decisions, which increases autonomy and leads to decentralisation of authority.
- *Supply chains*. Firms have to determine what tasks to do in-house and what tasks to buy from outside to optimise the number of activities. Across firms, written contracts and the reliability of partners is one aspect of the decision to outsource or not; another one is that the probability of mistakes rises and flexibility decreases when distance increases. When communication costs are relatively high, work gets coordinated within the firm or in foreign subsidiaries under the close control of the firm's management. When information acquisition is relatively easy, flexibility is higher, and firms can more easily switch to other suppliers or outlets when mistakes or hold-up problems occur.

5.1.1 The division of labour in three pictures

Figure 5.1 uses three pictures to illustrate the core of the production model we have in mind. There are four workers (w_1, …, w_4). To produce one unit of output, four tasks (t_1, …, t_4) have to be performed by these workers. In Figure 5.1, v_{ij} represents the time worker i needs to carry out task j. Workers have a comparative advantage in their own task. To keep things simple, this means that w_1 is best in carrying out t_1 and w_2 in t_2, and so on. The tasks have to be performed in order, such that t_1 is carried out first and t_4 is carried out last.

The upper picture shows two workers conducting two tasks each. The first worker (w_1) conducts the first two tasks and then hands over the work to the other worker (w_3) in this example, who completes the final two tasks. Production time for the first worker equals $v_{11}+v_{12}$, and production time for the second worker equals $v_{33}+v_{34}$. The first subscript refers to the worker and the second to the task. This is important, because production time is lowest when workers perform their own tasks. Hence, when w_1 and w_2 carry out t_1, production time for w_1 equals v_{11}, while it takes $v_{21}>v_{11}$ units of time for w_2 to do the same task. We assume that all workers are equally bad (or good) in performing tasks that are not their own. Besides production time, there is a need for coordination (c) between the two workers (since w_1 hands over the work to w_3 when the first two tasks are done). Coordination takes k units of time and is assumed the same for coordination between any of the four workers. Total production time T to

produce one unit of output consists of the time needed to conduct the four tasks and coordinate between the two workers. In this case, $T=v_{11}+v_{12}+v_{33}+v_{34}+k$.

Figure 5.1 The division of labour between workers and within and between firms

Production	Teams	Tasks and coordination	Production time T
Division of tasks between workers		t_1 c t_2 c t_3 c t_4	
	w_1	v_{11} 0 v_{12}	$T=v_{11}+v_{12}+v_{33}+v_{34}+k$
	coordination	k	
	w_3	v_{33} 0 v_{34}	
Organisation of work within the firm		t_1 c t_2 c t_3 c t_4	
	w_1	v_{11} 0 v_{12}	$T_1=v_{11}+v_{12}+v_{33}+v_{34}+k$
	coordination	k	
	w_3	v_{33} 0 v_{34}	
	w_2	v_{21} 0 v_{22}	$T_2=v_{21}+v_{22}+v_{43}+v_{44}+k$
	coordination	k	
	w_4	v_{43} 0 v_{44}	
Efficient production			$T_1=T_2=T$
Organisation of work within/ between firms		t_1 c t_2 c t_3 c t_4	
	w_1	v_{11} 0 v_{12}	$T^o_1=v_{11}+v_{12}+u_3+v_{34}+2k$
	coordination	k	
	w^o	u_3	
	coordination	k	
	w_3	v_{34}	
	w_2	v_{21} 0 v_{22}	$T^o_2=v_{21}+v_{22}+u_3+v_{44}+2k$
	coordination	k	
	w^o	u_3	
	coordination	k	
	w_4	v_{44}	
Outsourcing if			$(T_1+T_2)>(T^o_1+T^o_2)$

The second part of Figure 5.1 shows the firm with four workers and four tasks. Assume that the firm has to produce two goods. In this example, w_1 and w_2 perform t_1 and t_2, and w_3 and w_4 conduct t_3 and t_4. The firm composes production teams: Team 1 consists of w_1 and w_3, and Team 2 of w_2 and w_4. This composition of teams is one that minimises coordination costs k.[2] Coordination costs are minimised because production of one unit of output involves only two workers, which means that there is one coordination moment after the performance of t_2 and before the other worker starts with conducting t_3. The production of one good requires a total production time of $T=T_1=T_2$ for both production teams, under the assumption that all workers

[2] The other possibility is that w_1 and w_4 and w_2 and w_3 form the two teams.

are equally able to perform tasks that are not their own. Total production time is displayed towards the right of the figure.

The lower picture shows what happens if the firm decides to outsource part of production to another firm. The example drawn here shows that t_3 is outsourced to another company. Production time in the outside company is $u_3<v_3$. Now, part of the work previously carried out by w_2 and w_3 is outsourced. Production of one unit of output now involves three workers. One team consists and w_1, w_3 and the outside worker w^o, and the other team is made up of w_2, w_4 and the outsider w^o. Coordination costs rise to $2k$ because there is coordination between w_1 and w^o, and w^o and w_3 in the first team, and between and w_2 and w^o, and w^o and w_4 in the second team. Total production time with outsourcing (denoted by superscript o) now equals T^o_1 in Team 1 and T^o_2 in Team 2, with $T^o_1>T^o_2$. The reason that the first team is slower is that w_3 carries out t_4 in the first team, while w_4 does so in the second team. The firm will only outsource t_3 if $(T_1+T_2)>(T^o_1+T^o_2)$. This implies that outsourcing will take place only if the production of the outside worker or firm in carrying out t_3 at least makes up for the increased coordination costs and the productivity loss in the first team. In this example we assume coordination costs between workers within the same firm to be equal to coordination costs between workers in different firms. In reality, coordination costs increase with distance—especially when tasks are outsourced to another country. This implies that the difference between u_3 and v_3 has to be larger than k in order to make outsourcing beneficial.

As a result of technological change, the division of labour as drawn in Figure 5.1 changes. Bloom et al. (2009) present a model and evidence of the most important forces determining the modern division of labour (see also Figure 3.1 in Chapter 3). Basically, there are two possible changes of technology that influence the division of labour:

- Information acquisition becomes cheaper as a result of more efficient information technology (IT). We associate cheaper information acquisition with the diffusion of more advanced computer-assisted design and -manufacturing (CAD/CAM), which further increases the efficiency of production workers on the work floor and makes them more autonomous and able to do things independently. We also associate more efficient IT with the diffusion of novel Enterprise Resource Planning (ERP), which is used to store, retrieve and share information. This pushes autonomy down and decentralises decision-making. It makes local managers more responsible for production.
- Coordination costs between workers and within and between firms fall because of the implementation of more efficient communication technology (CT). A reduction in communication costs between tasks has been established as a result of email and mobile telecommunication, but may become more efficient with novel applications. This makes it easier to ask for help. Within and between companies, networks and intranets will further increase the span of control of managers, who can monitor larger parts of more specialised production processes and deal with more complex production processes.

How do the division of tasks between workers, and the organisation of work within and between firms change as a result of advances in IT and CT? Figure 5.2 uses three pictures to show the effects of better IT. These pictures are modifications of Figure 5.1. Figure 5.3 presents the new pictures with the effects of improvements in CT.

5.1.2 Improvements in information technology

IT improvements lead to *generalisation* of work because they enhance the productivity of workers and do not change coordination costs directly. The two workers displayed in the upper picture of Figure 5.1 now conduct all tasks because the productivity boost makes coordination too expensive (despite comparative advantages). Hence, the firm only needs w_1 to produce one unit of output. Better IT leads to $v_{13} < v_{33} + k$. This means that the production time lost of assigning w_1 to t_3 instead of having w_3 do t_3 (i.e., $v_{13} - v_{33}$) is less than the production time gained of having w_3 carrying out t_3 and coordinating work with w_1 at cost k.

Figure 5.2 Consequences of improvements in IT for the division of labour and the organisation of work within and between firms

Production	Teams	Tasks and coordination	Production time T
Division of tasks between workers		t_1 v_{11} c 0 t_2 v_{12} c 0 t_3 v_{13} c 0 t_4 v_{14}	
	w_1		$T_{IT}=v_{11}+v_{12}+v_{13}+v_{14}$
Organisation of work within the firm		t_1 v_{11} c 0 t_2 v_{12} c 0 t_3 v_{13} c 0 t_4 v_{14}	
	w_1		$T_{IT,1}=v_{11}+v_{12}+v_{13}+v_{14}$
	w_2	v_{21} 0 v_{22} 0 v_{23} 0 v_{24}	$T_{IT,2}=v_{21}+v_{22}+v_{23}+v_{24}$
Efficient production			$T_{IT,1}=T_{IT,2}=T_{IT}$
Organisation of work within/ between firms		t_1 v_{11} c 0 t_2 v_{12} c 0 t_3 v_{13} c 0 t_4 v_{14}	
	w_1		$T_{IT,1}=v_{11}+v_{12}+v_{13}+v_{14}$
	w^o	u_1 0 u_2 0 u_3 0 u_4	$T^o_{IT,2}=u_1+u_2+u_3+u_4$
Outsourcing if:			$(T_{IT,1}+T_{IT,2})>(T^o_{IT,1}+T^o_{IT,2})$

The organisation of work within the firm (producing two goods) now consists of two workers (w_1 and w_2) producing on their own, which means that production teams consist of one member only.[3] Note that the IT improvement leads to benefits because of higher productivity and savings on coordination between workers, and has costs in the sense that the comparative advantages of workers are no longer utilised.

This way of producing also has consequences for the way in which outsourcing takes place. It is very costly to outsource t_3, as shown above in Figure 5.1, because coordination costs have increased relatively. This means that outsourcing of production implies outsourcing of the

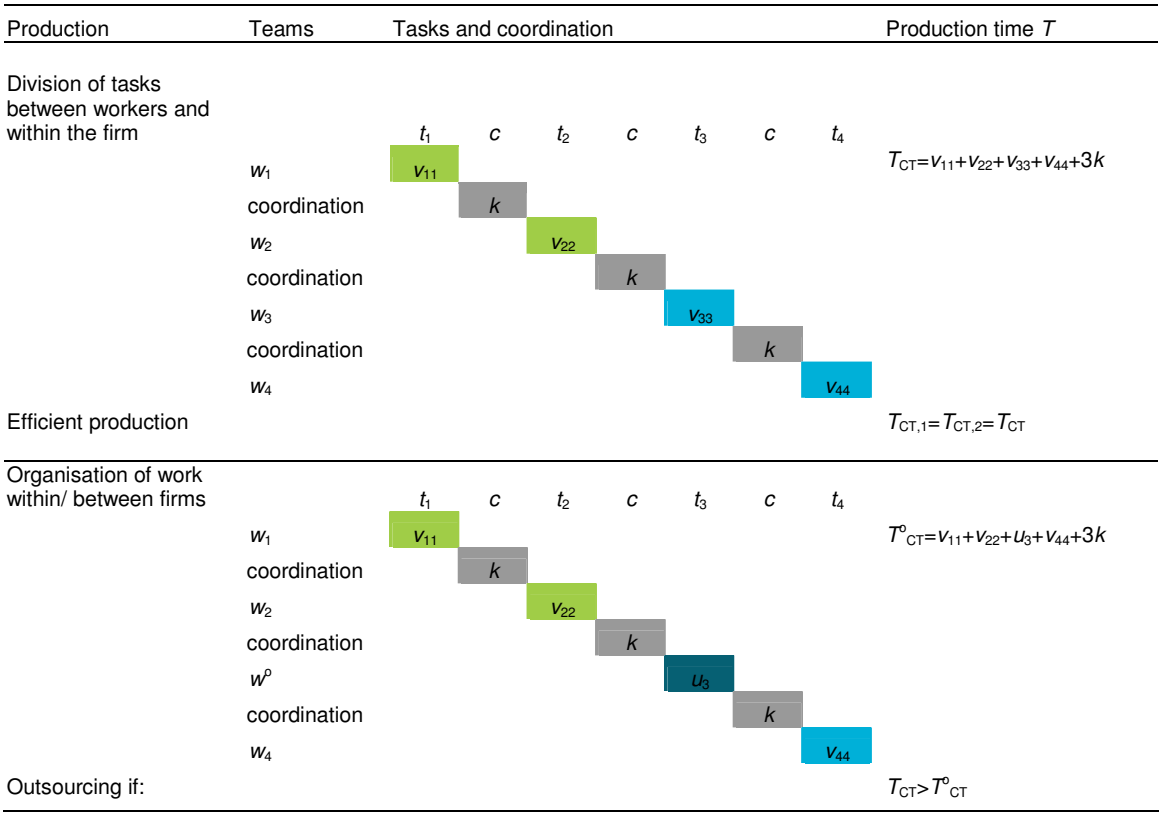
[3] The fact that it is w_1 and w_2 in this example is arbitrary. The point is that only one worker carries out all tasks to produce one unit of output, whereas previously two workers were employed to produce one unit of output.

production of the entire production of the production of one unit of product. The firm now consists of two plants or has outsourced production to another firm. The decision to outsource production now depends only on the production time of the outside worker ($T^o=u_1+u_2+u_3+u_4$), who is able to obtain the information about production from the firm's ERP.

5.1.3 Improvements in communication technology

Advances in communication technology (CT) reduce the costs of coordination and lead to *specialisation* of work. Figure 5.3 documents the effects of better CT. Because all workers have comparative advantages in their own tasks, production in the upper figure takes place by four workers each doing one task and coordinating their work with the next in line. So, w_1 coordinates with w_2, w_2 with w_3, and so on. Total production time now equals $T_{CT}=v_{11}+v_{22}+v_{33}+v_{44}+3k$.

Figure 5.3 Consequences of improvements in CT for the division of labour and the organisation of work within and between firms



Since the picture for the division of work in the firm is the same, it is not shown in Figure 5.3. In practice, of course, other forms of worker organisation are possible—with more hierarchies, for example, or more complex ways of coordinating work. The relevant mechanism here is that improvement in CT makes coordination cheaper and diminishes the need to combine tasks in a single worker. Hence, production teams become larger: in this example there is only one

production team, compared to two teams in Figure 5.1. This holds, regardless of how complex the organisation of tasks is.

Outsourcing of work now means outsourcing of individual tasks. Remaining in the example, outsourcing of t_3 makes w_3 redundant and results in a one-to-one battle between the inside and outside worker's production time. If $v_{33}>u_3$, this task is performed outside the firm and imported back when w_4 is up for production.

5.1.4 An important distinction

The difference between the outcomes in Figure 5.2 and 5.3 may seem an unimportant detail in the organisation of work, but below we show that it makes a huge difference which technology dominates. In particular, advances in IT or CT have a number of consequences for the division of labour, which we will discuss below in the following order. First, we sketch the benefits of the division of labour as traditionally identified by economists. Second, we examine how the division of labour has changed as a result of the computerisation of work. Third, we stress the important consequences of computerisation for the way in which we have to approach the labour market. Subsequently, we apply these consequences to the division of labour within workers (which tasks), and the division of labour within (who does what tasks) and across firms (which tasks are done in-house, and which are outsourced). Finally, we delve into the implications of this model for this study.

5.2 The division of labour

What determines who carries out what tasks in an economy? Discussions about the division of labour enter the economics literature via Adam Smith's *Wealth of Nations,* in which he puts forward the example of the pin factory that benefits from specialisation (Smith, 1776). Division of labour became a practical matter in Henry Ford's production model of the T-Ford and was criticised by Charlie Chaplin in the movie *Modern Times*. Essentially, the idea of the division of labour and the gains from specialisation were already present in Plato's piece *The Republic,* quoted at the beginning of this chapter. In the modern economic literature the division of labour is tied to discussions about the increasing importance of scientific and other knowledge for production. This influences the costs of coordination and the growth of markets.

Originally, Adam Smith related the division of labour to the extent of the market. Now, more than two centuries later, when markets have become very large, we know that many people within one market perform the same tasks without further specialisation. Smith already noticed that communication costs are crucial in determining the division of labour: "Were there no other communication between those two places, therefore, but by land-carriage, as no goods could be transported from the one to the other, except such whose price was very considerable in proportion to their weight, they could carry on but a small part of that commerce which at present subsists between them, and consequently could give but a small part of that encouragement which they at present mutually afford to each other's industry." For Smith, time

reduction in communication costs, as a result of the introduction of communication by water-carriage, increased the incentives for specialisation. Obviously, production costs have since then decreased a great deal, compared to communication costs: a decline nowadays in much more subtle communication between workers in the same workplace already makes a difference.

That is why, in an important contribution, Becker and Murphy (1992) argue that in every reasonable urban area several—often a great many—people are present who have essentially the same set of skills and tasks. They have specialised in the same type of work and compete locally or globally. For example, there are many psychiatrists serving a local market, and also more than one car mechanic. Depending on the size and extent of the market, the car mechanic can further specialise (repairing a certain type of car only) or increase the scope of his work by also cleaning and selling cars. By the same token, general practitioners living in small cities are likely to also deliver babies, whereas in larger areas they leave that to the obstetricians. So, the division of labour does not seem to be limited by the extent of the market only (as in Smith, when many specialists provide essentially the same service and compete in the same market). Nowadays, the division of labour is usually limited by the costs of coordinating workers with different specialities.

5.3 The new division of labour

Since the 1980s, the division of labour has also been heavily influenced by the computerisation of work. The adoption and rapid diffusion of the bundle of new information and communication technologies has been the most radical technological change of the last century, and its development will continue for a number of decades to come. Economists have been focussing on the economic consequences of this technological revolution for education, wages, workplace organisation, markets and competition, and networks and innovation. The ICT revolution has caused the costs of many kinds of interactions to drop by making a great many processes operate more efficiently, and it has allowed for the opportunity to engage in new interactions that have become cost effective.

ICT has affected the division of labour. At first, revolutionary technologies are implemented in a rather mechanical way to make it less costly to produce the same level of output. For example, the main reason for Charles Babbage to manufacture and use a computer around 1830 was to deal more accurately and efficiently with information. Such “number crunchers” were used until the late 1960s mainly to carry out mathematical and statistical procedures, mass-integrated data processing and simulations of Bayesian decision-making (Babbage, 1832). Over time, a revolutionary technology changes and amends (in an endogenous or co-invention manner) to do new things, such as to change the way in which markets are functioning and structured, demand and supply are brought together, or to restructure the way in which a firm is organised and influence the way in which innovation activities are pursued. These more incremental changes or innovations are the result of the opportunities offered by the main breakthrough of general-purpose technologies (GPTs). These latter consequences of new

technologies are often hard to predict when the technologies first emerge, but lie at the heart of the study of the economic consequences of technological change. Is it only computers that matter? No, but as Bresnahan (1999) shows in an overview study, the "computer" as a GPT has had by far the greatest impact on the way we work—and will continue to do so in coming decades, because its diffusion is far from complete. Varian (2010) presents several ways in which ICT has lowered transaction costs.

5.3.1 Computer technology

The simple model developed by Borghans and Ter Weel (2006) identifies three ways that computer technology has changed the division of labour. First, computer technology has taken over many routine job tasks. Imagine a worker who has to conduct two tasks—one routine task and one non-routine—to produce one unit of output. Computers offer an advantage in conducting tasks that can be described in simple rules, because rules can be programmed for a computer. Hence, computer technology assists the worker in doing the job. The adoption of computer technology for this worker depends on the costs of the computer equipment, software, networks and so forth, relative to the time he saves from working with computers. This sometimes implies that individual work becomes more specialised or that new jobs are created and others disappear. An example of more specialised work is the work of an accountant. In the past, accountants needed to combine calculus with a sharp eye for detail. Now, computer technology has taken over the calculus and it has become much more important for the accountant to interpret the results instead of calculating losses and benefits. It is even possible that the routine task is separated from his job and carried out by someone else. This change in work is defined as the *cost* effect of technological change.

Second, computer technology complements non-routine job tasks. Computerisation might also impact the non-routine aspects of the job. If the good that is produced and the way in which it is produced remain unchanged, there is no reason why the time required for non-routine tasks should change. However, the complementarity or substitutability between the two tasks, represented by changes in product characteristics, could be regarded as a channel for changing configurations of jobs. Such a relationship arises once a firm uses the possibilities of a computer to change the characteristics of the product, the production process, the division of time between the two tasks, or the organisation of work. For example, in case of the accountant two tasks cannot be separated if they are logically connected to each other. If, for example, it is impossible to separate the calculus- and checking tasks from one another (because computerisation requires a combination of man and machine), the tasks will remain within the same job—although there is a large price difference between the two. This second effect of computerisation is defined as the *connectivity* effect, which runs counter to the cost effect describe above (see the empirical evidence for the Netherlands in Chapter 4).

Both effects also have implications for the integration of the supply chain, because computer technology influences the way in which workers cooperate. Consider a situation in which an unskilled worker carries out the routine task , while a skilled worker carries out the non-routine

task. This is efficient if the time needed to instruct the unskilled worker to perform the routine task is recovered by the lower wage costs needed to carry out routine work. Splitting the two tasks into different jobs is profitable if the wage differential between both workers is large, instruction time is short, unskilled workers have a comparative advantage in routine work, and routine tasks are relatively time-consuming (i.e., if the cost effect dominates the connectivity effect). Splitting the tasks into different jobs may involve outsourcing of tasks to different firms. When significant parts of a job can be described in rules, the job is a candidate for outsourcing. Once the task is outsourced it may also become a candidate for offshoring to a different country—if the costs of conducting the task are lower in other countries. Outsourcing is beneficial if it can be assigned to another (national or offshore) firm, with reduced risk of miscommunication and lower costs of monitoring. For example, Texas Instruments has offshored part of its production to companies all over the world, while others outsource only to other domestic companies or ones close-by. In contrast, large insurance companies (such as Achmea) keep all production activities in-house in order to offer comprehensive insurance packages.

These examples show that the division of labour as a result of computerisation is important at three different levels: that of the individual worker, that of the firm and also across industries and countries. We now turn to the different applications of modern production technology.

5.4 The new division at work

Why is production technology so important in determining the division of labour, the organisation of work and trade between countries? Remember, production technology is defined as the number of tasks that must be carried out to produce output. Different types of workers need different amounts of time to conduct these tasks. The way in which a firm (or the economy) assigns tasks to workers yields the division of labour. In this setting, a more extensive division of labour raises productivity because the returns to time spent on tasks are generally greater to workers who concentrate on a narrower range of tasks (*specialisation* of work). On the other hand, a more generic division of labour minimises the costs of coordinating tasks between workers, and may increase productivity as well (*generalisation* of work). The optimal division of labour depends on the trade-off between the benefits from specialisation and the costs of communication or coordination.

The economic literature includes a number of levels in which the mechanisms determining the division of labour come to the fore: workers, firms, industries and countries.

5.4.1 Workers

Tasks are combined to produce output. To do so, all workers have to conduct a number of tasks. There are two extreme cases. On one side of the spectrum, a worker who does not specialise and performs a wide range of tasks himself allocates working time and investments among tasks to maximise the common output on each one. He is, on average, able to conduct all tasks

reasonably well, and can be defined as a jack-of-all-trades. This way of producing is explained and documented in Figure 5.2. On the other side of the spectrum, where there are increasing returns from concentrating on a narrower set of tasks, the productivity of specialists who combine their outputs is beneficial. Specialists excel at conducting one or a small number of tasks. Figure 5.3 depicts this situation, in which all workers conduct only one task.

In technical terms, the jack-of-all-trades takes advantage of the *cross-matching* of different tasks (e.g., from easy to difficult, or from unskilled to skilled, or from manual to non-manual). The advantage of this way of producing is that (in the most extreme case) one person is responsible for the entire production of a product and carries out all necessary steps: from extracting minerals to selling the good at the marketplace. The disadvantage is that his skills will be such that he is relatively overqualified for the easiest tasks and (on average) underqualified for the hardest ones. In the case of one good (cars, for example), the most-skilled worker will produce the best car and the least skilled person the worst. The most-skilled worker is overqualified for all tasks, except for the most difficult one; the least-skilled person is underqualified for all tasks, except for the easiest one. Workers with different skills will produce output of varying quality in such a setting, or the marginal value of having a more talented person in a team of, say, investment advisers increases when the abilities of the others working with him on the same project are less.

These properties correspond to processes that exhibit task *substitutability* or are largely dependent on the most-talented workers for quality. For example, some activities, such as research in pursuit of a new cancer treatment, require the most productive task to be a major determinant of the quality of the output. The remaining tasks are either dispensable or supporting tasks. In these activities, the productive process is as strong as its strongest link, which in a team of workers favours talented individuals working with less talented support staff, or in the case of the individual worker favours the most-skilled person being put in the job doing the most complex work.

The specialist, on the other hand, takes advantage of *self-matching* of different tasks and (in the limit) only carries out the task for which he is most equipped. This is possible in a world in which tasks of the same skill level are tied in production. In this world, all tasks are of similar importance, because the processes exhibit task *complementarity*. This means that the least-talented workers play an important role in team production and in determining which ranking and bundling of tasks along the lines of skill is crucial for the individual worker. The advantage is that the worker is matched to the task in which his marginal productivity is maximised. The disadvantage is that this worker produces only one tiny piece of the production of, say, a car and participates in a process in which the eventual quality of his output is conditional upon the work of others. For example, tasks in the production of automobiles are complementary, in the sense that a flaw in one worker's task performance causes a disproportionate reduction in the quality of output. If the brakes do not function properly, the quality of the entire car goes down. In this production process, the output is as strong as its weakest link. The recent turmoil at Toyota about malfunctioning parts is telling, in this respect.

The way in which workers are utilised is crucial for successful production. What is the optimal division of labour under different circumstances? The worker with the greatest skill is most productive when he pursues activities in which he combines the inputs of workers around him to utilise his own talent. The other workers are instrumental to his talent and are allowed to perform tasks at a tolerable level only. A good example is perhaps the Oscar-winning performance by Kate Winslet in *The Reader*. Winslet plays Hanna Schmitz, a German woman in her thirties whose teenage lover is unaware of the dark secret in her past. The other actors with a reasonably large part in the movie are David Kross, Ralph Fiennes, Alexandra Maria Lara, Bruno Ganz, Hannah Herzsprung and Karoline Herfurth. Excepting Ralph Fiennes, they are for the most part unknown, and did a decent job as supporting cast, but were eclipsed by Winslet's performance: they are substitutable for other actors because the movie generated so much attention and money because of Winslet's acting skills. What is important to note is that Winslet cannot perform on her own. She needs the other actors to produce and perform. Substitutability, and the principle of "it only takes one", leads to generalisation of production.

Kremer (1993) uses the example of the disaster with the space shuttle Challenger in 1986 to explain the importance of finding the right matching technology for specialists. He argues that it is sometimes impossible to substitute several low-skilled workers for a high-skilled worker because of the probability of mistakes. The space shuttle consisted of thousands of components, and it exploded because one of the parts, the O-rings, malfunctioned. The Challenger was as strong as its weakest link. The example shows that companies can fail at different points in the production process, and that small differences in quality create large differences in outcomes. In case production technology becomes twice as efficient, nothing changes because of decreasing returns to individual talent. However, when CT becomes twice as efficient, so that coordination of complementary specialist workers becomes easier, the probability of mistakes falls. As the Challenger example shows, avoiding mistakes by reducing bottlenecks in production is crucial when workers are complementary. When CT improves, messages become easier to transfer, so workers specialise more. This tendency towards specialisation improves the performance of tasks and reduces the probability of mistakes. Higher performance and fewer mistakes lead to a higher level of complementarity in production, which improves the quality of output. Complementarity and the principle of the weakest link lead to specialisation of production.

Basically, what we have described here is the optimal utilisation of workers and tasks by the market. This market works smoothly by assumption, but exchanges in the market that enable utilisation abstract from possible matching problems. Individual workers often do not know each other's quality, especially if they only meet once for a specific task or if they meet for the first time. For example, policymakers may look for input for making good economic decisions and ask for help. This leads to two problems. First, it is not clear whether it is a hard problem or an easy one, because this depends on whether the policymaker is smart or not. Second, the person he is asking for help may misrepresent himself as an expert, when in fact he just has only basic knowledge. Under such circumstances, the utilisation of workers and tasks does not work, because of adverse selection (a bad worker can conceal his lack of knowledge and ruin

the market). A natural solution to this problem is to establish firms that have an incentive to uphold a good reputation—in this example, the institute of CPB for delivering sound policy analysis.

5.4.2 Firms

Coordination between and within firms differs. The traditional answer to the boundary of the firm is that there is a need to provide incentives for specific investments in a context where hold-up is possible, due to (for example) incomplete contracts. These arguments apply to exchanges of goods, but not necessarily to modern production. In modern production the exchange of expertise and knowledge between workers has become much more important, with no physical (and verifiable) interactions taking place. To understand the division of labour within firms, we focus on the three most important mechanisms.

First, within firms, workers are coordinated by the firm. The organisation of the firm determines how the complementarity or substitutability of workers is used. This depends, among other things, on incentives, the organisation of tasks, and the available technology. What we know from principal-agent models of the firm is that specialisation goes along with larger team size: the jack-of-all-trades works alone, the specialist works with many other specialists, the number depending on the extent of specialisation and the complexity (or number of tasks) of production. One disadvantage of a larger team is that shirking and the number of conflicts among members increase with team size. Another problem is that extracting rents by holding-up others also grows with team size. In addition, coordination costs depend on whether workers trust each other and rely on each other. If there is no trust, coordination costs are higher. Finally, the example of the O-ring above demonstrates that production breakdowns and mistakes increase with team size.

The O-ring theory is also related to a second sort of coordination that is needed for specialisation. It turns out that the more specialised the workers are, the larger and more complex the communication network will be that coordinates all activities. Within a firm, specialised production needs horizontal coordination of production in teams. It also means that these teams need to be supervised. These supervisors need to be supervised as well, and so on, until vertical coordination reaches the CEO. Bolton and Dewatripont (1994) show that an efficient communication network is such that the number of links cannot be reduced without affecting organisational performance and output; and is such that the average number of agents involved in communication is minimised. What this implies is that coordination is costly and that it can lead to mistakes. The O-ring story is of course a dramatic example of where it can go wrong, but in everyday day life at the workplace many mistakes are due to communication trouble. The simplest example is perhaps when a message is transferred orally. We all know what happened in primary school when the teacher whispered a sentence in the ear of the first pupil sitting in a row; the message was subsequently transferred in whispers to the others down the row, with the resulting ‘message’ at the end bearing no resemblance to the original sentence. This example shows that firms may become more vertically integrated to avoid using unreliable

inputs from others when complementarity is crucial. In case of a complementarity, this reduces the matching efficiency of workers to tasks, but improves utilisation and control. These insights led Bolton and Dewatripont to conclude that the most efficient communication network in a firm takes the form of a pyramid. A pyramid centralises communication in a firm and minimises the number of people involved in communicating messages.

This pyramid structure is related to the hierarchy of the firm and the hierarchy of layers in government control (e.g., state-province-municipality). Garicano and Rossi-Hansberg (2006) present a model of how communication and hierarchy are influenced by new technologies. They show that better CT increases the span of control of managers, which increases team size and lowers the number of layers. Given the state of communication technology, firms that produce more complex goods are more likely to make mistakes. This makes the pyramid structure more relevant because firms want to place the highest skilled workers (assumed to make the least number of mistakes) in later stages of production. The reason for this is that mistakes at later stages destroy higher value inputs than do mistakes in earlier stages. Nowadays, CT improvements reduce mistakes across the whole production process, which allows for further specialisation, which in turn improves the matching efficiency of tasks to workers. This leads to larger teams and to managers overseeing larger parts of the production chain. This reduces the probability of mistakes, even if the supply chain is disintegrated. In the end, it can lead to larger or smaller firms depending on, for example, the importance of face-to-face contacts. They also show that IT improvements have the opposite effect. Under substitutability of tasks, the most productive worker gains from doing more tasks himself to increase productivity. The Garicano-Rossi-Hansberg study is core to the mechanism that we are after. They derive the conditions under which the work becomes more specialised or goes into the opposite direction of generalisation (as the two examples show).

Firms solve the matching problem between tasks and workers, which is important for coordinating work and reducing the number of mistakes. The optimal number of activities of a firm again involves the coordination of work. Some activities remain within the firm; others are outsourced to other firms. For example, insurance companies have taken on board a variety of activities to offer insurance packages from cradle to grave, but use outside firms to design their publicity campaigns. This outsourcing can be to other domestic firms or to offshore firms. In other words, communication costs also have an impact on the integration of the supply chain and the make-or-buy decisions of firms.

5.4.3 Outsourcing

Across firms, workers become coordinated by contracts and other agreements that govern transactions across firms. This involves coordination costs, and these coordination costs are expected to be lower than the costs of producing the inputs in-house. Modern production involves many downstream- and upstream production locations to produce output, so that the coordination problem is large—both internal and external to the firm. Williamson (1975) has shown that companies are less vertically integrated when it is cheaper to coordinate specialists

through market transactions. In the discussion above we described how this works and what the tradeoffs are. Between firms, the decision to outsource is again induced by the trade-off between the cost of communication and the gains from specialisation. Transaction-cost economics teaches us that the internal organisation of a firm is designed to improve incentives and limit agency costs. Vertical integration is the best-known application of this theory. Vertical integration encourages specific investments and reduces hold-up problems when markets are imperfect. Vertical integration should therefore be more prevalent when it is harder to write long-term contracts between upstream- and downstream firms.

The type of production technology also plays an important role. Improvements in CT make complementarity more important. This enhances specialisation both within and between industries. When it is possible to split tasks between workers and firms, supply chains become disintegrated. This is beneficial, because small differences in worker skill create large differences in productivity. As a result of complementarity, product quality is as strong as the worst component. By being able to outsource production to the most-skilled workers in every task, firms maximise product quality. This also implies that wage differences between workers are much larger than differences in skill. As a result, within industries and also within firms there is a positive correlation among the wages of workers in the same firm or industry, but in different occupations. For example, the best secretary will work for the best manager, and the worst one for the worst manager.

Integration of the supply chain and less outsourcing occurs when IT improves productivity. The reason is that substitutability of workers helps. Outsourcing of tasks becomes less interesting, because production efficiency depends on the in-house expertise on the core business of the firm. For example, if Kate Winslet becomes twice as productive, the production of two movies instead of one is more efficient in the same firm, using an in-house cast and the same director and production team. For the movies, it does not matter whether the villain is actor A or actor B—as long as the leading actor (Winslet) is of the right quality.

5.4.4 Offshoring

The final dimension is the international one. Next to distance in kilometres and differences in culture, democracy, trustworthiness, language and time zone, the international division of labour is determined by technology. The cases of Texas instruments and ASML at the beginning of this chapter reveal that the international dimension of the division of labour is important. The arguments for shipping parts of production abroad are not different from the arguments of outsourcing work to other industries. The outcomes might, however, differ a lot. With advancing technologies and the opening up of more and more countries, competition has increased. At the same time, production seems to be increasingly moving to places and to workers at which costs are minimised.

Almost daily, we read newspaper stories of companies in India and Surinam that answer customer service calls, read x-rays, develop software, prepare tax forms, and even perform surgery at a distance. But with what workers are Dutch workers competing? The relevant

competition for Dutch workers is determined, in principle, by the global pool of labour. In practice, however, it depends on the "communication distance" across tasks. This distance consists of a range of elements discussed above.

First, in a closed-economy setting, countries with more homogenous labour forces benefit from complementarity in production, relative to countries with a more heterogeneous labour force in which cross-matching is more important. So, improvements in communication technology (CT) make the first type of country more productive, and improvements in information technology (IT) improve productivity in the latter type. In an open-economy setting, this means that the homogenous country exports specialised products of different quality, whereas the heterogeneous country exports goods for which the quality of the individual crucial for the production team is the main determinant. With regard to tradable goods, this implies that systematic differences in product quality associated with differences in worker skill are one explanation of why Dutch bicycle manufacturers are able to compete with their Chinese counterparts. There are two possible stories for bike manufacturing; one based on CT improvements and one based on IT improvements. CT improvements allow Dutch bicycle manufacturers to combine domestic high-skilled workers with high-skilled workers from all over the world (for example, Italian designers), while they allow Chinese counterparts to do the same with low-skilled workers. This leads to trade in intermediate products, such as gears, handlebars, saddles and pedals. IT improvements increase the value of the most important part of the bike (put together by the most-skilled worker) more than the value of the other parts. For example, the weight of the frame determines to a large extent the speed of the racing bicycle. If the weight of the frame is crucial, and Dutch manufacturer *Gazelle* has employed the best frame builder, Gazelle will be able to put together the best bike and sell it all over the world. In both cases, the Dutch will do the high-skill work, and the countries abounding in relatively unskilled workers will have higher shares of low-quality and primary production. High-skill countries specialise in high-end production of complex products and tradable services.

Second, unreliable partners, bottlenecks in production and trade restrictions hurt the unbundling of jobs and the disintegration of supply chains. Hence, CT improvements can only be successfully implemented if efficiency wages are paid to prevent workers from shirking, if bottlenecks in production leading to mistakes are minimised and if there are no restrictions on importing the best intermediates. Recall that complementarity leads to product quality as high as the input of the lowest quality. Surges in IT are less vulnerable to such problems because IT keeps production in-house and firms in control of the local production plant.

Third, investments in human capital are likely to be higher if complementarity in production becomes more important. Imperfect matching as a result of a shortage of skill leads to mistakes, which calls for investment. On the other hand, if skills are not fully observable there is a discrepancy between matching and utilisation—as the example of the policymaker looking for policy analysis suggests. This leads to underinvestment. In an open economy, the relevant population becomes larger and the distance between workers is likely to reduce further. The pictures of the world income distribution in Chapter 3 suggest this to be the case because the

income distribution becomes denser. Nowadays, technological change (in the sense that CT improvements make the matching of workers more efficient worldwide) will both improve productivity and the incentives to invest in human capital. In an open economy in which production depends on the person in charge, and workers are substitutable and cross-matched, heterogeneity is more important in establishing cross-matching. Excellence in education pays off in a world of specialisation, whereas equity and substitutability are the best strategy when technology leads to generalisation of work. We will return to this subject in Chapter 10.

5.4.5 Trust

Trust is another important determinant of outsourcing. Contracts and other relationships between firms and financial intermediaries are important for investment, and credit-market imperfections affect the organization of the firm (Acemoglu et al., 2009). Trust affects firm size in two opposite ways. When there is limited trust, firms face credit constraints in the acquisition of other firms. This limits their size and the extent of vertical integration. Alternatively, when trust is limited, firms are too large because they do not trust parties from which they buy inputs. Hence, higher communication- or contracting costs in combination with greater trust could lead to greater or lower vertical integration.

Social capital, which encompasses trust en social networks, is classified into two broad categories: bonding and bridging social capital. This differentiation goes back to Putnam (2000), who argues that social networks have value because they foster norms of reciprocity that put a check on short-sighted and self-seeking behaviour. He defines bonding social capital as links among members of a homogenous group, and bridging social capital as links among different groups. There is a basic assumption behind the positive link between social capital and economic success: people connect to their family and friends (bonding social capital) but also extend their relationship network to other individuals who are outside the ethnic or social boundaries of a local network (bridging social capital). To make it clearer, *bonding* social capital is comprised of links mainly or exclusively among members of the same group (a local world), whereas *bridging* social capital is comprised of links among members of different groups among communities (local worlds linked in a global world).

Bonding social capital increases community social capital within groups, but may also reduce overall social capital by restricting links among groups. Moreover, relatively closed networks may act against the interests of other groups. Bridging social capital fosters curiosity and has a positive effect on economic outcomes such as innovation, whereas bonding social capital serves well to solve community problems, but has a negative effect on sociability outside the closed social network.

Table 5.1 summarises the two concepts of trust leading to four archetype societies.

Table 5.1 Trust and society outcomes

		Bridging	
		High	Low
Bonding	High	Inclusive society, ties within and between hierarchies and between different groups; change is driven by the community; confidence and creativity are the main characters.	Exclusive society; conflict with other ethnic and social groups; hard to initiate change; communities resist to change. Comfortable within the society but limiting for anyone who wants to experience outside.
	Low	Sort of clientalism, change initiated by leaders; little discussion within groups of what change may bring. The local world is used instrumentally rather than being a reference point.	Individualism; people solve their own problems and do not care about other groups. Low energy to bring about and agree on any change. Unstable because of loose ties.

5.5 Consequences and summary

The new division of labour has a number of implications. The distinct developments of information technology (IT) and communication technology (CT) lead to either generalisation or specialisation of workers, firms and supply chains. Table 5.2 summarises the main results of both possible directions. The left-hand side of the table shows what happens if generalisation dominates; the right-hand side of the table illustrates the consequences of specialisation.

Table 5.2 The new division of labour

	Generalisation	Specialisation
Production technology	Information Technology	Communication Technology
	CAD/CAM, ERP	Networks, Email
Workers	Jacks-of-all-trades, autonomous	Specialist, part of larger body
	Low wage inequality	High wage inequality
Firm	Decentralised	Hierarchical structure
Supply chain	Integrated	Disintegrated
	Heterogeneous production	Homogenous production
	Strongest link	Weakest link

Generalisation follows when production technology is dominated by information technologies and information systems that can be accessed from all over the world. For example, codified knowledge will be available on firms' intranets. Specialisation follows when CT is dominant and information is sent around the globe.

Workers respond to the opportunities offered by IT and CT. Further developments in IT stimulate the autonomy of workers, who do much of the work on their own and perform well in decentralised firms. Because they are all jacks-of-all-trades, team size will be small (as can be seen from a comparison of Figures 5.2 and 5.3). Also, wage inequality between workers will be moderate, given that all workers in this situation do several tasks reasonably well. The world of specialisation gives more or less opposite results. Workers focus on one or a few tasks, which

are supervised and coordinated in a hierarchical firm. They may dispose of their weaker tasks, excel in their specialisation and earn high wages. Competition for skilled workers will be high, which results in high levels of wage inequality.

Finally, supply chains change. They are more integrated in a world of IT, in which coordination of tasks is relatively expensive. Trade in intermediates is likely to fall in such a world, and firms do a lot of work in-house. In contrast, specialisation leads to disintegrated production chains, such as the Barbie doll example of the previous chapter. Trade in intermediates is higher, but the risk of mistakes increases.

6 Spatial development: Cities and economic geography

'A great city is not to be confounded with a populous one.'
Aristotle

Philips, a Dutch multinational in electronics, is in the Netherlands immediately associated with Eindhoven. Eindhoven is a relatively small, technology-oriented city in the south of the Netherlands. The roots of Philips are in Eindhoven, which has for decennia been its economic heart. Quite surprisingly, Philips moved its headquarters to Amsterdam in 1998. At first glance this might seem to be a strange choice: Amsterdam has significantly higher rents, and travel and transport times have been decreased heavily since the start of the company. Why, then, move towards the big and expensive city in the late 1990s? Amsterdam offered Philips proximity to a large international airport, centrality (particularly with respect to financial services), and an attractive and dynamic labour market. The attraction of Amsterdam and other cities in the Randstad is not restricted to Philips: most of the 25 AEX companies are located there today.

6.1 Why cities exist and why they have limits

Economic geography is about the division of production across space, and about the issues of where value added is created and where money is earned. It comprises developments determining whether economic activity becomes more concentrated or scattered over space. A high degree of concentration means that economic activity is clustered in one place or a few only, because many workers are clustered and because productivity in big cities is high.

Cities exist because there are benefits of being near an advantageous location (first-nature advantages) or because gains exist for people and firms being together (second-nature advantages). Examples of first-nature advantages are a productive soil, a favourable climate, the presence of navigable waterways and (immobile) labour. These are regional endowments that cannot be easily changed. They imply that economic activity will never be completely clustered in one place, but that some activity remains in remote areas. Second-nature advantages of clustering refer to the benefits of firms and workers (and consumers) to co-locate: firms want to be where large markets are, and large markets exist where many firms are located. These benefits from co-location are known as agglomeration economies, which exist when productivity rises with density. Well-known examples are scale benefits of local knowledge spillovers, labour market pooling and a thick consumer market.

The twofold reason for activity to concentrate has its counterpart in reasons for scattering. First, space is limited and resources (such as water, for example) are spread. It is impossible for six billion people to live in a single city, and it takes some imagination to cluster all Dutch citizens in one big Randstad metropolis. Even though many goods can be produced at distance, there are still some products nowadays that are non-tradable. These non-tradables, such as hairdressers and freshly baked sandwiches, are produced relatively close to the consumer.

Moreover, it will always be beneficial to employ the endowments of the lowlands, the forests, the mountains and the shores. Second, living and producing together involves not only gains but also costs. Costs of living together have to do with congestion and competition for local resources and local consumers. These agglomeration diseconomies imply that productivity declines with density.

What is the importance of this distinction between concentration and scattering? Imagine a pair of scales, with benefits and costs of clustering on either side. If the agglomeration benefits outweigh the costs, then economic activity concentrates in one or a few big cities. This may occur in the Netherlands, with a rising share of economic activity concentrating in a few cities or city areas. It may also occur globally, with a limited number of metropolitan areas attracting the greater part of future world production. In the opposite case, economic activity will be scattered, both in the Netherlands and worldwide. Concentration and scattering demand different policy responses in terms of infrastructure and regulation, because production in a metropolis is different from production in a set of smaller cities. It may also lead to different possibilities to maintain a welfare state.

Why is the consideration of different structures of cities important for thinking about scenarios for the Dutch economy in 2040? The balance between gains and costs of clustering may change in the coming decades. Most importantly, both arms of the balance are affected by changes in the mobility of goods, people and ideas. For example, free trade allows firms to exploit agglomeration economies, as they do not need to be close to their consumer market. However, free trade may also induce firms to leave the big cities (and locate in cheaper areas) if they can easily exchange intermediate goods over long distances. Similar reasoning applies to changes in mobility of people and ideas. In addition, the possible arrival of a new general-purpose technology (GPT) in the area of bits, atoms, nano and genes (BANG), as discussed in Part I, may have a strong concentration effect. To develop the GPT, complex interactions are necessary and people need to benefit from knowledge spillovers. This leads to concentration developments, as observed during the ICT revolution of the early 1980s and the industrial revolution earlier (e.g., Desmet and Rossi-Hansberg, 2009). On the other hand, the development of ICT is now at such a stage that the need to concentrate is falling. This reveals a tendency towards the scattering of economic activity.

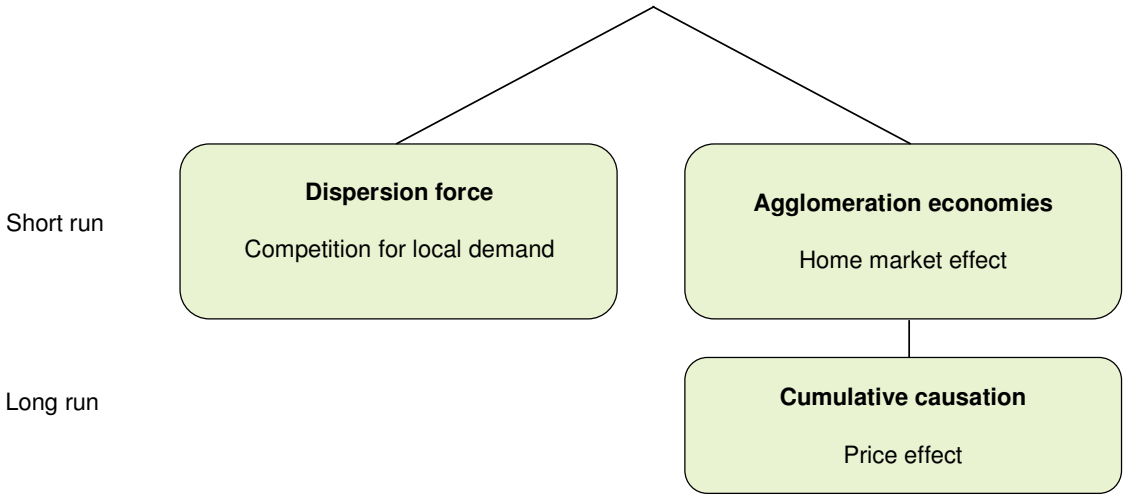
6.2 A basic model of the location of production

To develop the theoretical background of the development of cities, we first discuss the main economic theory on the location of production. The distribution of economic activity over space is clearly not random. But what are the economic reasons to cluster or disperse? This question is addressed by the Nobel Prize laureate Paul Krugman, in his path-breaking article on *Increasing Returns and Economic Geography* (Krugman, 1991).[1] Three ingredients are fundamental in his

[1] Brakman et al. (2005) and Brakman et al. (2009) present an in-depth overview of this literature.

analysis. The first ingredient is increasing returns to scale. This implies that production within a large single plant is cheaper than with multiple small plants. It makes sense that it is cheaper to produce 100 t-shirts at one location in a single plant than 100 t-shirts at 100 locations. This also implies that new firms may want to enter big cities, despite the fact that they have to pay higher wages and land prices, as their market increases with city size. Second, at least some of the production factors (capital or labour) are mobile. This assumption distinguishes this new literature from the existing trade theory, in which the relative amount of production factors determines trade. Since both labour and especially capital are to a certain extent mobile in reality, this seems to be a realistic assumption. The third ingredient is the cost of trading goods, which determines the balance between producing for the home market and foreign markets. Although the last century has witnessed greatly decreased transport costs and significantly diminished trade barriers, the transport of a product over space still costs money and time. The death of distance is a myth.

Figure 6.1 **Scattering and concentration in the Krugman model**



Next to these three ingredients there are two main forces: an agglomeration and a dispersion force, which are shown in Figure 6.1. The agglomeration force in the Krugman model is defined as the home-market effect. Consider the increasing returns to scale due to fixed costs of setting up a plant. Firms benefit from producing in a larger market (i.e. the home market) because the fixed costs can be spread over more consumers. This agglomeration force is strengthened by a price effect. Spreading fixed costs over more consumers decreases the price of products; hence, obtaining intermediate products is also cheaper in the agglomeration. Competition is the main dispersion force. If all competitors are located in one location, it is hard to achieve sufficient market share, and competition for intermediate inputs and workers raises the price of final products.

With these ingredients, and agglomeration and dispersion forces, the story of agglomeration goes as follows. Consider an economy with two similar regions (say, North and South), with

two sectors and two production factors. The agricultural sector is immobile and uses immobile peasants to produce tradable agricultural goods. The manufacturing sector is mobile, is produced with mobile labour and produces a costly tradable good. If trade in manufacturing goods is very costly, manufacturing firms are located in both regions in order to serve the local market. The only way Southern firms can efficiently serve the Northern market is by relocating. However, no single firm has an incentive to relocate, because this would raise competition in the destination market and reduces its profits. This competition effect is the key dispersion force in the Krugman model, which dominates the agglomeration forces at high trade costs.

A reduction in trade costs induces two contrasting effects. First, it becomes easier to exploit agglomeration benefits when a larger market can be reached from one location. This follows from increasing returns to scale, due to fixed costs of setting up a plant. Firms benefit from producing in a larger market because the fixed costs can be spread over more consumers. At lower trade costs, these fixed costs can also be spread over foreign consumers. Second, because it is the easier to reach the distant market, congestion and competition costs can be more easily avoided (the short run in Figure 6.1). The crucial element in the model is the balance between proximity to the larger market and competition for the local market. If the home-market effect exceeds the competition force, a firm decides to locate in the large region.

When proximity to the larger market overrules the congestion and competition costs, agglomeration of production occurs. The mobility of labour reinforces the clustering of production. If one firm, or a few, decide to produce in the Northern region, labour demand increases and wages rise. A couple of workers respond to the wage gap between both regions by migrating from South to North. As a result, the consumer market in North expands, which attracts more Southern firms and workers. This cumulative causation, where the demand for labour and the demand for manufacturing goods reinforce each other, continues until all manufacturing workers and firms are clustered in a single region (the long run in Figure 6.1). It operates via the price of labour and is therefore known as the price effect.

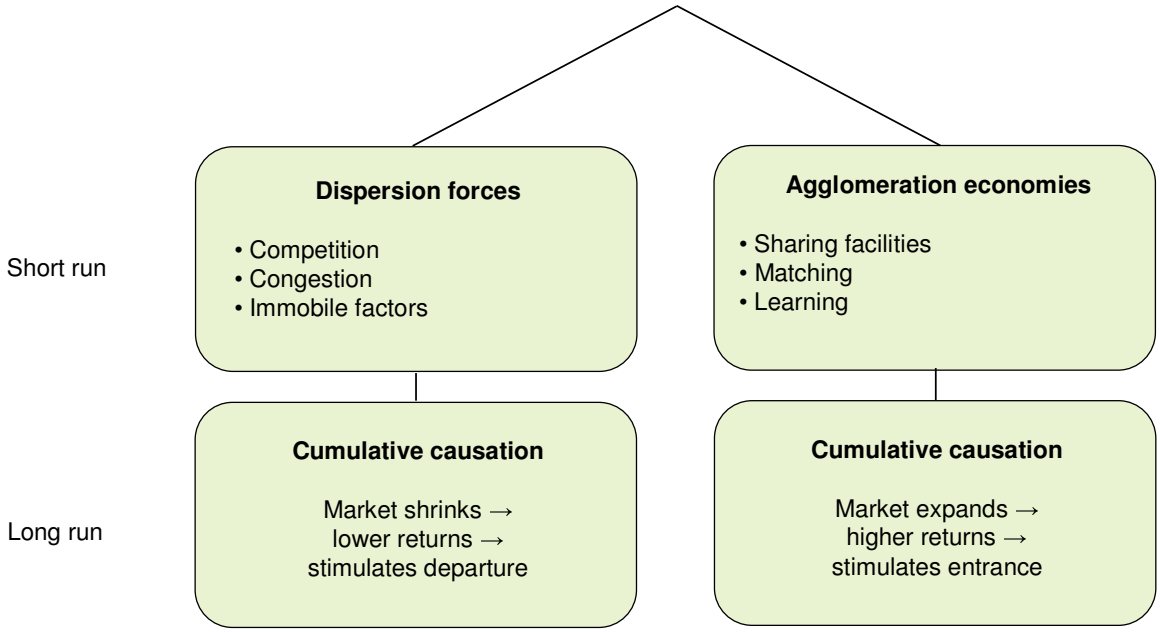
In this stylised model, clustering is of the all-or-nothing type. At high trade costs, dispersion forces dominate, and both markets are served by local firms. As soon as some firms relocate at some lower level of trade cost, all manufacturing firms and workers follow. In reality, however, clustering occurs only to some extent. Not all financial experts work in the City of London, and Eindhoven hosts only a fraction of high-tech firms and workers. These more-realistic elements of partial agglomeration are modelled in extensions and refinements of the Krugman model. Nevertheless, this stylised model yields the main ingredients that determine whether economic activity will be concentrated or scattered. The next step is to animate this model and discuss the main parameters in detail.

6.3 Mobility determines concentration and scattering

The division of production across space depends on the mobility of goods, people, money and ideas. Without this mobility the producer will be located next to the consumer (location determined by the demand side), just as production and consumption were inextricably tied together before the Industrial Revolution. Mobility of goods, people, money and ideas, increases the size of the market and the possibilities to exploit agglomeration economies (location determined by the supply side). Here, this section discusses in more detail the elements behind (changes in) the location of production.

Figure 6.2 summarises the main drivers of concentration and scattering. Each dispersion force or agglomeration economy may affect the balance between scattering and concentration and may trigger a cumulative causation in either direction.

Figure 6.2 Economic geography: scattering versus concentration



6.3.1 Mobility

With limited mobility of goods, people and ideas, economic activity has to be located near the market. The division of economic activity across space is mainly determined by first-nature advantages, including non-tradables and consumer amenities. So, a world with high mobility costs consists of relatively small self-supporting cities. The costs of clustering are large because distant markets can only be served at high costs. This implies that the gains from clustering are beyond reach.

The main driver to change this situation is increasing freeness of trade (e.g. higher mobility of goods, people and ideas). Figure 6.2 shows two possibilities for a firm: (i) to exploit agglomeration economies or (ii) to avoid congestion and competition costs. First, consider the

right arm of the balance. The decreasing costs of trade loosen the close ties between producers and the consumer market and create possibilities to exploit agglomeration economies. Serving distant cities becomes cheaper, and the accessible market grows in size. As a result, productivity in the growing city improves. Higher mobility of people strengthens the agglomeration process, as workers move to cities with high productivity. The possibilities to serve a large market, even the world market, from one city increase.

6.3.2 Agglomeration economies

What are these agglomeration economies; these benefits from clustering production? Alfred Marshall (1890) identifies three forces that can explain industry clustering: input sharing, labour-market pooling, and knowledge spillovers. These three reasons have survived over a century of economic thought. In their survey on agglomeration economies, Duranton and Puga (2004) distinguish three types of benefits at the micro level, based on sharing-, matching- and learning mechanisms. First, it is cheaper to *share* indivisible facilities, like public transport and infrastructure, dealing rooms or consumer facilities. Every city has at least some of these facilities, which are incredibly expensive when used individually, but quite payable when shared with others. Of course, a limited number of people may share a single facility—but then another can be built. Second, the quality and probability of *matches* improves in bigger cities. These matches occur between workers and firms, between firms and their suppliers or between firms and their consumers. All of them may benefit from a larger scale. Third, the generation, diffusion and accumulation of *knowledge* benefit from co-location. Learning is stimulated by proximity to and interactions with others. This link between knowledge and clustering will be explored later on in this section.

The mechanisms of sharing, matching and learning create increasing returns to the scale of the city. In the future (as in the past), cities that are supplied with these externalities will experience a minimum efficient scale. Of course, this scale depends on the kind of activity that takes place. For example, activities like steel production or an international airport can operate efficiently only at a sizable scale. This minimum scale is much smaller for a bakery or a pencil firm. More specifically, the balance of agglomeration and dispersion forces is different for each production process and for each component and task in that specific production process. This variation in agglomeration benefits leads to variation in agglomeration patterns between different economic activities. The tasks with the strongest agglomeration benefits are the first to move to the agglomeration with diminishing trade costs. Which tasks have the strongest agglomeration benefits? Baldwin (2009) suggests that supply-linked agglomeration forces are systematically more important for production stages near the end of the value-added chain. These production stages depend more on intermediates and require more traded inputs.

The microeconomic agglomeration benefits may interact and give rise to cumulative causality at the macro level (as indicated in the bottom part of Figure 6.2). How does the circular causality of location choice work? The mobility of production factors plays a key role here. Brakman, Garretsen and Schramm (2004) start with a couple of firms (with high

agglomeration benefits) and their workers moving into a city. The firms use local intermediaries, and workers spend their income locally. Their demand in the newly emerging core region benefits the indigenous firms. This increases the incentive for extraneous firms to follow these firms and workers, and to produce in or near the big market. Their demand for labour pushes up the wage rate and intensifies product-market competition. Sharing possibilities reduce consumption prices. This higher real wage in the city attracts even more migrants, and the circle of demand-linked forces continues. At the supply side, an increase in the number of local competitors reduces a firm's production costs through access to more locally produced intermediate inputs. This creates a circle of suppliers who relocate to cities with a high density of demanding firms, and demanders who relocate to the same city with cheap and abundant supply of intermediate products. Both circles of causality depend on the mobility of production factors and of increasing returns to scale. The latter implies that the return to the mobile factor rises when the factor becomes more abundant. The cluster of activity becomes increasingly more attractive.

6.3.3 Dispersion forces

In addition to the gains from clustering, higher mobility may also raise the cost of clustering (or equivalently, the benefits of dispersion), and stimulate the spreading of economic activity, as can be seen in the left part of Figure 6.2. For example, Murata and Thisse (2005) show that high commuting costs in combination with low trade costs lead to the dispersion of economic activity. Indeed, large cities have a clear disadvantage if commuting costs are high. Workers are able to alleviate the burden of urban costs by being dispersed, while retaining good access to all varieties.

What are these agglomeration diseconomies, or competition and congestion costs? At the micro level, they are the dark sides of the benefits. Congestion concerns the accessibility, or rather the inaccessibility of local resources, local facilities or local firms, workers and consumers. Congestion results if too many firms and workers compete for the same scarce resources or the same facilities, and leads to higher prices or costs. The high demand in the agglomeration causes rent prices to increase. The density of similar firms causes a very high competition level. Labour-market pooling turns into labour-market congestion. Matching is tougher if increasing numbers of firms are searching in the labour market, and when more and more workers are searching for a limited number of jobs. Also the demand for limited intermediate inputs increases. Learning may turn into a loss if the destruction or devaluation of old knowledge outweighs the benefits from the creation of new knowledge. In other words, competition tends to reduce the returns to scale, and the congestion and competition costs for the firm start to overrule the agglomeration benefits.

This dark side of clustering limits the agglomeration process and may even create a circular flow of firms or workers leaving a city simply because others did (see the bottom part in Figure 6.2 on cumulative causality). But why should one firm leaving the city lead to ongoing dispersion? In terms of the balance, the concentration arm loses weight relative to the dispersion

arm because of the agglomeration diseconomies. Both agglomeration and dispersion forces differ between firms, and this balance determines which firms leave the city the soonest. At a certain point the first firm faces a negative balance and leaves the city. For the other firms in the city this diminishes the benefits of agglomeration. The leaving firm did not take this into account when leaving. Hence, its departure affects the balance of other firms. They are more likely to leave the city because of the lost of weight of the concentration arm. When they leave, the agglomeration benefits of the remaining firms decrease, which causes relative 'weight loss' of their concentration arm, and so on.

This means the end of big cities—but certainly not the end of urbanisation. Agglomeration forces do not disappear, but the gains from clustering will be grasped at a smaller scale. High mobility implies that the gains from interaction between people and firms can be efficiently utilised. Some of these interactions are most efficient locally (face-to-face contacts, for example, and the exchange of non-tradables). Many other interactions, such as telecommunication and trade in goods, depend less on co-location and are more easily spread within regions, countries or even globally.

6.3.4 Illustration

This section argues that the mobility of goods and people are important drivers of clustering and scattering. One might object that mobility of goods has lost its importance, as trade already has become 'free'. In this line, Friedman (2005) argues that the world is flat and economic activity can take place everywhere and is basically independent of location. He states that technology and globalisation combine to flatten the world economy and that geographic location is no longer an advantage (or disadvantage). In contrast, Florida et al. (2008) show that there is a strong set of counterforces that lead to geographic clustering of economic activity. They strongly point to the spikes in economic activity and the rise of the mega region. It is between these two extremes that the world is evolving.

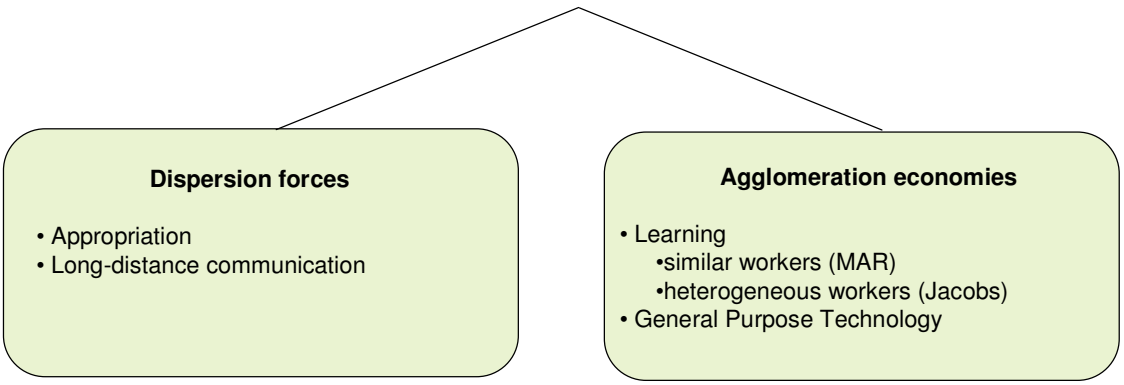
The huge investment in the Portuguese infrastructure underlines the unpredictability of agglomeration forces. Between 1985 and 1998, the motorway network increased sixfold (from 234 to 1,393 kilometres). Teixeira (2006) shows that, contrary to the Portuguese authorities' expectations, such a massive decrease in transport costs has not reduced regional imbalances. But he also argues that further reductions in transport costs may work the other way around.

This unpredictability is closely related to the presence of thresholds. Economic geography is often locked in. Empirical research has shown that even a huge shock like the bombing of German and Japanese cities in the Second World War will fail to seriously change the distribution of city size. What may occur, however, is that once a critical threshold is passed, small changes may suddenly have far-reaching implications, triggering the circular causality of firms and workers clustering together. At the industry level, it is easy to provide examples of complete industries moving in or out, quite suddenly. But also cities flourish or shrink, where Detroit and Venice are well-known examples of the latter.

6.4 Mobility of ideas

Agglomeration of economic activity is not only about commuting workers and trading commodities; it is also about knowledge and information transfer. Not only producers and consumers of goods become unbundled; even various tasks in the supply chain can be executed separately if the exchange of information is feasible and efficient at long distance. Still, distance matters because it is easier to communicate face-to-face than over a long distance, it is easier to learn from somebody sitting next to you and it is cheaper to share research- and education facilities with many people in big cities. Figure 6.3 summarises the dispersion and agglomeration forces.

Figure 6.3 Ideas and the clustering of economic activity



6.4.1 Agglomeration economies

When discussing the exchange of ideas, learning is the most important feature of an agglomeration economy. A fundamental feature of learning is that it is not a solitary activity, taking place in a void. Instead, it involves interactions with others—and many of these interactions have a face-to-face nature. The transfer of knowledge from one person to another is smoother via direct contact, as this prevents misunderstandings and eases adaptability. This transfer stimulates innovation, the creation of new ideas. Clearly, learning benefits from scale. The exchange of information in large cities is disproportionately high. By bringing together a large number of people, cities facilitate learning and innovation and stimulate growth (e.g., Duranton and Puga, 2004).

It matters whether cities are centres of diversity or clusters of homogeneity, but in both cases learning and innovation may flourish. Marshall (1890), focusing on homogeneity, states that a large concentration of similar workers induces learning and innovation. This hypothesis was later formalised by Arrow (1962) and Romer (1986) and labelled the MAR hypothesis. The MAR hypothesis states that cognitive proximity is essential for learning. It prevents misunderstandings and improves adaptability. Concretely, this hypothesis states, for instance, that economists work more efficiently with other economists since they share the same knowledge and ‘language’. A large group of similar workers facilitates learning, which shows

the benefits of specialisation. Henderson (2003) presents evidence consistent with the MAR hypothesis. In contrast, a large concentration of heterogeneous workers stimulates learning of a different kind, as Jacobs (1961) has put forward. Proximity of many workers with different knowledge speeds up the flow of ideas *between* groups. Jacobs therefore suggests, for instance, that an economist and a lawyer are more productive together because they do not share the same knowledge and thus create new knowledge when they cooperate. Cities thus facilitate both the cross-fertilisation of ideas between heterogeneous workers and the exchange of ideas among homogeneous workers.

The development of a GPT hinges on the agglomeration economies in the diffusion of knowledge. Desmet and Rossi-Hansberg (2009) argue that these gradual technological changes can be facilitated by the concentration of firms in the same region, as producers learn from each other how to implement the new GPT. Eventually, producers in all regions change and adapt their production techniques, the technology in the industry matures, and diffusion stops.

The benefits from clustering also emerge in more efficient matching and sharing of information and facilities. Tacit knowledge is more efficiently exchanged with trusted parties. Meeting and greeting improves bilateral understanding and may create trust. People talk more easily and open when they know each other. The selection of trustworthy and capable conversation partners is eased by face-to-face interactions (e.g., Storper and Venables, 2004). Finally, the development and exchange of knowledge often involve large facilities, which can be more efficiently shared with many researchers and students in big cities.

6.4.2 Dispersion forces

The discussion thus far has focussed on how the exchange of knowledge strengthens the agglomeration arm of the balance. The clustering of ideas also involves congestion and competition costs, however. With many researchers around, the competition for developing and marketing innovations will be very strong. Some researchers may prefer to be located in sparse areas and within small cities, particularly if they can acquire their knowledge easily via Internet, books and other mobile knowledge carriers. Agglomeration may limit the appropriation of returns to innovation, as researchers have to compete with many others and because new and better inventions may soon overtake their own.

The exchange of knowledge and information determines the balance between the gains and costs of knowledge clustering, just as the mobility of goods and people does for clustering people and firms. The development of ICT plays a crucial role in this by strengthening either the gains from clustering or the possibilities for dispersion. Unlike in the previous chapter, the distinction between IT and CT is not a key distinction here. CT and IT may stimulate both arms of the geography balance. Either one may strengthen both agglomeration- as well as dispersion forces.

CT improvements make it much easier to obtain information from all over the world. To be able to read Paul Krugman's papers, you can live in Princeton, Amsterdam or China—it doesn't matter, as long as you have access to the Internet. In other words, this improvement facilitates

scattering. However, if one likes to follow Krugman's courses, it is much easier to live in Princeton than to live in the Netherlands. So, many students may decide to visit Princeton and from there still benefit from communication technologies to chat with friends and family. Both effects hold in general: first, CT improvements make the world of ideas very flat. They increase the possibilities to exchange information with more people over a greater distance. Second, these possibilities give workers the opportunity to either disperse and move away from current knowledge centres or to cluster and benefit from all kinds of other agglomeration forces (Ioannides et al., 2008).

The impact of IT improvements on the location of economic activity is best explained with the supply chain, which is developed in Chapter 5. On the one hand, IT improvements make workers or parts of the supply chain more autonomous. Since it becomes easier to acquire information, workers depend less on the knowledge of others. Even if production processes operate in another city or country, they can still function very efficiently, which facilitates scattering. On the other hand, IT may increase the complexity of production processes and therefore strengthen agglomeration economies. The higher costs of the complex processes can be shared in the agglomeration. Complexity increases the chances of misunderstanding, however, which underlines the importance of good matching and face-to-face contacts. Knowledge and learning become more important with more complex production processes. IT may thus stimulate both scattering and concentration.

6.5 Mobility of multinational firms and foreign direct investment

Firms are mobile if goods, people and ideas are also mobile. The mobility of firms deserves special attention, for the simple reason that they are organisers of the production processes in the world, in countries and in cities. Of all firms, multinational firms are probably the most mobile, as well as being major actors in the division of economic activity across space. European countries and cities like to host headquarters and R&D departments, and dislike losing production units. How do agglomeration economies and firm location interact?

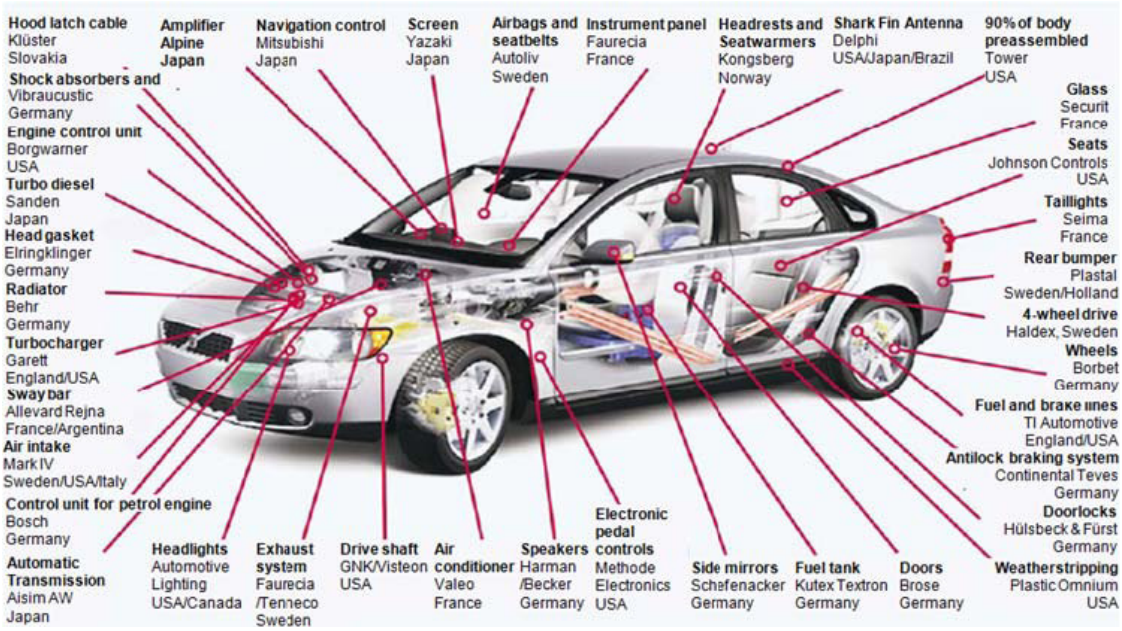
Horizontal multinationals choose to set up subsidiaries to save trade costs, but experience set-up costs twice. This choice is profitable if trade costs are high and/or the foreign market is large. A large market attracts foreign direct investment, which stimulates the economy and makes the market even bigger. Empirically, foreign direct investment (FDI) is stronger towards economically large regions, with a high market potential. Of course, inward FDI also affects the other side of the agglomeration balance, by raising competition and creating congestion. Depending on the balance, the investment behaviour of firms acts at as catalyst of either agglomeration or dispersion.

Vertical FDI also interferes with agglomeration economies. It occurs if production can be done more efficiently in another city or country. This part of firm behaviour was discussed in Chapter 5. If firms break up the supply chain among different workers, they may also decide to send part of the production process offshore. This has important implications for both the host

and the destination cities. The host city loses some activities, which may have important implications for the afflicted workers. Outsourcing also creates new opportunities. First, the unemployed workers may retrain and re-enter the labour market. Second, the activities that stay in the host city become more productive, as the complementary parts are more effectively produced in a foreign affiliate. All in all, the host city/country is likely to benefit from offshoring—in a way quite similar to the benefits from trade. Some groups, however, have to change, and others will be worse off. The destination city benefits from inward investment, which stimulates employment, creates local demand and might be accompanied by an inflow of knowledge and technology. However, some of the incumbent firms may lose the contest with the multinational, and will therefore be among the losers of inward FDI. Again, city size matters for the location choice of foreign direct investment—for reasons having to do with the availability of cheap but qualified labour, cheap but appropriate intermediate inputs, and knowledge spillovers. In other words, firms intend to benefit from learning from other firms, matching with suppliers and workers and sharing facilities.

Empirically, Markusen (2002) and Melitz (2003) show that the most productive and technically advanced firms become multinationals (and trade). These highly productive firms attract other firms looking for knowledge spillovers. Indeed, firms are more productive, on average, in large cities. Why this is so? Could it be due to agglomeration economies where larger cities promote interactions that increase productivity, or to firm selection where larger cities feature tough competition, allowing only the most productive to survive? For France, Combes et al. (2009) find estimates that suggest that agglomeration economies are dominant.

Figure 6.4 The origin of the components of the Volvo S40



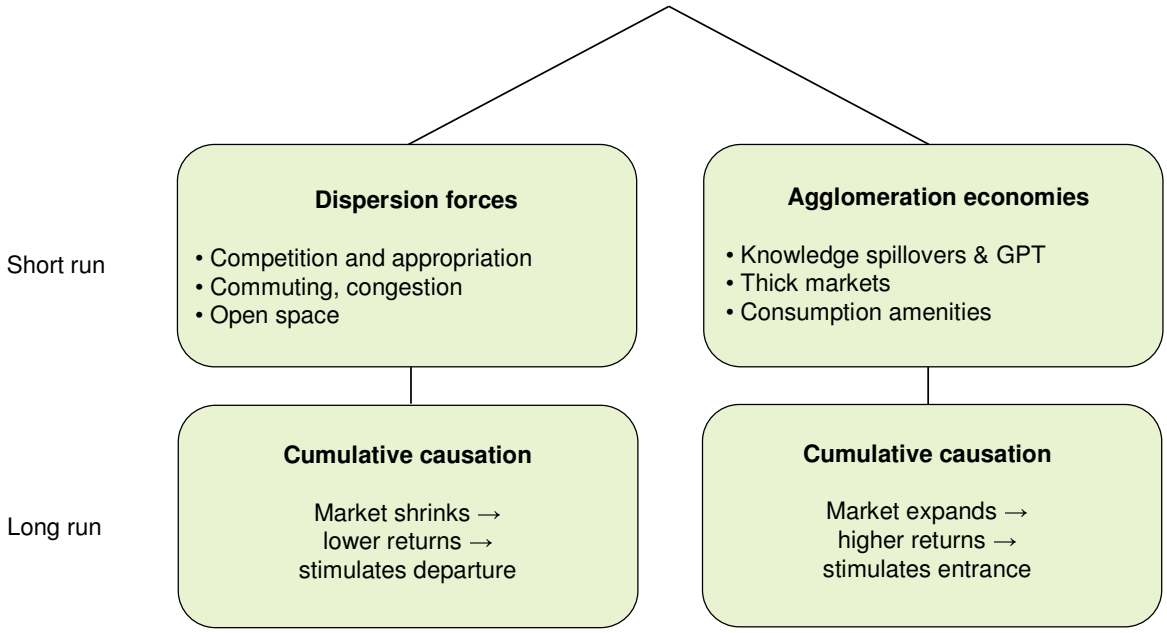
Source: Baldwin (2009).

Offshoring is not only concerned with the location of production units in low-wage countries. Very often, FDI is directed from rich to rich countries. The example of the production process of the Swedish car (see Figure 6.4) illustrates that most parts are produced, not in low-wage countries, but in other OECD countries, like Germany, France, Japan and the United States. FDI does not seem to focus on remote areas, but in the expensive production centres (like Detroit and the Ruhr-area). Agglomeration economies seem to be a key factor in the location and offshoring choices of multinationals. For other parts of the production process, firms make a different choice and develop new factories in developing countries (such as China) to benefit from low wages or presence near the market. Congestion and competition is avoided and economic activity disperses.

6.6 The determinants of economic geography

Figure 6.5 presents a summary of the arguments in this chapter. Concentrate or scatter? That is the question. The answer depends on agglomeration economies and dispersion forces, multiplied by the mobility of production factors moving into or out of cities.

Figure 6.5 The balance in economic geography



One possibility is that economic activity disperses. The production of tradable goods and services is spread globally, with the non-tradable services in its slipstream. Firms and workers have moved to, and are constantly willing to move to peripheral areas where competition is limited and congestion unheard of. Business can be done at distance; most intermediate inputs, workers and knowledge can be acquired globally, and most output can be sold from a large

distance. The virtual diffusion of knowledge is expanding enormously. Innovation tends to be incremental, with local applications of the globally available knowledge.

Alternatively, economic activity may concentrate. Firms explore the market potential optimally, by producing near their consumers, close to their suppliers and within a thick labour market. Large cities are innovative and may develop a new GPT. All kinds of agglomeration economies are very strong and may be intensified by circular causality of firms and workers moving to places where other firms, other workers and consumers are. Most intermediate inputs, workers and knowledge can be acquired or recruited locally, which minimises transaction costs. These agglomeration benefits outweigh the disadvantages of congestion and local competition. Congestion is a big issue in these large mega cities, and the pressure on local infrastructure is high. Local competition is a big hurdle for firms willing to locate in the large city. New firms either succeed, and become as large as the incumbent firms, or they fail. The outside options for the latter firms are limited, however, as the hinterland of the large global city are extremely broad and sparse. Still, the hinterland is not empty and mainly consists of small-scale activities closely tied to local amenities or producing for the local market.

The challenges of scattering and concentration vary widely. First, small cities flourish with excellent connections and open boundaries, both regionally and internationally, which implies the ongoing challenge of free trade. Large cities develop due to economies of scale, but may result in monopolistic markets with excessive market power and limited dynamics. Second, inequality is huge between the big cities and the hinterland, but is less of a problem in the scattered world. Next, labour-market risk is of different nature in both directions, being frequent but small in the scattered world, but rare and far-reaching if large cities are severely challenged. Finally, the challenges of limited resources and a polluted environment differ between scattered and concentrated scenarios: large cities have the opportunity to produce energy-efficiently, but are of course confronted with high concentrations of local emissions. Coordinated abatement of pollution is very difficult in a scattered world, but local emission is less of a problem.
Other challenges are common: human capital is the basic source of income and the main driver for growth in cities both large and small. Connections between cities (particularly in the exchange of information and ideas) are important in both developments. Unpredictability is another common challenge: no city can ever relax, as comparative advantages may change and may be taken over by any city in any country.

7 Composing the scenarios

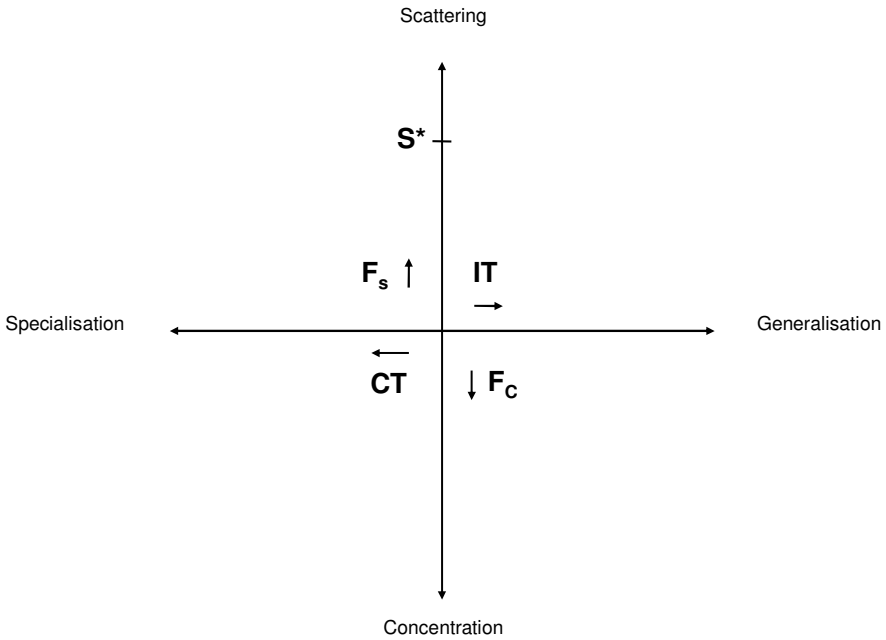
"Economists seek to understand cities with a framework that requires people to be indifferent over space, employers to be indifferent over where to locate and how many people to hire and builders to be indifferent about whether or not to build more or taller buildings. Almost everything economists do can be understood as part of the large question of understanding why people choose to locate in urban areas."
Edward L. Glaeser, 2007, *The Economic Approach to Cities*, p. 31

The analyses of production (Chapter 5) and spatial technologies (Chapter 6) are now in place. Before using these building blocks to derive the scenarios in Section 7.3, we first define the coordinate system along which the scenarios unfold in Section 7.1 and explain their titles and main characteristics in Section 7.2. The final sections provide empirical support for the framework and conclude with an example of a cappuccino that we assume you will want to consume now and in the future.

7.1 Coordinate system

The main topic of this study is *by whom* and *where* value added is created. That translates into the two main scenario axes in Figure 7.1. First, who is producing, and with what means? Second, where does production take place?

Figure 7.1 Two dimensions: Production technology and spatial development



7.1.1 Production technology: specialisation or generalisation

The horizontal axis addresses the division of labour. Jobs consist of tasks and workers vary in type. Different types of workers need different amounts of time to carry out each of these tasks. In addition to production time, workers spend time communicating in order to coordinate activities. The way in which a firm assigns tasks to workers yields the division of labour within the firm. In this setting, a more extensive division of labour raises productivity because the returns to time spent on tasks are generally greater to workers who concentrate on a narrower range of tasks. However, a more generic division of labour minimises the costs of coordinating tasks between workers and may increase productivity as well. The optimal division of labour depends on the trade-off between the benefits from specialisation and the costs of communication or coordination that would lead to generalisation.

Communication technology (CT) and information technology (IT) drive the shifts along the horizontal axis. CT improvements ease communication between workers and thus enable them to perform specialist tasks. In contrast, when communication costs are high and workers have sophisticated expert systems (IT) at their disposal that assist them in executing their tasks, workers can perform a broad range of tasks and become more generalised. Chapter 5 shows that the division of labour relates not only to the allocation of tasks among workers, but also to the delegation of decision power within the firm and the decision by firms to outsource or keep production inside. Easy communication due to improved CT (to the left of the horizontal axis) enables managers to control large parts of complex production processes. Consequently, decision power moves upward to higher levels in the firm hierarchy. Specialisation favours an organisation model in which teams of specialists perform complementary tasks. Since these teams are as strong as their weakest link, firms arrange teams according to the ability of their specialist workers. Several talented workers cooperate in one team; other less talented workers constitute another team. In addition, a closer delineation of tasks in such a specialisation-based organisational model also facilitates outsourcing. Firms rather easily separate out tasks that can be performed by specialised suppliers, and CT enables in-depth interaction with suppliers.

In contrast, highly developed expert systems (IT, to the right of the horizontal axis) support autonomous workers to perform a relatively large number of tasks. Firms become inclined to organise production with substitutable tasks, where talented workers determine a considerable part of the team's quality. Since quality largely depends on the talent of the best worker of the team, firms tend to team up several less talented workers with one very talented worker. IT also enables lower levels in the hierarchy to take autonomous decisions. Finally, firms execute more tasks in-house, because outsourcing is relatively difficult in an organisation with generalised tasks.

In sum, specialists, driven by CT, work together in centrally managed teams of homogeneous ability, while firms outsource a considerable part of their activities (broken supply chains). In contrast, when IT leads to generalisation, workers perform many tasks in autonomous teams of heterogeneous ability and firms keep many tasks inside.

The model behind the framework

Figure 7.1 shows that the scenarios unfold along the axes specialisation - generalisation and scattering - concentration. IT and CT drive generalisation G on the horizontal axis:

$$\dot{G} = \gamma IT - \delta CT * G \ .$$

$\dot{G}$ represents the change of generalisation in production (its time derivative). Communication technology (*CT*) enhances specialisation, whereas information technology (*IT*) promotes generalisation. In equilibrium, the degree of generalisation is stable, $\dot{G} = 0$, and the equilibrium degree of generalisation reads

$$\overline{G} = \frac{\gamma IT}{\delta CT} \ .$$

Along the vertical axis, the basic system that determines the degree of scattering *S* reads

$$\begin{aligned} \dot{S} &= -\alpha F_c + \beta F_s \left(S^* - S \right) \quad \left(S^* \geq S \right) \\ F_s &= F_s \left(ICT, \ldots \right) \\ F_c &= F_c \left(GPT, \ldots \right) \end{aligned} \ ,$$

in which $\dot{S}$ represents the change in *S* (its time derivative). S^* indicates the maximal degree of scattering. It depends on the preference for scattering from a consumption perspective: for instance, the preference for open space, and for nearby consumer services and consumer amenities. In particular, S^* originates from physical complementarities in consumer services: people don't go from Amsterdam to Paris to get a haircut. F_C stands for the forces that cause concentration and F_S for the forces that generate scattering. The forces F_C and F_S depend on many variables, of which the primary drivers are addressed in Table 7.1, and the richer structure is developed in Chapter 8. In equilibrium, $\dot{S} = 0$ and the equilibrium degree of scattering reads:

$$\overline{S} = S^* - \frac{\alpha F_c}{\beta F_s} \ .$$

Hence, in the absence of concentration forces (F_C tends to 0) or with strong spreading forces (F_S is large), *S* moves towards the maximal degree of scattering S^*.

Technology constitutes the major factor that initiates the development towards a specific scenario. The arrival of a new general-purpose technology (*GPT*) increases complexity and requires face-to face knowledge exchange, which raises F_C. Subsequently, additional concentration forces kick in, in a process of cumulative causation, which further raises F_C. High wages attract labour, thick labour markets enhance matching, and entry of suppliers enlarges product markets.
CT creates possibilities to perform tasks and cooperate with co-workers at a distance. Strong IT raises the ability of workers to perform many tasks and enables firms to coordinate tasks on a distance. Both developments raise F_S, which generates a tendency towards S^*.

7.1.2 Location: scattering or concentration

The process of clustering economic activity or spreading it across space depends on concentration forces and scattering forces labelled as F_C and F_S (see Chapter 6 and the box 'The model behind the framework'). In the scenarios concentration of economic activity in space (downward along the vertical axis in Figure 7.1) occurs for three major reasons. First, face-to-face contacts between workers at a specific location generate knowledge spillovers, which stimulate innovation and productivity growth. Second, consumers and firms benefit from a dense market for goods and services in the agglomeration, including public facilities like

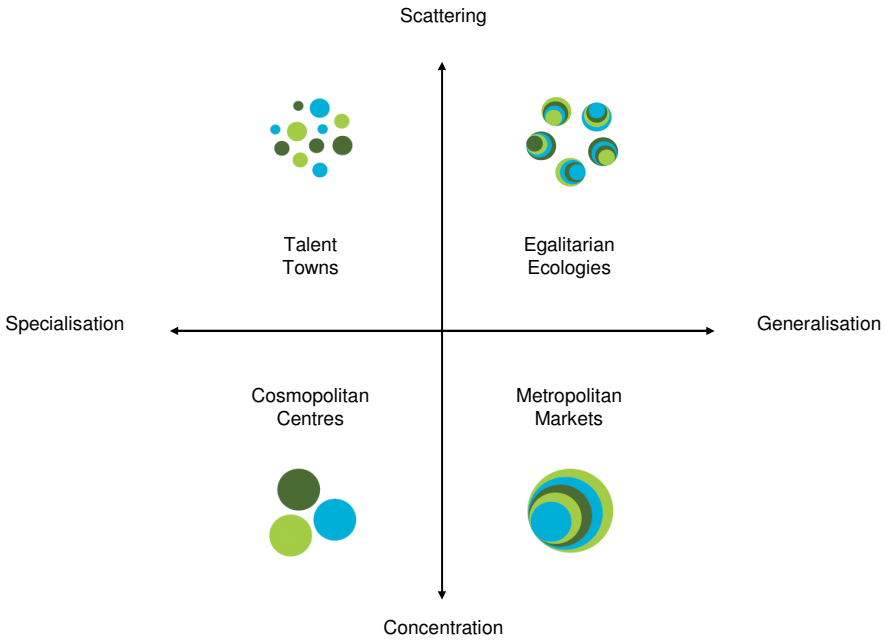
schools, theatres, etc. Consumers may choose from many varieties and firms may select the most suitable supplier from a broad range of alternatives. Hence, once firms start to settle in a specific city, expansion of the market makes the city more attractive to other firms as well. Third, agglomeration fosters matching on the labour market. Because of growing employment opportunities, workers move to an expanding city and firms have a broader recruitment base.

Opposing forces generate scattering (upward along the vertical axis). High costs of commuting in large cities create an incentive to spread activities over space.[2] Another important scattering force is competition for local resources. Scarcity of space in the agglomeration raises rents, productivity gains increase wages and the presence of many firms intensifies competition. Quite a few firms thrive in such an environment, but less productive or less innovative firms leave the agglomeration and try to earn revenues at a location in which costs are lower and competition is less intense. Finally, people prefer to live outside the bustle of a large city and enjoy the presence of nearby pastures, woodlands, lakes or the seaside.

7.2 Four scenarios

Combining the two dimensions yields four scenarios, which are depicted in Figure 7.2. Before discussing the drivers, we clarify the scenario titles and the symbols that represent them.

Figure 7.2 Four scenarios



[2] The classification of forces into agglomeration or scattering is somewhat arbitrary, because a change of sign may shift a force into the other category. For instance, according to Murata and Thisse (2005), *low* costs of commuting stimulate agglomeration. Table 7.1 classifies *high* commuting costs together with congestion as a scattering force, which amounts to the same thing. The classification in Table 7.1 has been chosen in such a way that the table corresponds as closely as possible to the scenario stories.

7.2.1 Titles characterise people and location

The titles of the scenarios in Figure 7.2 reflect the main characterisation of people and of location. The first word reflects the characterisation of people and the second location.

The scenario in which workers specialise and city size is relatively unimportant for production is labelled *Talent Towns*. Workers produce in virtual teams consisting of specialists, and are chosen based on their skills. These teams are of an international nature. Here, talent refers directly to the individual's characteristic features or specialised skills, his aptitude, and natural endowments. In terms of location, towns are relatively small (smaller than a metropolis). There are few reasons for economic activity to cluster (like, for example, a minimum scale to provide local services). Talent towns are likely to form everywhere based on where workers would like to live.

Cosmopolitan Centres are populated by workers that have a worldwide (as opposed to a limited or provincial) scope or bearing. They are specialised, mobile and attracted to this place from many parts of the world. The composition of teams is similar to that in Talent Towns, but face-to-face interactions are crucial for production. The centre refers to an area that is most important in relation to an indicated activity and its surroundings. It is a region of concentrated population or a large urban centre. Cosmopolitan Centres are large and specialised. Possible examples of contemporary Cosmopolitan Centres are Silicon Valley (centre of ICT), Detroit (centre of the automobile industry), Eindhoven (technology centre) and Wageningen (agricultural study centre). This is not to say that these will be the Cosmopolitan Centres of the future.

Equality—especially with respect to social, political and economic rights and privileges—results in *Egalitarian Ecologies*. Production takes place by jacks-of-all trades who mainly produce for the local market, the ecology. They take inputs from the world's knowledge stock and import intermediate goods. The local interrelationships between humans and their economic, social, and political organisations are important. The relatively small cities in Egalitarian Ecologies serve as economic and urban spikes in relatively empty space with a sufficiently large scale to be able to produce a variety of goods. Contemporary examples in the Netherlands would be Utrecht, Groningen or Maastricht.

Finally, *Metropolitan Markets* consist of very large cities, which act as magnets, or even black holes, absorbing most of the economic activity in the region or even country. The generalist workers can be employed easily in many occupations and have an urban character. Metropolitan Markets attract workers from the region at large. The market is the meeting place of people for the purpose of trade and matching. The geographical area of demand for commodities or services and the available supply of or potential demand for specified goods or services is huge. The cities are populated by several millions of people (or attract these numbers by day-to-day commuting). Examples of Metropolitan Markets could be New York, London, Paris and an extended Randstad metropolis.

7.2.2 Symbols visualise people and location

To capture the essence of the four scenarios we have designed four symbols that characterise the best of these worlds. Figure 7.2 presents the symbols we will use throughout the analysis. The size of the dots represents the relative size of the agglomerations, while the colours define the types of workers. In specialised cities workers of the same type live together, whereas different types of workers inhabit a generalised city.

7.3 Scenario drivers

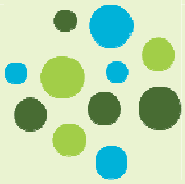
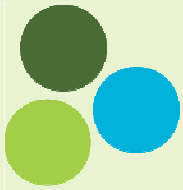
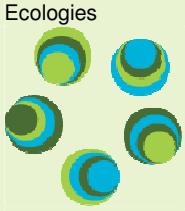
Table 7.1 summarises the main drivers of each of the scenarios. Technology constitutes a major initiating force in each scenario (see also the box 'The model behind the framework'), but it is by no means the only (and at times is not even the most important) driver. Technology sets in motion a process of cumulative causation, which over time develops the full scenario world. This section describes the main analytical drivers of the scenarios; Chapter 8 contains a full description of the scenario worlds based on many additional factors.

7.3.1 Talent Towns (TT)

Communication technology drives the *Talent Towns* scenario, both in the direction of specialisation and in the direction of scattering. In Talent Towns, CT develops to such an extent that virtual connections replace a considerable part of personal interaction. Figure 7.1 shows that this CT surge promotes specialisation of workers and firms. In addition, widespread virtual contacts reduce the need for personal face-to-face interaction and enable workers to work from home and virtually team up with workers who live far away. Neither firms nor workers need close contacts to find a good match on the labour market. With these concentration forces declining, local consumer facilities and preferences for open space become more important driving factors that determine city size. Alternatively stated, the relative weight of commuting and congestion as a scattering force rises, in comparison with the concentration forces (this explains the + in Table 7.1). Hence, in a process of cumulative causation, city size falls. Moreover, specialists tend to live together in towns with appealing facilities—for two reasons. Firstly, despite the growth in virtual communication, specialists to some degree still benefit from face-to-face interaction with their peers. Secondly, specialists differ in their preference for local facilities (designers favour a more creative environment than accountants do). In that way, Talent Towns acquire their distinctive characteristics.

Several auxiliary developments add to the TT world. International agreements that lower barriers of trade and codification of knowledge in manufacturing boost international trade and offshoring. Manufacturing largely moves to Asia, and the Dutch economy focuses on services, particularly business services. Many Dutch self-employed specialists offer their services on the international market, while they work at their place of residence.

Table 7.1 Summary of scenario drivers

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
				
Production technology	**Specialisation**	**Specialisation**	**Generalisation**	**Generalisation**
- Communication Technology	++	+	0	0
- GPT research-oriented	0	+	0	0
- Information Technology	0	0	++	+
- GPT application-oriented	0	0	0	+
Spatial development	**Scattering**	**Concentration**	**Scattering**	**Concentration**
- Face-to-face knowledge spillovers	0	++	0	+
- Long-distance knowledge exchange	++	0	+	0
- Dense markets	0	+	0	++
- Commuting, congestion	+	0	++	0

7.3.2 Cosmopolitan Centres (CC)

In the Cosmopolitan Centres scenario, two major technologies set in motion a process towards a world of specialised large cities. Analogously to Talent Towns, CT enhances the specialisation of workers and firms, although the technology expands less widely because part of R&D is directed at other technologies. In contrast to Talent Towns, bio- and nanotechnology take off in CC. This new general purpose technology (GPT, see Chapter 4) mainly expands on the interface between universities and specialised firms. Universities generate, test and patent most of the new ideas, which subsequently are licensed to specialised firms or commercialised through spin-offs. Due to the complexity of the new technology, innovation is science oriented. Applications in the form of widely marketable products occur on a relatively small scale.

The new GPT instigates concentration of economic activity in space, because it demands face-to-face interaction and cooperation. To master the new technologies, universities and firms extensively benefit from knowledge spillovers out of personal contacts among their researchers and developers. This concentration force turns cities into knowledge centres in a specific field related to the new technology. The model also spreads to other specialised activities, where specialists benefit from personal interaction. So at one place a biotech city materialises and at another place a fashion city. Dense labour- and product markets further fuel the growth of CCs. They attract high-skilled labour and local private and public services. In addition, international cooperation supports trade between specialised Cosmopolitan Centres.

7.3.3 Egalitarian Ecologies (EE)

Information technology takes centre stage in the Egalitarian Ecologies scenario. Bio- and nanotechnology remain in their infancy, while IT expands into high-level expert systems, which enable firms to produce many varieties adapted to local tastes. IT leads to generalisation of work and to firms performing relatively many tasks in-house. Besides the invention of expert systems, innovation is rather moderate in this world, and firms keep knowledge largely confidential. Hence, the need for face-to-face contacts in order to benefit from knowledge spillovers does not increase. Moreover, firms use expert systems to coordinate the operation of local plants from a distance. Generalisation of work implies that matching of workers and firms can take place relatively easily, without the need for dense labour markets. All of these factors lower concentration forces—a situation that manifests itself in Table 7.1 by an increase in the relative weight of commuting and congestion. Taken all together, scattering is dominant and cities shrink in size.

7.3.4 Metropolitan Markets (MM)

In the Metropolitan Markets scenario the dominance of largely self-supporting mega cities originates from the interaction of IT, a new GPT and a process of cumulative causation that strengthens other concentration forces. Analogously to Egalitarian Ecologies, in Metropolitan Markets IT promotes generalisation of work. Compared to Cosmopolitan Centres, the new GPT develops differently in MM. The bio- and nanotechnology expands strongly, and it soon enters an application phase. To apply the complex new technologies in marketable products, companies create large research centres and production facilities. In addition, firms devote resources to marketing, sales, customer services, and so forth. Firms grow in size and IT-related expert systems support the operation of large-scale plants. Large firms in MM have an incentive to cluster in order to benefit from knowledge spillovers—although this happens less intensively than it does in Cosmopolitan Centres, because technology is more shielded.

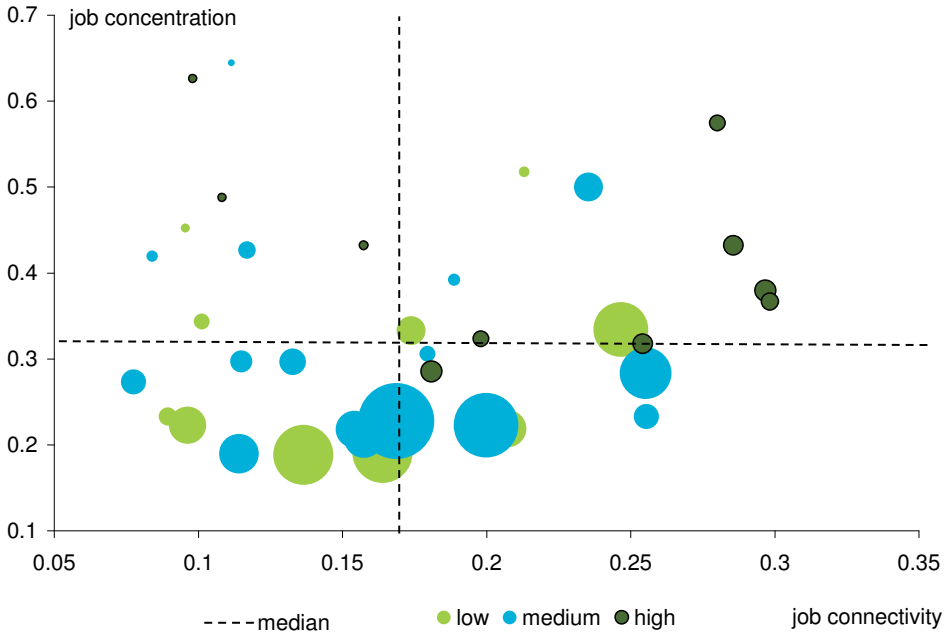
Additional concentration forces serve to raise the scale of cities. Clusters of large firms attract workers and suppliers of supplementary services. Dense markets for labour, goods and services enhance concentration, making cities in metropolitan markets largely self-supporting. Some offsetting scattering tendencies follow from the competition for local resources and the high costs of commuting and congestion in mega cities—but on balance, strong concentration forces dominate the MM world.

7.4 Illustration

To illustrate the importance of the division of labour across space as the main building block of the scenarios, Figure 7.3 shows the correlation between measures of job connectivity and job concentration. Job connectivity is measured as the “glue” between jobs. A higher level of job connectivity means that the likelihood that two jobs coexist in a region is higher. We summed up all combinations of jobs to obtain our measure of job connectivity. Job concentration is

measured using the approach developed in Ellison and Glaser (1997). It basically measures the share of an occupation relative to the population share in a region in the Netherlands. A higher level of job concentration means an overrepresentation of that job in a region.

Figure 7.3 Spatial job connectivity and job concentration in the Netherlands



Source: Akçomak et al. (2010).

The dots in Figure 7.3 represent occupations, and the size of the dots represents the size of these occupations in the Netherlands. The colours of the dots reflect the level of education of occupations in three categories (low, medium and high). The dotted lines present median values of the two variables. High levels of concentration together with low levels of connectivity suggest specialisation of work concentrated in a few areas, which is consistent with our scenario of Cosmopolitan Centres. The other extreme with low levels of concentration and high levels of connectivity suggests generalisation of work and scattering of activity across space. This is consistent with our scenario of Egalitarian Ecologies. The dots show that there are occupations (and economic activity) in all of the four scenario types at this moment. In terms of thinking about scenarios, it is a matter of what direction the cloud of dots will move. If it moves to the northwest we move towards Talent Towns, if it moves to the southeast we move towards Metropolitan Markets.

7.5 Cappuccino

In *The Undercover Economist,* Tim Harford uses the power of economic analysis to explain everyday life. One of his prime examples is "who pays for your coffee?" (Harford, 2006). The answer to this question is about the price of a cup of cappuccino at different locations, the importance of understanding how it is produced and who earns what in the supply chain. This chain runs from the anonymous farmer of the coffee beans somewhere in Brazil to the salesperson (a charming barista named Jacinta) charging £1.55 for a cappuccino during rush hour at Waterloo station in London. It also runs from the designer of the espresso machine to the person who has to convince the purchase manager of Starbucks, for example, to buy the machines. Or, it encompasses the process from the idea to set up a coffee bar to its design. The cappuccino is the product of an incredible team effort.

The 'team' producing the £1.55 cappuccino can take several forms. The most important determinants for the composition of the team are the people involved in the supply chain and the location of production and consumption. So, who produces what part of the supply chain? And, where does production take place? The previous two chapters and the analysis above have introduced the possible production technologies and spatial developments. Now, we will use this set-up to show how the same cappuccino is produced and consumed with different production technologies and at different locations.

The delicious cappuccino in Talent Towns is the joint effort of many specialists all over the world. Of course, the coffee beans are produced in Brazil and the milk comes from a farm nearby to guarantee its freshness. But then, the roasting of the beans can be done in any other country, possibly in Africa. Jacinta may choose among a large variety of beans, each with their own flavour, which she orders via the Internet. Consumers, in turn, switch easily between Jacinta and other baristas. It is important for Jacinta to supply a cappuccino in which the ingredients are of similar quality. The supply chain in producing the cappuccino machine is even more dispersed. It is designed by a self-employed worker in a small town in the Netherlands, but the technical details are outsourced to Japan. The electronics are made in Korea, the filter in South Africa, the cup in Indonesia and so on and so forth. All parts are assembled in small factories in Germany, Mexico and many other countries all over the world. All of this requires excellent communication and coordination, partly by the invisible hand of the market (the self-employed designer) and partly by a multinational firm with a strong hierarchal structure (in particular, near the end of the product chain).

There will be a single Cosmopolitan Centre in Vietnam specialised in cappuccino (and other coffee products), which serves the whole world. Having imported the beans from Brazil, many parts of the supply are concentrated in this city. From design to assemblage, from roasting to packing, all tasks are executed in close alignment by specialist workers who have frequent face-to-face contact with each other. Of course, various parts of the machine, like the electric cord and the on-off button, are imported from elsewhere. Consumers have little choice; both the Italian yuppie and the Senegalese landlord enjoy the same cappuccino, made in Vietnam.

The same multinational firm is active in Egalitarian Ecologies, but its cappuccino machines and flavours are adapted to local circumstances; some like it hot, others creamier. The machines are produced in many towns, by generalist workers who are able to adjust the machines to local demand. These workers start with an expert system, which provides them all information they need to construct the machine. Similarly, Jacinta starts reading the instructions and is then able to use, clean and repair the machine, as well as serving a delicious cappuccino to the customer.

Every Metropolitan Market produces its own cappuccino machine, in factories that also produce kettles, electric razors and even cars—a situation comparable to the Korean chaebols. Workers in such factories switch easily between these products (since every part of the production process is well documented and integrated in the ERP system). The cappuccino may differ between Metropolitan Markets, but consumers within the city have little choice: the cappuccino is a mass-produced article.

In all worlds, Jacinta serves your cappuccino with a smile. Perhaps you prefer the choice between many flavours in Talent Towns over the mass-produced article in Metropolitan Markets. You might want to design your own cappuccino machine with a pink-flower design in Egalitarian Ecologies and dislike the made-in-Vietnam apparel in Cosmopolitan Centres. Here we have to disappoint you: the world will evolve in one or another direction, but nobody can choose or determine it. That's the prerequisite of thinking in terms of different scenarios. The production of the cappuccino will evolve in one or the other direction, but there is one thing we can say: bon appétit. The cappuccino will be produced, as long as you are willing to pay for it.

8 Unfolding the scenarios

"By presenting other ways of seeing the world, scenarios allow us to break out of a one-eyed view. Scenarios give us something very precious: the ability to re-perceive reality."
Pierre Wack, Shell scenario pioneer.

Pierre Wack introduced scenarios at Shell to show the limitations of forecasting. Although forecasts can be accurate on many occasions, they sooner or later fail to predict major shifts, such as economic crises or major challenges to firms' markets and profits as a result of unexpected competitive pressures or new products. And these major shifts are typically the ones organisation and governments need to take account of, to develop their strategies. The picture of the Netherlands, together with the stylised facts and trends described in the first part of this study, provide an idea of what elements are likely to be of importance in the future. Now is the time to structure them into consistent pictures of the Netherlands of 2040.

This chapter describes each of the four scenarios in turn (Sections 8.1-8.4). The final section presents a summary table for the quick and anxious reader.

8.1 Talent Towns (TT)

The world of talent towns distinguishes itself by wide-ranging virtual cooperation in global networks, highly productive teams of specialists, small cities and intense competition. Communication technology enables specialist workers to co-operate in virtual teams (in particular, in service industries). People do not have to meet in person all the time in order to successfully design new products, improve upon production processes or devise a marketing campaign. Consequently, firms put together teams that consist of specialists from all over the world. Many of these teams come together to complete a certain task, and then dissolve afterwards.

Highly qualified people operate on a global market for their services. They find a match that enables them to fully exploit their talent. Firms put together workers of similar quality in one team, because the team is as strong as its weakest link. Consequently, wage differentials increase considerably between different teams of workers. Medium-skilled workers in services in Europe and the US earn a decent living. In contrast, wages of low-skilled workers are under downward pressure, due to global competition.

The comparative advantage of the Netherlands and other European countries lies with business services. Manufacturing activities move, for the most part, to Asia, because manufacturing knowledge increasingly becomes generally available and because trade facilitates the global transfer of final goods and intermediates. Knowledge of business services becomes the distinctive comparative advantage of the Netherlands. Dutch consultants, financial specialists, designers and publicity experts operate worldwide. In this highly competitive world,

exports of business services enable the Netherlands to increase imports of manufacturing products.

Service workers largely operate in specialised firms or global virtual teams from their home (town) offices. This generates a tendency to move to smaller cities to enjoy open space and local amenities. However, because they also benefit from contacts with their peers, workers prefer to live in specialised cities. To uphold attractive living conditions and supply attractive amenities, cities must maintain a certain minimum scale. Nevertheless, people spread and the size of cities falls.

8.1.1 TT: Main drivers

Talent towns primarily originate from the mutually reinforcing interaction between communication technology and globalisation. An expansion of CT facilitates specialist workers to cooperate globally in virtual teams. This boosts globalisation through the exchange of ideas and trade in services. In turn, globalisation of knowledge generates strong competition in innovation and makes it difficult for firms to appropriate the revenues of basic research. Consequently, new technologies (such as bio- and nanotechnology) remain shelved. Instead, innovation focuses on direct applications and new combinations in services and CT. Hence, globalisation and CT mutually strengthen each other.

Economic activity scatters over space. In their innovation and production processes firms combine mainly codified technological knowledge with the tacit knowledge of specialists. For two main reasons innovation and production are largely footloose. Firstly, a substantial amount of technological knowledge lies stored in blueprints or is embodied in equipment. This codified knowledge easily travels across space. Secondly, the surge in communication- and network technology facilitates worldwide virtual communication between production workers and enhances specialisation. Firms become global communication networks in which virtual connections flourish. Consequently, many workers no longer have to reside near the firms that employ them. They work where they like to live. Hence, cities that provide an excellent living environment attract high-skilled jobs. The need for high-quality living conditions, which encompasses the presence of open space and the absence of congestion, leads to talent towns of moderate scale scattered over attractive locations.

Together, these developments create a world of intense competition. In global product markets consumers and firms easily switch suppliers. Virtual connections enable firms to hire highly qualified specialists from all over the world. The firm that creates the best team of specialists outperforms its competitors. For instance, a top CEO receives support from top advisors and top management assistants. Or top engineers team up with top technicians and top designers. These teams earn very high wages, yet permanently face the threat that other teams overtake them. In that case, team members easily switch to other teams in other firms. This further increases the competitive pressure on firms.

8.1.2 TT: Technology and knowledge

Innovation in CT progresses rapidly. Computer technology develops beyond its current level, in the sense that it takes over tasks that were previously the domain of human beings. These "people tasks" show developments in virtual reality far beyond what is presently possible with, for example, Skype. For instance, technology improves virtual teleconferencing to such an extent that it comes close to personal interaction. People not only are able to virtually exchange written texts and speech, but technology also helps them to thoroughly read body language at a distance. These developments strongly facilitate cooperation in virtual teams—also on issues that require confidentiality or demand the combination of tacit knowledge.

Manufacturing knowledge becomes increasingly codified in broadly accessible blueprints. High value-added complementary business services (design, technology, logistics and organisation) are the main sources of tacit knowledge. Cooperation in global teams generates knowledge spillovers among heterogeneous team members. Connections between teams (researchers may belong to more than one team) and variations of teams over time further intensify spillovers.

Globalisation creates a highly competitive environment for innovation, which hampers basic research. Globalisation expands market size: firms generate huge revenues when they succeed in selling their products or services on the global marketplace. The winning firms and teams take it all. Therefore, firms try to find a competitive edge by being the first to market new products and services. Another strategy is to cooperate with other firms to design new products by combining complementary capabilities (such as in producing the Senseo). At the same time, firms face a threat of business stealing in a dynamic and rapidly changing market. Rapid dissemination of knowledge through global networks entails considerable risk that other firms imitate innovations and leapfrog in the race for the market. The threat of competition makes firms focus their innovation activities on direct application, incrementally improving upon the existing knowledge base.

Reputation is important in obtaining funds for innovation. Because innovation is demand-driven, there is a great deal of competition for finance between different teams within the firm and between firms. On the capital market, firm representatives have to convince venture-capital experts that their firm has the most promising ideas. Top specialists play an essential role in funding and knowledge formation: they combine masses of information, engage in new start-ups when they see new opportunities, attract top co-workers and develop many new applications. Their reputation travels fast through virtual networks. Hence, superstar teams manage to gain most of the funding.

8.1.3 TT: The world economy

Globalisation thrives, also because the BRICs (Brazil, Russia, India and China) and the rest of the developed world agree upon institutions that govern international trade of goods and services. The success of these institutional arrangements adds to the trust that already had been

developing in international relations. The global market connects people across the globe, and production takes place where costs are minimised.

BRICs have a comparative advantage in manufacturing, which they need to sell all over the world. Due to codification of knowledge in manufacturing and the surge in CT, wage competition and outsourcing intensify. These two factors fit in with the comparative advantage of China and other Asian tigers, which further specialise in manufacturing. Trade and transport of manufactured goods increase from Asia to Europe and the United States. Simultaneously, transport of intermediates among Asian countries rises as well. Brazil and Russia primarily benefit from their vast supplies of natural resources, yet Brazil, in particular, also succeeds in competing in some manufacturing sectors. In contrast to China, the Indian economy fails to meet the challenge of this highly competitive economic order. A lack of sufficient investment in human capital and high internal transaction costs hamper growth of the Indian economy.

The West remains powerful, because of its supremacy in high value-added production. The US focuses on innovation in CT, top-end engineering, and design- and business services. Europe further develops several of the technologies originating in the US and builds a strong position in healthcare technology. The EU completes its internal market for services, which gives a boost to the European business services sector. In international trade, European services exports balance manufacturing and raw material imports.

The Netherlands expands its comparative advantage in business services and personal services, including entertainment and other creative industries. Dutch consumers benefit from imports of cheap and high quality manufacturing products. This borderless world maximises gains from trade.

8.1.4 TT: Place of business

Talent town firms excel in coordination and networking. CT supports managerial control, which centralises decision-making in headquarters. Large manufacturing multinationals coordinate inputs from suppliers of intermediary products and from business services firms. International service firms hire high-skilled specialists from all over the world, who usually reside in their home country, cooperate through virtual linkages and incidentally meet one another at the firm's headquarter or at a customer's establishment. Firms set up flexible teams to deal with quickly changing market conditions.

Large firms apply outsourcing and offshoring at all levels as dominant strategies, and focus on coordination and innovation. The high degree of managerial control breaks up the supply chain. Firms outsource tasks to suppliers of intermediaries, to service providers and at times also to companies specialised in R&D. To a large extent, formal contracting governs outsourcing. In addition, progressive globalisation and freeness of trade increasingly facilitate offshoring: outsourcing to companies abroad. The success of these strategies depends on excellent connections facilitating the exchange of ideas, goods and human capital.

In the West, firms and people reside in relatively small TTs. Despite the break-up of the supply chain, many manufacturing firms still reach a substantial scale, due to indivisibilities in

their production processes. However, these factories largely move to Asia to benefit from lower wages. Easy communication and product diversity initiate dispersion of services firms. The need for supportive activities (e.g. studios for the entertainment industry, air connections, and personal services) creates a moderate incentive to cluster service firms and suppliers in space. Workers select their place of residence on the basis of attractive living conditions and contacts with their peers. People live together to benefit from consumption amenities such as restaurants, theatres, childcare centres, schools, and so forth. Some cities focus their amenities on specific groups of specialists, such as a creative environment that attracts designers, or technical facilities that appeal to engineers or researchers. In addition, despite the virtual linkages specialist workers also gain from personal interaction with their fellow specialists. Meeting in person raises the opportunity for specialists to monitor the developments in their field, exchange ideas or discuss reputations. All in all, these developments yield a tendency towards scattered and fairly specialised settlement patterns, which experience little congestion.

Footloose production leads to a 'flat' world in terms of opportunities. Complex jobs in manufacturing and services exist in regions that bind high-skilled workers and have excellent connections. Some regions specialise in more-profitable tasks than others, and become 'the top region of the world'. Crucial success factors are a skilled population, excellent connections and market-oriented institutions, where contracts can be freely made and are well secured.

In the Netherlands, the centre of gravity shifts away from the Randstad. The Rotterdam harbour benefits from imports of goods manufactured in Asia but loses from the transition in Germany towards services. Despite the large global market for services, extensive virtual connections limit demand for international air transport. Consequently, European airports, including Schiphol, lose traffic. In contrast, a top-class communication infrastructure (for example, telecommunication networks, Internet hubs) becomes a crucial asset for the Dutch economy.

8.1.5 TT: People

The TT world represents an economy in which firms fully explore talent and pay accordingly. Firms allocate talented experts in teams according to their marginal productivity in performing tasks. On the global market, talent can be utilised to its maximum. Talented and skilled specialists earn a good living. So, the world income distribution becomes less equal. The people at the right tail of the income distribution become richer. The others lose, especially unskilled workers whose jobs face strong competition.

Also in the Netherlands skilled activities gain ground. Market-based wage formation and global demand for service skills raise the skill premium. High-skilled Dutch specialists in business services compete in the global market and earn competitive wages. The same applies to top-class medium-skilled supporting tasks, such as management assistants. At the same time, inequality between top-class teams and low- to medium-class teams is large. Moreover, the shift to Asia of manufacturing puts pressure on low-skilled wages. The Netherlands loses a part of unskilled work, either through offshoring or through imports of low-skill-intensive products

from low-wage countries. Demand for non-tradable personal services forms a countervailing force. Still, wages of unskilled local services are under pressure, because the supply rises of unskilled labour from contested jobs in manufacturing. All together, inequality in the Netherlands increases.

People living in TTs benefit from bridging social capital towards their peers. They live in a competitive environment in which they exploit their own abilities to the greatest extent possible. High-skilled specialists have to communicate worldwide, and have to establish their reputation on the global labour market. Hence, they need to cooperate with people from different nationalities with their specific cultural backgrounds in a variety of firms that to some degree all have their specific firm culture. In these circumstances, binding social capital helps.

8.1.6 TT: Opportunities and challenges

Although talent towns offer many opportunities for individuals to stand out, people also face vulnerability and uncertainty. The strongly competitive environment enables high-skilled specialists to earn high incomes. However, the rising top performer of tomorrow can overtake the top performer of today. Moreover, when a certain specialisation becomes obsolete, an entire TT may lose its livelihood. Firms permanently need to adjust to changing market conditions. Flexibility is crucial, yet can be rather demanding for inflexible and less entrepreneurial people. Governments have to be aware of the risk that top-level specialists or highly qualified tasks could move abroad when the burden of taxation or regulation becomes high.

People who are less able will have to cope with low incomes and weak solidarity. Outsourcing and international trade put downward pressure on the wages of low-skilled workers. Mobility of labour, capital and tasks limit the tax base, which puts bounds on redistribution. An elaborate social insurance system would entail a substantial risk of adverse selection. For instance, high-skilled people with a small risk of becoming unemployed would move abroad, thereby eroding the premium base. Hence, the TT world faces the paradox of high demand for protection and redistribution, but limited supply.

In this world, globalisation strongly benefits from international cooperation. Governments have to protect international agreements on the free exchange of goods and services. Since intense competition permanently creates new winners and losers, there always is a chance that interest groups lobby for protectionism. If some government gives in, a cascade of retaliation may undermine the sources of wealth.

Talent towns demand high-skilled, service-oriented and communicative specialists. That offers an opportunity for the Netherlands. On average, Dutch human capital meets international standards and Dutch workers have an open attitude to the outside world. However, lack of excellence that often typifies Dutch higher education, constitutes a significant challenge for the Netherlands: in particular, because top specialists strongly raise the productivity of their team members, countries highly benefit from a culture and institutions that support excellence.

8.2 Cosmopolitan Centres (CC)

Envision a world of large cities with global connections hosting specialised workers and firms. In a cosmopolitan centre, many specialists from all over the world combine their efforts in designing and producing toys and cars, games and business software, but also a range of new products and services. Some firms and workers specialise in design, financial services or transport, others in electrical engineering or packaging. Companies acquire intermediary products and supporting services from all over the world. Headquarters of large companies in one country coordinate design and innovation in another country, purchase logistics services from another continent and offshore simple manufacturing tasks to low-wage countries. This global division of tasks relies first of all on efficient and relatively cheap communication technologies, which facilitate intensive coordination between all steps in the production process. The second characteristic of this piecemeal production process is just-in-time trade in intermediate products and services, for which a stable international environment is crucial.

Cities develop into clusters of these specialised activities. Specialist workers substantially benefit from grouping together and self-matching with one another. Working on complex tasks in a common location, specialists in a specific field disseminate knowledge, exchange ideas, share common facilities and establish a reputation among their peers. All of these activities thrive on face-to-face interaction. Production plants and service centres expand, because they are more efficient if they are large. They co-locate because they employ specialists that create value from face-to-face interaction with other similar specialists, and because they need dedicated suppliers. Consequently, a cosmopolitan centre of biotech R&D arises at one location, another location develops into a logistics centre, a third cosmopolitan centre consists of a set of company headquarters, and so on.

If the Netherlands meets its opportunities and challenges, it hosts a number of these clusters in which it has a comparative advantage. This advantage stems from our location and connections with the major economic regions in Europe and the rest of the world, from the education level of the population and from our international orientation. In addition, development of clusters is path-dependent; some CCs build on established strengths that already may have been present for decades. Examples of potential centres for the Netherlands are company headquarters, water management and engineering, biomass technology, medical engineering, creative activities or logistics services. CCs are very prosperous because they host a globally successful production cluster. This prosperity might be threatened if other cities contest or take over that comparative advantage.

8.2.1 CC: Main drivers

What are the main drivers to arrive at such a world? First, the trend of globalisation, with easy exchange of goods, people and (non-tacit) ideas continues. Increasingly free exchange of goods facilitates trade in intermediate products, intrinsic in the fragmentation of the supply chain. Free mobility of people is crucial for the development of cosmopolitan centres, which are melting

pots of various cultures, skill levels and brands—with the main commonality of working in a specific field. Information and codified knowledge flow freely and globally to support both innovation and production processes all over the world.

The second driver is efficient and cheap communication, which connects cities, firms and workers from all over the globe. With CT improvements being the driving force behind a more extensive division of labour, communication technology enables workers to specialise and makes them more dependent on each other. It also facilitates managers to control relatively large teams of specialists and to outsource a considerable range of tasks to suppliers. Globalisation and communication disconnect not only firms from their upstream suppliers and downstream demanders, but also firms and consumers. Consumers buy a considerable part of the goods they want from all over the world, and firms sell their products to consumers across the globe. Disconnection implies that production can take place anywhere, and that it will settle where it is most efficient.

The third driver explains the emergence of clusters. Particularly in the expanding fields of bio- and nanotechnology, innovation and production depend on strong agglomeration forces, which drive the co-location of people with a similar professional background and firms with similar products or processes. Specialist knowledge about complex products and processes has strong tacit features; it resides in the mind of people or in the knowledge base of companies. Dissemination of tacit knowledge and ideas mainly takes place in local networks. Moreover, firms in clusters benefit from the presence of a large group of qualified employees (so-called thick labour markets), from dedicated suppliers, and in a number of cases from high-quality university research. For example, a biotech cluster may expand close to a university with a strong biotech research program and attract both bio-engineers and specialised complementary services workers (such as lab assistants).

8.2.2 CC: Technology and knowledge

Following the ICT revolution, bio- and nanotechnology take off as a new GPT. Yet, because of the long gestation period of GPTs, these technologies—even towards the end of the scenario period—are still in a relatively fundamental research-intensive phase. The pervasiveness of the new GPT implies that manufacturing technology becomes increasingly specialised and requires a relatively high degree of tacit specialist expertise. In addition, also supplementary services (such as design, marketing and consumer services) demand a substantial amount of specialist knowledge. Consequently, *similar* specialists, both in manufacturing and in services, strongly gain from face-to-face interaction leading to local knowledge spillovers. At the same time, knowledge flows between *different* specialists are embodied in equipment (e.g. a biotech system) or are codified (e.g. a consultant report or a blueprint for a subcontractor).

Hence, in contrast to knowledge flows among similar specialists, knowledge between different specialists may travel long distances. However, knowledge flows among similar specialists constitute the most important driver for innovation and productivity growth.

Following the example of Silicon Valley (ICT), cosmopolitan centres may arise such as Atom State (nanotechnology), Neuron Field (neurotechnology) or Gene Pool (biotechnology).

Because of the relatively young GPT, innovation is research intensive, supply driven and organised in close cooperation with universities. Firms aim to develop new technologically advanced solutions and products, which can be plugged into existing and new products and processes. They focus on radical innovation and fundamental improvements instead of the development phase of innovation. Large firms are chiefly able to issue sufficient equity and gather sufficient funds on the capital market to finance these risky research projects. Together with universities, they set top-down research agendas. In addition, spin-offs from universities succeed close to the source and benefit from expertise within the CC.

8.2.3 CC: The world economy

China and several other Southeast Asian countries (including Malaysia, Indonesia, Thailand, Vietnam) take up the position as the world-manufacturing hub. These countries are able to attract or educate enough human capital to become the world's factory for relatively skill-extensive intermediate inputs and final products. Despite the existing labour potential in the informal economy and the low-productivity agricultural sector, rising productivity and a steadily expanding manufacturing sector generate an upward pressure on wages, particularly for medium- to high-skilled jobs. Consequently, simple activities (such as the assembly of final products) shift to other low-wage countries in Asia and Africa, which give these countries an impetus to escape from incessant poverty. These opportunities for developing countries ease the migration pressure on Europe. Russia attracts energy-intensive industries, primarily building on its vast natural reserves. Brazil fails to create the CCs it needs in order to compete on a global scale.

India attracts a considerable share of cosmopolitan service centres. The Indian government succeeds in expanding education, reducing red tape and encouraging competition. Indian cosmopolitan centres in IT, accountancy and consultancy service the world, supported by a labour force that masters the English language and demands moderate wages. Lower-educated workers find jobs in complementary services close to the successful centres.

The US and the EU compete in the very high-end segment of manufacturing and in a broad range of tradable services. Because US companies and universities are better equipped to perform early-stage radical innovation, CCs in the US specialise in fundamentally new products in the new GPT. Centres in the EU further develop these products and add complementary services. To fully exploit its potential and attract centres according to its scale, the European Internal Market for goods and services expands in three directions. Firstly, it reduces the barriers to services trade and intensifies competition in services, which enlarges services markets in Europe. Secondly, because of the importance of complementary research on new technologies in universities, the Union boosts the European Research Area for higher education and public research. Thirdly, governments harmonise the regulation of bio- and nanotechnology to create an EU-wide level playing field in these major new technologies.

8.2.4 CC: Place of business

CCs are dynamic places of face-to-face interaction between many specialised firms and workers. Economic activity is concentrated, but not too dense (i.e. an agglomeration of several smaller cities may arise). The hinterland of the agglomeration contains specialised jobs for which direct interaction with the heart of the cluster is less important. High-quality infrastructure facilitates the exchange of ideas, intermediate goods and people within cities. Cosmopolitan cities are connected via high-quality trade in intermediate and final goods, via high mobility of workers (and, of course, virtually). In this world, Schiphol airport flourishes in transporting both people and intermediates. Because low-wage countries manufacture the major part of final products, the Rotterdam harbour gains in the distribution of final products, but loses on the more bulky intermediaries and raw materials. On net, flows of goods through the harbour diminish.

Firms consist of specialised plants and service centres in different locations. There are relatively many medium-sized- to large firms. Managers have a large span of control in combining inputs, which centralises decision-making in local headquarters close in proximity to each other. Strong leaders with an authoritative management style direct strategic choices in firms, with limited feedback from specialists at dispersed locations. Managerial control coordinates innovation, marketing and product- and services flows between many different locations. Hence, vertical integration is low, with concentrations of specialised plants and services at different points in the world.

8.2.5 CC: People

Mobile high-skilled workers move to cosmopolitan centres, where they employ their talents in highly rewarding employment at specialised firms and where they encounter many of their peers. Since CCs attract specialists from all over the world, centres prosper where people command different languages and appreciate different cultures. To enhance cross-cultural understanding, society needs bridging social capital. Large companies provide a considerable part of these bridges by offering jobs to specialists from all over the world.

Low- and medium-skilled workers perform to some degree complementary tasks in clusters, and provide local and personal services that are in high demand around cosmopolitan centres. They are mobile between regions within countries, but have limited incentives to migrate internationally. Generally, sufficient job opportunities exist within the country of origin, as each region of the world has the opportunity to specialise in a piece of the fragmented supply chain.

The processes of matching high-skilled specialists between cosmopolitan centres and matching medium- to low-skilled workers within a country perform best if labour markets function rather flexibly both nationally and internationally.

The Dutch economy has a substantial stock of human capital at its disposal. The average worker is skilled, specialised and oriented towards research and services. He also possesses good communication skills and masters complex activities.

The Dutch income distribution is uneven and dynamic. Similar workers group together and gain from their interaction, which raises their productivity proportionately. Hence, talented workers earn top incomes when successful, but their earnings may come under pressure when new competing centres emerge. Less-talented workers earn relatively low yet reasonable incomes—but are also vulnerable to idiosyncratic shocks to their specialisation (such as a drop in demand for financial products). These labour-market characteristics increase inequality in wages and work conditions between different production locations. At the same time, global developments affect wage differences: changes in worldwide specialisation patterns may turn the income distribution around.

8.2.6 CC: Opportunities and challenges

A world populated with cosmopolitan centres offers various opportunities. New technologies not only create new consumer products, but also generate promising research directions to improve healthcare in an ageing world. The ongoing global division of labour enables emerging economies to substantiate their growth strategies, and enables less-privileged countries to escape from poverty. The combination of specialised centres and complementary tasks in their direct surroundings generates job opportunities for both high-skilled workers and medium- to low-skilled workers. Prosperous CCs create considerable wealth for their inhabitants.

At the same time, this world poses some considerable challenges. Cosmopolitan centres only thrive with international mobility of goods, people and ideas. Barriers to mobility on a global level may frustrate the emergence of centres—all the more so when countries try to use protective measures to support contested centres. At the European level, comparable arguments apply to the internal market. Due to their scale, the smaller European countries, in particular, host only a few CCs. Hence, EU countries benefit strongly from open borders and flexible labour markets.

Also education and research stand centre stage. Countries that fail to invest in the skills of their labour force and do not provide an open and high-quality research infrastructure lose out in the global competition for CCs. This particularly applies to a small country like the Netherlands, which even in the best circumstances will host only a few large CCs. Insufficient investment in the factors that create or attract these centres may imply that the Netherlands falls behind and loses a substantial part of its capacity to maintain a high-wage society.

Cosmopolitan centres and the specialists that inhibit them are vulnerable both to shocks that explicitly affect their specialisation and to the emergence of new more productive centres elsewhere. Consequently some cities prosper, but others marginalise. Therefore, income levels may differ substantially between centres and between a centre and its hinterland. Substantial income inequality also exists within cities, because the large CCs attract a broad range of supporting tasks. Although labour flows mitigate income differences to a certain extent, societies will on the whole need to find ways to deal with larger income inequality.

And finally, the CC world causes some social challenges. People in a society open to foreign influences have to accept cultural diversity. Moreover, specialists in CCs have relatively strong

ties with the companies they work for and with their peers, but rather loose ties with other people living in their neighbourhood. This may harm local social structures.

8.3 Egalitarian Ecologies (EE)

Variety and dispersal characterise egalitarian ecologies. Economic activity spreads out over medium-sized cities that host medium-sized firms. Production technology based on complex IT systems enables these firms to easily produce differentiated products that cater to differences in local demand. Children play with toy police cars, fire engines or buses that closely resemble the vehicles they see passing by on the street. Computer games and other products from creative industries become increasingly personalised. Consumers can easily add a personal touch in the design of the integrated electronics system, car, furniture or dress they desire to purchase.

Firms create market niches and sell these tradable products abroad. Supported by powerful IT systems, firms perform in-house a substantial part of their innovation, design, production and consumer support. Knowledge resides largely in the combination of the firm's IT infrastructure and the minds of its generalist employees, who master a broad range of tasks.

Due to in-house production and meagre inter-firm knowledge flows, firms do not need to locate near each other. To avoid competition for local resources and costs of congestion, they turn away from large cities and settle in medium-sized cities, which offer high-quality non-tradable private and public services, and which provide agreeable living conditions for their employees. Hence, living and working activities spread out over space.

In the Netherlands, medium-sized cities in the east and south of the country flourish. Firms producing high-quality consumer products and services settle in these cities and serve their international niche markets. These firms build on the strengths of the Dutch economy in fields such as creative industries, agricultural services, healthcare products, fashion and design. In addition, economic activity in the western Randstad keeps up, also because the Netherlands retains its position in transport of final goods all over Europe.

8.3.1 EE: Main drivers

In the EE world, technological progress centres on IT. In developed countries, the breakthrough of a new GPT stalls, and developing countries only moderately succeed in expanding their knowledge base and their stock of human capital. Hence, the world does not radically shift to a new source of welfare, but expands the development and application of ICT as the dominant GPT. ICT further develops towards increasingly complex and powerful expert systems that support workers, whereas the growth of CT levels off. Hence, communication becomes relatively expensive, which puts a limit on the division of tasks.

The moderate expansion of technology and global human capital directs globalisation towards tradable products. Trade in ideas runs dry. Technology and worldwide skills add only a limited number of new sources of wealth, while at the same time emerging economies exert an increasing demand on the global stock of natural resources. Rising prices of natural resources

transfer wealth from resource-poor countries to resource-rich countries. High prices of natural resources generate tensions in the international relations between resource-rich countries and resource-poor countries. Moreover, non-tariff barriers related to security measures hamper trade between the US, the EU and Asia. In this relatively low-trust international environment, trade primarily concerns the exchange of finished products within continents, governed by formal contracts. The exchange of knowledge and informal international cooperation between firms develop rather poorly.

The boost in production efficiency affects the organisation of firms and coordination between firms. Production workers gain from surges in production technologies (CAD/CAM) that facilitate problem solving and increase their autonomy. They need less access to superiors to take decisions. Highly developed expert systems (ERP) enable managers to collect very efficiently the information they need about the production chain. This increases the autonomy of plant managers within the firm. Communication with headquarters concerns mainly codified information, such as technological blueprints or financial accounts, and thus can be done at a distance. Hence, firms develop towards steep hierarchies employing generalist workers. Local managers report to their firm's headquarters, which may be situated abroad. These firms experience few advantages from coordination through the market. Generalist workers supported by expert systems perform many tasks in-house. Managers are able to oversee and command a large part of the supply chain. Consequently, a substantial part of the supply chain becomes integrated within the firm.

Weak agglomeration forces limit the expansion of cities. Firms, workers and consumers live together because production requires a certain minimum efficient scale. This applies to manufacturing of tradable final goods, as well as to production of non-tradable services, such as personal services, retail, education, healthcare or public transport. In addition, cities attract people because they provide pleasant living conditions (such as parks, theatres or nearby open space). However, because technology adds few reasons for people or firms to co-locate, dispersion and differentiation dominate. People and plants spread over cities of moderate size that to a certain degree differ in terms of economic activity, culture and consumer demand for variety.

Globalisation, organisation and agglomeration yield the picture of a world inhabited by a number of large conglomerate firms that coordinate the operation of medium-sized plants near local markets and trade products chiefly within global trade blocks. For products with relatively high costs of gathering information on local preferences, or with high transport costs to service local markets, these firms establish plants near the market. In addition, a range of small- and medium-sized firms serves local markets with niche products and services. Demand for variety induces substantial trade flows of final products that carry low costs of information or transport.

8.3.2 EE: Technology and knowledge

Bio- and nanotechnology expand at a slow pace. Despite research activities at various places in the world, only a few bio- and nanotechnology-related inventions manage to develop into

practical products. Three main reasons explain this slow expansion: relatively moderate growth of global human capital, limited international exchange of ideas and the considerable potential of ICT, which draws R&D towards IT-based innovation. A data revolution takes off in IT. Firms and people utilise the vast capability of IT to analyse and utilise data. For instance, firms apply IT to devise products and services tailor-made to the preferences of consumers, and consumers use IT to find their way among the broad supply of differentiated products. This results in a wide variety of products and services that is closely in line with consumer preferences. All in all, ICT remains the world's latest GPT for another 20 to 30 years.

The expansion of IT affects knowledge build-up and value creation in firms. Manufacturing knowledge becomes increasingly embodied in expert systems, produced by a few large global firms. Firms all over the world apply these systems. Expert teams provide complementary services (design, marketing or logistics) from inside the firm. Hence, firms create value from combining the generalist knowledge of engineers, the tacit knowledge of internal service providers and the specific knowledge of local tastes. Knowledge flows primarily within the firm—both within and between medium-scale subsidiaries operating in different locations.

IT developments and demand for new product varieties drive innovation. Primarily financed by bank credit, research effort by small- and medium-sized firms focuses on applying and modifying existing technologies. It builds on the new findings of large companies and looks for smart applications to directly serve the market. The wide product variety limits options for radical innovation: scope dominates scale. Therefore, innovation is applied and incremental.

8.3.3 EE: The world economy

Over the scenario period, the large world regions become more self-supporting. Tensions in international relations between resource-rich countries and resource-poor countries raise the risk of trade distortions. As a response to their integrated organisation model, and in order to limit global system-wide risks in supply chains (comparable to the credit crisis in finance), firms reduce global linkages. Trade in a broad variety of final goods adapted to local demand and governed by formal contracts dominates the world market.

Resource-rich countries strongly benefit from the surging prices of raw materials, yet face significant difficulties to invest their newly acquired wealth effectively. A number of weak leaders waste money on extravagant projects or through outright corruption. However, other countries succeed in investing in infrastructure and education. Their economies link up with the world economy.

BRICs concentrate on home-market development and fight their own battles. In particular, Russia revives as a raw material exporter. As a result of its booming economy and its command over a vast pool of scarce resources, Russia gains political strength. Partly as a response to social unrest, China expands social institutions. It pays a price in terms of lower investment and less export growth. In contrast, domestic demand rises. On net, the growth rate of the Chinese economy falls somewhat. China also meets increased competition from other Asian states that struggle with limited growth prospects. India partly succeeds in reforming its economy, offering

more room for market forces. Consequently, the internal market expands. Yet, most Indian firms still experience substantial difficulties in competing in international markets.

The West only moderately loses from the shift in political power to the East, because of the relative independent state of the different power blocks. The EU and the US derive their economic growth from the production and trade of a wide variety of tailor-made products. In addition, the US and a few booming Asian economies are very competitive in global production of expert systems and global IT technologies. By and large, the US and the EU become more inward looking and regionally differentiated.

8.3.4 EE: Place of business

Varied medium-sized cities fill the world of egalitarian ecologies. The minimum efficient scale in the supply of private and public goods and services determines the size of cities. Technology incites firms to keep a large part of the production chain in-house. Firms create value by offering high-quality products tailored to the preferences of consumers. Product differentiation implies that plants grow to moderate size. In that way, medium-sized plants fit in with medium-sized cities. Successful cities create extensive suburbs with excellent living conditions for their citizens, and generalist workers enjoy a broad range of employment possibilities. Employees have a rather substantial level of bargaining power on the local labour market. Hence, firms take into account the preferences of workers in their location decisions, and establish plants in the attractive medium-sized cities where workers want to live.

In this world of relatively self-supporting regions, economic activity spreads more evenly over countries. Consequently, the importance of transport within those regions and between adjacent regions outgrows international transport. In the Netherlands, medium-sized cities outside the Randstad gain importance. The Randstad benefits from the trade flows in differentiated final products through the two main ports of Rotterdam and Amsterdam.

8.3.5 EE: People

Emerging countries succeed only to a limited extent in improving their educational systems. At Asian universities, many high-skilled graduates complete their studies. With an average quality of education they manage to perform relatively standardised tasks, which are vital for their countries of origin, but do not add to the global stock of new ideas. These individuals thus do not exert a substantial downward pressure on wages of high-skilled workers in the West. At the same time, upward pressure on high-skilled wages is also lagging. Technology only moderately expands, which limits demand for high-skilled labour. Also individual talent is not explored fully because of integrated production. These factors limit wage differentials at the upper side of the income distribution compared to the median. The wages for the skilled will remain rather stable at the current level.

Utilisation of large labour reserves in the informal economy and low-productive sectors raises the supply of low-skilled and cheap labour in developing countries. Yet, this has only a moderate impact on Europe and the Netherlands, because European low-skilled workers are

part of local production processes. They find substantial employment in manufacturing firms and personal services in their region. Significant migration of low- to medium-skilled workers accommodates the increasing demand for personal services in ageing European societies. All in all, the wages for Dutch low-skilled workers will rise a bit, while the wages for the skilled will remain stable at the current level.

8.3.6 EE: Opportunities and challenges

The EE scenario represents a world with moderate growth, modest income differentials and an economy oriented towards local production traded in global niche markets. For the Netherlands, this world offers limited competition from the BRICs and other developing economies in the high end of technology and skills. However, strongly rising natural resource prices generate large transfers of funds to resource-intensive countries, and technological progress levels off. Disposable income consequently grows only modestly.

International relationships present substantial challenges. The risk of tensions in trade relations between the large global blocks may harm the open Dutch economy. Product differentiation offers compensatory trade opportunities for the Netherlands—particularly with European countries. Deepening of the European internal market is a necessary condition for the Netherlands to benefit from these opportunities for intra-European trade.

Innovation takes place in regional clusters. Successful cities are hotbeds of high-quality production, and offer opportunities for creative cooperation on a small scale. Strong international competition in niche markets causes cities that thrive on a small number of specific firms to be vulnerable to outside competition. Competitive firms may respond by offering product varieties that more closely adapt to consumer preferences, or multinational conglomerates may decide to transfer plants to more profitable locations. In the longer term, cities also face the risk of stagnation. Workers and plants can become locked-in, with limited opportunities inside the city, limited opportunities for learning from outside companies and limited outside options.

The relatively equal income distribution fits with the preference for equity in the Dutch society. However, social relations may come under pressure from the migration of low- and medium-skilled workers, which also poses a challenge to the Dutch education- and vocational training system.

8.4 Metropolitan Markets (MM)

The rise of mega-cities with more than 10 million inhabitants continues: a limited number of very large metropolises dominate the world. Large factories, huge office buildings and sky-high apartment blocks characterise these cities. Economic activity is concentrated in dense areas, where economies of scale and scope are optimally exploited. The hinterland and smaller cities face poor prospects, talented workers leave and sufficient production size may never be reached. Metropolitan Markets is a world where the winning cities take all.

Although these metropolises are large, they vary in size and topography. Their population averages some 20 million people, but ranges from over 10 million to a few mega-cities with a population that grows towards 100 million people. Geographically compact metropolises cover an area of some fifty by fifty kilometres. Yet, several other metropolises consist of three to five very well connected large cities at a distance of several hundreds of kilometres from each other. A prominent example of a very large geographically extensive mega-city is the Northeast Metropolis in the US, which connects Boston, New York, Philadelphia and Washington over some 700 kilometres. Currently, this region already houses about 55 million inhabitants. Hence, both in terms of population size as in terms of geography, a substantial right tail characterises the distribution of metropolises.

Metropolises attract firms and people. In metropolises, firms find trusted business partners, knowledge centres, a large supply of generalist workers and many consumers. People move to a metropolis to select the best job, to build interesting relationships and to benefit from a large supply of cultural and recreational services.

The Netherlands faces the challenge that it may be too small to fully exploit the benefits of a metropolis. In that case, it may find itself at the economic periphery. To create sufficient scale, the Netherlands may cooperate with neighbouring regions in Belgium, Germany or the UK.

8.4.1 MM: Main drivers

Bio- and nanotechnology break through. Their sheer complexity requires extensive research facilities and a high degree of tacit knowledge exchange within large firms to create sufficient potential for developing marketable applications. Expanding IT complements personal exchange. Expert systems enable managers to delegate decision-making power. Still, managers need face-to-face contacts with experts in order to assess the technological potential of the firm's product portfolio. Hence, managers have the potential to run a large firm, as long as the various departments of the firm are situated in close vicinity to each other.

Large companies act as magnets that boost agglomeration. Personal interaction not only concerns relationships within companies, but also contacts with suppliers, financiers and workers from different companies. Knowledge about technology, business opportunities, and reputation- and job characteristics flows within the metropolis and enhances the productivity of people and firms. Firms and workers also benefit from thick markets in the city. The presence of large firms attracts suppliers, business services and finance. In an expanding labour market, job applicants find many job opportunities and vice versa. In addition, the provision of public goods is relatively cheap, because their fixed costs can be covered by many people. For instance, investment in public transport yields high social revenues when many people use that service.

Relatively autarkic mega-cities check globalisation. A metropolis is to a large extent self-supporting, and carries a robust local market. Ideas expand considerably, yet ideas flow mainly within the mega-city. Trade mostly involves raw materials and some exchange of final goods between metropolises.

8.4.2 MM: Technology and knowledge

Bio- and nanotechnology develop into the dominant GPT. Initially, new innovations in this field arise out of the interaction between universities and companies. However, when the complexity and scope of the new GPT expand, firms increasingly grow in size and establish large internal R&D departments. This enables teams of generalist R&D workers to develop bio- and nanotechnology inventions into marketable products. Moreover, successful products require the combination of high-level technological knowledge and complementary services (design, marketing, consumer services, and so forth) provided by other departments in the firm or by dedicated suppliers in a process of co-innovation that involves the exchange of tacit knowledge. Finally, large firms issue bonds and finance R&D out of retained profits, since outside investors may be somewhat reluctant to finance large-scale research projects that are highly uncertain.

The expansion of bio- and nanotechnology draws R&D capabilities away from ICT-oriented research. Consequently, there is limited progress in CT. Innovation in this field focuses on IT applications. IT research develops various expert systems, which enable workers to operate relatively autonomously and assist managers in controlling the many complex interrelationships in the firm.

Firms put a great deal of effort in research to exploit the new technologies. Large-scale research within the company enables a firm to turn inventions into innovations, thereby appropriating the revenues from new findings and thus reaping the fruit of new products and processes. Consequently, supply drives radical innovation, which is focussed on new products to serve demand, and on new processes to shift out the efficiency frontier. Both research and development matter.

8.4.3 MM: The world economy

A limited number of metropolises, in which a considerable part of the global activity takes place, characterise the MM world. The US and Canada host some 15 metropolises, Europe about ten. Although the total European population is nearly twice that of North America, large concentrated urban areas are less common in Europe.[1] With the exception of several large cities, such as Paris, London and Istanbul, cities in individual European countries are relatively small. Moreover, differences in language and culture complicate the rise of cross-border mega-cities.

The BRIC countries explore their home markets, and demand many natural resources for growth. Successful metropolises strongly expand in China, followed by India and some other Asian countries, such as Indonesia and South Korea. The East becomes powerful, because Asian countries control resources and because concentration increases their scale beyond that of the West. The Russian economy depends on revenues from natural resources, but lacks the capacity to create substantial metropolises. Economic activity in the Sao Paulo–Rio de Janeiro region takes off and contributes to the economic growth of Brazil, which expands from agriculture into higher-end food industries.

[1] In 2005, 47 percent of the North American population lived in urban areas of 750,000+, against 19 percent in Europe (UN Population Reference Bureau).

Metropolises act rather independently. Due to the relatively autarkic metropolises, trade between global blocks is not very high. In addition, the battle for resources generates tensions between metropolises. These adverse relationships further hamper international trade. Weak incentives for international trade agreements offer little room for negotiating mutually beneficial trade agreements.

Some metropolises fail. Poverty and slums characterise large crowded urban areas in Africa and some Asian and South American countries. These cities suffer from dual housing markets—with exclusive zones for the elite, surrounded by slums without proper infrastructure. Moreover, politicians try to obtain local support by directing resources to the primary city, or they favour products or services from this city by imposing trade restrictions. Polarisation makes the primary city 'too attractive'. Many people migrate to the metropolis looking for a job—yet are barely able to eek out a decent living. These cities expand far beyond their efficient size.

8.4.4 MM: Place of business

The scale and scope of firms rise substantially. Complex R&D requires large in-house research facilities. To appropriate knowledge spillovers between different professions there is a strong tendency to incorporate many adjacent knowledge fields in a single firm. Integrated large firms combine manufacturing, design, marketing and so forth. Boundaries between manufacturing and consumer services weaken. Some specific business services, such as finance or accountancy, become standardised—and specialised firms deliver these services on a large scale. To take advantage of economies of scale and to benefit from knowledge spillovers, business service providers co-locate. Centralisation increases the demand for personal services on the large local market, which raises their prices and the wages of personal service providers. Higher wages attract labour from the hinterland to the metropolis, which augments centralisation. In addition, higher prices induce a shift from the supply of business services to personal services. Hence, most metropolises focus on personal services, while business services trade globally, with one metropolitan centre producing for other places.

Metropolises grow through the advantages they offer of living, working and innovating together. Some tasks demand day-to-day personal contacts. People that perform these tasks work together in a large firm. Firms involved in closely associated activities (such as co-innovation) cluster closely together. Other tasks require contact on a less frequent basis. Weekly visits, for instance, may offer sufficient interaction with less dedicated suppliers. These firms settle further away from each other in the metropolis.

Interaction and innovation generate strong productivity growth within the metropolis, and thus create sufficient wealth to address the negative effects of resource scarcity. Cities of critical mass flourish; smaller cities have to struggle for existence. Yet, resources remain important for production and congestion puts a bound on agglomeration. This prevents urbanisation continuing until only one giant city remains. Therefore, size and location still matter—although on a very large scale.

Cities need high-class internal connections to support an efficient local market. Condensed agglomerations above all require excellent local transport facilities. A metropolis that encompasses a few cities situated several hundreds kilometres away from each other needs frequent air transport connections between these centres. A one-day return business trip within such a metropolis facilitates personal interaction.

The Netherlands faces the crucial question whether the country is large enough to generate sufficient scale and scope to host a metropolis. Demographic projections expect the population of the Randstad to grow from a current 7 million to some 8 million people in 2040. When adding other cities in the south (the so-called Brabantse Stedenrij) and east (Wageningen, Ede, Arnhem, Nijmegen), the population of the Dutch extended Randstad rises to some 9.5 million in 2040. Still, that number is relatively low compared to other metropolises. Cooperation with adjacent regions in Belgium or Germany seems a feasible way for the Netherlands to create a metropolis that fits in the global pattern of centralisation. In Belgium, stronger ties with Antwerp and Brussels come to the fore; in Germany, that applies to the Ruhr Area.

8.4.5 MM: People

In MM, all people produce parts of final products; this limits the extent of talent utilisation. Workers require generalist knowledge in order to be able to combine insights from their field of work with insights from adjacent fields. IT-support enables them to perform a range of tasks. The benefits of interactions raise productivity and wages of skilled workers. They gain relative to unskilled workers, who to a lesser extent benefit from such interactions. Skilled workers move to the city centre; their high wages offset the high rents for housing. Unskilled workers earn a reasonable income, but cannot afford to live in the expensive production centres. They group together along the boundaries of production centres. Hence, the availability of work determines where people live.

Overall, wage inequality is high—both within metropolises and between the mega-city and its hinterland. The nearly fully self-supporting production centres need all types of workers to produce the very broad range of goods and services that take place in the city. This broad scope of activity results in large income differentials within the city. Also, wages differ considerably between the city and its hinterland. Innovation and interaction generate strong productivity growth within a metropolis, which acts as a magnet that attracts high-quality firms and workers. Less-productive (and accordingly less-rewarding) activities remain in the hinterland.

The integrated society in a metropolis requires a mixture of bonding and bridging social capital. Bonding enhances social coherence in firms and communities of practice. Workers identify themselves with their companies. People care about the history and future of their company, and have the tendency to invest money back into their company. At the same time, face-to-face contacts between people from different communities of practice, supported by bridging social capital, stimulate the exchange of knowledge and build trust. Researchers in the laboratory of a specific firm benefit from the ideas in other firms, communicate with people

working in design and marketing and rely on feedback collected by consumer service providers on the firm's product.

8.4.6 MM: Opportunities and challenges

A metropolis offers many opportunities to find promising ideas, establish a joint venture, search for the most suitable job, expand a network or build a reputation. Its broad range of activities turns the metropolis into an area with many prospects. In addition, the scale of the community reduces uncertainty. For instance, if one's job doesn't satisfy, many other job options can be found.

Once MMs are established, competition between the metropolises is relatively low. Due to their size and scope, metropolises have limited outside interaction, which makes firms inside a metropolis only moderately vulnerable to outside competitors. However, a metropolis always faces a low-probability high-impact risk that the total community may collapse, due to faulty decision-making. For instance, strong regulatory pressure or adverse business conditions may compel some firms and qualified workers to start moving to another metropolis. That may trigger a downward spiral lasting more than a few years, in which an increasing number of firms and workers migrate out of the first metropolis.

Within metropolises, large conglomerate firms control part of their markets, which constrains competition. Smaller suppliers of more custom-made intermediaries or standardised services face stronger competition. People work hard and invest many hours in their job.

Where the metropolis thrives, the hinterland lags behind. The metropolis attracts all of the highly productive firms and higher qualified people. Income inequality is large, both within the metropolis and between the metropolis and the hinterland. This may pose serious social problems for a country with a preference for equity, such as the Netherlands. An even deeper problem arises when the Netherlands fails to become part of a local metropolis. In that case, the Netherlands as a whole becomes a hinterland. Neighbouring European metropolises would attract all company headquarters, research centres and talented people.

Finally, congestion and pollution constitute high priorities for local politicians. Dense urban areas have to deal with congestion in private and public transport, with associated local pollution, with surging housing prices that may make living unaffordable for low-income earners, and with social problems that emerge in cities.

8.5 Summary

Table 8.1 presents a summary of the main features of the four scenarios. It is organised along the subheadings of the discussion in each of the scenarios. The table is meant as a summary, and the terms capture the main message, with the more elaborate explanation available in the description of the scenarios in Sections 8.1-8.4.

Table 8.1 Main Scenario characteristics

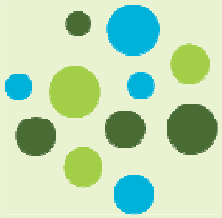
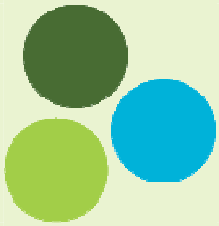
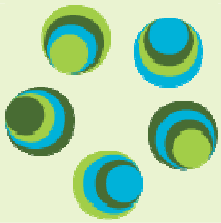
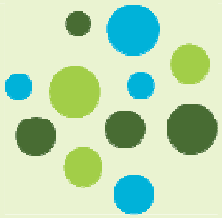
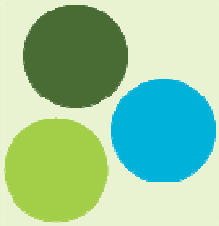
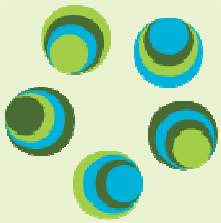
	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
				
City size, in population	100k – 200k	2 – 8 m	100k – 500k	> 10 m
Technology, knowledge				
Direction ICT	Communication	Communication	Information	Information
New GPT	None	Research-oriented	None	Application-oriented
Knowledge	Specific	Specific	General	General
Knowledge spillovers	Similar workers	Similar workers	Different workers	Different workers
Innovation	Direct applications, strong competition	Radical, firm – university links	Applied and incremental	Fundamental and applied, within firms
World economy				
Brasil	Attracts some manufacturing	Fails to create CC	Limited trade options	Regional growth engine
Russia	Benefits from its resources	Energy-intensive industries	Benefits from its resources	Some growth from natural resources
India	Stalls	Services centres	Inward-oriented	Several metropolises
China	Manufacturing	Manufacturing hub	Social tensions	Many metropolises
South-east Asia	Manufacturing intermediaries	Manufacturing	Growth-constrained	Some metropolises
United States	Top-end innovation and design	GPT, services	IT products and local varieties	Many metropolises
European Union	Business services	High-end services	Local varieties	Metropolis less common
Trade	Global market, high trust, strong trade agreements	High and broad, trade in intermediaries	Final products; limited idea flows, resource tensions, non-tariff barriers	Limited, autarkic metropolis, battle for resources
Place of business				
Agglomeration	Scattered	Concentrated	Weak, medium city size, local varieties	Highly concentrated
Infrastructure	Virtual + air connections	Extensive, high quality	Regional	Locally high quality
Organisation of firms	Virtual teams	Specialised plants	Medium-sized plants	Conglomerate
Decision power in firm	Centralised	Centralised	Decentralised	Decentralised
Supply chain	Broken, footloose	Outsourcing	Integrated	Highly integrated
Capital market	Continental, venture capital	Global, equity	National, credit	City, bonds

Table 8.1 (continued)	Main Scenario characteristics			
	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
				
People				
High-skilled workers	Talent is highly rewarded, operate from home	Talent is highly rewarded, move to CC	Moderate wages, live in suburbs	Substantial wages, live in city centre
Medium- to low-skilled workers	Strong competition, pressure on wages	Personal services, regionally mobile	Substantial demand, immigration, stable wages	Reasonable wages, live in outskirts of MMs
Social capital	Bridging	Bridging	Bonding	Bonding + bridging
Challenges and risks				
Markets for goods and services	Protectionism, large flexibility	Barriers to trade and mobility	Trade tensions	Market power of conglomerates
Resources	Lack of excellent human capital	Inadequate education and research infrastructure	High prices of natural resources	Congestion and pollution
Vulnerability to shocks	High: specific human capital and city output	High: specific human capital and large city output	Limited	Low
Income inequality	High: due to specialisation	Very high: large cities and specialisation	Low	High: due to large metropolises
Social	Weak solidarity, weak protection	Weak social structures	Ethnic tensions	Crowded cities

Part III Policies for the future

'A government could print a good edition of Shakespeare's works, but it could not get them written. When municipalities boast of their electric lighting and power works, they remind me of the man who boasted of 'the genius of my Hamlet' when he had but printed a new edition of it. The carcase of municipal electric works belongs to the officials: the genius belongs to free enterprise.'
Alfred Marshall, 1907, *Social Possibilities of Economic Chivalry*, p. 22.

In *The Magic Circle* (1886) we see a dark-haired woman standing by a cauldron on a wood fire.[1] With a stick she draws a circle around herself and the cauldron. Where her stick touches the ground, it lights up; this is a magic circle. In her other hand she carries a sickle-shaped knife to cut herbs to be put in the cauldron. The circle acts as a boundary to forces coming from outside; in the picture, these are negative forces such as doom and death. The border of the circle also shows how much manoeuvring room she has and reveals the scope of her influence. Standing in the centre of the circle and making use of the cauldron for the right recipe to deal with the world around her, she is a woman aware of the impact she has on her immediate environment (the circle)—and her task to protect this environment by providing the right ingredients (the cauldron).

The magic circle

This part of the study dwells on the "magic circle" of policy. The circle defines the scope of policymakers. In an integrated world in which more responsibilities are being transferred to Brussels, the circle of influence for a small open economy like the Netherlands seems to be

[1] *The Magic Circle* can be seen in Tate Britain in London or at http://www.johnwilliamwaterhouse.com/.

narrowing. This is not to say that Dutch policy has diminished in importance. On the contrary, the cauldron represents the recipe for action in a world characterised by ever-increasing unpredictability and sudden changes, implying that good and bad choices will have a larger effect on the economy than ever before. It is a matter of seizing opportunities or wasting resources—and a matter of trading off different options when government intervention is warranted.

Nowhere is the importance of these choices more evident than in labour-market policies. The process of globalisation, technological change and the rise of cities have since the 1980s led to a fall in the demand for unskilled labour relative to skilled labour in Western economies. Accordingly, a major challenge of labour-market policies has been to support the living standards of the unskilled without reducing their work incentives. At the same time, the knowledge economy has done its utmost to motivate people to obtain higher levels of education and to stimulate innovation in order to increase the productivity of skilled workers. Beyond the labour market, also the physical infrastructure, and the business environment, has been on the radar of Dutch policymakers. Policies have therefore aimed at making it more attractive for multinational firms to do business in the Netherlands, and at developing a sound physical infrastructure to serve as the main port to Europe.

This picture of the world is changing, and the trade-offs that policymakers will be facing will also change. As shown in the previous two parts of the study, a widespread and fundamental change is taking place in the organisation of production and work, leading to a geographic decomposition of value chains—an increasing flexibility, heterogeneity, and versatility of work. These developments lead to new, more complex patterns of winners and losers, calling for a new policy response. At the same time, cities are becoming the centres of economic activity, with economic activity either spreading across many relatively small agglomerations or concentrating in a few large cities.

This calls into question the radius of national policies—and could have the effect of decentralising more tasks to the city level or centralising them to the EU- or global level. Policy has to deal with these developments. Finally, as a result of globalisation the world is becoming more integrated, which implies that policy in a small open economy has to adapt to developments in the world economy. This does not mean that there will be fewer options from which to choose than before, but that choices should be made with an open mind towards the world outside—and not in isolation. Good choices raise returns more than they did before, but bad choices will be punished more harshly in an integrated world. A credible but also flexible government is crucial for making choices and communicating these choices to its citizens.

This study has thus far stalwartly kept its focus mainly on the production side of the economy—and this will continue to be the case here. Basically, the goal is to optimise the production function of the Dutch economy. This involves the Netherlands as a place of business (Chapter 9), the Dutch knowledge economy as a catalyst for productivity (Chapter 10), and the future of the labour market as a source of vitality and flexibility (Chapter 11). Finally, Chapter 12 presents a general view on strategic policymaking in *The Netherlands of 2040*.

9 Place of business

'Here is a pleasant situation, and yet nothing pleasant to be seen. Here is a harbour without ships, a port without trade, a fishery without nets, a people without business; and, that which is worse than all, they do not seem to desire business, much less do they understand it.'
Daniel Defoe, *A Tour Thro' the Whole Island of Great Britain,* Letter 12.

The Netherlands is an attractive place of business—but will it also be successful in the future? This question is too broad to answer, as the determinants of an attractive business environment are numerous and complex. We focus here on two issues, and leave other questions for future policy analysis.[1] First, in a globalised world in which production may become footloose, or where face-to-face interactions may become more important, or where access to the worldwide knowledge stock improves economic outcomes, workers and firms need to be connected in one way or another. With regard to the place of business, this is true both within and between cities. Infrastructure plays a crucial role in establishing these connections. How should future connections be developed in the different scenarios, and what are no-regret investments? Second, market transactions require regulation (for example, property rights and coordination of transactions by international rules) to ease the flow of people, goods and services and knowledge across the world. However, regulation is also needed to safeguard workers' rights or to improve environmental outcomes. This latter type of regulation may frustrate international flows. So, both sides of regulation may either support or hamper economic activity. The question can then be expressed as follows: who should prepare regulation, and at what level—and who should supervise its fair execution?

The scenarios have several important implications for the place of business, which are summarised in the first part of Table 9.1. First and foremost, cities are increasingly important, but the size of the representative city differs in the various scenarios, from just over 100,000 in *Talent Towns* (TT) to many millions in *Metropolitan Markets* (MM). The density of these cities depends on both size and specialisation. Large cities drive up the value of land and stimulate high-rise buildings (see, for example, the evidence presented in Figure 4.6 for Brabant, and the development of Boston throughout history described by Glaeser (2005b)). Specialisation benefits from frequent face-to-face interactions, which are optimised in dense urban areas. Together, size and specialisation suggest that urban density is highest in *Cosmopolitan Centres* (CC) (large and specialised) and lowest in *Egalitarian Ecologies* (EE) (small and not specialised).

Cities are parts of larger networks, which is especially important in the case of specialisation. The reason is that interactions between different types of cities are needed to

[1] For example, the location decisions of firms depend on the location of other firms. These agglomeration externalities, discussed in Chapter 6, may call for all kinds of government intervention—such as the development of a business district, the creation of knowledge institutions and a well-functioning labour market. Some of these issues are discussed in the next two policy chapters; others are left for future policy analysis.

coordinate the production process. If all cities together produce a car, but the many parts are produced all over the world, coordination is crucial to maintain quality. Toyota's recent problems in delivering a high-quality car show how delicate this coordination process may be. These networks often exceed national borders (in TT), and even may turn out to have a global character (in CC). This requires a level playing field in terms of regulation, because differences in regulation are likely to be exploited by firms and workers. Both the size of the cities and their networks determine the exchange of goods and services, people and ideas within and between cities. In the move towards smaller and specialised cities in TT, the exchange of knowledge and intermediate goods between cities becomes more important. Networks are less important for relatively autonomous cities. In EE, networks are mainly needed for trade in intermediate inputs and consumption goods. MM cities function quite autonomously, and rely on the exchange of knowledge and intermediate products mainly within the city.

Table 9.1 Outcome and policy orientation

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Outcome				
City – size	100k - 200k	2m - 8m	100k - 500k	> 10m
City – part of a larger network	Continental	Intercontinental	National	Autonomous
Urban density	+	++	0	+
Exchange within cities	0	++	+	+++
Exchange between cities	++	+	+	0
Policy orientation				
Infrastructure within cities	0	++	+	+++
Public infrastructure between cities	Europe	Europe	National	0
Extent of regulation, at city level	+	++	+	+++
Regulation, between cities	national	continental	national	global

What is a promising direction for government intervention aimed at creating an attractive place of business? First, the size of cities as well as the degree to which economic activity is specialised has important implications for what the cities look like in 2040. Large cities in MM and CC benefit from high density. Neither the development of multiple centres nor an orientation towards diversified construction is efficient in these scenarios. These cities act as magnets in attracting economic activity. Specialised cities in CC and TT benefit from the exchange of ideas between specialised workers. A higher degree of specialisation implies that higher values are attached to interactions (Combes, 2000).

Public infrastructure should accommodate the exchange of goods, people and ideas, the flows of which are quite specific for each scenario. A sound urban structure is important in MM, because of its enormous size. Intercity networks are important in TT. Both a sound urban structure and high-quality networks of goods and services are important in CC and EE. Of course, part of this infrastructure can be developed privately, but the government will remain involved through investments in subways, roads, railways, harbours, airports and telecom

networks. The main reason is that infrastructure is a public good (at least to some extent), which comes along with high fixed costs. Individual private parties are unwilling to pay for these fixed costs, given that the return to the investment in infrastructure accrues to the society.

A complicated element for infrastructure networks is their cross-border orientation in CC and TT. The EU has a role to play in terms of the coordination of international investment projects, such as high-speed trains—but also in terms of the regulation of virtual connections and transactions. CC cities, in particular, also need intercontinental connections, which can be operated privately.

Cities become increasingly important, so regulation may be reoriented towards the city level. While this holds true for all scenarios, it is particularly the case for the large-scale and autonomous scenarios. The orientation of regulation at the city level may differ substantially. For example, MM city size is extremely high, and some cities will tend to be oversized (as individual citizens or firms have limited opportunities outside the city). Spreading activities across several cities is efficient, but requires coordination mechanisms to work appropriately. In this context, restrictive regulation might be welcomed once a substantial city size has been reached. In contrast, the CC cities tend to be too small: individual firms and workers base their location decisions on private costs and benefits, but tend to ignore the benefits for other citizens of concentration in specialised areas. Specialists do not take into account the positive knowledge spillovers they will encounter when clustering in a city. This suggests that regulation at the city level in CC needs to support additional city growth to reach a minimum efficient scale to develop new technologies.

Finally, environmental regulation, trade negotiations and other types of cross-city regulation require some sort of coordination. The stronger the interrelations between cities, the more important this coordination tends to be. It needs a continental or global scope in the CC scenario, in which the EU might play an important role. The EU will be less relevant in MM, where either regulation at the city level or global coordination is the appropriate level of regulation. Finally, nation states continue to be the first-best unit of coordination in TT and EE. Nation states are able to bundle the interests of these types of cities to reach a minimum efficient scale. The role of provinces diminishes in all scenarios—either because the size of cities exceeds provincial borders, or because coordination at the national or European level is first best.

9.1 Mobile factors and attractors

To determine the scope for government intervention it is crucial to identify the factors that attract economic activity and to distinguish the mobile production factors in each of the four scenarios. Mobile factors demand connections, whereas attractors warrant local support.

The easiest way to understand the distinction between attractors and mobile factors is to ask whether the presence of this factor is crucial (or very important) in the development and existence of the city, or could it easily be demanded from abroad? In answering the question,

we focus on reasons why business activity eventually clusters in each of the scenarios, with firms benefiting from proximity to workers, access to a pool of ideas and the availability of demand. Other determinants of attractive cities, such as culture, entertainment and shopping centres, are not considered to be of immediate relevance for investigating the production side of the economy. The mobile production factors and attractors of each scenario are summarised in Table 9.2.

Table 9.2 **Attractors (A) and mobile production factors (M) in each scenario**

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Workers	M	A	M	A
Ideas	M	A	M	A
Demand	M	M	A	A

Workers

Large cities attract workers. The CC scenario features clusters of specialised workers who benefit from day-to-day interactions. The outside options for these specialists are poor, as they have to move and retrain simultaneously. The outside options for MM workers are worse, as the hinterland is quite poor and other big cities tend to be relatively far away and may be overcrowded. This suggests that MM and CC citizens alike are tied to the place of business and stay in large cities.

The outside options for TT and EE workers are much better: there are many cities around offering good job opportunities and affordable homes. Workers are likely to move between cities as economic circumstances change.

Ideas

Large cities contribute to economic efficiency by producing goods and services, but also to the efficient production of knowledge. There are two mechanisms by which knowledge is produced. First, the concentration of firms in the same industry stimulates knowledge transfers between workers and firms with the same specialisation, and facilitates innovation and growth. Employees from different firms in an industry exchange ideas about new products and new ways to produce goods: a higher concentration of specialised employees in a given location allows more opportunities for exchanging ideas that may lead to productive innovations. This effect is important in CC. Second, knowledge spillovers also occur among heterogeneous workers and industries. A diverse urban environment encourages innovation because it encompasses people with varied backgrounds and interests, thereby facilitating the exchange of ideas among individuals with different perspectives. This exchange is likely to lead to the development of new ideas, products and processes. This effect is important in MM. Both types of spillovers are strengthened by the fact that new GPTs will arrive in these scenarios (see Chapter 7).

In the small-scale TT and EE cities, the exchange of ideas (and intermediate inputs) occurs between, rather than within, cities. Direct knowledge spillovers are of less importance because the level of technological change is lower, with no new GPT arriving.

Demand

Demand for output determines the location of firms. A wide range of tasks is performed locally in MM, which implies that consumers will be served primarily by incumbent firms. This makes the city more attractive for both workers (as consumers) and firms. In CC, a fraction of all tasks is performed locally, though on a large scale. Basically, a set of specific tasks is monopolised by the centre. This implies that many intermediate goods and services will be traded. In terms of consumer service, market location hardly matters. A similar distinction holds between TT and EE, where in the latter case significantly more goods and services are produced locally.

9.2 Infrastructure

The exchange of goods, people and ideas depends on connections. The effectiveness of connections, in turn, depends on the quality of the infrastructure, defined as the system of public works in a city or country. Infrastructure encompasses both local roads and highways, both trams and intercity trains—and also includes harbours, airports and fibre optic cables.

9.2.1 Scope for government intervention

Public provision of infrastructure can be motivated on several grounds. First, much of the infrastructure has features of a public good. Roads and bridges are often publicly available, which means that users cannot be excluded but are able to ‘free ride’. To some extent, the use by one driver does not necessarily limit the use by another driver. In principle, road pricing can privatise this public good, but this demands not only a kind of toll system, but also sound information about users’ willingness to pay—and often the presence of monopolies in order to be able to profitably exploit the infrastructure. Secondly, cities exist because workers and firms benefit from clustering. The analysis in Chapter 6 shows that the size of cities depends on the balance between the gains of clustering (agglomeration economies, such as knowledge spillovers) and the costs (scattering forces, such as congestion). Connections within and between cities affect both gains and costs. The trade-off between gains and costs of sitting together in one place plays an important role in the development of cities and in the optimal distribution of production across space. Thirdly, infrastructure often involves externalities, of which network externalities are the most relevant. By improving the connection between two cities, one may affect the value of the connections with third cities; private parties do not take this effect into account. Finally, infrastructure exhibits high investment costs, which are both sunk and fixed. Were infrastructure to be provided privately, this fixed-cost nature would give substantial market power to the investor. This final reason for government intervention has to strike a balance between commitment and flexibility: commitment to deal with the complex

externality of collecting information and providing public goods, and flexibility to seize upon new developments and trends.

9.2.2 Trade-off in infrastructure policy: commitment versus flexibility

The main trade-off for public investment in infrastructure is between long-term commitment and flexibility. Large and sunk investments might be necessary for credibly improving the business climate and attracting private investors. Both private and public investments are long-lasting and benefit from commitment. The future has yet to unfold, however, and is inherently fraught with uncertainty for both private investors and policymakers. Currently, sound decisions about infrastructure might be subject to change. Huge investments with high sunk costs limit the flexibility to adjust to changing economic conditions. Yet, the span of time between decision-making and delivery necessitates that the relevant decisions be made today.

Baldwin (2009) argues that it becomes harder to predict the winners and losers of global competition. Integration of our economies together with advances in ICT has flattened the world in the sense that we are trading tasks, not final goods. It implies that production is often part of a larger chain, which is beyond the control of firms and policymakers. Small changes and differences in prices may lead to radical changes in this global supply chain. Related to this are sudden shocks. Activities that are incontestable today become contestable tomorrow and may leave the country the day after. This uncertainty and suddenness calls for policymakers to exhibit a kind of flexibility that comes at the expense of their credibility and commitment.

9.2.3 Two types of connections

In considering matters of infrastructure in the four scenarios, it is useful to distinguish between infrastructure within and between cities. The first type of infrastructure benefits local production processes and facilitates transport within cities. It aims to improve local production facilities and to overcome local congestion. Key examples are industrial estates and the underground. The second type of infrastructure improves the connections between cities and facilitates the exchange of goods, people and ideas at a distance. Key examples are the development of airports, high-speed train lines, harbours and fibre-optic cables.

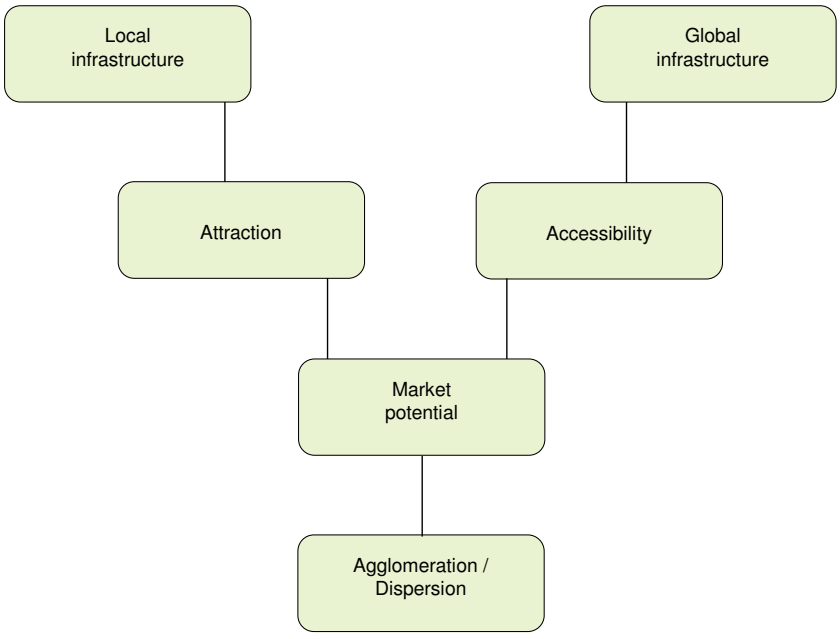
The distinction between attraction and mobility, as summarised in Table 9.2, guides our analysis. Attractors demand local investment and mobile production factors benefit from connections. So, cities should invest locally in their attractors. These investments draw business activity and workers, attract knowledge and stimulate innovation, and solve bottlenecks in local mobility and in the availability of facilities. Moreover, the returns to these investment projects will, to a large extent, accrue locally and can be taxed locally.

The economy as a whole benefits from mobility, both internationally and between cities. Bottlenecks in the exchange of goods, people and ideas hinder economic development. Infrastructure projects in support of the mobile production factors are therefore conducive to growth—conditional, of course, on being cost-effective. This is an example of a positive externality from public infrastructure, leading to more competition between producers located

in different regions and to thicker labour markets. This economy-wide effect cannot be captured by a private investor, but warrants public intervention. However, a warning should be made at this point, as the benefits of better access may be very unevenly distributed. Connecting two cities may benefit both—but may just as well lead to the growth of one at the expense of the other. For example, the Portuguese government has invested heavily in road networks, increasing the motorway network from 234 to 1,393 kilometres between 1985 and 1998. Although the investments were meant to stimulate economic activity in the remote Portuguese regions, Lisbon benefited primarily from the fall in transport costs.

The argument that connecting two cities may benefit both or only one was nicely summarised by Ottaviano (2008). Figure 9.1 shows that local infrastructure benefits attraction and global infrastructure stimulates accessibility. Both improve the market potential of cities or regions. Market potential measures the potential demand for products and services in a market. It depends on the proximity of both consumers and competitors, and is determined by the size of the home market and the proximity to other markets. Market potential improves—but whether this leads to agglomeration or dispersion is an open question. In the case of Portugal, it led to agglomeration of economic activity in the Lisbon area, where about a third of the Portuguese population resides.

Figure 9.1 Attraction and accessibility



Source: Ottaviano (2008).

9.2.4 Connections in the scenarios

The connections for workers, ideas and trade in final goods and services are specific to each of the four scenarios. Table 9.3 summarises what types of connections fit best in each scenario.[1]

Table 9.3 Connections for workers, ideas and final goods

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Workers	Continental	Local and global	National	Local
Ideas	Global	Local and global	Global	Local
Final goods	Global	Global	Continental	Limited

Talent Towns

In Talent Towns, connections are essential to facilitate the exchange of information, the trade in intermediate and final products and to a smaller extent to facilitate the mobility of people. Especially virtual connections to support specialised teams from all over the world are beneficial for attracting economic activity. Local investments might be needed to support specific local production processes, but in this very dynamic scenario, it is highly questionable whether these local investments will pay off or contribute to a city's value added. Connections, in contrast, do pay off. If TT materialises, the Netherlands needs to be a network of small-scale cities operating in a worldwide network of similar cities.

Cosmopolitan Centres

Connections between cities are important for the development of Cosmopolitan Centres. International support for the mobility of goods, people and ideas between cities improves the functioning of the whole economy. It facilitates the development of large cities and allows the economy to grasp economies of scale. However, it is unclear which city will benefit, as some may attract specialised workers and prosper, while others are unable to do so and decline. Individual cities lack the incentive to improve intercity connections for people. In this scenario, local infrastructure supports or facilitates local economies of scale by investing in local facilities. If CC becomes reality, the Netherlands has to develop a limited number of highly specialised cities. Improving the networks between these cities will be important because specialised cities cannot operate in isolation and are part of larger global supply chains.

Connections not only require infrastructure, but also depend on international regulation. Open borders for high-skilled immigrants complementing the existing expertise are crucial. The EU should arrange a level playing field for this—both internally and with other (groups of) countries. Currently, even with the EU in place, it is hard to transfer pension rights and to obtain working permits when more than two countries are involved. This frustrates migration of specialists and high-skilled workers.

[1] The summary follows from Table 9.2's discussion of attractors and mobile production factors and the several exchanges within and between cities in Table 9.1.

Egalitarian Ecologies

Local infrastructure supporting the liveability and local mobility of workers benefits local people and stimulates the local economy. Crucial for the functioning of the economy is the ability to have access to the global knowledge stock to produce local varieties of goods with state-of-the-art technologies, which demands high-standard telecommunication networks. Production in EE depends on the international trade of intermediate inputs for local production, which requires not only harbours and airports, but also reliable international relations. In this scenario, large cities are under pressure. Investment policies should be diversified, with the risk of being incoherent.

Metropolitan Markets

In this scenario, investments in infrastructure benefit the city, which is the attractor of a wide range of productive activity. Local investments in any kind of infrastructure, aimed at the mobility of goods, people or knowledge, are important. But even linkages between the city and the surrounding region encourage firms to cluster, produce jointly and serve distant markets from the central city. In fact, it is very hard for the government to stimulate the economy of peripheral cities because MM acts like a black hole absorbing all economic activity and all workers from the periphery. Its development seems to be consistent with the Portuguese example of Lisbon described above. Intercity investments enforce competition on the peripheral markets, which can be served more easily from the central city. And even local infrastructure in the peripheral regions hardly stimulates the local economy, as firms are unwilling to leave the central city. Economies of scale in the mega city dominate the location decisions of firms and workers.

In Metropolitan Markets, the Netherlands should develop the Randstad into an integrated city able to compete with large European cities, in the first place, but also with similar cities in other parts of the world. Public investment can primarily be targeted at improving the local network in the Randstad. Linkages with the other regions in the Netherlands and even with foreign MMs are of secondary importance.

9.2.5 No-regret: invest in urban quality

In all of the discussion about connections, one might forget the public investment that must occur in local infrastructure, buildings, sewage systems, theatres and so forth. Given the growing role of cities in the future of the Dutch economy, the quality of cities might be decisive in the international competition for headquarters, research departments and other high-skilled commercial activities. Of course, the way to improve the quality of the infrastructure will differ from city to city and from scenario to scenario, and deserves further consideration.

9.3 Regulation

Regulation is an important determinant for the location of economic activity. On the one hand, business activity depends on the regulation of contracts, financial transfers, property rights, patents and so forth, without which economic transactions become too expensive because of exorbitantly high contracting costs. On the other hand, regulation may restrict business activity—often because other socially desirable goals are pursued, such as the protection of workers or reduction of greenhouse gas emissions. We briefly consider both sides of the coin and discuss the implications in each of the four scenarios.

According to Nobel Prize laureate Douglas North (1994), institutions are pivotal. Defined as the "rules of the game", institutions provide the rules under which not only governments, businesses and employees, but also social organisations (such as trade unions, schools, churches, mosques or synagogues) operate. In addition to the rules, the players (or "organisations" in North's terminology) are also important. Businesses face great uncertainty if property rights are poorly protected, if contracts are difficult to enforce, if governments are corrupt or if they can arbitrarily jack up taxes on profits. In short, uncertainty can be reduced with well-designed and efficiently run institutions. The reduction of uncertainty helps to improve the investment climate and can thus promote economic growth.

Employment protection legislation (EPL) supports long-term relationships between firms and workers. This has pros and cons for both parties. For example, EPL stimulates firm-specific investments in human capital, which benefits both firms and workers. While it limits the flexibility of firms to fire workers, it also prevents firms from adjusting well to changes in labour-market conditions. EPL protects insiders (those with a job) from being fired, but reduces the hiring rate and labour-market options for outsiders. Consider a firm that dislikes EPL and prefers flexibility. This firm is willing and able to move its activities if EPL differs across TT and EE cities, which implies that EPL must be instigated at a national or even supranational level. In contrast, firms in MM and CC cities will hardly respond to stricter EPL, which reduces the need for coordination at a higher level of decision-making.

Environmental protection is (presumably) in the interest of society at large, but is not necessarily in the interest of individual workers and firms. As a consequence, individual firms and workers have an incentive to avoid strict environmental regulation and relocate to cities or countries with permissive rules. Again, in scenarios featuring mobility of either firms (TT and EE) or workers (CC), strict environmental regulation may depress economic activity. In these scenarios, (international) coordination is needed to protect the environment.

Policy has to strike a balance between the conflicting aims of regulation. A crucial question is at what level: locally, nationally or even internationally. This principle of subsidiarity guides us in this issue.

9.3.1 Subsidiarity

Subsidiarity is about the appropriate level of decision-making, which involves a careful assessment of the optimal level at which decisions should be taken (see Gelauff et al., 2008 for an overview and a number of applications). The local level is appropriate for many decisions in the absence of externalities and economies of scale in the decision-making process. Examples are decisions on local infrastructure, local taxes and facilities. Given the trend towards urbanisation, where economic activity prospers in local concert, more and more autonomy might be handed over to cities.

However, in the context of externalities and economies of scale, decision-making at a more central level might be more efficient. This applies to investments in infrastructure between cities and between countries; it applies to the coordination of tax and regulation policy in the scattered scenarios (TT and EE); it applies to education policy, where uniformity in certificates may improve the mobility of high-skilled workers; it applies to welfare states, where risk-sharing between workers in different cities is more efficient, and so forth.

9.3.2 Subsidiarity in four scenarios

If coordination is needed, what is the appropriate level? Table 9.4 summarises the level of coordination that is most efficient in each of the scenarios.

Table 9.4 Subsidiarity: what governance level should regulate economic behaviour?

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
City	x	x	x	x
Province				
Country			x	
European Union	x			
Global institutions	x	x		

Talent Towns

Next to the city, the EU and global institutions such as the WTO will become important in Talent Towns. In this scenario, the world is flat, and nearly everything is footloose. Firms easily move from one city to another—not only within the Netherlands but also internationally. Moreover, firms attract their ideas and intermediate inputs from all over the world. Supranational rules are important in creating and sustaining a level playing field. The EU level or the federal level in the US suffices for many types of regulation, such as employment protection and the regulation of business services. Countries in TT will search for bridges to strike trade deals with others. International trade and financial markets, in particular, may be regulated globally.

Cosmopolitan Centres

Next to coordination at the city level, global coordination is essential in Cosmopolitan Centres. Cities are big enough to perform many public tasks locally, but the large and specialised cities strongly interfere at the global level. They demand each other's input and compete against each other. Only global coordination via organisations like the WTO and the IMF can sustain a level playing field. These organisations become more powerful. Nation states should transfer responsibility to make efficient trade possible. It is also important that more countries join these organisations—to construct a worldwide level-playing field for all kinds of transactions.

Egalitarian Ecologies

Next to the city, the nation state seems to be the most appropriate level of coordination in Egalitarian Ecologies. The nation state may levy taxes, and provide regulation and investment in infrastructure without bothering too much about the international context. International spillovers are limited and economies of scale exceptional. Global coordination likely fails because too many parties have competing interests and none of them can credibly take the lead. For international trade it is important that the current international institutions remain in place, despite the fact that countries will have a tendency to produce more on their own.

Metropolitan Markets

In Metropolitan Markets cities rule the world—their own world first and foremost. The independence of cities is very large; they may regulate many issues locally. Global coordination plays a supplementary role in this scenario. Global cities communicate with each other; they are the G20s of the future. Just like the G20, this coordination occurs on demand, infrequently and with the full commitment of all parties. Small-sized cities have limited influence in this scenario, and have to accept the rules set by the biggest players.

9.3.3 No-regret policies

In all scenarios, cities become increasingly important, so regulation may be reoriented towards the city level. While this holds true for all scenarios, it is particularly true for the large-scale and autonomous scenarios (MM). Of course, regulation across cities will always be needed, especially in the scenarios with specialised and small-sized cities (TT). The stronger the interrelations between cities, the more important coordination will be. Nation states, the EU and international organisations may organise this coordination, but the role of provinces diminishes in all scenarios—either because the size of cities exceeds provincial borders, or because coordination at the national- or European level is first best.

10 Knowledge economy

'Knowledge will forever govern ignorance; and a people who mean to be their own governors must arm themselves with the power which knowledge gives.'
James Madison, third president of the United States.

The history, facts and trends set forth in Part I underscore one of its main conclusions: knowledge has mattered, continues to matter and will matter even more in the future. Knowledge is crucial for development because it leads to better production technology and new products. Better production technology improves outcomes; new products satisfy consumer demand. The inputs in creating knowledge are education, science and innovation. Knowledge creation comes with knowledge spillovers to outside firms or rent spillovers to consumers, which could limit the incentives for private parties to engage in knowledge production. In addition, asymmetric information in the form of signalling and coordination problems could lead to finance restrictions, when financiers have insufficient insight into risks (adverse selection), or to insufficient cooperation in the market.[1] These market failures constitute the main motives for policy intervention in the knowledge economy. Yet, often the government struggles with the same problems as private parties do. For instance, information asymmetries exist not only among private parties, but also between policymakers and private parties. Hence, policymakers often have to deal with trade-offs. A major trade-off concerns the issue of whether policymakers should or should not act: policy may seize upon opportunities to resolve market failures, but it has to avoid wasting resources when private parties take advantage of policy by exploiting information asymmetries.

Knowledge features prominently in all scenarios, but it develops in different ways, as shown in the first part of Table 10.1. The arrival of a new general-purpose technology (GPT) distinguishes the CC and MM scenarios from the TT and EE scenarios. The GPT makes innovation more fundamental and research based—either through partnerships between universities and firms in CC, or through extensive research facilities within firms in MM. In contrast, applied innovation processes characterise TT and EE, building on a further expansion of ICT, which is the current GPT (see also Chapter 7). The division of labour and the associated spatial patterns distinguish the TT and CC scenarios from the EE and MM scenarios. The high degree of specialisation in TT and CC demands specialised workers. Because workers with a particular specialisation work and live together, these scenarios benefit from knowledge spillovers among similar workers. In contrast, in the generalised EE and MM scenarios, knowledge flows primarily between different types of workers.

[1] Another market failure in this area is market power. Market power can lead to exorbitant entry costs and too-low incentives for incumbent firms to innovate. We abstract from market power in the present study because its effect is rather limited, relative to the importance of spillovers and information problems.

Table 10.1 The knowledge economy: outcome and policy orientation

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Outcome				
GPT	0	Research oriented	0	Application oriented
Knowledge	Specific	Specific	General	General
Knowledge spillovers among	Similar workers	Similar workers	Different workers	Different workers
Innovation	Direct applications, strong competition	Radical, firm-university linkages	Applied and incremental	Fundamental and applied, within firms
Policy orientation				
Education	Specialised	Specialised	Broad	Broad
Science	Utilisation	GPT	Utilisation	GPT
Universities	Specialised	Specialised	Broad	Broad
Public-private cooperation	0	+	0	0
Innovation subsidy	+ / specific	++ / specific	+ / generic	0
Innovation credit	+	0	+	0

The structure of the knowledge economy in the scenarios has implications for the orientation of policy in the fields of education, science and innovation. Workers need a broad education if generalisation rules the world (EE and MM scenarios), whereas with specialisation (TT and CC) they need highly focussed education in which excellence pays off in their fields of specialisation. In tertiary education, this specialisation in TT and CC is in line with the scientific specialisation of universities. Utilisation-oriented scientific research at universities supports the applied innovation processes in TT and EE. Development of the new GPT demands high-quality fundamental science, particularly in CC, where strong public-private interaction between scientific research and innovation by firms moves the GPT forward.

Innovation policy has two main orientations: subsidies that encourage firms to invest in innovation and public credits that solve credit constraints in financing innovation. In the TT scenario, firms innovate close to the market in a highly competitive environment. Policymakers may to some extent support innovation with specific subsidies targeted at the specialisation of a particular talent town, taking into account the risk that subsidies leak abroad. That risk is much smaller in the larger and more autonomous CC scenario, where considerable knowledge spillovers warrant extensive specific subsidies. In contrast, generic subsidies, such as tax deductions for wages of researchers, support firms in the generalised EE scenario. Moreover, the predominantly small- and medium-sized firms in TT and EE may find it difficult to obtain funds to finance innovation. That calls for public support—for instance, through seed capital that fits in the elaborate venture capital market in TT, or through public innovation credits that complement the bank-oriented capital market in EE. Finally, MM cities needn't worry about developing any special innovation policy, as MM firms generate most knowledge inside their research facilities. The limited knowledge spillovers enable them to appropriate most of the returns. Moreover, firms finance innovation from retained earnings and have excellent access to the capital market.

Before discussing the scope for government intervention and policy options for each of the pillars of the knowledge economy (education, science and innovation), we first briefly present the structure of the knowledge economy.[1] This structure reveals that education, science and innovation are strongly related and complementary. Policies addressing education should also take into account the consequences of these interrelations for the design of science and innovation policies.

10.1 Ideas and people

Ideas and people are the two major ingredients for the knowledge economy. Firms use ideas to improve upon their production process and to design new products—or even new product varieties. Of course, it is people who develop ideas into new technologies and implement these in the production process, and who think up new ideas. In that sense, ideas seem to be directly linked to people. Still, it is necessary to closely distinguish both inputs in production and innovation, since ideas may move between people in various ways. Indeed, flows of ideas constitute one of the main channels of knowledge formation—and thus of technological and organisational progress.

The functioning of the knowledge economy and the motives for public policy depend upon the degree to which ideas are linked to people or to firms. In their most abstract form, ideas closely resemble information. Ideas exist independently from people; they can be fully *codified* in some information carrier (a computer file, for instance). Examples include blueprints for a machine or a scientific article. The central characteristics of these codified ideas are that they are non-rival and non-excludable (i.e. these ideas are public goods). Non-rival means that in contrast to most products, an idea does not depreciate when it is used again and again. Romer (2010) describes non-rivalry of ideas as follows: "If you can explain it on the phone, present it in a lecture, describe it on paper, or send it over the Internet, it is non-rival. The formula for a new pharmaceutical is a non-rival good." Excludability is defined as the degree to which the owner of the good can charge a fee for its use. For example, laws allow for patents that make the formula for a new AIDS drug partially excludable. So, for a limited period of time some usage of the formula to manufacture the drug is not permitted without the permission of the owner. Permission can be granted by licensing, for example.

The codified character of ideas implies that they are globally available for anyone with access to information carriers. However, putting ideas into practice often requires that people add a considerable amount of *tacit* knowledge. In contrast to codified ideas, tacit knowledge resides in the minds of people. Someone may easily distribute a blueprint or a scientific article over the Internet, but the ability to understand its contents is something completely different. Such understanding often requires a lengthy education or training before people have built up sufficient tacit knowledge to be able to absorb and apply ideas. In particular, at the forefront of

[1] CPB (2002) provides a detailed background report about the economics of the knowledge economy and the many trade-offs involved for policymakers. Here we focus on the most pressing ones from the perspective of the scenarios.

science and innovation, picking up ideas from the global stock of ideas often only succeeds if people are engaged in that kind of research themselves, so they can understand the jargon and put the ideas in perspective.

An economy that operates in high-end manufacturing and service production needs outstanding knowledge inputs. It needs high-skilled researchers, who are able to create new and valuable ideas both in science and in innovation. It also needs access to the global stock of ideas, and experts who manage to transform these ideas into new or better products, more efficient production processes or organisational improvements.

This perspective explains why education, science and innovation constitute the pillars of a country's knowledge economy and why they are interrelated. The purpose of education and training is to equip people with such a degree of tacit knowledge that they have the potential to create new ideas or absorb a part of the exiting knowledge base and apply ideas from the outside. Using the tacit knowledge of researchers and the scientific knowledge base, science generates fundamentally new ideas that often require considerable evolution to be practically relevant. Innovation mainly concerns the combination of scientific, practical and organisational ideas with tacit knowledge that resides both in the minds of workers and in the culture of a company to devise new products or new production processes.

10.2 Education policy

Education involves an investment decision. Society and young people invest money, effort and time now to obtain higher wages in the future. Education policies concern not only the quantity of money spent on education, but also the timing of that spending and the quality of education provided. Timing matters, because education is a cumulative process: skills obtained early in life increase the ability to acquire other skills in the future. High-quality education raises the return on educational investment. Before turning to education policy in the scenarios, we briefly discuss the motives for government involvement with education. Next, based on the outcomes of the scenarios, we single out the most important trade-offs that policymakers face when they consider educational policy in the future. That leads to scenario-dependent policy options. We finish with some no-regret policies that look favourable in all scenarios.

10.2.1 Scope for government intervention

Why should governments finance education? Basically, education is a private good because it is excludable (admission can be refused) and rival (a teacher can spend his time only once). However, individuals do not take into account the full benefits of their investments on society at large; this leads to educational investments that are too low. These social benefits are twofold. First, a higher-educated workforce is better able to explore ideas, adopt new technologies, benefit from the world's knowledge frontier and cope with social problems, such as crime. This constitutes an efficiency argument for the intervention of policymakers. Individuals also face uncertainty about the outcomes of their educational choices, which can lead to suboptimal

levels of investment, as well. Credit constraints and incomplete markets for student loans are reflections of these uncertainties. Second, prevention of social deprivation is an important target, from an equity point of view. Education lowers income differentials, improves people's health and strengthens social cohesion. Many educational policies use the equity argument for government intervention.

10.2.2 The trade-off in education policy: generalisation vs. specialisation

The basic trade-off is between general- and specific education at primary, secondary and tertiary education. General education is important in the EE and MM scenarios; tailor-made education is important in TT and CC. Table 10.2 summarises the trade-offs for education.

Table 10.2 Trade-offs in education

	Specialisation (Talent Towns and Cosmopolitan Centres)	Generalisation (Egalitarian Ecologies and Metropolitan Markets)
Primary education	Early selection	Accessibility
Secondary education	Vocational schools	High schools
Tertiary education	Excellence	Accessibility

Primary education

At the primary-school level, the choice between specialisation and generalisation implies acknowledging heterogeneity or stimulating homogeneity in the education of pupils.

Acknowledging heterogeneity in Talent Towns and Cosmopolitan Centres implies early selection to create different levels of classes. Based on early-age test scores, schools place high-ability pupils together in a class. The pace of teaching then approaches the pace at which average-ability pupils learn instead of the pace of the lowest-ability pupils. This speeds up the learning of the high-ability children, who do not have to wait for new instructions but can go on. Working together is also very important when specialisation is important. The emphasis should be on performing tasks in teams rather than solving problems individually. The costs of early selection are that low-ability children benefit, in general, from the presence of high-ability children—so that selection lowers their performance. Specialisation emphasises within-cohort inequality in schools. As a consequence, elite groups might appear—which could lead to social tension.

Stimulating homogeneity in Egalitarian Ecologies and Metropolitan Markets calls for accessibility in the form of mixed-ability classes. Low-ability children perform better because they are not denied access to the positive influence of high-ability children. Consequently, they also perform better in the generalist teams that inhabit the EE and MM worlds. In addition, a system based on mixed-ability classes benefits from a government policy that defines a general learning target for everybody and provides means to reach that target. Such a system creates the

possibility for a broad range of children to obtain a basic level of education and qualify for advanced schooling.

The trade-off between early selection and accessibility falls within the basic trade-off between equity and efficiency. Accessibility promotes equal opportunity for all, whereas selection enhances education according to ability. Ultimately, the choice for efficiency or equity is a political one, but the choice for equity in the TT and CC scenarios leads to relatively high underperformance of high-ability pupils and fewer prospects for firms to compete successfully with high-quality specialised teams.

Secondary education

At the secondary-school level, the basic trade-off means early selection, specialisation on future tasks and on-the-job learning by apprenticeships versus a broad and homogenous high-school system followed by modest specialisation on the job.

Early selection increases specialisation in TT and CC, in terms of both levels (inflow from primary school) and types of education. The education system needs to be decentralised in order for local communities to determine their own educational needs. Because of early specialisation, students might regret choices and face switching costs. Schools should have incentives to prevent dropouts by penalising dropping out and by rewarding excellent academic performance. Together with mandatory publication of student achievements and assistance in their initial career steps, this intervention increases the transparency and durability , respectively, of performance across schools, which is likely to foster educational quality. Towards the end of the curriculum it is important to combine work and school via apprenticeships. This stimulates students to gain experience in working in specialised teams and to deepen their type of specialisation. The high-ability students move on to university instead of doing apprenticeships.

A broad and homogenous high-school system, such as is presently in place in the US, is effective in EE and MM scenarios. Schools are homogenous and the central government plays a major role in setting standards for education and school inputs. Towards the end of the curriculum, internships might help students to select a job. Secondary education will be broad, and students who would like to go to university opt for a more theoretical curriculum, whereas students focusing on obtaining jobs pursue a more practical curriculum.

Tertiary education

At the tertiary level of education, specialisation in TT and CC focuses on the creation of excellence. Incentives and competition are maximised and universities select the best students. In particular, competition on a European scale, in line with the European Research Area in science (see Section 10.3.4), boosts excellence. The best universities are likely to charge the highest tuition fees, and students pay for their own education. After a bachelor education, the focus is on PhD trajectories or advanced master programmes aimed at further specialisation. The PhD trajectory is theoretical and comprises a considerable amount of high-level scientific

education, while the master programmes prepare students for private-sector jobs by providing targeted and specialised training. Master programmes are specialised, and not all universities offer the same programmes.

Accessibility is important in EE and MM. Universities have to set minimum standards and are controlled by the government, both in terms of their budgets and the quality of education. In these worlds, universities charge the same tuition fees and there is no selection of students. All universities supply a similar package of master programmes.

10.2.3 No-regret policies

In all scenarios the level of human capital is increasing around the world, and emerging economies are narrowing the gap in world income distribution, which implies that competition is on the rise (see also facts 7, 8, 9 and 10 in Chapter 3). It becomes increasingly expensive to repair the lags in development of countries that fall behind, and top-class education increasingly becomes an asset for countries specialising in high-end manufacturing and services. In a global world, the room for redistribution through progressive taxes becomes smaller—and the benefits of policies to prevent people from falling behind rise. In terms of educational policies, we observe three areas for which new investments are efficient, regardless of the scenarios: investment in the very young, investment in English language training and investment in good teachers.

Investing in the very young

The increasing importance of human capital and the higher costs of repairing knowledge deficiencies make it increasingly essential to invest in the very young. The rate of return to a dollar of investment made while a child is young is higher than the rate of return to the same dollar made at a later age (Cunha et al., 2006). Especially preschool investments in human capital have a high rate of return (Heckman, 2007). This implies that children from families with a weak social background, who run a large risk of falling behind, should be targeted in particular for participation in specially designed preschool programs. It is often difficult to reach these families, however, and to encourage parents to have their children join a program. Should this prove a real hindrance, then lowering the compulsory education age to three would be an effective way to reach the entire target group. This offers the additional advantage that the quality of compulsory education may exceed that of day-care, provided that the introduction of compulsory education coincides with investment in highly qualified teachers and methods suited to the very young (Datta Gupta and Simonsen, 2010). In that case, all children would benefit from playing in a rich and stimulating learning environment with qualified teachers who monitor their cognitive and social development. For this policy to pay off to society, the benefits of reaching the target group and a providing higher quality education should exceed the costs of the necessary investments. The high returns to preschool investments contribute to a positive outcome of this social cost-benefit assessment.

The reasons for the high returns to early preschool investments are twofold. Firstly, early investments are harvested over a longer horizon than those made later in the life cycle. This was shown by Becker (1962) and later in a dynamic version by Ben-Porath (1967). Secondly, and more importantly, because early investments raise the productivity of later investments, human capital is a cumulative process. Learning begets learning, because skills acquired early on facilitate later learning—and this is true not only for formal schooling, but also for the effectiveness of on-the-job learning and training. The cumulative effect is boosted by the fact that young children are more malleable with regard to cognition and behaviour than are adolescents or adults (see also Heckman and Jacobs, 2010). Thus, inadequate investments early on have a level effect on the future accumulation of human capital and a continuing effect over the life cycle. In order to compensate for early deficits later on, huge investments will need to be made at great costs—in terms of both loss of income during reparation and the cumulative loss up to the point of remediation.

The benefits of early interventions manifest themselves not only in higher wages or economic success, but also in terms of behaviour. Ample evidence suggests that foregone investments at early age limit social and emotional competencies that make learning at later ages less efficient—and therefore harder and less likely to continue (Borghans et al., 2008). Differences between children become apparent already in the first eight months of enhanced pre-school education (Fryer and Levitt, 2006). Next to genetic differences at the time of birth, differences in nurture and environment at young ages also have a strong and long-lasting impact on social outcomes. These findings have been confirmed by research in psychology and neurobiology that show that early experiences are crucial for the development of the brain and child behaviour (Nelson, 2000 and Knudsen et al., 2006). The first four years are characterised by rapid development of fundamental capabilities on which children build their future human capital. Next to enormous developments in language and cognitive skills, children develop emotional, social and normative capabilities during this period. Productive early environments therefore lead to fewer social problems (such as crime) and behavioural problems (such as misconduct in school, smoking, drug use and alcohol abuse) (Segal, 2008 and Urzua, 2008).

Investing in English language training

Knowledge stocks and flows are becoming increasingly international. The ability to contribute to the knowledge economy—in terms of both ideas and skills—implies that communication in English is crucial. While it's not unthinkable that Chinese language training will become necessary, most of the Chinese contributions to the worldwide knowledge stock are presently in English. And, with the development of India, the South-Asian economies and South-America, it seems likely that English will remain the dominant international language. In all of our scenarios, people are contributing to and making use of the worldwide knowledge stock for production and development. This applies not only to high-educated workers, but also to blue-collar manual workers, who have to be able to read manuals for operating machines and communicate with colleagues and headquarters all over the world. Only local service workers

are likely to be unaffected by the globalisation of knowledge. However, also from a societal point of view, people will benefit from having a good working knowledge of the English language. The Internet is dominated by English web pages, and anyone who wants to remain connected will find it essential to be able to read and understand what is going on.

Children at early ages are sensitive to developing language skills. This means that their education in different languages should already start in primary schools. In this malleable period of brain development, language can be incorporated in the curriculum in several ways. Incorporation of English in the current curriculum can be established without additional investments in specific English language teachers. English can be included in the ordinary curriculum by teaching some courses (partly) in English and by exposing children to teaching materials in English, such as accessible educational television programmes or games. As such, this change would not necessarily involve specialised training of primary school teachers.

Improving the quality of teachers

Many measures have been taken to raise the quality of education. Hanushek and Kimko (2000) demonstrate that quality differences in schools have a dramatic impact on productivity and national growth rates. To assess the effects of these measures, a great deal of attention has been directed at inputs—particularly those perceived to be relevant for policy (such as school resources or characteristics of teachers). The available evidence is mixed (see Hanushek, 2003, for a review of 90 studies, and Hanushek and Rivkin, 2010, for an update), and the conclusion of much of the research is that not many measures improve outcomes.

What has been established is the following. Despite the many difficulties in measuring teacher quality and educational outcomes (which has resulted, by the way, in a strong debate in the economic literature about the validity of measures), teacher quality noticeably matters for educational outcomes. In the Netherlands, the level of education of teachers has been falling over time, and the uproar in the news some time ago in reaction to the dismal performance of future teachers with regard to math and languages suggests that teacher quality in primary and secondary education may be falling. Research indicates that teacher performance may be improved by providing incentives for good performance, such as performance-related pay for individual teachers or for teams. Performance pay for school managers also seems to improve school quality.

10.3 Science policy

Science creates fundamental knowledge. Although this is codified in scientific publications available all over the world, it is hard to comprehend without the tacit knowledge obtained by a scientific education and experience in scientific research. Analogously to Section 10.2, this section reviews science policy in the scenarios in four steps: the motives for government science policy; an important trade-off in science policy; scenario-dependent policy options; and a no-regret policy option.

10.3.1 Scope for government intervention

All over the world, governments finance a substantial part of scientific research. Two main answers exist to the question 'Why?' First of all, for a considerable part of scientific research a market does not exist. Few firms are willing to pay for fundamental research in archaeology, astronomy, fundamental physics, etc. Societies, however, assign intrinsic value to science, independent of commercial application, which makes funding of these fields of science pre-eminently a public issue.

Secondly, knowledge spillovers limit private incentives to invest in science and at the same time raise their social value. Arrow (1962) and Nelson (1959) show that there is private underinvestment in scientific research. The reason is the inability to capture the entire stream of economic returns from investments in new knowledge. Knowledge that escapes from exploitation by the originator and is taken up by others for profitable use increases social welfare. The originator goes unrewarded, however, because these spillovers do not generate private revenues. This market failure is exacerbated in science, because practically applicable basic scientific knowledge usually has the potential to expand in many directions and be applied in many instances. Hence, creating opportunities for outside parties to benefit from scientific knowledge at low cost is socially very valuable.

Institutions in fundamental science solve this dilemma by turning the incentives upside down. Public finance links up with strong incentives to publish outcomes of scientific research (publish or perish). Universities, which are often government institutions, pay researchers to send out new ideas and publish or codify these new ideas in peer-reviewed outlets. A scientist does not benefit from private exploitation of his knowledge, but on the contrary from public dissemination. A long list of publications yields prestige, reputation, promotion and ultimately tenure. In this way knowledge is disseminated widely to benefit society at large.

10.3.2 Trade-off in science policy: performance vs. utilisation

No matter how useful it may be to link public finance with publication incentives to encourage dissemination of knowledge, for relatively applied scientific fields these incentives may hamper application-oriented research that benefits society. The reason is that publication incentives affect the research agenda. "Publish or perish" implies that researchers take up research topics that most likely will result in publications in esteemed peer-reviewed journals. Those do not necessarily have to be topics where science can contribute to solving problems that exist in society. For instance, a researcher may find it more rewarding (from a publication perspective) to expand a theoretical model instead of investing heavily in data gathering and applying existing methodology to solve some concrete practical problem. Therefore, in relatively applied fields researchers face not only publication incentives, but also utilisation incentives (such as research financed by private parties, revenues from patenting and opportunities to create a private firm as a spin-off (science parks)).

These considerations would lead to a trade-off for academic research between performance and utilisation. A strong focus on performance creates the best quality of scientific output, while

a focus on utilisation creates the best application of ideas to socially relevant questions, such as climate change or combating diseases. However, evidence on this trade-off is mixed. Top scientists often excel both in basic and in applied research. Furthermore, scientists do not operate in a vacuum. Social needs and practical questions also guide the scientific research agenda— particularly in applied fields (such as health research) scientists are strongly motivated to solve real-world problems.

Moreover, several authors have argued that for European universities it seems that the trade-off is not yet binding, since both performance and utilisation lag behind the United States. Studies focusing on the sources of the relatively low European research quality (compared to the US) emphasise the relevance of incentives (both at individual and department levels) and the need to promote profound institutional reforms in most European countries (e.g., Jacobs and Van der Ploeg, 2006; Drèze and Estevan, 2006). Aghion et al. (2009) find in an analysis of university performance in the period 1947-2005 that university autonomy and competition for funding to a large extent explain university performance. Universities that have experienced more freedom in dedicating resources to fundamental research and that have been forced to compete for funding have fared better. European countries have invested less in their university systems compared to the United States. On average, EU25 members spend 1.3 percent of GDP on higher education, versus 3.3 percent in the United States. At the same time, European universities have been less autonomous, particularly with regard to budgets—but also in hiring, remuneration, curriculum design and student selection, especially at the master's level.

10.3.3 Scenario-dependent policy

When the trade-off is partly absent or non-binding, both performance and utilisation incentives may be strengthened in European science. Still, the emphasis on performance or utilisation also depends on the outcomes of the scenarios (see Table 10.3).

Table 10.3 Orientation of science policy

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Performance or utilisation	Utilisation	Performance	Utilisation	Performance
Specialised or broad universities	Specialised	Specialised	Broad	Broad

Utilisation of knowledge matters in a scattered world. In Talent Towns, it is important that specialised knowledge is created that can be used by local workers to innovate and compete worldwide. In Egalitarian Ecologies, utilisation is important to serve local demand. The global knowledge stock needs to be translated into products for the local market. This also implies that EE universities need to be broad. Relative to the current landscape in the Netherlands and Europe, the TT scenario fosters the specialisation of universities towards the specialisation of local production, whereas Egalitarian Ecologies will leave the landscape relatively unchanged.

EE universities resemble the current Dutch universities, which serve a large part of the market and have expertise in many different fields. They are also scattered across the country.

Performance is crucial in Cosmopolitan Centres and Metropolitan Markets. The arrival of the new GPT requires outstanding researchers from all over the world to cluster and work on developing the new technology. Scale is also important for developing the new GPT because knowledge spillovers among researchers are crucial. The research carried out in the CC scenario is specialised, depending on the type of specialisation the centres attract. Close collaboration with companies is important for developing the GPT further. This can lead to spin-offs by innovative and specialised groups of researchers. In MM, the GPT is developed to larger extent inside companies in large laboratories that benefit from general spillovers between different fields of research and collaborate with universities. Multidisciplinary teams of researchers are important to explore new fields.

10.3.4 No-regret policy

With regard to science, further internationalisation and collaboration provide a clear indication of two fields where policy works out favourably in all scenarios.

European research area

The European Research Area (ERA) was established in 2000 with the aim of creating a unified research area across all of Europe. The most important advantage of the ERA would be an increase in market size, so as to ensure that university potential will be better utilised in Europe, due to less dispersion of resources and activities ("stepping on toes" instead of "standing on giant shoulders"; Jones, 2002). In addition, reform of country-specific funding, regulation and rigidities may enhance incentives for performance. The ERA increases the market for students and researchers by creating a single market for scientific research. This increases competition for funding and talent. Competition for funding and peer-review of research proposals on a larger scale increases the quality of research.

Scale is a second issue that is important for fundamental research. Many European universities lack critical mass because they have been operating within national boundaries and national institutions that limit incentives for performance. This has led to the scattering of research activities and underutilisation of complementarities in research and the building of infrastructure. While the average quality of European university research is good (see Fact 7 in Chapter 3), it is not up to the leading world standards. Concentration of resources and specialisation in niches helps to create excellence in Cosmopolitan Centres and Talent Towns. In addition, the ERA yields a network of universities and public research organisations across the EU. This is of importance for Talent Towns and Egalitarian Ecologies, because they are unable to host large universities and thus have to specialise (TT) and focus on utilisation of knowledge (EE).

The ERA offers several advantages for universities in EE and MM scenarios: autonomy to position themselves (MM), opportunities to cooperate and compete at European and

international levels (EE), and ways to better link their research activities to the needs of industry and society (EE). Positioning and autonomy are crucial in MM and CC because these cities in these scenarios have to attract researchers. Professionalism in the management of research, and adherence to more transparent standards of quality, with which comparisons can be made across universities and cities, are important for assessing the quality of the research. Within the ERA, the European Research Council (ERC) plays an important role in the competition for grants to fund academic research at the European level—comparable to the role of the National Science Foundation (NSF) and the National Institutes of Health (NIH) in the United States.

The ERA also stimulates virtual centres of excellence in the form of strong and durable partnerships between universities. This is the purpose of the networks of excellence in the research Framework Programme. In particular, Talent Towns and Egalitarian Ecologies benefit from virtual centres of excellence. Other instruments, such as large-scale research facilities shared by several institutions to pool research-management capabilities (including knowledge transfer, fund-raising and other key functions), could help to create virtual centres of excellence. For some of these networks scale is important, which offers opportunities for MM and CC universities to host these facilities.

All in all, in line with the ongoing internationalisation of knowledge, ERA benefits science in all scenarios—albeit in different ways. In Talent Towns and Cosmopolitan Centres, ERA primarily induces competition, which leads to excellence and specialisation. In Egalitarian Ecologies and Metropolitan Markets, the emphasis of ERA is on networks and links with the international science base.

Collaboration in science

Scientific advances and the level of scientific knowledge is increasing around the world. It takes a considerable amount of education before people have gathered sufficient tacit knowledge to be able to participate in scientific research (see Section 1.1). Because the total stock of scientific knowledge increases strongly over time, new researchers face an ever-increasing ‘burden’ of knowledge that they need to master (Wuchty et al., 2007 and Jones, 2010). They respond by extending their period of education and / or by narrowing their expertise. The latter effect, together with the tendency towards multidisciplinary research, implies that increasingly teams, as opposed to individuals, generate scientific contributions. The teams differ in orientation over the scenarios. In TT and CC scenarios, researchers join specialized teams with colleagues of comparable quality. In the worlds of EE and MM, they participate in generalized teams that consist of a single top-level researcher working with several less-qualified colleagues. Still—in all scenarios—teamwork will increase in science.

To adjust scientific policy accordingly, team rewards and team evaluation can be used effectively in all scenarios to stimulate research collaboration. Current institutions mainly focus on individual rewards. Team rewards can help to set appropriate incentives for individuals to invest in collaborative effort. Appropriate team evaluation is a necessary condition, because only teams show sufficient quality and scope to be able to judge a collaborative effort. Team

evaluation may take place when the time comes to decide whether or not to finance a research project, publish a scientific research, grant a patent or promote someone to a tenured position. An example of such an approach is some version of the English Research Assessment Exercise in which teams obtain finance based on their scientific contributions of a previous period.

10.4 Innovation policy

Technological progress results for the most part from innovation activities of private firms. However, the incentives for innovation that firms get on the market differ at times from incentives that would be optimal from a social perspective. That is where innovation policy steps in. This section reviews innovation policy using the same structure as the previous two sections.

10.4.1 Scope for government intervention

Private incentives for innovation may differ from socially desired incentives, for two main reasons. The first reason is similar to the main motive for public science policy: knowledge spillovers that private parties cannot fully appropriate. Nelson helps to identify these by establishing a benchmark where underperformance would not be expected to occur, “To the extent that the results of applied research are predictable and related only to a specific invention desired by a firm, and to the extent that the firm can collect through the market the full value of the invention to society, opportunities for private profit through applied research will just match social benefits of applied research, and the optimum quantity of a society’s resources will tend to be thus directed. ” (Nelson, 1959, p. 300). Departure from these conditions is likely to create a divergence between private incentives and the socially desired production of knowledge. For example, society would like to have the best AIDS drug developed, not necessarily the most profitable one. The size of this divergence represents an opportunity cost of relying solely on market mechanisms, which should then be weighed against the costs that might arise from intervention. Policy instruments to reduce the divergence are innovation subsidies that increase incentives for innovation or intellectual property rights that enable firms to appropriate the returns on innovation.

The second reason explaining the differences in incentives concerns asymmetric information, which may exist between a firm and a party that contemplates financing the firm’s innovation project or between two firms that consider joining hands in co-innovation. The fundamental problem is that the outcomes of investment in innovative projects are uncertain; have potentially high returns but also encompass high risks. This implies that it is hard for a person with a promising idea to obtain funding for exploring the idea. In addition, two firms that cooperate in a highly uncertain innovation project face difficulties to decide ex-ante upon the division of efforts and revenues. When one of the firms has more information about the project, the other firm may become reluctant to participate in order to avoid the risk of getting too little out of the project. In this case, asymmetric information could lead to a lack of

productive cooperation. Policy instruments in this area are public innovation credit, creation of a venture capital market, platforms for information exchange or obligations for parties to make information available.

10.4.2 The trade-off in innovation policy: seizing opportunities or wasting resources

Knowledge spillovers and asymmetric information merit government intervention. R&D subsidies or creating or extending intellectual property rights (IPR) are examples of ways to deal with spillovers. Venture capital and information provision are examples of coping with information and coordination issues. These measures increase the private returns to knowledge creation and the incentives to engage in R&D.

However, seizing opportunities by government intervention is hard, which gives rise to a difficult trade-off. Policymakers suffer from the same information problems as private firms do, and the size of spillovers is often hard to capture when designing government programmes to stimulate innovation. Hence, innovation policymakers face an intricate trade-off: seizing opportunities to encourage innovation or wasting resources when policy is not effective, due to information asymmetries between policymakers and private firms.

Governments face at least four information problems:

- Policymakers often do not know whether public investments crowd out private initiatives. It is possible that without the subsidies the investment would still have taken place.
- It is hard for policymakers to judge whether firms indeed spend public money on innovation.
- It is often unknown to what extent appropriation problems can be solved by the market; consultants or industry associations, for instance, may also tackle information problems.
- The design of government intervention is not costless. In 2010, total public investment in innovation in the Netherlands amounts to 1.8 billion Euros. The costs incurred for executing the different programmes amount to 75 million Euros (or about 4 percent of the total public spending on innovation).

Taking account of these possible problems is important because at present every euro spent on innovation in the Netherlands is matched by about 27 cents of public investment.[2] In terms of scenarios, the following picture emerges:

[2] Total private innovation investments are about 5.8 billion Euros; Pubic investments 1.8 billion Euros.

Table 10.4 Seizing opportunities or wasting resources	
Scenario	Outcome
Talent Towns	There is a high probability of wasting resources because knowledge flows away easily once created. The world is very dynamic and specialised, making the probability that governments bet on the wrong horse relatively large.
Cosmopolitan Centres	It is important to seize the opportunities that arise from the arrival of a new GPT by stimulating public-private cooperation in developing new technologies.
Egalitarian Ecologies	Seizing opportunities is possible by granting subsidies to stimulate innovation for local applications. There is some scope for public finance, but funding can to a considerable extent be arranged through the market, because cities operate on a relatively small and autarkic scale, making trust an important asset to coordinate market transactions.
Metropolitan Markets	The arrival of a GPT merits large integrated firms. Innovation policies are less effective because of limited additionality (the probability is high that large firms crowd out the public innovation budget); information problems, moreover, can be solved by the firms themselves and large firms face scale economies in R&D.

10.4.3 Scenario-dependent policies

This section discusses four types of scenario-specific orientations for innovation policy. Table 10.5 summarises the outcomes. The line 'Scope' in the table summarises the trade-off (from Table 10.4) between seizing opportunities and wasting resources.

Specific or generic

Specific innovation policies only work if the government has low search costs and is able to discriminate between successful and less successful investments. When there are relatively large differences in knowledge spillovers between sectors or industries, and when they can be measured, specific policies can help to internalise these spillovers. Specific innovation policies also work if new technologies are promising, but have failed to offer a private return that attracts private investors. This might be the case because of technological lock-in. Rules that prohibit the use of old technologies or subsidies for the development of the new technology may be efficient. Finally, when search costs are low, specifically targeting policies is efficient. In the generalised EE and MM scenarios, government search costs are high, which limits the ability of the government to target policy. Hence, if anything, generic policies work better. In the TT and CC scenarios, the government can target policies (i.e. subsidies) to support the specialisation of the city. However, these polices are only feasible when the specialisation of a city has materialised to some degree. Backing (early) winners is an effective policy in these cases, but innovation policy is unable to create the specialisation of a CC or TT from scratch. In addition, CC governments can foster public-private cooperation between large, specialised universities and private companies. This may result in specialised campuses.

Table 10.5 Innovation policies

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Scope	Limited	High	Limited	Hardly
Specific or generic	Specific	Specific	Generic	Generic
Public-private cooperation	0	+	0	0
Small or large companies	Small	Large	Small	Large
Entrants or incumbent firms	Entrants	Both	Incumbents	Incumbents
Intellectual property rights	+	++	+	+
Innovation subsidy	+	++	+	0
Innovation credit	+	0	+	0

Small or large companies

The academic literature is not clear about the effectiveness of subsidising large or small companies. Exorbitantly high fixed costs could prevent small companies from entering the "innovation market". For example, small companies might have difficulties in getting access to the global stock of ideas, which limits the effectiveness of their research effort. Or, differences in scale could lead to diminished utilisation of knowledge, because small firms have only a limited and temporary capacity for research. When the capital market does not function well, small companies might have a disadvantage because they are likely to face stronger credit constraints. Large companies have scale advantages in knowledge production. They are able to install permanent research capacity, which streamlines the innovation effort. On the other hand, there might be strongly decreasing returns to scale, which limits the effectiveness of large companies in innovation.

Innovation in CC and MM scenarios takes place in large companies. Firms in the former specialise in the early stages of technology development and benefit from knowledge spillovers between similar workers. Governments can stimulate company-university exchange programmes to develop new technologies. In MM, firms deal with innovation internally. They are not easily budget-constrained, and benefit from scale economies in developing new technologies. There is hardly any scope for government policies—saving a well-developed system of intellectual property rights. At the other side of the spectrum, the smaller scale of TT and EE worlds offers opportunities for small- and medium-sized companies to innovate. Stimulating these firms to connect to the worldwide knowledge base and invest in R&D helps them to pursue innovative projects.

Entrants or incumbent firms

Fostering entry is efficient when entrants create relatively high knowledge spillovers or when policy aimed at entrants is more effective. Looking at the numbers, most innovation effort is undertaken by incumbent firms. However, entrants allocate a larger share of their resources to innovation, and an extra euro of subsidy to an entrant generates more R&D than spending that euro on an incumbent firm (the additionality of the subsidy is higher). This makes subsidising

the marginal effort worthwhile. In addition, entrants have to build up their reputation, and face credit constraints because venture capitalists are less willing to invest in firms without some sort of reputation. This is particularly the case in Talent Towns, with small- and credit-constrained firms. Another feature of this scenario is that local trust is not very high because workers participate in rather loose global production teams. This makes venture capitalists reluctant to invest. Public seed capital or innovation credits aimed at bringing prototypes to the market could foster innovation. In addition, intellectual property rights (IPR) help to appropriate the rents from these innovations.

In the other scenarios, incumbents are more important for innovation. Established firms, either serving the global market or producing locally, could be stimulated to engage in R&D by taking away credit constraints. This is more important in Egalitarian Ecologies than in Cosmopolitan Centres or Metropolitan Markets. In CC, spin-offs could arise from university-company interactions. These spin-offs could be stimulated by sound IPR and subsidies.

Subsidies and innovation credit

Subsidies target the internalisation of knowledge spillovers; innovation credits are meant to solve credit constraints. Subsidies are particularly effective in Cosmopolitan Centres, which thrive on knowledge spillovers in developing new technology. Specific subsidies can also support the specialisation of Talent Towns—although only to a limited extent because policymakers have to take into account the risk that subsidies leak abroad. Egalitarian Ecologies can benefit from generic innovation subsidies, such as wage subsidies for engineers, when developing new technologies. Both TT and EE benefit from innovation credits because the predominantly small- and medium-sized firms face credit constraints. Finally, in Metropolitan Markets there is no room for public innovation subsidies or credits. Large firms are able to internalize knowledge spillovers, scale economies and information asymmetries.

10.4.4 No-regret policy: European patent

Patents grant appropriation of inventions for a certain period, which creates incentives to innovate. Patent applications in the EU have been lagging behind Japan, the US and recently even behind China. Since the late 1990s, Japanese patent applications have stabilised around 400,000 patent applications each year. The US has experienced a sharp increase in the number of patent applications—from 200,000 in 1996 to about 450,000 in 2008. China's filings increased from 50,000 applications in 2000 to almost 300,000 applications in 2008. In contrast, European patent applications have only grown from 150,000 in 2000 to almost 220,000 in 2008.

An important reason for the lacklustre patent growth in Europe has been the cost of patenting. Nearly 50 years of attempts to create the EU patent have led to failure thus far, due to lingering unresolved issues regarding language and the design of a centralised patent litigation court. Three main problems might be easily resolved. First, language has been a major obstacle. Although almost 80 percent of all filings have been in English, the French and Germans file mainly in their own languages. All other nations file in English only (even China). Stipulating

that filing may be done only in English could save significant translation costs. Second, patents are expensive and the European system is complex. National patent offices face costs and grant patents, as does the European Patent Office. Integration and/or abolishment of national offices could make the system more efficient. Finally, governance fails because national patent offices have diverging views on control, and fear the loss of control when Europe takes over. Streamlining the system could thus save costs.

11 Labour market

'We have shown that most of the adjustment of states to shocks is through movements of labor, rather than through job creation or job migration. Cities and states affected by an adverse shock may find this adjustment unappealing. However, if firms' and workers' private costs and benefits of moving reflect social costs and benefits, the adjustment is efficient.'
Olivier J. Blanchard and Lawrence F. Katz, 1992, *Regional Evolutions*, p. 54.

The labour market in the Netherlands of 2040 may be scattered or highly clustered; it may be highly specialised or employ workers with general skills. Chapter 10 discussed among other things the consequences for the education of workers, which is their preparation for the labour market. We now turn to workers on the labour market, focusing on labour-market risk, the risk of losing jobs. We address the opportunities for workers to cope with job uncertainty and show how governments may intervene, support workers and solve labour-market imperfections. In their interventions, governments have to choose between flexibility and security, between the ability to benefit from opportunities and insurance against negative shocks.

The scenarios have important implications for workers, which are summarised in Table 11.1. First, workers earn higher wages, because they have a high return to their human capital in large cities and when they carry out specialised tasks. In large cities, workers benefit from learning, spillovers, thick labour markets and widely available facilities. Specialised workers get a high payoff, as they are able to excel in their limited task and do not have to spread their work effort over a range of many tasks.

The generalised cities of Metropolitan Markets and Egalitarian Ecologies are well able to cope with negative shocks—in particular, with idiosyncratic shocks affecting only part of the production process. Some workers and firms become unemployed or bankrupt, respectively, but other segments of the market flourish simultaneously. This means that there are many options to find another job; also the opportunities for starting a new business are quite good.

The downside for specialised workers is the riskiness and specificity of their jobs. They cannot easily switch, once a negative shock occurs. Even the specialisation of complete cities might be at risk in Talent Towns and Cosmopolitan Centres. This implies that the negative shocks for workers accumulate: they lose their jobs, the value of their houses collapses and vacancies will be insufficient. So, specialisation-specific shocks do not affect some workers within each city (as would be the case in MM and EE scenarios), but all workers within some cities—and if cities are very large (in CC), the consequences may well be interminable. An example of such a city is Detroit. Specialisation in the car industry brought wealth to Detroit, but as competitiveness is lost, the city is in decline.

Table 11.1 Outcome and policy

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Outcome				
Return to human capital	+	++	0	+
Income inequality	+	++	0	+
Specificity of human capital	+	+	0	0
Riskiness to city's output	+	++	0	0
Policy orientation				
Redistribution	national	continental	national	city
Optimal social security pool	national	continental	national	city
Rental market for houses	+	++	0	0

Workers are confronted with uncertainty about their jobs. They are sometimes hit personally, but in other cases their whole specialisation or industry collapses. This uncertainty will expand over time, given the ongoing development of the knowledge economy, the unbundling of production processes and the enhanced competition from all over the world. Labour-market institutions have to support workers in changing jobs or tasks. Flexibility on the housing market might support this change, particularly if job-to-job mobility involves moving between cities.

Western governments have dealt with risk and inequality on the labour market by building welfare states. It is not our aim here to question this public solution, but to discuss its scope. Our conclusion is that welfare states are under pressure in the scenarios in which risk and inequality are very large, whereas they remain feasible in scenarios with relatively low risk and moderate inequality. Consider the scenario of Cosmopolitan Centres, with sizable inequality and risk. Countries of the size of the Netherlands host only one or a few specialised cities. If one of these cities would be confronted with a serious negative shock, the country as a whole is affected. Insurance at the country level is very difficult, both publicly and privately; this means that supranational organisations such as the EU have to step in. At the other extreme, welfare states can be easily organised nationally in Egalitarian Ecologies, but in this scenario risk and inequality are quite moderate. This lowers the demand for a large welfare state.

Regulation of the housing market may require serious revision relative to the current situation (see Donders et al., 2010). In particular, in Talent Towns and Cosmopolitan Centres, where labour- and housing-market risks are highly correlated, workers who own their houses are hit twice by negative shocks. Workers who rent houses are only confronted with the unemployment risk, with the housing-price risk left to the homeowners. So, the private solution for workers to avoid the accumulation of risk is to leave the housing-market risk to private companies. These companies are able to spread the risk, even in TT and CC, by owning houses in several cities or even countries. Public institutions, such as regulation and taxation of the housing market, should accommodate this. This might require a revision of the currently strict regulation on rental prices, of taxes on housing transfers and of the mortgage tax deduction.

This chapter first discusses the private response to labour-market uncertainty. Public policy should accommodate this private response, both in the public provision of insurance and in the regulation of the housing market. The main implications for redistribution wrap up the chapter.

11.1 Workers' response to labour-market shocks

Consider a worker with a job at risk. This risk may stem from preferences changing away from products, or from technological changes making products obsolete. Job uncertainty may also stem from competition by other workers, like older workers who have to compete with younger colleagues, or workers who are challenged by cheaper labour abroad. These shocks occur in all scenarios, but the implications for workers and the way that they are likely to respond differ. We limit attention to permanent shocks and abstract from temporary labour-market uncertainty, which we assume to be beyond the control of the workers (it is thus the result of an exogenous shock, not due to moral hazard on the side of the worker).

11.1.1 Private response

Shocks occur in all scenarios. Sometimes all shocks occur simultaneously, but most are idiosyncratic. This distinction is crucial for generalist workers, who can quite easily cope with idiosyncratic shocks, but are severely hit by economy-wide shocks. These economy-wide shocks may have a huge impact in terms of job maintenance and outside options. For the specialised workers, this distinction matters less for their job maintenance, but does of course affect the opportunity of finding a new task or job.

The basic response to uncertainty is diversification. This response is common on the capital market, where investors diversify their portfolios, but is more difficult on the labour market. Most workers have a single job within a single firm and are able to perform a limited number of tasks. Even in the US diversification is very limited, with about 5 – 10 percent of the workers having two or more jobs. Within their jobs, some workers have a more diversified package of tasks than others, and have better outside options. Among other things, the outside options for workers depend on their degree of specialisation. The super-specialist excelling in a single task likely faces a substantial drop in income if he is fired. The outside options for a generalist might be as good as his current income, but he faces the disadvantage that he doesn't excel in his current job.

Diversification only helps in advance of a shock, and may facilitate the response once it actually occurs. Still, some shocks may be too big for even the most diversified worker. Consider those that permanently affect a worker's job opportunities. For both worker and firm it is clear that the current job, with unchanged conditions, is no longer feasible. This deterioration might be attributed to either a reduction in the demand for a workers' output or intensified competition from other workers or firms. How do workers respond if they are confronted with these supply shocks, which are too big to ignore? They may choose one (or a combination) of

the following alternatives: job mobility, retraining, moving house, accepting a wage adjustment or becoming unemployed (which although not really a choice, might result, after all).

- Job mobility: Workers may change jobs. Job mobility, in its purest form, implies that the worker will perform the same task, or the same set of tasks, in another firm. Adjustment is costly because a worker has to adapt to the rules and habits of the new firm.
- Retraining: Workers may change tasks, for which they have to retrain. This retraining may either be on the job or at school; it may either be on the boss's time or in their own time. In its purest form, these tasks are performed within the same firm. Adjustment is costly because retraining requires time and money.
- Moving: Workers may change places and move to another city, either within the Netherlands or abroad. In its purest form, this solution implies that the worker performs the same tasks within the same firm, but in another place. The expenses incurred by moving, which depend among other things on the cost of moving houses, are a clear barrier to this type of adjustment.
- Wage adjustment: Workers may accept a lower wage and continue in their current job. This response fits in a situation where the gain of moving to the other task is very limited. Of course, wage adjustment may be part of a package in which a worker resigns his position and starts performing a new task in a new firm.
- Unemployment: If all else fails, or if workers are unable to or unwilling to choose one of the other four alternatives, they will become permanently unemployed and receive social assistance.

Note that in all options we emphasize the disadvantages, which is natural in discussing the responses to negative shocks. In any case, the most important gain is that the alternatives are even worse. For example, a worker is willing to accept a wage cut if retraining is very expensive, if family ties prevent removing and if other jobs are hard to find. Of course, we do not exclude that improved job opportunities may be a positive side effect of changing to a better-paid job or task.

In addition to labour-market shocks and responses, workers may also be confronted with a shock in their wealth (in the value of their house, for example). This wealth risk becomes problematic if it is positively correlated with labour-market risk. This is likely to be the case for housing markets in the specialised scenarios of Talent Towns and Cosmopolitan Centres, where specialist workers of the same city are hit simultaneously. They sell their houses massively, causing a huge drop in prices. The optimal response to this correlated risk is to diversify. One option is to rent a house instead of owning it. Alternatively, one might insure oneself against a drop in housing value, as was proposed by Shiller and Weiss (1999) in their article on home-equity insurance.

11.1.2 Scenarios

The most likely and most beneficial response to labour-market uncertainty differs between scenarios. In the high-concentration scenarios (CC and MM), shocks will occur with low probability but may have huge impact. In the scenarios with scattered cities (TT and EE), shocks may occur more frequently, but with smaller impact. The following table summarises the most promising responses to permanent shocks, indicated with a plus or a double plus. Less-promising options are left blank.

Table 11.2 Promising responses to permanent labour-market shocks

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Job mobility		+	+	++
Retraining	++	++		
Moving	+	+		
Wage adjustment	+		+	

Talent Towns

The job opportunities for TT workers depend primarily on their specialisation in combination with excellent communication abilities; location is of second order. Two options are promising when these workers lose their job when their specialisation is taken over. First, they may retrain and specialise in a new task. Workers specialised in today's software programs will have to 'keep up with the Joneses' and learn new languages or new applications. Moving to another city might be part of this job switch. If retraining and moving is too expensive, and the drop in income is limited, the specialised workers might accept a wage cut rather than retrain. The alternative of job mobility is very unattractive. Searching for a new job on the local labour market is very difficult, as the local labour market is very thin, with an extremely limited number of vacancies. Moving without retraining is hardly a good option, either, because job opportunities for the worker's specialisation won't be much better in another city.

Cosmopolitan Centres

The specialist workers in the CC scenario are operating on a large local labour market with a robust demand for their skills but also fierce competition for the vacancies. It is important to distinguish between moderate shocks that may affect only an individual firm, and huge shocks that impact an entire profession. In the first situation, the fired workers will search for a job on the thick local labour market. This option is unavailable, however, if the profession—and with it the specialised city—is severely hit. In response, many workers will have to retrain, and eventually the whole city collapses or has to change profession. Moving is a promising alternative if a competing city with the same profession proves to be more competitive and more successful. In the end, workers will be most productive in proximate interaction with other specialists, and do not have to be close to the consumer market.

Egalitarian Ecologies

The labour market is quite thin in the small EE cities. Nevertheless, neither retraining nor moving to another place is a promising response to a negative shock. Retraining is unlikely to pay off, as general skills are the decisive determinant of a worker's productivity. Neither is moving a good alternative, as it neither creates new demand nor improves a worker's production network. Therefore, the EE worker faced with a negative shock will probably either change jobs or accept a wage cut.

Metropolitan Markets

The labour market in MM is very thick, with abundant job opportunities inside, but very few vacancies outside, the big city. A fired worker will therefore search for a job on the large local labour market. Since the MM worker is trained in general skills, retraining will only play a very limited role in his response to negative shocks. Moving will only be a matter of last resort, in situations where the entire city loses its position in the global competition: just as Antwerp overtook Bruges in the sixteenth century, Amsterdam may be challenged by London, New York or Shanghai in the MM scenario. These disastrous events are unlikely to occur; unemployed MM workers will thus set their sights on another job in the sizable local labour market.

11.2 Risk sharing and government intervention

Workers will be confronted with negative shocks, to which they may respond by moving to another firm, to another sector or specialisation or to another place. Alternatively, the labour-market shock may permanently reduce their income. The feasibility of these responses differs between scenarios, from retraining in the specialisation scenarios (TT and CC) to wage adjustment in the scattering scenarios (EE and TT). What role may governments play in sharing these risks on the labour market and accommodating worker responses? Taking for granted the fact that workers are risk averse, spreading the risk reduces their uncertainty and raises welfare. The key policy question is then how public provision of insurance affects private behaviour.[1]

Insurance improves welfare by smoothing consumption between employed- and non-employed periods or between employed- and non-employed persons. Most people are risk averse; only in lotteries are people happy to give up 15 Euros for a small probability of winning more. They prefer a certain amount of income to an uncertain income flow with the same expected return. Workers generally prefer a job with a permanent contract to a flexible contract.

One alternative to insurance is to smooth consumption by borrowing and lending on the capital market. However, unemployed people, in particular, face liquidity constraints and have to save in advance to guarantee consumption in periods without income. Moreover, consumption smoothing is only possible in response to temporary changes in income, but does

[1] De Mooij (2006) provides an extensive discussion of the future of the welfare state.

not mitigate permanent reductions in income. In both cases, workers may pool the income risk, rather than engaging in precautionary saving individually.

The key disadvantage of risk sharing is moral hazard, which may occur if risks can be influenced by the claimant. Once insured, people change their behaviour and affect the probability of occurrence or the size of the claim. Insurance is not likely to affect the flow in and out of unemployment, as neither the risk of unemployment nor the probability of finding a new job is completely exogenous. Turning the argument around, insurance is hardly feasible if the behavioural responses of the insured are very big. Only if the behaviour of the insured can be perfectly monitored, an efficient insurance contract would be feasible. Perfect monitoring is generally not feasible, and would be very expensive. So, the optimal insurance contract strikes a balance between the gains from insurance and the costs from moral hazard.

11.2.1 Publicly provided insurance and protection

The government has several instruments (including unemployment benefits and employment protection) that it can use to allocate labour-market risk or income uncertainty between workers. Each instrument has to strike a balance between the gains of spreading risk and the disincentives of moral hazard. The gains are quite uniform across the scenarios, but the efficiency loss depends on the mobility of the worker (i.e. on the way he likely responds to changes in his job opportunities). Table 11.2 has shown that these responses are scenario-specific. This implies that that the public insurance device will be scenario-specific as well. The applicability of the instruments in each scenario is summarised in Table 11.3.

Table 11.3 Government policy to reduce labour-market uncertainty

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Unemployment benefits	Facilitate retraining	Facilitate retraining	Facilitate job-job mobility	Limited
	Publicly provided at the EU level	Private savings account	Private savings account	Private savings account
Social assistance	Last resort	Limited	Last resort	Limited
Labour tax	Flat and low	Progressive	Flat	Progressive
Employment protection legislation	Desirable, but unfeasible	Feasible	Less desirable	Less desirable
Active labour-market policy	Stimulate mobility	Stimulate mobility	Low return	Low return

The main publicly-provided sharing devices against unemployment risk in the Netherlands are unemployment benefits and social assistance. Unemployment benefits are meant to insure against temporary unemployment. The provision may improve matching on the labour market, as workers do not have to accept the first (poor) job offer, but may be more patient and wait for another offer that better matches their abilities and preferences. In other words, insurance may facilitate the movements workers need to make in response to labour-market shocks (see Table 11.2). These benefits should be temporary—supplemented, perhaps, by an active labour-market

policy and sanctions to guarantee successful labour-market transitions. Unemployment benefits are most welcome in scenarios in which transitions are important, but costly (if workers have to retrain) or difficult (if the labour market is thin).

Social assistance is, among other things, an insurance against long-term labour-market risk. It acts as a last resort for workers who become permanently unemployed, which will occur relatively frequently in the TT and EE scenarios, where wage adjustments are inevitable responses to negative labour-market shocks. The downside of social assistance is moral hazard, where workers with a sufficient earning capacity choose to quit the labour market and accept the income transfer.

The government may provide public insurance against idiosyncratic income uncertainty by implementing a progressive tax system in which households with higher income realisations pay higher average tax rates. This makes after-tax labour income less risky than pre-tax income. The key advantage of this instrument is that it effectively reduces long-term income uncertainty: you pay a large tax rate if you do permanently well, and a lower tax rate if your career is on a less-prosperous path. The gains from insurance should be weighted against the disincentive effects of progressive income taxes on labour supply (e.g., Krueger and Perri, 2009). The case in favour of progressive taxes is stronger for large life-cycle income differences and weak labour-supply disincentives. Income differences are pronounced in TT and CC, but the high mobility of workers prevents progressivity in the first scenario. Income differences are less pronounced in EE and MM, but the limited mobility of workers between cities or countries allows for progressive taxes in the MM scenario.

Next, we turn to policies that keep workers from losing jobs or support them in finding a new job. Employment protection legislation (EPL) shifts part of the labour-market uncertainty from employees to employers. These laws stimulate workers to accept more productive but riskier jobs, thereby possibly bolstering aggregate productivity. A second gain of EPL is the internalisation of externalities, by letting firms paying part of the societal costs of unemployment (which include public transfers and lower tax revenues). The downside of EPL is limited job-to-job mobility, which aggravates mismatches on the labour market. The case for EPL is strongest in the CC scenario, with costly retraining for workers and limited mobility of firms. The potential gains for EPL are also large in TT, but firms in this scenario are too mobile to be seriously regulated by EPL.

Active labour-market policy comes in many forms. Here we focus on instruments that may facilitate the switch to another specialisation. First, governments may have better information about job opportunities and offer job search assistance via government-operated labour-market exchange and placement services. This instrument is among the most cost-effective active labour-market policies (De Mooij, 2006). Second, governments may provide compulsory training schemes for unemployed workers, in situations where groups of ‘similar’ workers become unemployed, but are hesitate to retrain. These training schemes should be applied sparingly, as they are often expensive and turn out to be quite ineffective empirically. Only in

scenarios with a highly specialised labour force may active labour-market policy successfully support job-to-job mobility and retraining.

11.2.2 Public versus private provision

It holds true for all instruments that the public provision of insurance should be carefully weighed against private insurance schemes. Moreover, public insurance may crowd out private insurance—and in the end workers may even be worse off rather than better protected against income uncertainty. The extreme case may in particular hold for public instruments with compulsory collective insurance.

Consider again unemployment benefits. Shocks can be cushioned by spreading income over the life cycle—either by individuals privately or by the public provision of unemployment benefits. Bovenberg et al. (2006) show that for the Danish unemployment benefits, about half of the transfers are between people; the rest is over the life cycle. This sharing device is most relevant with temporary unemployment, or temporary reductions in wage income. From the perspective of an individual's lifetime income, these shocks are relatively small. A small sacrifice in annual income during periods of employment will suffice to guarantee income in unemployment.

Two main obstacles prevent this risk sharing over the life cycle. First, workers may act myopically, be short sighted and prove themselves unable to use the opportunity of life cycle spreading. Second, credit constraints prevent workers from borrowing against future income. Jongen and Van Vuren (2008) show that the gains from a public provision of saving accounts may improve welfare if credit constraints are sizable. Unfortunately, the empirical literature on the size of today's credit constraints is thin. One of the reasons might be that the public support for unemployed workers is sufficiently generous, and workers simply don't have to apply for loans. This implies that credit constraints will become more important in Talent Towns, a fragmented world with limited public insurance. In other scenarios, the case for public provision of unemployment benefits is much weaker, either because job-to-job mobility is very easy and short term in thick labour markets, or because credit constraints are less binding (in Egalitarian Ecologies).

The case for public provision of insurance on the labour market is strongest in a scenario in which labour mobility frequently crosses national borders (Talent Towns), which hampers its implementation or maintenance.

11.2.3 Scenarios and no-regret policies

This section discusses Table 11.3 from the perspective of each scenario. Retraining and wage flexibility are the preferable means to cope with labour-market uncertainty in Talent Towns. The government may support these responses by active labour-market policy and unemployment benefits with limited duration. Both may be offered collectively, as many shocks are idiosyncratic and the gains from pooling are large. The challenge in this scenario is to provide collective support for self-employed workers (in Dutch: ZZP; zelfstandigen zonder

personeel). Moral hazard is not a serious problem, as the world is highly dynamic; workers have to cope with many challenges, which makes a laid-back attitude disastrous. Progressive taxes are highly distortionary, as workers are mobile and able to work in whatever country they like.

National governments have limited means with which to insure the risk that an entire profession (or task) loses market share in Cosmopolitan Centres. These shocks are simply too big, and resemble the difficulties Iceland faces in dealing with the collapse of its financial centre. With this limitation in mind, retraining and moving to another place (probably in another country) are the preferable means for workers to cope with labour-market uncertainty. The government may support retraining by active labour-market policy, but runs the risk of retraining workers for other countries, as workers are highly mobile. Any impediments against international and intercity mobility should be minimised. Moving to another place shouldn't be made more expensive than necessary, so any institutions at the housing market or in the transferability of pensions that limit the mobility of workers are very expensive. Finally, EPL may improve risk sharing between employees and employers, as the latter are not easily distracted by restrictive regulation.

Job mobility and wage adjustment are the preferable means to cope with labour-market uncertainty in Egalitarian Ecologies. Both can be supported by social assistance. Job-to-job mobility can be supported by social assistance with a high replacement rate and limited duration.

Job mobility is the main adjustment device in Metropolitan Markets, which may be supported with social insurance. Policies such as EPL that limit job mobility do not fit in this scenario, which lacks already sufficient dynamics. Moreover, MM cities already run the risk of being monopolistic, which should not be aggravated with protectionist devices. Only in the exceptional case that the entire city shrinks and loses the race against bigger cities (such as London), will workers have to move. In this latter situation, the government will have neither the means (very low tax revenues) nor the scope (limited to national borders) to support workers in migrating.

The conclusion from this discussion is that there is a discrepancy between demand for public insurance and its feasibility. Jobs are highly uncertain in Talent Towns, but policy is very limited in supporting them. Policy is quite feasible in Metropolitan Markets, but hardly needed in the thick labour market. In terms of the trade-off between incentives and insurance: incentives are huge in the TT scenario, but collective insurance hardly feasible: successful workers are able to evade public insurance by moving to another country. Insurance is feasible in the MM world, but incentives are quite weak. This outcome points to a limited role for the welfare state in all scenarios. In the balance of gains and costs of public insurance, either the gains are limited or the costs (in terms of moral hazard or adverse selection) are substantial.

11.3 Redistribution

Next, we briefly discuss redistribution, the second key function of the welfare state. With respect to insurance, we have seen that the need for and feasibility of social insurance move in opposite directions. With regard to redistribution, a similar conclusion follows if we confront income inequality and the scope for national regulation and taxation in each scenario. Table 11.4 distinguishes income inequality in three dimensions. The income inequality within cities is more pronounced in bigger and specialised cities. Specialisation helps to get the best return out of the quality in which a worker excels, whereas generalised workers have to perform several tasks reasonably well. Moreover, larger cities host a greater variety of people, living from suburbs to residential areas, which creates more inequality. Income inequality between cities depends mostly on a given city's degree of specialisation. Some specialised cities will be very successful—at least for some time (such as the glass blowers of Venice), whereas other cities are specialised in tasks with a low return (such as currently the Detroit car industry). Finally, in scenarios where agglomeration economies are very important, such as MM and CC, there will be a huge income gap between city and hinterland. Income inequality is therefore most uneven in CC, followed by MM and TT. As its name already indicates, EE is the most equitable scenario.

Table 11.4 Income inequality and the governance of the welfare state

	Talent Towns	Cosmopolitan Centres	Egalitarian Ecologies	Metropolitan Markets
Income inequality				
* Within city	+	+	0	+
* Between cities	+	+	0	0
* City - hinterland	0	+	0	+
Redistribution	Continental	City or global	National	City

Egalitarian Ecologies, however, is also the scenario in which the national government has the strongest influence, as has been argued in Section 9.3. MM cities have very limited incentives to deal with the income lag of the hinterland. TT and CC cities have an incentive to set up a redistribution scheme, as a means of insurance against negative shocks, but this scheme should exceed the national level. It might therefore be hard to implement. So once again, redistribution via national welfare states is very difficult in scenarios where it is most urgent.

11.4 Housing market

We have pointed to the role of housing markets in either supporting or hampering workers in responding to changing circumstances. In particular, in Cosmopolitan Centres and Talent Towns, where flexibility of workers is needed, institutional reform in favour of the rental market should be seriously considered.

Donders et al. (2010) investigate reforms for the Dutch housing market. They argue that there are two counteracting reasons for public support of homeownership. On the one hand, homeowners might take better care of their property, which benefits the neighbourhood. On the other hand, ownership limits mobility on the labour market and hampers workers' response to distant job opportunities. The study argues that the balance between both effects is likely to be negligible, which implies that, even today, public support cannot be motivated on economic grounds. In scenarios demanding more flexibility from workers, the balance might very well turn negative, meaning that changing houses should be supported rather than discouraged. This has also implications for the transfer (or conveyance) tax, which taxes housing transactions. This tax is harmful in all scenarios and should even be turned into a subsidy in scenarios demanding more flexibility from workers (particularly CC)

An additional argument against private property is the accumulation of negative shocks. If the specialisation of cities in TT or CC scenarios is negatively hit, many workers become unemployed and firms shut down their vacancies. Workers will thus have to move to another city to find a job. During this downturn, many workers are going to sell their house, which severely reduces the value. In this case—which is not unlikely in the specialisation scenarios—homeowners are hit twice. Workers who rent their house are better off; they simply terminate the tenancy.

In fact, the risk is shared between the worker bearing the labour-market risk and the proprietor bearing the house value risk. The proprietor is able to diversify the risk by owning houses in several cities or by holding a diversified asset portfolio in general. This argument shows that the government should reconsider subsidies on homeownership in a scenario like Cosmopolitan Centres.

12 Strategic policymaking

'I am convinced that changes in technology and globalization will only make cities more vital. Why do I think that the face-to-face interactions that are enabled by cities are actually complementary with new technologies rather thank taking the more standard view that face-to-face interactions and electronic interactions are substitutes? New technologies increase the returns to being smart and face-to-face interactions are a crucial element in becoming smart. New technologies enabled the growth of world trade, but that trade is centered in cities which enable people from different countries to connect.'
Edward L. Glaeser, 2010, *The Paradox of Urban Triumph*, 2010 CPB Lecture.

How can this study, with four distinct scenarios, be used for strategic thinking about the future? What is the use for policymakers? The relatively broad scope of the study—using developments in cities, human capital and the world economy at large—has the advantage that it can be used as background information and input for many different subjects that require a long-term perspective. It also means that to analyse other policy areas of interest, a further elaboration of the framework will be needed.

Before exploring how scenarios can support strategic policymaking it is useful to remember what the main characteristics of scenarios are (see also Chapter 1 and De Mooij and Tang, 2003). Scenarios are consistent, plausible and challenging stories of possible futures. They do not predict the future—in principle, an infinite number of scenarios exist, which makes each individual scenario useless as a prediction. The aim of scenarios is to span the future in the same way as a number of vectors span a mathematical space. To reach that aim, the scenarios together they should cover such a degree of variation that they confront the policy issues at hand with the most relevant uncertainties. This means that scenarios serve as a fixed background for strategic policymaking. The policymaker can neither select the most attractive scenario nor adjust a scenario to have it fit more closely his policy objectives. All in all, scenarios do not answer the question 'what will happen that may affect a policy?' but they provide policymakers with a tool to answer questions such as, 'what will be the effect of a policy measure if … ?'

12.1 Scenarios: A way to effectively deal with uncertainty

The critical message of the present study is that any decisions taken about long-term investments or other policy actions should take into account uncertainty about future developments—and not be based on a single scenario. The first lesson we drew in Chapter 1 is that current events have the tendency to be considered as generic—watersheds between past and present. This turned out disastrously for *Echo and Narcissus,* and most certainly will also be the wrong course of action today. Therefore, it is impossible to point to a single scenario as being the most probable, as all scenarios have an equal probability of being "true" or "false". The

future is fundamentally uncertain in almost all respects, and the only 'benefit' to be had of picking one particular scenario would be to create a false sense of certainty.

Yet, in the policy arena choices have to be made. They cannot be made conditional on future events, but have to be made today, based on current knowledge. For policies that can be changed fairly rapidly, it is feasible to take action immediately and adjust the policy when it turns out wrong. More difficult are policies with a great lead-time and/or investments that involve large sunk costs. In such circumstances, the policymaker has to trade off the benefits of waiting and learning about future developments against the costs of delay. The trends in Chapter 4 and the scenario framework in Chapter 7 may help to monitor developments and learn about the world that is materialising.

Keeping all options open until there is less uncertainty about future developments is often impossible. At some point, decisions have to be made. Present decisions should not be looked upon as ultimate wisdom, but as inevitable choices made while facing a fundamentally uncertain future. In that sense, policymakers could be seen as entrepreneurs making an investment decision that could yield positive returns but may also result into failure. The uncertainty should be used to build in measures to operate as flexibly as possible with respect to changing circumstances or in case future developments turn out to be different than those assumed initially. Hence, policymakers must in some way take into account uncertainty about future developments. This is where the four scenarios come into play.

Basically, the government should implement policies for which the social benefits exceed the costs. Both costs and benefits may differ across scenarios. For example, Chapter 10 shows that in one scenario public-private cooperation between private firms and universities is beneficial (Cosmopolitan Centres), while in the other scenarios this benefits the development of a strong knowledge economy to a much less extent. As for infrastructure, Chapter 9 argues that local connections (such as the underground or a ring road) are crucial in the large-city scenarios (CC and MM), but are not likely to pay off in smaller cities. For each scenario one can subtract the costs from the benefits. The outcome may be positive in some scenarios and negative in others. Of course, as Chapters 9 to 11 clearly indicate, in various cases a full cost-benefit calculation is not feasible. Yet, it often proves possible to obtain a qualitative impression about the expected sign of the cost-benefit balance, in order to assess whether a given policy appears promising in a certain scenario context or not.

These exercises are very useful for thinking about strategic choices, because they force policymakers to confront various possible decisions with various potential futures using their power of imagination (which is the final lesson in Chapter 1). The best choice then differs from project to project. In general, the outcome of a project might fall into one of four cases. The simplest case, first of all, is when the social cost benefit analysis yields a positive outcome in all scenarios. In that case, the associated policy turns out to be a no-regret policy; it is indifferent to the uncertainty about the future represented in the scenarios. Often these policies respond to the facts and trends presented in Part I of this study—such as the switch from sectors to tasks following the ongoing development of ICT, and the growing importance of cities relative to

countries. Secondly, when a policy looks favourable in three out of four scenarios it is robust to future uncertainty. Implementation looks reasonably promising. Thirdly, when a positive result occurs only in one or two scenarios, uncertainty is large. If a decision has to be taken, then a viable option is to just count on uncertainty and weight the benefits and costs in each scenario with a one-fourth probability. This approach may also help to identify the fourth case: the low probability - high impact event. If circumstances in a certain scenario entail a risk of very large and costly consequences—or even a disaster—then a project that minimises the probability of these consequences frequently pays off. This holds true for the danger of flooding, but may also apply to job uncertainty. In the former case, the government decides to invest in strong dikes, whereas in the latter one might opt for a generous welfare state.

12.2 The magic circle of strategic policymaking

The influence circle of national governments shrinks, but the impact of their actions increases. This conclusion, illustrated with *The Magic Circle* in the introduction to Part III, follows from the previous policy chapters. First and ultimately for all scenarios, technology drives the scenarios: global developments such as the advance of ICT or a new general-purpose technology (GPT) coming along, strongly influence the future of the Dutch economy. Technology progresses largely autonomously; policy may to some extent affect science and innovation within a scenario (see Chapter 10), but is unable to steer technology towards a new GPT. Secondly, as globalisation continues, international communication becomes increasingly important and the government is more or less obliged to support English language training in public schools. Would it decide differently, the consequences for the Dutch position in trade and business services (to mention a few) would be detrimental. Or to take another example, globalisation and the surge of international connections limits the scope for welfare states, which are generally organised nationally. The Netherlands might become very unattractive, were the government to expand the welfare state considerably and raise taxes.

The influence circle implies that governments have to move with the tide of all-encompassing trends such as technological change—and that deviations from the dominant developments are costly. More countries are using knowledge as the dominant input into the production process. Producing more advanced products makes an economy less vulnerable to adverse shocks. In recessions, industries producing the least advanced products are being hit strongest (see Di Govianni and Levchenko, 2009, for an analysis of the current economic crisis). Emerging knowledge economies urge developed economies to sustain high-quality education, science and innovation. More importantly, knowledge is relatively fluid and mobile, as it is embodied in people and blueprints. Codified knowledge is produced in many different locations and can be accessed and applied independent of place. Talented and productive people are attracted by an attractive place of business, a flexible labour market and good educational and research facilities. Hence, in all these fields governments cannot diverge from keeping policy up to standard.

Despite their being less vulnerable to shocks compared to basic industries, knowledge-intensive industries and tradable services may also experience rapid change. Due to the integration of the world economy and the upgrading of various countries to higher quality products and services, the suddenness and size of changes is likely to rise for Western economies (and the Netherlands, in particular, as a very open service economy). The recent crisis, for example, has revealed the vulnerability of the financial sector. Moreover, several parts of the services production chain (such as software development) have been outsourced to India. Also for industrial production, competitive positions are uncertain. The partial collapse of the car industry in the United States in the last ten years is a good example of a sector losing its competitive edge. These processes will continue. They call for a policy strategy to deal with the uncertainty surrounding this suddenness. The circle of influence is too narrow to offset the downturn of particular industries. But the role of governments might be decisive in designing institutions for change—such as flexible labour markets, capital markets, property markets and innovation systems.

The right policy response is to closely monitor the competitiveness of the place of business, the quality of the knowledge economy and the flexibility of the Dutch labour market. Chapter 9 stresses the importance of a sound infrastructure and regulation. Chapter 10 points to the benefits to be had from a highly educated labour force, with workers being able to excel in current activities and change to other jobs. Chapter 11 shows that workers occasionally have to move or to retrain for a new job. They might be more flexible, willing and able to move, if they rent rather than own their house. So institutions contributing towards flexibility of the labour- and housing market should be seriously considered, particularly in Cosmopolitan Centres, where unemployment and a drop in housing value likely coincide.

12.3 Other applications

There is one world, hundreds of countries, thousands of cities, billions of workers, uncountable policy options—and yet only four scenarios. So we have had to make choices, by focussing on only three policy applications. We have focused on policies concerning the place of business, the knowledge economy and the labour market. And even within these areas we have only touched upon a selection of policy issues.

Of course, it would be possible to extend the analysis to other policy areas. For example, the movement of goods and people has important implications for environmental policy. The transition from sectors to tasks has far-reaching implications for industrial policy, regulation, and education, which go far beyond the analysis in Chapters 9 to 11—and this list is far from complete. The challenge for policymakers is to take the scenarios, consider the examples in the previous chapters and investigate the future of their own policy area.

The framework developed in Part II is a general economic framework. It sketches a broad picture of the role of tasks, cities and knowledge in the world economy, and subsequently zooms in on the Netherlands. This framework can be applied to other modern economies as

well, or to a set of countries, such as the European Union. Other countries in the developed world can also benefit from an analysis of how smart cities and clever people shape the future.

Finally, in line with the scenario tradition at CPB, this study will have a successor. This qualitative approach will be followed by a quantitative assessment. The gauntlet will be taken up by the team producing the WLO (*Welvaart en Leefomgeving*) study, which will be used for a variety of applications in Dutch policymaking.

References

Acemoglu, D., 2002, Technical change, inequality, and the labor market, *Journal of Economic Literature*, vol. 40, no. 1, pp 7-72.

Acemoglu, D., 2009, *Introduction to Modern Economic Growth*, Princeton University Press, Princeton, NJ.

Acemoglu, D. and D.H. Autor, 2010, Skills, tasks and technologies: Implications for employment and earnings, in: O. Ashenfelter and D.E. Card, eds., *Handbook of Labor Economics*, vol. 4, North-Holland, Amsterdam, forthcoming.

Acemoglu, D., S. Johnson and T. Mitton, 2009, Determinants of vertical integration: financial development and contracting costs, *Journal of Finance*, vol. 63, no. 3, pp. 1251-1290.

Ades, A.F. and E.L. Glaeser, 1995, Trade and circuses: Explaining urban giants, *Quarterly Journal of Economics*, vol. 110, no. 1, pp. 195-227.

Aghion, P., M. Dewatripont, C.M. Hoxby, A. Mas-Colell and A. Sapir, 2009, The governance and performance of research universities: Evidence from Europe and the U.S., NBER Working Paper 14851.

Akçomak, I.S., L. Borghans and B. ter Weel, 2010, Tasks, technology and trade, Working Paper, CPB Netherlands Bureau for Economic Policy Analysis.

Akçomak, I.S., H.D. Webbink and B. ter Weel, 2010, The long-run impact of human capital, Working Paper, CPB Netherlands Bureau for Economic Policy Analysis.

Akçomak, I.S. and B. ter Weel, 2009, Social capital, innovation and growth: Evidence from Europe, *European Economic Review*, vol. 53, no. 5, pp. 544-567.

Arrow, K.I., 1962, The economic implications of learning by doing, *Review of Economic Studies*, vol. 29, no. 3, pp. 155-173.

Aubert, P., E. Caroli and M. Roger, 2006, New technologies, organisation and age: Firm-level evidence, *Economic Journal*, vol. 116, no. 509, pp. F73-F93.

Autor, D.H, F. Levy and R.J. Murnane, 2003, The skill content of recent technological change: An empirical exploration, *Quarterly Journal of Economics*, vol. 118, no.4, pp. 1279-1334.

Babbage, C., 1832, *On the Economy of Machinery and Manufactures*, Frank Cass, London.

Bairoch, P., 1988, *Cities and Economic Development*, University of Chicago Press, Chicago, IL.

Baldwin, R., 2009, Integration of the North American economy and new paradigm globalisation, CEPR Discussion Paper 7523.

Baldwin, R. and P. Martin, 1999, Two waves of globalisation: Superficial similarities, fundamental differences, NBER Working Paper 6904.

Becker, G.S., 1962, Investment in human capital: A theoretical analysis, *Journal of Political Economy*, vol. 70, no. 5, part 2, pp. 9-49.

Becker, G.S. and K.M. Murphy, 1992, The division of labor, coordination costs and knowledge, *Quarterly Journal of Economics*, vol. 107, no. 4, pp. 1137-1160.

Ben-Porath, Y., 1967, The production of human capital and the life cycle of earnings, *Journal of Political Economy*, vol. 75, no. 4, pp. 352-365.

Bergstrand, J.H. and P. Egger, 2008, The growth of FDI relative to trade: Measurement, determinants, and consequences of international trade flows in intermediates, Working Paper, Kellog Institute for International Studies, University of Notre Dame.

Blanchard, O.J. and L.F. Katz, 1992, Regional evolutions, *Brookings Papers on Economic Activity*, vol. 1992, no. 1, pp. 1-75.

Bloom, N., L. Garicano, R. Sadun and J. van Reenen, 2009, The distinct effects of information technology and communication technology on firm organization, NBER Working Paper 14975.

Bolton, P. and M. Dewatripont, 1994, The firm as a communication network, *Quarterly Journal of Economics*, vol. 109, no. 4, pp. 809-839.

Borghans, L., A.L. Duckworth, J.J. Heckman and B. ter Weel, 2008, The economics and psychology of personality traits, *Journal of Human Resources*, vol. 43, no. 4, pp. 972-1059.

Borghans, L. and B. ter Weel, 2005, How computerization has changed the labour market: A review of the evidence and a new perspective, in L. Soete and B. ter Weel, eds., *The Economics of the Digital Society*, Edward Elgar, Cheltenham, pp. 219-247.

Borghans, L. and B. ter Weel, 2006, The division of labour, worker organisation, and technological change, *Economic Journal*, vol. 116, no. 509, pp. F45-F72.

Bovenberg, A.L., M.I. Hansen and P.B. Sørensen, 2006, Individual savings accounts for social insurance: Rationale and alternative designs, *International Tax and Public Finance*, vol. 15, no. 1, pp. 67-86.

Bradford De Long, J. and A. Shleifer, 1993, Princes and merchants: European city growth before the industrial revolution, *Journal of Law and Economics*, vol. 36, no. 2, pp. 671-702.

Brakman, S., H. Garretsen, J. Gorter, A. van der Horst and M. Schram, 2005, *New economic geography, empirics, and regional policy*, CPB Special Publication 56, CPB, The Hague.

Brakman. S., H. Garretsen and C. van Marrewijk, 2009, *The New Introduction to Geographical Economics*, Cambridge University Press, Cambridge.

Brakman, S., H. Garretsen, and M. Schramm, 2004, The strategic bombing of German cities during WWII and its impact on city growth, *Journal of Economic Geography*, vol. 4, no. 2, pp 201-218.

Bresnahan, T.F., 1999, Computerisation and wage dispersion: an analytical reinterpretation, *Economic Journal*, vol. 109, no. 456, pp. F390-415.

Bresnahan, T.F., E. Brynjolfsson and L.M. Hitt, 2002, Information technology, workplace organization and the demand for skilled labor: firm-level evidence, *Quarterly Journal of Economics*, vol. 117, no. 1, pp. 339-376.

Bresnahan, T.F. and M. Trajtenberg, 1995, General purpose technologies “engines of growth”?, *Journal of Econometrics*, vol. 65, no. 1, pp. 83-108.

Campante, F. and E.L. Glaeser, 2009, Yet another tale of two cities: Buenos Aires and Chicago, NBER Working Paper 15104.

Caroli, E. and J. van Reenen, 2001, Skill-biased organizational change? Evidence from a panel of British and French establishments, *Quarterly Journal of Economics*, vol. 116, no. 4, pp. 1449-1492.

Combes, P-P., 2000, Economic structure and local growth: France, 1984-1993, *Journal of Urban Economics*, vol. 47, no. 3, pp. 329-355.

Combes, P.-P., G. Duranton, L. Gobillon, D. Puga and S. Roux, 2009, The productivity advantages of large cities: Distinguishing agglomeration from firm selection, CEPR Discussion Paper 7191.

CPB, 1955, Een Verkenning der Economische Toekomstmogelijkheden van Nederland, 1950-1970, CPB, The Hague, see http://www.nl240.nl.

CPB, 1992, Sca*nning the Future, A Long-Term Scenario Study of the World Economy 1990-2015*, Sdu Publishers, The Hague.

CPB, 2002, *De pijlers onder de kenniseconomie; opties voor institutionele vernieuwing*, CPB Special Publication 35, CPB, The Hague.

CPB, 2009, De great moderation in Nederland, CPB Memorandum 226, CPB, The Hague.

Creusen, H. and A. Lejour, 2009, The contribution of trade policy to the openness of the Dutch economy, CPB Document 194, CPB, The Hague.

Cunha, F., J.J. Heckman, L. Lochner and D.V. Masterov, 2006, Interpreting the evidence on life cycle skill formation, in: E. Hanushek and F. Welch, eds., *Handbook of the Economics of Education*, North-Holland, Amsterdam, pp. 697-812.

Datta Gupta, N. and M. Simonsen, 2010, Non-cognitive child outcomes and high quality child care, *Journal of Public Economics*, vol. 94, no. 1, pp. 30-42.

Davis, D.R. and D.E. Weinstein, 2002, Bones, bombs, and break points: The geography of economic activity, *American Economic Review*, vol. 92, no. 5, pp. 1269-1289.

Desmet, K. and E. Rossi-Hansberg, 2009, Spatial growth and industrial age, *Journal of Economic Theory*, vol. 144, no. 6, pp. 2477-2502.

Di Giovanni, J. and A.A. Levchenko, 2009, Putting the parts together: trade, vertical linkages, and business cycle comovement, IMF Working Paper 09/181.

Dole, S.H., 1964, *Habitable Planets for Man*, Blaisdell Publishing Company, New York, NY.

Donders, J., M. van Dijk and G. Romijn, 2010, *Hervorming van het Nederlandse Woonbeleid*, Koninklijke De Swart, The Hague.

Drèze, J. and F. Estevan, 2006, Research and higher education in economics: can we deliver the Lisbon objectives?, CORE Discussion Papers 2006-051.

Drucker, P., 1969, *The Age of Discontinuity; Guidelines to Our changing Society,* Harper and Row, New York, NY.

Duranton, G., 2007, Urban evolutions: The fast, the slow and the still, *American Economic Review*, vol. 97, no. 1, pp. 197-221.

Duranton, G. and D. Puga, 2001, Nursery cities: Urban diversity, process innovation, and the life cycle of products, *American Economic Review*, vol. 91, no. 5, pp. 1454-1477.

Duranton, G. and D. Puga, 2004, Micro-foundations of urban agglomeration economies, in: V. Henderson and J.-F. Thisse, eds., *Handbook of Regional and Urban Economics*, vol. 4, North-Holland, Amsterdam.

Duranton, G. and D. Puga, 2005, From sectoral to functional urban specialisation, *Journal of Urban Economics*, vol. 57, no. 2, pp. 343-370.

Eichholtz, P.M.A., 1997, A long run house price index: The Herengracht index, 1628-1973, *Real Estate Economics*, vol. 25, no. 2, pp. 175-192.

Ellison, G. and E.L. Glaeser, 1997, Geographic concentration in US manufacturing industry: a dartboard approach, *Journal of Political Economy*, vol. 105, no. 5, pp. 889-927.

Feenstra, R.C. and G.H. Hanson, 1999, The impact of outsourcing and high-technology capital on wages: Estimates for the U.S., 1972-1990, *Quarterly Journal of Economics*, vol. 114, no. 3, pp. 907-940.

Feenstra, R.C. and S.-J. Wei, 2009, Introduction to "China's growing role in world trade", NBER Working Paper 14716.

Feldman, M.P. and D.B. Audretsch, 1999, Innovation in cities: Science-based diversity, specialization and localized competition, *European Economic Review*, vol. 42, no. 2, pp. 409-429.

Florida, R., 2002, *The Rise of the Creative Class... and How it's Transforming Work, Leisure, Community and Everyday Life*, Basic Books, New York, NY.

Florida, R., T. Gulden and C. Mellander, 2008, The rise of the mega-region, *Cambridge Journal of Regions, Economy and Society*, vol. 1, no. 3, pp. 459-476.

Friedman, T., 2005, *The World is Flat, A Brief History of the Twenty-first Century*, Farrar, Straus & Giroux, New York, NY.

Fryer, R.G. and S.D. Levitt, 2006, Testing for racial differences in the mental ability of young children, NBER Working Paper 12066.

Galenson, D.W. and B.A. Weinberg, Age and the quality of work: The case of modern American painters, *Journal of Political Economy*, vol. 108, no. 4, pp. 671-777.

Galor, O., 2005, From stagnation to growth: Unified growth theory, in P. Aghion and S. Durlauf, eds., *Handbook of Economic Growth*, North-Holland, Amsterdam, pp. 171-293.

Garicano, L. and E. Rossi-Hansberg, 2006, Organization and inequality in a knowledge economy, *Quarterly Journal of Economics*, vol. 121, no. 4, pp. 1383-1435.

Gaspar, J. and E.L. Glaeser,1998, Information technology and the future of cities, *Journal of Urban Economics*, vol. 43, no. 1, pp. 136-156.

Gelauff, G., I. Grilo and A. Lejour, eds., 2008, *Subsidiarity and Economic Reform in Europe*, Springer-Verlag, Berlin.

Glaeser, E.L., 2005a, Book review of Richard Florida's "The Rise of the Creative Class", *Regional Science and Urban Economics*, vol. 35, no. 3, pp. 593-596.

Glaeser, E.L., 2005b, Reinventing Boston: 1630-2003, *Journal of Economic Geography*, vol. 5, no. 2, pp. 119-153.

Glaeser, E.L., 2010, The paradox of urban triumph, CPB Lecture, 22 June 2010.

Glaeser, E.L. and J.D. Gottlieb, 2009, The wealth of cities: Agglomeration economies and spatial equilibrium in the United States, *Journal of Economic Literature*, vol. 47, no. 4, pp. 983-1028.

Glaeser, E.L., H. Kallal, J. Scheinkman and A. Shleifer, 1992, Growth in cities, *Journal of Political Economy*, vol. 100, no. 6. pp. 1126-1152.

Glaeser, E.L. and D.C. Maré, 2001, Cities and skills, *Journal of Labor Economics*, vol. 19, no. 2, pp. 316-342.

Glaeser, E.L. and A. Saiz, 2004, The rise of the skilled city, *Brookings-Wharton Papers on Urban Affairs*, vol. 5, pp. 47-94.

Glaeser, E.L., J. Scheinkman and A. Shleifer, 1995, Economic growth in a cross-section of cities, *Journal of Monetary Economics*, vol. 36, no. 1, pp. 117-143.

Goldin, C. and L.F. Katz, 2008, *The Race between Education and Technology*, Harvard University Press, Cambridge, MA.

Gorter, J. and S.J. Kok, 2009, Agglomeration economies in the Netherlands, CPB Discussion Paper No. 124, CPB, The Hague.

Griliches, Z., 1992, The search for R&D spillovers, *Scandinavian Journal of Economics*, vol. 94, no. 1, pp. 29-47.

Griffith, R., S. Lee and J. van Reenen, 2007, Is distance dying at last? Falling home bias in fixed effects models of patent citations, NBER Working Paper W13338.

Grossman, G.M. and E. Rossi-Hansberg, 2006, The rise of offshoring: It's not wine for cloth anymore, in: Jackson Hole Conference Volume, *The New Economic Geography: Effects and Policy Implications*, Federal Reserve Bank of Kansas City, Kansas City, KS, pp. 59-102.

Grossman, G.M. and E. Rossi-Hansberg, 2008, Trading tasks: A simple theory of offshoring, *American Economic Review*, vol. 98, no. 5, pp. 1978-1997.

Gyourko, J., C.J. Mayer and T. Sinai, 2006, Superstar cities, Wharton Real Estate Center Working Paper, The Wharton School, University of Pennsylvania.

Hanushek, E.A., 2003, The failure of input-based schooling policies, *Economic Journal*, vol. 113, no. 485, pp. F64-F98.

Hanushek, E.A. and D.D. Kimko, 2000, Schooling, labor force quality, and the growth of nations, *American Economic Review*, vol. 90, no. 5, pp. 1184-1208.

Hanushek, E.A. and S.G. Rivkin, 2010, Generalizations about using value-added measures of teacher quality, *American Economic Review*, vol. 100, no. 2, pp. 267-271.

Harford, T., 2006, *The Undercover Economist*, Little, London.

Harris, R.G., 1998, Internet as the GPT: Factor market implications, in E. Helpman, ed., *General Purpose Technologies and Economic Growth*, MIT Press, Cambridge, MA, pp. 145-166.

Head, K., T. Mayer and J. Ries, 2009, How remote is the offshoring threat?, *European Economic Review*, vol. 53, no. 4, pp. 429-444.

Heckman, J.J., 2007, The economics, technology and neuroscience of human capability formation, *Proceedings of the National Academy of Sciences*, vol. 104, no. 33, pp. 13250-13255.

Heckman, J.J. and B. Jacobs, 2010, Policies to create and destroy human capital in Europe, NBER Working Paper 15742

Helpman, E., ed., 1998, *General Purpose Technologies and Economic Growth*, MIT Press, Cambridge, MA.

Helpman, E., 2006, Trade, FDI and the organization of firms, *Journal of Economic Literature*, vol. 44, no. 3, pp. 589-630.

Helpman, E. and M. Trajtenberg, 1998a, A time to sow and a time to reap: Growth based on General purpose technologies, in E. Helpman, ed., *General Purpose Technologies and Economic Growth*, MIT Press, Cambridge, MA, pp. 55-83.

Helpman, E. and M. Trajtenberg, 1998b, Diffusion of general purpose technologies, in E. Helpman, ed., *General Purpose Technologies and Economic Growth*, MIT Press, Cambridge, MA, pp. 85-119.

Henderson, J.V., 2003, Marshall's scale economies, *Journal of Urban Economics*, vol. 53, no. 1, pp. 1-28

Hobijn, B. and D. Comin, 2004, Cross-country technology adoption: Making the theories face the facts, *Journal of Monetary Economics*, vol. 51, no. 1, pp. 39-83.

Ioannides, Y.M., H.G. Overman, E. Rossi-Hansberg and K. Schmidheiny, 2008, The effect of information and communication technologies on urban structure, *Economic Policy*, vol. 23, no. 54, pp. 201-242.

Jacobs, B. and F. van der Ploeg, 2006, Guide to reform of higher education: A European perspective, *Economic Policy*, vol. 21, no. 47, pp. 537-592.

Jacobs, J., 1961, *The Death and Life of Great American Cities*, Vintage Books, New York, NY.

Jacobs, J., 1969, *The Economy of Cities*, Pinguin Books, Middlesex.

Jones, B.F., 2010, As science evolves, how can science policy?, NBER Working Paper 16002.

Jones, C.I., 2002, *Introduction to Economic Growth*, WW Norton and Company, New York, NY.

Jones, C.I. and P.M. Romer, 2010, The new Kaldor facts: Ideas, institutions, populations and human capital, *American Economic Journal: Macroeconomics*, vol. 2, no. 1, pp. 224-245.

Jongen, E. and A. van Vuren, 2008, Individuele spaarrekeningen voor werkloosheid: mirakel of mythe?, CPB Document 135, CPB, The Hague.

Jovanovic, B. and P.L. Rousseau, 2005, General purpose technologies, in P. Aghion and S. Durlauf, eds., *Handbook of Economic Growth*, North-Holland, Amsterdam, pp. 1181-1224.

Klahr, D. and H.J. Leavitt, 1967, Tasks, organizational structures, computers, in: C.A. Myers, ed., *The Impact of Computers on Management*, MIT Press, Cambridge, MA.

Knudsen, E.I., J.J. Heckman, J.L. Cameron and J.P. Shonkoff, 2006, Economic, neurobiological, and behavioral aspects on building America's future workforce, *Proceedings of the National Academy of Sciences*, vol. 103, no. 27, pp. 10155-10162.

Kremer, M., 1993, The o-ring theory of economic development, *Quarterly Journal of Economics*, vol. 108, no. 3, pp. 551-575.

Krueger, D and F. Perri, 2009, Public versus private risk sharing, NBER Working Paper 15582.

Krugman, P.R., 1980, Scale economies, product differentiation, and the pattern of trade, *American Economic Review*, vol. 70, no. 5, pp. 950-959.

Krugman, P.R., 1991, Increasing returns and economic geography, *Journal of Political Economy*, vol. 99, no. 3, pp. 483-499.

Krugman, P.R. and R. Livas Elizondo, 1996, Trade policy and the third world metropolis, *Journal of Development Economics*, vol. 49, no. 1, pp. 137-150.

Leamer, E.E., 2007, A flat world, a level playing field, a small world after all, or none of the above: A review of Thomas L. Friedman's *The World is Flat*, *Journal of Economic Literature*, vol. 43, no. 1, pp. 83-126.

Liu, X., A. Park and Y. Zhao, 2010, Explaining rising returns to education in urban China in the 1990s, IZA Discussion Paper 4872.

Lovely, M., S. Rosenthal and S. Sharma, 2005, Information, agglomeration, and the headquarters of U.S. exporters, *Regional Science and Urban Economics*, vol. 35, no. 1, pp. 167-191.

Lucas, R.E., 1993, Making a miracle, *Econometrica*, vol. 61, no. 2, pp. 251-272.

Machlup, F., 1962, *The Production and Distribution of Knowledge in the United States*, Princeton University Press, Princeton, NJ.

Mak, G., 1999, *De Eeuw van mijn Vader*, Atlas, Amsterdam.

Markusen, J.R., 2002, *Multinational Firms and the Theory of International Trade*, MIT Press, Cambridge, MA.

Marlet, G.A. and C.M. van Woerkens, 2007, The Dutch creative class and how it fosters urban employment growth, *Urban Studies*, vol. 44, no. 13, pp. 2605-2626.

Marshall, A. 1890, *Principles of Economics*, Macmillan, London.

Marshall, A. 1920, The social possibilities of economic chivalry, *Economic Journal*, vol. 17, no. 65, pp. 7-29.

Melitz, M.J., 2003, The impact of trade on intraindustry reallocations and aggregate industry productivity, *Econometrica*, vol. 71, no. 5, pp. 1695-1725.

Miroudot, S., R. Lanz and A. Ragoussis, 2009, Trade in intermediate goods and services, OECD Trade Policy Working Papers 93.

Mokyr, J., 1993, Technological progress and the decline of European mortality, *American Economic Review*, vol. 83, no. 2, pp. 324-330.

Mooij, R. de, 2006, *Reinventing the Welfare State*, Koninklijke De Swart, The Hague.

Mooij, R. de, and P. Tang, 2003, *Four Futures of Europe*, Koninklijke De Swart, The Hague.

Moretti, E., 2010, Local labor markets, NBER Working Paper 15947.

Murata, Y. and J.-F. Thisse, 2005, A simple model of economic geography à la Helpman-Tabuchi, *Journal of Urban Economics*, vol. 58, no. 1, pp. 137-155.

Nelson, C.A., 2000, The neurobiological bases of early intervention, in: J.P. Shonkoff en S.J. Meisels, eds., *Handbook of Early Child Intervention*, Cambridge University Press, New York, NY, pp. 204-227.

Nelson, R.R., 1959, The simple economics of basic scientific research, *Journal of Political Economy*, vol. 67, no. 3, pp. 297-306.

Nelson, R.R. and E.S. Phelps, 1966, Investment in humans, technological diffusion, and economic growth, *American Economic Review*, vol. 56, no 1, pp. 69-75.

North, D.C., 1981, *Structure and Change in Economic History*, Nueva York, New York, NY.

North, D.C., 1994, Economic Performance through time, *American Economic Review*, vol. 84, nr. 3, pp. 359-368.

Orwell, G., 1949, *1984*, New American Library, New York, NY.

Ottaviano, G., 2008, Infrastructure and economic geography: an overview of theory and evidence, *European Investment Bank Papers*, vol. 13, no. 2, pp. 8-35.

Pred, A., 1966, *The Spatial Dynamics of US Urban Industrial Growth*, MIT Press, Cambridge, MA.

Putnam, R., 2000, *Bowling Alone: The Collapse and Revival of American Community*, Simon and Schuster, New York, NY.

Rauch, J.E., 1993., Does history matter only when it matters little? The case of city-industry location, *Journal of Urban Economics*, vol. 108, no. 3, pp. 843-867.

Ricardo, D., 1817, *On the Principles of Political Economy and Taxation*, John Murray, London.

Rifkin, J., 2004, *The European Dream: How Europe's Vision of the Future Is Quietly Eclipsing the American Dream*, Penguin, New York, NY.

Romer, P.M., 1986, Increasing returns and long-run growth, *Journal of Political Economy*, vol. 94, no. 5, pp. 1002-1037

Romer, P.M., 2010, Which parts of globalization matter for catch-up growth?, NBER Working Paper 15755.

Rossi-Hansberg, E. and G. Wright, 2007, Establishment size dynamics in the aggregate economy, *American Economic Review*, vol. 97, no. 5, pp. 1639-1666.

Sala-i-Martin, X., 2006, The world distribution of income: Falling poverty and ... convergence, period, *Quarterly Journal of Economics*, vol. 121, no. 2, pp. 351-397.

Segal, C., 2008, Classroom behavior, *Journal of Human Resources*, vol. 43, no. 4, pp. 783-814.

Shiller, R.J. and A.N. Weiss, 1999, Home equity insurance, Home equity insurance, *Journal of Real Estate Finance and Economics*, vol. 19, no. 1, pp. 21-47.

Simon, C.J. and C. Nardinelli, 2002, Human capital and the rise of American cities, 1900-1990, *Regional Science and Urban Economics*, vol. 32, no. 1, pp. 59-96.

Smith, A., 1776, *An Inquiry into the Nature and Causes of the Wealth of Nations*, Methuen, London.

Soete, L. and B. ter Weel, 2005, *The Economics of the Digital Society*, Edward Elgar, Cheltenham.

Storper, M. and A. Venables, 2004, Buzz: face-to-face contact and the urban economy, *Journal of Economic Geography*, vol. 4, no. 2, pp. 351-370.

Straathof, B., G.J. Linders, A. Lejour and J. Möhlmann, 2008, The internal market and the Dutch economy: Implications for trade and economic growth, CPB Document 168, CPB, The Hague.

Suyker, W. and H.L.F. de Groot, 2006, China and the Dutch economy: Stylised facts and prospects, CPB Document 127, CPB, The Hague.

Teixeira, A.C., 2006, Transport policies in light of the new economic geography: the Portuguese experience, *Regional Science and Urban Economics*, vol. 36, no. 4, pp. 450-466.

Urzua, S., 2008, Racial labor market gaps: The role of abilities and schooling choices, *Journal of Human Resources*, vol. 43, no. 4, pp. 919-971.

Varian, H.R., 2010, Computer mediated transactions, *American Economic Review*, vol. 100, no. 2, pp. 1-10.

Venables, A.J., 2001, Geography and international inequalities: The impact of new technologies, *Journal of Industry, Competition and Trade*, vol. 1, no. 2, pp. 135-159.

Von Hippel, E., 1994, Sticky information and the locus of problem solving: Implications for innovation, *Management Science*, vol. 40, no. 4, pp. 429-439.

Vries, J. de, 1984, *European Urbanization, 1500-1800*, MIT Press, Cambridge, MA.

Weinberg, B.A. and D.W. Galenson, 2007, Creative careers: The life cycles of Nobel laureates in economics, NBER Working Paper 11799.

Williamson, O.E., 1975, *Markets and Hierarchies: Analysis and Antitrust Implications*, The Free Press, New York, NY.

Wright, R., 2000, *Nonzero: The Logic of Human Destiny*, http://www.nonzero.org.

Wuchty, S., B.F. Jones and B. Uzzi, 2007, The increasing dominance of teams in production of knowledge, *Science*, vol. 316, no. 5827, pp. 1036-1039.

Youtie, J., M. Iacopetta and S. Graham, 2008, Assessing the nature of nanotechnology: can we uncover an emerging general purpose technology?, *Journal of Technology Transfer*, vol. 33, no. 3, pp. 315-329.

2040

Young people choosing to invest in schooling, firms setting up a new business, workers deciding where to pursue their careers, and governments aiming at strategic policymaking all have to make decisions about an uncertain future. Scenarios help to visualise the consequences of their choices against a set of possible futures.

This study presents four scenarios that can be used to think about the Dutch economic prospects in 2040: how will we earn our daily bread in thirty years' time? People and cities are the foundational building blocks of the scenarios. The study is about who earns the money and where it is earned. What will the future bring for workers in the Netherlands? In what types of cities will production take place? How will we educate our next generation of workers?

Where will the Dutch economy be in 2040? And how should citizens and policymakers deal with the uncertainty of taking decisions at present on policies with long-term consequences? In response to the various challenges that might be foreseen during the next three decades, the study explores the policy agenda in three areas: the attractiveness of the Dutch place of business, the future of the knowledge economy and the challenges for the labour market.

ISBN 978-90-5833-461-9