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Two Quantitative Scenarios for the Future of Manufacturing in Europe

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Abstract in English

This paper presents two scenarios for the future of manufacturing in Europe with varying trends in globalisation, technological progress and energy efficiency. From these scenarios, we conclude that the trend towards a services economy is likely to continue with employment shifting away from manufacturing towards services. However, manufacturing production still grows and is important for trade in Europe. The sectors which are already the most open ones for international trade are also the ones mostly affected by this trend. These include chemicals, rubber and plastics, the combined machinery and equipment sectors, textiles and wearing apparel, and wood and other manufacturing. R&D policies and internal market policies in Europe can have strong positive impact on manufacturing. These policies do not alter the trend that Europe's share in global production and trade will continue to decline, but they do mitigate the overall decline, in particular in the chemicals, rubber and plastics, and combined machinery and equipment sectors.

Key words: Scenarios, Manufacturing, Industrial policy, Europe

JEL code: L60, C68

Abstract in Dutch

Dit document presenteert twee scenario's voor de toekomst van de industrie in Europa met verschillende trends voor globalisering, technologische vooruitgang en energie-efficiëntie. We concluderen dat de verschuiving naar een diensteneconomie zich waarschijnlijk voortzet met een bijbehorende verschuiving van de werkgelegenheid. De industriële productie blijft echter toenemen en blijft belangrijk voor de handel in Europa. De industriële sectoren die het meest internationaal georiënteerd zijn, worden ook het meest beïnvloed. Dit zijn chemie, rubber en plastic, machines en apparaten, textiel en kleding en hout en overige industrie. R&D-beleid en interne-marktbeleid in Europa kunnen een significante positieve invloed op industriële productie hebben. Dit beleid verandert niet de trend van Europa's dalende aandelen in de wereld productie en handel, maar zwakt deze daling wel af. Dit geldt in het bijzonder voor de chemie, rubber en plastic en machines en apparaten.

Steekwoorden: scenario's, industriële sectoren, industriebeleid, Europa

Een uitgebreide Nederlandse samenvatting is beschikbaar via www.cpb.nl.

Contents

Preface	7
Summary	9
1 Introduction	11
2 Quantification of the scenarios	13
3 Framework policies and the macro impact on manufacturing	21
4 Manufacturing in Cosy at Home	27
5 Manufacturing in Adventuring in the World	35
6 Conclusions	43
References	45
Common characteristics in the scenarios	47

Preface

Manufacturing in Europe is affected by a changing world. Globalisation, EU integration, shifting demand and progress in science and technology, and innovation will all have a major impact on how the manufacturing landscape in Europe in terms of location, production, distribution of labour and physical appearance will manifest itself in the near and longer-term future. Change creates opportunities but also challenges. This is true for European citizens and European firms, but also for national governments and the European Union.

This study investigates the future of manufacturing in Europe using a scenario approach. The purpose of this long-term scenario study is twofold: to provide policy makers, decision makers and others with two long-term scenario-based views on the future of European manufacturing, and to explore the scope for EU policies to affect this future positively.

The development of these two scenarios has been requested by the European Commission and carried out within the Framework Service Contract B2/ENTR/05/091 – FC. The main results are summarized in the Competitiveness Report 2007 published by the European Commission (2007b), November 2007. This document provides more details of the study, in particular on the quantification of the scenarios. CPB and TNO collaborated in this study. Arjan Lejour and Gerard Verweij co-authored this paper. They benefited from comments by the commission, in particular by Emmanuelle Maincent and Ronald MacKay, who supervised the project, and Felix Brandes and Frans van der Zee from TNO.

Coen Teulings
Director CPB

Summary

Is there a future for manufacturing in Europe and can framework policies help to improve this future? The glory time for manufacturing as steering engine for Europe's economy and provider of employment for the majority of its labour force is over. The share of manufacturing in employment as well as in value added decreases in the OECD countries, including Europe, already for decades. However, three quarters of all trade is trade in goods, and its productivity still increases much faster than productivity in services. This document provides a quantitative scenario study showing that the trend of a declining manufacturing sector is likely to continue over the next decades and that Asia will become the world's most important provider of manufacturing goods. It also shows that framework policies can help to mitigate this decline, but not reverse it. This does not mean that there is no future for manufacturing in Europe. In 2025 Europe's share in the overall global manufacturing production and trade will still be about 20%, and manufacturing will still contribute more than 15% to value added in Europe. A further strengthening of the internal market and adequate R&D and innovation policies can have a substantial impact on these shares; both are within reach of EU policy-making. We do not want to imply however that these policies have to be pursued. These facilitate growth in manufacturing but these policies are not necessary optimal to stimulate welfare or economic growth in Europe.

The literature indicates that globalisation, technological progress, business models, ageing and the availability of energy and sustainability of the environment are among the main drivers for the future of manufacturing in Europe. The future trends of these drivers are uncertain. In order to assess Europe's future in manufacturing two scenarios have been developed with varying quantitative trends in globalisation, technological progress and energy efficiency. From these scenarios, we conclude that the trend towards a services economy is likely to continue, with employment shifting away from manufacturing towards services and with manufacturing contributing less to the European economy in terms of employment and value added. However, manufacturing production still grows and is important for trade in Europe. In the *Adventuring the World* scenario in which globalisation and technological progress thrive, production grows quickly, but the geographical centre of global manufacturing production shifts to Asia. In the *Cosy at Home* scenario with less globalisation and technological progress, production grows more slowly and the European share in global production is relatively larger.

A number of interesting conclusions on the future of manufacturing in Europe can be drawn. The increase in trade and, more generally, globalisation appears to be one of the most important drivers. The manufacturing sectors which are already most open for international trade are also the ones mostly affected by this trend. These include textiles and wearing apparel, wood and other manufacturing, chemicals, rubber and plastics, electronic equipment, transport equipment

and other machinery and equipment. Overall, the sectors food products and pulp, paper and publishing are less affected. These are sectors which are more domestically oriented, less R&D intensive and face less technological progress. Europe has no comparative advantages in textiles and wearing apparel, electronic equipment and basic metals. These disadvantages will further manifest themselves in the oncoming twenty years. This in particular applies to electronic equipment which – while in the past a relative big sector - will decline even further. Textiles and wearing apparel is an already small sector in terms of value added and employment, which means that an even less prosperous future for this sector will also have less overall impact. Chemicals, rubber and plastics, transport equipment and other transport and equipment will remain important manufacturing sectors in Europe, although the comparative advantages in the other machinery and equipment sector will slide away.

It has to be noted that the developments may also differ *within* the ten manufacturing sectors identified. In most of these aggregate sectors one can distinguish between basic and specialized manufacturing. Basic manufacturing will on average be more affected by international competitiveness than specialized manufacturing. Possible intra-sector shifts from basic to specialized manufacturing are not analysed here, but are certainly relevant.

Of the framework policies analysed in this study, R&D and innovation policies and strengthening the internal market have the strongest and most positive impact on manufacturing. These are also the most ambitious in terms of policy formulation and implementation, but potentially very effective in supporting manufacturing because of their R&D intensive and open-to-trade nature. Improving skills, reducing the administrative burden and increasing energy efficiency have the least impact on manufacturing. The framework policies do not alter the trend that Europe's share in global production and trade will continue to decline, but they do mitigate the overall decline, in particular in the chemicals, rubber and plastics, and combined machinery and equipment sectors.

1 Introduction

Manufacturing in Europe is affected by a changing world. Firstly, in 2004 ten countries joined the EU, in 2007 followed by Bulgaria and Rumania. Most of the new Member States have a different economic structure and other comparative advantages than the 'old' EU-15, in particular in labour-intensive industries. This is also the case for the candidate Member States in the Balkan countries and Turkey. Enlargement hence not only offers opportunities in terms of a larger domestic EU market, but also in terms of specialisation and - associated - economies of scale and scope.

Secondly, there is the new wave of globalisation, which is unprecedented both in scale and in speed. This process of economic integration - with resources becoming more mobile, economies becoming increasingly interdependent and financial markets becoming increasingly international – has important implications for the future of manufacturing. This also holds for the integration of China and India in the world economy, home to about 35 percent of the world population. Both countries are leading and highly competitive exporters, India in software and IT-enabled services, and China in skill-intensive manufactures. Especially China has emerged as the new locomotive of the Asian region, and has in less than 20 years become the main world's manufacturing and trade platform. Globalisation has also impacted European manufacturing in another way: lower production costs and the potential of huge new consumer markets have caused European manufacturers to increase the quality and design of their products and have led to international sourcing of (parts of their) production.

Thirdly, consumer demand in Europe itself is changing. As its citizens are becoming richer, they demand more services and make more requirements on manufactured goods. Demographics (ageing) might strengthen this change.

Finally, the pace of technological change appears to have sped up, in view of globalisation and increasing international competition. Globalisation, EU integration, shifting demand and progress in science and technology, and innovation – whether disruptive or not – will all have a major impact on how the manufacturing landscape in Europe in terms of location, production, distribution of labour and physical appearance will manifest itself in the near and longer-term future. Change creates opportunities but also challenges. This is true for European citizens and European firms, but also for national governments and the European Union.

The future of manufacturing is assessed using two scenarios. The purpose of the scenarios is twofold: to provide policy makers, decision makers and others with two long-term scenario-based views on the future of European manufacturing, and to explore the scope for EU policies to positively address and influence the future. The scenarios have been developed in three consecutive stages, consisting of (i) a survey of existing futures studies, (ii) the drafting of qualitative scenarios, and (iii) a quantification of the scenarios using WorldScan, a dynamic applied general equilibrium model for the world economy (Lejour et al., 2006).

The survey of futures studies (Van der Zee and Brandes, 2007) served two goals: to help identifying the relevant main drivers and trends that from our current perspective and knowledge can be seen as key to the future of manufacturing in Europe, and to explore what other expert groups and think tanks regard as possible manufacturing futures.

These drivers and trends have been translated in two scenarios and are extensively described in Brandes et al. (2007). In this study scenarios are conceived as feasible and consistent views of the future. They do not aim to predict the future, but rather to sketch alternative futures. These future states of the world then form the background against which strategic decisions can be explored. The uncertainty is reflected by sketching different developments in the fundamental drivers for the future of manufacturing in Europe.

This document concentrates on the quantification of the scenarios and less on the qualitative scenarios. The scenarios are quantified for three main reasons. The first is that the model ensures that the scenarios are consistent in several respects, since economic variables conform to identities, constraints and the current knowledge about interactions in the economy. Secondly, the quantification gives a feel for the relative importance of various developments for the future well-being of society. Thirdly, the model offers also the possibility to assess the impact of framework policies and their relative importance. These two scenarios differ from the CPB scenarios in the Four Futures (FF) study (De Mooij and Tang, 2003). First, the scenarios developed here focus on manufacturing. Much more manufacturing sectors are distinguished and described than in the FF study. Second, the future trends are based upon the survey of Van der Zee and Brandes (2007). Third, the FF study develops four scenarios around two key uncertainties: the degree of international cooperation and the mix of public and private responsibilities. The two manufacturing scenarios do not take account of the latter key uncertainty. Fourth, this study focuses on the enlarged EU of 27 Member States, while the FF study concentrates mainly on EU15.

The contents of this study are as follows. Section 2 provides a numerical illustration of the macroeconomic developments in the scenarios using WorldScan. Section 3 analyses the impact of framework policies in support of manufacturing developments in Europe. Section 4 focuses on the developments in European manufacturing in the *Cosy at Home* scenario. Similarly, section 5 discusses the results of the *Adventuring the World* scenario. Section 6 concludes.

2 Quantification of the scenarios

This section provides a numerical illustration of the two scenarios until 2040, but with a focus on the period until 2025. It foremost illustrates scenario trends related to economic growth and economic integration which are at the heart of the WorldScan model (Lejour et al. , 2006). The two scenarios exemplify two explicit but ‘moderate extremes’. In *Cosy at Home*, inward-looking, risk-averse, indecisive behaviour in the public as well as in the private realm dominate. In this scenario, technical progress is low, transport and communications costs do not decline, trade barriers remain in place and energy efficiency does not improve drastically. These elements are quantified below. In *Adventuring the World* outward-looking (resulting in a further opening-up), risk-loving and pro-active behaviour are prime. New technologies succeed each others quickly, trade barriers are slashed down and transport and communication possibilities improve. Moreover, energy use is becoming more and more efficient. Brandes et al. (2007) give a more extensive description of the qualitative scenarios.

Worldscan

WorldScan is a multi-sector, multi-region Applied General Equilibrium (AGE) model. The model builds upon neoclassical theory, and solves for the equilibrium that maximizes welfare across the entire economy, subject to technological constraints, greenhouse gas limitations, etc.). Producers maximise their profits and consumers maximise their utility. Production technologies relate output to inputs, so a potential increase in the output of a sector leads to extra demand for inputs. This links output to input markets. Moreover, trade flows between countries, and in particular two-way intra-industry trade, are well modelled. The integration of national goods and services markets and of capital markets creates the possibility to analyse spillovers between countries. Another advantage is that these models distinguish several sectors in the economy. This model version inhibits endogenous R&D decisions and spillovers and with imperfect competition. It distinguishes 15 regions and 20 sectors. Seven large EU countries are modelled separately, and two aggregates for the other old and new member states. Also United States, Japan, China, India South-East Asia and the rest of the world are distinguished. The sectors are agriculture, energy, ten manufacturing sectors and seven services sectors. The last sector is the R&D sector.

This section presents the variation in exogenous inputs between the scenarios and the outcomes. Table 2.1 gives an overview of the scenario-specific trends. These trends determine the variation between the scenarios in two ways: directly, because the exogenous trends differ between the scenarios; and indirectly, because these differences imply also the variation in the model outcomes. Both scenarios have also common characteristics. These are presented in the appendix.

The exogenous trends are subdivided into three categories: Labour productivity (includes unemployment), Global trade relations, and Capital (including savings) and Energy markets. Each category is discussed separately in one of the succeeding sections.

Table 2.1 **Variation in exogenous inputs**

Trend	Cosy at Home	Adventuring the World
Labour productivity EU	low	high
Unemployment rate	constant over time	declining
Global trade barriers	high	low
Energy efficiency	low	high
Savings policy	no	yes
Capital mobility	low	high

Note that the terms low and high are used to describe the development of a trend in one scenario compared with the development in the other scenario. It is not meant to characterise differences between various trends in one scenario.

2.1 **Labour productivity**

Adventuring the World is the globalisation scenario represented by successful trade-liberalisation rounds and increasing capital mobility. Economic growth is high in *Adventuring the World* because of more technology spillovers and a more rapid catching up of the developing countries (represented in higher TFP growth). Table 2.2 presents the annual average growth rates in labour productivity for the sub-periods 2006-2025 and 2025-2040. The growth in labour productivity is heavily based on the growth in TFP and the capital-labour ratio. *Adventuring the World* focuses on a smooth functioning of national and international goods and services markets. Innovation and fierce competition spur labour productivity all over the world. The twelve new EU members and Asia catch-up fast with the EU-15 and the rest of the OECD. The growth in labour productivity in the Rest of the World is much lower than in these catching-up regions.

Table 2.2 **Labour productivity growth, annual averages 2006-2040 by region**

	Cosy at Home		Adventuring the World	
	2006-2025	2025-2040	2006-2025	2025-2040
EU27	1.5	1.2	2.5	2.7
EU-15	1.3	1.0	2.4	2.5
EU-12	3.1	2.2	4.7	3.8
Rest OECD	1.3	0.9	2.0	2.0
Asia	3.3	2.8	4.6	4.2
Rest of the World	1.9	1.8	2.9	2.8

Source: WorldScan.

In *Cosy at Home*, labour productivity growth is lower than in *Adventuring the World*: the difference is about 1 %. No important innovations spur economic growth. This is the case for all regions.

Table 2.2 shows that the spread for the EU-27 between labour productivity growth rates is 1.5%-point. As we see below, that explains a large part of the variation in GDP growth. From the table, it also follows for the EU-27 that labour productivity growth differs in *Cosy at Home* about 0.3%-points and in *Adventuring the World* 0.2%-points between the period 2006-2025 and the period 2025-2040. However, sectoral TFP growth is constant over time.¹ Two mechanisms explain this apparent contradiction. First, the economy shifts from manufacturing towards services. Macro labour productivity growth is the aggregate of sectoral growth, and service sectors inhibit productivity growth less than the former sectors. Second, the growth of the capital-labour ratio also affects labour productivity growth.

Table 2.2 also reveals the pattern of catching up. Labour productivity growth in poorer regions, i.e. the EU-12 members and the non-OECD, exceeds that in the EU-15, the United States and Japan. This process will, in time, narrow the gap in GDP per capita between regions. The developments in labour productivity and employment growth determine GDP growth.

Table 2.3 GDP growth, annual averages 2006-2040 by region

	Cosy at Home		Adventuring the World	
	2006-2025	2025-2040	2006-2025	2025-2040
EU27	1.3	0.7	2.5	2.3
EU-15	1.2	0.7	2.4	2.3
EU-12	2.6	0.9	4.4	2.6
Rest OECD	1.5	1.2	2.3	2.3
Asia	4.6	3.3	6.1	4.8
Rest of the World	3.3	2.5	4.5	3.6
World	2.3	1.9	3.4	3.1

Source: WorldScan.

The pattern of GDP growth in Table 2.3 is similar to that of labour productivity growth. Therefore, 0.1% between 2006 and 2025, which results in a slightly lower GDP growth compared with labour productivity growth. Between 2025 and 2040, this effect becomes stronger for the EU-15: employment declines with about 0.2% to 0.3% resulting in a lower GDP growth compared with labour productivity growth. The decline in employment for the EU-15 consists of a declining population growth and participation rate. For the new EU-27 members, the differences between GDP growth and labour productivity growth are more pronounced. Between 2006 and 2025 employment declines with 0.3% or 0.5% and between 2025 and 2040 with 1.2% or 1.3%. The large differences between 2006-2025 and 2025-2040

¹ Except for the transition path between current TFP growth in 2006 and scenario specific TFP growth 2010.

are mainly due to a fall in participation rate over time. Therefore, GDP growth is relatively low in comparison with the labour productivity growth for the new EU-27 members.

2.2 A redirection of trade

In *Adventuring the World*, global trade-liberalisation is successful and leads to a reduction in tariffs and NTBs between 2006-2015 (Doha round) and 2021-2030 (post-Doha round). The Doha round leads worldwide to a reduction of tariffs in manufacturing and services with 50% and in agriculture, food and raw materials with 25%. Also the NTBs are reduced with 25%. The post-Doha round encompasses a further reduction of tariffs in the manufacturing and services sectors with 50% and in agriculture, food and raw materials with 25%. Again, the NTBs are reduced with 25%. In *Cosy at Home*, global trade liberalisation fails.

In *Adventuring the World*, we furthermore assume that the costs of international trade are gradually reduced with 80%. This will facilitate international trade. In *Cosy at Home*, the situation is quite different; for the EU-15 members the costs of international trade are reduced with only 50%, while outside the EU-15 international trade costs are even increased with 50%.

The variation in regional and global trade policies leads to a diverse picture of openness in the scenarios. Table 2.4 presents the openness of the EU-27 and the other regions. Openness is measured as the average value of imports and exports divided by national income. It also includes intra EU-27 trade, which is an important share of total trade, as we will see below. In the *Cosy at Home* scenario openness is about constant over time for the EU-15 and the rest OECD, but decreases with 5 to 10% for the other regions. The shift to services in the latter regions which are less open for cross border trade is the main reason for the overall drop in openness. This is completely different in *Adventuring the World*, which features liberalised global trade. Not only are tariffs and non-tariff barriers lowered or even eliminated, but also trade is facilitated by more transparent and uniform customs procedures. The degree of openness increases by about 10%-points and for Asia by even 25%-points compared to *Cosy at Home*.

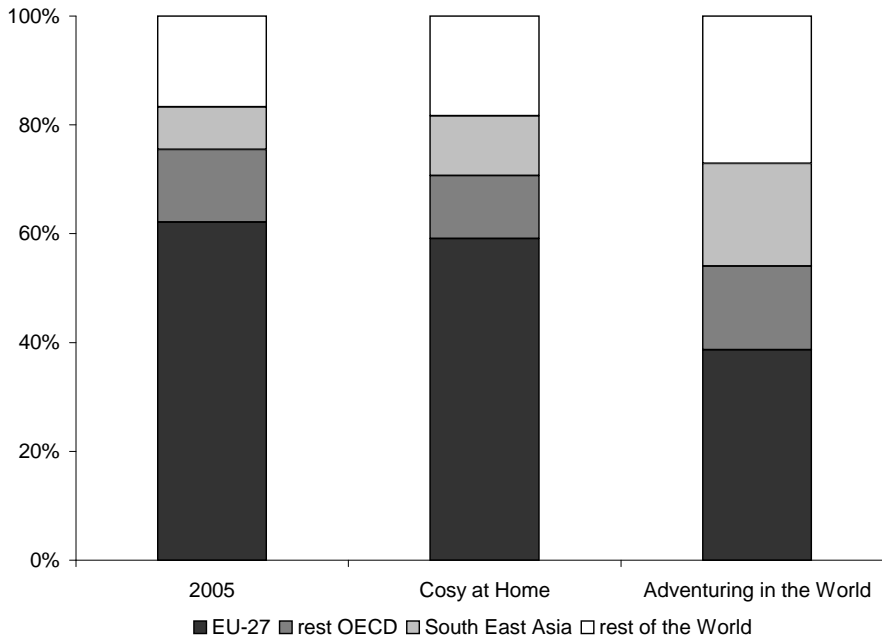
Table 2.4 Openness of the various regions in 2040

	2005	Cosy at Home	Adventuring the World
EU-27	34.1	33.3	39.3
EU-15	32.2	31.7	37.1
EU-12	63.5	51.0	62.8
Rest OECD	10.4	11.5	19.4
Asia	30.3	22.8	47.3
Rest of the World	22.8	17.7	31.9

Source: WorldScan; all aggregates include intra trade

Changes in the openness of regions and differences in regional growth patterns affect also the size and direction of trade flows. The direction of trade changes drastically in both scenarios as shown in Figure 2.1.

Figure 2.1 Direction of EU-27 exports flows in 2005 and 2025



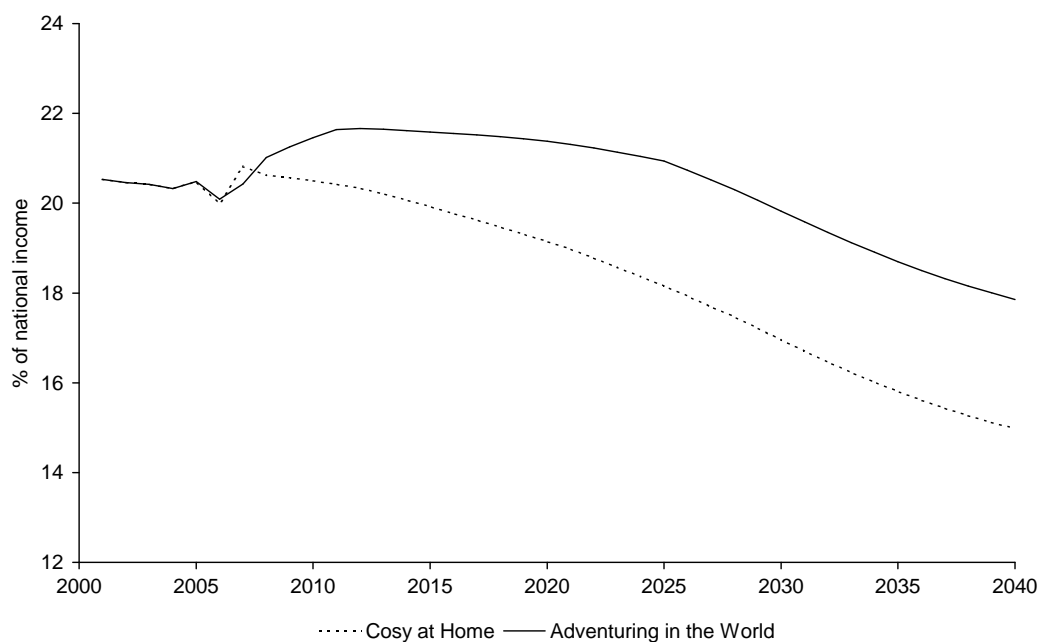
Asia will become a more important trading partner for Europe during the coming decades in *Cosy at Home* and *Adventuring the World*, in particular. This is triggered by high economic growth in Asia. This redirection of trade goes at the expense of the internal EU-27 trade share. Also the Rest of the World, as Figure 2.1 shows, becomes a more important trading partner for the EU-27, although less pronounced as South East Asia. In general, the redirection of trade is stronger in *Adventuring the World*, with its high GDP per capita growth and trade liberalisation, than in *Cosy at Home*.

2.3 Capital and energy markets

In the globalisation scenario *Adventuring the World*, we assume that capital market integration will increase. In this scenario, it will become easier for the EU-27 to attract capital from abroad in order to finance investment, given the decreasing macro saving rates due to ageing.

Moreover, we assume that governments in the EU-27, and also in the US and Japan, are active in increasing savings by eliminating budget deficits and by stimulating private savings. This is reflected by higher macro savings rates of about 2% -points in 2020 and 2040.

Figure 2.2 Savings as share of national income in the EU



Governments do not follow these policies in *Cosy at Home*, and saving rates are subsequently lower. Besides that, in the fragmented world of *Cosy at Home*, capital mobility is even reduced. Irrespective of these differences, Figure 2.2 shows that saving rates in the EU decline in both scenarios because of the aging population (see Lejour et al., 2006).

Savings depend on GDP per capita growth, demographic characteristics and savings policies. Higher GDP growth stimulates savings, while ageing hinders it. As a result, savings are highest in *Adventuring the World* and lowest in *Cosy at Home* (as confirmed in Table 2.5). Even in *Adventuring the World*, national savings in the EU-27 decline (as a share of national income) by 3%-points. The effect of ageing on savings dominates the effects of higher GDP growth and a savings policy. In South East Asia, savings decline by about 6%-points. The savings in the rest OECD also decline, but somewhat less than in the EU.

Table 2.5 National savings (as ratio of national income)

	Past	Cosy at Home		Adventuring in the World	
	2005	2025	2040	2025	2040
EU-27	20.5	18.2	15.0	20.9	17.9
EU-15	20.3	18.2	15.2	21.2	18.3
EU-12	23.3	17.7	12.3	18.2	12.8
Rest OECD	19.8	16.5	15.7	18.7	18.0
South East Asia	30.2	29.7	24.3	30.0	24.6
Non-OECD	20.7	21.1	19.1	21.3	19.4

Source: WorldScan

The international capital markets play only a minor role in determining the sectoral production structure, because the capital inputs are distributed quite homogenous across sectors. Despite this homogeneity, some spread in capital shares exists across sectors. As can be seen in the appendix, table a.3, relatively high physical capital shares in value added are found for the sectors energy carriers (62%), food products (53%) and other business services (51%).

However, savings do not only flow to the international markets for physical capital: they are also used nationally to finance R&D investments. After adding up physical and R&D capital inputs, the sectors electronic equipment (45%), transport equipment (40%) and chemicals (45%) also reveal substantial capital input shares.

Besides the supply of capital, also the demand for capital determines the behaviour of the capital markets. The demand for capital will largely depend on the growth in GDP; more GDP growth corresponds to a larger demand for capital. We will not expand further on these issues, because the capital markets are not the main drivers in the scenarios.

The *Adventuring the World* scenario is characterised by relatively fast technological growth. This process also shows up in the energy-specific technology, which improves with 1.5% per annum. An increase in energy efficiency will result in a reduced demand for the energy carriers in the production process. However, the rise in energy efficiency also makes the production price decline, especially in the energy intensive sectors. As a consequence, the demand for energy intensive products will rise, as will the demand for energy inputs. These two opposing effects will lead to a net decline in energy demand.

In the *Cosy at Home* scenario, less technological growth is assumed. Therefore, the improvements in energy-specific technology are assumed to be only 0.5% per annum, which is modest in comparison with the 1.5% in the *Adventuring the World* scenario. Consequently, the shifts in sectoral production as described above for the *Adventuring the World* scenario are less pronounced.

The results for energy efficiency improvements should be analysed with some caution, because the WorldScan version we have used to analyse the scenarios does not attach any costs to the development and implementation of these energy technologies.

3 Framework policies and the macro impact on manufacturing

The question is whether the trends in manufacturing could be affected by policies. We do not explicitly think of targeting and subsidizing specific industries but concentrate on framework policies which could affect the environment in which industrial production takes place in Europe. For both scenarios we will analyse the impact of fostering good framework policies, supporting the development of manufacturing in Europe (see sections 4 and 5). This section presents the macroeconomic impact of conducting these policy packages and describes the imputed framework policies.

According to EC (2005) framework policies could include upgrading skills, better regulation and less administrative burdens for firms, R&D and innovation policies, A strong competitive Single Market, including competition, environmental policies, supporting energy policies and global trade policy. Although most of these policies will affect the manufacturing sectors in general, the outcomes will be sector specific. For energy-intensive sectors, energy policy has much more impact than on energy extensive sectors. This will also be the case for developments of skills or R&D. There are two caveats here. First, global trade policy is already one of the elements in *Adventuring the World* because the degree of globalisation was identified as one of the most important driving forces for the future of manufacturing. It is not possible to consider this policy in the policy package because trade is already much liberalised in *Adventuring the World*. The second caveat is that this version of the model focuses on sectoral detail in manufacturing and not on energy sectors. It is not possible to model the development of alternative energy carriers, emission trading, or more competition in specific energy sectors. We model energy efficiency in production and more integration of the aggregated energy sector is part of a stronger internal market.

3.1 Overall effects of framework policies

Table 3.1 presents the macro outcomes on GDP, the volume of consumption and exports for the EU as a whole in 2025 for both scenarios. The effects on the manufacturing sectors are discussed in sections 4 and 5. All results are presented as relative changes compared to the respective baseline in 2025. From the results, it appears that GDP could increase by 8% in the EU, consumption by about 9% and exports by 40%. The differences between the two scenarios are minor. In *Adventuring the World* the GDP increase is slightly larger than in *Cosy at Home*, mainly because of the large impact of R&D and Internal market policies. The increase in exports is higher in *Cosy at Home*. This is a composition effect because a higher share of total exports is destined to other European countries in *Cosy at Home*. An increase in intra-EU exports due to new single market policies has thus a larger effect on total exports. R&D and

innovation policies have the largest impacts. These ambitious policies are responsible for about 40% of the total GDP effect. The reduction in administrative burden adds about 1.5% to GDP and internal market policies about 2%. Skills contribute less, but in time if the whole labour force has been educated the effects will be larger, see Gelauff and Lejour (2006). The (ambitious) internal market policies have a substantial effect on trade. The export numbers reflects total EU exports. Intra EU trade effects will be about twice as large.

Table 3.1 Macro effects of framework policies in EU27

EU	Skills	R&D	Administrative burden	Internal market	Energy	Total
Cosy at Home						
GDP	0.5	3.0	1.5	1.7	0.9	7.7
Consumption	0.5	1.6	1.4	5.5	0.9	9.8
Exports	0.5	4.8	1.4	40.6	1.8	49.0
Adventuring the World						
GDP	0.6	3.5	1.6	2.3	0.8	8.8
Consumption	0.5	1.6	1.4	5.2	0.8	9.4
Exports	0.6	5.9	1.6	29.0	1.5	38.5

Source: WorldScan simulations. The results are % changes from the baseline in 2025.

The remaining sub-sections describe these five framework policies in more detail.

3.2 Skills

As part of the Lisbon process, the Barcelona summit of 2002 endorsed common objectives for education and training in Europe. The May 2003 Council agreed on five targets (European Commission, 2004b) by 2010:

- An EU average rate of no more than 10% early school leavers should be achieved.²
- At least 85% of 22 year olds in the European Union should have completed upper secondary education or higher.
- The percentage of low-achieving 15 year olds in reading literacy in the European Union should have decreased by at least 20% compared to the year 2000.
- The European Union average level of participation in Lifelong Learning should be at least 12.5% of the adult working age population (25-64 age group).
- The total number of graduates in mathematics, science and technology (MS&T) in the European Union should increase by at least 15% by 2010 while at the same time the level of gender imbalance should decrease.

² It was not possible to implement this target separately in the analysis, see Gelauff and Lejour (2006).

To compute the impact of reaching the targets on education and training, Jacobs (2005) developed a small, independent ‘satellite model’ to WorldScan, which incorporates various aspects of skill-formation needed to simulate the targets. The satellite model also contains a stylised cohort model to compute the impact of reaching the targets in 2010 on the skill structure of the labour force in the period 2010-2040. The cohort model takes into account that it takes many years before the skill structure of the labour force has adjusted to the higher educated cohorts that leave formal education. The satellite model calculates a time path of the increase of labour efficiency that originates from Europe reaching the skill targets in 2010. This increase in labour efficiency is subsequently inserted in the WorldScan model, which computes the general equilibrium effects of the education and training policies.

From the analysis in Gelauff and Lejour (2006), we know that it takes a long time before the benefits of the efforts for improving skills can be reaped. The macroeconomic gains will be substantially higher in 2040 than in 2025 because in the latter year a large part of the labour force has been educated in a period before the Lisbon reforms were introduced. Therefore, it is important to formulate new skill policies in time and not to wait until the full benefits of these policies are realized. Although it is difficult to attain the targets formulated above in 2010, these target are not very ambitious. In order to guarantee sufficient supply of skilled workers for manufacturing, it seems prudent to formulate more ambitious policies for the decades after 2010.

Because the WorldScan model does not distinguish MS&T workers we are not able to evaluate the effect of policies to stimulate the supply of these workers, but this does not imply that increasing the number of MS&T workers is not important for manufacturing in Europe.

3.3 Less red tape in Europe

Firms often complain about the time and costs involved to deal with administrative activities. To implement the reduction of administrative cost in WorldScan, we assume that these costs largely consist of wages for workers that firms need to hire to comply with government regulations and to provide the government with information. Reducing the administrative burden implies that some of these workers can contribute directly to production. The reduction therefore takes the form of an increase in labour efficiency: fewer workers are needed, while production is not affected directly. Furthermore, we assume that the cost reduction is achieved by making the administrative process more efficient; it does not undermine government regulations.

The Netherlands is one of the very few countries which currently has detailed information on the administrative burden of government regulations. For 2002, the administrative burden in the Netherlands is equivalent to 3.7% of GDP (of which about 40% is due to EU regulation) and is projected to fall with 25%, e.g. with 0.9% of GDP. Therefore, we use the key figures for the Netherlands as a benchmark for the other member states of the European Union. To arrive at a

meaningful international comparison, Kox (2005) combined the Dutch data on the total administrative burden with the Djankov *et al.* (2002) data on inter-country differences in firm-start-up costs to obtain estimates of the administrative burden per country.

This study does not assess the effectiveness of reducing red tape by 25%. A part of the administrative burden could be overdone and therefore reduced without any harmful effects, but another part of the administrative burden is inevitable and necessary. A part of the regulation has to aim to check for example the quality of products and services or to protect the well being of employees. These issues are not addressed within the policy package. It seems clear that the administrative burden for firm could be reduced because the whole burden is a stack of non-integrated regulations which seems to cumulate over time. For a careful analysis, more detailed information on the administrative burden is necessary. In recent years, some initiatives came up to improve the monitoring and registration of the administrative burden. This detailed information could be useful to assess the necessity of reducing the administrative burden.

3.4 Research and Development

Research and Development (R&D) is a key factor for technological change, and consequently economic growth. New technologies can boost productivity and raise incomes. The European Council agreed to raise these R&D expenditures from 1.9% in 2004 to 2.7% of GDP in 2010. In the WorldScan simulations, we assume that the targets are reached in 2010 (with some exceptions). We do not claim that this assumption is realistic. In particular in the new member states, current R&D expenditures are less than 1% percent. It is very difficult to increase these expenditures substantially within a few years and to attract or train sufficient researchers in such a relatively short period of time. Although a fruitful R&D climate in Europe can be a comparative advantage for manufacturing, it is questionable whether a further increase in R&D spending on top of the Lisbon target is effective. Ample availability of knowledge workers, and clustering of innovation activities to increase interaction and a good diffusion of new ideas and technologies could be more important.

We take account of some of the policy costs of achieving the R&D target by using a national R&D subsidy to reduce the investment price for R&D. This probably underestimates the costs for two reasons. First, we assume that the subsidy is spent effectively leading to more R&D expenditure. The literature suggests this is not the case, a part of the subsidies carry a deadweight loss. Second, the subsidy is paid by a lump-sum transfer from the domestic households. In practice, most taxes are proportional such as the income tax, so we abstract from the excess-burden of proportional taxes.

R&D also generates international spillovers: R&D in one country has an external effect on productivity in the country itself as well as for its trading partners. WorldScan distinguishes domestic spillovers from other sectors in the economy, and of foreign sectors to reflect international spillovers.

3.5 A stronger Single market

EC (2006) proposes to integrate services markets in Europe. Until now, cross border trade and FDI remains limited due to the level of and differences in regulation in services between member states. Also with respect to goods markets, Europe can integrate further. The principle of mutual recognition does not work satisfactory and EC (2007a) proposes to improve the functioning of this principle. Moreover, in public procurement, only a tiny fraction is awarded by foreign firms (Ilzkovitz et al., 2007). This suggest that goods and services markets can be integrated further. The European Commission aims also to integrate energy markets further. We increase trade in services, energy and manufacturing by reducing NTB in cross border trade between the member states, see also Gelauff and Lejour (2006) on opening up services markets. We lower the NTBs in intra-EU services and energy trade by 20% points and in goods and agriculture by 10% points. The 20% reduction in NTBs for services trade is in the range suggested by De Bruijn et al. (2008) to analyse the impact of the Services directive. Kox and Lejour (2006) argue that the implementation of the Services directive will not remove all barriers in services trade within the EU. Also Dekker et al. (2007) argue that the internal market is far from complete and further integration could enhance welfare in the EU.

3.6 Environmental policy

We assume that Europe promotes energy efficiency in order to slow down the depletion of fossil fuels and to cut carbon emissions. By promoting R&D in clean technologies, public campaigns to change conduct and regulation, firms produce more environmental friendly and fossil fuels are saved. The reduced necessity for fossil fuels reduces production costs and stimulates production, in particular for energy-intensive firms. We increase energy efficiency in production in all sectors (except the energy sector itself) by 1% per year. However, we are not able to incorporate the costs of developing more energy efficient technologies. Moreover, we want to remind that the analytical framework to assess the future of manufacturing in Europe does not inhibit sufficient details to model carefully energy and environmental policies such as stimulating renewables, biomass and biofuels, environmental taxes and emission trading schemes. By definition, environmental policy is very rudimentary modelled here.

4 Manufacturing in Cosy at Home

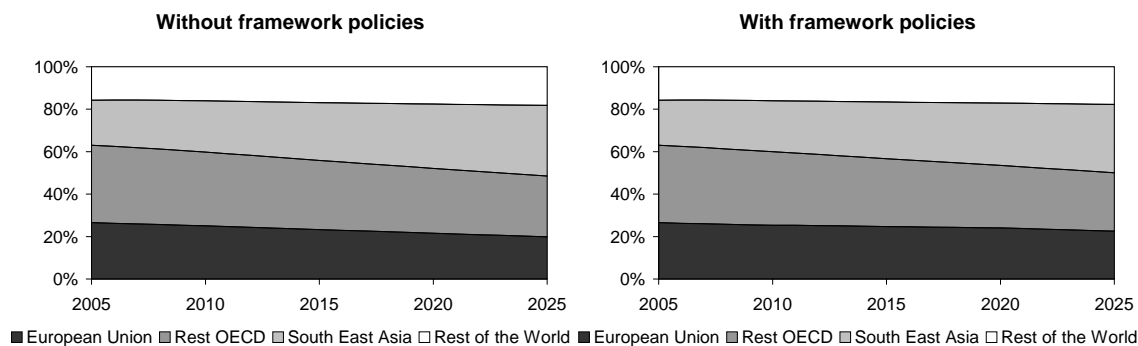
This section presents the future of European manufacturing in the *Cosy at Home* scenario. First we consider the manufacturing sector in a broad perspective. We present developments in value added and shares in global production and trade. We also discuss the impact of the framework policies. After the broad picture of European manufacturing is sketched in section 4.1, section 4.2 concentrates on particular manufacturing sectors characterised by various levels of technology and R&D intensity and labour skill intensity. For these sectors, we also assess the impact of framework policies. The developments in *Adventuring the World* are presented in section 5.

4.1 Manufacturing in a broad perspective

Consumer demand for services will increase relatively to the demand for commodities. This drives the trend towards a services economy. The share of manufacturing in Europe decreases from 22.9% to 20.1% of value added between 2005 and 2025 and the share of services increases from 72.2% to 74.6%. The share of primary industry including energy remains more or less the same. In comparison with the twentieth century, the speed of structural changes seems to slow down.

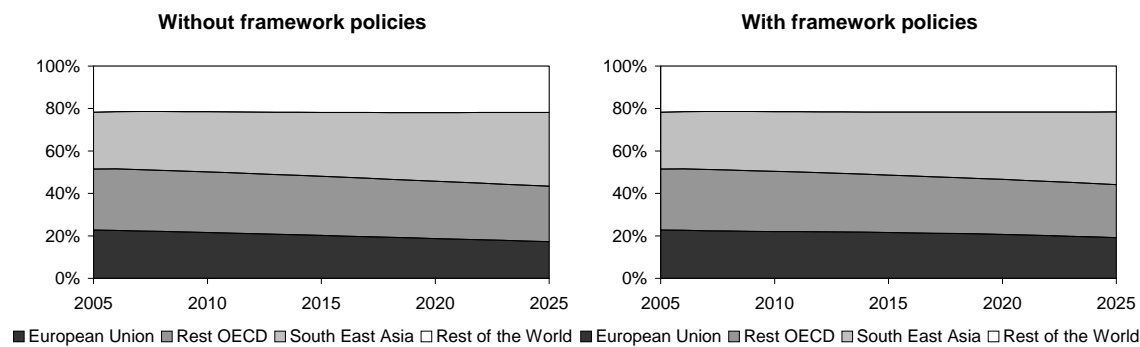
Manufacturing production shifts from the traditional developed regions to Asia from 21.2 to 33.2 % of global production as is shown in Figure 4.1. In 2025, Asia will produce the largest share of manufacturing goods. Europe's share decreases from 26.6% to 19.7% and the share of the Rest of the OECD decrease by about 8% points. The change for the rest of the world is modest. If the EU puts its framework policies in place, Europe produces still 22.5% of all manufacturing in 2025. This is 2.8% points higher than without framework policies. Although a smaller share of all manufacturing production will take place in Europe within two decades, this decline is smaller with supporting framework policies.

Figure 4.1 Regional shares in the world production of manufacturing for Cosy at Home



For trade shares, we see a similar pattern. Europe’s share in global manufacturing trade decreases from 22.7% to 17.3% in 2025.³ Also for the rest of the OECD countries, the global trade share decrease substantially. China, India and the South-East Asia increase their market share from 26.7% to 34.8% as can be seen in Figure 4.2. The implementation of framework policies mitigate Europe’s decline in manufacturing trade shares. In 2025, the global trade share is still 19.2% which is about 2% point higher than without framework policies. Interestingly, the trade and production share of the rest of the world remain more or less constant. It is solely the rise of Asia which reduces Europe’s market shares.

Figure 4.2 Regional shares in the world exports of manufacturing for Cosy at Home



4.2 Manufacturing in a detailed perspective

Labour productivity growth hides some important differences between sectors. In particular, some sectors will experience faster growth than others, while the relative performance of sectors differs across the scenarios. Table 4.1 presents growth in production volumes by sector and the impact of the framework policies. The production increases are fuelled by the assumptions on TFP growth (see appendix). TFP growth is high in agriculture, transport services and communication and production growth is also relatively high in these sectors. On average, TFP growth is higher in manufacturing than in the services sectors, but the effects on sectoral production growth are less clear. Here the degree of international competition in manufacturing comes in as determining factor. In electronic equipment, production does not even increase the next two decades and in basic metals and other machinery and equipment production growth is significantly below average. Also in textiles and wearing apparel, production growth is relatively low.

Although the framework policies are not sector specific, these policies have a large effect on manufacturing sectors. In particular for electronic equipment, production growth is now 2% higher per annum. In sectors like transport equipment, other machinery and equipment, chemicals, rubber and plastics, and textiles it is about 1% per year.

³ Note that intra-EU trade is excluded from these figures.

Table 4.1 EU production growth by sector for Cosy at Home (annual growth in % for 2005-2025)

Sector	No framework policies	Framework policies
Agriculture, oil and minerals	1.8	1.8
Energy carriers	2.0	2.1
Food products	1.3	1.4
Textiles and wearing apparel	1.0	1.8
Wood and other manufacturing	1.6	2.1
Pulp, paper and publishing	1.2	1.4
Chemicals, rubber and plastics	1.3	2.2
Non-metallic minerals	1.1	1.4
Basic metals	0.8	1.4
Electronic equipment	- 0.1	2.1
Transport equipment	1.2	2.4
Other machinery and equipment	0.5	1.3
Research and development	0.1	2.6
Transport services	1.9	2.2
Construction	0.9	1.3
Trade services	1.1	1.3
Communication	1.7	1.7
Financial services	1.2	1.2
Other business services	1.2	1.3
Other services	1.2	1.4

Source: WorldScan

The strengthening of the internal market has a substantial effect on trade in manufacturing sectors like textiles, and the combined machinery and equipment sectors as is presented in Table 4.2. These sectors are together with chemicals and wood products the most open for trade. The increase in manufacturing production draws resources from the services sectors. As a result services production declines in spite of the increased trade opportunities in services. Trade in services is more stimulated than trade in goods within this policy. Due to the openness of manufacturing sectors, it has much more effect on production in these sectors. This does not imply that opening up services markets is of no use. If services trade within the EU was not stimulated by this policy the adverse affects of stimulating good trade on services output would be bigger.

The increase in R&D benefits the most R&D intensive industries, like electronic and transport equipment, other machinery and equipment and chemicals. Also non-metallic minerals and basic metals benefit more than the R&D-extensive service sectors. R&D does not only affect the sectors directly but also indirectly by the spillovers between domestic sectors and the international spillovers.

More energy efficiency seems to increase production in most sectors. In particular the energy-intensive sectors, like the chemical industry and transport services, benefit. For the energy

sector itself it has a negative impact due to reduced energy demand. Non-metallic minerals benefits because it is energy-intensive, a manufacturing sectors like transport equipment benefit because equipment is more demanded by the increase in transport services.

Table 4.2 Production volume changes per sector due to framework policies in 2025, Cosy at Home

	Skills	R&D	Administra- tive burden.	Internal market	Energy	Total
Agriculture, oil and minerals	0.3	0.7	1.0	- 2.3	0.3	0.0
Energy carriers	0.3	2.1	1.2	2.2	- 3.3	2.4
Food products	0.2	1.2	0.9	0.2	0.7	3.1
Textiles and wearing apparel	0.6	0.7	1.9	13.1	0.9	17.3
Wood and other manufacturing	0.5	1.7	1.7	5.3	1.5	10.8
Pulp, paper and publishing	0.5	1.9	1.4	- 1.1	0.9	3.5
Chemicals, rubber and plastics	0.5	9.1	1.6	4.4	3.2	18.9
Non-metallic minerals	0.4	3.7	1.4	- 0.9	1.2	5.9
Basic metals	0.6	5.1	1.9	3.7	- 0.2	11.1
Electronic equipment	0.7	24.6	2.4	24.9	0.6	53.2
Transport equipment	0.6	11.6	1.8	9.8	1.2	25.0
Other machinery and equipment	0.7	6.1	2.0	9.9	0.0	18.8
Research and development	1.1	54.9	2.2	5.2	0.2	63.6
Transport services	0.4	0.8	1.2	0.5	4.2	7.2
Construction	0.4	2.3	1.4	2.9	0.7	7.7
Trade services	0.4	1.3	1.2	0.1	0.5	3.5
Communication	0.5	0.7	1.3	- 1.1	0.1	1.5
Financial services	0.5	0.3	1.3	- 1.9	0.1	0.3
Other business services	0.4	1.1	1.3	- 0.8	0.3	2.3
Other services	0.5	0.7	1.4	1.5	0.4	4.4

Source: WorldScan. The numbers represents relative changes in production compared to the baseline (=scenario without framework policies) in 2025. The totals are the aggregates of the five separate policies and are also reflected by the differences in annual production growth in Table 6.1.

From Figure 4.1, we know that Europe's share in global manufacturing declines by about 7% points. Table 4.3 shows that this decline is larger in electronic equipment and other machinery and equipment. For food products and wood and other manufacturing and pulp, paper and publishing it is much lower. Also in services, Europe's share in production decreases, although on average the changes are smaller reflecting a shift towards services in production in Europe. Framework policies such as formulated in section 4, counteract this decline. In particular in electronic equipment, the effects are staggering. The sector benefits extremely from subsidising R&D activities and the strengthening of the internal market.⁴ Also in transport equipment, chemicals, rubber and plastics and textiles and wearing apparel, Europe increases its share in global production by more than 2% points compared to a lack of these policies. Between 2005

⁴ We do not present here the effects of the five separate policies. We have done this for the changes in production growth by sector in Table 4.2. The impact of the policies on production is representative for the impact on other variables.

and 2025, the share in production still decreases but at a much slower pace than without supporting policies.

Table 4.3 EU production as share of world production by sector for Cosy at Home, 2025

Sector	2005	2025	2025
		No framework policies	Framework policies
Agriculture, oil and minerals	14.3	11.6	11.9
Energy carriers	19.2	16.5	17.8
Food products	26.9	22.7	23.5
Textiles and wearing apparel	19.3	13.9	16.2
Wood and other manufacturing	25.6	21.8	23.8
Pulp, paper and publishing	27.8	23.4	24.4
Chemicals, rubber and plastics	27.7	20.7	23.5
Non-metallic minerals	28.6	21.5	22.7
Basic metals	26.2	19.0	20.8
Electronic equipment	22.1	12.9	19.0
Transport equipment	29.3	23.5	27.6
Other machinery and equipment	28.5	19.0	22.1
Research and development	22.5	18.9	29.8
Transport services	25.5	22.0	23.1
Construction	24.8	19.3	20.9
Trade services	23.4	20.0	21.5
Communication	24.8	20.6	21.8
Financial services	21.7	18.7	19.7
Other business services	29.1	26.2	27.7
Other services	28.1	23.8	25.8

Source: WorldScan

In 2005, the EU has the highest production shares in medium-high technology sectors and in other business services. In the high technology sector, electronic equipment, Europe's market share is relatively low and in time this process is reinforced.

Table 4.4 complements these conclusions by presenting the shift of Europe's trade shares in global trade, represented by exports. Europe's exports reflect external trade. In electronic equipment, Europe's exports share is already low in 2005 and it decreases over time. This is also the case for textiles and wearing apparel. In wood and other manufacturing, Europe's trade share increases, and for food products it remains constant. In other machinery and equipment, the decline in market shares is substantial and framework policies do not have much impact here. For transport equipment, the framework policies are helpful in maintaining market shares the next two decades. Europe's market shares in most services sectors increase somewhat, although the framework policies do not contribute to that increase. The reason is that these policies are more supportive for manufacturing because of the R&D intensity and trade openness. As a result, these sectors draw resources away from services.

Table 4.4 EU export flows as share of world export flows by sector for Cosy at Home

Sector	2005	2025	2025
		No framework policies	Framework policies
Agriculture, oil and minerals	4.9	5.9	5.1
Energy carriers	10.3	22.4	19.5
Food products	26.0	26.6	24.9
Textiles and wearing apparel	12.4	9.5	9.7
Wood and other manufacturing	20.6	23.5	23.8
Pulp, paper and publishing	25.2	22.8	20.4
Chemicals, rubber and plastics	30.9	24.9	28.7
Non-metallic minerals	30.6	28.6	26.6
Basic metals	19.8	16.2	15.0
Electronic equipment	12.5	7.4	10.7
Transport equipment	27.5	22.2	27.5
Other machinery and equipment	25.9	16.8	17.5
Transport services	29.0	31.4	28.4
Construction	43.2	50.1	46.3
Trade services	31.1	38.0	31.8
Communication	31.0	24.6	18.8
Financial services	39.1	39.8	33.3
Other business services	36.2	37.3	31.3
Other services	30.5	31.6	24.6

Source: WorldScan

The share of electronic equipment and other machinery and equipment in total exports reduces over time. Overall the share of manufacturing in EU exports decreases from 65.6% to 54.1% in 2025. For services its aggregate share in exports increase by about 8.7%. The framework policies limit these changes by about 50%.

Table 4.5 shows the so-called revealed comparative advantages of the various sectors in the EU. It measures the exports of a particular sector in total exports relative to the average export share of that sector in other countries (and multiplied by 100).⁵ Hence, if a sector features an index higher than 100, then it is said that a region specialises its exports in that sector (i.e. it has a comparative advantage in that sector relative to other regions). From Table 4.5, we learn that the EU-27 specialises today in the exports of food products, paper products, chemicals and non-metallic minerals, transport equipment, other machinery and equipment and services.⁶ According to Cosy at Home, the EU-27 maintains its comparative advantage in most of these sectors. Only in other machinery and equipment, the comparative advantage disappears, but it increases in wood and other manufacturing. In services, comparative advantages even increases for every sector.

⁵ Also here, only extra EU exports are included in the analysis.

⁶ Export of construction is small en not discussed further.

Europe has no comparative advantage in textiles and wearing apparel, basic metals and electronic equipment. This will not change over time and its competitiveness is only slightly affected by the framework policies.

Table 4.5 Revealed comparative advantage in the EU-27 for Cosy at Home

Sector	2005	2025	2025
		No framework policies	Framework policies
Agriculture, oil and minerals	21	29	25
Energy carriers	44	110	96
Food products	112	130	122
Textiles and wearing apparel	53	46	48
Wood and other manufacturing	89	115	117
Pulp, paper and publishing	109	111	100
Chemicals, rubber and plastics	133	122	141
Non-metallic minerals	132	140	130
Basic metals	85	79	74
Electronic equipment	54	36	53
Transport equipment	119	108	135
Other machinery and equipment	112	82	86
Transport services	125	153	139
Construction	186	245	227
Trade services	134	186	156
Communication	134	120	92
Financial services	169	195	164
Other business services	156	182	154
Other services	132	154	121

Source: WorldScan

5 Manufacturing in Adventuring in the World

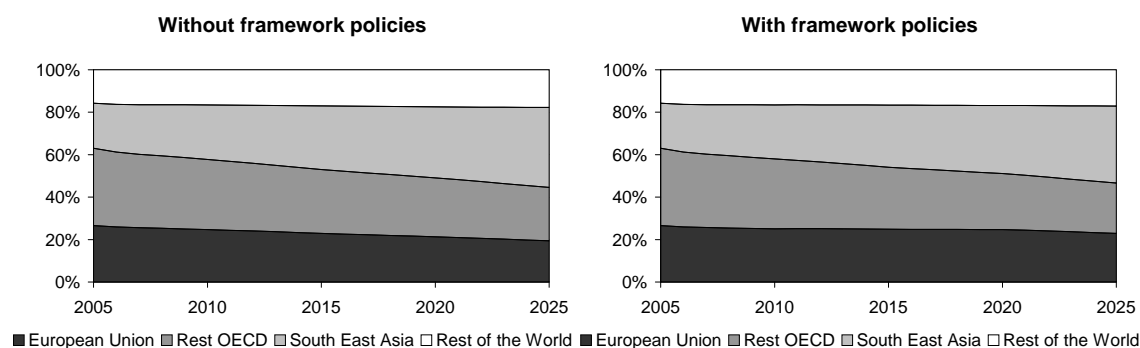
This section presents the future of European manufacturing in *Adventuring the World*. It has a similar structure as section 4. First, the overall developments of European manufacturing are discussed by presenting changes in value added and shares in global production and trade. The macroeconomic impact of the framework policies is also assessed. Section 5.2 concentrates on specific manufacturing sectors characterised by different of technology, R&D intensity, skill intensity, and trade openness. We focus on production growth, shares in global production and trade, and revealed comparative advantages by sector. For each sector, we also assess the impact of the framework policies.

5.1 Manufacturing in a broad perspective

The trend towards services is stronger in *Adventuring the World* than in *Cosy at Home*. The share of services in value added increase to 76.1% in 2025. This is 1.5% points higher than in *Cosy at Home*. The share of manufacturing is correspondingly lower, it is only 18.8% in 2025. This is a decline of 5% points between 2005 and 2025, but is also indicates that not all manufacturing will disappear from Europe in spite of the rise of Asia.

The relative decline of manufacturing in Europe is also illustrated in Figure 5.1.

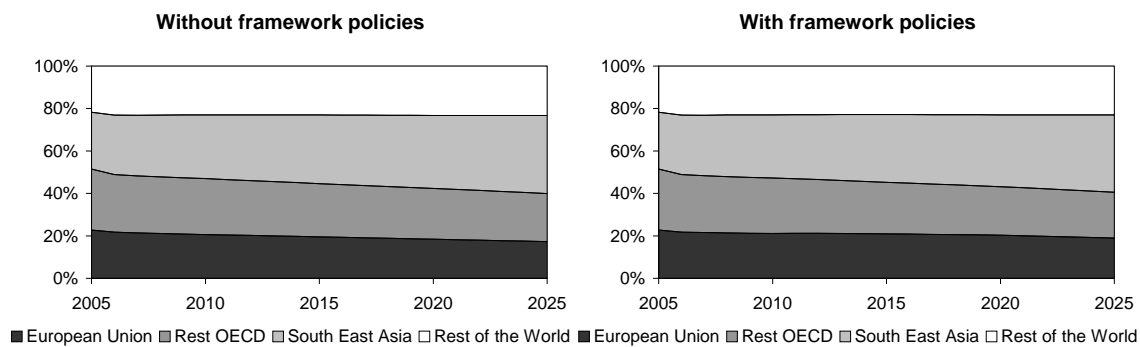
Figure 5.1 Regional shares in the world production of manufacturing for Adventuring in the World



Europe's share in global production decreases from 26.6% to 19.4% in 2025. Asia's share increases from 21.2% to 37.7%. In *Adventuring the World* the production shifts are somewhat larger than in *Cosy at Home*. The share of the Rest of the OECD decreases by about 11%. The framework policies mitigate Europe's decline in manufacturing. In 2025 Europe's share is still 22.9% which is 3.5% points higher than without framework policies. The impact of the framework policies is larger in *Adventuring the World* than in *Cosy at Home*. The increased competition in *Adventuring the World* worsens on average the position of European manufacturing, but its competitiveness becomes also more sensitive for good policies.

Figure 5.2 presents the developments in the manufacturing trade shares of the EU, Rest OECD, Asia and the rest of the world between 2005 and 2025 in *Adventuring the World*. Also here, the patterns are presented with and without framework policies. Europe's share in global manufacturing trade decreases from 22.7% to 17.3% in 2025, the same decrease as in *Cosy at Home*.⁷ However, the global trade shares of China, India and South-East Asia increase from 26.7 to 36.8%, 2% points higher than in *Cosy at Home*. This comes at the expense of the Rest OECD. Framework policies support the future of European manufacturing. The decrease in trade share of global manufacturing is mitigated to 19.0% in 2025.

Figure 5.2 Regional shares in the world exports of manufacturing for Adventuring in the World



5.2 Manufacturing in a detailed perspective

Economic growth in Europe and the world is higher in *Adventuring the World* than in *Cosy at Home* (see Table 2.3). This is also reflected in production growth by sector. If we compare Table 5.1 and Table 4.1 production grows faster in *Adventuring the World* than in *Cosy at Home* for nearly all sectors in Europe, except textiles and wearing apparel and electronic equipment (comparison based on no framework policies case). These are also sectors in which Europe has a comparative disadvantage. It seems that increasing globalisation and a faster technological change reinforces existing specialization patterns.

For most sectors, production growth is about 1% per year higher in *Adventuring the World*. For wood and other manufacturing, transport equipment, construction and non-metallic minerals, it is about 2% higher per year and for chemicals, rubbers and plastics and transport services about 1.5%.

As is concluded from *Cosy at Home*, framework policies have a substantial effect on production growth in manufacturing. The sector electronic equipment grows by 3% per year extra if these policies are implemented. For chemicals, rubber and plastics, transport equipment

⁷ Note that intra-EU trade is excluded from these figures.

the yearly growth increase is about 1.5% and for textiles and wearing apparel and other machinery and equipment about 1%. Production growth effects in services are much smaller.

Table 5.1 EU production growth by sector for *Adventuring in the World* (annual growth in % for 2005-

Sector	No framework policies	Framework policies
Agriculture, oil and minerals	2.7	2.8
Energy carriers	3.4	3.6
Food products	2.1	2.4
Textiles and wearing apparel	0.1	1.1
Wood and other manufacturing	3.8	4.4
Pulp, paper and publishing	2.3	2.5
Chemicals, rubber and plastics	2.7	4.1
Non-metallic minerals	3.1	3.4
Basic metals	2.0	2.7
Electronic equipment	- 1.1	2.0
Transport equipment	3.1	4.6
Other machinery and equipment	1.5	2.6
Research and development	0.8	3.7
Transport services	3.4	3.8
Construction	2.8	3.1
Trade services	2.0	2.2
Communication	3.1	3.2
Financial services	2.0	2.0
Other business services	2.2	2.3
Other services	2.0	2.2

Source: WorldScan

Table 5.2 presents the impact of each of the policies: increasing skills, increasing R&D, reducing the administrative burden, strengthening the internal market and improving energy efficiency on production. In most services sectors production hardly increases but in manufacturing some of the production changes are stunning. In electronic equipment production increases by 80%. In the sectors textiles and wearing apparel, wood and other manufacturing, chemicals, basic metals, transport equipment and other machinery and equipment production increases by more than 10% to about 30% in 2025. Key are the R&D and innovation policies and the strengthening of the internal market. For the R&D-intensive manufacturing sectors R&D policy and increased trade through the internal market contribute both for nearly 50% to the overall effect. For R&D-extensive sectors, like textiles, and wood and other manufacturing only the internal market policy is important. The skills policy, reduction of administrative burden and more energy efficiency contribute less to manufacturing production. Only energy efficiency has a substantial effect on the production of chemicals, rubber and plastics. The impact of the skills policy and the reduction of the administrative burden varies less by sector, but these policies have more impact on manufacturing than on services on average. These differences are more pronounced in *Adventuring the World* than in *Cosy at Home*.

Table 5.2 Production volume changes per sector in 2025, Adventuring in the World

	Skills	R&D	Administra- tive burden	Internal market	Energy	Total
Agriculture, oil and minerals	0.3	0.5	1.0	- 1.9	0.5	0.5
Energy carriers	0.3	2.2	1.1	3.7	- 3.9	3.6
Food products	0.3	1.4	1.1	0.7	0.7	4.2
Textiles and wearing apparel	0.9	-1.6	2.4	17.5	1.1	20.4
Wood and other manufacturing	0.6	0.9	1.8	8.1	1.9	13.4
Pulp, paper and publishing	0.6	1.4	1.6	- 0.4	0.8	4.1
Chemicals, rubber and plastics	0.7	13.8	2.0	10.8	4.4	31.7
Non-metallic minerals	0.5	3.2	1.6	- 0.3	1.3	6.5
Basic metals	0.9	5.1	2.4	9.0	- 2.1	15.3
Electronic equipment	0.9	40.7	3.2	39.7	1.2	85.8
Transport equipment	0.7	16.4	2.0	12.1	1.3	32.4
Other machinery and equipment	1.0	8.0	2.5	13.1	- 0.5	24.0
Research and development	1.4	64.0	2.2	5.4	0.6	73.7
Transport services	0.5	0.8	1.3	0.3	4.4	7.3
Construction	0.4	2.0	1.4	2.4	0.6	6.9
Trade services	0.5	1.5	1.3	0.4	0.4	4.1
Communication	0.5	0.8	1.5	- 0.7	0.2	2.4
Financial services	0.6	0.4	1.4	- 1.7	0.2	0.8
Other business services	0.4	1.3	1.4	- 0.3	0.3	3.1
Other services	0.5	0.5	1.4	1.0	0.3	3.7

Source: WorldScan

Table 5.1 shows that production increases in all sectors, except for electronic equipment without policy. This does however not imply that manufacturing in Europe keeps the growth path of manufacturing in other regions. High economic growth in Asia expands manufacturing production there. The Asian share at the world markets increases, both measured in production and trade, see Figure 5.1 and Figure 5.2. On average, Europe's share in production decreases by about 5.4% points. For electronic equipment, the decline is dramatic from 22% to less than 8% (see Table 5.3), but also in other machinery and equipment and textiles and wearing apparel the decline is substantial, about 10% of global production. In chemicals, rubber and plastics and basic metals, the loss in production share is also substantial, but in wood and other manufacturing we see a small increase in the share of global production. The pattern of changes in production shares differs in both scenarios. The average decrease is equal, but the changes per sector over time are more pronounced in the *Adventuring the World*.

The framework policies contribute to European's share of manufacturing production. In all sectors production share increases most notably for chemicals, rubber and plastics, electronic equipment and transport equipment. In transport equipment and wood and other manufacturing, Europe's production shares even increase compared to 2005.

Table 5.3 EU-27 production as share of world production by sector for *Adventuring in the World*

Sector	2005	2025	2025
		No framework policies	Framework policies
Agriculture, oil and minerals	14.3	11.8	12.0
Energy carriers	19.2	18.4	19.8
Food products	26.9	23.0	23.9
Textiles and wearing apparel	19.3	9.7	11.5
Wood and other manufacturing	25.6	25.9	28.7
Pulp, paper and publishing	27.8	24.6	25.6
Chemicals, rubber and plastics	27.7	21.1	26.3
Non-metallic minerals	28.6	24.9	26.2
Basic metals	26.2	18.6	21.0
Electronic equipment	22.1	7.7	13.7
Transport equipment	29.3	24.8	31.0
Other machinery and equipment	28.5	17.7	21.4
Research and development	22.5	18.6	30.8
Transport services	25.5	23.5	24.7
Construction	24.8	21.0	22.5
Trade services	23.4	20.6	22.0
Communication	24.8	20.7	21.8
Financial services	21.7	19.1	20.0
Other business services	29.1	27.5	28.9
Other services	28.1	24.2	26.0

Source: WorldScan

Table 5.4 shows the impact of globalisation and faster technological growth in *Adventuring the World* on the share of EU exports in global exports by sector. Already in 2005, Europe's share in manufacturing is on average lower than in services, which is not surprising because nearly no countries export services outside the OECD countries. Only in chemicals, rubber and plastics and non-metallic minerals, Europe has a similar position as in services. In particular in electronic equipment and textiles and wearing apparel, Europe's trade shares are low. Over time, the trade shares decrease in all manufacturing sectors, except wood and other manufacturing and non metallic minerals. It increases in nearly all services sectors except communication and other services. The decline in chemicals, rubber and plastics, and the combined machinery and equipment sectors is substantial. While in the past mainly unskilled labour-intensive sectors were affected by increasing international competition, more skilled and capital-intensive sectors are also affected the coming decades.

Table 5.4 EU export flows as share of world export flows by sector for Adventuring in the World

Sector	2005	2025	2025
		No framework policies	Framework policies
Agriculture, oil and minerals	4.9	8.2	7.4
Energy carriers	10.3	26.0	24.3
Food products	26.0	24.6	23.8
Textiles and wearing apparel	12.4	9.5	9.1
Wood and other manufacturing	20.6	26.9	27.7
Pulp, paper and publishing	25.2	23.4	21.6
Chemicals, rubber and plastics	30.9	23.0	27.8
Non-metallic minerals	30.6	32.1	30.9
Basic metals	19.8	15.9	15.1
Electronic equipment	12.5	6.5	9.1
Transport equipment	27.5	22.2	27.7
Other machinery and equipment	25.9	15.9	16.5
Transport services	29.0	39.1	37.3
Construction	43.2	52.1	48.6
Trade services	31.1	39.9	34.5
Communication	31.0	28.3	23.1
Financial services	39.1	41.0	35.7
Other business services	36.2	37.2	32.5
Other services	30.5	29.7	23.7

Source: WorldScan

The changes in EU trade shares are more or less comparable in both scenarios. Differences are found in the increases in wood and other manufacturing and non-metallic minerals in *Adventuring the World*. The framework policies support some EU manufacturing export shares, but not in food products, textiles and wearing apparel, pulp, paper and publishing, non-metallic minerals and basic metals. These are R&D-intensive manufacturing sectors, but also framework policies do not offset the decline of the R&D-intensive sectors over time in the EU. The positive effect of framework policies on the R&D-intensive sectors in Europe comes at the relative expense of services.

In the composition of the EU exports, the share of other manufacturing and equipment declines. The share of sectors like food products, wood and other manufacturing, pulp, paper and printing, basic metals, and non-metallic minerals increases somewhat. Overall, the changes in the export composition are less pronounced in *Adventuring the World* than in *Cosy at Home*. With framework policies, the changes are even smaller. The share of manufacturing products in EU exports decreases only by 2 percentage points between 2005 and 2025.

Despite these similarities, the developments in comparative advantages vary substantially among the scenarios. In general, the revealed comparative advantages change most in *Adventuring the World*, where markets become more integrated. Europe loses competitiveness in textiles and wearing apparel, basic metals, and electronic equipment. These are already

sectors in which Europe did not specialize. It loses its comparative advantage in other machinery and equipment. The comparative advantages in wood and other manufacturing and non-metallic minerals and services increases with and without framework policies. For chemicals, rubber and plastics, framework policies are necessary to keep the competitive advantage of 2005.

Table 5.5 Revealed comparative advantage in the EU-27 for Adventuring in the World

Sector	2005	2025	2025
		No framework policies	Framework policies
Agriculture, oil and minerals	21	40	36
Energy carriers	44	128	118
Food products	112	121	115
Textiles and wearing apparel	53	47	44
Wood and other manufacturing	89	133	134
Pulp, paper and publishing	109	115	105
Chemicals, rubber and plastics	133	113	134
Non-metallic minerals	132	158	149
Basic metals	85	78	73
Electronic equipment	54	32	44
Transport equipment	119	110	134
Other machinery and equipment	112	79	80
Transport services	125	192	181
Construction	186	257	235
Trade services	134	196	167
Communication	134	139	112
Financial services	169	202	173
Other business services	156	183	157
Other services	132	146	115

Source: WorldScan

6 Conclusions

Is there a future for manufacturing in Europe and can framework policies help to improve this future? The answer to these questions can be analysed from different perspectives. The glory time for manufacturing as steering engine for Europe's economy and provider of employment for the majority of its labour force is over. This is already the case for a long time. The share of manufacturing in employment as well as in value added decreases in the OECD countries, including Europe, already for decades on end, although its share in trade remains still high and its productivity still increases. This scenario study shows that the trend of a declining manufacturing sector is likely to continue over the next decades and that Asia will become the world's most important provider of manufacturing goods. Framework policies can help to mitigate this decline, but not reverse it. This does not mean that there is no future for manufacturing in Europe. In 2025, Europe's share in the overall global manufacturing production and trade will still be about 20%, and manufacturing will still contribute more than 15% to value added in Europe. A further strengthening of the internal market and adequate R&D and innovation policies can have a substantial impact on these shares.

The literature indicates that globalisation, technological progress, business models, ageing and the availability of energy and sustainability of the environment are among the main drivers for the future of manufacturing in Europe. The future trends of these drivers are uncertain. In order to assess Europe's future in manufacturing we have developed two scenarios with varying trends in globalisation, technological progress, business models and energy efficiency. From these scenarios, we conclude that the trend towards a services economy is likely to continue and manufacturing contributes less to the European economy in terms of employment and value added. However, manufacturing production still grows and is important for trade in Europe. In the *Adventuring the World* scenario in which globalisation and technological progress thrive, production grows quickly, but the geographical centre of global manufacturing production shifts to Asia. In the *Cosy at Home* scenario with less globalisation and technological progress, production grows more slowly and the European share in global production is relatively larger.

Within manufacturing, various developments take place. Based on historical productivity growth paths of manufacturing sectors, their trade openness, R&D intensity, energy efficiency, and skill intensity, it is highly likely that these (sub)sectors will develop differently over time. It has to be noted also that the developments may also differ *within* the ten manufacturing sectors identified. In most of these aggregate sectors, one can distinguish basic and specialized manufacturing. Basic manufacturing will on average be more affected by international competitiveness than specialized manufacturing. Possible intra-sector shifts from basic to specialized manufacturing are not analysed here, but are certainly relevant. In this study, an applied general equilibrium framework was used to represent Europe's relations with other

regions and to assess the relations between manufacturing and services sectors. This is a very valuable framework because linkages and spillovers between sectors and countries are very important for the functioning of economies. However, this choice excludes a further, more detailed look at manufacturing sectors at a more disaggregated level.

A number of interesting conclusions on the future of manufacturing in Europe can be drawn. The increase in trade and, more generally, globalisation appears to be one of the most important drivers. The sectors which are already most open for international trade are also the ones mostly affected by this trend. These include textiles and wearing apparel, wood and other manufacturing, chemicals, rubber and plastics, electronic equipment, transport equipment and other machinery and equipment. Overall, the sectors food products and pulp, paper and publishing are less affected. These are sectors which are more domestically oriented, less R&D intensive and face less technological progress. Europe has no comparative advantages in textiles and wearing apparel, electronic equipment and basic metals. These disadvantages will further manifest themselves in the oncoming twenty years. This in particular applies to electronic equipment which – while in the past a relative big sector - will decline even further. Textiles and wearing apparel is an already small sector in terms of value added and employment, which means that an even less prosperous future for this sector will also have less overall impact. Chemicals, rubber and plastics, transport equipment and other transport and equipment will remain important manufacturing sectors in Europe, although the comparative advantages in the other machinery and equipment sector will slide away.

Of the framework policies analysed in this study, improving skills, reducing the administrative burden and increasing energy efficiency, have the least impact on manufacturing. R&D and innovation policies and strengthening the internal market on the other hand have the strongest and most positive impact on manufacturing. These are also the most ambitious in terms of policy formulation and implementation, but potentially very effective in supporting manufacturing because of their R&D intensive and open-to-trade nature. These policies do not alter the trend that Europe's share in global production and trade will continue to decline, but they do mitigate the overall decline, in particular in the chemicals, rubber and plastics, and combined machinery and equipment sectors.

References

Brandes F., A. M. Lejour, G. Verweij, and F. van der Zee, 2007, The future of Manufacturing in Europe, http://ec.europa.eu/enterprise/enterprise_policy/industry/index_en.htm.

De Bruijn, R., H. Kox and A.M. Lejour, 2008, Economic benefits of an integrated European market for services, *Journal of Policy Modelling*, forthcoming.

De Mooij, R.A., and P.J.G. Tang, 2003, *Four Futures of Europe*, CPB Special Publication, The Hague.

Dekker, P., A. van der Horst, H. Kox, A. Lejour, B. Straathof, P. Tammes and C. Wennekers, et al, 2007, *Market Place Europe, European Outlook 5*, CPB Special Publication 68, CPB & SCP, The Hague.

Dimaranan, B.V. and R.A. McDougall, 2005, *Global Trade, Assistance, and Production: The GTAP 6 Data Base*, Center for Global Trade Analysis, Purdue University.

Djankov, S., R. La Porta, F. Lopez and A. Shleifer, 2002, The regulation of entry, *Quarterly Journal of Economics*, vol. 117, no.1, pp. 1-37.

European Commission, 2004a, Proposal for a Directive of the European Parliament and of the Council on Services in the Internal Market, SEC (2004) 21, Brussels.

European Commission, 2004b, Progress towards the Common Objectives in Education and Training, Commission Staff Working Paper, SEC, 2004, 73, Brussels.

European Commission, 2005, Implementing the Community Lisbon Programme :a policy framework to strengthen EU manufacturing - towards a more integrated approach for Industrial policy, 474 final.

European Commission, 2007a, Proposals for a Regulation of the European Parliament and of the council laying down procedures relating to the application of certain national technical rules to products lawfully marketed in another Member State and repealing Decision 3052/95/EC, Communication COM (2007) 36 final.

European Commission, 2007b, Competitiveness Report 2007, COM(2007)666 and SEC(2007)1444.

Eurostat, 2002, *Eurostat New National Baseline Population Scenarios*, Luxembourg.

Gelauff, G.M.M., and A.M. Lejour, 2006, The New Lisbon Strategy: An estimation of the economic impact of reaching five Lisbon targets, European Commission, DG Enterprise and Industry, Industrial Policy and Economic Reforms papers 1, also published as CPB Document 104.

Ilzkovitz, F., A. Dierx, V. Kovacs and N. Sousa, 2007, Steps towards a deeper economic integration: the Internal Market in the 21st century, A contribution to the Single Market Review, DG EcFin Economic Papers, 271, Brussels.

Jacobs, B., 2005, Simulating the skills targets in WorldScan, CPB Memorandum 135, The Hague.

Kox, H., 2005, Intra-EU differences in regulation-caused administrative burden for companies, CPB Memorandum 136, The Hague.

Kox, H, and A.M. Lejour, 2006, Dynamic effects of European services liberalisation: more to be gained, In *Global Challenges for Europe*, Report by the secretariat to the Economic council, PART 1, Prime Minister's Office Publications 18/2006, 131-142.

Lejour, A.M.L., P. Veenendaal, G. Verweij, and N.I.M. van Leeuwen, 2006, WorldScan: a model for international economic policy analysis, CPB Document 111.

United Nations, 2002, *World Population Prospects*.

World Bank, 2007, *World Development Indicators*, Washington, DC.

Van der Zee, F.A. and F. Brandes, 2007, Manufacturing Futures for Europe – A Survey of the Literature, http://ec.europa.eu/enterprise/enterprise_policy/industry/index_en.htm.

Common characteristics in the scenarios

Several exogenous variables are similar in all scenarios. We have two reasons to do so. The first is that some trends are common in all scenarios, such as trade liberalisation between the EU-15 and the Central and Eastern European countries (CEEC). The second is that the model is calibrated on one database, which is scenario independent. Many elasticities and exogenous variables, such as trade barriers, are determined in the calibration procedure and are therefore identical in all scenarios.

Our calibration year is 2001. The model is calibrated on the basis of the GTAP database, version 6 (Dimaranan and McDougall, 2005). Using data of the World Bank (2007), we run the model from 2001 to 2005 to reproduce GDP per capita and unemployment rates until 2005.

Table A.1 Common trends in the scenarios

Variable	Source
Population growth	Projections from Eurostat and IPCC
Participation rates	Projections based on ILO, Eurostat and UN
Relative sectoral TFP growth	Based on historical trends ISDB data (OECD)
Sectoral consumption	Based on GTAP data
Substitution elasticities for international trade	Based on Hertel et al. (2004), and for services own guess
EU enlargement	Elimination all remaining tariffs EU-15- EU-12

Source: Lejour et al. (2006)

Population growth and labour-market participation

The population projection are based on assumptions on fertility, migration and life. Table A.2 shows that population growth in the EU-27 declines in time from 0.2 % per year to zero. For the new EU-27 members (mainly the Central and Eastern European countries) the population will even diminish.

Table A.2 Population growth (annual averages 2006-2040) and participation rates (as ratio of population)

Region	Population growth		Participation rate		
	2006-2025	2025-2040	2005	2025	2040
EU-27	0.2	0	47.0	43.6	40.6
EU-15	0.3	0.1	47.3	43.3	40.8
EU-12	- 0.3	- 0.5	46.0	44.4	39.3
Rest OECD	0.6	0.4	50.8	47.5	43.6
South East Asia	1.1	0.5	48.4	50.6	50.9
Rest of the World	1.0	0.6	42.7	45.8	46.8

Source: Eurostat (2002) for EU-27, and United Nations (2002) for other regions.

Outside the EU-27, the population growth is much higher. In the period 2006-2025 the population of the Rest of the OECD, i.e. the United States and Japan, increases with 0.6% per year and the population of the non-OECD even with more than 1% per year. In the second period (2025-2040) of the scenarios, population grows less rapid, but still round 0.5% per year.

Table A.2 shows that participation rates in the EU-27 are declining. The drop in participation (as a share of total population) in the EU-27 is foremost a result of population developments, i.e. aging. In 2005 still 47.0% of the total population participates on the labour-market, while in 2040 this ratio is only 40.6%. The same trend can also be seen in the Rest of the OECD. Outside the OECD the opposite trend emerges: participation rates are increasing from 48.4% in 2005 to 50.9% in 2040 for South East Asia and from 42.7% to 46.8% for the Rest of the World.

Table A.3 Sectoral value added and its components in percentages for the EU-27 in 2001

Sector	Share value added	Relative TFP-growth	Low-skilled labour	High-skilled labour	Physical capital	R&D capital
Agriculture, oil and minerals	2.7	1.8	48	6	26	1
Energy carriers ^a	2.2	1.0	17	16	62	2
Food products	3.4	1.1	31	15	53	1
Textiles and wearing apparel	1.1	1.6	51	18	31	1
Wood and other manufacturing	0.9	1.3	45	18	36	1
Pulp, paper and publishing	1.7	1.1	37	28	34	1
Chemicals, rubber and plastics	3.3	2.3	35	19	30	15
Non-metallic minerals	1.2	1.5	38	19	41	2
Basic metals	2.6	1.7	45	24	29	2
Electronic equipment	1.9	1.7	39	16	21	24
Transport equipment	2.5	1.7	46	14	15	25
Other machinery and equipment	4.7	1.6	37	33	23	7
Research and development	1.3	1.7	13	77	11	0
Transport services	4.2	1.3	43	25	32	0
Construction ^b	4.7	0.6	60	2	37	0
Trade services	13.0	0.8	42	22	36	0
Communication	2.5	2.5	21	40	39	0
Financial services ^b	4.1	0.8	23	46	31	0
Other business services ^b	11.9	0.8	16	32	51	0
Other services	30.3	0.6	28	42	30	0

Source: Lejour et al. (2006). Note that numbers larger (smaller) than 1 imply that sectoral TFP grows faster (slower) than average (macro) TFP

^a Relative TFP growth is imposed due to missing data

^b Relative TFP growth is set equal to that in other services, because underlying data delivered (implausible) negative growth.

Sectoral value added

Sectoral value added is created by the input of labour, physical capital, and R&D capital and the production technology. The second column of table a.3 shows the share of manufacturing in macro value added for the EU-27: 23 %. This number is small compared with the 72 % of the

services sectors. The largest manufacturing sectors are the combined machinery and equipment sector (9 %) and the chemicals, rubber and plastics sector (3 %).

Table A.3 gives also numbers for the EU-27 on the input shares of value added. Only modest variation exists across the manufacturing sectors for low-skilled labour (31 % - 51 %), high skilled labour (14 % - 33 %) and physical capital (15 % - 41 %). In contrast, the R&D endowments are highly concentrated in the sectors electronic and transport equipment, and in the sector chemicals, rubber and plastics.

In the scenarios, the quantities of the inputs of value added will change and so will value added. Not only changes in the input quantities, but also changes in the efficiency of the production technology will determine the change in value added. TFP growth depends on the scenario characteristics, but we introduce common trends for the relative sectoral TFP growth. These numbers show that TFP growth is relatively high in telecommunications, agriculture, and most manufacturing sectors. It is very low or negligible in most service sectors, except transport and communications.

Energy use by firms

As can be seen in table a.4, the energy intensive sectors are: energy carriers itself (23.2%), agriculture (5.1%), paper, pulp and publishing (4.1%), chemicals, rubber and plastics (10.5%), non-metallic mineral products (8%), basic metals (6.0%) and, as is to be expected, transport services (21.6 %). The output of these sectors is likely to expand as a result of the improvement in energy efficiency. The other manufacturing sectors are hardly more energy-intensive than the services sectors (except transport), most notably the machinery and equipment sectors.

Table A.4 Value share of energy costs as % of total production costs in 2001 for the EU-27

Agriculture, oil and minerals	5.1	Transport equipment	0.9
Energy carriers	23.2	Other Machinery and equipment	0.8
Food products	1.9	Research and development	1.2
Textiles and wearing apparel	2.2	Transport services	21.6
Wood and other manufacturing	1.6	Construction	0.4
Pulp, paper and publishing	4.1	Trade services	1.7
Chemicals, rubber and plastics	10.5	Communication	0.9
Non-metallic minerals	8.0	Financial services	0.6
Basic metals	6.0	Other business services	0.9
Electronic equipment	0.6	Other services	1.1

Source: Dimaranan et al. (2005).

Trade and trade barriers

The sectoral trade pattern for the EU-27 members in the year 2001 can be read from table a.5. Of all the exports from the EU-27, 77 % originates from the manufacturing sectors and 71 % of the imports consists of manufacturing, in particular the sectors chemicals, rubber and plastics, and the combined machinery and equipment sectors. Compared with the agriculture and services sectors, the manufacturing sectors export large parts of their production output. Similarly, also large parts of the domestic demand for manufacturing products comes from imports. Particularly high exports shares (percentage output) and imports shares (percentage absorption) are found for the sectors textiles and wearing apparel, chemicals, rubbers and plastics, and the combined machinery and equipment sectors. Changes in this trade pattern will emerge as a result of differences in trade prices between regions. The elasticity of substitution determines the sensitivity of the trade patterns for price differences. In table a.5 can be seen, that relatively high values for the manufacturing sectors are specified, which implies more intensive price competition on international trade markets for these sectors than for services sectors.

Table A.5 Characteristics for trade with the EU-27 in 2001

Sector	Substitution elasticity	Export share in output	Export share in total exports	Import share in absorption	Import share in total imports
Agriculture, oil and minerals	5.4	15	2.3	30	5.8
Energy carriers	6.9	10	1.7	17	3.0
Food products	5.0	16	5.0	15	4.7
Textiles and wearing apparel	7.5	39	3.8	43	4.8
Wood and other manufacturing	7.1	36	3.0	35	2.9
Pulp, paper and publishing	5.9	20	2.7	19	2.4
Chemicals. rubber and plastics	6.6	42	12.9	38	10.8
Non-metallic minerals	5.8	22	2.0	19	1.7
Basic metals	7.1	26	6.4	26	6.4
Electronic equipment	8.8	48	7.4	53	8.8
Transport equipment	6.3	52	13.1	48	11.1
Other machinery and equipment	8.0	50	18.5	46	15.9
Transport services	3.8	17	6.7	18	6.7
Construction	3.8	2	0.6	2	0.6
Trade services	3.8	4	2.4	4	2.7
Communication	3.8	7	0.7	8	0.7
Financial services	3.8	7	1.7	6	1.6
Other business services	3.8	12	6.4	11	6.5
Other services	3.8	2	2.7	2	2.9

Source: WorldScan

Import and export prices are determined by the prices of production, although import and export taxes (both of the tariff and non tariff type) and transport costs also influence import and export prices. Changes in these taxes and in transport costs will be specific for the scenarios.

The elimination of import and export tariffs resulting from the EU enlargement have been incorporated in both scenarios. However, import and export tariffs outside the EU-27 remain, especially for the agricultural and manufacturing sectors. We will introduce various forms of trade liberalisation on a regional and global scale in the scenarios.

We have incorporated non-tariff barriers (NTBs) in the model. These NTBs are important not only in services, but also in manufacturing and agriculture. Quantification of the NTBs is done in a straightforward manner: we assume for 2001 a non tariff barrier of 20 % (as ratio of import value) for all sectors and regions, which can be reduced in time with the size depending on the specific scenario, region and sector.

