

THE FUTURE OF MANUFACTURING IN EUROPE

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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 each to about 20 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.

As part of its renewed Lisbon Strategy, the European Commission has launched a policy framework to strengthen EU manufacturing and to improve the framework conditions for the manufacturing industry by a number of horizontal and sectoral initiatives. This outline of work for industrial policy - which is to complement the work at Member State level and addresses the key challenges - needs to be extended through further analysis and policy action. A mid-term review of this outline is due for 2007.

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 positively address and influence the future. The scenarios in this study 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 studies¹ 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

¹ Published as an independent background report to this study, see Van der Zee and Brandes (2007).

manufacturing futures. The timeframe for this literature survey was a long-term one and ranged from 2015 to 2050. *FutMan*, *ManVis* and *Manufuture* - three major EU-wide foresight projects conducted over the past 5 years – formed the backbone of the survey. The results of these foresight studies were supplemented by a wide range of other materials ranging from theme or aspect futures studies (e.g. expected income developments; impacts of climate change) to similar foresight studies accomplished in other countries, such as the U.S. (e.g. IMTI, 1998; SRI 2007), Japan (Nistep, 2005) and China (NRCSTD, 2005).

The contents of this study are as follows. Section 2 describes and discusses the two principal scenarios *Cosy at Home* and *Adventuring the World* of this study in qualitative terms. Section 3 provides a numerical illustration of the macroeconomic developments in the scenarios using WorldScan. Section 4 analyses the impact of framework policies in support of manufacturing developments in Europe. Section 5 focuses on the developments in European manufacturing in the *Cosy at Home* scenario. Similarly, section 6 discusses the results of the *Adventuring the World* scenario. Section 7 concludes.

2. SCENARIOS COSY AT HOME VERSUS ADVENTURING THE WORLD

The TNO background study *Manufacturing Futures for Europe – A Survey of the Literature* (Van der Zee and Brandes, 2007) - identifies at least five sets of major drivers affecting the future of European manufacturing. These drivers are: *globalisation and international competition, technological progress, socio-demographic change (in income and wealth, social values, shifting preferences, ageing), energy and resource scarcity, and climate change and the environment*. Uncertainty as to how these drivers and their underlying forces will evolve over time is one of the few certainties that emerge from the variety of surveyed futures studies. In order to form a more systematic idea about how the future of manufacturing in Europe might look like, two scenarios are developed: **Cosy at Home** and **Adventuring the World**.

The distinguishing features of the two scenarios relate to an important extent to a different treatment of the drivers and their possible development over the next two to three decades. 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 *Adventuring the World* outward-looking (resulting in a further opening-up), risk-loving and pro-active behaviour are prime.

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. Governments, non-governmental organisations and companies have to take strategic decisions under uncertainty. The uncertainty refers to the environment in which decision makers operate. Indeed, the world can change rapidly due to natural events, political changes, social developments, and technological trends. By considering alternative futures, one can better prepare for unforeseen circumstances such as the future of manufacturing and perhaps take early action to deal with a particular conjuncture.

The uncertainty is reflected by sketching different developments in the fundamental drivers for the future of manufacturing in Europe. The scenarios are also quantified using an applied general equilibrium model. This has three main purposes. 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.

Scenario I: Cosy at Home

The *Cosy at Home* scenario depicts a European manufacturing sector that faces an overall business and political climate that gradually becomes more inward-looking and passive. Uncertainty and indecisiveness at world level is answered with a European response of retreat. Politically unstable regions, threats of international terrorism, lacking binding action at world scale to tackle the negative consequences of climate change and the inevitable depletion of fossil fuels, and – related - the lack of real breakthroughs in alternative energy production and promising new technologies (nano-technology and to a lesser extent biotechnology), give people the feeling of standstill and uneasiness. This in turn translates into a downturn in consumer and producer confidence and more inward-looking and risk-averse behaviour. Trust is something that may be found close by, but certainly not far from home. Rising energy prices and stark increases in monitoring and control of international movements of persons, goods and services result in a cost explosion in international transport and trade which significantly alters the turn-of-the-century trend towards a more and more integrated world economy.

Globalisation and international competition

Multinational organisations such as the WTO and UN, the ‘natural’ providers of global public goods and global problem solving capacity based on global collaboration, gradually lose credibility and effectiveness as new overarching international agreements end up inconclusively time and again. The failure of the WTO Doha Round repeats itself. Consequently, the recent trend of regionalism observed in Asia - in which countries seek to sign Preferential Trade Agreements (PTAs) - proliferates. The world is fragmented into different trade blocks and existing world institutions are too weak to enable effective global coordination. As a result of global negotiations of trade liberalisation having failed, the WTO becomes marginalized in international trade matters. Protectionist moves and trade restrictions lead to a standstill in globalisation.

Regulations gradually replace the climate of openness and trust, and are introduced to check and safeguard the trustworthiness of foreign trade partners and investors. International migration and the search for and attraction of talent faces serious restrictions. The European Union and the United States have different views on global trade and non-trade issues. The new emerging giants China and India remain underrepresented in the existing multilateral forums and look actively for other ways to have their say. PTAs are but one of the instruments to do so. The United States deepen their trade relations linkages with Central and Latin America by establishing a pan-American free trade area. At the same time, Latin American economic and political self-confidence is building up and translating into further inter-Latin-American co-operation. The region is no longer the backyard of the U.S. China collaborates even more closely than today with Africa and Latin America, thus securing continuity in its much needed flow of energy and natural resources. Europe has been less pro-active, and has missed the boat in securing sufficient energy supplies and resources for the future. Due to global warming, hydropower potential in Europe decreases, while alternative energy policy targets are not sufficiently met. As a result energy prices for private and industrial households are soaring.

The catching up process of the newest Member States (EU-12) slows down and even the Asian Tigers run less fast due to slowing exports as a result of increasing non-tariff barriers to trade and increasing international transport costs. Exchange rate shocks (Chinese renminbi and the US\$), large risk capital movements without adequate regulatory supervision and means of conflict resolution, and huge instability in housing markets across Europe and America (mortgages) lead to new subsequent financial crises, in particular in Asia and in the US which further slows down global economic growth. Because the Asian Tigers are

progressing less fast, European manufacturers remain more competitive than would otherwise have been the case. Chinese and Indian manufacturing continues to focus on labour-intensive production and assembly activities. Due to social instability and inadequate investment in education, knowledge and skills, China and India and the other Asian developing economies are not able to transform their economies into front running knowledge-based economies. Although there is progress, progress remains piecemeal, spotty and scattered. Apart from some basic R&D, the much-feared off-shoring of core R&D from Europe to Asia does not take place, apart from a few sectors such as ICTs and electronics. Competition for the limited pool of specialised high-skilled labour in Asia leads to a steep rise in labour costs, which makes relocation less attractive.

Slower than expected catching up of the last wave of accession countries, especially in technology and innovation, implies that comparative advantage remains asymmetrically distributed over Europe. This, however, offers manufacturers of the 'old' EU-15 plenty of opportunities to offshore parts of their production, especially the more medium-skilled labour-intensive part to the EU-12. Labour still remains relatively cheap, whereas the education and skills base in Central and Eastern Europe finds itself at comparable and sometimes higher levels as their Asian competitors.

Technological progress

Technological progress is expected to slow down due to lack of international collaboration, cuts in business R&D due to continuing pressures due to financialisation and short-term shareholder gains at the expense of longer-term stakeholder objectives, and lack of adequate public incentives to force R&D efforts beyond current levels. The Barcelona R&D 3% objective is not met. Only the Nordic countries live up to future expectations and continue their R&D efforts and achievements at similar and even higher levels than today. The combined effect of easing competitive pressures and lacking progress at the technological frontier - important for the release of new competitive products – could have the effect of a double-edged sword for European manufacturing firms.

R&D investments and efforts world-wide remain at equal levels, despite various policy initiatives beyond the Lisbon agenda. As a result the promising technologies of the early 2000s - nanotechnologies and to a lesser extent biotechnology – are, even though they will gradually reach the market, far less spectacular in reach and impact than expected. Micro-systems such as actuators, integrated sensors and microprocessors are more widely used across production systems, increasing machine intelligence and efficiency. The envisaged plug-and-produce systems facilitated by micro-system development do not yet materialise, however. Smart and advanced materials with abilities of improving product and process performance, and changing material attributes such as colour and shape to external stimuli, respectively, attract considerable interest from customers. Increasing protectionist tendencies, few trendsetting launching customers and lack of purchasing power preclude European manufacturers from becoming a global leading actor in this area.

Progress in biotechnology halts primarily because consumer values on genetically modified organisms (GMOs) and risk perception in Europe have resulted in strict regulations, which as a consequence means that emerging economies such as China and Korea, as well as the US have taken a firm lead.

ICT technologies, on the other hand, pervasively intrude our lives, to the benefit of business (B2B, B2C), consumer choice (product availability; quality improvement) and further customization, education (e-learning), health (eHealth, telemedicine) and the overall quality of life. Automation and the reorganization of business processes in combination with RFID-type technologies revolutionize regional and global value networks and supply chains, even if increasing protectionist barriers restrict immediate resulting growth. Less than expected

international cooperation and less physical international contacts, however, hamper the further diffusion of knowledge; ICTs can only partly counteract this trend.

The hindrances on trade, foreign investment, technological progress and migration will have substantial effects on European manufacturing. Organisational structures and business models will adapt to the changing environment. Firms that were pursuing outsourcing and offshoring strategies, will focus on integrating processes back into the organisation to regain control and security over supply. Due to increased transport, communication and compliance costs, overall production costs become too high to profitably break-up production processes and set a limit to relocation world-wide. As a result overseas offshoring generally becomes less popular and production becomes more concentrated in terms of both location and ownership. Central and Eastern Europe, being part of the EU but still enjoying labour cost advantages, becomes a preferred production location for European manufacturing companies to South-East Asia. Headquarters and accompanying services, including R&D, remain in Europe. Certain forms of offshoring, particularly ICT-based business process outsourcing (BPO) services, appear less affected and continue to grow, even outside Europe. Stable, low-risk regions receive a bigger share of the pie, however, as firms become more risk-conscious.

Socio-economic drivers

Low economic growth and reversed tendencies of off-shoring slow down high aspirations of transformation towards a truly 24/7 ICT-driven services economy. Firms outsource fewer services and especially business services develop less fast. Whereas the investment climate is not very attractive within Europe, opportunities outside are not much better. Consumer demand for services still expands as income grows, albeit at a slower rate than at the turn of the century. Demand is in particular fuelled by shifts in consumer preferences due to ageing, not only expressed by increasing demand for health care, care and living for elderly, but also in leisure goods and services. However, government budgets will suffer from extra spending on pensions due to numbers of pensioners and increased life expectancy to such an extent that part of the care will have to be financed by the elderly themselves. More consumption will be paid out of dis-savings. For manufacturing firms, ageing offers opportunities but also requires changes, in particular in satisfying the need for (design of) new products for an ageing, more diverse and less able society. However, as many countries around the world are expected to undergo similar 'greying' in the future, European manufacturing firms could exploit Europe as a lead market for ageing client groups and hence build competitive advantage. The downside of ageing is a shrinking workforce that has to support an ever-increasing inactive part of society. Ageing will cause labour shortages, especially in the high-skilled labour segment. Opportunities for low skilled workers are bleak, however, due to increasing requirements of the knowledge-based society. Despite the strong demand for high-skilled workers, migration is restricted. EU Member States maintain lengthy and costly procedures for entering the European Union even for knowledge workers, and the much needed harmonisation at EU level stops short due to political tensions and risks at Member State level. The United States gradually lifts the restrictions on immigration of knowledge workers and is taking a firm lead again in attracting talent; Europe has difficulties in catching up.

Climate change and the environment; energy and resources

Society is not really environment-minded and neither drastic changes nor measures to reduce the potential impact of climate change are taken. Consumers do not really care and producers try to offend any initiative to environmental-friendly regulation. In particular energy-intensive industries such as the chemical industry are afraid for further cost-raising measures which could undermine their global competitiveness. Protectionist tendencies and the increasingly weakening position of multilateral organisations mean that countries fail to agree on credible binding climate change policies. Countries blame each other for emitting too much carbon,

while waiting for others to reduce emissions and taking the first step. Because of the lack of international cooperation, leading European initiatives could indeed actively stimulate the relocation of energy-intensive industries to other parts of the world. Europe attempts to reduce pollution and to stimulate environmentally friendly and new alternative energy technologies, by going alone towards a greener future. However, non-binding commitments instead of strict regulations look nice on paper, but in reality do not live up to expectations.

Limited energy savings are achieved though, with people becoming more worried about the nearing depletion of fossil fuels after 2020 and the oil price remaining at very high levels. The latter hurts energy-intensive industries. Yet since foreign competitors are hurt as well, relative competitiveness remains largely intact. Increases in energy efficiency are solely driven by costs concerns. Political window-dressing precludes a real leap forward. Instead, Japan and Korea take the lead in environmentally friendly production methods, in developing disruptive energy-saving technologies and in making alternative energy sources a viable and competitive alternative for society.

Scenario II. Adventuring the World

The *Adventuring the World* scenario depicts a European manufacturing sector that is faced with an overall business and political climate of international cooperation, openness, but also strong competition. European self-confidence strengthens as the political and ideological emptiness that characterised the turn-of-the-century era has been replaced with new inspiring notions of Europe's role in the world, which includes a front runner in solving problems of global warming, energy use and ageing as well as major breakthroughs in European social and cultural integration. The momentum of renewed decisiveness is also found at world level, and geo-political instability and threats of international terrorism gradually disappear. Considerable progress is made in alternative energy production and promising new technologies (nanotechnologies and biotechnology). A general upswing in consumer and producer confidence combines with new openness, and outward-looking and adventurous entrepreneurial behaviour. Trust relationships thrive. Rising energy prices stimulate new and more cost efficient energy-saving ways of transport of persons and products. Adequate road pricing and energy taxation increasingly supplant traditional labour taxes, making mobility and energy consumption better manageable and less harmful in its effects.

Globalisation and international competition

Heterogeneity between countries is a breeding ground for new ideas and solutions for bottlenecks. Multilateral forums such as the WTO successfully solve existing disagreements between countries. Free trade in agriculture and services is fostered, and a further opening up forces a substantial industrial restructuring in Europe. In terms of employment and contribution to GDP, the agricultural sector contracts even further, and the same is true for the traditional manufacturing sectors, such as textiles, leather and footwear production. Yet, European companies active in textiles, leather and footwear remain competitive because of smart off-shoring strategies and a stronger focus on high-value added niche segments. Although industrial restructuring entails substantial changes in terms of employment (layoffs, retraining) and relocation of production facilities, the European economy has become sufficiently flexible to cope with these changes. High-skilled jobs are created in manufacturing and in services, but labour supply shortages initially lead to fierce competition for skilled workers and a strong upward pressure on labour costs. Temporary postings of knowledge workers become much easier, as the needed regulatory framework is harmonised at the EU level. Low skilled work is practically only created in sectors outside manufacturing such as health care and care for the elderly. Increased off-shoring reinforces cross-border trade in both final products and services, and in parts and components, both within Europe and between Europe and the world. It also engenders considerable foreign investment.

The accession countries gradually catch up with the EU-15 due to increased technology transfer and foreign direct investment. Manufacturing firms exploit the opportunities in Central and Eastern European regions as a competitive alternative to offshoring in South-East Asia, with labour cost advantages to the EU-15 still existing. However, this especially applies to light manufacturing industries and business services (offshoring specialisation). But while Central and Eastern Europe catches up fast, so does Asia. Per capita incomes in China and India rise significantly, and although still below levels in industrialized countries, a large and rising middle- and high-income class in both countries makes domestic consumption an important growth factor. In real GDP terms, China and India are in the runner up to become the largest economies in the world. Asia represents the most promising growth markets for manufacturing firms. Although large parts of the more labour-intensive manufacturing production have moved to these countries making them the centre of global manufacturing production, European manufacturing firms profit from off-shoring giving them the opportunity to specialise further, while creating new jobs at home in finance, marketing, sales and R&D. Average incomes in Korea, Singapore, Hong Kong and Taiwan even outpace those in the old industrialized world. Technological progress and increasing international trade also stimulate GDP growth in Europe, Japan and the US, however. Outsourcing and off-shoring are beneficial to offshore destinations as well as offshore origins, as they lower overall production costs, but also engender new business activities.

Fast and massive economic growth in Asia means that Asia gradually develops towards a services economy, allowing governments to increase expenditure on education and innovation. The Asian skills base broadens significantly, and slowly but steadily converges to the high standards known in Europe, Japan and the United States. Due to the considerable time lap between education and entrance of the labour market, it will take 15 to 20 years from now before the effects of this widening educational and skills base reach the market. Western countries will also benefit from these developments since the pool of attractive high-skilled migrants is expected to become considerably larger, giving more scope to temporary labour migration as well as to the off-shoring of more complex tasks. The search for talent will be increasingly a global one. This will offer the opportunity to solve labour supply shortages due to ageing.

Technological progress

Globalisation, international cooperation and competition spur economic growth and at the same time create an optimistic view on the future. Intensified competitive pressures that drive further investment in R&D, in particular by businesses. International cooperation stimulates the diffusion of knowledge and spurs technological progress. The transition to knowledge based-manufacturing – the Manufuture paradigm (Manufuture, 2004) – is gradually achieved, although huge efforts are required in reallocating and retraining parts of the workforce, especially the low-skilled, in order to withstand global competition. Advances in nano-technologies, micro-systems, smart and advanced materials, and bio-technology all allow manufacturing firms to create high performing, more customized products and processes revolutionising manufacturing. The envisaged plug-and-produce systems facilitated by micro-system materialize, and a new generation of trendsetting daring launching customers – also in the ageing customer segment – stands up. Income and wealth are abundant and stimulate new consumption experiments.

Europe with its well-developed institutions is technologically competitive with the U.S. and Asia in these fields. ICTs have become embedded in and part of everyday processes enabling flexible organisation of networks and work-leisure choices. As a result tendencies to outsource and offshore can be better and more efficiently further pursued, creating ever more specialisation. The proliferation of global value networks continues, led by further progress in automation, ICT-led reorganisation of business processes. Virtual manufacturing (VM, also

labelled as virtual design) in the fashion, furniture, automotive, shipbuilding and aerospace industries, to mention a few examples, reaches new dimensions, both in speed, precision and combinatory capabilities. Because of improvements in ICT infrastructure, ease of communications, and smarter organization of business processes (including VM), SMEs gradually get a more significant role in global production networks. Economies of scale shift to the advantage of SMEs.

Globalisation spurred by international cooperation and political stability considerably transforms European manufacturing. ICT technologies enabling networking and global organisational structures mean that the larger European manufacturing firms have turned into manufacturing orchestrators managing production rather than producing themselves. Only high-knowledge intensive functions remain in Europe and other industrialised countries, whereas off-shorable low-skilled activities have been completely relocated. The transformation to knowledge-intensive manufacturing is successful but requires a greater proportion of high-skilled. Due to a shrinking working population, it is difficult for European manufacturers to attract the required high skilled people. EU Member States take various measures to increase the labour supply, such as eliminating the fiscal incentives for early retirement, introducing labour market reforms to reduce unemployment, offering life-long learning trajectories and retraining programmes, and path breaking steps to improve the labour participation of women (child care provisions, tax incentives for young families, etc.). However, the measures only partially offset the structural reduction in labour supply. Immigration policies for knowledge workers have been softened and harmonised at EU level which ease the administrative burden of attracting temporary labour from outside Europe.

Socio-economic drivers

High income growth and ageing change consumer demand patterns. Consumers in Western economies particularly demand products suitable for older and less able people. Demand for health, care and specialised leisure services increases. While European countries struggle to finance the costs of 'greying', the affluent can afford personal care. These types of services flourish and create employment for the less skilled. Retraining of part of the workforce is needed, emphasizing both professional requirements as well as communication and social skills.

Increased demand for business services is another important driver of growth. This applies to third-party logistics (3PL), such as customs clearance and freight forwarding, quality assessment services, but also to communication, transport, distribution and financial services. Business services are expanding rapidly due to continued sourcing. As global value networks becomes even more important, smart organisational change, integrative skills and new business models go at a premium. European companies lead the way as skilled orchestrators of large value networks. More emphasis in training and education is put on acquiring the right skills such as networking, intercultural literacy, flexibility, mobility and excellent communication skills in order to extend Europe's competitive edge in this area. Firms being able to attract the most talented employees will have a considerable advantage. A climate of tolerance, freedom and openness combined with a rich cultural and historical diversity allows European manufacturing firms to attract talented workers. Cluster strategies start to pay off; Europe's city regions compete for talent.

European integration gets a firm boost as more countries enter the euro area which not only smoothes intra-European trade both also gives new impetus to the euro to overtake the US dollar as the major global currency. European integration has taught governments, firms and people to cooperate, while valuing and respecting cultural and historical diversity. Older European values including openness towards other cultures and doing business in other parts of the world appear of great value in the globalised society. This historical and multicultural

background helps European manufacturing firms to organise their international production processes successfully as against competitors.

European citizens are concerned with the poor and less well-off in other parts of the world, which is expressed predominantly through increased development aid. But the 2015 UN Millennium Goals come within reach first and foremost because of considerable progress in poverty reduction in Asia (China and India), as a result of market-led economic growth. Trade and not aid is leading the way.

Customization and servation, which imply a whole new approach to doing business and no longer emphasize the maximisation of output and unit sales, but instead revenue generation via long-term customer relationships, are prime. More traditional characteristics like speed and performance become relatively less important. Producers which can not keep up with these changes will not survive.

Climate change and the environment; energy and resources

The preservation of the environment is felt as a collective responsibility and adequate action is taken at the global level. Countries agree to cut carbon emissions substantially, among others by introducing a global emission trading scheme and adequate institutional monitoring and control. Global action on climate change is enforced around the globe, with carbon pricing altering the incentives for offshoring of CO₂ intensive industries. Governments also focus on efforts to develop environmental-friendly technologies, particularly renewable energies and energy efficient technologies. Although effective alternatives for the long-term future are developed, fierce competition for securing future energy needs continues. Europe takes a pro-active stance and is able to establish new trust *quid pro quo* energy treaties with major suppliers (Russia, OPEC). The bio-energy industry flourishes, but due to competition with food production for human intake (oilseeds, sugar), soaring food prices result. The environmental industry booms. Governments actively support R&D and new technologies are developed. Venture capital, especially for real start-ups, becomes more easily accessible. The manufacturing industry is able to attract talent, and is fashionable again. Real contributions to helping the preservation of the environment are rewarded in monetary terms and get societal credit. The energy industry also develops quickly. Oil industries spend large shares of their profits in order to further develop alternative energy sources. Transport and the automotive industry have to transform in order to keep up with the demand for more energy-friendly vehicles.

3. QUANTIFICATION OF THE SCENARIOS

This section provides a numerical illustration of the scenarios presented in section 2. We used CPB's applied general equilibrium model WorldScan (Lejour et al., 2006) for this illustration. Lejour and Verweij (2007) explain in detail the translation from the qualitative scenarios to the quantitative ones and they also provide more detailed results. This section presents the main trends. Because a large part of the scenarios can not be quantified, this section gives not a complete overview of the scenarios. It only illustrates scenario trends which are related to economic growth and economic integration which are at the heart of the WorldScan model.

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.

The scenario-specific 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. Here we briefly review the variation in exogenous inputs. Lejour and Verweij (2007) discuss these inputs and the results in greater detail.

Table 3.1 Variation in exogenous inputs

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

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.

Employment and labour productivity together determine production and growth. First, we present the assumptions on labour productivity growth (or implicitly on total factor productivity) and then on for economic growth. Given population developments, we know growth per capita. We analyse these results and compare these developments in the different regions. Then we shift the focus to trade. The developments of EU exports is analysed in section 3.2

3.1. Labour productivity

Adventuring the World is the globalisation scenarios 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 3.2 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.

Table 3.2 Labour productivity growth, annual averages 2006-2040 by region

	Cosv 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.

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.

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 3.2 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.² 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 3.2 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. The pattern of GDP growth is similar to that of labour productivity growth. Therefore, we focus only on the differences with table 3.2.

Table 3.3 GDP growth, annual averages 2006-2040 by region

	Cosv 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

² Except for the transition path between current TFP growth in 2006 and scenario specific TFP growth 2010.

Employment in the EU-15 decreases by about 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 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.

3.2. 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 3.4 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 and 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 with even 25%-points.

Table 3.4 Openness of the various regions in 2040

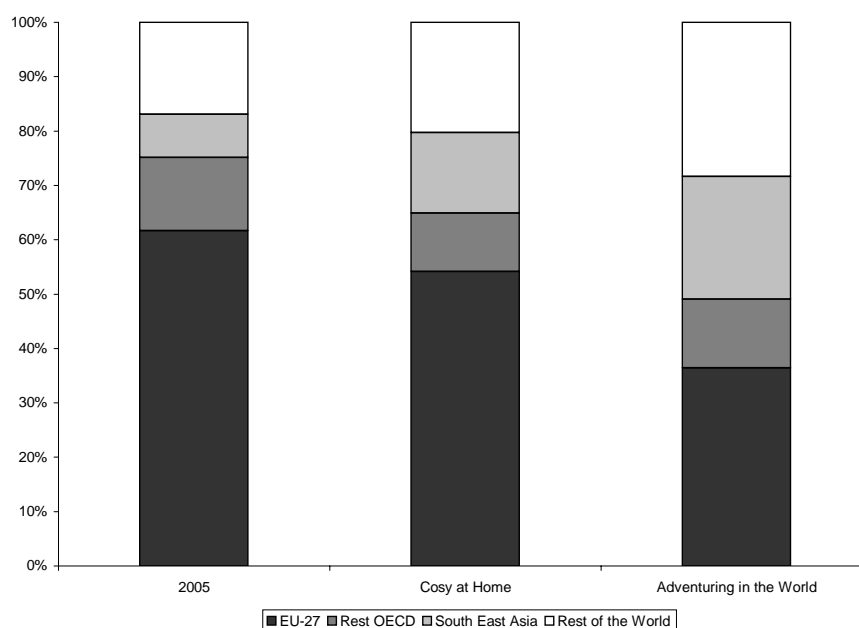
	2005	Cosv at Home	Adventuring the World
EU-27	34.1	33.3	39.3
EU-15	32.2	31.7	37.1
EU-12	63.5	51.0	62.8
Rest OECD	10.4	11.5	19.4
Asia	30.3	22.8	47.3
Rest of the World	22.8	17.7	31.9

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 3.1 .

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 3.1 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*.

Figure 3.1 Direction of EU-15 exports flows



4. FRAMEWORK POLICIES AND THE MACRO IMPACT ON MANUFACTURING

The preceding section sketched the macroeconomic developments of both scenarios. It showed the possible impact of globalization, technological change, ageing, and structural change towards a services economy on economic growth and trade. The impact on manufacturing as a whole and various manufacturing sectors in both scenarios will be discussed in sections 5 and 6. As we will see Europe will become less important as place for manufacturing production in both scenarios. Manufacturing will shift to Asia.

The question is whether these trends could be affected by policies. We do not explicitly think of targeting and subsidizing specific industries but concentrate on frame work 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 in sections 5 and 6. This section describes the framework policies and the macroeconomic impact of conducting these policy packages.

Framework policies (EC, 2005) included in the analysis are:

- 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.
- global trade policy

We will assess the impact of this package of policies on the development of manufacturing. although most of these policies will affect the manufacturing sectors in general, the outcomes will not 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* we can not pursue the same policy package in both scenarios. 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, 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.

4.1. 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.³
- 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).

³ It was not possible to implement this target separately in the analysis, see Gelauff and Lejour (2006).

- 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.

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 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, the skill targets does not seem to be very ambitious.⁴ 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. Moreover extra MS&T workers could be essential for conduct extra R&D. A main input for R&D are high-skilled workers. If those are not available,⁵ the R&D policy (section 4.3) is less effective. We are not able to model the positive spillover effects of increasing skills on the return of R&D, but these expected positive effects are relevant

4.2. 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)

⁴ Barrell et al. (2007) show that the average schooling time is increased by about 3%. Assuming (and not modeled) that the acquirement of skills per schooling hour does not increase, one can not expect big economic benefits from the skill policies.

⁵ Gelauff and Lejour (2006) mention that the old EU15 countries need 30% to 60% extra R&D workers to meet the original R%D target of 3%.

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.

4.3. 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. The size over these spillovers is open to the empirical debate which is not settled yet. Canton *et al.* (2005) summarize the empirical literature and conclude that the social returns on R&D including the spillovers range from 30% to 100%. Gelauff and Lejour (2006) assess the effects of raising R&D using lower bound and upper bound estimates. In the upperbound case GDP effects are three times as high. It seems however implausible that the social returns of extra R&D (from 1.9% to 2.7% of GDP) will meet those of the upperbound estimates, because the most attractive R&D projects are already selected. New R&D projects will probably deliver less returns and there is the risk that new subsidized R&D investment crowds out private investments.

4.4. 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 (2007) 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. (2007) 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.

4.5. 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.

4.6. Overall effects of framework policies

We present the macro outcomes for the EU as a whole in 2025 for both scenarios. The effect on the manufacturing sectors are discussed in section 5 and 6. Table 4.1 presents the effects of the various framework policies on GDP, the volume of consumption and exports. in both scenarios. 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 based on the lowerbound returns in the literature. 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). From that study we know that the GDP effects are three times as high in 2040 compared to 2025. Even in 2040 the economic effects are not very substantial compared to other framework policies. The policy is not very ambitious because it increases schooling time only with 2% (Barrell et al., 2007). Moreover the costs of extra

schooling in terms of the loss of working time are relatively high. The (ambitious) internal market policies have a substantial effect on trade. The export number reflects total EU exports. Intra EU trade effects will be about twice as large.

Table 4.1 Macro effects of framework policies in EU27

EU	Skills	R&D	Admin. 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.

5. MANUFACTURING IN COSY AT HOME

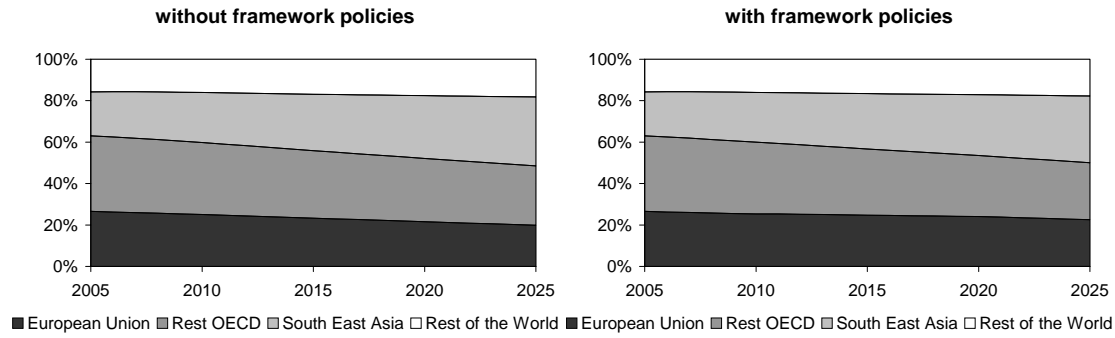
This section presents the future of European manufacturing in the *Cosy at Home* scenario. First we consider the manufacturing sector in a broad perspective. We present developments in value added and shares in global production and trade. We also discuss the impact of the framework policies. After the broad picture of European manufacturing is sketched in section 5.1, section 5.2 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. Section 5 focuses on the developments in *Cosy at Home*, and the developments in *Adventuring the World* are presented in section 6.

5.1. 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.

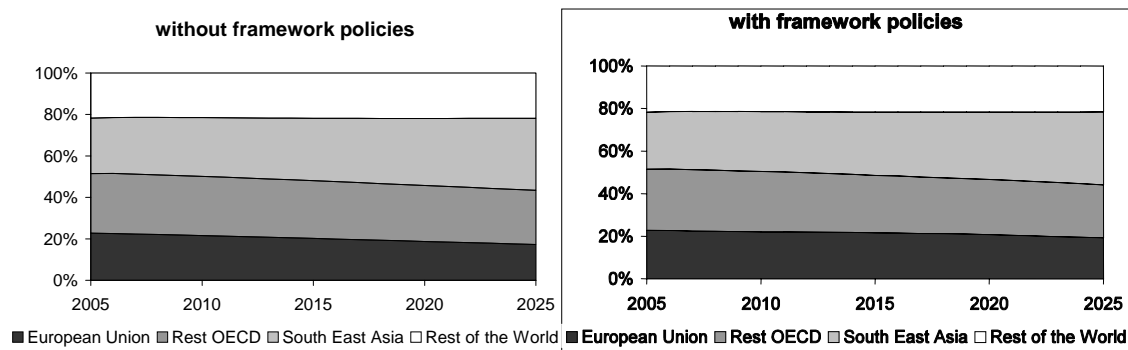
Manufacturing production shifts from the traditional developed regions to Asia from 21.2 to 33.2 % of global production as is shown in Figure 5.1. In 2025, Asia will produce the largest share of manufacturing goods. Europe's share decreases from 26.6% to 19.7% and the share of the Rest of the OECD decrease 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 5.1 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 2025.⁶ 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 5.2. 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 5.2 Regional shares in the world exports of manufacturing for Cosy at Home



5.2. 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 5.1 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 Lejour and Verweij (2007). 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.

⁶ Note that intra-EU trade is excluded from these figures.

Table 5.1 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

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.

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 5.2. 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.

Table 5.2 Production volume changes per sector due to framework policies in 2025, Cosy at Home

	Skills	R&D	Admin.	Internal	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.

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 as 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.

From Figure 5.1 we know the Europe's share in global manufacturing declines by about 7% points. Table 5.3 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.⁷ 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.

⁷ We do not present here the effects of the 5 separate policies. We have done this for the changes in production growth by sector in Table 5.2. The impact of the policies on production is representative for the impact on other variables.

Between 2005 and 2025 the share in production still decreases but at a much slower pace than without supporting policies.

Table 5.3 EU production as share of world production by sector for Cosy at Home, 2025

Sector	No framework policies		Framework policies
	2005	2025	2025
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 5.4 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 5.4 EU export flows as share of world export flows by sector for *Cosy at Home*

Sector	No framework policies		Framework policies
	2005	2025	2025
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 5.5 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).⁸ 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 5.5 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.⁹ 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.

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

⁸ Also here only extra- EU exports are included in the analysis.

⁹ Export of construction is small en not discussed further

Table 5.5 Revealed comparative advantage in the EU-27 for *Cosy at Home*

Sector	No framework policies		Framework policies
	2005	2025	2025
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

6. 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 5. 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 6.2 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.

6.1. 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 6.1. 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

frame 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 6.1 Regional shares in the world production of manufacturing for *Adventuring in the World*

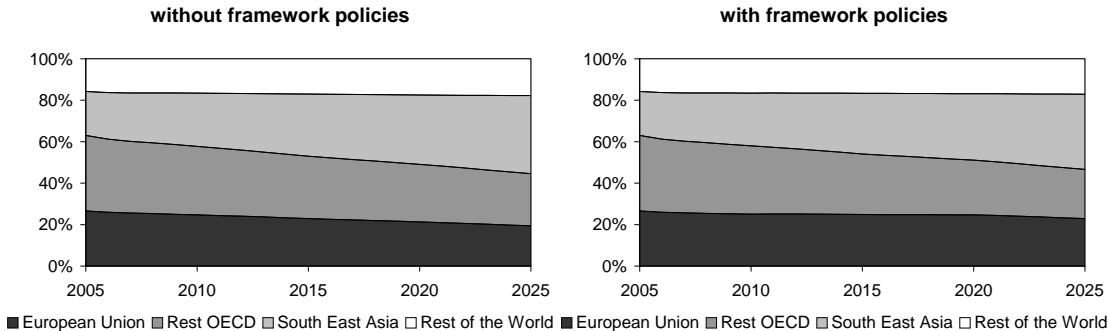
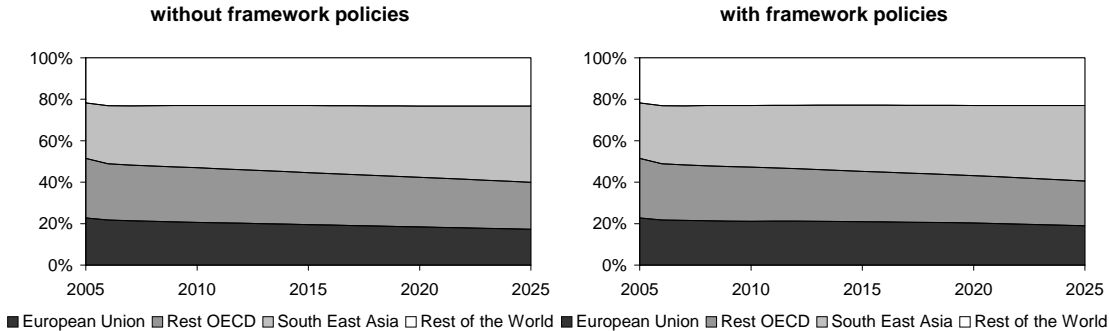


Figure 6.2 presents the developments in the manufacturing trade shares of the EU, Rest OECD, Asia and the rest of the world between 2005 and 2025 in *Adventuring the World*. Also here the patterns are presented with and without framework policies. Europe’s share in global manufacturing trade decreases from 22.7% to 17.3% in 2025, the same decrease as in *cosy at Home*.¹⁰ 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 6.2 Regional shares in the world exports of manufacturing for *Adventuring in the World*



6.2. 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 3.3). This is also reflected in production growth by sector. If we compare Table 6.1 and Table 5.1 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

¹⁰ Note that intra-EU trade is excluded from these figures.

minerals it is about 2% higher per year and for chemicals, rubbers and plastics and transport services about 1.5%.

Table 6.1 EU production growth by sector for Adventuring in the World (annual growth in % for 2005-2025)

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

As is concluded from *Cosy at Home*, framework policies have a substantial effect on production growth in manufacturing. The sector electronic equipment grows 3% per year extra if these policies are implemented. For chemicals, rubber and plastics, transport equipment 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 6.2 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 increase 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 of 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 6.2 Production volume changes per sector in 2025, *Adventuring in the World*

	Skills	R&D	Admin.	Internal	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 6.1 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 increase measured in production and trade, see Figure 6.1 and Figure 6.2. 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 6.3), 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 increases compared to 2005.

Table 6.3 EU27 production as share of world production by sector for *Adventuring in the World*

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

Source: WorldScan

Table 6.4 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 exports services outside the OECD countries. Only in chemicals, rubber and plastics and non-metallic minerals Europe have 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 6.4 EU export flows as share of world export flows by sector for *Adventuring in the World*

Sector	No framework policies		Framework policies	
	2005	2025	2005	2025
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. Some differences are 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-extensive manufacturing sectors, but also policies due 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 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 increase 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% 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 6.5 Revealed comparative advantage in the EU-27 for Adventuring in the World

Sector	No framework policies		Framework policies
	2005	2025	2025
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

7. CONCLUSIONS

Does manufacturing in Europe has a future and can framework policies support 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 massive employment is over for already a long time. The share of manufacturing in employment as well as in value added has decreased in the OECD countries, including Europe, already for decades on end reflecting structural changes in the economies. However, manufacturing remains important for trade, and its productivity increases outpace that in services. This scenario study shows that the structural change towards services in Europe is likely to continue over the next decades, albeit at a slower speed. Asia will become the world's most important provider of manufacturing goods, but not as such at the expense of Europe. Due to high economic growth in Asia, global manufacturing will increase which will be prominently produced in Asia. There is a future for manufacturing in Europe. In 2025 Europe's share in the overall global manufacturing production and trade will be about 20% (much higher in than its share in population), and manufacturing will contribute more than 15% to value added in Europe. Manufacturing will remain the most important driver for Europe's exports. 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. However the framework policies cannot reverse the trend of a sliding share of manufacturing in value added and employment.

The literature indicates that globalisation, technological progress, business models, ageing and the availability of energy and sustainability of the environment are 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, albeit at a lower speed. Employment shifts away from manufacturing towards services and manufacturing contributes less to the European economy in terms of its value added share. In terms of production manufacturing will grow and will remain 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, manufacturing production grows more slowly and the European share in global production is relatively larger.

Within manufacturing various developments take place. We have discriminated between ten aggregate manufacturing sectors: food products, textiles and wearing apparel, wood and other manufacturing, pulp, paper and publishing, chemicals, rubber and plastics, basic metals, non-metallic minerals, electronic equipment, transport equipment and other machinery and equipment. Existing futures and foresight studies as identified in the literature survey underlying the scenarios (Van der Zee and Brandes, 2007) do not give much guidance on specifying possible future developments in the scenarios. These studies largely focus, among others, on emerging and new technologies and their potential, as well as new and different forms of industry-user interaction ('business models'), yet without translating these into productivity developments. Moreover, based on historical productivity growth paths of these 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 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. 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 influenced. 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. In particular this 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 be the important manufacturing sectors in Europe, although the comparative advantages in the other machinery and equipment sector will slide away. These

sectors are important in the composition of Europe's exports and produce about a quarter of global production and global trade in these sectors the coming decades.

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. In the coming decades Europe's decreasing share in global manufacturing production and trade will slow down. The framework policies support this slow down of the relative decline of manufacturing in Europe, such that in some manufacturing sectors such as chemicals, rubber and plastics, and combined machinery and equipment sectors the declining trend comes nearly even to a standstill.

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