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Five Lisbon highlights

The economic impact of reaching these targets

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Abstract in English

The Lisbon strategy could reinvigorate Europe's economy and boost employment. In 2000 the European leaders agreed to stimulate economic growth and employment and make Europe's economy the most competitive in the world. If Europe would really reach the goals they set, Europe's Gross Domestic Product could increase by 12 to 23% and employment by about 11%. This paper draws this conclusion after having analysed five of the most important Lisbon goals: the internal market for services, the reduction of administrative burdens, goals on improving human capital, the 3% target on research and development expenditures, and the 70% target on the employment rate. Using CPB's general equilibrium model for the world economy we have simulated the consequences for Europe of reaching the Lisbon targets in these fields.

Key words: Jobs creation and economic growth, Lisbon agenda, general equilibrium model

JEL code: E20, E61, D58, O52

Abstract in Dutch

De Lissabon agenda kan een substantiële bijdrage leveren aan de Europese economie en werkgelegenheid. In 2000 hebben de Europese leiders afgesproken om de economische groei en werkgelegenheid te stimuleren en de Europese economie de meest concurrerende ter wereld te maken. Als Europa de doelstellingen bereikt die toen bepaald zijn, zou het BBP met 12 tot 23% kunnen toenemen en werkgelegenheid met ongeveer 11%. Deze conclusie volgt na de analyse van vijf van de meest belangrijke Lissabon doelstellingen te weten: de interne markt voor diensten, een vermindering van de administratieve lasten, doelstellingen om het menselijk kapitaal te vergroten, de 3% doelstelling voor uitgaven aan onderzoek en ontwikkeling en de 70% doelstelling voor werkgelegenheid. We hebben de economische gevolgen van deze doelstellingen gekwantificeerd door gebruik te maken van het CPB model WorldScan: een algemeen-evenwichtsmodel voor de wereldeconomie.

Steekwoorden: werkgelegenheid en economische groei, Lissabon agenda, algemeen-evenwichtsmodel

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Preface

A stronger emphasis on job creation and economic growth is one of the main conclusions of the midterm review of the Lisbon strategy. It is one of the top priorities of the Barroso's presidency of the European Commission together with more emphasis on implementation of the Lisbon agenda through national action plans. The Sapir (2003) and Kok (2004) reports constitute important analytical building blocks underlying the mid-term review. Nevertheless, several questions remain unanswered, of which not one of the least is to quantify what benefits the Lisbon strategy can provide for the European economy.

This study quantifies some of the main elements of the Lisbon strategy using our applied general equilibrium model WorldScan as an important tool for analysis. The project was initiated and commissioned by Directorate General Enterprise & Industry of the European Commission as background material for the Competitiveness Report. We want to thank Hannes Leo of WIFO for the collaboration and management of the project.

A large part of the statistical and technical work for this project has been carried out by Nico van Leeuwen and Gerard Verweij. Bas Jacobs contributed heavily to the skill model, and Henk Kox contributed to the data on administrative burdens. The authors thank Isabel Grilo and Josefina Monteagudo of DG Enterprise & Industry, and the participants of the workshops in Vienna at the WIFO institute for fruitful discussions and comments. Moreover the authors acknowledge the constructive comments of their CPB colleagues Eric Canton, Maarten Cornet, Sjef Ederveen, Rob Euwals, Albert van der Horst, Egbert Jongen, Richard Nahuis, Marc Pomp, Bert Smid, Paul Veenendaal, and Dinand Webbink.

Henk Don,
Director CPB

Summary

The Lisbon strategy could reinvigorate Europe's economy and boost employment. In 2000 the European leaders agreed to stimulate economic growth and employment and make Europe's economy the most competitive in the world. If Europe would really reach the goals they set, Europe's GDP could increase by 12 to 23% and employment by about 11%. For more than a decade economic and employment growth would be at least 0.8% higher. However, to reach these goals important efforts to develop the policy measures will be necessary in most countries, the costs of which could not be entirely integrated in this analysis.

These conclusions are drawn after having analysed five of the most important Lisbon goals. Using a general equilibrium model for the world economy we have analysed the opening up of the services market, reduction of administrative burdens, goals on improving human capital, the 3% target on R&D expenditures, and the goals on employment. Working towards all these goals together would revive European's economy and its labour market.

Simulations are used to quantify the consequences of Europe reaching the Lisbon targets in these fields for Europe as a whole, for individual countries and for sectors in Europe. The simulations answer the question: 'What if Europe would reach the Lisbon targets?' They do not take into account all costs of policy measures needed to get to the targets. Moreover the economic effects of the policies are sometimes uncertain. To incorporate this uncertainty we report a lower bound and an upper bound scenario for the two most effective targets in terms of economic growth, employment and R&D.

Jobs creation associated with reaching the 70% employment target, manifests itself in a considerable increase of GDP by 6.3 to 9.2%, depending on the scenario. Reaching these targets may require a substantial cut in taxes and social security benefits. The impact of several skills targets (less early school leavers, more graduates from secondary education, increased reading literacy and more lifelong learning) takes a long time to materialise and appears highly dependent on the initial position of countries. In the long run the increase in labour efficiency ranges from about 0.5% for countries with a high skilled labour force to 3% for countries with much less human capital and hence with much potential for catching up.

Also R&D contributes considerably to economic growth. The direct consequences and associated knowledge spillovers of spending 3% on R&D in 2010 and sustaining it until 2020 amount to 3.5 to 11.6% of GDP, in the two scenarios. In the upper bound scenario the GDP gains range from 3% for countries which already have reached the target to 30% for those countries which currently spend hardly any money on R&D.

The opening up of the services markets yields a modest increase of GDP of about 0.2% through expansion of services trade. This constitutes a lower limit since effects on FDI could not be taken into account. A lower administrative burden on companies completes the set of simulations. Reducing red tape by 25% pays off in a 1.4% increase of GDP.

This range of applications covers the main fields of the Lisbon strategy. Moreover, a simulation of the five policy fields combined provides as a rough estimate that the total economic benefits of reaching these Lisbon targets amount to 12 to 23% of Europe's GDP. These benefits reveal the potential that the Lisbon strategy has to stimulate growth and to create new jobs. But it also shows how ambitious the goals the EU has set itself are. The lesson to be drawn here is that resolute commitments to implement the reforms necessary to reach the Lisbon goals will in the end determine whether or not Lisbon will deliver.

1 Highlights of Lisbon: an overview

1.1 Introduction

A stronger emphasis on job creation and economic growth is one of the main conclusions of the midterm review of the Lisbon strategy. It is one of the top priorities of the Barroso's presidency of the European Commission together with more emphasis on implementation of Lisbon through national action plans. The Sapir (2003) and Kok (2004) reports constitute important analytical building blocks underlying the mid-term review. Nevertheless, several questions remain unanswered, of which not one of the least is to quantify what benefits the Lisbon strategy will provide for the European economy.

Despite an impressive amount of research the task remains arduous to asses the benefits of the Lisbon strategy for Europe. In a survey on the costs of non-Lisbon the Commission (DG ECFIN, 2005) states: 'However, it is extremely difficult to quantify the impact of the reforms as the heterogeneity of individual reform measures, the time lags in their implementation, the complementarities and trade-offs between reforms in different domains, and the influence of short- to medium-term developments make it difficult to separate the effects of reforms undertaken from other determinants of performance.' For this reason this paper focuses on five highlights that cover the most important elements of the Lisbon strategy. For each of these policies we analyse the economic effects of reaching the targets.

A general equilibrium model for the world economy (WorldScan) is used to quantify the consequences of reaching the Lisbon targets. The model is linked to specific 'satellite' sub models, accounting schemes or empirical background research. In such a way, specific Lisbon policies are translated to the economic model. The model quantifies the policy effects by taking various kinds of feedback into account. It includes behavioural feedbacks in the domestic economy for the EU member states (for instance the impact of higher employment on wages) and international feedbacks (such as effects on trade). Moreover, because the economic model is rich in sectoral detail, the method adds insights into the impact of Lisbon policies on sectoral competitiveness.[1]

[1] We distinguish ten sectors: agriculture, energy, four manufacturing sectors with various technology levels, four services sectors: transport, other commercial, R&D and other services. We treat nearly all EU member states, separately. Belgium and Luxembourg are combined in one region. The Baltic States, Malta and Cyprus are also combined in one region.

Applied general equilibrium model WorldScan

Applied general equilibrium models are based on microeconomic behaviour of all economic agents. Producers maximise their profits and consumers maximise their utility. Production technologies relate output to inputs, such that 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. Because WorldScan is a dynamic model, it is well suited to simulate long-term developments in demography, technology, energy and globalisation. The model consists of several types of equations: behavioural equations which describe the behaviour of firms and consumers, identities and accounting relations. These accounting relations are necessary to represent the framework of the national accounts of an economy. This version of the model will be documented in Lejour *et al.* (2006).

The analysis concerns five objectives of the Lisbon strategy: employment, human capital, research and development (R&D), the internal market for services and the administrative burden. Simulations quantify the consequences for Europe of reaching the 70% employment target, several skills targets (less early school leavers, more graduates from secondary education, increased reading literacy and more lifelong learning), the 3% R&D target, the trade effects of opening up the services markets and less administrative burdens on companies. The employment target appears a natural candidate for inclusion, because it represents the jobs pillar of the strategy. On the productivity growth pillar, R&D comes to the fore, because it is an important input in innovation and it has high social returns. The third highlight, human capital, as a factor of production directly contributes to productivity growth. In the field of competition and the functioning of markets, the internal market for services and administrative costs are areas for further analysis, mainly because empirical research is available on the direct effects on trade and productivity, respectively. Hence, this range of applications covers the main fields of the Lisbon strategy. Moreover, a simulation of the five policy fields combined provides a rough estimate of the total economic benefits of reaching the Lisbon targets.

From the start the scope of the analysis should be emphasised. The simulations have a 'what if' character, in the sense that they calculate the effects on the economy if Europe would reach the Lisbon targets. They do not assess the possibility of really reaching the targets in 2010. Moreover, they do not always analyse the costs of the policy measures that may be needed to achieve the targets. For example, to arrive at the employment target, lower marginal income tax rates may stimulate labour market participation, but they also cut into the government budget. That may result in a decline of the provision of public goods, which also benefit society or the economy. The analysis of the employment target only takes these costs into account ex-post in a rather rudimentary way. In so far as costs of policies are excluded from the simulations, we overestimate the benefits of the Lisbon strategy. A downward bias in the results originates from the fact that we do not incorporate all policy measures of the Lisbon strategy. Hence, this exercise can be extended and deepened in various ways, both by delving deeper into policy design and policy costs and by extending the range of policy measures.

To some extent the economic effects of reaching the Lisbon targets remain uncertain. Uncertainty most strongly applies to investments in R&D: empirical research yields social returns to R&D in the range of 30 to 100%. To bear this uncertainty we introduced a bandwidth by simulating a lower bound scenario and an upper bound scenario. Also for the employment target we dealt with uncertainty by varying assumptions on labour participation of women and on the productivity distribution of people who become employed. No bandwidth exists for the other three Lisbon objectives (skills, internal market for services and administrative burden). The main reason is that the economic effects of reaching these targets appear smaller compared to the unemployment and the R&D targets, therefore making a distinction would only change the quantitative results moderately. The presentation in this paper follows the lower bound scenario.

This chapter contains a broad overview of the main results of the simulations. Its structure is as follows. Section 1.2 briefly explains the main characteristics of each of the Lisbon targets and their effects on job creation and economic growth. Section 1.3 reviews the results on consumption, trade and the labour market. Section 1.4 presents the sectoral characteristics of the simulations. Finally, Section 1.5 contrasts these outcomes of the lower bound scenario with those of the upper bound scenario.

Chapter 2 to 8 provide more background and details. Chapter 2 briefly reviews the linkage between the Lisbon strategy and jobs and growth in Europe, Chapter 3 presents the analytical framework, in which the WorldScan model features prominently. Subsequently the various highlights of the Lisbon strategy pass in review: employment in Chapter 4, human capital in Chapter 5, R&D in Chapter 6, the internal market for services in Chapter 7 and administrative burden in Chapter 8.

1.2 Jobs creation and economic growth

This section presents the impact of the Lisbon scenarios on jobs and growth in the lower bound scenario. The impact of the various Lisbon goals are analysed as deviations from a baseline scenario, simulated in WorldScan. Given the baseline we implement the Lisbon goals one by one in order to analyse the difference in outcomes with the baseline. The baseline is described in Chapter 3.

Table 1.1 decomposes the growth effect of the combined simulation into the contributions of the specific Lisbon policies. For the first simulation on the employment target, the table contains the relative change compared to the baseline. For the other Lisbon goals the changes in GDP are relative to the previous simulations. We have simulated subsequently the employment target, the skills target, the services directive, the reduction in administrative burdens, and the R&D target. Hence, column (2) of Table 1.1 compares the effects of reaching the skills target to the simulation in which Europe reaches the employment target. Column (3) shows the effect of opening up the services markets compared to the skills targets and so on. The last column (6) shows the effects of the five policies combined relative to the baseline.

1.2.1 Employment

A very important goal in the "jobs and growth" strategy is the employment target. It is set at 70% in 2010, which implies that 70% of the population between 15 and 64 aged should have at least a part-time job.

We have simulated two employment scenarios, a lower bound and an upper bound scenario. The economic effects of reaching the employment target are smaller in the lower bound scenario compared to the upper bound scenario. The reason is that in the lower bound scenario we apply a baseline with increasing participation rates for women until 2010. The last decades we have seen an increase in labour-market participation of women. Nowadays more women in younger age cohorts participate in the labour market than say 20 years ago. Because these women are accustomed to be active in the formal labour market, it is likely that they will remain employed at an older age. Hence, it seems reasonable to assume that the participation rates of these women will be higher when they are older than the current cohort of that older age. This implies that the difference with the 70% target is smaller than in the upper bound baseline, where we keep participation rates constant after 2003 for all age-cohorts.

Besides this participation effect, we add a second component to the lower bound scenario. It is often said that extra employment is not as productive as existing employment. According to this view the unemployed and people who do not participate on the labour market are on average less educated than the average worker. Extra employment comes from two sources in WorldScan: unemployment falls and participation rates increase. Taking an extreme position, in the lower bound scenario we assume that all extra employment is low-skilled. This contrasts with the upper bound scenario where the supply of skills of the labour inflow is the same as for the existing labour force. By consequence, the increase in employment contributes less to productivity and GDP in the lower bound scenario.

The 70% employment target has to be reached on average in the EU. To derive country-specific targets, which are presented extensively in Chapter 4, we set an upper limit for the employment rate of 75%. Each country will proportionally reduce the gap between the maximum of 75% and the 2003 rate. This implies that a country with a low employment rate, such as Poland, still faces a very ambitious target, but it will be lower than 70%. Countries that already have met the 70% target also increase employment to some extent. For the years after 2010 we assume that the unemployment rates and the age-specific labour-market participation rates stay constant.

Table 1.1 GDP effects of five Lisbon goals in 2025: lower bound scenario

	Employment	Human capital	Services	Administrative Burden	R&D	Total
Column	(1)	(2)	(3)	(4)	(5)	(6)
EU	6.3	0.5	0.2	1.6	3.5	12.0
Germany	4.9	0.5	0.2	1.6	3.1	10.4
France	7.9	0.4	0.2	1.7	3.2	13.3
United Kingdom	2.3	0.7	0.1	0.9	2.8	6.8
Italy	11.8	0.5	0.2	1.9	4.5	18.9
Spain	8.8	0.7	0.1	1.8	4.7	16.1
The Netherlands	0.6	0.3	0.2	1.5	3.5	6.1
Belgium and Luxembourg	12.3	0.6	0.3	1.5	3.9	18.6
Denmark	0.4	0.6	0.4	1.1	2.2	4.6
Sweden	1.9	0.3	0.3	1.1	0.7	4.4
Finland	5.1	0.1	0.4	1.2	2.0	8.8
Ireland	4.2	0.4	0.2	1.3	4.5	10.7
Austria	2.3	0.2	0.4	1.8	3.4	8.2
Greece	10.9	0.9	0.2	2.3	4.3	18.6
Portugal	2.5	2.4	0.1	1.8	4.5	11.3
Poland	17.2	0.6	0.2	2.2	5.7	25.9
Czech Republic	6.4	0.3	0.4	1.7	5.1	13.8
Hungary	10.4	0.4	0.7	2.6	5.8	20.0
Slovakia	11.9	0.3	0.9	2.5	8.1	23.6
Slovenia	9.9	0.4	0.4	1.8	5.1	17.7
Rest EU	6.5	0.2	0.3	2.5	6.2	15.8

Source: WorldScan simulations. The numbers in column (2) to (5) are relative changes from the policy simulations in the previous columns in the year 2525. In column (1) and (6) the numbers are relative changes from the baseline.

Reaching the employment target implies that employment rises by nearly 11% in the EU in the lower bound scenario. This translates into a growth impulse of 6.3% (see column 1 of Table 1.1). The increase in jobs outpaces economic growth because productivity falls due to the inflow of low-skilled and the large increase in employment.

The variation within the EU is large. In Austria, Denmark, Sweden, the UK, Portugal, and the Netherlands GDP changes moderately. These countries are relatively close to the employment target. In contrast, the distance from the target is large in Italy, Belgium, Greece, Hungary, Poland, and Slovakia. GDP increases by more than 10% in these countries.

These 'what if' simulations abstract from policy measures to increase participation and reduce unemployment. Yet, it is possible to get a rough idea of policies that may be used to reach the targets. For instance, if we use the income tax rate and social security benefits as policy instruments, an 8%-points fall of the income tax rate could bring about the increase of labour market participation by women for Europe as a whole. In addition, a decrease of social security benefits by 10% to 22%[2] relative to wages could induce the fall in unemployment incorporated in the lower bound scenario.

[2] The range results from different elasticities found in the literature, see Chapter 4 for details.

1.2.2 Skills

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

1. An EU average rate of no more than 10% early school leavers should be achieved.[3]
2. At least 85% of 22 year olds in the European Union should have completed upper secondary education or higher.
3. 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.
4. 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).
5. 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.

European Commission (2004b) emphasises that the targets apply to the EU as a whole and not to individual countries. In accordance with the other Lisbon simulations we follow the general rule to compute country specific targets that has also been applied in other simulations. We set an upper limit above the target and above the highest base level value (sometimes countries already in the base data exceed the targets). We then set the target for a country proportional to the distance of the base level value of that country and the upper limit. In this way countries that are at the largest distance from the target have to make the largest effort. At the same time, because the upper limit exceeds the target, countries that have reached or exceeded the target are still assumed to make some (although generally small) effort.

The what-if character of the simulations implies that we do not explicitly deal with the policies required to reach the targets. Nevertheless, some simulations still capture the most important costs of achieving the skills targets, namely the opportunity costs of increasing levels

[3] It was not possible to implement this target separately in the analysis, see Chapter 5.

of education and the opportunity costs of acquiring more skills on the job. In particular, raising the number of better skilled workers in the population automatically implies that there are less low skilled workers available. Moreover, if skills upgrading requires more time in education, less labour time is available and earnings are lower. Also, increasing training efforts will imply lower labour earnings in the short run as workers spend less time being productive when they spent their time accumulating human capital.

Column (2) of Table 1.1 presents the growth effects in 2025 of reaching the skills targets. This comes down to 0.5% increase in GDP in the EU. The 2025 outcomes depend on two main components, the level of skills in a particular country and the relative importance of the lifelong learning target. The level of skills determines the overall size of the skills effect. For instance, Portugal benefits most, because the initial skill level is low compared to the target. Benefits for Finland are small because it already scores well on all of the skills targets.

More training effort has two contrasting effects. Firstly, participation in training demands time that without training would have been used for working. Because working time has to be invested up front in training, the initial labour efficiency effects are negative. Secondly, increasing training time raises the growth rate of on-the-job training. These positive effects from human capital accumulation gradually build up and after a number of years dominate the results. This relevance of this effect follows from comparing Austria to the United Kingdom. For Austria lifelong learning yields a major contribution. By consequence, the effects of the initial setback outweigh the positive effects of training: the GDP effects in 2025 are relatively small. In the United Kingdom the initial setback is smaller and the other targets add to relatively larger effects in 2025.

On the longer run the positive effects of lifelong learning kick in. In 2040 the GDP gains[4] are much larger than in 2025, because it takes several decades before the skills targets have affected the human capital of all age cohorts of the labour force. In 2040 Austria outperforms the United Kingdom.

1.2.3 The internal market for services

A cornerstone of the European Union is the principle that goods, services, capital and labour can move freely between the member states. The internal market for goods seems to function well, after the implementation of the Single Market programme in 1992. That is however not the case for the internal market in services. Service providers often experience obstacles if they want to export their services to other EU member states, or when they want to start a subsidiary company in other EU member states. The EC (2004a) has recently proposed a directive to reduce the impediments for trade in commercial services. A key element of this directive is the

[4] The effects for 2040 are presented in the Annex. All together, GDP in Europe rises by 1.7% in 2040 if Europe reaches the skills targets in 2010. This 2040 GDP effect is more than three times the effect in 2025, which illustrates the long lags involved in the process of skill upgrading.

'country of origin' principle. A service provider who complied with the national regulation of the country of origin should no longer be hampered by regulation in the destination country.

The main economic implication of the proposed measures is a substantial reduction of regulation heterogeneity. Taking into account the empirical uncertainties of the impact of the EU directive on regulation heterogeneity and of the heterogeneity indicators on trade and investment, Kox *et al*. (2004a) estimate that commercial services trade (excluding transport services) could increase by 30 to 60 per cent in the EU, while foreign direct investment stocks in services might increase by 20 to 35 per cent due to the directive.

Following up on Kox *et al*. (2004a) we estimate the welfare effects of the increase in commercial services trade using WorldScan. This is not a complete welfare analysis of the proposed measures, because the current version of the model does not include FDI flows and lacks economies to scale. Economies of scale can trigger additional welfare effects of more open services markets in the EU. By consequence, the outcomes of the present analysis of extra trade have to be considered as a lower bound.

Ex ante the measures meant to open up the services markets will increase other commercial services trade by about 30% (the lower bound of the Kox *et al*. estimates). This is substantial for the sector itself; however at a macro-economic level this increase is modest. Kox *et al*. (2004b) show that other commercial services trade makes up only about 10% of total EU trade. Moreover, about half of other commercial services trade is directed to countries outside the EU. So, only about 5% of EU trade is affected by the services directive. By consequence, the 30% increase in increase other commercial services trade would lead to a total trade increase in the EU of about 1.5%. Given the small effects on total trade and the constant returns to scale assumption in production it is not surprising that the GDP effects are modest, on average 0.2% in the EU (see column (3) of Table 1.1).

The country specific effects differ depending on the reduction in regulatory heterogeneity between the countries and their most important trading partners in other commercial services trade. E.g. the trade effects for France, United Kingdom, Spain and Portugal are modest. From the data we know that these countries trade relatively much with each other and that the regulatory heterogeneity between these countries is small. For countries like Austria, Denmark, Hungary and Slovakia the regulatory heterogeneity with their most important trading partners is much larger and so is the effect of less heterogeneity.

1.2.4 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 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.

In the WorldScan simulation all countries experience a reduction in the administrative costs as a percentage of GDP by a quarter. Using country specific labour income shares we translate these into an increase in labour efficiency. On average, labour efficiency rises by 1.5% in Europe in 2025. Without R&D spillovers the long term change in GDP volume will equal the initial shock of 1.5%. R&D spillovers slightly magnify this outcome to 1.6% (see column (4) of Table 1.1). Country specific effects mirror the distribution of administrative costs over countries. These effects are relatively small.

1.2.5 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. Amounting to 2% of GDP in 2003, public and private R&D expenditures are lagging behind in Europe compared to the United States (2.8%) and the rest of the OECD (3.1%). The European Council agreed to raise these expenditures to 3% of GDP in 2010. In the WorldScan simulations we assume that the targets are reached in 2010. 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.

New technologies and better products boost productivity, not only in the innovating sector itself, but also in other sectors. In addition, since the influential paper by Coe and Helpman (1995) it is well established that investment in R&D 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. Therefore, we incorporate an empirical relation between total factor productivity (TFP) growth and the growth of R&D stocks in WorldScan. We distinguish three types of R&D stocks: the R&D stocks of the own sector, of other sectors in the economy to reflect domestic spillovers, and of foreign sectors to reflect international spillovers. In addition, we have incorporated the R&D decision of firms in our model based on profit maximisation.

The estimated TFP equation in WorldScan expresses the impact of a marginal increase in R&D. The 50% increase to meet the Lisbon target is not a marginal increase at all. Hence, we may doubt whether the extra R&D is as productive as current R&D. The estimated social return on R&D is in the top range of the results in the literature and the most interesting R&D projects may already have been conducted. Therefore we consider the estimated elasticities and the calculated returns on R&D as an upper bound. In the lower bound scenario we substantially reduce the coefficients for the national and international R&D spillovers such that the social rate of return on R&D equals the lower bound of the estimates in the literature.

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.

To take country differences into account, we cover proportionally the gap between current R&D spending and an artificial target by increasing R&D expenditure between 2005 and 2010. The artificial target is set at 4.5%. For each country the gap between current spending and the limit of 4.5% is proportionally decreased, in such a way that the 3% level for the EU is reached in 2010. Countries with initially less spending on R&D have to increase their R&D effort substantially, while countries with initially high R&D spending face less ambitious targets. Column (5) of Table 1.1 presents the growth effects of the scenario where the R&D spillovers are modest. The R&D stock in the EU is increased by about 66%. This leads to a GDP gain of about 3.5%. The effects for the individual countries depend to a large extent on the distance between 3% and their current levels of R&D spending. For the Scandinavian countries the GDP effects are the smallest because they have already reached the 3% level (except Denmark). Productivity in these countries increases slightly because they benefit from the spillovers of higher R&D stocks in other countries. For Germany and France the effects are about equal to the EU average. Although they have to increase their R&D spending, the gap to the target is not as large as for other countries. For other large countries, such as Italy and Spain, the effects are much larger. Their R&D stocks increase by about 160%, leading to GDP gains of over 4%. For most new member states the effects are even larger. GDP gains are 5% or higher in these countries. Their R&D stocks double at least.

1.2.6 Combined effects

Column (6) of Table 1.1 contains the effects on economic growth of all Lisbon targets combined. GDP in the EU could increase by 12% in 2025 if all goals are met, which is quite large. Economic growth would step up by about three quarters of a percentage point until 2025. This is mainly caused by a large employment increase due to the 70% employment target and a large increase in labour productivity due to the expanding R&D stock. The skills target, the trade-effects of opening up the services market and the reduction in administrative barriers contribute much less to the GDP increase.

This conclusion also holds for the individual countries. The GDP increase varies from 4.5% for Sweden to 26% for Poland. In general the effects of the Lisbon goals for the new member states are much larger than for most of the older member states, in particular the non-Mediterranean countries. These large differences are mainly due to the variation in efforts needed to reach the employment and R&D target. The new member states and most of the Mediterranean countries are far away from the Lisbon goals on employment and R&D in 2003. As a consequence the economies of these countries are most affected if the targets are reached.

1.3 Consumption, trade and the labour market

1.3.1 Consumption

The effects on consumption per capita are smaller than those on GDP (see **Fout! Verwijzingsbron niet gevonden.**). Overall consumption per capita increases by about 9% until 2025 instead of 12% for GDP. This is caused by negative terms-of-trade effects for most of the Lisbon policies. The terms-of-trade effect is the largest for the R&D targets. The productivity increases exert a downward pressure on producer prices. Therefore export prices decrease while import prices do not change substantially, in particular for the imports from outside the EU.

For nearly all member states, the increase in employment contributes more to consumption growth than the increase in R&D spending. The variation in consumption effects over countries and policies is similar to the GDP effects.[5]

[5] The only exception is Sweden. Sweden already is close to most Lisbon targets so it benefits least from reaching the targets. Hence, the fall in Swedish export prices is relatively small, while Sweden benefits from falling import prices, because other EU countries lower their export prices. By consequence, terms-of-trade effects are positive in Sweden.

Table 1.2	Consumption effects of five Lisbon goals in 2025; lower bound scenario					
	Employment	Human capital	Services	Administrative burden	R&D	Total
Column	(1)	(2)	(3)	(4)	(5)	(6)
EU	5.6	0.5	0.5	1.4	1.3	9.2
Germany	4.7	0.5	0.5	1.5	1.1	8.2
France	6.9	0.3	0.3	1.5	1.1	10.0
United Kingdom	2.2	0.6	0.3	0.9	0.8	4.9
Italy	10.2	0.5	0.4	1.7	1.5	14.3
Spain	7.3	0.6	0.3	1.6	1.8	11.6
The Netherlands	0.9	0.3	0.7	1.4	1.3	4.5
Belgium and Luxembourg	10.3	0.5	1.3	1.4	1.6	15.1
Denmark	0.5	0.5	0.7	1.0	0.9	3.7
Sweden	2.0	0.3	0.7	1.1	0.9	5.0
Finland	5.0	0.1	0.5	1.2	0.9	7.7
Ireland	3.9	0.4	1.6	1.2	1.3	8.4
Austria	2.3	0.2	1.0	1.6	1.4	6.4
Greece	8.8	0.7	0.3	1.9	1.9	13.7
Portugal	2.4	2.0	0.3	1.6	2.0	8.2
Poland	14.7	0.5	0.4	2.0	2.5	20.0
Czech Republic	5.7	0.2	0.7	1.5	2.5	10.7
Hungary	9.1	0.3	1.0	2.3	2.5	15.3
Slovakia	10.0	0.3	1.2	2.2	4.8	18.4
Slovenia	8.9	0.4	0.6	1.7	2.6	14.1
Rest EU	5.3	0.2	0.8	2.1	2.9	11.1

Source: WorldScan simulations. The numbers in column (2) to (5) are relative changes from the policy simulations in the previous column in the year 2025. In column (1) and (6) the numbers are relative changes from the baseline.

1.3.2 Trade

EU exports increase by 17% in 2025 (**Fout! Verwijzingsbron niet gevonden.**). These include intra and extra EU-exports. At least half of the export increase, and for some countries slightly more, results from the R&D component. The increase in employment also stimulates trade substantially, while opening of the services market has only an effect on trade in other commercial services.

By comparing **Fout! Verwijzingsbron niet gevonden.** to Table 1.1 it is evident that the total exports effects are larger than the GDP effects. For the Lisbon policies on employment, skills and the reduction in administrative burden the trade effects are similar to those on GDP. The differences originate from the simulations on R&D and the opening up of services markets, which clearly have a trade stimulating effect. The increase in R&D stimulates productivity in the high technology sectors, in particular. These sectors are also the most tradable sectors. Their share in trade is much higher than it is in value added. Consequently, the trade effect of R&D policy is larger than the effect on GDP. The services directive aims at integrating the national services markets in the EU. It stimulates trade openness of countries by reducing barriers to trade in other commercial services.

Table 1.3 Export effects of the five Lisbon policies in 2025: lower bound scenario

	Employment	Human capital	Services	Administrative burden	R&D	Total
Column	(1)	(2)	(3)	(4)	(5)	(6)
EU	6.7	0.6	1.9	1.6	6.4	17.2
Germany	5.3	0.5	1.8	1.6	5.8	15.0
France	8.3	0.5	1.4	1.8	6.3	18.3
United Kingdom	3.0	0.6	1.7	1.0	6.2	12.5
Italy	11.3	0.6	2.2	1.9	7.7	23.7
Spain	9.6	0.9	1.5	1.9	8.9	22.8
The Netherlands	1.4	0.3	2.3	1.4	5.8	11.3
Belgium and Luxembourg	12.3	0.6	2.0	1.6	6.5	23.0
Denmark	1.1	0.5	2.7	1.1	4.1	9.6
Sweden	2.5	0.3	2.2	1.1	1.2	7.3
Finland	4.4	0.2	2.0	1.1	5.3	13.0
Ireland	4.1	0.4	1.2	1.2	6.7	13.6
Austria	3.5	0.3	3.2	2.0	6.5	15.6
Greece	9.4	0.8	2.6	2.0	4.8	19.5
Portugal	4.5	2.4	1.6	2.0	7.6	18.0
Poland	17.6	0.7	1.5	2.4	8.4	30.6
Czech republic	7.3	0.4	1.6	1.8	7.5	18.7
Hungary	10.0	0.4	2.7	2.4	8.2	23.7
Slovakia	11.5	0.4	2.7	2.4	9.0	26.0
Slovenia	10.3	0.5	1.9	2.0	7.6	22.3
Rest EU	7.3	0.3	2.1	2.4	9.6	21.7

Source: WorldScan simulations. The numbers in column (2) to (5) are relative changes from the policy simulations in the previous column in the year 2025. In column (1) and (6) the numbers are relative changes from the baseline.

1.3.3 Labour market

The Lisbon policies also affect the labour market, directly and indirectly: directly, because the employment simulation stimulates labour supply; indirectly, because some policies affect (labour) productivity, which feeds forward into wages. Note that in WorldScan unemployment and labour-market participation are exogenous (see Section 3.2). In case of the employment target employment rises in line with the increase in participation and the fall in unemployment. In the other simulations total employment does not change.

Fout! Verwijzingsbron niet gevonden. presents the wage outcomes for the five policies. Overall real wages hardly change in the EU. Effects for individual countries vary from −2.3% in Italy to 7.8% in Portugal. The increase in real wages mainly follows from higher productivity, induced by the enlarged R&D stocks, see column (5). The policies for improving skills (Portugal is an exception), the trade-effects of opening up the services markets and the reduction in administrative burden contribute moderately to labour productivity and thereby to higher wages. In general the modest, positive effects of these three policies on real wages are offset by the reduction in real wages induced by the increase in employment. The increase in employment has a negative effect on labour productivity, partly because the lower bound scenario assumes that the additional inflow of labour is low skilled. The total wage outcome for a country depends on the difference between the negative effect of the employment simulation and the sum of the positive effects of the other simulations.

Table 1.4 Development of real wages after implementing five Lisbon policies in 2025; lower bound scenario

	Employment	Human capital	Services	Administrative burden	R&D	Total
Column	(1)	(2)	(3)	(4)	(5)	(6)
EU	– 4.3	0.4	0.5	1.3	3.0	0.9
Germany	– 2.5	0.4	0.5	1.4	2.6	2.4
France	– 4.2	0.3	0.3	1.4	2.9	0.7
United Kingdom	– 0.9	0.6	0.4	0.9	2.6	3.5
Italy	– 7.8	0.4	0.4	1.4	3.6	– 2.0
Spain	– 4.5	0.6	0.2	1.4	4.0	1.8
The Netherlands	0.1	0.3	0.9	1.4	3.0	5.7
Belgium and Luxembourg	– 6.6	0.4	1.3	1.2	2.8	– 0.9
Denmark	0.2	0.5	0.7	1.0	2.2	4.6
Sweden	– 0.5	0.3	0.7	1.0	0.8	2.2
Finland	– 2.5	0.1	0.4	1.0	1.7	0.7
Ireland	– 2.0	0.4	1.7	1.2	3.5	4.7
Austria	– 0.8	0.2	1.0	1.6	3.2	5.3
Greece	– 4.5	0.7	0.3	1.8	4.6	2.9
Portugal	– 0.5	2.1	0.3	1.6	4.6	8.2
Poland	– 7.4	0.4	0.3	1.6	4.6	– 0.6
Czech Republic	– 2.8	0.2	0.6	1.4	4.8	4.3
Hungary	– 6.1	0.3	0.7	2.0	4.9	1.8
Slovakia	– 5.6	0.2	1.0	1.8	6.7	4.2
Slovenia	– 3.3	0.4	0.6	1.5	4.0	3.1
Rest EU	– 2.9	0.2	0.8	1.9	5.4	5.4

Source: WorldScan simulations. The numbers in column (2) to (5) are relative changes from the policy simulations in the previous column in the year 2025. In column (1) and (6) the numbers are relative changes from the baseline.

1.4 Sectoral effects

Nearly all Lisbon policies analysed in this paper do not have a specific sectoral focus. The employment target, the R&D expenditure target, the skills target and the administrative burden are economy-wide goals. Only the measures in the area of the internal market for services are focussed on a specific sector: commercial services, except for transport services. This does not imply that reaching the Lisbon targets has a neutral impact on the sectoral structure in the EU economy. For two reasons this is not the case. The first is that the EU member states have diverse sectoral structures and that the member states are affected differently by the Lisbon goals. Even if these goals have a neutral impact on the sector structure per country, it will not have a neutral impact on the EU economy as a whole. The second reason is that sectors differ, also per country. Some sectors are more R&D intensive; others are more labour and/or skill intensive. Moreover, the sectors require different amounts of inputs.

Table 1.5 Sectoral production developments in the EU: lower bound scenario

Production volume in 2025	Employment	Human capital	Services	Administrative burden	R&D	Total
Column	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture	9.8	0.5	0.2	1.5	1.4	13.4
Energy	5.0	0.4	0.3	1.2	2.7	9.6
Low tech manufacturing	7.9	0.6	0.2	1.7	1.4	11.8
Medium-low tech manufacturing	9.0	0.7	0.2	2.0	5.4	17.4
Medium-high tech manufacturing	7.8	0.7	0.3	1.9	11.0	21.7
High tech manufacturing	10.5	0.8	0.4	2.3	22.0	36.0
Transport services	6.9	0.6	0.2	1.6	2.4	11.6
Other commercial services	5.8	0.5	0.2	1.5	1.7	9.7
R&D	3.6	1.1	0.3	1.6	71.0	77.7
Other services	5.0	0.5	0.2	1.5	0.8	8.1

Source: WorldScan simulations. The numbers in column (2) to (5) are relative changes from the policy simulations in the previous column in the year 2025. In column (1) and (6) the numbers are relative changes from the baseline.

Fout! Verwijzingsbron niet gevonden. shows the changes in sectoral production for the separate Lisbon targets and for all targets combined. Production in the R&D sector surges by nearly 80%, due to the ambitious R&D targets. Because R&D is heavily subsidised, the R&D intensive sectors (high tech manufacturing and medium-high tech manufacturing) benefit most. The R&D extensive sectors, other commercial services and other services, do not expand as much as the R&D intensive sectors. Also the employment target stimulates production, while the other targets do not contribute that much to extra production. For all targets, production increases most in the tradable sectors (the manufacturing sectors).

Table 1.6 Sectoral employment developments in the EU: lower bound scenario

Employment 2025	Employment	Human capital	Services	Administrative burden	R&D	Total
Column	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture	18.2	0.0	0.0	-0.1	-3.1	14.9
Energy	8.3	0.0	0.0	-0.1	-2.5	5.8
Low tech manufacturing	11.4	0.0	0.1	0.0	-3.1	8.4
Medium-low tech manufacturing	12.1	0.1	0.1	0.3	0.3	12.9
High-medium tech manufacturing	10.9	0.1	0.2	0.2	-1.0	10.3
High tech manufacturing	15.5	0.3	0.2	0.6	4.4	21.0
Transport services	10.0	0.0	0.0	-0.1	-1.5	8.4
Other commercial services	7.9	0.0	– 0.1	0.1	-0.5	7.4
R&D	3.8	0.5	0.2	-0.2	77.0	81.4
Other services	6.0	– 0.1	0.1	-0.2	-1.2	4.6

Source: WorldScan simulations. The numbers in column (2) to (5) are relative changes from the policy simulations in the previous column in the year 2025. In column (1) and (6) the numbers are relative changes from the baseline.

The sectoral employment pattern is heavily correlated with the changes in production. **Fout! Verwijzingsbron niet gevonden.** shows that employment increases most in the R&D sector and in high tech manufacturing. Note that total employment only increases from implementing the 70% employment target. For the other targets the sectoral employment changes offset each other. The R&D target generates substantial sectoral employment changes, for the other targets the effects are fairly modest.

Table 1.7 Sectoral exports in EU: lower bound scenario

Export in 2025	Employment	Human capital	Services	Administrative burden	R&D	Total
Column	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture	8.8	0.4	0.0	1.2	0.0	10.6
Energy	2.0	0.1	0.2	0.6	1.2	4.1
Low tech manufacturing	7.4	0.5	0.2	1.6	0.4	10.1
Medium-low tech manufacturing	8.6	0.7	0.2	1.9	3.1	14.5
Medium-high tech manufacturing	7.2	0.6	0.3	1.8	11.2	21.1
High tech manufacturing	8.8	0.8	0.3	2.1	22.0	34.0
Transport services	4.8	0.4	0.1	1.2	− 0.1	6.5
Other commercial services	3.3	0.4	16.5	1.3	− 2.7	18.7
Other services	1.9	0.7	− 0.6	1.6	− 5.2	− 1.6

Source: WorldScan simulations. The numbers in column (2) to (5) are relative changes from the policy simulations in the previous column in the year 2025. In column (1) and (6) the numbers are relative changes from the baseline.

Exports increase most in the manufacturing sectors, in particular in high tech manufacturing and in medium-high tech manufacturing (see **Fout! Verwijzingsbron niet gevonden.**). Also trade in other commercial services increases substantially, due to the effect of opening up the services market.

From **Fout! Verwijzingsbron niet gevonden.** we know that overall exports increase by 17%. Exports in medium-high tech and high tech manufacturing increase faster. These products will form a larger part of the total EU exports. The shares of agriculture, energy, low tech manufacturing and services fall. Specialisation of the R&D intensive sectors will increase, while it decreases in other sectors. Due to the measures to open up the services market, specialisation in the other commercial services will increase. If all five policies are combined, specialisation in other commercial services decreases in spite of measures addressing the services market. The reason is that the changes in the specialisation and export pattern are dominated by the changes from the large increase of R&D spending.

1.5 Lisbon in perspective

This paper quantifies the economic effects of reaching five highlights of Europe's Lisbon strategy. The implementation of these five targets could give a boost to Europe's economy: overall GDP could increase by 12% and consumption by 9%. This is a substantial effect. Although it has to be qualified, because we do not conduct a full welfare assessment, this effect is at the lower end of our bandwidth. So far we have only analysed the lower bound scenario for the employment and R&D expenditures target. If labour-market participation of women does not increase autonomously until 2010, and if a substantial share of extra employment needed to fulfil the target is high-skilled, the effects of the employment target on GDP could be much higher. The same applies for the R&D expenditures target if the social rate of return is much higher. **Fout! Verwijzingsbron niet gevonden.** presents the results of the upper bound scenario.

Table 1.8 GDP effects of the five Lisbon goals in 2025: upper bound scenario

	Employment	Human capital	Services	Administrative burden	R&D	Total
Column	(1)	(2)	(3)	(4)	(5)	(6)
EU	9.2	0.5	0.2	1.6	11.6	23.2
Germany	7.2	0.5	0.3	1.7	9.6	19.3
France	10.6	0.4	0.2	1.8	10.1	23.1
United Kingdom	3.8	0.7	0.1	1.0	7.9	13.4
Italy	18.2	0.6	0.2	2.0	15.7	36.7
Spain	14.0	0.8	0.1	1.9	16.8	33.6
The Netherlands	2.7	0.3	0.2	1.5	10.0	14.8
Belgium and Luxembourg	18.2	0.6	0.3	1.6	13.8	34.6
Denmark	0.9	0.6	0.4	1.1	7.3	10.3
Sweden	2.0	0.3	0.3	1.1	3.9	7.6
Finland	6.1	0.1	0.4	1.2	6.0	13.8
Ireland	7.6	0.4	0.2	1.3	18.0	27.6
Austria	5.1	0.2	0.4	1.9	11.0	18.6
Greece	14.6	1.0	0.2	2.3	17.0	35.0
Portugal	4.8	2.5	0.2	1.8	17.5	26.7
Poland	20.0	0.6	0.2	2.3	23.2	46.2
Czech Republic	8.1	0.3	0.4	1.7	19.4	30.0
Hungary	14.6	0.4	0.7	2.7	25.6	44.0
Slovakia	15.2	0.3	0.9	2.5	35.3	54.3
Slovenia	14.5	0.5	0.4	1.9	20.1	37.3
Rest EU	8.0	0.2	0.3	2.5	25.2	36.3

Source: WorldScan simulations. The numbers in column (2) to (5) are relative changes from the policy simulations in the previous column in the year 2025. In column (1) and (6) the numbers are relative changes from the baseline.

Jobs creation associated with reaching the 70% employment target generates a GDP increase of 6.3 to 9.2% (compare Table 1.1 and **Fout! Verwijzingsbron niet gevonden.**). One reason is that the lower bound scenario assumes that the additional labour inflow entirely consists of low-skilled (hence low-productive) workers, whereas in the upper bound scenario the inflow represents the skill distribution in the labour force. The second reason is that labour-market participation of women does not increase autonomously.

From the literature it is possible to obtain a rough indication of the policies that may bring about these substantial changes in employment and economic growth. For instance, we use the income tax rates and social security benefits as possible policy instruments. From calculations it follows that income tax rates have to fall by 8% points to generate the increase in labour supply of women in the lower bound scenario. Financing this tax reduction would require substantial cuts in government expenditure, i.e. in the provision of public goods. In addition, the ratio of social security benefits to wages (the so-called replacement ratio) would have to fall by 10 to 22 %-points depending on the elasticities found in the literature, which would entail substantial changes in the income distribution..

The impact of several skills targets (less early school leavers, more graduates from secondary education, increased reading literacy and more lifelong learning) appears highly dependent on the initial position of countries. In 2025 the increase in labour efficiency ranges from a marginal 0.1% for countries with a high skilled labour force to the order of 1% for countries with much less human capital and hence with much potential for catching up.[6] In 2040 the range of labour efficiency effects amounts to 0.5% to 3%, about three times as large as the 2025 effects (see Annex 3). This shows that it takes a considerable amount of time before higher skills manifest themselves in the labour force.

The measures meant to open up the services market yield a modest increase of GDP of about 0.2% through expansion of services trade. This constitutes a lower limit since effects on FDI could not be taken into account in the current version of WorldScan. A lower administrative burden on companies yields somewhat larger effects: reducing red tape by 25% pays off in a 1.6% increase of GDP.

Also R&D contributes considerably to economic growth. Uncertainty about the social returns to R&D generates a rather large bandwidth of the consequences for economic growth. The direct consequences and associated knowledge spillovers of spending 3% on R&D in 2010 and sustaining it until 2020 range from 3.5% of GDP in the lower bound scenario (Table 1.1) to 11.6% in the upper bound scenario (**Fout! Verwijzingsbron niet gevonden.**) on average for the EU. Also the country variation is large, in particular in the upper bound scenario. There the GDP gains range from 34% for countries which already have reached the target to 30% for those countries which currently spend hardly any money on R&D.

All five policy fields combined provide a rough estimate that the highlights of Lisbon will increase Europe's GDP by 12 to 23%. The associated rise of consumption amounts to 9 - 19%. The consumption effects are smaller than the GDP effects due to the negative terms of trade

[6] Portugal being the outlier with a potential for catching up of 2.5% of GDP.

effect of most policies. The trade effects (17 to 32%) are larger because of the trade-promoting effects resulting from opening up the services market and the impact of increased R&D expenditures on the tradable R&D intensive sectors. These two policies also affect the sectoral structure of the EU economy. In particular the R&D intensive sectors benefit substantially.

The large effects of these five policies give an indication of the economic potential of Lisbon, but do not represent a full welfare analysis as we have emphasised before. Table 1.9 shows the policy elements that we have analysed for each of the goals. These elements are important, but we have also excluded elements from our analysis such as leisure and inequality in welfare and the costs of many policy instruments. Some of these excluded elements would reduce the GDP and consumption effects of the Lisbon policies, some others, in particular with respect to the services market, could increase these benefits. This requires a more in-depth analysis of each of the policy fields. The contribution of this paper is an integrated 'what if' analysis of five polices, which is by its broader scope less detailed.

Table 1.9 The analysed effects of the Lisbon policies

Goal	Analysed effects	excluded effects
Employment	extra employment	costs of labour-market policies
	less productive extra employment	costs of labour-participation policies
		changes in leisure
		changes inequality and poverty
Human capital	increase in skills	costs of extra education
	extra schooling time	
Research and development	increase in R&D expenditures	effectiveness of extra expenditures
	effects of R&D subsidy	excess burden of subsidies
Internal market for services	trade effects	competition effects
		FDI effects
		employment effects
Administrative burden	higher labour efficiency	benefits of administrative rules

The huge benefits of the Lisbon agenda may be interpreted in two ways. On the one hand they may show what potential lies ahead for Europe. In particular for the new member states, it is tempting to conclude that the Lisbon policies are a major element for catching up. On the other hand the benefits illustrate the vast ambition of the Lisbon targets. Policies to reach the targets entail costs which may lead to less funding for the provision of public goods, and reduced leisure, costs which only partly could be taken into account in this analysis. Moreover, it is very hard to imagine that the targets really will be reached by 2010. But if large benefits indeed emerge on the horizon, pursuing these policies beyond 2010 may be an appealing perspective.

2 The European economy and the Lisbon strategy

This chapter sets the stage by briefly reviewing several aspects of the European economy. At times it uses the US economy as a mirror to identify strengths and weaknesses of the European economy. Moreover, it connects the Lisbon strategy to determinants of employment and economic growth in order to assess through which channels the strategy may deliver jobs and growth. It also surveys some of the empirical evidence on the impact of the determinants on productivity.

Table 2.1 Jobs, growth and the Lisbon strategy

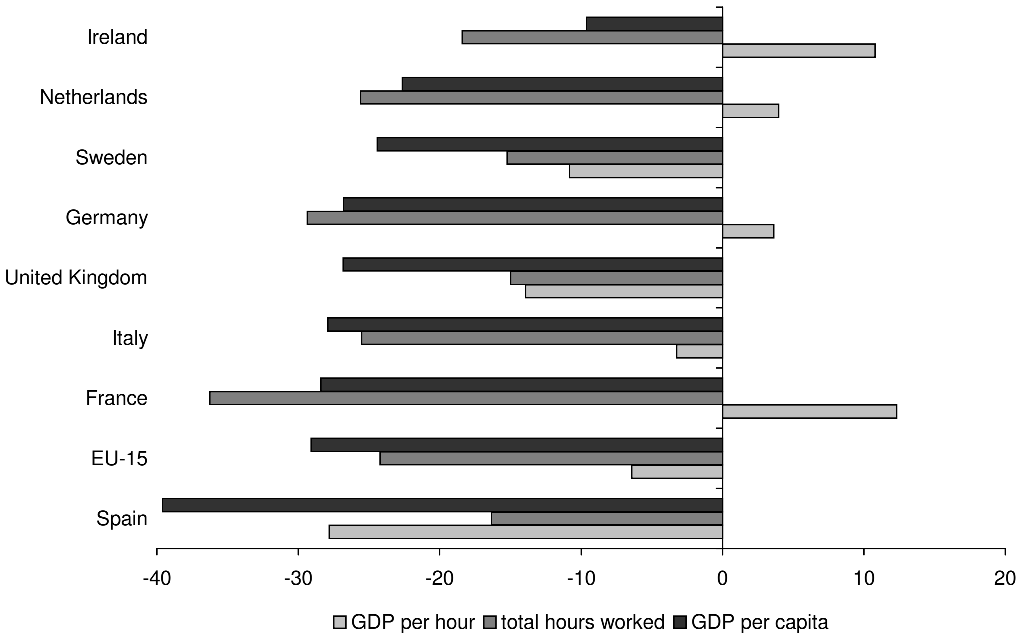
	Determinant of employment and growth	Lisbon policies
Labour	Labour supply	Employment target, participation
	Matching	Labour mobility
Capital	Market size	Internal Market: services, network industries
	Cost of capital	Financial services markets
Innovation	ICT	Information society
	R&D, knowledge spillovers	R&D target
		Attract top-researchers
	Knowledge infrastructure	European Research Area
		Linkages between firms and research institutes (universities)
Human capital	Education	Upper secondary education, literacy, graduates in mathematics, science and technology
	Training	Participation in life-long learning
Competition	Market structure	Competition policy, internal market
	Constraints	Administrative costs
		Taxation, regulation

The Lisbon strategy influences job creation and economic growth both through the resources available for firms and through their productivity. Table 2.1 presents an overview of these linkages. It starts with labour and capital resources, followed by the three main determinants of total factor productivity (TFP): innovation, human capital and competition / functioning of markets. For each of these determinants Table 2.1 lists the relevant elements of the Lisbon strategy. As such it provides an organising framework that links Lisbon policies with jobs and growth.

2.1 Labour utilisation

Labour utilisation to a considerable degree explains differences in GDP per capita between the United States and Europe. Figure 2.1 shows that the annual number of hours worked in Europe lags 15 to 35 percentage points behind the United States. For the EU15, the difference in employment rate explains one-third of the difference in total hours worked. The employment rate equals the number of people employed divided by the number of people in the age group 15 - 64. It constitutes the core of the employment target in the Lisbon strategy, which has been set at a 70% employment rate. Additional targets pertain to a female employment rate of 60% and an employment rate for older workers of 50%. These targets in particular become relevant when in the coming decades the old age dependency ratio will rise considerably due to ageing.

Figure 2.1 Components of GDP per capita as a percentage difference with the US, EU 15 and selected European countries, 2003



Source: Ederveen *et al*. (2005)

The larger part of the difference in labour utilisation in the US and the EU follows, however, from the difference in hours worked per worker. The average worker in the EU15 works 1550 hours annually. That is about 300 hours less than their colleagues in the United States.[7] Yet the employment part of the Lisbon strategy does not take the number of hours worked into account. Hence, even when Europe reaches the employment targets, there remains scope for further mobilisation of labour resources, at least from the perspective of the US.

A difficult question is whether the lower employment rate and the lower number of hours worked in Europe can be attributed to institutional failure or to a stronger preference for equity or for leisure. Various studies demonstrate a negative relationship between labour supply and income tax rates (Nickell *et al.*, 2005). Also income tax rates, social security contribution rates and replacement rates appear to raise equilibrium unemployment rates. Relatively strong

[7] Dekker and Ederveen (2005) discuss these differences and their causes extensively.

preference for equity may induce European societies to pay the price of higher taxes and contributions so as to provide an adequate level of social security to their citizens. However, various trends have shifted the trade-off between economic growth and equity. For instance, internationalisation may require more flexible labour markets to shift labour to sectors in which Europe has a comparative advantage with respect to emerging economies. Ageing and skill biased technological change increase scarcity of (skilled) labour, which raises the price of inactivity and leisure. In that perspective, European labour market institutions and social security institutions may have become outdated and institutional reforms have to address institutional failure.

European labour markets improved considerably during the 1990s. Table 2.2 shows that after 1995 the negative employment growth of the early 1990s turned into an annual increase of 1.1%. However, this improvement is not sufficient to reach the Lisbon targets, also because employment growth fell back after 2000 (DG ECFIN, 2005, p24).

Table 2.2 Employment and components of labour productivity growth in Europe and the United States e 1991-2001

	United States 1991-1995	1996-2001	Europe 1991-1995	1996-2001
Employment	1.2	1.7	– 0.9	1.1
Labour productivity	1.2	1.9	2.4	1.4
Non-ICT capital	0.2	0.3	1.0	0.5
ICT capital	0.4	0.7	0.3	0.4
TFP	0.6	0.8	1.1	0.5

Source: O'Mahony and Van Ark (2003, p216).

2.2 Capital intensity

Capital deepening of production contributes to labour productivity growth. Workers are more productive when they dispose of more capital. Table 2.2 shows that the contribution of capital deepening fell in Europe after 1995, from 1% to 0.5% per year, which explains about half of the slowdown in labour productivity growth in Europe (from 2.4 to 1.4%). This is the mirror image of the strong increase in employment growth in the same period: labour substituted for capital in production. Ederveen *et al.* (2005) provide evidence of the strong impact of employment growth on capital deepening during 1970-2003.

Two implications follow. First if employment growth returns to the (on average less than 1.1%) rate of population growth, capital deepening and labour productivity growth will increase. Second, the Lisbon target of higher employment on the medium term has its price in terms of less capital deepening and slower productivity growth.[8]

Investment in ICT-capital increased after 1995 in the US. Its contribution to productivity growth rose from 0.4 to 0.7 % per year (Table 2.2). In Europe the contribution of ICT-capital shows a moderate increase to 0.4%.

The Lisbon strategy mainly addresses capital formation through increasing market size and lowering the cost of capital. European market integration enhances efficient allocation of equipment capital and integration may expand opportunities for investment in markets where economies of scale are important. Financial market integration lowers the user cost of capital, which also stimulates investment. According to London Economics (2002), full integration of financial markets in Europe would lower the cost of capital by 0.5 %-points, which would generate a 6% increase in investment.

2.3 Labour productivity and total factor productivity

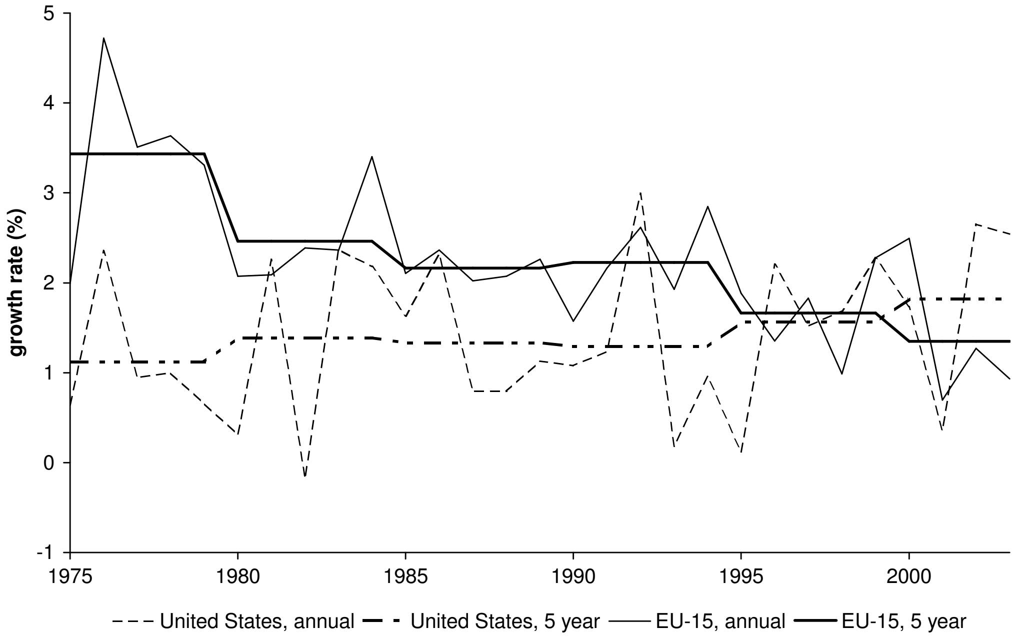
2.3.1 Catching-up

In a longer time perspective, catching up has considerably contributed to European labour productivity growth. Figure 2.2 shows a downward trend in European labour productivity growth, whereas productivity growth in the US depicts an upward trend. After the Second World War Europe benefited from many possibilities to copy and adapt technology from the US. Approaching the technological frontier, possibilities to learn from the US diminished, in particular for West European countries like Austria, Belgium, Denmark, France, Germany and the Netherlands. That raises the question how Europe has to enhance productivity growth at the frontier.

Reaching the frontier may also have contributed to the weak productivity performance after 1995. The growth rate of total factor productivity (TFP) fell in Europe after 1995, whereas it accelerated in the US (Table 2.2).

[8] Note that except for terms of trade effects, capital labour substitution is a temporary phenomenon (Broer and Huizinga, 2004). In a small open economy with free entry the capital stock adjusts to expanding labour supply and the capital-labour ratio returns to its equilibrium value. In a large economy (like the EU) expanding production in line with a larger labour stock can only be achieved through (modest) terms of trade losses, a lower wage rate and lower labour productivity.

Figure 2.2 Hourly labour productivity growth 1975-2003: five year moving averages



Source Ederveen *et al.* (2005)

2.3.2 ICT

From a sectoral perspective both production and use of ICT explain a considerable part of the post 1995 performance of the US compared to Europe. Table 2.3 decomposes the difference in labour productivity growth between the EU-15 and the US according to the sectoral ICT taxonomy of O'Mahony and Van Ark (2003). The first line of the table shows that over 1979-1990 labour productivity in Europe grew 1% per year faster than in the US. According to the bottom three lines of the table, traditional non-ICT sectors explain most of this difference. The US only outperforms the EU in ICT producing manufacturing. The figure of -0.31 in the table tells that the very productive computer manufacturing industry in the US caused macro productivity to grow 0.31 % faster in the US than in Europe. In contrast, the efficient telecom sector in Europe yielded a slightly positive contribution from ICT using services. A comparable picture exists for the period 1990-1995.

The major change after 1995 takes place in ICT using services, such as wholesale, retail, financial services and business services. In the US, productivity growth in these sectors increased from 1.6% over 1990-1995 to 5.3% over 1995-2001 (O'Mahony and Van Ark 2003, p78). In contrast, it equalled 1.8% in both periods in Europe. By consequence, these sectors contributed 1% point (from Table 2.3 – (– 0.75 – 0.26)) to the acceleration in macro productivity growth in the US after 1995.

Table 2.3 Sectoral decomposition of the difference in labour productivity growth between EU 15 and the US (%-point per year)

	1979-1990	1990-1995	1995-2001
Total economy	0.99	1.19	– 0.54
ICT producing sectors	– 0.13	– 0.25	– 0.45
Manufacturing	– 0.31	– 0.29	– 0.60
Services	0.08	0.04	0.15
ICT using sectors	0.38	0.44	– 0.61
Manufacturing	0.19	0.18	0.14
Services	0.19	0.26	– 0.75
ICT poor sectors	0.73	0.99	0.44
Manufacturing	0.27	0.01	0.24
Services	0.41	0.88	0.32

Source: O'Mahony and Van Ark (2003, p. 83).

Yet, productivity growth in ICT using sectors is more than merely investing in ICT. About a quarter of the productivity increase in US ICT using sectors after 1995 originates from higher investment in ICT capital (O'Mahony and Van Ark 2003, p95). The other three quarters consist of TFP growth. Micro econometric and case study evidence shows that combining ICT investment with innovations in organisation and upgrading of worker skills contributes to productivity growth (Baily en Kirkegaard, 2004). In addition, firms in US service sectors are able to exploit economies of scale and benefit from less regulation on product and labour markets, which stimulates competition and experimentation (Bartelsman *et al*., 2003).

In terms of the Lisbon agenda these developments in Europe and the US put the spotlight on policies that promote TFP growth through innovation, human capital formation and competition.

2.3.3 Innovation

Innovation is one of the driving forces of TFP and research and development (R&D) is a corner stone of innovation. Empirical research on the relationship between R&D and TFP yields very high social returns to R&D, conservative estimates are in the order of 30% (Canton *et al*., 2005). These social returns substantially exceed the private rates of return of about 7 to 14%. Positive externalities explain the high social returns on R&D: investment by one firm not only increases the productivity of that firm but also of other firms, within or outside the same sector and within or outside the same country. High social returns that exceed private returns motivate public support for R&D.

Expenditure on R&D amounts to 2% of GDP in Europe and lies somewhat below 3% of GDP in the US. According to the empirical research this would contribute to higher TFP in the US. However, it is hard to explain the past 1995 productivity performance of Europe and the US from R&D, because R&D ratios are fairly stable over time (Ederveen *et al*., 2005). Neither the fall in the growth rate of TFP in Europe nor the increase in the US can be linked directly to developments in R&D. Moreover, a large role for R&D is in conflict with productivity growth taking place in ICT-using sectors, as the R&D-intensity of successful service sectors like wholesale and retail trade is quite low.

What might have changed is the character of R&D in Europe. The return on R&D in Europe may have declined since European economies have shifted towards the technology frontier. R&D to absorb state-of-the-art technologies becomes less important when fewer technologies are left to absorb. If diffusion of R&D involves long time lags and the US was engaged in frontier R&D at a much earlier stage, after 1995 R&D in the US might have paid off more in terms of new technologies and stronger TFP growth. Until now, empirical evidence that might support this hypothesis is lacking.

Prominent in the Lisbon strategy is the target to increase R&D spending to 3% of GDP with companies performing two thirds of this target. Chapter 6 analyses the economic consequences of reaching the 3% target. Yet, R&D is not the only determinant of innovation. The Lisbon strategy features a range of policy measures to enhance knowledge creation and diffusion. Within the European Research Area high on the agenda are research funding through the European Research Council and the interconnection between scientific research institutes and firms. The Lisbon agenda also aims at enhancing mobility of researchers within Europe and into Europe (Kok, 2004). Empirical evidence is scarce on the effectiveness of various policy measures that intend to stimulate R&D and innovation (Canton *et al.*, 2005).

2.3.4 Human capital

The Lisbon strategy not only aims at the quantity but also at the quality of employment. The European Council has adopted a comprehensive set of education and training targets (European Commission, 2004b). In education, preventing drop-outs and increasing participation in upper secondary education occupy centre stage. Investments in training have to enhance lifelong learning, which increases flexibility of workers and enables elderly workers to retain to up-to-date human capital. There is considerable diversity among European countries with respect to these targets. For instance, new member states excel in the number of graduates with upper secondary education (see Chapter 5 for more background).

As a factor of production, human capital investments directly contribute to productivity growth and thus to higher wages.[9] The estimated private rate of return on investment in initial education equals 6 - 9%, in other words an extra year of education raises future wages by 6 to 9% (Harmon *et al.*, 2003). Recent estimates of returns to on-the-job training are of the same magnitude (Leuven and Oosterbeek, 2002). In the future, private rates of return on human capital investment will most likely increase, due to skill-biased technological change, internationalisation and capital-skill complementarity (Jacobs, 2004).

[9] The remainder of this section draws heavily on Jacobs and Webbink (2004).

Human capital might also affect productivity indirectly. Several mechanisms have been proposed in the theoretical literature. Firstly, increasing returns and positive external effects may raise social returns to education above private returns. However, empirical evidence does not support this conjecture: social returns to education roughly equal private returns. Secondly, investing in education might increase the productivity of R&D, because a larger share of the workforce will be engaged in R&D. But also in this case empirical support is absent: complementarity between skill levels and R&D cannot be found. Thirdly, human capital may facilitate technology adoption and catching up of countries towards the technological frontier (Griffith *et al*,. 2000). Empirical support for this mechanism is not very robust and for a range of European countries it has lost relevance, because these countries have largely caught up with the US (see Section 2.3.1). An exception may be that not so much the level as the composition of human capital makes a difference. According to Krueger and Kumar (2002, 2004) people in the US have been able to adjust to ICT more easily, because education in the US is more general. Fourthly, education may increase the quality of institutions and of the political process, which encourages innovation and productivity growth. Empirical evidence is convincing for developing countries, but this factor does not seem decisive for developed countries. So all in all human capital directly promotes productivity, but evidence for indirect effects is lacking.

The rising productivity gap with the US after 1995 does not seem to originate from lagging investment in human capital. Recent data are scarce, but comparing 1995 to 1975 the number of schooling years in Europe is catching up to US levels, while Europe increasingly outperforms the US in international comparable literacy tests (Ederveen, *et al*., 2005, p43). Taking into account the long lags involved in human capital formation, this evidence does not support the hypothesis that Europe is falling behind due to inferior investment in education. As indicated above, only the composition of human capital may have played a role, in the sense that specific education in Europe may have hindered adoption of ICT.

In terms of policy intervention, evidence indicates that investment in early childhood is most effective to build human capital. Social returns to early childhood education exceed those of other policy interventions (Heckman, 2000). Still, early childhood education is not part of the Lisbon agenda on education. A survey of a broad range of interventions in compulsory and post-compulsory schooling yields a rather mixed picture (Canton *et al*., 2005). Effects depend on differences in type, design and implementation of specific interventions.

2.3.5 Competition and the functioning of markets

The impact of competition on productivity and economic growth operates via three channels: allocative, productive and dynamic efficiency (DG ECFIN, 2005). Via the first channel competition lowers rents, which improves the functioning of the price mechanism to allocate resources and output to their most productive use. Moreover, a more competitive environment due to product market reforms may increase entry of new competitors. The second channel entails more productive work organisation and less slack and agency costs in firms that operate in a competitive environment. Via the third channel competition generates incentives for innovation. However, not only too little competition but also too much competition may hamper innovation, because firms need rents to finance costly R&D.

Empirical evidence points at an inverted U-shaped relationship between competition and innovation (Aghion, *et al.*, 2005). Also, various studies show that regulatory reform has positive effects on TFP (DG ECFIN, 2005, Canton *et al*., 2005), which would imply that the industries affected by these reforms were on the left side of the inverted U.

According to Bartelsman *et al.* (2003) entry and exit rates of firms in the US and Europe are largely comparable. Yet, although the intensity of creative destruction may not differ considerably, the process of creative destruction does diverge. Relatively to incumbents, firms that enter markets in the US are smaller and less productive than firms in Europe. However successful firms in the US grow faster, which points at the possibility that market experimentation is larger in the US.

The Lisbon strategy contains a range of measures to improve the functioning of markets in Europe. An important element is the completion of the internal market for goods and services through the services directive, the liberalisation of net work industries and the financial services action plan (Kok, 2004). In addition, the strategy aims to stimulate entrepreneurship both by improving the quality of legislation and by reducing the administrative burden on firms.

2.4 Conclusion

The preceding brief review of the Lisbon strategy and the post 1995 performance of the European economy in comparison with the United States yield a number of observations:

- Labour utilisation explains most of the lag in GDP per capita in Europe. One third of the lag follows from the difference in the employment rate, two thirds from the difference in the number of working hours per worker.
- The second half of the 1990s witnessed considerable employment growth in Europe, which slowed down after 2000.
- The mirror image of this employment growth is less capital deepening, which explains part of the slowdown of labour productivity growth in Europe after 1995.

- Less room for catching up led to a gradual decline of European productivity growth.
- The acceleration of productivity growth in the US after 1995 was concentrated in ICT using services: retail, wholesale, business services and financial services.
- Empirical research shows that R&D contributes to economic growth, both directly and indirectly through (international) knowledge spillovers.
- The US invests more in R&D, but US R&D did not increase substantially after 1995.
- Human capital directly contributes to productivity growth, but evidence on the indirect impact of human capital is lacking. Social returns to human capital equal private returns.
- No support can be found for the hypothesis that Europe is falling behind the US after 1995 due to low levels of investment in education, but the composition of human capital may have mattered.
- Markets in the US entail more experimentation: successful entrants grow faster.

These observations yield as a first general conclusion that there is no single cause for differences between the European and the American growth performance. Hence, strengthening employment and economic growth in Europe calls for a multifaceted strategy, which is exactly what the Lisbon strategy intends to be (compare Table 2.1). The many facets of the strategy at the same time require selectivity in analysing the economic consequences. Therefore, this paper focuses on highlights of Lisbon. The employment target is a natural candidate for inclusion, because it represents the jobs pillar of the strategy. On the productivity growth pillar, R&D comes to the fore, because it is an important input in innovation and it has high social returns. The third highlight, human capital, as a factor of production directly contributes to productivity growth. In the field of competition and the functioning of markets, the internal market for services and administrative costs are topics for further analysis, mainly because empirical research is available on the direct effects on trade and productivity, respectively.

As to the second general conclusion, the analysis shows that promoting jobs and growth entails many complex interactions. Therefore, assessing the impact of the multifaceted Lisbon strategy on the complexities of employment and productivity growth puts specific demands on an analytical framework. This is the topic of the next chapter.

3 A framework for analysis: WorldScan

3.1 Framework

The policies on the Lisbon agenda are multifaceted. They cover a broad range of employment and productivity issues: the size of the labour force, the quality of labour, R&D and its diffusion, the functioning of markets and administrative barriers. This list is far from complete, but it covers at least the issues we address in this paper.

The interactions between these Lisbon policies and the rest of the economy are complex. Take for example an increase in the employment rate. Labour becomes cheaper. This initially lowers the capital-labour ratio and thereby productivity per worker. By consequence, firms want to attract more capital. Scarcity for capital increases and the price of capital rises on the international markets, if member states demand more (foreign) capital. The benefit of cheaper labour and more expensive capital depends on the intensity of these two factor inputs in production. Labour-intensive industries would benefit most.

Moreover, firms compete with firms of other EU and non-EU countries. In the other EU countries the labour force also expands. This favours the labour-intensive firms in these countries. So it remains unclear to what extent labour-intensive industries from specific countries can improve their competitiveness. That depends on the functioning of the internal market in the EU and the increase in the labour force of the various member states.

Furthermore, these industries also compete with less labour-intensive industries on their home market to attract sufficient inputs for production. The expansion of labour-intensive firms could benefit those industries which deliver many intermediate goods or services to these firms. Other sectors could be negatively affected because input prices increase. However, this is also the case for the same industries in other EU countries. On balance, what do these effects imply for international competitiveness of industries?

3.1.1 Models

The example above illustrates the complex interactions between sectors nationally and internationally and between output and input markets. The effects of reaching a Lisbon target can only be meaningfully considered by taking account of these interactions. Some of these interactions will reduce the initial effects of Lisbon policies, others will enforce the effects. Hence, it is only feasible to take all these interactions into account within a formal analytical framework in the form of an economic model. In principle there are two types of economic models available: macro econometric models and general equilibrium models.

The advantage of macro econometric models is that the crucial behavioural equations are empirically underpinned. This comes however at a price. In general these models can only be estimated if several economic equations that represent various economic mechanisms are combined in one equation (a so called reduced form equation). Moreover, these models are not very capable to analyse national macroeconomic effects of the Lisbon goals and take international spillovers between member states into account at the same time. Another disadvantage is that most of these models do not incorporate much sectoral detail; they focus mainly on macroeconomic relations.

These disadvantages do not play a role in global general equilibrium models. These models are based on microeconomic behaviour of all relevant agents. 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 is relevant for the Lisbon policies, because the sectoral effects can vary considerably. Increases in for example R&D spending affect the high-technology manufacturing sectors differently than the R&D-extensive service sectors. An other example is the implementation of the services directive which mainly affects the commercial services sector. The distinction of the economy in various sectors is necessary for a meaningful analysis of the various Lisbon goals.

This plea for sectoral diversification in the model could be repeated at every level of sectoral desaggregation. For example, if we distinguish a commercial services sector it could be meaningful to disaggregate the various commercial services, because all these services may be differently affected by the services directive. Here, we face the limits of analytical tractability and data. National accounts only distinguish a certain number of economic sectors and, more importantly researchers can not meaningfully analyse the effects of many sectors in many countries or present these in a coherent and concise way. Although a sectoral classification is an asset of global general equilibrium models, the number of sectors that can be distinguished has its limits.

A disadvantage of applied general equilibrium models is that these models sometimes lack an empirical underpinning. These models are calibrated on macroeconomic data and input-output data of a certain base year. The calibration determines a number of parameters in the model, but values of many other parameters have to be taken from the literature. Not all of these parameters are well estimated in the context of a CGE model. Moreover, the models are calibrated only at one point in time. It remains unclear whether these models can explain trade developments very well. Another problem is that most applied general equilibrium models are static.

Some of these disadvantages of CGE models apply to a less extent to our model: WorldScan. WorldScan is a dynamic model and able to analyse policy variants over long time periods. Moreover, we have spent much time to underpin the behavioural equations empirically.

Examples of these equations are consumer behaviour, savings behaviour, international capital mobility, and the effect of R&D spillovers on productivity. This solves to some extent the first disadvantage mentioned above: WorldScan is better empirically underpinned than many other CGE models. But still not all parameters are estimated. So we have to interpret the outcomes with some care. The results mainly give an indication of the size of the effects and of the relative effects of one sector or county to another.

3.1.2 Modelling Lisbon policies

A complication concerns the implementation of Lisbon policies in WorldScan. Some of the targets are rather specific and difficult to link to the more general structure of WorldScan. For instance, WorldScan has no direct mechanism to analyse improvements in literacy, one of the Lisbon skills targets, or a reduction of the administrative burden on firms. This is a well-known feature of policy analysis with large models.

In principle two approaches exist to deal with this. One is to expand WorldScan with more detailed formal sub models of specific policy fields. The other approach is to use off-model accounting schemes or satellite models to provide the linkages. The former option is theoretically more attractive, because it is easier to impose theoretical consistency. However, it is time consuming and can only be applied for a limited number of policy fields. Expanding a CGE model in many different directions quickly makes the model unmanageable. This option mainly comes in sight if sufficient theoretical insights and empirical evidence is available, if a range of future model applications is foreseen, or if the topic at hand has crucial interactions with other parts of the model. For example, in a range of climate change applications we use a separate version of WorldScan with a more elaborate energy sub model.[10] The current application to the Lisbon policies entails a range of diverse applications for which often only limited theoretical studies and empirical evidence exist. Therefore our analytical method consists of the combination of the CGE model as a general working horse and more specific accounting schemes or satellite models to link specific Lisbon policies to the model.

The present version of the model does not incorporate all costs to reach the Lisbon goals systematically. There are several reasons for abstracting from some of the costs. The first is that the member states did agree on the Lisbon goals itself but not on the instruments to reach these goals. Often these instruments are not specified. Second, WorldScan does not contain all proper policy instruments. We include the subsidy costs for stimulating R&D and the opportunity costs of time spent on learning. We do not include the costs of active labour-market policies, direct costs of schooling, costs of reducing red tape or of adapting the regulatory framework to implement the services directive. Therefore we present results of “what if” simulations. We analyse the macroeconomic and sectoral effects of reaching the various Lisbon goals without considering all the associated costs systematically.

[10] See Kets and Verweij (2005), and Lejour *et al.* (2006).

Finally, we do not carry out a systematic welfare analysis. In the model consumer utility depends on consumption, but does not include leisure, environmental quality or inequality. By consequence, the simulation outcomes do not represent a trade-off between GDP effects and leisure or environmental quality, or between efficiency and equity. These limitations of our quantitative analysis have to by taken in mind when we interpret the simulation outcomes.

3.2 The World Scan model

WorldScan is an applied general equilibrium model for the world economy. The model was developed in the nineties for CPB's earlier scenario study *Scanning the Future* (1992). The model has thereafter often been used for scenario studies, analyses of climate-change policies and trade policies.[11] WorldScan is well suited to simulate scenario developments on demography, technology, energy and globalisation. The model consists of several types of equations: behavioural equations which describe the behaviour of firms and consumers, identities and accounting relations. These accounting relations are necessary to represent the framework of the national accounts of an economy. A few years ago a previous version of the model has been documented (CPB, 1999). The current version of the model has been substantially revised and much better empirically underpinned. See Lejour *et al.* (2006) for an up-to-date publication. Below we describe the main mechanisms of the model.

General Equilibrium

General equilibrium models describe supply and demand relations in markets. In these models, prices of goods and factor inputs are flexible, such that demand and supply become equal at an equilibrium price. These models also describe the interactions between several markets. For example, firms must determine the factor inputs necessary to produce a final good, given the price and supply of that good. Supply, which depends on the equilibrium product price, determines the necessary inputs and therefore demand on the input markets. When consumers prefer more final goods, the price of these goods will increase. Firms want to produce more and will demand more inputs. As a result, the prices for the input factors will increase because of the increase in demand for the final good. These mechanisms are called general equilibrium effects.

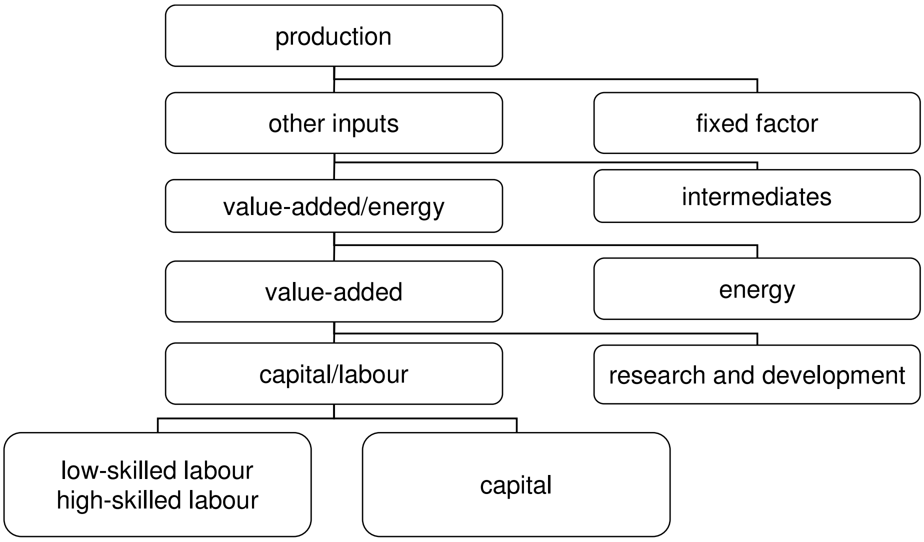
Producers

The version of WorldScan used in this paper distinguishes 10 goods and services markets, a labour market, and a capital market for each of the 23 countries and regions. There are 10 types of producers, each of which produces one type of good or service. We call this a sector. All goods are produced by using labour, capital, R&D and intermediate inputs, albeit in different

[11] See our website http://www.cpb.nl/eng/general/org/program/is/publicaties/.

proportions. The relative demand for each of these inputs depends on the characteristics of the sectoral production function. The production structure is shown in Figure 3.1. In general, we assume that labour and capital are fairly good substitutes. We consider the various intermediate inputs as good substitutes, but there are hardly any substitution possibilities between the intermediate inputs, on the one hand, and capital, labour and R&D, on the other hand.

Figure 3.1 Production structure in WorldScan



Consumers

Consumers demand the various goods and services, and provide labour and capital to the firms. They consume goods and services in different proportions, depending on their prices and the income elasticities of these goods and services. Some of these goods and services are luxury goods, of which consumption shares increase if income rises; others are necessary goods, of which shares in consumption decrease if income goes up. We assume that the supply of labour is exogenous. Because consumers save part of their income, they are able to supply capital to firms in return for non-wage income. Savings depend on income growth and demographic characteristics. In the OECD countries, demography mainly concerns ageing within the population, which reduces savings.

The government

Most CGE models do not model the government in much detail. This goes back to the national accounts and input-output tables that are normally used as data sources. These data do not include government transfers and social security. The government collects taxes on imports and consumption. It spends tax income on (export) subsidies and public consumption. This is also the case in WorldScan. Government transfers and social security are not modelled. Our underlying database and the model contain various taxes on import, export, consumption, production, investment and intermediate goods. The revenues of these taxes are a source of income for consumers besides capital and labour income. We have also introduced a tax or subsidy on R&D investment in the model. These revenues or expenditures also accrue to the consumers in the same way as the other taxes.

Labour markets

Consumers supply labour and firms demand it. We assume that there are national markets for high-skilled and low-skilled labour in which the prices of labour (the wage rates) are flexible. We have modelled unemployment exogenously: a part of labour supply is unemployed. The supply of labour minus the unemployment level will be equal to labour demand in equilibrium.

Capital markets

Consumers supply capital and firms demand it. Equilibrium between demand and supply determines the price of capital.[12] In contrast to the labour market, regional capital markets are assumed to be linked to each other. So if capital is abundant in one region (and thus is relatively inexpensive), it is invested in another region in which capital is scarce (capital is expensive). However, there are some barriers to investing abroad. Therefore, interregional capital mobility reduces, but does not eliminate, capital price differentials between regions. In the latter case we would have one global capital market.

Capital used in production is built up from investment goods corrected for depreciation of these goods. Investment goods consist of several goods from various sectors, such as capital goods, services, and buildings (construction). The producers supply these goods.

The market for R&D

The model distinguishes a separate R&D sector in each country. That sector produces R&D products which are demanded by the other sectors. The R&D expenditures of demanding sectors are interpreted as investments. These investments accumulate into the R&D stock, just as capital investments accumulate into the capital stock. The yearly investments depend upon the optimal R&D stock in a sector. The R&D stock is optimal if the marginal product of R&D equals the user costs of R&D. R&D income contributes to value added just as capital and labour income.

The R&D stock in a sector has positive spillovers to productivity in other sectors and in other countries. The size of these spillovers depends on the importance of that sector as intermediate in other sectors and on the trade volume. We have estimated the relation between R&D spillovers and productivity and have implemented this relation in WorldScan. Chapter 6 discusses this relation in more detail.

[12] Actually, the price of capital is a function of the investment price times the sum of the real interest rate and depreciation rate.

Goods markets and trade

The regional goods and services markets are linked to each other, except for the R&D sector. Not only the home market, but also foreign markets determine demand for a good. We assume that each region produces a different variety of that good. Because we distinguish 23 regions, there are 23 varieties for each of the 9 non-R&D sectors. In principle, consumers and producers demand all these varieties. The demand for each of the varieties depends on its relative price, the substitution possibilities between the varieties, transportation costs, trade barriers and preferences for the variety. If the price of a particular variety goes up, demand will decrease in favour of other varieties. Hence, total demand for each variety depends on the demand on the home and foreign markets.

GDP growth

So far, we have viewed the model only from a static perspective and have neglected the dynamics, particularly economic growth. Economic growth is measured by value added growth. Value added grows by the increase in labour productivity and labour. Labour growth is exogenous and is derived from population growth differentiated according to age cohort, age-specific participation rates, and the unemployment rate. Labour productivity growth depends on the assumptions about technological progress. There is no one-to-one relation between technology and labour productivity, because productivity is also related to capital and R&D growth per unit of labour, which are endogenous. Over time, however, technological progress largely determines labour productivity growth. Hence, in a simulation the assumptions on technological progress and employment largely fix economic growth.

Regions and sectors

We distinguish 23 regions and 10 sectors (see Table 3.1). All EU countries are modelled separately, except for Belgium and Luxembourg and the three Baltic States, Cyprus and Malta. Moreover, we distinguish the United States, Rest OECD, and Rest of the world. For each region, we distinguish 10 sectors. These consist of agriculture, energy (primary energy and electricity), four manufacturing sectors (high, high-medium, low-medium and low technology) and three services sectors (transport, other commercial and other). The last sector is the R&D sector. It deviates from the other sectors in the sense that we assume that there is no international trade in R&D goods.

Table 3.1 Overview of regions, sectors and production inputs in WorldScan

Germany	Agriculture	Value added
France	Low tech manufacturing	High-skilled labour
United kingdom	Medium-low tech manufacturing	Low-skilled labour
Italy	Medium-high tech manufacturing	Capital
Spain	High tech manufacturing	R&D stock
The Netherlands	Transport services	Fixed factor
Belgium-Luxembourg	Other commercial services	
Denmark	Other services (government)	Intermediate goods
Sweden	Energy	Agriculture
Finland	R&D	Low tech manufacturing
Ireland		Medium-low tech manufacturing
Austria		Medium-high tech manufacturing
Greece		High tech manufacturing
Portugal		Transport services
Poland		Other commercial services
Czech Republic		Other services (government)
Hungary		
Slovakia		Energy
Slovenia		
Rest EU		
United States		
Rest OECD		
Non OECD		

3.3 Baseline characteristics

This section describes the characteristics of our baseline. It provides a sketch of the economic background upon which we implement the various Lisbon policies. First, we describe the macroeconomic background. Second, we focus on some sectoral details, which are necessary to understand the sectoral impact of the policy variants. In the main text we only present the developments for the EU as a whole. Annex 1 provides more information for the various member states.

In order to being able to evaluate the impact of the various Lisbon policies, we have developed a baseline in which these goals are not implemented. The baseline describes a time path of economic development between now and the final year of our simulations, 2040. The differences between the policy variant simulation and the baseline represent the effects of implementing the Lisbon policy.

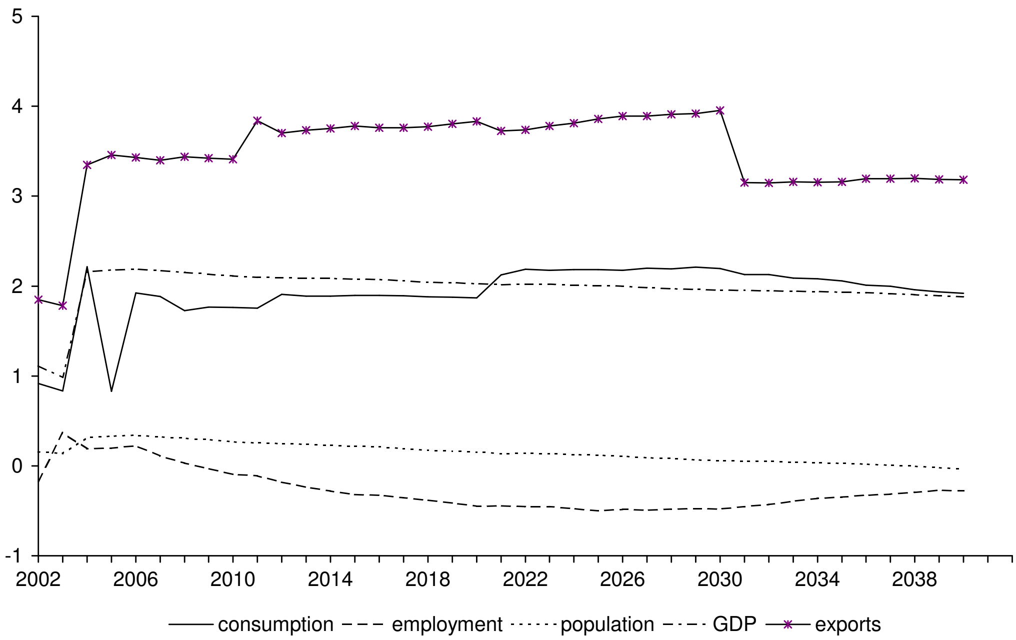
The baseline has to fulfil certain conditions. First it has to comply with recent economic developments. The starting year of our simulations is 2001, because that is the latest year for which data are available to calibrate the model. The time path between 2001 and 2004 has to include the accession of the new member states to the internal market. Moreover, we expect some catching up of these countries towards the old ones. Second, the baseline has to be neutral with respect to the implementation of the policy variants. If we would incorporate a large increase in skills or increase in R&D expenditures in the baseline, it would become easier to reach the Lisbon targets. This means that we aim at moderate economic growth within the EU in the baseline.

Taking in mind these considerations, our baseline is based upon one of our long-term scenarios for Europe. Recently, CPB has developed four long-term scenarios of the European economy.[13] As a starting point for our baseline we chose the Strong Europe scenario.[14] In this scenario economic growth in Europe is moderate and markets integrate further, regionally and globally. Below we describe some of the characteristics of the baseline.

3.3.1 Macroeconomic characteristics

Population grows hardly within the EU due to aging. Figure 3.2 shows that population growth declines in time from 0.35% per year to zero. In the Central and Eastern European countries population will diminish. The population projections are derived from Eurostat (2002) for the EU15 countries and the United Nations (2002) for the other countries.

Figure 3.2 Annual growth rates for the EU as a whole 2001 and 2040



Source: WorldScan simulations

[13] See De Mooij and Tang (2003) for a motivation, derivation, and qualitative description of the scenarios, and Lejour (2003) for the quantitative illustration.

[14] This does not imply that we consider the realisation of this scenario more likely than one of the others. We only selected this scenario because its characteristics fit into the conditions of the baseline in this analysis. We do not implement all characteristics of this scenario, so the baseline is not a copy of Strong Europe.

GDP growth slightly decreases over time due to the decline in population growth. GDP growth per capita is more or less constant. Between 2001 and 2003 GDP growth is targeted on the actual numbers of the World Bank (2004). From 2004 onwards we assume a constant growth of total factor productivity. This leads to a GDP per capita growth rate within the EU of about 1.9%.[15] In most new EU member states on average growth is about 2% points higher. We expect that these countries gradually catch up to the welfare level of the older members states. In time participation rates decline, because people become older. We assume that participation of the various age cohorts remain constant in time. The increase in female labour market participation does not offset lower participation due to ageing. Therefore employment growth falls over time, on average by 0.3% in the EU (see Figure 3.2). This is mainly caused by the reduction in employment in Germany, Italy, Spain and the countries in Central and Eastern Europe.[16] These countries are most affected by population aging.

Exports grow faster than GDP. This in line with observed developments in trade, on average trade grows about twice as fast as GDP. Between 2010 and 2030, export growth is stimulated by reduced tariff and non-tariff trade barriers due to assumed successful WTO negotiations and a further integration of the internal market. After 2030 market integration is not further stimulated. Therefore exports grow less fast.

3.3.2 Sectoral characteristics

Table 3.2 presents the sectoral structure for the EU economy in 2001. This gives a good indication of the general pattern, although the numbers will differ at the level of the member states. The other commercial services sector and the other services sector are the largest sectors in the economy in terms of value added and employment. Of the manufacturing sectors, low technology and medium-high technology sectors are the largest ones. The first one consists of food processing and textiles among others, the latter one consists of machinery and equipment and chemicals.

The manufacturing sectors are much more open in terms of exports ratios (exports divided by production) than the other sectors. In other services, which are mainly government services, there is hardly any trade at all. Medium-high tech and high tech manufacturing are much more tradable than low tech manufacturing. Medium-high tech manufacturing also provides the largest part of total exports. Other important exporting sectors are low tech manufacturing and other commercial services. Transport services are by definition also tradable. Note that trade also includes intra-EU trade.

The EU seems to specialise in the production of medium tech manufacturing and services. As a measure for specialisation we use the Balassa index. This index relates the share of a product or service in total exports of a country to that share for a reference group of countries. As a reference group we choose the whole world. A number larger than 100 indicates that

[15] 2.0% GDP growth minus 0.1% population growth.

[16] Table in Annex 1 provides more information on the country-specific characteristics.

Europe exports relatively more products of a sector than other countries do. Then Europe is specialised in the production of that particular good or service. The table also shows that in other services the European exports are relatively large compared to other countries. However, the volume of exports is low due to the non-tradability of a large part of these services. R&D is not exported by definition, so there is no specialisation index for the R&D sector.

Table 3.2 Sectoral characteristics for the EU as a whole in 2001

Sectors	Employment share	Value-added share	Export ratio	Specialisation	Export share
Agriculture	4.2	2.5	17.6	41.0	2.3
Energy	1.3	2.1	10.7	66.0	1.7
Low tech manufacturing	8.5	8.1	24.4	99.6	16.5
Medium-low tech manufacturing	4.5	3.8	25.4	112.4	8.4
Medium-high tech manufacturing	9.0	9.4	50.5	116.9	42.1
High tech manufacturing	2.3	1.9	48.9	68.3	7.5
Transport services	4.9	4.1	19.3	106.7	5.5
Other commercial services	38.8	44.3	5.7	105.7	12.9
Research and development	2.0	1.4	0.0		
Other services	24.5	22.3	0.6	161.3	0.5

Source: own calculations based on GTAP data, 2001.
All numbers are expressed as ratios. The sectoral shares in employment, value added and exports add up to 100. The export ratio is defined as the volume of exports divided by the volume of production. Specialisation is approximated by the Balassa index: a number larger than 100 indicates specialisation.

Over time, the structure of the EU economy changes. That is not only the case, because some countries grow faster than others, but also because the structures of national economies change. As countries become richer, people spend a larger part of their income on services. This is also reflected in Table 3.3. If we compare the outcome for the sectoral structure in 2040 with that in 2001 (see Table 3.2), the contributions of agriculture and manufacturing have declined substantially. The other commercial services sector has boomed in that period. Note that also value added of the R&D sector has declined. The reason is that value added of medium-high tech and high tech manufacturing have declined rather dramatically. Although the R&D intensity in these sectors is more or less constant in time, the decline of these sectors at the benefit of R&D-extensive sectors reduces total R&D expenditures (as share of value added).

In nearly all sectors trade-openness increases. This is indicated by the higher numbers for the export ratio in 2040. This is a characteristic of our baseline, which is also shown by the growth rate of total exports that exceeds the growth rate of GDP in Figure 3.2. Markets integrate further, because trade barriers and transport costs fall. The specialisation in services becomes more pronounced.

Table 3.3 Sectoral structure EU economy in 2040

Sectors	Value-added share	Export ratio	Specialisation	Export share
Agriculture	1.8	37.2	61.1	4.4
Energy	3.4	42.9	154.0	8.9
Low tech manufacturing	4.5	36.3	70.8	13.9
Medium-low tech manufacturing	2.4	38.9	120.5	10.3
Medium-high tech manufacturing	5.4	57.0	112.8	36.9
High tech manufacturing	0.8	64.8	54.7	5.8
Transport services	3.1	21.9	122.0	4.8
Other commercial services	49.8	7.1	130.0	13.4
Research and development	0.5	0.0		
Other services	28.1	0.6	170.7	0.5

Source: WorldScan simulations.

All numbers are expressed as ratios. The sectoral shares in employment, value added and exports add up to 100. The export ratio is defined as the volume of exports divided by the volume of production. Specialisation is approximated by the Balassa index: A number larger than 100 indicates specialisation.

4 Employment

One of the most important Lisbon policies is a better use of human capital in the economy. This priority becomes even more prominent considering the ageing population in the next decades. The better use of human capital can be disentangled in two directions: quantity and quality. This chapter focuses on the quantity of human capital, while Chapter 5 concentrates on quality.

A very important goal of the "jobs and growth" strategy is increasing employment. The employment target is set at 70% in 2010, which implies that 70% of the population between 15 and 64 aged should have at least a part-time job. Except for the overall employment rate, there are also a 60% employment goal for women and a 50% employment goal for the 55 to 64 aged.

In this chapter we focus on the overall employment target. We analyse the economic effects of reaching this target for various situations. It is uncertain to what extent employment increases autonomously, because of higher labour-market participation of women. We handle this uncertainty by constructing a lower bound and an upper bound scenario. In our lower bound scenario we assume that the employment rate already increases to some extent until 2010 in the baseline due to an autonomous increase in female labour-market participation. In this scenario we also distinguish the case that the employment increase consists only of low-skilled people and the case that it consists of a mix of low and high-skilled people. In our upper bound scenario the female participation rates remain constant until 2010 in the baseline. The employment effect of reaching the target is larger in this scenario. Section 4.2 discusses the macroeconomic effects of these scenarios. Section 4.3 highlights some of the sectoral outcomes.

Note that we do not conduct a full welfare analysis. First of all, we do not explicitly include the policy costs of reaching the employment targets. The direct costs of employment and labour-market participation policies are excluded, because these costs are not well-specified in the Lisbon strategy and in WorldScan. Second, we do not analyse any indirect costs in terms of welfare, such as the impact on equity of lowering replacement rates to reduce unemployment. Third, we do not consider the welfare effects of less leisure. Section 4.4 discusses some of these issues. For the EU as a whole that section gives a rough impression of the costs of labour-market policies to raise participation and to reduce unemployment.

4.1 Employment in Europe

The European Council has agreed upon specific targets on employment. According to the official Lisbon criteria the employment rate should be 70% in 2010. The employment rate is defined as the number of people which are employed as a share of the population within the age category 15 to 64. The EU has made some progress in reaching these targets, although at a slow pace in recent years compared to the second half of the 1990s (DG ECFIN, 2005). In 2003 the overall employment rate is 62.9%, one percentage point higher than in 2000.

Table 4.1	**Employment, unemployment and participation rates, 2003**			
Countries	Employment rate EU[a]	Calculated employment rate[b]	Unemployment rate[a]	Participation rate ILO
Column	(1)	(2)	(3)	(4)
Austria	69.2	69.5	4.3	72.6
Belgium-Luxembourg	59.6	59.7	7.8	64.7
Denmark	75.1	75.3	5.6	79.8
Finland	67.7	68.2	9.0	74.9
France	63.2	63.1	9.5	69.7
Germany	65.0	66.0	9.6	73.0
UK	71.8	70.6	4.9	74.3
Greece	57.8	58.9	9.7	65.2
Ireland	65.4	65.0	4.6	68.1
Italy	56.1	56.9	8.6	62.2
The Netherlands	73.5	73.5	3.8	76.4
Portugal	67.2	70.1	6.3	74.8
Spain	59.7	59.3	11.3	66.8
Sweden	72.9	73.8	5.6	78.2
Czech Republic	64.7	65.5	7.8	71.1
Hungary	57.0	57.4	5.8	61.0
Poland	51.2	52.0	19.2	64.4
Slovakia	57.7	58.0	17.5	70.3
Slovenia	62.6	63.0	6.5	67.4
Rest EU	. .	64.6	10.5	72.2
EU25	62.9	63.2	9.1	69.6

[a]Source: Eurostat LFS (2004).
[b]Source: Calculated employment rate in WorldScan is product of the participation rates (column (4), source ILO, 2002) and 1 minus the unemployment rate (column (3), source Eurostat, 2004). The participation rate of ILO is build up from a cohort and sex-specific population model. Data sources are: Eurostat (2002, 2004), UN (2002); and ILO (2002).

The first column of Table 4.1 depicts the employment rates for all EU countries. According to Table 4.1, Denmark, Great Britain, the Netherlands, and Sweden have already reached the employment target for 2010. Yet, note that these employment rates only measure the number of employed and neglect the number of working hours. For instance, the Netherlands has already reached the 70% target due to the large number of people who are part-time employed. If employment rates would be measured in numbers of hours worked, the Netherlands would be lagging behind (see OECD, 2004). In countries like, Greece, Italy, Hungary, Poland, and Slovakia, the employment rate is even lower than 60%. These countries still have a long way to go to the 70% target. On average the employment level has to increase by 11% in the EU to reach the 70% target.

WorldScan computes employment rates in two steps. First, from the population projections of Eurostat (2002) and our projections on participation rates (Lejour and van Leeuwen, 2002), we derive the size of the labour force. The labour force projections are built up from sex-specific projections of five years age-cohorts and their labour-market participation rates. The resulting participation rates for 2003 are shown in the last column of Table 4.1. Over time the total participation rates will decline due to changes in the composition of the population even if the cohort and sex-specific participation rates do not change.

From the participation rate and the exogenous unemployment rate we derive the employment rate. Between 2001 and 2003 we use the observed unemployment rates from Eurostat (2004) in our model. From 2004 onwards we assume in our baseline simulation that the unemployment rates remain constant. Note that our calculated employment rates for 2003 deviate slightly from those reported by Eurostat.

4.2 Macroeconomic effects of reaching the employment target

As stated above we analyse two types of employment scenarios, a lower bound and an upper bound scenario. The economic effects of reaching the employment target are smaller in the lower bound scenario compared to the upper bound scenario. The reason is that in the lower bound scenario we apply a baseline with increasing participation rates for women until 2010.[17] The last decades we have seen an increase in labour-market participation of women. Nowadays more women in younger age cohorts participate in the labour market than say 20 years ago. Because these women are accustomed to be active at the formal labour market, they will probably remain employed at an older age. Hence, it seems reasonable to assume that the participation rates of these women will be higher when they are older than the current cohort of that older age. By consequence, in this lower bound scenario the overall employment rate in the baseline increases from 62.9% in 2003 to 63.8% in 2010. This implies that the difference with the 70% target is smaller than in the upper bound baseline, where we keep participation rates constant after 2003 for all age-cohorts. After 2010 we assume constant participation rates per age cohort in both scenarios, in order not to complicate the comparison any further.

Besides this participation effect, we add a second component to the lower bound scenario. In contrast to the upper bound scenario we assume that the entire labour inflow is low skilled. By consequence, productivity growth will be negatively affected. This section presents the macroeconomic analysis of reaching the employment target in both scenarios. We start with the lower bound scenario in the two components: Section 4.2.1 analyses the effects of the assumptions on participation and unemployment reduction, Section 4.2.2 adds an assumption on the productivity distribution of the extra employment . Section 4.2.3 presents the results of the upper bound scenario.

[17] Technically, we assume that half of the increase in participation of a five year age-cohort compared to the same age-cohort five years before - measured as an percent point increase -, spills over to the same cohort, five years later (and older).The participation rate of that cohort is then equal to the participation rate of the same age-cohort five years before plus 50% of the increase in participation of the same cohort five years earlier.

4.2.1 Lower bound employment scenario: participation

The 70% employment target has to be reached on average in the EU. Some countries will have an employment rate of more than 70% while others will have a rate below 70% in 2010. To derive country-specific targets in this simulation we set an upper limit for the employment rate of 75%. Each country is assumed to reduce proportionally the gap between the maximum of 75% and the 2003 rate. This implies that a country with a low employment rate, such as Poland, faces a very ambitious target, but it will be less than 70% (see Table 4.2). For the years after 2010 we assume that the unemployment rates and the age-specific labour-market participation rates remain constant. The overall employment rate will decline due to ageing.

Table 4.2 Employment, unemployment and participation rates, 2010

Countries	Employment rate; baseline	Employment rate: lower bound scenario	Unemployment rate: lower bound scenario	Participation rate: lower bound scenario
Column	(1)	(2)	(3)	(4)
Austria	70.8	72.7	3.7	75.5
Belgium-Luxembourg	58.5	67.9	6.9	72.9
Denmark	74.4	74.7	4.5	78.2
Finland	66.4	71.4	4.7	74.9
France	62.3	69.5	4.9	73.0
Germany	67.4	71.5	7.0	77.0
UK	70.7	72.9	2.5	74.8
Greece	60.4	68.5	2.8	70.5
Ireland	67.2	71.1	1.1	71.9
Italy	58.2	67.4	4.4	70.5
The Netherlands	72.9	73.4	1.8	74.8
Portugal	71.0	72.9	3.1	75.2
Spain	61.3	68.6	5.9	72.9
Sweden	71.9	73.8	3.0	76.1
Czech Republic	64.7	70.7	4.2	73.7
Hungary	57.7	67.5	1.1	68.3
Poland	52.2	65.5	8.6	71.6
Slovakia	58.4	67.8	8.6	74.1
Slovenia	63.2	70.0	5.7	74.3
Rest EU	64.1	70.3	2.5	72.1
EU25	63.8	70.0	5.0	73.7

Source: WorldScan. The employment rate in column (2) is the products of the participation rate (column (4)) and 1 minus the unemployment rate (Column (3)) The participation rate is build up from a cohort and sex-specific population model.

Interpreting the 70% employment target as an EU average, countries that already have met the 70% target also increase employment to some extent. Therefore employment increases in Denmark, Sweden, UK, Portugal and the Netherlands. Also the countries which are near the 70% target in 2003 will have an employment target exceeding 70% in 2010. Examples are Germany, Austria, Finland, Ireland, Czech Republic and Rest EU (see Table 4.2). The increase in the employment rate has to be achieved through higher participation rates and or lower unemployment rates. The last two columns in Table 4.2 show the combination of unemployment rates and participation rates for which the employment rates in the scenario (second column) are met.

Table 4.3 presents the long-term macroeconomic effects of reaching the 70% employment target for the lower bound scenario in 2010. It shows the effects of an increase in the employment rates on employment, GDP, consumption, exports and real wages. On average employment will increase by 10.3% in the EU in 2025. The GDP gain is 3% points lower because labour becomes less productive due to the substitution of capital to labour. This is also reflected in a fall of real wages of 3.1% compared to the baseline. Because of lower wages, consumption rises less than GDP. The terms-of-trade effect is negative: the EU has to lower export prices to expand on international markets. Investment will increase - but less than the increase in GDP -, because capital becomes more productive and the real interest rate will rise. Europe will attract more capital from abroad to finance extra investment. The volume of exports increases by about the same amount as GDP and imports increase by less.

Table 4.3 Macroeconomic effects of 70% employment target in 2025: lower bound scenario

Countries	GDP	Consumption	Exports	Employment	Real wages
EU	7.7	6.9	8.0	10.3	− 3.1
Germany	6.0	5.7	6.3	7.2	− 1.6
France	9.4	8.4	9.7	11.9	− 2.9
United Kingdom	2.9	2.8	3.6	3.2	− 0.5
Italy	15.1	13.3	13.9	19.6	− 5.4
Spain	10.6	9.1	11.0	12.8	− 3.0
The Netherlands	0.6	0.9	1.8	0.7	0.1
Belgium-Luxembourg	16.8	14.6	14.8	18.2	− 3.1
Denmark	0.6	0.8	1.5	0.3	0.4
Sweden	2.3	2.4	2.9	2.5	− 0.2
Finland	6.0	6.0	5.2	7.5	− 1.7
Ireland	5.1	4.8	4.8	6.0	− 1.2
Austria	3.1	2.9	4.4	3.1	− 0.1
Greece	12.6	10.4	10.7	15.0	− 3.1
Portugal	3.2	3.0	5.3	3.0	0.1
Poland	19.7	17.1	19.4	24.1	− 5.6
Czech Republic	7.7	7.0	8.6	8.7	− 1.7
Hungary	13.1	11.6	12.1	16.2	− 4.0
Slovakia	13.4	11.5	13.0	16.4	− 4.4
Slovenia	13.9	12.6	13.0	12.7	− 0.1
Rest EU	7.1	5.8	8.1	8.6	− 2.4
United States	− 0.1	0.0	− 0.1	0.0	− 0.1
Rest OECD	− 0.1	0.1	0.0	0.0	0.0
Non OECD	0.0	0.2	0.9	0.0	0.1

Source: WorldScan simulations. The numbers are relative changes to the baseline in 2025. This is the alternative baseline with increasing labour-market participation rates for women.

The variation within the EU is large. In Austria, Denmark, Sweden, the UK, Portugal and the Netherlands employment changes moderately. In Denmark, the Netherlands and Portugal wages will even increase slightly to offset the increasing costs of capital. Because of the scarcity of capital in the EU, these countries will export capital. These countries' import prices are lower, because other countries reduce their export prices to conquer foreign markets. Hence, the terms-of-trade effect for these countries is positive, leading to more consumption. The employment changes in Italy, Belgium, Greece, Hungary, Poland, and Slovakia are large. These changes exceed 15 percentage points, while the GDP changes are at least 12%. In these countries real wages fall and there is a negative terms-of-trade effect.

4.2.2 Lower bound employment scenario: productivity

It is often said that extra employment is not as productive as existing employment. According to this view the unemployed and people who do not participate in the labour market are on average less productive. If this is true we overestimate the economic effects of the employment target. Extra employment comes from two sources in our model. First, unemployment is reduced. In the previous simulation we assume that about 80% of the people who find a job is low-skilled, according to Eurostat data. Second, the participation rates increase. So far we have assumed that the supply of skills of the extra labour force is the same as for the existing labour force. This means we consider 65% of the labour force as low-skilled and 35% as high-skilled.

Now we modify this assumption. Taking an extreme position we assume that all extra employment is low-skilled. We add the effects of this assumption to the lower bound scenario. The results are presented in Table 4.4. We compare these results with the ones in Table 4.3 above, where extra employment consists of a combination of low and high-skilled workers. Measured as a head count, the employment effect is the same in both analyses, but in efficiency terms the outcome is different. The GDP and consumption effects are lower and the negative effect on real wages is higher in Table 4.4. Low-skilled labour is less productive; therefore the increase in employment contributes less to productivity and GDP.

The GDP effect is about 15% lower compared to Table 4.3. In that simulation about 30% of the extra workers are high-skilled.[18] The low-skilled workers are about 40% less productive than the high-skilled workers. This difference in productivity explains the differences in outcomes. The effect per country differs slightly. The variation in economic effects is the same as in the previous simulations.

[18] This number is a weighted average of extra workers who were initially unemployed, and who did not participate at all. 20% of those who were unemployed are high skilled, and 35% of those who did not participate are high skilled.

Table 4.4 Macroeconomic effects of 70% employment target in 2025: lower bound scenario with low-skilled employment

Countries	GDP	Consumption	Exports	Employment	Real wages
EU	6.3	5.6	6.7	10.3	− 4.3
Germany	4.9	4.7	5.3	7.2	− 2.5
France	7.9	6.9	8.3	11.9	− 4.2
United Kingdom	2.3	2.2	3.0	3.2	− 0.9
Italy	11.8	10.2	11.3	19.6	− 7.8
Spain	8.8	7.3	9.6	12.8	− 4.5
The Netherlands	0.6	0.9	1.4	0.7	0.1
Belgium-Luxembourg	12.3	10.3	12.3	18.2	− 6.6
Denmark	0.4	0.5	1.1	0.3	0.2
Sweden	1.9	2.0	2.5	2.5	− 0.5
Finland	5.1	5.0	4.4	7.5	− 2.5
Ireland	4.2	3.9	4.1	6.0	− 2.0
Austria	2.3	2.3	3.5	3.1	− 0.8
Greece	10.9	8.8	9.4	15.0	− 4.5
Portugal	2.5	2.4	4.5	3.0	− 0.5
Poland	17.2	14.7	17.6	24.1	− 7.4
Czech Republic	6.4	5.7	7.3	8.7	− 2.8
Hungary	10.4	9.1	10.0	16.2	− 6.1
Slovakia	11.9	10.0	11.5	16.4	− 5.6
Slovenia	9.9	8.9	10.3	12.7	− 3.3
Rest EU	6.5	5.3	7.3	8.6	− 2.9
United States	− 0.1	0.0	− 0.2	0.0	− 0.1
Rest OECD	− 0.1	0.0	0.0	0.0	− 0.1
Non OECD	− 0.1	0.1	0.6	0.0	0.0

Source: WorldScan simulations. The numbers are relative changes to the baseline in 2025.

Table 4.4 contains the results of the full lower bound scenario for employment. Of course the assumption that the entire increase of employment consists of low-skilled workers is somewhat extreme. Nonetheless, this puts some other rather optimistic aspects of this Lisbon target in perspective, such as the absence of costs of policies in the scenarios or the ambition that the targets will be reached in 2010. Recently, DG Employment (2004) has developed scenarios for unemployment and labour-market participation between 2003 and 2010. They estimate that the overall employment rates for the EU20[19] will increase from 62.9% in 2003 to 66.5% in 2010 according to their most optimistic scenario. This suggests that the targets are not feasible in 2010. Hence, the full economic benefits of reaching the employment target will also not be attainable in 2010. This does not exclude the possibility that the employment target will be met at a later stage. For instance the results for 2040 in Annex 2 will not change substantially, if the employment target will be reached say ten years later. A comparison with Table 4.5 shows that the differences between 2025 and 2040 for the EU as a whole are minor. For those countries that face the largest effects of the employment target, the differences are slightly larger.

[19] The Baltic States, Malta and Luxembourg are excluded.

4.2.3 Upper bound employment scenario

Table 4.5 shows the macroeconomic effects of the employment target for the upper bound scenario. Because participation rates for women are held constant the employment rate is lower in the baseline of this scenario than in the baseline of the lower bound scenario. Hence, the employment gain of reaching the target is larger: 11.9% instead of 10.3% in the lower bound scenario. The GDP gain is 9.2%. The abundance of extra labour depresses labour productivity, so real wages are 3.4% lower on average. Exports develop more or less in line with GDP. The increase in consumption is slightly lower due to the negative terms-of-trade effect: the price of imported goods and services rises relatively to the price of exported goods and services.

Table 4.5 Macroeconomic effects of 70% employment target in 2025: upper bound scenario

Countries	GDP	Consumption	Exports	Employment	Real wages
EU	9.2	8.3	9.5	11.9	– 3.4
Germany	7.2	6.8	7.5	8.6	– 1.8
France	10.6	9.5	11.0	13.2	– 3.0
United Kingdom	3.8	3.6	4.6	4.2	– 0.5
Italy	18.2	16.1	16.7	23.5	– 6.1
Spain	14.0	11.9	14.1	16.5	– 3.5
The Netherlands	2.7	2.8	3.7	3.2	– 0.4
Belgium-Luxembourg	18.2	15.9	16.3	19.6	– 3.1
Denmark	0.9	1.1	1.9	0.6	0.4
Sweden	2.0	2.2	2.9	2.1	– 0.1
Finland	6.1	6.1	5.5	7.6	– 1.6
Ireland	7.6	7.0	6.7	8.8	– 1.7
Austria	5.1	4.7	6.5	5.3	– 0.5
Greece	14.6	12.1	12.4	17.1	– 3.4
Portugal	4.8	4.4	7.3	4.5	0.2
Poland	20.0	17.4	20.1	24.4	– 5.6
Czech Republic	8.1	7.4	9.4	9.1	– 1.5
Hungary	14.6	13.0	13.5	17.8	– 4.1
Slovakia	15.2	13.1	14.7	18.4	– 4.7
Slovenia	14.5	13.2	14.0	13.0	0.2
Rest EU	8.0	6.6	9.0	9.5	– 2.5
United States	– 0.2	0.1	– 0.1	0.0	– 0.1
Rest OECD	– 0.1	0.1	0.0	0.0	0.0
Non OECD	0.0	0.2	1.1	0.0	0.1

Source: WorldScan simulations. The numbers are relative changes to the baseline in 2025.

The variation in outcomes for the member states can be completely traced back to their efforts to reach the target. In Denmark, Sweden, United Kingdom, The Netherlands, and Portugal employment rates are already high in the baseline. The increase in employment is thus modest and so are the GDP and consumption effects. In Sweden and Denmark the consumption increase is even slightly larger than the GDP increase, because of a positive terms-of-trade effect. Export prices deteriorate mildly, while import prices fall more strongly because of the negative wage developments in other EU countries. In some EU countries employment rises by 15% or more. Examples are Italy, Spain, Belgium, Greece, Poland, Hungary and Slovakia. These countries will not meet the 70% employment rate in 2010, but the employment rate will exceed 65%. This is a substantial increase given the current low employment rates. GDP and consumption increase by at least 10% in these countries.

4.3 Impact on sectoral competitiveness

The employment target in Europe is above all a macroeconomic goal. Higher employment stimulates output and value added. Labour productivity will decrease because of the abundance of labour and output prices will decrease, because the fall in wages exceeds the fall in productivity. This leads to lower export prices, which stimulates exports but also causes a negative terms-of-trade effect. This economic mechanism works in principle in every sector of the economy. The precise effects may differ because labour and trade intensities differ over sectors (see for the latter Table 3.2).

Most of the exports take place in manufacturing. The lower wages, induced by the employment impulse, improve competitiveness and stimulate foreign demand. In manufacturing sectors exports increase by about 8% (see Table 4.6). The increase in foreign demand above the extra demand from inside Europe stimulates production in manufacturing. The share of manufacturing in total exports increases slightly. The Balassa index of specialisation increases by 1% point in the manufacturing sectors. The increased share of manufacturing in total exports implies a lower share of services in exports. This is also shown by the drop in the index of export specialisation, the Balassa index.

Because of the increase in output, manufacturing sectors also demand extra inputs. As a result inputs become scarcer at the expense of the other sectors. In energy and services output expands less than in manufacturing.

The overall sectoral results are also affected by the employment changes at the country level. For example, the countries which already passed the employment target have a relatively larger services sector than most of the new member states. In the former countries the employment target has a relatively larger effect on the services sectors than on the manufacturing sectors. Most of the new member states have relatively small services sectors and large manufacturing sectors. The employment increase is substantial in those countries which contributes to the large employment effects in manufacturing for the EU as a whole.

Table 4.6 Sectoral EU-wide effects of employment target in 2025: lower bound scenario with low skilled

Sectors	Employment	Production	Labour productivity	Exports	Specialisation index
Agriculture	19.1	9.8	− 8.6	8.8	1.4
Energy	10.7	5.0	− 4.5	2.0	− 3.5
Low tech manufacturing	13.5	7.9	− 5.7	7.4	0.7
Medium-low tech manufacturing	14.1	9.0	− 5.5	8.6	1.0
Medium-high tech manufacturing	12.7	7.8	− 5.3	7.2	0.1
High tech manufacturing	16.4	10.5	− 6.3	8.8	1.6
Transport services	12.1	6.9	− 5.2	4.8	− 2.1
Other commercial services	9.9	5.8	− 3.5	3.3	− 3.5
Research and development	4.8	3.6	0.3		
Other services	8.2	5.0	− 2.8	1.9	− 6.6
Total	10.3	6.8	− 3.5	6.7	

Source: WorldScan simulations.
The numbers on employment, production and labour productivity are relative changes compared to the baseline in 2025. The number on specialisation is an absolute change in the Balassa index in 2025.

4.4 Employment and policy costs

The ‘what if’ simulations in Table 4.3 to Table 4.5 abstract from policy measures to increase participation and reduce unemployment. WorldScan cannot simulate the effects of policies that will raise employment, because participation and unemployment are exogenous (see Section 3.2). However, it is possible to get a rough idea of policies that may be used to reach the targets. To illustrate one potential policy option this section estimates which reduction in income tax rates and social security benefits might be needed to achieve the participation and unemployment effects in the simulations. It is not possible to differentiate these estimates by country, because that would require too much country specific institutional detail. Hence, we estimate the policy inputs needed to reach the targets for Europe as a whole, using average elasticities taken from the literature.

In the lower bound simulation of Table 4.4 labour supply of women increases by 5.8% and labour supply of men by 5.4%. The tax elasticity of labour supply can be written as:

$$i_s = -\frac{1}{1-t}\,\varepsilon_l\ \Delta t$$

with t the rate of income taxes and social security contributions, ε_l the wage elasticity of labour supply and l_s the volume of labour supply. The unweighted average of the income tax rate relevant for the labour supply decision of women (second earner, 100% Average Production Worker) equals 33.9% for the EU countries in Table 6.1 of OECD (2005, p166). A meta-analysis of labour supply elasticities yields an elasticity of 0.5 for women and 0.1 for men

(Evers, 2005). Hence, to obtain the participation effect for women the income tax rate has to fall by (1 − 0.339) x 5.8 / 0.5 = 8 %-points, which is quite substantial. The relevant income tax rate thus has to be reduced from 33.9% to 26%.

A much larger fall in tax rates would be required to account for the labour supply increase of men, because the wage elasticity for men is much smaller. However, the additional labour supply of men largely concerns elderly men and depends more strongly on (early) retirement arrangements than on taxes. Because retirement schemes vary substantially across Europe we are not able to estimate the additional policy impulse for men.

Unemployment has to fall from 9.1% to 5% to meet the unemployment target according to Table 4.2. The long-term or equilibrium unemployment rate depends on the tax wedge and the replacement rate, i.e. the ratio of social security benefits to wages (see Nickell *et al.*, 2005). Econometric estimates of wage equations imply a coefficient of 0.1 for the impact of the income tax rate on equilibrium unemployment (10 %-points lower tax rates reduce the employment rate by 1 %-point). Hence the above reduction in income tax rates by 8 %-points will reduce the equilibrium rate of unemployment rate by 0.8 %-points.

The econometric estimates also imply a coefficient of 0.15 for the influence of the replacement ratio (10 %-points lower replacement rate reduces the employment rate by 1.5 %-point). In addition, a very large fall in the replacement ratio of 22 %-points would be required to reduce the unemployment rate by another 3.3 %-points. Applying the larger 0.32 tax coefficient from Planas *et al.* (2003), the fall in the replacement rate comes down to 10 % points.

In the upper bound simulation participation of women increases by 9.3% and the unemployment rate also falls by 4.1 %-points. Analogously to the computations above, to reach these targets the income tax rate has to fall by 12 %-points and the replacement rate by 2%-points to 19 %-points, depending on the tax elasticity.[20]

All in all, GDP and consumption will surge if the 70% employment target is met in Europe. The GDP gain varies from 6.3% to 9.2%, but this is no free ride. In this example the substantial costs of reaching the employment target manifest themselves in the supply of public goods and in equity or social cohesion. In the lower bound scenario, financing an 8% reduction in tax rates would require a substantial cut in the provision of public goods, for instance in the fields of infrastructure or defence spending. Lower replacement rates in the order of 10 to 22 %-points imply that social security benefits fall considerably relative to wages.

[20] The income tax rate has to fall by (1 − 0.339) x 9.3 / 0.5 = 12 %-points, leading to a 1.2% point to 3.8% point fall in the unemployment rate.

5 Human capital

Human capital directly contributes to productivity. Education and training raise workers' productivity, which manifests itself in higher wages. A range of empirical studies on differences in wage profiles show that an extra year of schooling yields a private rate of return of 6 to 9% (Harmon *et al.*, 2003). No robust empirical evidence can be found for additional indirect effects of human capital, for instance due to increasing returns or complementarity with R&D (see Section 2.3.4).

Several trends increase scarcity of human capital. One of the most important trends is skill biased technical change, i.e. technology that enhances the productivity and wages of high-skilled workers (Jacobs, 2004). In addition, relocation and international trade to a limited extent explain increased unemployment of low-skilled workers and rising wage differentials between low- and high skilled workers (Euroframe-EFN, 2005, Chapter 3). Ageing increases labour scarcity and if ageing results from declining fertility rates, the labour inflow of educated school leavers diminishes. Therefore, on-the-job training gains importance. Changes in work organisation towards flexibility, job rotation, multitasking and worker autonomy add to the significance of on-the-job training. As a consequence of these trends private rates of return on human capital investment are expected to increase, which underscores the importance of human capital investments.

5.1 Human capital in Europe

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) to be met by 2010:

1. The percentage of early school leavers should be at most 10% on average.
2. At least 85% of 22 year olds in the European Union should have completed upper secondary education or higher.
3. 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.
4. 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).
5. The total number of graduates in mathematics, science and technology (MS&T) in the European Union should increase by at least 15% while at the same time the gender imbalance should decrease.

Implementation of these targets in the WorldScan model is far from straightforward. Currently, WorldScan uses production functions with two skill levels, which correspond with:

- Low skilled: all up to and including completed secondary education (ISC 01+2+3),
- High skilled: tertiary education (ISC 5+6).

Effects on productivity and wages result from shifts between low and high skilled labour. However the above targets induce no shifts between skill levels in WorldScan. Targets 1 - 3 concern shifts within the low skilled category, target 5 concerns a shift within the high skilled category and target 4 may relate to both categories but will hardly induce any shifts between categories. The main consequence of reaching these targets is that labour efficiency of the two skill levels improves. Targets 1 - 3 (5) will make low (high) skilled labour more productive and target 4 largely generates an increase in labour efficiency all over the board.

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. This extension allows for three disaggregated skill groups at the lower education level and for two types of higher educated workers: non-MS&T and MS&T workers. The disaggregated skills equations are calibrated, based on substitution elasticities and returns to education that are found in the literature. Furthermore, the satellite model captures on-the-job-training and the quality of education in a rudimentary, but consistent, fashion.

Another aspect of implementation is the time lag between formal education and the skill structure of the labour force. It takes many years before the skill structure of the labour force has adjusted to the higher educated cohorts that leave formal education. To take this into account Jacobs' satellite model 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. This cohort model is a crude approximation to reality because it assumes that all cohorts are equally sized. Although the simulations of the skills model are somewhat sensitive to the underlying demographic assumptions, this approximation affects the baseline time-paths and the Lisbon time-paths for the workforce equally. As such, the demographical assumptions will not create a systematic bias when comparing the Lisbon simulations with those of the baseline.

Implementation also has a regional dimension. European Commission (2004b) shows that countries differ with respect to their position vis-à-vis the targets. At the same time European Commission (2004b) emphasises that the targets apply to the EU as a whole and not to individual countries. In accordance with the other Lisbon simulations we follow the rule to compute country specific targets that has also been applied in other simulations (for instance see Section 4.2). We set an upper limit above the target and above the highest base level value (sometimes countries already in the base data exceed the targets). We then set the target for a country proportional to the distance of the base level value of that country and the upper limit.[21] In this way countries that are at the largest distance from the target have to make the largest effort. At the same time, because the upper limit exceeds the target, countries that have reached or exceeded the target are still assumed to make some (although generally small) effort. The only exception to this rule is the target on mathematics, science and technology graduates. European Commission (2004b) specifies this target as a percentage change and we uniformly apply that change to all countries (see Section 5.1.5 for further explanation).

Combining disaggregated skill categories, on-the-job training and quality of education with a stylised cohort model, 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.

The simulations capture the most important costs of achieving the skills targets, namely the opportunity costs of increasing levels of education and the opportunity costs of acquiring more skills on the job. In particular, raising the number of better skilled workers in the population automatically implies that there are less low skilled workers available. Moreover, if skills upgrading requires more time in education, less labour time is available and earnings are lower. Also, increasing training efforts will imply lower labour earnings in the short run as workers spend less time being productive when they spent their time accumulating human capital. However, we ignore the direct and institutional costs associated with larger levels of investment in formal schooling and training. In addition, the policy costs are not taken into account of increasing literacy levels and of shifting the composition of graduates from non-MS&T to MS&E fields. Hence, in the simulations the economic costs of reaching the skill-targets are likely to be underestimated.

Furthermore, the satellite model contains many uncertain parameters. Wherever possible, we have chosen the most plausible values known from the economic literature. In several instances, parameters are not precisely known and we have set them at rather optimistic upper-bound values. Therefore, one can view our simulations as a rosy picture one can paint of reaching the Lisbon targets on skill formation because we to a certain extent underestimate the costs and in some cases use optimistic parameter values.

Before turning to the WorldScan simulations, the remainder of this section explains for each of the targets the way it has been implemented. It focuses on the intuition and shows for each target the contribution to the increase in labour efficiency over time. Technical details can be found in Jacobs (2005).

[21] For each of the relevant skills simulations the specific equations used in this procedure can be found in section 7 of Jacobs (2005).

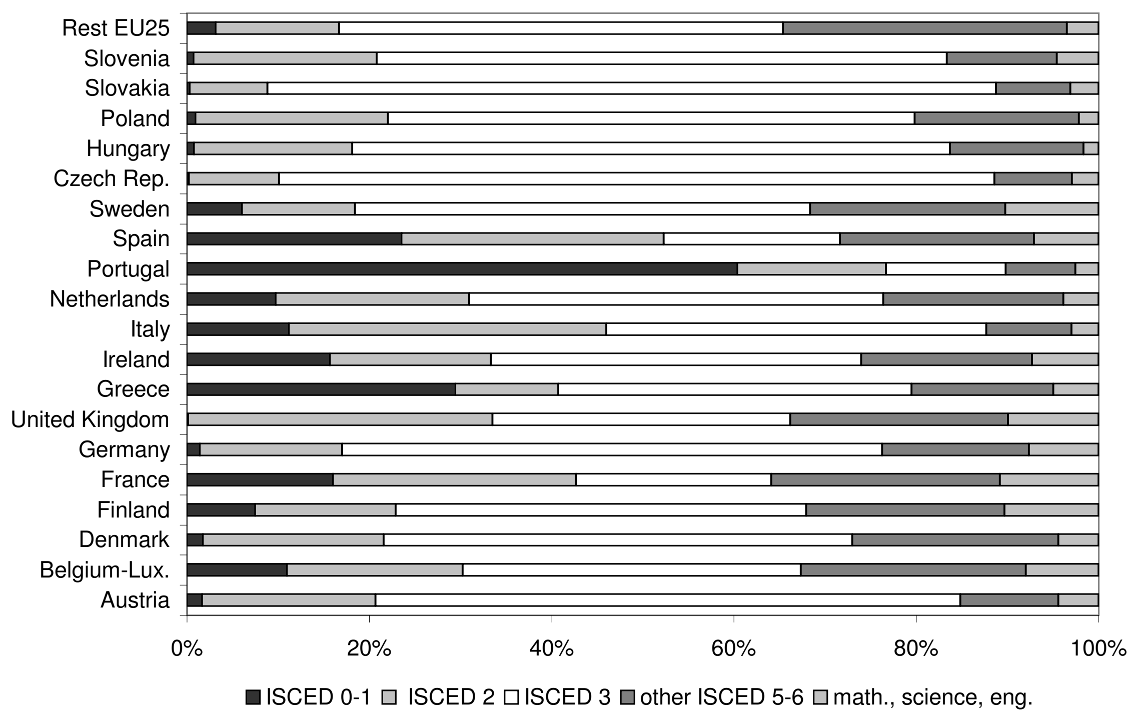
5.1.1 Early school leavers

This target has not been analysed separately. The indicator for early school leavers is the share of the population aged 18-24 with only lower secondary education and not in education or training (European Commission, 2004b, p56). Hence, preventing early school leaving implies that students obtain upper secondary education. However, we cannot distinguish this outcome from that of the second target which states that a larger percentage of students should have completed upper secondary education. Although from a policy perspective it might be relevant to separate the two targets, in terms of outcomes the effects cannot be distinguished. Therefore, in our simulations the upper secondary education target (discussed in the next subsection) encompasses this target.

5.1.2 Upper secondary education

Many regard upper secondary education as a basic qualification that is required to function well in the knowledge economy and knowledge society (compare European Commission 2004b). The Councils' objective states that 85% of *22 year* olds should have completed at least upper secondary education in 2010. To fit in with the demographic data of the WorldScan model we use a slightly different benchmark, *viz.* the percentage of *24-29 year* olds that have completed at least upper secondary education. Using this age group to derive education benchmarks, we also take into account that some of the people of younger ages may not have completed their initial education, in particular in tertiary education. All in all, in the base year our benchmark hardly differs from that in European Commission (2004b).

Figure 5.1 Skill distribution of the labour force in 2001



Many new member states excel in education. They already exceed the target of 85%. Hence, to arrive at country specific targets we set an upper limit of 96%, which lies somewhat above the 94.6 value of Slovakia. Next, we interpolate between the base year data and this upper limit in such a way that the EU reaches the target of 85% upper secondary education (see Jacobs, 2005 for details). Having set the target, we shift graduates from the lower secondary education category to the upper secondary education category. In addition we make an adjustment for countries with relatively many low-skilled graduates in the base year data, such as Portugal (see Figure 5.1). In these countries we also shift some students from primary to lower secondary education. In the satellite model the shifts towards higher skill categories generate an increase in labour efficiency.

Figure 5.2 presents a concise overview of the labour efficiency inputs computed from the Jacobs (2005) skills model. For all countries the four bars show the increase in labour efficiency due to skills upgrading after 10, 20 30 and 40 years, respectively. The subdivision of each bar represents the contribution of the four targets that have been simulated. All bars start at negative numbers because the lifelong learning simulation entails an ex-ante loss in efficiency when labour time has to be used for training activities (see Section 5.1.4).

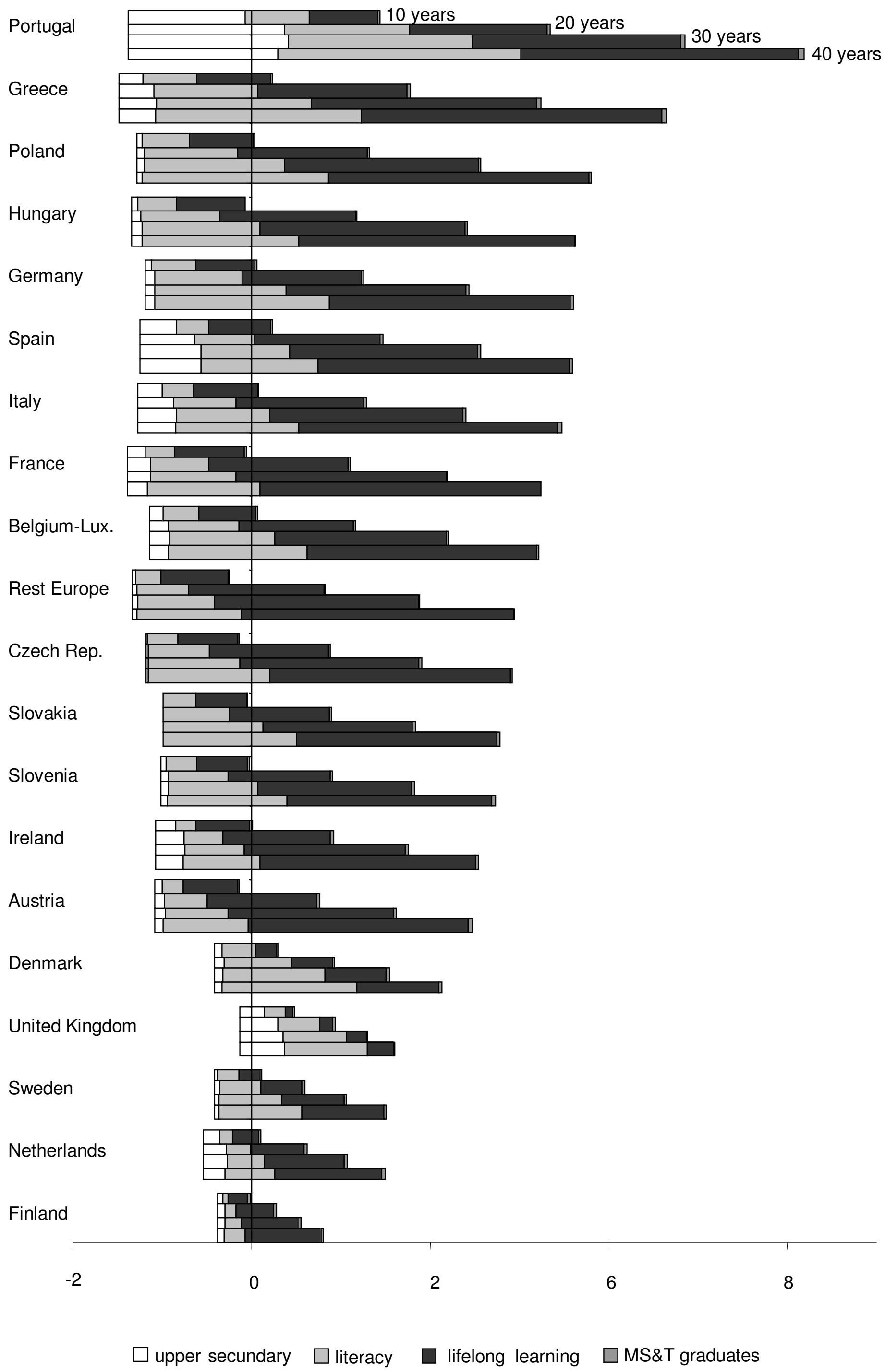
The upper bars in Figure 5.2 illustrate that after 10 years the shift towards upper secondary education increases labour efficiency by 0.1% in the Nordic countries and the new member states to 1.3% in Portugal. All countries show some further increase in subsequent decades, for instance in Portugal the labour efficiency contribution rises to 1.7% after 40 years. These dynamics originate from two effects. Firstly, the skill composition of the labour force rises gradually because each year a new higher educated cohort enters the labour market. Secondly, wages of upper secondary educated workers fall relatively to the base line to absorb the larger cohorts on the labour market and wages of lower secondary skilled workers rise relatively.[22] By consequence, the returns of additional investments in upper secondary education fall over time. The combined effect of these two developments is that the contribution of this target to labour efficiency levels off in the second half of the period.

5.1.3 Literacy

The indicator for the literacy target follows from the OECD PISA 2000 survey (European Commission 2004b, p28). It is defined as the percentage of pupils with reading literacy proficiency level 1 and lower in the Pisa reading scale. These pupils master only the least complex reading tasks, such as locating a single piece of information. The Ministers of Education adopted the target that the percentage of low achieving 15 years olds should have fallen by at least 20% in 2010 compared to 2000.

[22] Wage effects are relatively small because low skilled workers are relatively close substitutes. The elasticity of substitution between the low skilled labour categories has been set at 3 (Jacobs, 2005).

Figure 5.2 Labour efficiency effects of four types of skills targets after 10, 20, 30 and 40 years (in percents)



Per country the four bars show the increase in labour efficiency due to skills upgrading after 10, 20 30 and 40 years. The subdivision of each bar represents the contribution of the four targets that have been simulated. All bars start at negative numbers because the lifelong learning simulation entails an ex-ante loss in efficiency when labour time has to be used for training activities.

To implement the literacy target we assume that the distribution of PISA test scores shifts symmetrically in such a way that the fraction of low achieving students falls from 17.2% to 13.7% for the EU. This implies that policies not only improve reading literacy at lower levels but also ‘trickle upward’ to higher reading proficiency levels. By consequence, no distributional effects occur. This was the most convenient technical assumption available. Using estimates of the returns to literacy from the literature, it follows that reaching the EU target comes down to a 1.6% increase of quality of human capital (Jacobs, 2005).

Some countries (Finland, the Netherlands, Austria, Ireland, Sweden, UK) perform very well on the literacy target; other countries (Portugal, Greece) have much scope to make up for the difference with the high-performers. Therefore we have differentiated the 1.6% human capital quality increase over countries. We set a lower limit of 5% pupils with reading literacy proficiency level 1 and lower. This value is slightly below the 7% of the best performing country, Finland. Country specific targets follow from interpolation between this limit and each country’s current literacy rate, taking account of the fact that the weighted average of country targets has to equal the target for the EU as a whole.

The contributions of this component to the total increase in labour efficiency depicted in Figure 5.2 illustrate the dialectics of progress. Countries that already perform well on literacy of course benefit relatively less from reaching this target. In other words, the substantial contribution to labour efficiency for some countries constitute just as substantial challenges for these countries.

5.1.4 Lifelong learning

Lifelong learning gains importance in economies and societies that change quickly and increasingly become based on knowledge. The indicator selected by the European Commission (2004b, p51) consists of the percentage of the population aged 25-64 who participated in education and training 4 weeks prior to the European Commission Labour Force Survey. For the EU that percentage has to increase from a current 7.9% to 12.5% in 2010. We took account of differences among countries by setting an upper limit of 25%, which somewhat exceeds the highest value of 22.9% in the United Kingdom. Again, country specific targets follow from interpolating between the upper limit and the country’s current rate of participation in life long learning in such a way that the EU target is met.

More training effort has two contrasting effects. Firstly, participation in training demands time that without training would have been used for working. Because working time has to be invested up front in training, the initial labour efficiency effects are negative, which explains the negative starting points of the bars in Figure 5.2. Secondly, increasing training time raises the growth rate of on-the-job training (see Jacobs, 2005). On-the-job training directly increases the growth rate of the stocks of human capital across all cohorts. These positive effects from human capital accumulation gradually build up and after a number of years dominate the results.

5.1.5 Mathematics, science and technology graduates

More scientific specialists and researchers are available in Europe if more students opt for mathematics, science and technology (MS&T) studies. The Council has set the target that the number of graduates in these studies should increase by at least 15% (European Commission, 2004b, p34) and that gender imbalance should decrease. We lack instruments to address the latter target. We decided to implement the 15% increase in MS&T graduates uniformly over all countries, mainly because the effects of this simulation are relatively small, which hardly warrants the effort of differentiation.

For several reasons the impact of reaching this target on labour efficiency is small (see Figure 5.2). The decision at hand involves opting for an MS&T study instead of another tertiary study. Opportunity costs of this choice are an extra year of study, whereas wages of MS&T graduates do not strongly exceed wages of people with other types of tertiary education. On the labour market substitution between MS&T graduates and graduates with other tertiary education is less elastic than substitution of low-skilled workers, which implies that the fall in MS&T wages is relatively large when the target has been reached. Moreover, no complementarity between MS&T graduates and R&D has been assumed. No strong empirical evidence for this complementarity can be found and in our R&D simulations we assume that the additional number of R&D workers required come out of the large pool of high skilled people.[23]

Figure 5.2 also shows the combined impact of reaching the skills targets on labour efficiency. Differences between countries are considerable. As stated above, the main reason that several countries benefit little from skills upgrading, is that the level of skills in these countries already is (very) high.

5.2 Macroeconomic effects of reaching the skills targets

Table 5.1 presents the macroeconomic effects in 2025 of reaching the skills targets. This comes down to 0.5% increase in labour efficiency in the EU, which in WorldScan directly translates into wages, GDP and consumption per capita. Country specific effects mirror the inputs depicted in Figure 5.2.

The 2025 outcomes depend on two main components, the level of skills in a particular country and the relative importance of the lifelong learning target. The level of skills determines the overall size of the skills effect. For instance, Portugal benefits most, because the initial skill level is low compared to the target. It even has to pay a small price in terms of trade to expand in international markets. Benefits for Finland are small because it already scores well on all of the skills targets (see Figure 5.2). The relative importance of the lifelong learning target determines the initial setback due to training investment which still has a relatively high weight in 2025. This relevance of this effect follows from comparing Austria to the United Kingdom

[23] See also Jacobs and Webbink (2004) for an analysis of the labour market for MS&T workers in the Netherlands.

and Denmark in Figure 5.2. For Austria lifelong learning yields a major contribution. By consequence, the effects of the initial setback in the first 10 to 20 years outweigh the positive effects of training. In Denmark and the United Kingdom the initial setback is smaller and the other targets add to relatively larger effects in 2025. Comparable differences exist between other countries, such as Sweden or the Czech Republic and the United Kingdom.

Table 5.1 Effects of skill upgrading in the EU-25 in 2025

Countries	Labour productivity shock	Real average wage	Gross domestic product	Terms-of-trade	Consumption per capita
Europe	0.5	0.5	0.5	0.0	0.4
Germany	0.5	0.4	0.5	0.0	0.4
France	0.4	0.3	0.4	0.0	0.3
United Kingdom	0.6	0.6	0.6	– 0.1	0.6
Italy	0.5	0.4	0.5	0.0	0.4
Spain	0.7	0.6	0.7	– 0.1	0.6
The Netherlands	0.3	0.3	0.3	0.0	0.3
Belgium-Luxembourg	0.5	0.5	0.5	0.0	0.5
Denmark	0.6	0.5	0.6	0.0	0.5
Sweden	0.3	0.3	0.3	0.0	0.3
Finland	0.1	0.1	0.1	0.0	0.1
Ireland	0.4	0.4	0.4	0.0	0.4
Austria	0.2	0.2	0.2	0.0	0.2
Greece	0.8	0.8	0.8	– 0.1	0.7
Portugal	2.3	2.2	2.4	– 0.3	1.9
Poland	0.5	0.4	0.5	– 0.1	0.4
Czech Republic	0.2	0.2	0.2	0.0	0.2
Hungary	0.4	0.3	0.4	0.0	0.3
Slovakia	0.3	0.2	0.3	0.0	0.3
Slovenia	0.4	0.4	0.4	0.0	0.4
Rest EU	0.3	0.2	0.3	0.0	0.2
United States	0.0	0.0	0.0	0.0	0.0
Rest OECD	0.0	0.0	0.0	0.0	0.0
Non OECD	0.0	0.0	0.0	0.0	0.0

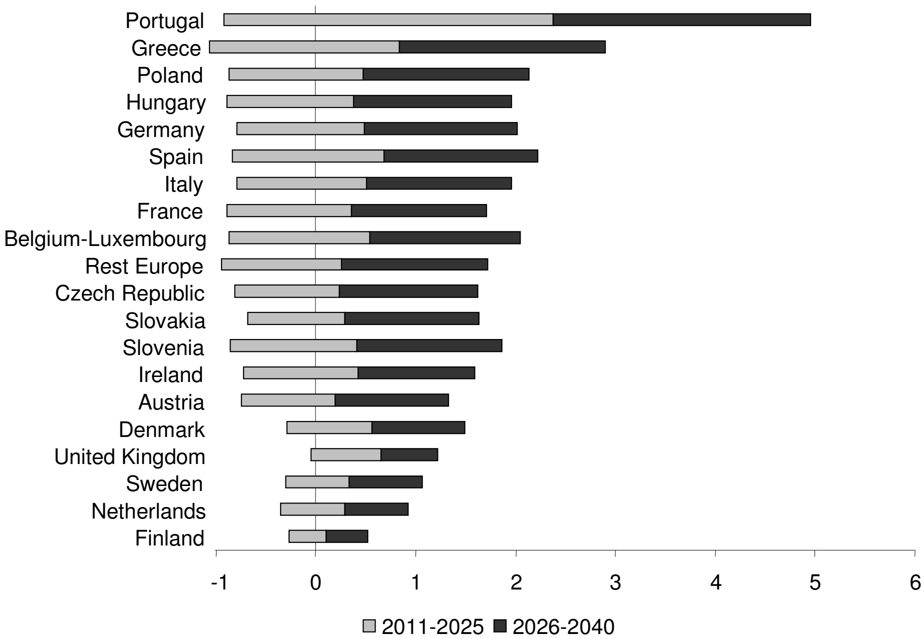
Source: WorldScan simulations, Cumulated difference in % compared to the baseline in 2025.

On the longer run the positive effects of lifelong learning dominate. Figure 5.3 presents the initial (negative) GDP effect in 2011, and GDP effects in 2025 and 2040 (taken from annex).The negative GDP effects of the schooling time investment in 2011 are depicted at the left side of the horizontal bars. The figure shows that in 2025 the negative effects from the time investment are more than offset. In 2040 the GDP gains are much larger than in 2025, because it takes several decades before the skills targets have affected the human capital of all age cohorts of the labour force.

In 2040 clearly the ‘level of skills’ effects dominate. Portugal and Greece are on top. Relatively large effects in the new member states mainly originate from the literacy and the lifelong learning target (compare Figure 5.2 and Figure 5.3). In 2040 the difference between

Austria and Demark is small and Austria outperforms the United Kingdom. The GDP effects in the Czech Republic even exceed those in both Denmark and the United Kingdom. All together, GDP in Europe rises by 1.7% in 2040 if Europe reaches the skills targets in 2010. This 2040 GDP effect is more than three times the effect in 2025, which illustrates the long lags involved in the process of skill upgrading.

Figure 5.3 Cumulative effects on GDP over 2011-2025 and 2026-2040 due to Europe reaching the skills targets in 2010



Source: WorldScan simulations, cumulated differences in % compared to the baseline.

5.3 Sectors and skills

Skill upgrading benefits labour intensive and skill intensive sectors. Table 5.2 shows some shifts in the sectoral structure towards the R&D sector and the medium-high tech manufacturing sector. The R&D sector is most affected because it is very skilled labour intensive. Due to the tradability of high and medium-high tech manufacturing it is easier for these sectors to sell extra production than it is for other sectors Yet, because skill upgrading takes place all over the labour force, sectoral shifts are not very pronounced.

Table 5.2 Sectoral EU-wide effects of skill upgrading in 2025

Sectors	Employment	Production	Labour productivity	Exports	Specialisation
Agriculture	0.0	0.5	0.4	0.4	0.0
Energy	0.0	0.4	0.4	0.1	− 0.3
Low tech manufacturing	0.0	0.6	0.5	0.5	0.0
Medium-low tech manufacturing	0.1	0.7	0.5	0.6	0.0
Medium-high tech manufacturing	0.1	0.6	0.5	0.6	0.0
High tech manufacturing	0.2	0.8	0.4	0.7	0.1
Transport services	0.0	0.5	0.5	0.4	− 0.2
Other commercial services	0.0	0.5	0.5	0.4	− 0.2
Research and development	0.5	1.1	0.5		
Other services	− 0.1	0.5	0.6	0.7	− 0.1
Total	0.0	0.5	0.5	0.5	

Source: WorldScan simulations.

The numbers on employment, production and labour productivity are relative changes compared to the baseline in 2025. The numbers on specialisation are an absolute change in the Balassa index in 2025.

6 Research and development

Research and Development (R&D) is a key factor for technological changes, and consequently for economic growth. New technologies can boost productivity and raise incomes. Amounting to 2% of GDP in 2003, public and private R&D expenditures are lagging behind in Europe compared to the United States (2.8%) and the rest of the OECD (3.1%). The European Council agreed to raise these expenditures to 3% of GDP in 2010.

This chapter analyses the effects of reaching this target. It does not assess the probability of reaching this target, nor the effectiveness of R&D to improve productivity. Increasing R&D expenditures from 2% to 3% of GDP is a 50% increase in R&D expenditures in less than a decade. At least for three reasons that will not be easy: to perform R&D firms need money, R&D scientists and good ideas. Increasing R&D expenditure takes a considerable amount of finance. R&D for a large extent consists of input by researchers. Sheenan and Wyckoff (2003) have estimated that to reach the R&D targets the EU15 needs 30% to 60% extra researchers. Although a large pool of high skilled people may be available (compare Section 5.1.5), it takes time to train them or to educate them. Moreover, firms and the government have the tendency to exploit the most profitable R&D projects first. The extra projects financed by the increase in R&D expenditure are probably less effective in raising productivity.

These caveats imply that the simulations have a strong ‘what if’ character. Although we use a government subsidy (financed by a lump-sum consumer tax) as an instrument to reach the 3% target, it underestimates the costs of reaching the target. Moreover, studies that estimate the impact of R&D on productivity probably overestimate the gains when applied to such large (out of sample) boosts in R&D expenditures as agreed upon in the Lisbon agenda. Therefore in a lower and an upper bound scenario we present a bandwidth of outcomes resulting from reaching the R&D target.

R&D expenditures and in particular R&D decisions are not commonly modelled in AGE models. Section 6.1 is devoted to this issue. It discusses the R&D decision of firms, R&D spillovers in the economy and the data. Section 6.2 presents the design of the simulation and the macroeconomic outcomes. The sectoral outcomes are discussed in Section 6.3, and Section 6.4 presents some sensitivity analysis. The last section concludes.

6.1 R&D in Europe

New technologies and better products boost productivity, not only in the innovating sector itself, but across all sectors. Since the influential paper by Coe and Helpman (1995) it is well established that investment in R&D 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.[24]

Sectoral and international spillovers prove to be important for analysing the economic effects of R&D expenditures and policies. Recently, some researchers have introduced these spillovers in CGE models.[25] However, in all these models the R&D decision is not based on optimisation behaviour of firms. In constrast, we have incorporated the R&D decision of firms in our model based on profit maximisation. We introduce this issue in Section 6.1.1. The following section discusses the data issues involved with the modelling of R&D in CGE models. Subsequently, Section 6.1.3 reviews our modelling of R&D spillovers and the underlying empirics, based on Lejour and Nahuis (2005), and Lejour and Tang (2006).

6.1.1 The R&D decision

Each period firms decide on their optimal R&D stock. Just as labour and capital, R&D generates value added for the firm. The R&D stock is treated as a capital stock. A firm invests each period in R&D and these investments contribute to the R&D stock, which also depreciates over time. Hence, R&D expenditures in period t, I, equal the R&D stock in period t, V, minus the stock in period t-1, corrected for depreciation:

$$I_t = V_t - (1-\delta)V_{t-1} \quad (1)$$

The optimal R&D stock is derived from cost minimisation, which implies that the marginal product of the R&D stock equals the user costs of R&D. User costs, p_V, equal the investment price for R&D, p_{RD}, times the sum of the return on R&D, a risk premium, o, and the depreciation rate. We assume that the return on R&D is equal to the return on capital, the real interest rate, r.

$$p_V = p_{RD}(r + o + \delta) \quad (2)$$

Note that this expression is similar to the user costs of capital. Yet the values of the two variables may differ, because the risk premia and depreciation rates may differ. $p_v V$ is equal to the contribution of R&D to value added. We assume that the value added nest in the production function is a CES construct of the R&D stock and the CES nesting of capital and labour, see Figure 3.1. The substitution elasticity between R&D and the capital-labour nest is 0.9.[26]

[24] Since then many researchers have studied R&D and R&D spillovers we do not replicate the literature here. For some recent overviews we refer to Jacobs *et al.* (2002) and Keller (2004).

[25] Examples are Diao et al. (1999), and Lejour and Nahuis (2005). Bayoumi *et al.* (1999) have incorporated R&D in the macroeconometric model of the IMF Multimod. Recently, Brécard *et al.* (2004) have modelled R&D in their sectoral econometric model Némésis.

[26] There are not many applied models which have incorporated the R&D stock, nor are there good estimates of the substitution between R&D and other inputs. Some examples are Den Butter and Wollmer (1996), and Van Bergeijk *et al.* (1997). Both papers assume complementarity between R&D and physical capital. However, the latter assumes substitution between R&D and human capital.

R&D is produced by the R&D sector. This is a separate sector in the model. Its production structure is based on the input structure of the R&D sector in the US. This is one of the few countries that explicitly distinguishes a R&D sector in its national accounts. The main input of R&D is high-skilled labour. The R&D sector only produces for domestic firms, we neglect international trade in R&D.

We are fully aware of the simplifications we have made in modelling R&D. We model one representative R&D sector while in practice R&D is performed by business enterprises, higher education and government research institutes. The inputs in these three sectors to produce R&D will differ, just as their productivity. Other publications, such as DG E&I (2004), analyse the differences between these sectors. WorldScan is not suited to deal with these differences. Yet, these simplifications fit in our general analysis of the main economic effects of five Lisbon goals. It is our purpose to present a broad overview of these effects, and not to conduct an in depth investigation of each specific Lisbon goal.

6.1.2 Data issues

We calibrate WorldScan on the GTAP database which separates many sectors, but no R&D sector: R&D forms a part of the other business sector. In addition national accounts often consider R&D as expenditures for intermediate goods. R&D is not seen as an investment, as most economists do, and does not contribute to value added. We do not wish to inflate value added by R&D income. Therefore we subtract R&D income from capital and labour income in the calibration year, so that we calibrate the total of R&D, capital and labour income on valued added in the GTAP database.

The output of the R&D sector equals the R&D expenditures of firms in an economy. We subtract this output and the corresponding inputs from the GTAP data of the other business services sector in order to stay as close to the database as possible. The R&D depreciation rate is set at 11%, following Carson *et al*. (1994). An alternative would be a depreciation rate of 15%, which according to Griliches (2000) is the number most often used. However, the empirical base is weak.[27]

In 2003, the EU countries spent on average nearly 2% of their GDP on R&D.[28] Table 6.1 shows that the variation within the EU is large. Sweden, Finland, Denmark, Germany, Belgium, France and Austria spend more than 2% in 2003, with the Scandinavian countries as the biggest R&D spenders. The new EU member states and the southern ones spend much less on R&D. These countries have some distance to meet the 3% Lisbon target on R&D. The current EU average is also far below R&D spending in the United States and the Rest of the OECD.

[27] We have done a sensitivity analyses with a depreciation rate of 15%. On average for the EU the effects of the policy variant are about 8% lower.

[28] We do not discriminate according to the source of finance. We refer to DG E&I (2004) for these numbers.

Table 6.1	National R&D expenditures in 2003		
Country	R&D expenditures	Country	R&D expenditures
EU	1.96	Austria	2.19
Germany	2.50	Greece	0.64
France	2.19	Portugal	0.80
United Kingdom	1.87	Poland	0.59
Italy	1.12	Czech Republic	1.35
Spain	1.11	Hungary	1.02
The Netherlands	1.89	Slovakia	0.58
Belgium-Luxembourg	2.33	Slovenia	1.53
Denmark	2.60	Rest EU	0.67
Sweden	4.30	United States	2.80
Finland	3.51	Rest OECD	3.12
Ireland	1.09	Non OECD	0.76

Source: Eurostat Cronos database. R&D expenditures are expressed as percentage of GDP. If 2003 data were not available, we have used 2002 or 2001 data.

The sectoral variation in R&D is also large. Keller (2002) shows that most of the R&D takes place within manufacturing (more than 80%), in particular in machinery and equipment and chemicals. Table 6.2 shows that 60% of all R&D expenditures in the EU takes place in medium-high technology manufacturing. This sector consists of machinery and equipment, excluding electronic equipment, and chemicals, rubber and plastics. High technology manufacturing, consisting of electronic equipment, is responsible for about 21% of all R&D expenditures. As a share of value added, this is the most R&D-intensive sector. R&D is also relatively intense in medium-high technology manufacturing. In the sector energy and medium-low technology manufacturing the R&D intensity is about the macro average, while it is substantially lower in services.

Over time it becomes more difficult to maintain the Lisbon target of 3% R&D spending. In the WorldScan baseline the overall R&D intensity in the EU falls from 2% in 2003 to 1.1% in 2040 for three reasons. Firstly, the EU economy shifts towards a services economy between now and 2040. This restructuring explains about half of the decline. Services sectors are less R&D intensive than manufacturing. The shares of high technology and medium-high technology manufacturing in the economy are more or less halved (compare Table 3.3 and Table 3.2), thereby reducing the demand for R&D substantially.

A second reason concerns the aggregation over EU member states. The new member states grow faster than the older ones. Because their R&D intensities are lower, the sectoral R&D intensity in the EU will fall over time even if the R&D intensities of the individual countries remain constant.

Table 6.2 R&D expenditures in the EU per sector, 2003

Sector	R&D intensity (% of sectoral value added)	Share of total R&D expenditures
Agriculture	0.9	1.1
Energy	1.8	1.8
Low tech manufacturing	0.7	2.7
Medium-low tech manufacturing	1.9	3.5
Medium-high tech manufacturing	12.9	60.0
High tech manufacturing	21.1	21.3
Transport services	0.2	0.5
Other commercial services	0.3	5.9
Other services	0.3	3.2
R&D	0.0	0.0
Total	2.0	166.5 (billion)

Sources: Eurostat Cronos database, and OECD ANBERD database

Thirdly, the user costs of R&D rise over time due to a moderate increase of the interest rate in the base simulation, while the investment price of R&D remains nearly constant (compare equation (2) above). As a result, the volume of R&D investment falls because of substitution from R&D towards labour in production. Therefore, the R&D expenditure share (investment price times R&D volume divided by the value of GDP) declines, while the value added share (user costs times R&D investment volume divided by the value of value added) remains more or less constant. Quantitatively, the R&D intensity in high technology manufacturing decreases from 21.1% in 2003 to 17% in 2040 in our baseline and in medium-high technology from 12.9% to 11%. This third effect is smaller for a lower elasticity of substitution between R&D on the one hand and capital and labour on the other hand.

All in all, to a large extent the fall of the R&D rate over time is due to the restructuring of the economy towards R&D extensive sectors and towards the more important role of R&D-extensive member states in the EU economy.

6.1.3 R&D spillovers

Based on the innovative ideas of Coe and Helpman (1995) we incorporate an empirical relation between total factor productivity (TFP) growth and the growth of R&D stocks in the model. We distinguish three types of R&D stocks: the R&D stocks of the own sector, of other sectors in the economy to reflect domestic spillovers, and of foreign sectors to reflect international spillovers.

We model the received spillovers from other domestic sectors analogously to Jacobs et al. (2002). The growth rate of the spillover stock (S) in sector j depends on the growth rate of the R&D stocks (V) in the other sectors weighted by the intermediate deliveries of these sectors to sector j:

$$\dot{S}_j{}^D = \sum_{i \neq j} w_{ij}^D \dot{V}_i \qquad (3)$$

Where a single dot above *V* represents the growth rate and w_{ij}^D represents the share of domestic intermediate deliveries of sector *i* in production of sector *j*. Thus *S* is a weighted aggregate of various growth rates. *S* grows less fast than the R&D stocks because the weights do not add up to 1. Sector j not only receives spillovers from other sectors in its own country, but also from sectors abroad:

$$\dot{S}_{jk}{}^F = \sum_{l \neq k} \sum_i n_{lk} \, w_{ij}^F \, \dot{V}_{il} \qquad (4)$$

The variable *n* represents the share of country l in total import of country k and $w_{ij}{}^F$ represents the share of intermediate deliveries of sector *i* from other countries in the production of sector *j*.

The empirical relation between TFP growth and the R&D stocks is based on data of 14 OECD countries and 12 sectors for the period 1980 to 1999.[29] The data are from the ANBERD database of the OECD for the R&D expenditures, and from the STAN data base of the OECD to construct total factor productivity (TFP) growth and value added. The growth of TFP is related to the growth of the own sectoral spillovers, the domestic R&D spillovers from other sectors and the foreign R&D spillovers. The estimated equation reads:

$$\dot{T}_{sr,t} = \beta_V \dot{V}_{sr,t} + \beta_D \dot{S}_{sr,t}^D + \beta_F \dot{S}_{sr,t}^F + \sum_r D_r + \sum_t D_t + \varepsilon_{sr,t} \qquad (5)$$

D_r and D_t are country and time dummies, and ε is the disturbance term. Table 6.3 presents the estimation results. We have estimated with dynamic OLS,[30] because the OLS estimates can be biased due to the non-stationarity of the time series. As is usual for these estimates we introduce two lags and one lead of the differences of the explanatory variables in the equation.

Table 6.3 R&D spillovers on TFP growth

Coefficient	Parameter estimate	Standard error	Elasticity (%)
Own sector R&D spillover	0.049**	0.022	4.9
Domestic sectoral R&D spillover	0.325***	0.107	7.4
Foreign R&D spillover	0.868***	0.233	5.6
Total elasticity			18.0

R^2 is 0.183. The number of observations is 2250. The equation is estimated with dynamic OLS using two leads and one lead. **, *** denote statistical significance at the 5% and 1% level. Country and time dummies are included but not presented. Data sources are OECD (2003), ANBERD and STAN database. Lejour and Tang (2006) provide more details. Note that we do not use the own sector R&D spillover in WorldScan because this effect is already captured by the R&D stock as production factor.

[29] The 14 countries are Australia, Canada, Germany, Denmark, Spain, Finland, France, United Kingdom, Italy, Japan, Netherlands, Norway, Sweden, and the United States.

[30] see Funk (2001), and Kao *et al.* (1999).

The elasticity for the own sectoral R&D spillovers is low compared to other studies. In his overview of the estimates of the own R&D elasticity Nadiri (1993) concludes that these are in the range of 6% to 42%. Our domestic spillover elasticity equals 7.4% (the weighted average of the share of own intermediate deliveries is 0.226 times the parameter estimate).Our result is comparable to Verspagen (1997) who reports elasticities for the domestic spillovers of 2% to 9%. This is relatively low compared to Jacobs *et al.* (2002) and Keller (1997) who find elasticities of about 15%, and Nadiri's overview reports spillover elasticities between 10% and 26%. The foreign spillover elasticity is 5.6% (the weighted average of the share of foreign intermediate deliveries is 0.065). This is comparable to the results of Coe and Helpman (1995). They find an elasticity of TFP to foreign R&D of 6-9%. Jacobs *et al*. (2002) report an elasticity of 12.9%, but that is only valid for the manufacturing sector. For the total economy it is probably much lower.

As a result our total elasticity is about 18%. So a 1 percent change in the global R&D stock leads to a 0.18 percent increase in total factor productivity. The return on R&D is much higher: every euro spent on R&D world-wide instead of on GDP leads to nearly 0.9 euro extra GDP. This is a rate of return of about 90%.[31] This is close to the upper range of the social rate of return on R&D found by other researchers. Canton *et al*. (2005) conclude that these estimates typically are in the range of 30% to 100%. Jones and Williams (1998) claim that these estimates are conservative because they do not take account of the full dynamic effects of R&D. Griffith *et al.* (2000) estimate for most OECD countries social rates of return on R&D of about 50% or higher.[32]

These estimations express the impact of a marginal increase in R&D. The 50% increase to meet the Lisbon target is not a marginal increase at all. Hence, we may doubt whether the extra R&D is as productive as current R&D. The estimated social return on R&D is in the top range of the results in the literature and the most interesting R&D projects may already have been conducted. Therefore we consider the estimated elasticities and the calculated returns on R&D as an upper bound. In the policy analysis below we start with an analysis with lower coefficients for the national and international R&D spillovers. These coefficients are about 25% of the estimates in Table 6.3. As a result, the social rate of return on R&D is 30%, the lower bound of the estimates in the literature. Subsequently we present the upper bound simulations with the estimated coefficients from Table 6.3.

[31] The return can easily be calculated from the elasticity, assuming that the effects on TFP and GDP are the same. Multiplying the elasticity by the GDP level and dividing it by the R&D stock one arrives a the return of R&D.

[32] Note that the estimates are based on a growth equation in which R&D only affects TFP. The R&D stock is no separate input in production as it in WorldScan. In WorldScan the own R&D stock already delivers a return on its investment. Therefore we assume that the spillover effect of own sectoral R&D on TFP growth is zero. The elasticity of R&D on TFP is still about 18%, because for most countries and sectors the elasticity on private R&D in the model is 4% to 5%.

6.2 Macroeconomic effects of reaching the R&D targets

This section describes the macroeconomic effects of two simulations to arrive at the 3% target of R&D expenditures as a share of GDP in 2010. These two simulations nearly cover the full range of estimated social returns to R&D of 30% to 100%. The Lisbon target includes private and public R&D spending. We assume that the targets are achieved in 2010. We do not claim that this assumption is realistic. In particular in the new member states, the 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. The simulations have thus to be interpreted as 'what if' analyses.

We take account of some of the policy costs of achieving the R&D target by using a national R&D subsidy.[33] This probably underestimates the costs for two reasons. First, we assume that the subsidy is spent effectively leading to more R&D expenditures. 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.

The simulation is designed by:

- Covering proportionally the gap between current R&D spending and an artificial target by increasing R&D expenditure between 2005 and 2010. The artificial target is set at 4.5%. For each country the gap between current spending and the limit of 4.5% is proportionally decreased, in such a way that the 3% level for the EU is reached in 2010. Countries with initially less spending on R&D have to increase their R&D effort substantially, while countries with initially high R&D spending face less ambitious targets. Their R&D spending will exceed the target of 3%. We assume that the member states want to maintain the 2010 target between 2010 and 2020.
- Introducing a country-specific subsidy to reduce the investment price for R&D. For every year until 2020 the subsidy is optimised, such that the target is met. From 2020 onwards we assume that this subsidy rate remains constant.
- Increasing R&D spending in all sectors proportionally: the subsidy is not sector-specific.
- Reducing disposable income of domestic consumers by a lump-sum transfer equal to the R&D subsidy.
- Reducing our empirical estimates of the R&D spillovers such that the social return on R&D is about 30% in the lower bound scenario. In the upper bound scenario the estimates are used

[33] We introduce a country-specific subsidy, because the R&D target differs for each country. These targets have to be agreed upon jointly by the member states in order to achieve the 3% target. The choice for the subsidy and targets is a convenient one for our purposes here. In practice direct government support of R&D often takes the form of tax incentives or grants. Grants are often aimed at specific R&D projects while tax incentives have a more general nature, see DG E&I (2004). The effectiveness of both instruments differs. We do not want to make a choice between these two instruments here. We have chosen for a subsidy for the sake of modelling and the generality of our modelling approach.

implying that the social rate of return is about 90%. In this way we cover the full range of return on R&D found in the literature.

- Assuming a lower elasticity of substitution between the R&D stock and the capital-labour nest in production equal to 0.5 in our sensitivity analysis. Empirical estimates of the elasticity of substitution are lacking. In most theoretical models, an elasticity of 1 is assumed. Most economists think that R&D and capital are complementary, which implies a low elasticity. We handle this uncertainty by simulating a variant of the lower bound scenario with a lower elasticity of substitution. The results are reported in Section 6.4.

The design of the simulations has some implications for the economic effects of reaching the target. Between 2005 and 2010 R&D spending in the EU increases by more than 50%. The R&D stocks will not increase proportionally because 3% spending only takes place in 2010 and the deprecation rate of R&D is considered to be 11%. One would need at least 9 years of 3% spending to increase the R&D stocks by about 50% and therefore we assume that the governments stick to the 3% target between 2011 and 2020. After that we assume that the subsidy rate is constant,[34] however this assumption is not sufficient to hold on to the 3% target. After 2020, even with a constant subsidy rate, R&D investment (and thus spending) will return to a level of replacement investment that belongs to the R&D stock. That level will be much higher than in the baseline because the R&D stock is higher now, but less than 3% of GDP.

6.2.1 Lower bound R&D scenario

Table 6.4 presents the macroeconomic effects of the scenario where the R&D spillovers are modest. The R&D stock in the EU is increased by about 66%, causing a GDP gain of about 3.2%,[35] which corresponds by and large to a R&D elasticity of 5%. The social rate of return is about 30% for the EU as a whole. The increase in productivity leads to lower producer and export prices. This causes a negative terms-of-trade effect. Consumption will increase about 2% less than GDP and exports will increase more than GDP.

[34] In principle it is also possible to assume that the 3% target has to be reached after 2020. However, as explained above it becomes more and more difficult to reach the target due to the restructuring towards R&D extensive sectors.

[35] The annex presents the long-term results in 2040. These effects are slightly larger than the ones presented in Table 6.4 for the year 2025.

Table 6.4 Macroeconomic effect of 3% R&D target in 2025: lower bound scenario

Country	GDP	Consumption	Exports	Real wages	R&D stock
EU	3.2	1.2	5.9	3.1	66.1
Germany	2.9	1.0	5.4	2.6	44.5
France	2.9	1.0	5.7	3.0	58.7
United Kingdom	2.7	0.8	5.9	2.5	63.2
Italy	4.0	1.3	6.8	3.9	158.6
Spain	4.2	1.6	8.0	4.1	165.8
The Netherlands	3.4	1.2	5.6	3.0	79.2
Belgium-Luxembourg	3.4	1.4	5.8	2.9	51.8
Denmark	2.2	0.8	4.0	2.2	32.1
Sweden	0.7	0.8	1.2	0.8	– 2.5
Finland	1.9	0.8	5.0	1.7	19.9
Ireland	4.3	1.2	6.3	3.4	149.7
Austria	3.3	1.3	6.2	3.2	52.8
Greece	3.8	1.7	4.1	4.7	239.1
Portugal	4.2	1.9	7.1	4.5	166.7
Poland	4.7	2.1	7.0	4.8	249.5
Czech Republic	4.7	2.3	6.9	4.9	113.2
Hungary	5.2	2.3	7.3	5.0	190.2
Slovakia	7.0	4.2	7.9	6.9	219.9
Slovenia	4.6	2.3	6.9	4.1	71.8
Rest EU	5.7	2.6	8.8	5.4	302.3
United States	– 0.1	0.1	– 0.6	0.0	– 1.0
Rest OECD	0.0	0.1	– 0.2	0.1	– 1.5
Non OECD	0.1	0.3	0.4	0.2	– 1.4

Source: WorldScan simulations. The numbers are cumulative changes compared to the baseline in 2025.

The country effects depend to a large extent on the distance between 3% and their current levels of R&D spending, see Table 6.1. For the Scandinavian countries the GDP effects are the smallest because they have already reached the 3% level (except Denmark). Productivity in Sweden increases slightly because it benefits from the spillovers of higher R&D stocks in other countries.[36] Note that this country has high import ratios, so international spillovers are relatively large. For Germany and France the effects are relatively small. Although they have to increase their R&D spending, the gap to the target is not as large as for other countries.

For other large countries, such as Italy and Spain, the effects are much larger. Their R&D stocks increase by about 160%, leading to GDP gains of about 4%. For most new member states and Greece the effects are even larger. GDP and exports gains are 5% or higher in these countries. Their R&D stocks double at least. The regions outside the EU benefit slightly from Europe's productivity increases. Due to lower import prices, these regions improve their terms-of-trade and consumption rises somewhat.

In 2020, the EU spends 152 billion US dollars on R&D subsidies to reach the target, see Table 6.5. This is an extra R&D subsidy above all existing R&D subsidies and tax breaks. The

[36] Because employment is exogenous, the GDP effects equal the productivity effects.

subsidy is about a percent of the Union's GDP.[37] In Germany, France and the UK the subsidy rate is in the same order of magnitude. For Italy and Spain it is much higher. These countries need a subsidy rate of 64% to stimulate their R&D activities. For countries like Greece, Poland, Hungary, Slovakia and Rest EU the R&D subsidy is even 2% of GDP.

Table 6.5 R&D subsidy in 2020: lower bound scenario

Country	Subsidy rate	Subsidy (billion US$)	R&D stock (%)	R&D price (%)	R&D investment volume (%)	Private R&D expenditure (billion US$)[a]
Column	(1)	(2)	(3)	(4)	(5)	(6)
EU		152.3	66			21.3
Germany	0.33	26.5	43.2	2.4	63.2	5.5
France	0.39	21.8	56.9	2.5	83.4	4.5
United Kingdom	0.40	27.0	62.4	2.2	79.8	3.5
Italy	0.64	23.1	155.4	2.8	221.1	2.1
Spain	0.64	15.4	164.3	2.4	214.8	1.1
The Netherlands	0.45	7.0	78.5	2.4	114.5	1.4
Belgium-Luxembourg	0.33	3.9	50.4	2.3	68.4	1.0
Denmark	0.24	2.1	31.4	1.7	40.5	0.5
Sweden	0.00	0.0	-2.9	0.3	– 3.2	– 0.4
Finland	0.15	1.1	19.2	1.8	27.1	0.7
Ireland	0.63	2.5	147.9	1.8	188.8	0.1
Austria	0.35	3.1	51.9	2.3	71.1	0.7
Greece	0.72	3.3	236.2	2.0	282.0	0.1
Portugal	0.66	2.8	164.9	2.1	211.6	0.1
Poland	0.75	6.7	247.4	1.9	319.6	0.2
Czech Republic	0.56	1.7	112.0	2.7	140.9	0.1
Hungary	0.69	1.7	188.7	2.2	244.8	0.1
Slovakia	0.72	0.5	217.8	2.7	218.2	0.0
Slovenia	0.45	0.5	71.4	2.4	90.0	0.0
Rest EU	0.77	1.5	302.7	2.0	372.7	0.0

[a]This is extra private R&D expenditure above the subsidy. The total extra private R&D expenditures are 175 billion US$ for the EU.
Source: WorldScan simulations.

The subsidy rate has hardly any impact on the price of R&D investment. This effect is sometimes disputed in the literature. Critics of R&D subsidies argue that it will raise the price for R&D researchers, and thereby increase the before-tax price of R&D investment. We do not distinguish R&D researchers from other high-skilled workers (compare Section 5.1.5) and wages are determined nationally and not per sector. These assumptions reduce the price increase of R&D investment, and eliminate the possible effect of crowding out of private R&D expenditures due to a price increase induced by the subsidy.[38]

[37] The subsidy in terms of GDP is more or less equal to the subsidy rate times the 3% target.
[38] See e.g. Guellec et al. (2003), Hall and van Reenen (2000), and David et al. (2000).

hence, the R&D subsidy has mainly a volume effect on R&D investment. The increase in investment is fully determined by the subsidy rate. In Poland, and the Rest EU the subsidy rate is 75% leading to an increase in investment of about 300% or even higher in 2020. In the UK the subsidy is 40%, leading to an 80% increase in R&D investment.

The volume changes of the R&D stocks are smaller. This is due to the fact that the increase in R&D investment accelerates over time. It becomes harder to meet the 3% R&D expenditures target, due to the structural move towards R&D extensive sectors. In response the national governments increase the R&D subsidy between 2010 and 2020, and investment accelerates. It takes time to build up the R&D stock and therefore the proportional increase in the stocks always lags that in investment.[39]

The last column in Table 6.5 shows that the R&D subsidy also leads to extra private R&D expenditures. The gap between the expenditure target and R&D expenditure in the baseline is not fully covered by public expenditures, that is to say the subsidy. However, the extra private expenditures are relatively small: in 2020 it amounts to about 21 billion US$ for the EU as a whole which is about 15% of the extra public expenditures. So in the short term the R&D subsidy has a positive leverage effect on private R&D expenditures.

In the long term this leverage effect vanishes, however. The increase in private R&D expenditures compared to the baseline is fully covered by public spending. The amount of subsidies thus leads to a same amount of extra private R&D spending. This corresponds more or less to the conclusion of Hall and van Reenen (2000). Although the evidence is mixed, and the methodologies to analyse the impact of R&D policy are questioned, they claim that on average one extra dollar tax credit on R&D (or subsidy) leads to one extra dollar R&D.

6.2.2 Upper bound R&D scenario

Table 6.6 presents the effects of the 3% R&D target if the return on R&D is much higher. Here we use the estimated coefficients for the R&D spillovers on total factor productivity in the model instead of the much lower coefficients in lower bound scenario. R&D spending in all EU countries is increased in such a way that the gap between current spending and maximal spending of 4.5% is reduced proportionally.

[39] After 2020, the subsidy rate is constant. Then the volume increase in investment will return to that of replacement investment, belonging to the increased R&D stock. This will take about 10 years. Subsequently the volume increases in investment and the stock are similar.

Table 6.6	Macroeconomic effects of 3% R&D target in 2025: upper bound scenario				
	GDP	Consumption	Exports	Real wages	R&D stock
EU	10.1	7.0	16.0	9.5	74.1
Germany	8.5	6.0	13.1	8.0	49.8
France	8.9	6.4	14.2	9.0	65.0
United Kingdom	7.3	4.7	12.9	6.9	69.6
Italy	12.7	8.4	18.9	12.0	177.0
Spain	14.3	9.7	22.9	13.6	187.0
The Netherlands	9.2	6.3	13.3	8.6	87.7
Belgium-Luxembourg	11.0	7.1	17.3	9.2	59.4
Denmark	6.8	4.9	10.4	6.5	36.6
Sweden	3.5	3.5	5.6	3.5	– 1.7
Finland	5.4	4.1	11.0	5.1	22.4
Ireland	15.7	9.7	20.9	12.5	167.2
Austria	9.9	6.8	16.0	9.5	59.4
Greece	14.6	10.4	16.1	15.0	274.0
Portugal	15.9	11.2	23.6	15.7	190.8
Poland	18.4	13.4	24.4	17.4	288.4
Czech Republic	17.3	12.9	22.7	16.8	129.3
Hungary	20.8	14.7	26.6	19.1	218.5
Slovakia	29.2	21.9	31.4	26.8	257.3
Slovenia	16.8	12.5	22.7	15.1	83.5
Rest EU	22.1	14.8	28.9	19.6	350.3
United States	0.0	0.3	– 0.2	0.2	– 1.7
Rest OECD	0.3	0.7	0.4	0.6	– 2.5
Non OECD	1.0	1.3	2.3	1.2	– 1.4

Source: WorldScan simulations. The numbers are cumulative changes compared to the baseline in 2025.

The increase in R&D for the EU is on average slightly larger now: 75% instead of 66% in Table 6.4. The GDP effects are much higher. The social rate of return is now about 90%. This leads to a GDP effect of about 10% in 2025 and consumption increases by 7%. The negative terms-of-trade effects limit the extra consumption possibilities induced by extra income. The variation between the member states is the same as in Table 6.4, but the variation is more pronounced. In Poland and the Rest EU R&D stocks increase by more than 300%. GDP effects for these countries are incredibly high: 20% or even more. These GDP gains will not be realised, because the expansion of the R&D stocks is far from realistic between now and 2020.

6.3 Impact on sectoral competitiveness

Increases in R&D spending and R&D stocks do not have a neutral effect on the various sectors in the economy. First of all the stimulus of R&D benefits the R&D sector. Demand for its output rises substantially; on average R&D production increases by 68% in the EU (see Table 6.7). Labour productivity in the R&D sector hardly increases, because we assume that the R&D sector itself does not use R&D as input.

Employment in R&D increases by 75%. This is about the upper range of the OECD estimates by Sheehan and Wyckoff (2003). They estimate that the number of researchers for the EU15 has to increase by 30% to 60% to reach the 3% target in 2010.[40] Given a number of about 1 million researchers in 2000 this means about 600 thousand scientists extra. In our framework it is possible to attract that amount of researchers, because all high-skilled workers are equal and do not differ in qualifications.

From Table 6.2 we know that medium-high technology and high technology manufacturing are the most R&D intensive sectors. Because we have introduced a subsidy that does not distinguish R&D activities per sector, the most R&D intensive sectors benefit most from lower input prices for R&D. Labour productivity increases most in these sectors. In the other sectors this effect is smaller. Table 6.7 shows that the volume of production in high technology manufacturing increases by about 20% in the EU. The EU countries will also export relatively more high technology goods. The Balassa index of specialisation shows an increase of 6% points. Production expansion in the medium-high tech manufacturing sector does also exceed the macro average. This sector also exports more products and its international competitiveness will increase.

The other sectors will benefit less from the boost in R&D. First of all these sectors are less R&D intensive. Secondly, the demand for labour in the R&D sectors attracts employees from the other sectors. In particular in the services industries Europe looses competitiveness. Europe exports relatively less services, because manufacturing has regained competitiveness. Employment in other commercial services increases, because its inputs are heavily demanded by the expansionary R&D sector. Therefore production in other commercial services expands more than for other services.

Table 6.7 Sectoral effects EU of 3% R&D target in 2025: lower bound scenario

Sectors	Employment	Production	Labour productivity	Specialisation
Agriculture	– 2.4	1.2	3.8	– 1.8
Energy	– 2.3	2.5	4.4	– 3.3
Low tech manufacturing	– 2.4	1.9	3.7	– 2.1
Medium-low tech manufacturing	0.2	5.0	3.9	– 2.4
Medium-high tech manufacturing	– 0.6	10.2	5.1	3.3
High tech manufacturing	4.7	19.7	5.5	6.1
Transport services	– 1.0	2.5	3.5	– 4.2
Other commercial services	– 0.1	1.9	2.3	– 7.0
Research and development	72.4	67.8	–2.1	
Other services	– 0.8	1.0	2.1	– 11.3
Total	0.0	4.9	4.0	

Source: WorldScan simulations.
The numbers on employment, production and labour productivity are relative changes compared to the baseline in 2025. The number on specialisation is an absolute change in the Balassa index in 2025.

[40] Note that for the EU15, the employment increase will be lower than 75%, because the current R&D expenditures of the EU15 are higher than those of the new member states.

6.4 Sensitivity analysis

We have modelled the R&D stock in the value added nest. Value added has a CES nesting with the R&D stock and a CES capital-labour nest, see Figure 3.1. From the literature we know that R&D and capital are complementary. We have, however, no precise estimate of the substitution between R&D and capital and labour. So far we have assumed that the substitution elasticity is 0.9. Now we conduct a sensitivity analysis with a substitution elasticity of 0.5. We also included that elasticity in our calibration procedure and the baseline in order to compare the effects of the R&D Lisbon policy with the baseline.

Table 6.8 Macroeconomic effects of lower bound scenario: less substitution between R&D and capital-labour

	GDP	Consumption	Exports	Real wages	R&D stock
EU	2.9	0.6	6.5	3.3	55.2
Germany	2.6	0.5	5.9	2.9	34.4
France	2.6	0.4	6.3	3.3	47.3
United Kingdom	2.6	0.3	7.3	2.9	53.8
Italy	3.6	0.6	7.3	4.0	134.9
Spain	3.8	1.0	8.7	4.3	144.7
The Netherlands	3.2	0.8	6.2	3.1	71.4
Belgium-Luxembourg	3.1	0.9	6.0	3.0	44.2
Denmark	2.0	0.4	4.6	2.4	29.2
Sweden	0.6	0.7	1.1	0.7	– 3.2
Finland	1.6	0.5	5.1	1.6	15.4
Ireland	3.8	0.3	7.2	3.4	120.6
Austria	3.0	0.8	6.9	3.5	45.2
Greece	3.2	1.0	3.8	5.0	211.1
Portugal	3.7	1.3	7.3	4.4	152.8
Poland	4.1	1.3	7.4	4.9	197.3
Czech Republic	4.0	1.3	7.5	5.0	85.9
Hungary	4.3	1.2	7.8	4.9	142.8
Slovakia	6.1	3.1	7.9	6.7	184.5
Slovenia	3.9	1.3	7.5	4.0	55.8
Rest EU	5.1	1.8	9.9	5.6	238.8
United States	– 0.1	0.0	– 0.6	0.0	– 1.2
Rest OECD	0.0	0.1	– 0.3	0.1	– 1.8
Non OECD	0.1	0.2	0.4	0.2	– 1.7

Source: WorldScan simulations. The numbers are cumulative changes compared tot the baseline in 2025. The outcomes have to be compared with Table 6.4.

The results are presented in Table 6.8 and can be compared with the ones in Table 6.4 If the substitution elasticity is lower, the macro effects will be about half a percentage point lower. For the EU as a whole, GDP and consumption increase 0.3% points and 0.6% less, respectively. Export increase by 0.4% points more. The reason is that the level of R&D expenditures is on average higher in the baseline now. In Section 6.1 we have explained that in time sectoral R&D

expenditures decrease in the baseline because R&D becomes more expensive than labour. Firms want to substitute R&D for labour. Due to the low elasticity of substitution firms have less substitution possibilities. Thus the R&D stock is higher in the new baseline as well as the expenditures. For all countries the subsidy and the increase in the R&D stock will be lower.

Other substitution possibilities between R&D and capital-labour do not change our analysis of the R&D target substantially: the quantitative differences are minor. We have also conducted this sensitivity analysis in case the returns on R&D are much larger, as in Table 6.6. The conclusions are the same: although we have no precise information on the substitution between R&D and capital and labour, this hardly affects the outcomes of our quantitative analysis.

6.5 Conclusions

This section has analysed the economic effects of an increase in R&D expenditures to 3% of GDP in the EU. We introduced a government subsidy as an instrument to stimulate private R&D, because R&D decisions are endogenous in our model. In spite of this instrument the analysis does not take account of all the costs of increasing R&D expenditures nor of the effectiveness of subsidies as instrument to promote R&D. We have used simulations to quantify the impact of the R&D target. These simulations are “what if simulations” describing the economic effects if the targets are reached, however they do not describe the plausibility that the targets are met. Because we do not analyse all costs of achieving the target and there is no consensus on the social returns to R&D for such large changes in R&D expenditures, we present a bandwidth of outcomes.

According to the lower and upper bound scenarios GDP could increase by 3.2% to 10.1% for the EU on average in 2025. Consumption increases slightly less, because of a negative terms-of-trade effect. The R&D stock increases by about 70%. The effects for the member states vary widely depending on their target and current level of R&D spending. The effects for most of the Scandinavian countries are minor because these countries spend already many resources on R&D. Most Mediterranean countries and the new member states do not spend much on R&D. Their efforts to meet the Lisbon targets have to be very ambitious. Their R&D stocks have to increase by 160% to 300% depending on the specific country. If these countries do meet these targets, the economic gains are subsequently large: at least a 4% GDP gain if the return on R&D is at the lower end of the estimated spectrum, and at least 13% if the return on R&D is at the higher end of the estimated spectrum.

The high and medium-high technology sectors benefit most of the extra R&D efforts. Most of the R&D is conducted in these sectors, so the productivity gains are also large. Because the products from these sectors are also very tradable, this also stimulates trade and leads to increased specialisation in these sectors.

7 The internal market for services

7.1 The services directive: reducing heterogeneity in regulation

A cornerstone of the European Union (EU) is the principle that goods, services, capital and labour can move freely between the member states. The internal market for goods seems to function well, after the implementation of the Single Market programme in 1992. That is however not the case for the internal market for services. Service providers often experience obstacles if they want to export their services to other EU member states, or when they want to start a subsidiary company in other EU member states. The EC (2002) has concluded that these impediments are to a considerable degree caused by national regulations for service exporters, foreign investors in services, and for the service product itself. Such regulations are mostly made for domestic purposes without much regard for the interests of foreign service providers.

The EC has proposed a directive to reduce the impediments for trade in commercial services.[41] A key element of this directive is the 'country of origin' principle. A service provider who complied with the national regulation of the country of origin should no longer –save for a few explicitly named derogatory issues– be hampered by regulation in the destination country. The establishment of foreign subsidiaries by service firms has to be facilitated by introducing a single point of contact in each member state, i.e. a single "desk" where the foreign service providers can fulfil all their administrative and regulatory obligations. The directive also aims to eliminate unnecessary and discriminatory regulation such as nationality and residence restrictions. The proposed EU directive takes a "horizontal" approach. The same principles apply to a wide range of different EU service sectors, ranging from retail trade to business services, from courier services to construction, from tourism services to commercial medical services. The EU directive is intended to become effective from 2010 onwards. It may have a large impact on the European service economy. The proposed measures have a large impact on the European service economy, boosting bilateral service trade between EU member states as well as intra-EU direct investment in the service sector.

Completing the internal market for goods and services is an essential part of the Lisbon strategy. Substantial productivity increases are hardly possible if the service sector, representing some 70 per cent of the European economy, remains hampered by national regulatory differences. In most service sectors, still less than 5 per cent of production is exported to other EU member states.[42] In a study commissioned by the European Commission, O'Mahony and Van Ark (2003) conclude that the widening gap between the EU and the US in economic growth per capita is to an important extent caused by the fact that the USA succeeds better than the EU in raising the productivity of services industries (see Table 2.3). It might be very

[41] See EC (2004a). The proposals were preceded by a report that took stock of the intra-European regulation barriers for trade and investment in service markets EC (2002).
[42] Cf. Kox *et al.* (2004a).

difficult to strengthen the competitiveness and efficiency of European service industries without alleviating the effects of national regulatory barriers to the cross-border provision of services.

Kox *et al*. (2004a) have dealt with the economic impact of recent EU proposals on trade and direct investment in the Internal Market for services. Their work builds upon recent empirical OECD work on the relations between national regulation intensity and trade patterns. The OECD researchers have established that regulation may affect trade and direct investment.[43] Kox *et al*. (2004a) have refined the OECD method of analysis. Instead of only looking at the *level* of regulation they have focused on the *heterogeneity* in the forms and contents of national regulations for service markets in the European Union. They concluded that it is largely the heterogeneity in regulation that hampers trade and not the level of regulation as such. Heterogeneity in regulation causes additional transaction and qualification costs when service providers do business in other EU member states. The report also finds strong empirical evidence that regulation heterogeneity has a negative impact on intra-EU trade and foreign direct investment in service markets.

The main economic implication of the proposed EU directive is that it will substantially reduce regulation heterogeneity, in particular by the ‘country of origin’ principle, by the ‘single point of contact’ and by the elimination of discriminatory elements against foreign service providers. Taking into account the empirical uncertainties of the impact of the EU directive on regulation heterogeneity and of the heterogeneity indicators on trade and investment, Kox *et al*. (2004a) estimate that commercial services trade (excluding transport services) could increase by 30 to 60 per cent in the EU, while foreign direct investment stocks in services might increase by 20 to 35 per cent.

Following up on Kox *et al*. (2004a) we estimate the welfare effects of the increase in commercial services trade using WorldScan. This is not a complete welfare analysis of the services directive for two reasons. The first is that the model does not include FDI flows, so we are not able to analyse the welfare effects of the increase in FDI stocks in the commercial services sector. The second reason is that in the current version of the WorldScan model all sectors inhibit constant returns to scale in production. However, several manufacturing and services sectors are characterised by economies to scale. Economies of scale can trigger additional welfare effects of more open services markets in the EU because more open markets increase the opportunities to exploit economies to scale and could lead to lower prices. By consequence, the outcomes of the present welfare analysis of extra trade due to the services directive have to be considered as a lower bound.

[43] In particular, Nicoletti *et al.* (2003). The OECD researchers conclude that the level of regulation hampers trade in services and foreign direct investment significantly in the OECD countries. They find that a reduction in national regulation levels to that of the least-regulated country (unrelated to the EU directive) – i.e. the United Kingdom– could increase bilateral trade in services by about 20%, while the foreign capital stock could increase by 10% to 20%. They do not discriminate the *level of* and *heterogeneity in* regulation as Kox *et al.* (2004a) do. It could be possible that their result with respect to the level of regulation also picks up some heterogeneity.

We have simulated the increase of commercial services trade in the EU associated with the lower bound of about 30% from Kox *et al*. (2004a). They have estimated the potential trade increase for every bilateral commercial services trade flow in the EU. Given our baseline we incorporate this in the model by reducing the bilateral non-tariff barriers (NTB's) in other commercial services in such a way that every trade flow increases by the amount estimated *ex ante*. Then the simulations show the welfare effects of the trade increase. Hence, in order to induce the estimated trade increases we have to calibrate the NTB's. Lejour *et al*. (2004) have developed a method to calibrate NTB's. In essence, they translate the potential trade increase into a (Samuelson iceberg) trade-cost equivalent of the barriers. If they abolish the NTB's in the model, they arrive at the (ex-ante) trade levels that correspond to the predictions from the empirical model. This procedure is explained more extensively in Lejour *et al*. (2004, 2006).

Table 7.1 presents the level of the NTB's after calibration in percentages of the import value. The bilateral NTB's are averages over the destinations. The NTB's are low for the exporting countries Belgium, the Netherlands, and France. For Austria, Denmark, and the new accession countries the NTB's are relatively high. High barriers represent relatively large regulatory heterogeneity that hampers trade. The elimination of these barriers according to the proposals in the directive should have the largest trade effects in these countries.

Table 7.1 Non-tariff barriers due to differences in regulation, 2001

Country	NTB	Country	NTB
Austria	0.153	Hungary	0.143
Belgium-Luxembourg	0.097	Ireland	0.117
Czech Rep.	0.140	Italy	0.130
Germany	0.122	The Netherlands	0.090
Denmark	0.154	Poland	0.150
Spain	0.123	Portugal	0.108
Finland	0.120	Rest EU	0.150
France	0.084	Slovakia	0.146
UK	0.113	Slovenia	0.145
Greece	0.134	Sweden	0.108

Source : WorldScan and Kox *et al.* (2004a). Numbers are expressed as percentages of import value. The bilateral NTB's are averages over the destination countries of the exporting country.

7.2 Trade effects of the services directive

Ex ante the services directive will increase other commercial services trade by about 30%. This is substantial for the sector itself; however at a macroeconomic level this increase is modest. Kox *et al*. (2004b) show that other commercial services trade makes up only about 10% of total EU trade. Moreover, about half of other commercial services trade is directed to countries outside the EU. So, only about 5% of EU trade is affected by the services directive. By consequence, the 30% increase in other commercial services trade would lead to a total trade increase in the EU of about 1.5%. The results in Table 7.2 confirm this. Overall, the trade effects are slightly larger than according to this rule of thumb calculation.

Table 7.2 Macroeconomic effects of the trade increase due to services directive in 2025

Country	GDP	Consumption	Exports	Real wages
European Union	0.2	0.4	1.7	0.5
Germany	0.2	0.5	1.7	0.5
France	0.1	0.2	1.3	0.3
United Kingdom	0.0	0.3	1.6	0.4
Italy	0.2	0.4	1.9	0.4
Spain	0.1	0.2	1.4	0.3
The Netherlands	0.2	0.7	2.3	0.9
Belgium-Luxembourg	0.2	1.2	1.8	1.4
Denmark	0.4	0.7	2.7	0.6
Sweden	0.3	0.6	2.2	0.7
Finland	0.4	0.5	1.9	0.4
Ireland	0.2	1.5	1.2	1.7
Austria	0.4	0.9	3.1	1.0
Greece	0.1	0.3	2.3	0.3
Portugal	0.1	0.3	1.5	0.3
Poland	0.2	0.3	1.3	0.3
Czech Republic	0.4	0.6	1.5	0.6
Hungary	0.6	0.9	2.4	0.7
Slovakia	0.8	1.0	2.4	1.0
Slovenia	0.3	0.6	1.7	0.6
Rest EU	0.3	0.7	1.9	0.8
United States	0.0	0.0	0.0	0.0
Rest OECD	0.0	0.0	0.0	0.0
Non OECD	0.0	0.0	0.0	0.0

Source: WorldScan simulations. The numbers are cumulative changes compared to the baseline in 2025.

The country-specific effects on exports and imports differ depending on the reduction in regulatory heterogeneity between the countries and their most important trading partners in other commercial services trade. E.g. the trade effects for France, Spain and Portugal are modest. From the data we know that these countries trade relatively much with each other and that the regulatory heterogeneity between these countries is small. The level of the NTB's is low for these countries (see Table 7.1). For countries like Austria, Denmark, Hungary and Slovakia, the regulatory heterogeneity with their most important trading partners is much larger and so is the effect of less heterogeneity.

Given the small effects on total trade and the assumption of constant returns to scale in production, it is not surprising that the GDP effects are modest, on average 0.2% in the EU (in 2025).[44] They vary between 0.4% to 0.8% for the countries with the largest trade increases and about 0.1% for countries with the lowest trade increases. The consumption effects are slightly

[44] In 2040, the effect is slightly larger. The GDP increase of the EU is about 0.4%, and the consumption increase 0.6% see the annex.

larger. The reason is that lowering the NTB's reduces consumer prices without lowering export prices. So consumption possibilities expand. This is also reflected in the terms-of-trade effect. Note that because the terms-of-trade effect also includes the NTB's in the import prices, there is an overall positive terms-of-trade effect.

As stated in Section 7.1, the macroeconomic effects do not reflect a full-scale analysis of the services directive. Simulations of other CGE models suggest that on average the overall GDP and welfare effects are twice as large with increasing returns to scale as with constant returns to scale in production.[45] Furthermore, the upper bound of the estimated trade effects by Kox *et al.* (2004b) is twice as high as the lower bound, suggesting that the welfare effects could double using the upper bound with constant returns to scale in production. Moreover the services directive will stimulate foreign direct investment, which is also not taken into account.

7.3 Impact on sectoral competitiveness

The changes in total exports are mainly due to the exports in other commercial services. These exports increase by 16%, see Table 7.3. Notice that these exports include intra-EU and extra-EU exports. Because intra-EU exports form about half of total exports in other commercial services, the 30% increase in intra-EU trade leads to a 15% increase for the total exports in these sectors. Exports in other sectors also increase slightly: their producer prices decrease slightly, because intermediate inputs of other commercial services become cheaper within the EU. Also the others sectors become slightly more competitive. Production increases across all sectors. Employment in other commercial services is reduced due to the restructuring of that sector in response to increased market entry. Because of market integration, the most competitive countries will specialise in the production of other commercial services. In these countries labour productivity rises and other commercial services produce demanded output using less inputs, including labour. Other sectors will attract more labour.

The other commercial services sector thus develops differently in the various member states. Table 7.4 shows that the sectoral effects are modest, value added and production will increase by about 0.3% and 0.2% in 2025, respectively.[46] Labour productivity increases by about the same number. The value added effect for other commercial services is not larger than the increase in GDP (see Table 7.2), because value added increases in all other sectors by about the same extent .

[45] Francois *et al.* (2005) simulate the effects for the Doha round using constant returns to scale and increasing returns. On a global level the effects are twice as large using increasing returns instead of constant returns. For individual countries the differences can be much larger or smaller.

[46] In 2040 the effects are slightly larger.

Table 7.3 Sectoral effects of the services directive in 2025

Sector	Employment	Production	Labour productivity	Exports	Specialisation
Agriculture	0.0	0.1	0.3	0.0	− 0.7
Energy	0.0	0.3	0.3	0.2	− 1.5
Low tech manufacturing	0.1	0.2	0.3	0.1	− 1.1
Medium-low tech manufacturing	0.1	0.2	0.3	0.2	− 1.6
Medium-high tech manufacturing	0.1	0.3	0.3	0.2	− 1.5
High tech manufacturing	0.2	0.4	0.4	0.3	− 0.8
Transport services	0.0	0.2	0.3	0.1	− 1.7
Other commercial services	− 0.1	0.2	0.4	15.7	8.4
Research and development	0.2	0.3	0.3		
Other services	0.1	0.2	0.2	− 0.6	− 3.2
Total	0.0	0.2	0.4	1.7	

Source: WorldScan simulations. The numbers are cumulative changes compared to the baseline in 2025.

Table 7.4 Volume changes in other commercial services sector in 2025

Country	Production	Value added	Exports	Specialisation
Europe	0.2	0.3	15.5	8.4
Germany	0.3	0.4	18.7	10.0
France	− 0.1	0.0	8.9	1.4
United Kingdom	0.4	0.6	14.1	10.1
Italy	0.2	0.3	16.9	9.6
Spain	− 0.1	0.0	16.3	6.1
The Netherlands	0.6	1.0	15.2	11.9
Belgium-Luxembourg	1.2	1.7	15.8	12.0
Denmark	− 0.4	− 0.1	22.6	11.5
Sweden	0.1	0.3	13.7	6.7
Finland	− 0.7	− 0.5	19.8	4.6
Ireland	1.1	1.7	11.6	6.4
Austria	0.4	0.7	20.7	16.1
Greece	− 0.2	− 0.1	15.3	6.9
Portugal	0.3	0.5	17.1	9.6
Poland	− 0.3	− 0.2	19.0	4.0
Czech Republic	− 0.4	− 0.1	28.1	5.2
Hungary	− 0.8	− 0.6	17.5	3.1
Slovakia	− 0.6	− 0.3	25.4	6.5
Slovenia	− 0.9	− 0.7	24.8	3.9
Rest EU	− 0.4	− 0.2	25.2	8.7
United States	0.0	0.0	− 0.6	− 6.7
Rest OECD	0.0	0.0	− 0.5	− 5.8
Non OECD	0.0	0.0	− 0.7	− 4.1

Source: WorldScan simulations. All numbers are relative volume changes in 2025 compared to the baseline.

The country specific results differ, depending on the competitiveness of the commercial services sector across Europe. In particular the Netherlands, Belgium, and the UK are relatively specialised in that sector (see Kox *et al*. (2004b)). Their imports do not increase much. For other countries, such as the new member states, Denmark and Finland, exports increase substantially, but that is also the case for their imports. Although other commercial services will contribute to a larger extent to their exports, these countries do not specialise much in this sector. They become more specialised in this sector compared to the rest of the world, but not compared to the EU average. In these countries value added in commercial services decreases somewhat, because specialisation patterns shift to the more specialised countries.

Although the services directive does not expand the other commercial services sector in these countries, the implementation of that directive is still beneficial. These countries shift some to their resources to other sectors in which they are more productive. Moreover, other commercial services become relatively cheaper.

8 Less red tape in Europe

8.1 Administrative costs

Firms often complain about the time and costs involved to deal with administrative activities. One of the problems is that the mandatory information that private companies have to supply to public authorities is always institutionalised, and hence, subject to hysteresis. A regular re-evaluation process of mandatory information flows can therefore be useful, since this administrative burden affects the overall cost efficiency and the international competitiveness of domestic firms.

In recent years policymakers have become more focussed on this issue. For example, the Netherlands wants to reduce the administrative burden for businesses between 2004 and 2007 with 25%. With the aid of the so called Standard Cost Model (IPAL, 2003) the costs of providing information by the business sector to the government were estimated to amount to 16.4 billion euro in 2002 (IPAL, 2004). This is about 3.7 % of Dutch GDP, which is quite considerable.

Although these numbers only apply to the Netherlands, it seems reasonable to assume that the costs of administrative barriers are substantial throughout Europe. Indeed, a significant part, approximately 40%, of the administrative burden is the result of international (mainly European) legislation. Hence, reducing the administrative burden not only is an issue for the governments of the member states but for the European Union as well.

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. Therefore, we use the key figures for the Netherlands as a benchmark for the other member states of the European Union. For 2002, the administrative burden in the Netherlands is equivalent to 3.7% of GDP and is projected to fall with 25%, e.g. with 0.9% of GDP. According to the base year data for the Dutch labour income share, this amounts to a labour-efficiency increase of 1.6% in the Netherlands (compare Tang and Verweij, 2004). This effect on labour efficiency has been allocated to other EU countries in two ways whose outcomes are presented in the subsequent sections:

- Country differentiation: Scant information on differences in the costs of starting a new firm among countries is used for the distribution of labour efficiency over countries.
- Sectoral differentiation: Information on the impact of administrative costs on sectors is added to the country specific distribution of labour efficiency.

8.2 Macro economic effects of less administrative costs

8.2.1 Country differentiation

Internationally comparative studies on the costs of the administrative burden on companies are very scarce. One of the problems is that information requirements by governments can be quite heterogeneous over countries. The most straightforward way to arrive at a meaningful international comparison is to study the administrative burden that arises when a firm performs a standardised activity that requires mandatory information provision to the government. For this purpose Kox (2005) has used a well-documented internationally comparative study by a team of World Bank researchers, dealing with the costs associated with the start-up of a new firm. Djankov *et al.* (2002) assessed the administrative costs of firm start-ups in 85 countries, including most EU countries. They track all officially required administrative procedures and costs that are normally required for setting up an identical standard firm: taxes, screening of the entrepreneur, safety and health, environmental and labour-related requirements. For their research they used official information and information by country experts.

Kox (2005) combined the Dutch data on the total administrative burden with the Djankov data on inter-country differences in firm-start-up costs. The inter-country differences in firm start-up costs are rather large according to the Djankov data. This does not only hold for differences between 'old' and 'new' EU member states, but also for more or less comparable countries such as for instance the UK and the Netherlands. Even though the differences may hold for this specific type of activity (firm start-up), country disparities are probably less extreme when averaged across all activities. That is why the inter-country distribution in the Djankov data has been truncated, preserving most of the inter-country information (see Kox, 2005 for more details).

Table 8.1 Presents the distribution of the administrative burden over countries according to the method of Kox (2005). The total administrative burden ranges between 1.5% of GDP in the UK, Sweden and Finland to 6.8% of GDP in Hungary and Greece. In the WorldScan simulation presented in Table 8.2 one additional adjustment has been made on the inputs from Table 8.1. Dutch data show that 42% of the administrative burden stems from European legislation. It may be expected that this part of the burden (as percentage of GDP) falls rather uniformly on all EU countries. Hence, in the simulation we applied the distribution from Table 8.1 for 58% of the labour efficiency shock and added for 42% a uniform shock due to EU legislation.

Table 8.1 Estimated administrative burden for EU countries, percentage of GDP (market prices), 2003[a]

	As % of GDP	In billion US dollars
Austria	4.6	11.2
Belgium	2.8	8.1
Czech	3.3	2.7
Denmark	1.9	3.8
Finland	1.5	2.3
France	3.7	61.6
Germany	3.7	85.5
Greece	6.8	10.6
Hungary	6.8	4.4
Ireland	2.4	3.2
Italy	4.6	61.9
The Netherlands	3.7	16.7
Poland	5.0	10.0
Portugal	4.6	6.0
Slovak	4.6	1.3
Slovenia	4.1	.
Spain	4.6	3.4
Sweden	1.5	4.2
UK	1.5	24.3

[a]Using the compressed 1999 distribution of market-entry costs by country (Djankov / OECD data).
Source: Kox (2005).

8.2.2 Macroeconomic results

All countries experience a reduction in the administrative costs as a percentage of GDP by a quarter. Using country specific labour income shares we translate these into an increase in labour efficiency. On average, labour efficiency rises by 1.5% in Europe in 2025 (see Table 8.2).[47] Initially this will raise the volume of GDP in Europe by about 1.5 * 0.638 = 0.9%, where 0.638 is the mean labour-income share for the EU-25. In the long run the capital stock adjusts to the higher level of labour productivity. By consequence, the long term change in GDP volume will equal the initial shock of 1.5%. In the long run, the additional demand for capital is supplied without a substantial rise in the price of capital, because extra savings bring the capital market back to equilibrium.

For two reasons the outcomes of the simulation in Table 8.2 diverge slightly from the initial productivity impulse of about 1.5. Firstly, R&D spillovers magnify the outcomes of the administrative burden reduction (see the column Total factor productivity in Table 8.2; Section

[47] In the annex, we present the long-term results in 2040. Compared to 2025, the long-term term effects of relative changes in production and consumption differ slightly, see Table Annex 6.

6.1.3 contains more background on R&D spillovers). The rise in GDP induces more spending on R&D by industry. More R&D improves production processes and products. This stimulates productivity, not only in the innovating sector itself, but also in the sectors using the improved products as intermediates in their own production process (R&D spillovers). The productivity increase generates an additional increase in GDP of about 0.2 %. Secondly, domestic and foreign products are imperfect substitutes. Extra production has to be exported and traded against imports. To conquer foreign markets export prices have to fall compared to import prices, resulting in a loss of 0.1% in the terms-of-trade. This loss is quite modest. The R&D spillover effect and the terms-of-trade effect partly offset each other. On balance, welfare measured by consumption per capita hardly differs from the initial productivity impulse.

Table 8.2 Macroeconomic effects of a 25% country specific reduction in the administrative burden in the EU-25

	Labour productivity shock	Gross domestic product	Total factor productivity	Terms-of-trade	Consumption per capita
Europe	1.5	1.5	0.2	− 0.1	1.4
Germany	1.6	1.6	0.2	− 0.1	1.5
France	1.6	1.7	0.2	− 0.2	1.5
United Kingdom	0.9	0.9	0.1	0.0	0.9
Italy	1.7	1.8	0.2	− 0.2	1.6
Spain	1.7	1.7	0.2	− 0.2	1.5
The Netherlands	1.5	1.5	0.1	− 0.1	1.4
Belgium-Luxembourg	1.4	1.4	0.2	− 0.1	1.3
Denmark	1.1	1.1	0.2	0.0	1.1
Sweden	1.0	1.1	0.1	0.0	1.1
Finland	1.1	1.2	0.1	0.0	1.2
Ireland	1.2	1.3	0.2	− 0.1	1.2
Austria	1.9	1.9	0.2	− 0.2	1.6
Greece	2.0	2.1	0.2	− 0.3	1.7
Portugal	1.8	1.8	0.3	− 0.1	1.6
Poland	1.9	2.0	0.3	− 0.2	1.8
Czech Republic	1.6	1.6	0.4	− 0.1	1.5
Hungary	2.3	2.4	0.3	− 0.2	2.2
Slovakia	2.1	2.3	0.5	− 0.1	2.0
Slovenia	1.7	1.7	0.4	− 0.1	1.6
Rest EU	2.2	2.4	0.4	− 0.2	2.0
United States	0.0	0.0	0.0	0.1	0.0
Rest OECD	0.0	0.0	0.0	0.1	0.0
Non OECD	0.0	0.0	0.0	0.1	0.0

Source: WorldScan simulations, Cumulated difference in % compared to the baseline in 2025.

8.3 Impact on sectoral competitiveness

The distribution of the administrative burden is not uniform over sectors (see Jansen and Tom, 2003 and the survey by Kox, 2005). A relatively large burden falls on agriculture and private services. Therefore in this simulation we applied the 25% reduction to the sector specific distribution of the administrative burden. This has been done in such a way that for each country the weighted average of the sector specific labour productivity shocks equals the macro country specific shock from Section 8.2. By consequence, the macro outcomes of this simulation in Table 8.3 hardly differ from those in Table 8.2.

Table 8.3 Effects of a 25% country and sector specific reduction in the administrative burden in the EU-25

	Labour productivity shock	Gross domestic product	Total factor productivity	Terms-of-trade	Consumption per capita
Europe	1.4	1.4	0.0	− 0.1	1.2
Germany	1.5	1.4	0.0	0.0	1.4
France	1.7	1.6	0.1	− 0.1	1.4
United Kingdom	0.9	0.9	0.0	− 0.1	0.8
Italy	1.7	1.6	0.1	− 0.1	1.4
Spain	1.7	1.6	0.0	− 0.2	1.3
The Netherlands	1.5	1.4	0.0	− 0.1	1.2
Belgium-Luxembourg	1.3	1.2	0.0	− 0.1	1.1
Denmark	1.1	1.0	0.0	− 0.1	0.8
Sweden	1.1	0.9	0.0	0.0	0.9
Finland	1.2	1.0	0.0	0.0	1.0
Ireland	1.1	1.1	0.0	− 0.1	1.0
Austria	1.7	1.6	0.1	− 0.1	1.4
Greece	1.8	1.7	0.0	− 0.3	1.4
Portugal	1.8	1.7	0.1	− 0.1	1.3
Poland	1.8	1.6	0.0	− 0.2	1.4
Czech Republic	1.4	1.3	0.1	− 0.1	1.1
Hungary	2.0	2.0	0.0	− 0.1	1.7
Slovakia	1.9	1.8	0.1	− 0.1	1.5
Slovenia	1.4	1.3	0.1	− 0.1	1.2
Rest EU	2.0	2.0	0.0	− 0.3	1.6
United States	0.0	0.0	0.0	0.0	0.0
Rest OECD	0.0	0.0	0.0	0.1	0.0
Non OECD	0.0	0.0	0.0	0.1	0.0

Source: WorldScan simulations, cumulated difference in % compared to the baseline in 2025.

Table 8.4 contains the ex-ante increase in labour productivity per sector. It shows that due to the reduction in administrative burden relatively more labour can be used for productive activities in the sectors Agriculture, Transport and Commercial Services. We would expect that for these sectors the production volume rises compared to the other sectors. However, in order to sell this extra production these sectors experience some terms of trade losses with respect to non-EU suppliers and with respect to other sectors. For firms in manufacturing sectors and agriculture it is easier to sell the extra production abroad due to the tradability of these products compared to in commercial services in particular.

Table 8.4 Effects on sectoral labour efficiency of a 25% country and sector specific reduction in the administrative burden in the EU-25

	Agriculture	Energy	Manufacturing	Transport services	Other commercial services	Other services
Germany	6.5	0.2	1.5	2.2	2.5	0.4
France	6.7	5.0	1.7	2.6	2.2	0.9
United Kingdom	7.2	0.1	0.9	1.6	1.2	0.4
Italy	6.4	0.2	1.9	2.9	2.9	0.4
Spain	7.3	0.4	1.6	2.9	2.4	0.6
The Netherlands	7.3	0.6	1.9	2.7	2.1	0.7
Belgium-Luxembourg	6.4	0.2	1.3	2.9	2.0	0.5
Denmark	10.9	0.2	1.1	2.1	1.3	0.4
Sweden	7.5	0.3	1.1	1.6	1.5	0.3
Finland	7.6	0.2	1.3	2.1	1.3	0.4
Ireland	5.3	0.1	1.6	1.9	1.5	0.5
Austria	7.4	0.2	1.6	2.6	2.3	1.1
Greece	8.3	0.2	1.4	2.4	2.1	0.5
Portugal	9.3	0.2	1.7	2.9	2.3	0.6
Poland	8.7	0.2	1.7	2.4	2.8	0.5
Czech Republic	6.6	0.3	1.6	2.6	1.9	0.4
Hungary	9.8	0.3	2.4	3.8	3.2	0.7
Slovakia	8.7	0.4	2.2	4.0	3.2	0.6
Slovenia	8.1	0.2	1.4	2.5	2.1	0.5
Rest EU	9.6	0.2	2.3	4.0	3.2	0.8

Source: WorldScan simulations.

Table 8.5 shows the sectoral effects of the 25% reduction in administrative burden for the EU as a whole. Production increases most in agriculture, because agricultural firms experience the greatest relief of the administrative burden. Exports in agriculture also increase by about 4%. In the manufacturing sectors the changes in production and labour productivity are about equal to those in transport and other commercial services. Due to the production increases in manufacturing, demand for research and development expands.

Table 8.5 Sectoral effects of 25% country and sector specific reduction in the administrative burden in the EU-25 in 2025

	Employment	Production	Labour productivity	Exports	Specialisation
Agriculture	− 0.2	3.9	3.1	4.8	1.6
Energy	0.2	0.9	1.2	0.2	− 0.8
Low tech manufacturing	0.1	1.4	1.5	1.3	0.1
Medium-low tech manufacturing	0.0	1.4	1.4	1.2	− 0.1
Medium-high tech manufacturing	0.0	1.3	1.3	1.1	− 0.2
High tech manufacturing	0.1	1.3	1.3	1.1	0.0
Transport services	− 0.3	1.6	1.7	1.5	− 0.1
Other commercial services	− 0.2	1.5	1.7	1.3	− 0.2
Research and development	0.6	0.6	0.6		
Other services	0.2	0.8	0.8	− 1.0	− 2.6
Total	0.0	1.4	1.4	1.3	

Source: WorldScan simulations, Cumulated difference in % compared to the baseline in 2025.

Annex 1 Background tables on baseline characteristics

Baseline characteristics between 2001 and 2040

Country	Population[a]	GDP[a]	Consumption[a]	Exports[a]	Employment[a]	Savings[b]	Participation[b]
EU	0.1	2.0	1.9	3.5	− 0.3	23.2	43.4
Germany	0.2	1.6	1.6	2.9	− 0.3	23.2	45.1
France	0.4	1.9	1.8	3.4	0.0	24.0	41.7
United Kingdom	0.4	2.1	2.0	3.6	0.1	19.4	46.0
Italy	− 0.1	1.3	1.2	2.9	− 0.7	22.7	37.4
Spain	0.1	2.3	2.2	4.3	− 0.5	26.3	42.1
The Netherlands	0.5	1.7	1.8	2.5	0.1	26.4	47.1
Belgium-Luxembourg	0.3	1.8	1.9	2.7	− 0.2	24.5	38.5
Denmark	0.4	2.3	2.2	3.5	0.0	25.0	49.4
Sweden	0.4	2.3	2.2	3.3	0.1	23.4	48.5
Finland	0.2	2.2	2.2	3.4	− 0.2	24.8	45.5
Ireland	0.8	2.9	2.5	3.8	0.6	28.9	44.2
Austria	0.2	2.2	2.2	3.2	− 0.2	26.1	45.3
Greece	0.2	2.3	2.4	3.7	− 0.1	24.2	40.6
Portugal	0.4	2.2	2.3	3.5	0.0	29.7	47.6
Poland	− 0.3	3.7	3.3	6.6	− 0.7	18.9	43.6
Czech Republic	− 0.3	3.6	3.6	5.7	− 0.9	24.9	47.0
Hungary	− 0.5	3.4	3.2	5.6	− 0.9	24.1	40.4
Slovakia	− 0.1	3.9	3.7	5.5	− 0.5	28.4	47.5
Slovenia	− 0.4	3.5	3.5	6.4	− 1.2	20.3	43.0
Rest EU	− 0.7	3.5	3.2	6.0	− 1.0	17.0	47.8
United States	0.7	2.4	2.2	4.6	0.5	22.1	48.6
Rest OECD	0.4	2.0	2.1	3.8	0.3	24.6	47.3
Non OECD	0.9	4.5	4.3	5.5	1.1	27.1	49.5

Source: WorldScan simulations.

[a] The numbers are average annual growth rates between 2001 and 2040.

[b] The numbers are average ratios between 2001 and 2040. Savings is defined as share of national income, and participation as labour supply as share of total population.

Annex 2 Long-term effects of employment target

Macroeconomic effects of employment target in 2040, lower bound scenario

Country	GDP	Consumption	Exports	Employment	Real wages
EU	6.8	6.1	7.2	10.1	− 3.7
Germany	5.1	5.0	5.5	6.8	− 1.9
France	8.3	7.5	7.9	11.6	− 3.5
United Kingdom	2.5	2.4	3.0	3.2	− 0.8
Italy	11.9	10.6	10.8	17.9	− 6.3
Spain	9.3	8.0	8.9	12.7	− 4.0
The Netherlands	0.9	1.1	1.7	0.9	0.2
Belgium-Luxembourg	11.9	10.1	11.7	16.6	− 5.6
Denmark	0.6	0.7	1.5	0.5	0.2
Sweden	2.3	2.4	3.1	2.7	− 0.5
Finland	5.4	5.4	4.7	7.4	− 2.0
Ireland	5.1	4.6	4.9	6.9	− 2.2
Austria	2.7	2.6	3.9	3.1	− 0.4
Greece	11.7	9.6	10.3	15.5	− 4.5
Portugal	2.7	2.6	4.3	3.0	− 0.3
Poland	21.6	18.8	21.0	29.5	− 8.4
Czech Republic	8.0	7.2	8.9	10.4	− 2.9
Hungary	13.2	11.9	11.7	20.3	− 7.1
Slovakia	14.2	12.5	13.2	18.8	− 5.6
Slovenia	12.4	11.1	11.7	16.1	− 4.3
Rest EU	7.3	6.1	7.6	9.1	− 2.7
United States	− 0.1	0.0	0.0	0.0	0.0
Rest OECD	− 0.1	0.1	0.1	0.0	0.0
Non OECD	0.0	0.1	0.9	0.0	0.1

Source: WorldScan simulations. The numbers are cumulative differences with the baseline in 2040. The effects have to be compared with Table 4.4.

Sectoral EU-wide effects of employment target in 2040, lower bound scenario

Sector	Employment	Production	Labour productivity	Exports	Specialisation
Agriculture	17.6	9.3	− 7.8	8.3	1.2
Energy	9.2	4.2	− 4.0	2.1	− 4.7
Low tech manufacturing	14.7	9.8	− 5.5	8.6	1.1
Medium-low tech manufacturing	14.1	9.9	− 5.2	9.3	1.3
Medium-high tech manufacturing	12.2	8.7	− 4.6	7.6	0.4
High tech manufacturing	15.9	11.1	− 5.8	9.2	1.5
Transport services	12.1	7.7	− 4.7	5.0	− 2.1
Other commercial services	9.9	6.4	− 3.0	3.7	− 3.7
Research and development	5.0	3.8	0.7		
Other services	8.3	5.3	− 2.7	1.5	− 7.5
Total	10.1	7.5	− 2.8	7.2	

Source: WorldScan simulations. The numbers have to be compared with Table 4.6.

Annex 3 Long-term effects of skills upgrading

Effects of a skill upgrading in the EU-25 in 2040

Country	Labour productivity shock	Real average wage	Gross domestic product	Terms-of-trade	Consumption per capita
Europe	1.7	1.6	1.7	− 0.1	1.6
Germany	2.0	1.8	2.0	− 0.2	1.8
France	1.8	1.6	1.7	− 0.2	1.5
United Kingdom	1.2	1.1	1.2	− 0.1	1.1
Italy	1.8	1.7	1.9	− 0.2	1.9
Spain	2.2	2.0	2.2	− 0.2	2.0
The Netherlands	0.9	0.9	0.9	0.0	0.9
Belgium-Luxembourg	1.9	1.8	2.0	− 0.2	1.8
Denmark	1.5	1.4	1.5	− 0.1	1.4
Sweden	1.1	1.0	1.1	0.0	1.1
Finland	0.5	0.5	0.5	0.0	0.5
Ireland	1.5	1.4	1.6	− 0.1	1.4
Austria	1.4	1.2	1.3	− 0.1	1.2
Greece	2.9	2.6	2.9	− 0.4	2.4
Portugal	4.8	4.4	4.9	− 0.5	4.2
Poland	2.0	1.9	2.1	− 0.2	1.9
Czech Republic	1.6	1.5	1.7	− 0.1	1.5
Hungary	1.8	1.8	2.0	− 0.1	1.7
Slovakia	1.6	1.5	1.6	0.0	1.5
Slovenia	1.8	1.7	1.9	− 0.1	1.7
Rest EU	1.5	1.4	1.6	− 0.1	1.4
United States	0.0	0.0	0.0	0.1	0.0
Rest OECD	0.0	0.0	0.0	0.1	0.0
Non OECD	0.0	0.0	0.0	0.1	0.0

Source: WorldScan simulations, Cumulated difference in % compared to the baseline in 2025. The effects have to be compared with Table 5.1.

Sectoral EU-wide effects of skill upgrading in 2040

Sector	Employment	Production	Labour productivity	Exports	Specialisation
Agriculture	− 0.1	1.6	1.6	1.3	0.0
Energy	− 0.3	1.0	1.4	0.3	− 1.3
Low tech manufacturing	0.2	2.1	1.7	1.9	0.2
Medium-low tech manufacturing	0.4	2.3	1.7	2.1	0.2
Medium-high tech manufacturing	0.3	2.2	1.6	2.1	0.2
High tech manufacturing	0.9	2.6	1.5	2.3	0.4
Transport services	0.0	1.8	1.7	1.4	− 0.5
Other commercial services	0.1	1.7	1.6	1.2	− 0.7
Research and development	0.3	2.3	1.7		
Other services	− 0.2	1.7	1.8	2.3	0.0
Total	0.0	1.9	1.7	1.7	

Source: WorldScan simulations. The numbers have to be compared with Table 5.2

Annex 4 Long-term effects of R&D target

Macroeconomic effect of 3% R&D target in 2040: the case of low social return on R&D

Country	GDP	Consumption	Exports	Real wages	R&D stock
EU	3.6	1.6	5.8	3.0	67.6
Germany	3.3	1.5	5.4	2.7	45.3
France	3.5	1.5	5.3	3.0	59.7
United Kingdom	3.1	1.1	5.9	2.5	62.8
Italy	4.5	1.9	6.7	3.7	159.6
Spain	4.6	2.0	7.2	3.9	162.8
The Netherlands	3.7	1.5	5.2	2.7	78.1
Belgium-Luxembourg	3.9	1.7	6.2	2.8	52.6
Denmark	2.4	1.0	4.3	2.1	32.3
Sweden	0.7	0.9	1.3	0.9	− 1.6
Finland	2.1	1.0	5.0	1.7	20.1
Ireland	4.8	1.6	6.5	3.4	149.7
Austria	3.8	1.7	6.1	3.1	52.3
Greece	3.8	1.5	5.3	4.7	238.8
Portugal	4.4	2.2	6.4	4.0	165.8
Poland	5.4	2.8	6.4	4.4	248.0
Czech Republic	5.0	2.7	6.5	4.4	111.6
Hungary	5.5	2.9	6.0	4.5	189.5
Slovakia	7.4	4.8	8.0	6.7	220.8
Slovenia	4.8	2.7	5.6	3.5	69.4
Rest EU	6.3	3.3	7.9	4.9	291.4
United States	0.0	0.1	− 0.3	0.1	− 0.7
Rest OECD	0.0	0.2	− 0.1	0.2	− 1.0
Non OECD	0.1	0.3	0.5	0.3	− 0.8

Source: WorldScan simulations. The numbers are cumulative changes compared to the baseline in 2040. The numbers have to be compared with Table 6.4.

Sectoral effects EU of Lisbon targets given EU targets of 3%

Sector	Employment	Production	Labour productivity	Specialisation
Agriculture	− 2.2	1.7	3.7	− 1.7
Energy	− 2.4	2.4	4.3	− 3.3
Low tech manufacturing	− 2.2	2.3	3.8	− 1.7
Medium-low tech manufacturing	0.1	5.0	3.9	− 2.0
Medium-high tech manufacturing	− 0.8	9.9	4.9	3.2
High tech manufacturing	4.3	18.9	5.2	5.6
Transport services	− 0.9	2.7	3.5	− 3.9
Other commercial services	0.0	2.0	2.3	− 6.5
Research and development	70.2	67.9	− 1.0	
Other services	− 0.7	1.1	2.1	− 10.9
Total	0.0	4.9	4.1	

Source: WorldScan simulations. The numbers on employment and labour productivity are relative changes compared to the baseline in 2040. The number on specialisation is an absolute change in the Balassa index in 2040. The number have to be compared with Table 6.7.

Annex 5 Long-term effects of the services directive

Macroeconomic effects of the services directive in 2040

Country	GDP	Consumption	Exports	Real wages
European Union	0.3	0.6	1.5	0.6
Germany	0.4	0.6	1.4	0.7
France	0.3	0.3	1.1	0.4
United Kingdom	0.1	0.4	1.0	0.5
Italy	0.3	0.5	1.6	0.5
Spain	0.2	0.3	1.2	0.3
The Netherlands	0.4	0.8	1.9	1.1
Belgium-Luxembourg	0.3	1.3	1.6	1.5
Denmark	0.7	0.9	2.7	0.8
Sweden	0.5	0.8	2.1	0.8
Finland	0.6	0.7	2.1	0.5
Ireland	0.2	1.7	1.0	1.8
Austria	0.6	1.2	2.8	1.3
Greece	0.3	0.4	2.0	0.4
Portugal	0.2	0.3	1.0	0.4
Poland	0.5	0.5	1.6	0.5
Czech Republic	0.9	0.9	2.0	0.8
Hungary	1.3	1.2	3.2	1.0
Slovakia	1.4	1.4	2.9	1.3
Slovenia	1.1	0.8	2.8	0.8
Rest EU	0.9	1.1	2.5	1.0
United States	0.0	0.0	0.0	0.0
Rest OECD	0.0	0.0	0.0	0.0
Non OECD	0.0	0.0	0.1	0.0

Source: WorldScan simulations. The numbers are cumulative changes compared to the baseline in 2040.

Sectoral effects of the services directive in 2040

Sector	Employment	Production	Labour productivity	Exports	Specialisation
Agriculture	− 0.1	0.3	0.5	0.2	− 0.9
Energy	− 0.2	0.3	0.6	0.2	− 2.2
Low tech manufacturing	0.1	0.4	0.5	0.4	− 0.9
Medium-low tech manufacturing	0.1	0.5	0.6	0.5	− 1.5
Medium-high tech manufacturing	0.0	0.6	0.6	0.5	− 1.4
High tech manufacturing	0.1	0.8	0.7	0.9	− 0.5
Transport services	0.0	0.3	0.5	0.2	− 1.8
Other commercial services	− 0.1	0.3	0.6	14.9	8.4
Research and development	0.0	0.3	0.6		
Other services	0.1	0.3	0.3	− 1.2	− 3.8
Total	0.0	0.4	0.5	1.5	

Source: WorldScan simulations. The numbers are cumulative changes compared to the baseline in 2040.

Annex 6: Long-term effects of less red tape

Effects of a 25% uniform reduction in the administrative burden in the EU-25 in 2040

Country	Labour productivity shock	Gross domestic product	Total factor productivity	Terms-of-trade	Consumption per capita
Europe	1.6	1.6	0.2	− 0.1	1.5
Germany	1.7	1.7	0.2	− 0.2	1.6
France	1.7	1.8	0.2	− 0.2	1.6
United Kingdom	1.0	1.0	0.1	− 0.1	0.9
Italy	1.8	1.9	0.2	− 0.2	1.8
Spain	1.7	1.8	0.2	− 0.2	1.7
The Netherlands	1.5	1.6	0.1	− 0.1	1.5
Belgium-Luxembourg	1.4	1.4	0.3	− 0.1	1.3
Denmark	1.2	1.2	0.2	− 0.1	1.1
Sweden	1.1	1.1	0.1	− 0.1	1.1
Finland	1.2	1.2	0.1	0.0	1.2
Ireland	1.3	1.3	0.2	− 0.1	1.3
Austria	2.0	2.0	0.2	− 0.2	1.8
Greece	2.1	2.2	0.3	− 0.3	1.8
Portugal	1.8	1.9	0.3	− 0.1	1.6
Poland	2.0	2.2	0.3	− 0.2	2.0
Czech Republic	1.7	1.8	0.4	− 0.1	1.6
Hungary	2.4	2.6	0.2	− 0.1	2.4
Slovakia	2.3	2.5	0.5	− 0.1	2.3
Slovenia	1.7	1.8	0.5	− 0.1	1.7
Rest EU	2.3	2.6	0.4	− 0.2	2.2
United States	0.0	0.0	0.0	0.1	0.0
Rest OECD	0.0	0.0	0.0	0.1	0.0
Non OECD	0.0	0.0	0.0	0.1	0.0

Source: WorldScan simulations, Cumulated difference in % compared to the baseline in 2040.

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