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Quantitative Assessment of Structural Reforms: Modelling the Lisbon Strategy

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QUANTITATIVE ASSESSMENT OF STRUCTURAL REFORMS: MODELLING THE LISBON STRATEGY

Alfonso Arpaia, Isabel Grilo, Werner Roeger, Janos Varga, Jan in 't Veld and Peter Wobst

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Executive summary

Using a variety of economic models, the Commission services have examined the impact of several reforms forming part of the Growth and Jobs Strategy (GJS). Overall, the results show that past reforms have delivered significant benefits, and that further reforms in key areas could generate important additional gains. The modelling results provide support for the existence of positive interactions between structural reforms in different areas, and thus for having a comprehensive reform strategy. They also highlight spillovers between reforms at EU and national level, the magnitude of which is being enhanced through the growing intensity of trade and investment.

Labour and product markets are at the core of the reform agenda. It is estimated that reforms in areas such as unemployment benefits, taxes and the ease of entry for new firms have reduced the structural unemployment rate by almost 1.4 p.p. and boosted GDP in the EU15 by 2% since 1995. This positive outcome partly stems from the interaction of product market reforms on job creation (i.e. by facilitating wage moderation and the entry of new firms to markets). These results would have been even higher if the simulation took account of the positive impact of the reforms on the participation rate.

Between 2000 and 2005, the employment rate of older workers (aged 55 to 64) in EU 15 increased by 6 p.p. to 44% and the effective retirement age rose by more than one year: this represents considerable progress towards the goal of a 50% employment rate for older workers by 2010. Analysis carried out at EU level on the economic and budgetary impact of ageing populations confirms that a considerable share of this increase is due to past reforms of pension and early retirement systems. It also projects that by 2025, the employment rate of older workers will rise to close to 60% and effective retirement ages will go up by one more year: approximately, one third of these gains will result from the lagged phasing-in of enacted pension reforms. An alternative set of simulations examines the economic gains from a one year increase in the effective retirement age: as a result of increased labour supply and a lower tax burden, this would bring about a rise of almost 1.5% in GDP by 2025 and 2.5% by 2050 in the EU15.

A central aim of the revised strategy for Growth and Jobs Strategy is to better align reform efforts at EU and national level, not least by giving full effect to the internal market programme. A recent analysis, carried out as part of the on-going review of the Internal Market, shows that past efforts to deepen the internal market, coupled with its extension to the EU10 economies following enlargement, have been an important source of jobs and growth. Over the period 1992-2006, the achievement of an enlarged Internal Market is estimated to have resulted in a 2.2% increase in the EU25 GDP and the creation of 2.75 million additional jobs (equivalent to a 1.4% increase in total employment). The analysis also confirms that these gains could be doubled with the removal of remaining Internal Market barriers.

The need for continuing with ambitious reform efforts is demonstrated in simulations showing that higher R&D expenditure can lead to an enhanced economic performance. In spring 2006, Member States announced country-specific targets for R&D expenditure amounting to 2.7% of EU25 GDP by 2010 from the current level of 1.9%. If Member States achieve their targets, R&D activities will rise by 50% in 2025 generating—through technological progress—an increase of between 2.6% and 4.4% in GDP on the basis of conservative assumptions.

Moreover, as technological progress benefits from the R&D activities elsewhere, there are large benefits from spillovers across countries and sectors. International spillovers account for some 25-30% of the overall effect on GDP for the EU25, with their scale depending upon the intensity of trade across countries. This points to potential synergies between R&D policy and internal market measures that increase market opening and therefore magnify R&D spillovers.

Efforts are underway to reduce costs for European businesses in complying with administrative requirements laid out in national and European legislation. General administrative compliance costs have been estimated at 3.5% of GDP for the EU25. The effect of a gradual reduction by 25% between 2006 and 2010 of the administrative burdens for businesses related to these is estimated at 1.1% additional GDP for the EU25 by 2010, which mainly results from boosting labour efficiency as workers undertaking such administrative tasks are freed up to carry out more productive activities. The full economic effect unfolds over time through subsequent capital accumulation reaching 1.3% by 2015. The impact of this cost reduction would be quite diverse across Member States, reflecting the level of the administrative burden in each country. A separate modelling exercise for the EU15 shows the competition enhancing effects induced by the potential entry of new firms, a channel that could lead to a significant additional GDP increase over the long-run.

This exercise relies upon different methodologies and data sources, and as for all modelling exercises, caution must be exercised in interpreting the results as each model has its strengths and weaknesses and does not take all economic aspects into account. In particular, no single model encompass all potentially important policy reform measures which contribute to growth and employment.

1. Introduction

Europe has a clear challenge. It has far too few jobs and a sustainable growth rate that is just too slow. Product and labour markets do not seem to be flexible enough. Too much regulation seems to be tying hands of Europe's businesses. Investment in knowledge creation and its further use in production are insufficient. Nevertheless, there is broad agreement about the way to meet Europe's challenge. Comprehensive structural reforms that tackle the frictions braking Member States' economies need to be implemented.

The implementation of the reform agenda needs to be accompanied by a thorough economic analysis of the impact of the reform measures. This concerns their potential to boost growth and generate jobs in the countries undertaking these reforms and in the EU as a whole. Quantitative analysis making use of state-of-art modelling tools can provide useful insights about the plausible size of growth and employment effects of such reforms, about the nature and length of the adjustment process following the introduction of a reform, and about the possible spillover effects across countries and reform areas.

This paper presents results of the model-based simulations, undertaken in a joint exercise of Directorate General for Economic and Financial Affairs and Directorate General for Enterprise and Industries, conducted with an aim to provide answers to some of these issues. These simulations also served as an input into the 2007 Annual Progress Report. The focus of the paper is on several areas covered by the Growth and Jobs strategy (GJS). They are not, however, intended as an assessment of reforms currently being undertaken in Member States or at Community level. This exercise should rather be seen as a first step towards building up the analytical capacity necessary for better understanding effects of structural reforms. The analysis presented in this paper cover the following areas:

- labour and product market reforms;
- pension reforms aiming at increases in effective retirement age;
- the completion of the Internal Market;
- reductions in administrative burden; and
- increases in R&D spending.

This list does not cover all the types of reform measures which are being implemented as part of the GJS and which can potentially contribute to growth and jobs. The choice was determined by the importance of given areas for growth and jobs as well as the suitability of the modelling tools used. Where possible, several models and modelling approaches were used so as to provide a range of results, which better takes into account the uncertainty around the results and allows for assessing the robustness of the results.

These results combine a set of simulations using several versions of the QUEST model (a macroeconometric model developed by the Directorate General for Economic and Financial Affairs) and WorldScan (a computable general equilibrium model developed at the CPB, Netherlands Bureau for Economic Policy Analysis, and used by Directorate General for Enterprise and Industries). In addition, econometric analysis of effects of structural reforms on unemployment was undertaken. It is important to keep in mind that this exercise relies upon different methodologies and data sources, and as for all modelling exercises, caution must be exercised in interpreting the results as they have their strengths and weaknesses.

The technical features of the employed models and the nature of the exercises also determined the geographical coverage of the exercise. To the extent possible the focus was on EU25 and country-specific results were produced. However, results produced with the latest versions of the QUEST model (a Dynamic Stochastic General Equilibrium (DSGE) model) cover the EU15 aggregates only. Currently, the model is being further developed to extend its coverage to the whole EU25 and to allow for country specific analysis. In addition, the backward-looking part of the exercise examining the effects of past reforms in labour and product markets focused solely on the EU15 countries.

Table 1 provides an overview of the areas covered in the simulations, modelling approaches used and the coverage of the exercises.

Table 1: Overview of model simulations

Area	Modelling approach	Coverage
Labour and product markets	QUEST II Econometric estimates	EU15 13 OECD countries[1]
Effective retirement age	ECFIN ageing model	EU15 aggregate
Internal Market	QUEST II	EU25 aggregate
Administrative burden	QUEST III WorldScan	EU15 aggregate EU25
Increased R&D spending	QUEST III WorldScan	EU15 aggregate EU25

2. The effects of past labour and product market reforms

2.1 The effects of policy shocks on the unemployment rate - econometric simulations

This section presents econometric simulations of policy induced changes in the unemployment rate. Calculations are based on the baseline specifications of the unemployment rate equation estimated for the revised OECD job strategy (Bassanini and Duval, 2006). The simulations are based on an aggregate unemployment rate equation estimated for all the OECD countries. They do not consider the effects of labour market reforms on the employment and/or the participation rates. Nevertheless they provide a useful indication of the likely aggregate effects of structural reforms on the labour market. A part of these results then serves as an input into the modelling exercise presented in the section 2.2.

The main results can be summarised as follows. First, the change in the tax wedge, in the replacement rate and in the product market regulation over the period 1995-2003 contributed to a decline in the structural unemployment rate of about 0.8 percentage points. This figure is based on the change in the tax wedge based on national accounts data. In contrast, when the

[1] Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, United Kingdom.

change of the tax wedge for specific family types is taken as representative of the whole population, the fall in the structural unemployment rate is much larger (about 2 percentage points).

Second, if one considers only the changes in the policy variables that contribute to a decline in the unemployment rate (e.g. a decline in the tax wedge - based on national accounts data - and in the replacement rate, shorter benefit duration, less regulated product markets), the decline in the structural unemployment rate amounts to 1.2 percentage points.

2.1.1 Methodology

To identify the role of policies and institutions, a static reduced form was estimated by Bassanini and Duval (2006) over the period 1982-2003 on a panel of 20 OECD countries[2]:

$$U_{it} = \sum_j \beta_j X_{it}^j + \chi G_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$$

α_i and λ_t are country and time period fixed effects,[3] U_{it} is the standardised rate of unemployment, and G_{it} is the OECD measure of the output gap. Finally, the X^j's represent the policies and institutions considered among the explanatory variables. The variables included are: the tax-wedge between labour cost and take-home pay calculated on the basis of the OECD tax model for a single-earner couple with two children, at average earnings levels; a second measure of the tax wedge is based on national accounts and includes also consumption taxes; a summary measure of unemployment benefit generosity (an average of replacement rates across various earnings levels, family situations and durations of unemployment); the degree of stringency of EPL; the average degree of stringency of product market regulation (PMR) across seven non-manufacturing industries;[4] union membership rates; the degree of centralisation/co-ordination of wage bargaining.

Using the observed changes in these policy/institutional variables in the recent past, the contribution of each of these variables to the change in unemployment can be calculated. The above equation is used to simulate the change in the unemployment rate between 1995 and 2003 which in the Bassanini and Duval's paper is due to policy shocks. Policy shocks are identified with changes in each policy variable. Formally, the estimated coefficients (table

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2 Bassanini, A and R. Duval (2006), "Employment Patterns in OECD Countries: Reassessing the Role of Policies and Institutions", OECD Social Employment and Migration Working Papers o. 35. Countries included in the sample are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

3 The inclusion of country effects is necessary to control for country-specific averages of omitted policies and institutions. Since the policy and institutional indicators included in the analysis tend to be much more correlated across countries than within a given country and over time, one can expect that the inclusion of country effects is sufficient to control for most of the relevant omitted variables. The choice of fixed rather than random country effects reflects the view that country effects are unlikely to be independent from other explanatory variables included in the estimated equation – in which case random-effects FGLS estimators would yield inconsistent estimates.

4 This PMR indicator is used here because it is available over the whole period 1975-2003 for most OECD countries, unlike the economy-wide indicator which covers only the period 1998-2003. One drawback is that changes in the PMR indicator for non-manufacturing industries do not incorporate all aspects of regulatory reforms that have been undertaken by a number of OECD countries in the past decades, such as administrative reforms affecting all sectors. As a result, the unemployment effects of regulatory reforms may not be fully captured by the econometric estimates.

1.2) are used to calculate the changes in the unemployment rate due to policy shocks and to the change in the output gap.

$$\hat{U}_{i2003} - \hat{U}_{i1995} = \sum_j \hat{\beta}_j (X^j_{i2003} - X^j_{i1995}) + \hat{\chi}(G_{i2003} - G_{i1995})$$

where ^ denotes the estimated coefficients.

The baseline equation contains 4 specifications (table 1.2). Specification 1 relates the unemployment rate to the OECD summary measure of the average replacement rate, the tax wedge, an index of product market regulation, a dummy variable for the degree of corporatism, the output gap, union density and EPL. Of these variables, the unemployment effects of both union density and EPL turn out to be statistically insignificant. Specification 2 explores whether the impact of the replacement rate reflects the combined effect of the replacement rate during the first year of unemployment, the duration of benefit receipt and the interaction between these variables. In this case all variables turn out to have some effects on the unemployment rate. In particular, the estimate suggests a reduction in the benefit duration has a stronger effect on unemployment than a similar reduction in the replacement rate during the 1st year of unemployment. Specification 3 splits the EPL into a component for regular and temporary workers; both turn out to be statistically significant (but not their interaction). However, only for the EPL for regular workers does tightening employment protection legislation imply a higher unemployment rate. [5]

The tax wedge used in specification 1 is derived from OECD tax model and captures only *labour* taxes (social security contributions and income taxes), but not consumption taxes.[6] A broader measure of the tax wedge, which includes both labour and consumption taxes, has been derived from National Accounts data.[7] Re-estimating the equation using the National Accounts measure yields similar coefficients for all the explanatory variables, while no significant difference is found between the impact of labour and consumption taxes.

Before presenting the results of these simulations a note of caution is needed. First, Bassanini and Duval (2006) estimate a static equation relating target variables to policy variables and the output gap. The static equation implicitly assumes that all effects of policy changes are exhausted in one year only. This implies that the effect of the policy variables might be biased upward. To a certain extent this choice is forced by the (almost) time unvarying nature of some labour market institutions. However, simulating the effects of policy shocks over a long period (1995-2003) may reduce this bias. Nevertheless, it cannot be excluded that policy-induced changes in the unemployment rate reflect some policy shocks that occurred before 1995.

Second, the implicit assumption in the pooled estimate is that the effects of policy are the same for all OECD countries. This is not very convincing as it is equivalent to assuming that the deep parameters are the same across different countries and, implicitly, that labour market institutions do not explain cross countries differences in labour market performance.

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5 For temporary workers the opposite occurs although the authors contend that this finding depends from the inclusion of Spain in the sample.

6 The source is the OECD Taxing Wages Database, which defines it as the wedge between the labour cost to the employer and the corresponding net take-home pay of the employee for a single-earner couple with two children earning 100% of APW earnings. The tax wedge expresses the sum of personal income tax and all social security contributions as a percentage of total labour cost.

7 The National Accounts measure is more likely to suffer from endogeneity problems and provides a cruder picture of the tax incentives effectively faced by individuals than the tax model measure of the tax wedge. Hence, Tax model based measures of the tax wedge should be preferred.

Finally, in addition to policy and non-policy variables, the econometric specification includes global shocks captured by time varying fixed effects. Hence, the change in the observed unemployment rate equals the sum of the contribution of policy variables, of the output-gap of the global shocks and of a residual, which cannot be identified by the equation as the authors do not report the value of the time fixed effects.

2.1.2 Results of econometric simulations

The baseline specification is used to provide for each country the contribution to the change in the unemployment rate between 1995 and 2003 due to policy shocks and the output gap or to policy shocks only (see table 2A in the annex and graphs 1 and 2). Table 2A also reports the contributions of policy shocks to changes in the unemployment rate of the representative country (row un-weighted average) and of the EU aggregate (row weighted average)[8]. Policy shocks are reported in graph 1.

Between 1995 and 2003 the EU15 unemployment rate fell 2.7 percentage points. In the case of specifications 1 to 3, policy variables alone explain between 70% and 80% of the total decline in unemployment. In the case of specification 4, which measures the tax wedge on the basis of National Accounts data, policy variables explain less than 1/3 of the total decline in the unemployment rate (Graph 2).

It turns out that the tax wedge measures used in the econometric specification are responsible for these different effects. Indeed, the fall in the unemployment rate due to a change in the tax wedge is higher when this wedge is measured on the basis of the OECD tax model for a single earner couple with two children earning 100% of the APW than when it is calculated from the National Accounts. This finding does not depend on the different estimated response of unemployment as the estimated coefficients do not differ too much (see table 1.2). It is rather the change in the two measures of the wedge that drives the results. An exploration of countries' policy shocks reveals large heterogeneity in the changes of the tax wedge. For example, some countries such as Ireland and the UK implemented specific policies (in work benefits for married couples and increased child allowances) aiming at reducing the tax burden for specific family types. In other countries, the reduction in the tax wedge was more generalised. Hence, the tax wedge indicator based on the single-earner couple with two children is too specific and doubts may arise about its use as the determinant of the overall unemployment rate. Ideally, one would calculate a weighted average of the tax wedge for different family types with weights being taken from the family structure of the working population.[9] We leave this for future work. The tax wedge based on national accounts (specification 4) is therefore the preferred measure.

In terms of the contributions of single policy shocks, a reduction in the tax wedge and in the tightness of product market regulation accounts for a large decline in the unemployment rate. In the case of specification 2, a reform of the unemployment benefits system which increases the initial unemployment benefit replacement rate (for the EU un-weighted and weighted

[8] EU refers to the EU Countries in the OECD database namely Austria, Belgium, Germany, Denmark, Spain, Finland, France, UK, Ireland, Italy, Netherlands, Portugal and Sweden.

[9] In technical terms, the implicit assumption of poolability of the unemployment effects of a change in the tax wedge for a single earner couple with two children is not very convincing as it is equivalent to assume that countries have the same structure of the population and the same policies for different segment of this population.

average respectively by 3.3 and 5.9) and reduces its duration (for the EU un-weighted and weighted average respectively by about 1 month and less than one month) explains 10 per cent of the change in the unemployment rate due to policy shocks.

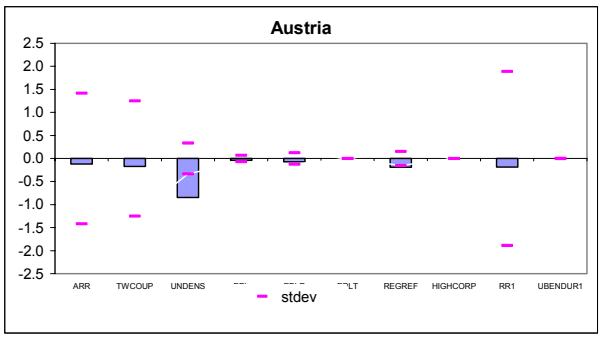
Table 1.2. **Baseline unemployment rate equation, 1982-2003**

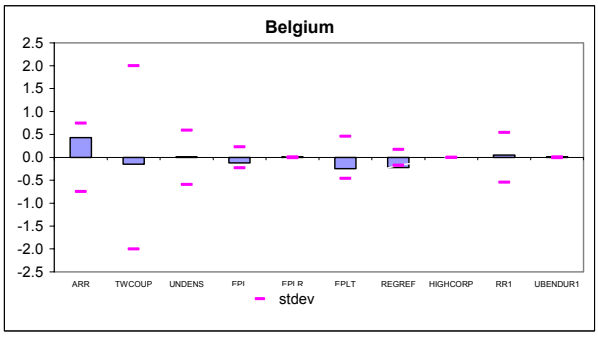
	1	2	3	4	5	6	7
	Excluding Germany, Finland and Sweden 1990-1991, common OG	= 1 with RR split into 2 components	= 1 with EPL split into 2 components	= 1 with tax wedge derived from National Accounts	= 4 with separate labour and consumption tax rates	= 1 with standard macroeconomic shocks	= 6 with labour demand shock
Average replacement rate (RR)	0.12 [6.28]***		0.12 [6.79]***	0.08 [4.22]***	0.09 [4.16]***	0.10 [4.55]***	0.09 [3.93]***
Tax wedge	0.28 [9.75]***	0.27 [10.96]***	0.27 [11.14]***	0.24 [4.49]***		0.24 [8.22]***	0.22 [6.57]***
Union density	-0.03 [1.57]	-0.03 [1.89]*	-0.03 [1.64]	-0.02 [0.56]	-0.01 [0.49]	0.04 [1.69]*	0.06 [2.51]**
EPL	-0.31 [0.98]	-0.20 [0.55]		0.03 [0.08]	0.01 [0.02]	-0.60 [1.45]	-0.51 [1.19]
PMR	0.60 [2.98]***	0.67 [3.29]***	0.73 [3.52]***	0.50 [2.17]**	0.50 [2.17]**	0.53 [2.24]**	0.79 [3.32]***
High corporatism	-1.42 [3.57]***	-1.09 [2.88]***	-1.39 [3.94]***	-2.06 [4.80]***	-2.09 [4.89]***	-1.42 [3.56]***	-1.58 [3.84]***
Output gap	-0.48 [14.00]***	-0.48 [14.21]***	-0.47 [13.99]***	-0.54 [11.89]***	-0.54 [11.60]***		
RR 1st year		0.09 [7.37]***					
Benefit duration		2.64 [2.03]**					
(RR 1st)*(duration)		0.09 [2.69]***					
EPL regular			1.28 [2.49]**				
EPL temporary			-0.45 [2.16]**				
(EPL reg)*(EPL temp)			-0.28 [1.21]				
Labour tax rate					0.25 [4.82]***		
Consumption tax rate					0.21 [1.92]*		
Macroeconomic shocks:							
TFP shock						-13.01 [3.55]***	-9.02 [2.45]**
Terms of trade shock						19.44 [6.73]***	19.13 [6.55]***
Interest rate shock						0.22 [4.71]***	0.19 [3.98]***
Labour demand shock							11.84 [3.94]***
Country dummies	yes	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes
Observations	434	434	434	398	398	419	397
R-squared	0.98	0.92	0.92	0.98	0.98	0.98	0.98

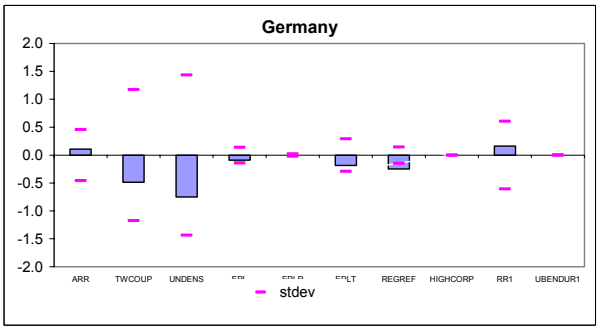
OG = output gap. Absolute value of robust t statistics in brackets.
* significant at 10%; ** significant at 5%; *** significant at 1%
Source: Estimates by the OECD Secretariat on the basis of data sources described in Annex 2.

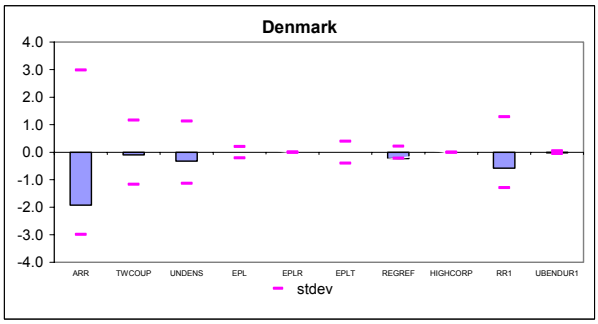
Source: Bassanini-Duval

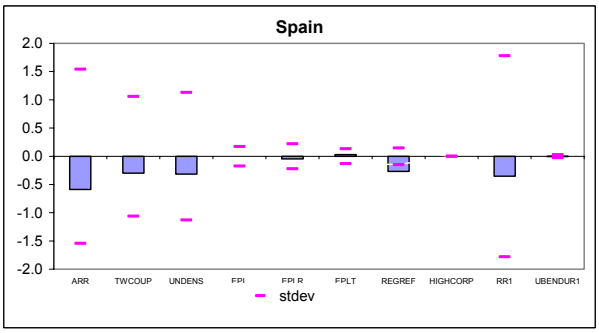
Graph 1 Policy Shocks: 1995-2003

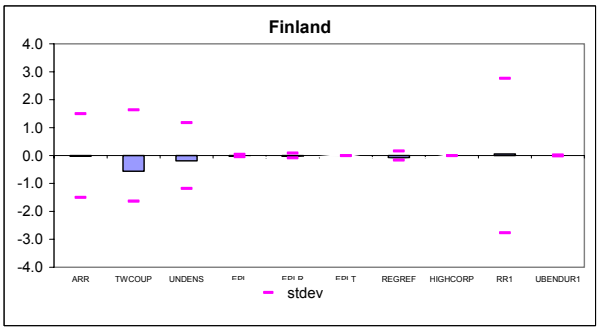


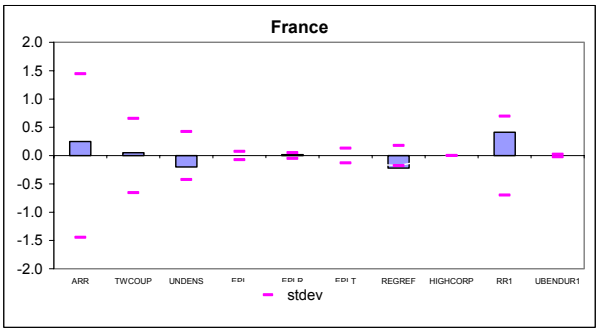


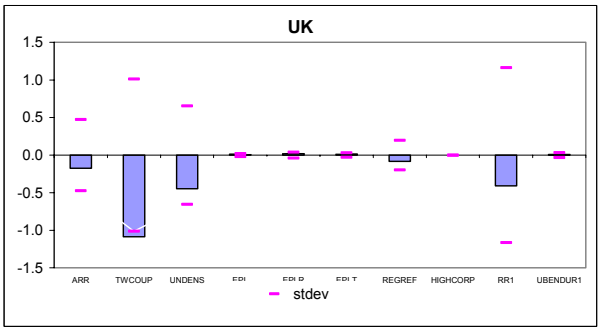


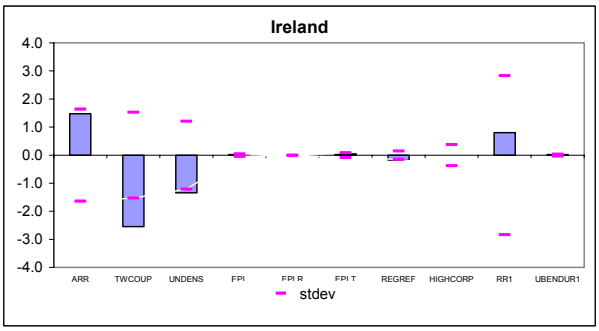


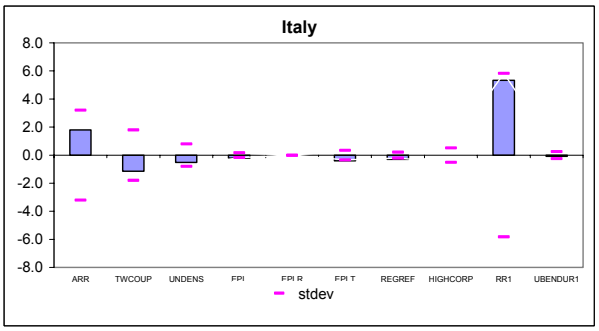




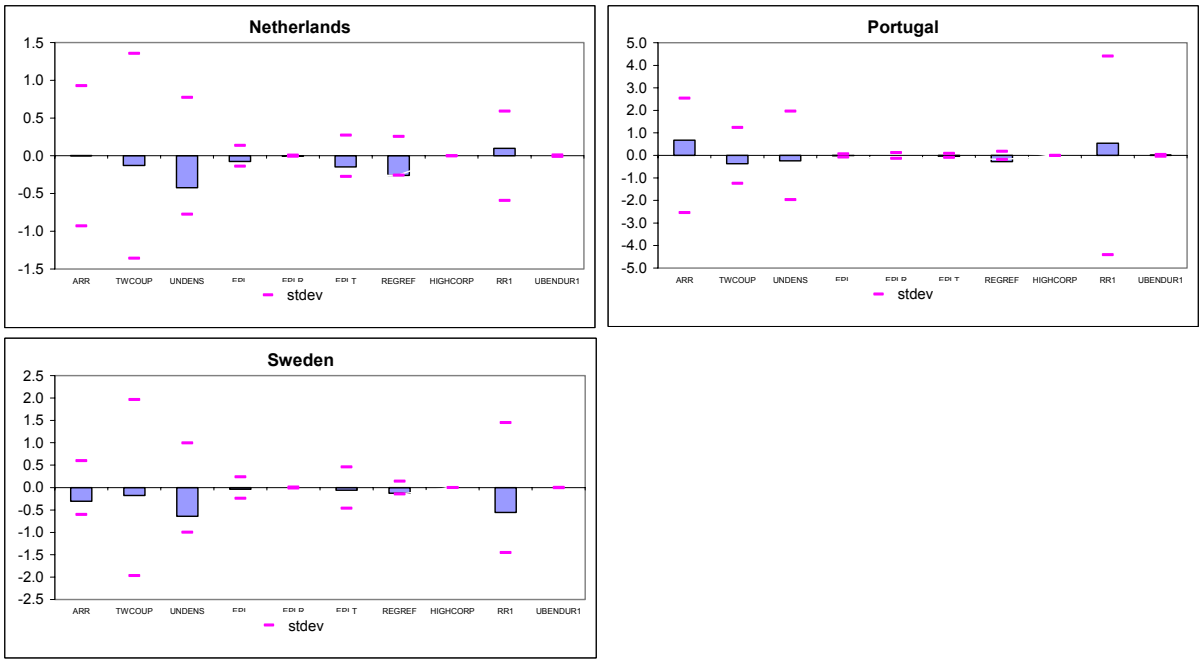








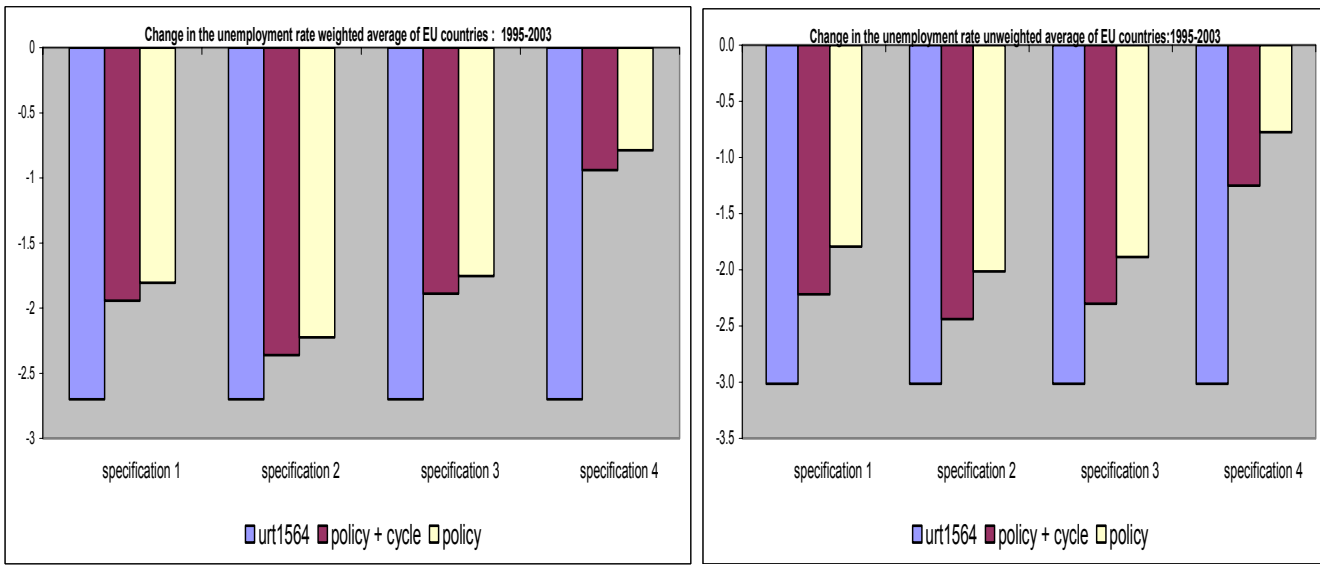
Graph 1 Policy Shocks: 1995-2003 (cont'd)



Source: Own's calculation on Bassanini and Duval (2006) data; Standard deviation is calculated on annual changes in the policy indicators. Given the relatively short-time span, a change larger than one standard deviation is considered to be statistically significant

Note: The variables are defined as follows: arr – Average unemployment benefit replacement rate (%); rr1 – Initial unemployment benefit replacement rate (%); ubendur1 – Unemployment benefit duration (years); twcoup – Tax wedge (%); epl – employment protection legislation; eplr – EPL regular contracts; eplt – EPL temporary contracts; pmr – product market regulation; undens – Union density (%); highcorp – High corporatism.

Graph 2: Change in unemployment



Source: Own's calculation on Bassanini and Duval (2006) data.

2.2 The effects of labour and product market reforms – simulations using the QUEST II model

This section describes QUEST II model simulations of policy induced changes in labour and product markets and describes the estimated contributions of these reforms to observed output growth and reductions in the unemployment rate. While improvements in data availability should allow refining of this exercise in the future, this first attempt already gives a positive message as regards the contribution of past reforms to growth and employment.

The main results of this simulation exercise can be summarised as follows. For the labour and product market variables considered in this exercise (changes in tax wedge, average unemployment benefit replacement rate and price mark-ups), past changes over the period 1995-2003 have on balance made a positive contribution to growth and employment in the EU15, contributing 1.2 percent to GDP and 0.56 percentage points to the reduction in the structural unemployment rate. The estimated contribution of all favourable changes alone, i.e. excluding any of detrimental changes in policy variables that have occurred, has been much larger. Reforms have raised GDP in the EU15 by 2 percent and reduced the structural unemployment rate by 1.4 percentage points.

2.2.1 Methodology

This exercise uses the QUEST II model to analyse the role of observed changes in benefit replacement rates, taxation and product market changes on the rate of unemployment using the OECD indicators analysed in the preceding section for the same period 1995-2003.

In the wage bargaining framework in the QUEST II model, the equilibrium unemployment rate depends on the 'reservation wage', which is a function of unemployment benefits (Pisarides, 1994). Changes in unemployment benefit replacement rates therefore have an effect on the equilibrium unemployment rate in the model. In case benefits are taxed differently to wages, the unemployment rate is also affected by tax changes. If benefits were fully tax exempt, an increase in wage taxes would reduce after-tax wage income relative to the reservation wage, lead to higher wage demands, and the tax increase would be mainly borne by firms and have a negative impact on employment. Product market reforms that lead to a more competitive environment lower the mark-up firms can charge over marginal costs. More competitive products markets lead to an expansion of activity levels and labour demand and reduce the equilibrium rate of unemployment.

Box 2: The European Commission's QUEST II model

This box provides an overview of main features of the QUEST II model and describes how it can be used to analyse the potential impact of structural reforms[10]. The QUEST II model contains detailed structural models for each of the 25 EU member states, as well as the US and Japan, and smaller trade-feedback models for other countries and regions in the world. The model can be characterised as a New Keynesian Model, which combines the rigorous microfoundations of dynamic general equilibrium models with features of Keynesian style rigidities. The behavioural equations in the model are based on principles of dynamic optimisation of private households and firms. Economic agents are assumed to maximise utility and profit functions subject to intertemporal budget constraints and consumption and investment decisions therefore incorporate forward looking behaviour. The short run dynamic responses of the model also have a theoretical basis, like the presence of adjustment costs and overlapping contracts.

The supply side of the economy is modelled explicitly via a neo-classical production function. This assures that the long run behaviour of the model resembles closely the standard neo-classical growth model and the model reaches a steady state growth path with a growth rate essentially determined by the rate of (exogenous) technical progress and the growth rate of the population. However, the model does take product and labour market imperfections into account. Firms are not perfectly competitive but can charge mark-ups over marginal cost in the long run. This mark-up affects prices, but also affects the demand for labour and investment. In general the size of mark-ups is inversely related to economic activity and the level of economic activity will be lower than that predicted from a model with perfect competition. Also, a bargaining framework is used to describe the interaction between firms and workers/trade unions, with wages set as a mark-up over the reservation wage, and involuntary unemployment persists even in the long run. Both types of mark-ups are suggested by economic theory as good quantitative indicators of the degree of product and labour market distortions. In the case of the labour market, in addition to the wage mark-up, the level of the reservation wage is itself related to structural policy measures such as minimum wages and social benefits. These features make the QUEST II model a suitable tool for analysing the effects of structural policies on growth and employment provided a link between policy measures and mark ups can be established empirically. The models can also be used to look a the effects of knowledge investment by using information on the marginal efficiency of different types of investment from empirical growth accounting studies and the effects of R&D investment by using estimates which link R&D investment to TFP.

It should be noted that the QUEST II model allows for a comprehensive analysis of structural reforms by not only looking at (long run) supply side effects but also taking (short run) demand effects into account. The short run behaviour of the model is influenced by standard Keynesian features since the model allows for imperfectly flexible wages and prices, liquidity constrained consumption, adjustment costs for investment and labour hoarding. These features distinguish QUEST II from other general equilibrium models and permit an assessment of potential adverse demand effects in the short run during the adjustment process to structural reforms.
Finally, QUEST II contains a detailed description of the public finances and includes various tax variables, like wage, profit and value-added taxes. It therefore allows to take into account the budgetary implications of structural reforms.

Structural policies can either be directly or indirectly evaluated depending on how the respective policy measures are represented in the model. The effects of all those policy instruments which are used as exogenous variables in the model can be analysed directly by simulating permanent changes of the respective policy instrument. This holds, for example, for tax rates, social security contributions and social benefits. There are other policy measures which do not directly affect endogenous variables but have an indirect effect on the economy by changing the degree of competition in goods and labour markets or boosting technological progress. In other words these policy measures have an effect on the size of mark-ups or TFP. Examples of such measures are anti-trust regulation, measures to reduce entry barriers in the case of goods markets, changes in hiring and firing rules in the case of labour markets or investments in R&D. The macroeconomic effects of these measures can be evaluated in a two step procedure. First an empirical link between such policy measures and mark ups must be established. In a second step the QUEST II model can be used to analyse the effect of the respective mark-up reduction on the macroeconomic variables of interest.

QUEST II has been used previously to analyse the effects of structural reforms. Recent examples are an analysis for DG MARKT on the macroeconomic effects of the Single market program after 10 years and an analysis of the macroeconomic effects of structural reforms in labour and product markets in the 90s on macroeconomic performance, published in the EU Economy Review 2002 and an analysis of the effects of a tax shift from direct to indirect taxation for DG TAXUD. The model has also been used to look at the impact of pension reforms in the EU (see EU Economy Review 2001).

[10] For a more detailed description of the model, see Roeger and in 't Veld (1997, 2002)

2.2.2 Changes in labour market institutions

Table 2 describes changes in the OECD indicators on labour market institutions between 1995 and 2003. The unemployment benefit replacement rate [11] has on average increased in the EU. There are some large outliers (large increases in Ireland and Italy, large reduction in Denmark) but in both Germany and France the average benefit replacement rate has increased by 1 and 2 percentage points respectively. At an aggregate macroeconomic level it appears therefore that there have been increases in benefit generosity in some countries. However, this measure may not fully reflect significant changes in benefit replacement rates for low earnings and low skilled groups, which have in many countries become less generous and raised employment levels for these groups. As the current version of the model does not distinguish between different skill groups, the effects of reduced benefit generosity for the lower skilled cannot be captured in this exercise. In the simulation, the average replacement rate is used and in countries where this has increased, the model will predict a negative impact on employment levels. The tax wedge measure applied here is derived from National Accounts and covers both labour and consumption taxes[12]. On aggregate there has been a reduction in the tax wedge in the EU, a small increase in labour taxes more than compensated for by a reduction in consumption taxes.

Table 2 : Changes in labour market variables

	Average replacement rate	Tax wedge (NA)	Labour tax rates (NA)	Cons. tax rates (NA)
Austria	-1.0	1.7	1.2	0.6
Belgium	3.4	0.2	0.9	-0.6
Germany	0.9	-1.6	-1.0	-0.6
Denmark	-15.4	3.1	1.4	1.8
Spain	-4.7	2.0	0.6	1.4
Finland	-0.2	-1.8	-2.2	0.3
France	2.0	-1.2	-0.1	-1.1
UK	-1.4	0.0	1.6	-1.6
Ireland	11.8	-6.8	1.3	-8.2
Italy	14.4	0.4	2.2	-1.8
Netherlands	0.0	-4.5	-5.7	1.2
Portugal	5.4	0.0	0.6	-0.6
Sweden	-2.4	0.2	1.1	-1.0
EU unweighted average	1.0	-0.6	0.1	-0.8
EU weighted average	1.8	-0.5	0.2	-0.7

Source: Database OECD (see Bassanini and Duval (2006); changes 2003-1995.

[11] The average unemployment benefit replacement rate is measured across two income situations (100% and 67% of APW earnings), three family situations (single, with dependent spouse, with spouse in work) and three different unemployment durations (1st year, 2nd and 3rd years, and 4th and 5th years of unemployment).

[12] Although tax measures derived from National Accounts can suffer from endogeneity problems, this should be less of a problem when we take differences between 1995 and 2003. The measure derived from National Accounts is wider than the alternative measure in the OECD database, the labour tax wedge for a single-earner couple, with two children at average earnings levels, which is derived from OECD tax models and captures labour taxes (income taxes and social security contributions) but not consumption taxes.

2.2.3 Changes in product markets

More competition in product markets can also impact on labour market performance. Increased entry by new firms raises output and labour demand. A more competitive product market, in which firms extract lower rents, could also strengthen the bargaining position of employers, reducing wage demands and so increasing employment. To capture the employment effects of product market regulations, Bassanini and Duval (2006) include the OECD PMR indicator in their regression. This indicator measures regulatory impediments to product market competition in seven non-manufacturing industries (energy and service industries). In the QUEST model the variable that best captures product market competition is the mark-up of prices over marginal costs. Griffith and Harrison (2004) perform a panel data econometric analysis of the role of several product market reform indicators on the mark-up, using Fraser Institute indicators (which are a wider measure than the OECD PMR indicator and apply to the business sector, rather than only network industries) over the period 1985-2000. They find mark-ups are lower when entry is easier and the average tariff is lower, but higher when there are less price controls. Applying their regression results to changes in these indicators between 1995 and 2003, changes in the mark-ups can be calculated (Table 3). Griffith and Harrison find over their estimation period a strong effect from lower tariffs, but applying their coefficient to our data period yields unrealistically large reductions in the mark-ups. This is possibly due to differences in variation over the respective sample periods, but an update of the panel data econometric analysis would be required to shed further light on this. We have chosen to focus instead on the effects of the ease of starting a new business and price controls only. According to these calculations, average mark-ups in the EU15 have declined by 1.3 percentage points [13]. Mark-ups have fallen most in Sweden, the UK and Austria, France and Germany. Further analysis should show whether the reductions in mark-ups in Table 2 are consistent with those that can be estimated from more detailed sectoral price and productivity data using the forthcoming EUKLEMS database, but for the moment data availability prevents us from estimating mark-ups directly.

[13] The calculated mark-ups have also been rescaled to correct for differences in the mean value of the mark-ups, which are higher in the Griffith&Harrison study than in the QUEST model baseline.

Table 3 : Changes in Fraser Institute indicators of product market reform and estimated changes in mark-ups

	Change in Fraser Institute Indicators 1995-2003			Estimated change in mark-ups 1995-2003	
Countries:	5Civ Starting a new business	5Ci Price controls	4Aii Mean tariff rate	Starting a new business + Price controls	Starting a new business + Price controls + Mean tariff rate
Austria	1.8	0.0	1.1	-0.022	-0.050
Belgium	-0.1	0.0	0.7	0.001	-0.018
Denmark	-0.2	-2.0	1.1	-0.014	-0.042
Finland	-0.9	-1.0	1.1	0.002	-0.026
France	1.1	-1.0	1.1	-0.021	-0.049
Germany	0.2	-2.0	1.1	-0.019	-0.047
Greece	-0.5	-2.0	1.1	-0.010	-0.041
Ireland	-1.6	-4.0	1.1	-0.013	-0.033
Italy	-0.3	-1.0	1.1	-0.005	-0.020
Netherlands	-1.4	-1.0	1.1	0.008	-0.028
Portugal	0.0	0.0	1.1	0.000	-0.022
Spain	-1.2	-1.0	1.1	0.006	-0.063
Sweden	2.3	-1.0	1.1	-0.035	-0.056
United Kingdom	-0.4	-4.0	1.1	-0.027	-0.050
EU15 (average)	-0.03	-1.70	1.05	-0.013	-0.041

Source: Gwartney&Lawson (2006). and estimates based on Griffith&Harrison (2004), , Table 9

2.2.4 Simulation results

What has been the long run effect of these changes in labour and product market variables on output and unemployment in the EU member states? To answer this question each of the changes identified above has been simulated with the QUEST model. There have, of course, been other important policy measures which have contributed to growth and employment, but the simulations can only show the contributions of the changes in the policy variables that are considered here. Table 4 below shows the resulting long run changes in GDP and unemployment for each scenario separately and when all are combined[14]. In all cases, the simulations include spillovers from reforms in other EU member states which further enhance growth effects.

On an aggregate macroeconomic level, the unemployment benefit replacement rate has increased on average in the EU, and this leads to an increase in the unemployment rate of 0.3 percentage points for the EU15. As mentioned above, this measure may not fully reflect substantial differences in benefit generosity for different skill levels and hence not properly capture reforms that have taken place. As measured by the average replacement rate, benefits have become more generous in Italy and Ireland especially and this has had the strongest detrimental impact on the unemployment rate in these countries. In Denmark on the other hand, the replacement rate has fallen substantially and this has had a positive effect on employment and activity levels.

[14] Note that there was no data on labour market variables for Greece and hence the results shown are pure spillovers.

As indicated by the tax wedge data derived from National Accounts, most EU member states have seen a reduction in taxes over the period 1995-2003. According to the model, this has led to a decline in the unemployment rate of 0.2 percentage points for the EU15. For some countries, these tax indicators point to a negative impact on employment (Denmark, Italy, Austria, Spain, Sweden, UK, Belgium). The effect of product market reforms, as captured by the derived reductions in mark-ups, has been generally positive and led to a fall in the unemployment rate by 0.7 percentage points. On average for the EU15, all scenarios combined yield a reduction in the structural unemployment rate of almost 0.6 percentage points, but for the euro area only 0.3 percentage points. The estimated impact of policy changes on output has been 1.2 percent, somewhat smaller for the euro area (0.8 percent). For comparison, the estimated fall in the NAIRU over this period for the EU15 was 0.8 percentage points, while output grew by almost 20 percent (Table 5).

As is clear from the tables, not all changes in labour market and product market policies have been favourable. In some member states tax rates and replacement rates have increased and this has a negative impact on employment in the model. Therefore it is interesting to see what the estimated effect of only the favourable changes has been. For that purpose the final column in Table 4 shows the results of a separate simulation in which all unfavourable changes that went 'in the wrong direction' have been excluded, and this could be interpreted as representing the effects of 'true reforms'. This can be compared to the net effects of all changes in policy variables and the difference can be attributed to 'unfavourable' changes in policies which have partly (or completely) counteracted the positive effects of reforms.

Including only the favourable changes for each of the member states yields much larger positive effects (see final column Table 4), with the largest gains for Denmark, Ireland and the UK. For the EU15 on average, reforms are estimated to have contributed 2 per cent to output and 1.4 percentage points to the reduction in the structural rate of unemployment. For the euro area the estimated contributions are only slightly smaller, 1.7 percent higher GDP and 1.1 pp. lower NAIRU. Comparing this to the 'net' effects of all policy changes in the previous column shows the extent to which unfavourable policy changes have offset the gains from reforms.

For individual countries, the results mainly reflect the changes in labour and product market set out in Tables 3 and 4., For Germany, interestingly, the contribution of these policy changes on unemployment and growth are estimated to have been significant (with reductions in the structural unemployment rate of -1.6 and -1.9 respectively). The estimated effects for Italy and Portugal are the most disappointing.

One can conclude from this exercise that the reforms included here have made a substantial contribution to growth and employment. Further analysis should show whether these findings are robust for other indicators of reforms. The focus here has been on only a limited number of indicators and many other policy reform measures are likely to have contributed to the improvements in labour market performance. Further work is required to improve data inputs and to capture a wider range of reforms.

Table 4: Simulated long run effects of changes in labour and product markets 1995-2003 on GDP and the rate of unemployment

	Benefit replacement rate		Labour and consumption tax rates (NA)		*Of which: labour taxes*		*Of which: consumption taxes*		Mark-up		All changes combined		Favourable changes only	
	GDP	U	GDP	U	*GDP*	*U*	*GDP*	*U*	GDP	U	GDP	U	GDP	U
BE	-0.52	0.60	-0.07	0.21	*-0.21*	*0.37*	*0.14*	*-0.15*	0.37	-0.20	-0.23	0.62	0.81	-0.53
DK	1.93	-2.75	-0.95	1.34	*-0.62*	*0.86*	*-0.32*	*0.47*	1.63	-0.95	2.61	-2.34	4.00	-3.91
DE	-0.29	0.25	0.55	-0.75	*0.39*	*-0.57*	*0.16*	*-0.18*	1.75	-1.13	2.00	-1.62	2.46	-1.94
GR	*-0.06*	*0.01*	*0.02*	*-0.01*	*0.01*	*-0.00*	*0.01*	*-0.01*	0.10	0.03	0.06	0.03	0.63	-0.15
ES	0.25	-0.57	-0.21	0.31	*-0.07*	*0.14*	*-0.14*	*0.17*	-0.03	0.11	0.01	-0.16	0.82	-0.62
FR	-0.38	0.38	0.27	-0.30	*0.06*	*-0.05*	*0.22*	*-0.25*	1.72	-0.72	1.61	-0.64	2.10	-1.05
IE	-2.39	3.07	1.07	-1.13	*-0.35*	*0.48*	*1.42*	*-1.61*	1.31	-0.54	-0.11	1.53	2.91	-2.22
IT	-1.53	1.91	-0.21	0.37	*-0.46*	*0.64*	*0.25*	*-0.27*	0.45	-0.09	-1.32	2.22	0.80	-0.37
NL	-0.11	0.04	1.19	-1.62	*1.31*	*-1.81*	*-0.13*	*0.19*	-0.31	0.17	0.77	-1.41	1.70	-2.01
AT	-0.03	-0.03	-0.21	0.35	*-0.18*	*0.29*	*-0.02*	*0.06*	1.29	-0.47	1.05	-0.20	1.48	-0.60
PT	-0.38	0.47	0.00	0.03	*-0.05*	*0.08*	*0.05*	*-0.05*	0.08	-0.00	-0.31	0.50	0.16	-0.06
SF	-0.16	0.01	0.73	-0.95	*0.71*	*-1.00*	*0.01*	*0.04*	0.51	-0.16	1.07	-1.10	1.69	-1.35
SW	0.25	-0.28	-0.22	0.27	*-0.41*	*0.47*	*0.19*	*-0.21*	3.55	-1.38	3.58	-1.40	4.11	-1.94
UK	0.21	-0.26	0.20	0.22	*-0.49*	*0.60*	*0.29*	*-0.37*	2.71	-1.45	2.72	-1.49	3.25	-2.12
EU12	-0.52	0.52	0.25	-0.29	*0.10*	*-0.14*	*0.15*	*-0.15*	1.04	-0.52	0.76	-0.28	1.68	-1.14
EU15	-0.34	0.30	0.14	-0.16	*-0.02*	*0.02*	*0.17*	*-0.18*	1.38	-0.71	1.18	-0.56	2.04	-1.38

Table 5: Contributions to growth and unemployment

	Simulated contribution of all observed policy changes	Simulated contribution of favourable policy changes	*1995-2003*
Cumulative GDP growth :			
EU12	0.76	1.68	*18.48*
EU15	1.18	2.04	*19.66*
Change in NAIRU:			
EU12	-0.28	-1.14	*-0.75 (9.22 - 8.47)*
EU15	-0.56	-1.38	*-0.78 (8.71 - 7.93)*

3. Pension reform: the effect of increasing the effective retirement age – a simulation using ECFIN's Ageing model

In this retirement simulation, the effective retirement age, presently close to 60 in the EU, is gradually brought back up to the average statutory retirement age of 65 over the next 10 years.[15] Part of the rationale for this simulation is the fact that since the 1960s there has been an enormous deterioration in the so-called "passivity" ratio which measures the number of years worked relative to the number of years spent in retirement. In the 1960s, the passivity ratio was about 3[16] but this ratio has recently fallen to less than 2 due to increases in life expectancy and falls in the effective retirement age to less than 60.

3.1 Methodology

The model used for the analysis in this paper is a conventional neoclassical, overlapping generations, model. It is a variant of the QUEST II model. Households are divided into two groups, namely working age and pensioners. Since there is no bequest motive in the model, this implies that pensioners have a lower propensity to save than working age households (in fact, consistent with the life cycle hypothesis, pensioners dissave in order to end up with zero assets at the end of their life). Production is characterised by a neoclassical production function with constant returns to scale (for more details on the model refer to Roeger and Mc Morrow (2003).

3.2 Simulation results

From the graphs given to summarise the effects of this retirement simulation (i.e. graphs 3a-3d), it is clear that an increase in the effective retirement age (ERA) to the statutory age has major benefits in terms of growth and budgetary sustainability, as well as being relatively favourable with regard to income distribution.

In terms of budgetary developments, the impact is quite dramatic. As a rough rule of thumb the public expenditure impact of an increase in the ERA is of the order of 1 to 1 (i.e. if workers were to work, on average, one additional year before retiring, the increase in public expenditure on pensions over the period to 2050 would be reduced by 0.84 of a percentage point of GDP). This strong budgetary gain is however predicated on the assumption that any additional years in employment do not yield any additional pension benefits.[17]

In addition to the very favourable public finance impact, the increase in the average working life also appears to simultaneously meet other key policy objectives such as boosting growth

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[15] For this simulation ECFIN ageing model was used which is a variant of the QUEST II model with overlapping generations specification.

[16] In other words workers spent 3 years in employment for every year spent in retirement.

[17] This assumption is crucial since in a separate simulation based on an "actuarially fair" adjustment of pensions to reflect the increased number of contribution years, the budgetary gain from an additional year of work falls from 0.84 of a percentage point of GDP to 0.6, while the GDP gain stays roughly the same as in the main simulation. The definition of "actuarially fair" used in this simulation is based on the assumption that in return for the extra five years of contributions that the generosity of one's annual pension would increase by slightly less than 12 per cent relative to what it would otherwise have been but pensioners will receive this higher pension for, on average, five years less than in the baseline scenario. Consequently, while the fiscal gain is reduced it still remains relatively substantial.

and avoiding big changes in income distribution, which in the longer term could call into question the political sustainability of any pension reforms that have been set in place.

In terms of GDP, the increase in the retirement age has a significant effect on the level of GDP, with the latter growing by over 13 per cent compared with the baseline, thereby on its own going a long way towards offsetting the GDP loss associated with ageing.[18]

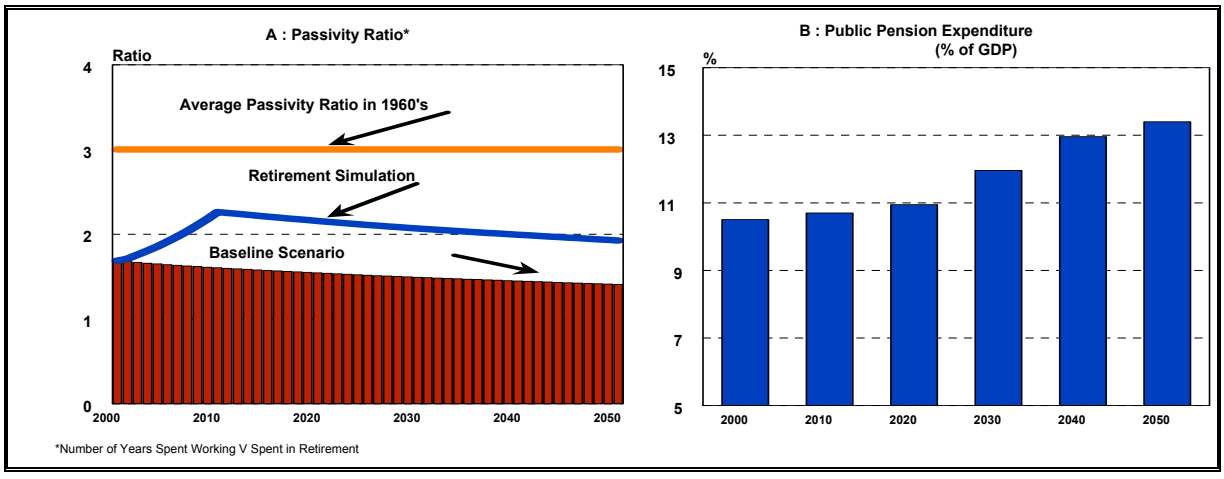
Finally, as shown in Graph 3d, this parametric reform is also relatively good from an income distribution perspective, with the consumption of both the working age population and pensioners rising relative to the baseline.

Table 6: Increase in Effective Retirement Age from 60 to 65

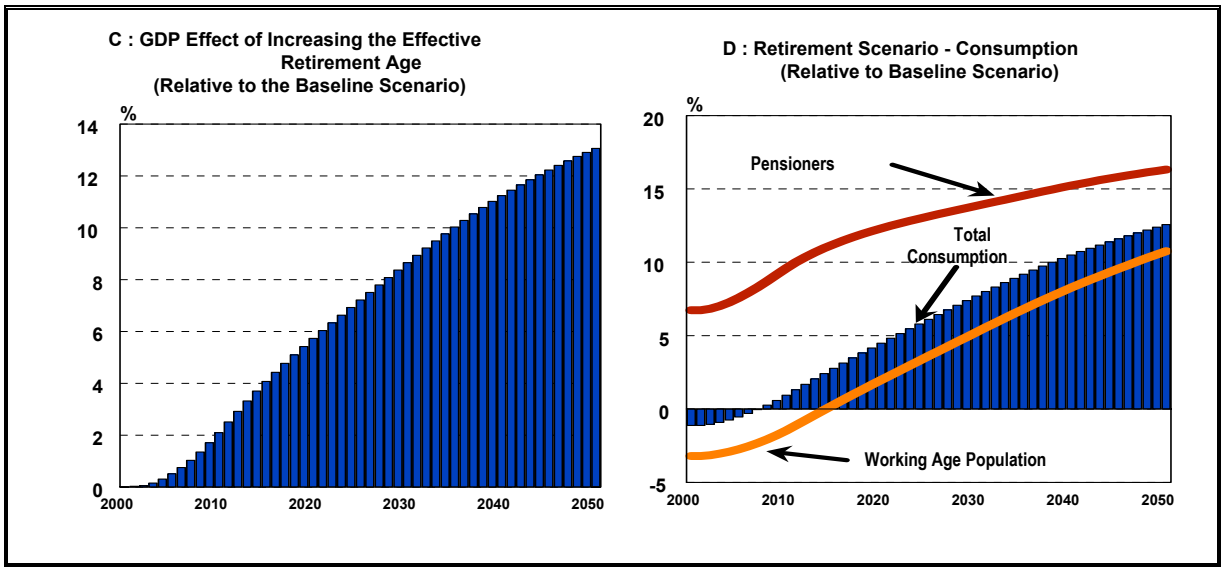
	Growth	Budgetary Impact		Income Distribution	
	GDP per capita (% Diff. from Baseline)	Social Security Contributions (% of Wages)	Public Pension Expenditure (% of GDP)	Working Age Population Consumption (% Diff. from Baseline)	Pensioners Consumption (% Diff. from Baseline)
2005	0	16.1	10.5	0	0
2030	+8.7	18.3	12.0	+5.2	+13.8
2050	+13.1	20.5	13.4	+10.8	+16.3*

* Given that pensioners do not receive any additional pension entitlements from working the five extra years, assumed in the simulation, this higher level of consumption relative to that of the working age population simply reflects the fact that life cycle consumers will have a shorter period over which to consume their accumulated lifetime wealth.

Graph 3 : Increase in the Effective Retirement Age to 65



[18] Note that the Annual Progress Report refers to a one-year increase in the effective retirement age. Using an approximate linearity of the model simulations, these figures are scaled-down results reported in the Table 6.



4. The Internal Market in an enlarged EU - the effects of simulations using the QUEST II model

This section presents simulations of the macroeconomic impact of the Internal Market Programme, particularly taking into account the more recent progress made in terms of liberalisation of network industries and the accession of 10 new Member States.

The Commission's QUEST II model has been used to carry out simulations ex-post of the macroeconomic impact of the Internal Market over the period 1992-2006. The simulations for the manufacturing industry are based on parameter estimates found in the empirical literature on the impact of the Internal Market on price-cost mark-ups and total factor productivity[19].

For network industries, the reduction in aggregate price-cost mark-ups associated with the liberalisation of network industries (electricity and telecommunication) is assumed to be 0.5%. This parameter estimate is based on preliminary evidence for the electricity sector suggesting a decline in price-cost margins of up to 25%[20]. A somewhat larger decline in price-cost margins in telecommunications is assumed in light of the faster pace of liberalisation in that sector[21]. The 0.5% aggregate mark-up shock reflects these sectoral declines in price-cost margins plus the weight of the electricity and telecommunication sectors in GDP. The introduction of this shock in QUEST II results in an increase in GDP and employment of 0.4% and 0.6% respectively after 4 years; GDP is estimated to increase by 0.6% after 10 years[22].

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19 See: Allen *et al.* (1998), Buigues et al. (1990), Bottasso and Sembenelli (2001), Notaro (2002) and Salgado (2002).

20 See: Roeger and Warzynski (2002).

21 The (cautious) assumption has been made that mark-ups in the telecommunications sector have decreased by 50% more than in electricity. This assumption is also consistent with the more advanced state of liberalisation in telecommunications.

These effects are somewhat stronger than the Internal Market effects, because in these simulations it is assumed that deregulation also has an effect on rent sharing between workers and firms. The decline in

These intra-EU15 simulations have been combined with simulations capturing the effects of EU enlargement. The enlargement simulations consist of three steps: (1) isolating the trade effect of the enlargement; (2) computing the resulting effect on mark-ups and total factor productivity; and finally (3) introducing the estimated mark-up and total factor productivity shocks into the QUEST model. According to the simulations, the magnitude of the enlargement effects varied substantially between the old and new Member States as the latter faced much higher mark-up and total factor productivity shocks during the early years of the enlargement. For the EU15 the simulations showed a 0.27% GDP increase in 2006[23] (relative to the baseline level) as a result of enlargement. This was accompanied by a slight increase in employment. (see table 7 and 8). In contrast the simulations for the new Member States showed a GDP increase of 2.9% on average, while employment increased by 0.5% in 2006 (relative to the baseline).

To compute the combined effect of EU15 integration and the enlargement, the corresponding yearly mark-up and total factor productivity shocks have been added up. Table 9 presents the results for the EU25. These results show that the enlarged Internal Market (including liberalisation of network industries) is an important source of growth and jobs. As a result of the progress made over the period 1992-2006 in achieving an enlarged Internal Market of 25 Member States, GDP and employment levels have increased significantly. The estimated "gains" from the Internal Market in 2006 amount to 2.2% of EU GDP (or 223 billion euro) and 1.4% of total employment (or 2.75 million jobs). These gains could have been substantially larger if services market had been fully opened up to cross-border competition.

Table 7: GDP effects of the Internal Market (SMP), the liberalisation of network industries and enlargement (deviation from baseline level), 2002-2006

Years	**EU15**						**EU10**	
	Network+SMP[a]		Enlargement		Network+SMP+Enlargement		Enlargement[b]	
	mrd EUR	**%**	**mrd EUR**	**%**	**mrd EUR**	**%**	**mrd EUR**	**%**
2002	164,5	1,79%	15,9	0,17%	180,4	1,96%	8,8	1,96%
2003	168,4	1,81%	18,9	0,20%	187,3	2,01%	11,4	2,45%
2004	172,2	1,81%	21,2	0,22%	193,4	2,03%	12,8	2,62%
2005	176,1	1,83%	24,5	0,25%	200,6	2,08%	14,8	2,90%
2006	179,9	1,83%	27,1	0,27%	207,0	2,10%	15,6	2,91%

price-cost mark-ups is therefore associated with a decline in the mark-up of wages over the reservation wage.

[23] The enlargement trade effect is identifiable already in the years before enlargement took place in 2004.

Table 8: Employment effects of the Internal Market (SMP), the liberalisation of network industries and enlargement (deviation from baseline level), 2002-2006

Years	EU15						EU10	
	Network+SMP[a]		Enlargement		Network+SMP+Enlargement		Enlargement[b]	
	1000 p.	**%**	**1000 p.**	**%**	**1000 p.**	**%**	**1000 p.**	**%**
2002	2450,6	1,47%	67,9	0,04%	2518,5	1,51%	118,9	0,41%
2003	2454,5	1,46%	85,4	0,05%	2539,9	1,51%	104,2	0,36%
2004	2458,3	1,45%	86,0	0,05%	2544,3	1,50%	116,5	0,40%
2005	2462,2	1,44%	104,1	0,06%	2566,3	1,50%	145,0	0,49%
2006	2466,0	1,43%	122,4	0,07%	2588,4	1,50%	162,1	0,54%

Table 9: Total GDP and employment effects of the Internal Market (SMP), the liberalisation of network industries and enlargement (deviation from baseline level), 2002-2006

Years	EU25			
	Total GDP effect		Total employment effect	
	mrd EUR	**%**	**1000 p.**	**%**
2002	189,2	1,96%	2637,4	1,35%
2003	198,7	2,05%	2644,1	1,34%
2004	206,2	2,08%	2660,8	1,34%
2005	215,4	2,15%	2711,2	1,35%
2006	222,6	2,18%	2750,5	1,36%

Sources: * EU15 Internal Market and network liberalization effect: W. Röger and K. Sekkat (2002), 'Request from DG MARKT to Assess the Macroeconomic Effects of the Single Market Program after 10 years.'
** Effect of enlargement on EU15 and EU10: J. Varga (2006): 'Ex-post Simulation of the Early Enlargement Process with QUEST II.' The impact of enlargement is based on manufacturing data only, see p. 8. "Table 1: Ex-post enlargement effects (deviation from baseline-level), EU12-EU15"
GDP: AMECO, Gross domestic product at current market prices in mrd EUR in 2002 prices
EMPLOYMENT: Employment, 1000 persons; total economy (National accounts)
Note: The EU15 network + SMP effect (column A) is calculated by linear interpolation from the results of Roeger and Sekkat (2002).

5. Reductions in administrative burden

Reducing the costs European companies encounter due to compliance with administrative regulation laid out in national and European legislation is one of the five most important Lisbon goals. Estimates provided by the CPB Netherlands Bureau for Economic Policy Analysis (CPB) suggest that in EU administrative costs imposed on European companies are in the magnitude of 3.5% of GDP.

This section analyses the effects of reducing these costs by 25% over the period 2006 to 2010 in EU. It presents results of two sets of simulations: one produced with the QUEST model and the second with the WorldScan model. Both simulations are designed in a similar way:

starting from an impact effect of 0.8% of GDP which is equivalent to the 25% reduction in administrative burden. Nevertheless, the channels through which the effects materialise are different. In the QUEST simulation, we regard a reduction of administrative burden as a reduction of fixed costs. In other words, the reduction of fixed costs implies that the productivity of an individual production worker is not increased by a reduction of administrative cost, only average productivity of all employees is increased because the firm can produce the same level of output with a smaller number of employees working in the administrative departments of the company. On the other hand, the WorldScan simulation assumes that reduction in administrative burden leads to an increase in the efficiency of labour, i.e. the shock is given through labour augmenting technical progress.

Unfortunately not many quantitative estimates on the size of the administrative burden exist. In order to arrive at an estimate in the case of Europe, Kox (2005) combines two sources, namely an international comparative study conducted by World Bank economists (Djankov et al. (2002)) which compiles information on firm start-up costs for 85 countries, with an aggregate measure of administrative costs carried out for the Netherlands which not only takes into account administrative costs arising from starting a new company but also contains information about administrative costs of existing firms.

The Djankov study tracks all officially required administrative procedures and costs which are normally required for setting up a firm, such as taxes, screening costs, safety & health, environmental and labour related requirements. The study uses official information as well as information by country experts. Djankov et al. count the number of mandatory procedures in the above mentioned areas and estimate the time it takes for completing each procedure in order to arrive at a cost measure. As an alternative source Kox also uses an OECD study which also focuses on the cost/time it takes to register a public limited company. Both the OECD and the Djankov study arrive at similar results concerning the time it takes to comply with the administrative procedures. In both studies, the countries with the lowest administrative start up costs are the UK, Sweden, Finland and Denmark, while the countries with the largest start up costs are Greece, Spain, Portugal and Italy.

The aggregate measure for the Netherlands is based on a study carried out by the Dutch government for the year 2002 where the administrative costs implied by government regulations and information requirements are estimated based on interviews in which companies where asked to provide information about the annual costs of such regulations[24].

In order to obtain aggregate measures for all EU member states Kox merges the aggregate information for the Netherlands with the cross section information on start up costs to estimate aggregate costs for all EU member states. Obviously these are rough estimates since they assume that the distribution of start up costs is representative for the administrative burden in general. According to these estimates, the total administrative burden in EU is about 3.4% of GDP and it varies across countries with Greece and Hungary showing the highest estimate of 6.8% and the UK, Sweden and Finland the lowest estimate of 1.5% of GDP.

[24] In autumn 2004, the EU finance ministers have agreed on a similar methodology for assessing the costs of administrative burdens in their respective countries either on more general or more narrowly defined policy areas. See, Informal ECOFIN bulletin, 10 and 11 September 2004 and 'The Administrative Burden Declaration' from June 2004.

5.1 QUEST III simulation results

The results of the simulation exercise with the QUEST III model can be summarised briefly as follows.[25] We start from the observation that the administrative burden acts like a fixed cost for firms. Therefore a reduction of the administrative burden has a direct cost reducing effect but it also reduces entry barriers and may therefore have a competition enhancing effect, depending on the degree of competition in the goods market. Two scenarios are analysed. In scenario 1 we only consider a cost reduction of 25% (or 0.85% of GDP), while scenario 2 combines the cost reduction with a competition effect. Scenario 1 yields a long run GDP level effect of about 1% (0.9% in 2025). If the reduction of administrative burdens leads to new entry as assumed in scenario 2, an output effect of up to a maximum of 2% (1.8% in 2025) is feasible.

Important additional information supplied by the Dutch study is that the administrative costs are to a large extent size-independent of overhead costs. This fixed cost nature of the administrative burden will be taken into account in the simulation exercise. In the QUEST III model, production is subject to fixed and variable cost.

In the simulation exercise it is assumed that firms require less overhead labour if the administrative burden is reduced (for a more technical description, see the appendix to this note). While the reduction of fixed costs is an immediate consequence of a reduction in administrative burden, there is one possible additional implication. The fixed costs associated with regulation can be regarded as an entry barrier. They define a lower bound for mark ups firms must charge in order to cover these fixed costs. With well functioning product markets it can be expected that a reduction in fixed costs will lead to more entry and an erosion of mark ups to re establish the pre reform level of economic rents. In the following we therefore present two scenarios. In the first scenario we only consider the macroeconomic effects of a reduction in the regulatory burden under the assumption that no entry takes place (administrative cost reduction with imperfect goods markets). In a second scenario we allow for entry. In fact we consider a maximum possible competition effect by allowing entry and an associated decrease in mark ups to a point where all additional profits from a reduction in administrative costs would be eroded. (administrative cost reduction with free entry). In the simulations reported below it is assumed that the administrative burden in EU15 which currently amounts to 3.4% of GDP is reduced by 25% (or .85% of GDP) over the period 2006 to 2010.

5.1.1 Scenario 1: Reducing administrative costs only

A reduction in administrative costs is beneficial for firms since it reduces average production costs, i. e. less overhead labour is required for producing the same level of output. However, unlike an increase in labour augmenting technical progress, a reduction of fixed costs does not increase the marginal product of labour and therefore it leads to a downward shift in labour demand[26]. It increases profitability of firms and therefore increases investment, however, as

[25] This exercise is carried out for the EU15 aggregate. For the simulation, a new variant of the QUEST III model (based on the estimated DSGE model described in Ratto et al. (2006)) is used which incorporates improvements on the production side. In particular a clear distinction is made between variable costs and fixed costs (especially in the form of overhead labour). For more detail, see Annex B.

[26] See Appendix B.

shown in Table 10 below the increase in investment is not strong enough to prevent employment from falling below the baseline level.

Table 10: Reducing administrative costs

	Without free entry						With free entry					
	Y	C	I	K	WR	L	Y	C	I	K	WR	L
2006	0.2	0.1	-0.0	-0.0	0.1	0.0	0.2	0.1	0.5	0.0	0.1	0.1
2007	0.1	0.3	-0.4	-0.0	0.3	-0.2	0.4	0.3	0.9	0.1	0.5	0.1
2010	0.6	0.5	0.3	-0.0	-0.1	-0.4	1.3	0.7	2.1	0.3	1.2	0.1
2015	0.9	0.8	0.4	0.1	-0.2	-0.4	1.6	1.1	2.4	1.0	1.5	0.1
2025	0.9	0.9	0.5	0.3	-0.2	-0.4	1.8	1.2	2.5	1.7	1.7	0.1
2055	1.0	0.9	0.5	0.5	-0.1	-0.4	2.0	1.4	2.7	2.5	1.9	0.1

Source QUEST III model
The results reported in the table are per cent deviations from baseline levels.
Y: GDP; C: private consumption; I: investment; K: capital; WR: real wage rate;
L: employment

The results show, a reduction in administrative burden is beneficial in terms of output, investment and consumption but it has negative employment effects. Because of negative employment effects the overall macroeconomic impact of the reform does hardly exceed the direct effect. Also notice, in this scenario a reduction in administrative costs has distributional consequences, the wage share declines by about 1% point, while the rate of pure profits (revenue minus labour and capital costs as a percent of the capital stock (at replacement value)) increases by .4% points.

5.1.2 Scenario 2: Reducing administrative costs and allowing free entry

If goods markets are sufficiently flexible such that a reduction of fixed costs induces the entry of new firms, then there is more room for employment creation. In this scenario it is assumed that entry leads to a reduction in mark ups until the pre-reform rate of pure profits is re-established.[27] This must be seen as the maximum possible competition effect that can be achieved by this reform. As can be seen in Table 10, taking into account competition effects, can significantly increases the output response associated with a reduction in the administrative cost. In particular increased competition and new entry prevents a decline of employment and leads to an increase in real wages. While in the first scenario the benefits of reducing the administrative burden accrue to capital owners, with free entry benefits accrue to workers.

5.2 WorldScan simulation results

We estimate the effects of a gradual reduction up to 2010 of 25% in the costs European companies encounter due to compliance with administrative regulation laid out in national and European legislation using the WorldScan[28] model (Lejour et al., 2006). This exercise follows Gelauff and Lejour (2006).

[27] In the model this implies a reduction of the mark up of 1.2 % points.

[28] WorldScan is a global (recursive) dynamic computable general equilibrium model with multiple regions, sectors, and production factors as well as imperfect competition that focuses on the economies of the

5.2.1 Methodology

The implementation of the scenarios varies from the earlier simulations in Gelauff and Lejour (2006) in as such that (i) we apply the country distribution of administrative cost (see first data column of Table 11) to the entire 25% cost reduction and not only to the part that corresponds to the national legislation (estimated at 58% for The Netherlands), while the part that corresponds to the European legislation (estimated at 42% for The Netherlands) is associated with the Dutch estimate of administrative costs at 3.7% of GDP and (ii) we impose a gradual achievement of the cost reduction for the 2006-10 period in 5% annual decrements, instead of imposing the entire reduction in 2005.

Box 3: The WORLDSCAN model

WorldScan is an applied computable general equilibrium model (CGE) for the world economy developed at the CPB, Netherlands Bureau for Economic Policy Analysis.[29] It is a recursively dynamic model of the global economy with multi-region and multi-sector detail, the regions being connected by bilateral trade flows at industry level. The model covers up to 87 regions and 57 sectors providing considerable flexibility in showing regional and industry detail.

WorldScan is a flexible model that has been developed to construct long-term scenarios for the global economy and to enable policy analyses in the field of international economics. Simulating certain economic developments may reveal important impacts on the world economy and identify related policy problems. Long-run scenarios have frequently been used as baselines for exploring the impacts of structural reforms and alternative policy options with WorldScan, for example in the fields of global warming, economic integration and trade.

The core version of WorldScan is extended in separate directions to form dedicated versions, such as: a climate change version, a version with R&D spillovers, and a version with imperfect competition and increasing returns to scale. Hence, the model has considerable flexibility in incorporating those economic mechanisms that are thought to be of most interest for specific policy applications. For the simulations presented in this paper, the appropriate version of WorldScan has been chosen with respect to the analytical context, namely the version with imperfect competition for the reduction in administrative burden and the version with R&D spillovers for the increase in R&D expenditure.

WorldScan fits into the tradition of applied general equilibrium models building upon neoclassical theory. It has strong micro-foundations and explicitly determines simultaneous equilibrium on a large number of markets. The model is solved as an equation system and thus is cast in a CGE format. The mechanisms of the model are founded on empirical analysis where possible. Examples are the empirical foundation of R&D spillovers, non-tariff trade barriers, the degree of international capital mobility, savings rates, total factor productivity growth and projected labour supply.

Economic growth in WorldScan can be targeted in scenarios through adjustments of primary inputs, such as labour, and the rate of technological change. In principle, the growth of total factor productivity is exogenous in WorldScan. However, productivity is affected endogenously if spillovers of R&D on productivity are introduced. Labour supply is exogenous and derived from demographic trends and projected rates of labour participation. Savings depend on the demographic composition of the population and the growth rate of per capita income. Investments are savings-led and capital mobility is internationally less than perfect. Hence, countries will face different real interest rates. Regional households are guided by utility maximisation in buying goods and services. The model's interregional linkages through trade in goods and services depend on customers' demand for interregional varieties. Trade is impaired by formal barriers to trade and possibly by non-tariff trade barriers as well. The government is part of the regional household, hence there is no need to impose the government budget to balance and all tax and tariff rates are exogenous.

The dynamics of the model are determined as follows. Valued added grows by the increase of labour productivity and the rise of labour supply. Labour productivity is determined by technological progress and capital growth per unit of labour. Employment growth is exogenous, and derived from population growth, its age-composition, age-specific participation rates, and the unemployment rate. Hence, technological progress and the factors underlying labour supply are the main driving forces for diverging development patterns.

Table 11 presents the administrative costs that occur to the private sector as percentage share of total GDP across Member States. These administrative costs only reflect the activities directly related to the compliance with information requirement contained in legislation (like

European Union. It has been developed at The CPB Netherlands Bureau for Economic Policy Analysis (www.cpb.nl).

[29] For a more detailed description of the WorldScan model refer to the CPB document No. 111 (2006) from which this box has been derived (www.cpb.nl/eng/pub/cpbreeksen/document/111).

the time and effort in filling out forms), but do *not* reflect any kind of efficiency gains in associated production processes due to better regulation or the general elimination of legislation. Hence, the respective costs mainly comprise wages for employees and can be reduced, for example, through the avoidance of double reporting and the elimination of redundant/out-dated reporting. Table 1 indicates that administrative costs show a wide range of distribution across economies, but apparently the country values do not correlate with the economic size of a country or whether it is a new or old Member State.

Table 11: Reduction of administrative costs and gains in labour efficiency

Member State	Administrative costs share in GDP (in %)[1]	Labour costs share in value added (in %)	Increase in labour efficiency Δ eff (in %)[3]
Austria	4,6	51,3	2,2
Belgium+Luxembourg	2,8	66,2	1,1
Czech republic	3,3	50,9	1,6
Germany	3,7	57,4	1,6
Denmark	1,9	62,5	0,8
Spain	4,6	55,6	2,1
Finland	1,5	53,6	0,7
France	3,7	51,6	1,8
UK	1,5	65,0	0,6
Greece	6,8	59,5	2,9
Hungary	6,8	48,3	3,5
Ireland	2,4	57,2	1,1
Italy	4,6	50,4	2,3
Netherlands	3,7	56,9	1,6
Poland	5,0	52,2	2,4
Portugal	4,6	61,9	1,9
Baltics + Malta + Cyprus	6,8	52,0	3,3
Slovakia	4,6	44,8	2,6
Slovenia	4,1	64,8	1,6
Sweden	1,5	65,2	0,6
EU-25[2]	3,5	56,9	1,6

1 Kox (2005).

2 EU-25 figures are GDP-weighted averages.

3 The increase in labour efficiency that corresponds to a 25% reduction in administrative burden to the private sector is computed as:

$$\Delta \text{ eff} = 0.25 * (\text{AdmCost} / \text{GDP}) / (\text{LabCost} / \text{GDP})$$

where: Δ *eff* is the change in labour efficiency
AdmCost / GDP is the share of administrative costs in total GDP
LabCost / GDP is the share of labour costs in total GDP

As described by Gelauff and Lejour (2006), administrative costs are assumed to mainly comprise wages and their reduction can therefore be interpreted as an increase in labour efficiency. The relative change not only depends on the initial size of the costs, but also on the labour cost share in total GDP at factor cost (value added), which in turn also varies considerably across Member States as shown in the second data column of Table 1. Consequently, the change in labour efficiency that would correspond to a 25% reduction of the administrative costs covers a wide range from 0.6% increase in the case of the United Kingdom to 3.5% in the case of Hungary. While the United Kingdom starts from the lowest administrative cost share and one of the highest labour cost shares among all Member States,

it is exactly the opposite for Hungary, which not only starts from high administrative costs relative to GDP, but also from a labour cost share in GDP at factor cost, which is some 15 percentage points lower than for the top three Member States.

5.2.2 Simulation results

In the medium term the gains for the EU-25 are about 1.3% additional GDP in 2025 vis-à-vis the baseline scenario[30] in case that all Member States achieve the 25% reduction in administrative burden by 2010.[31,32] The potential gains by country range even further from 0.5% to 2.6% of GDP in 2025 depending on their initial relative magnitude in administrative burden. Additional scenarios show that individual Member States can only gain through their own efforts in reducing the (in some cases very high) administrative costs for their private sector and not via spillovers from other Member States' reductions. However, given the potentially high administrative costs in some countries, Europe's competitiveness vis-à-vis its trading partners very much depends on the joint effort by all Member States in working towards the Lisbon target of cutting red tape.

6. The effect of increasing R&D expenditures

In 2000, the Lisbon Council set a goal for increased R&D expenditure at 3% of GDP to be achieved in a decade. During the Spring Council in 2006, however, Member States have announced country-specific targets (cf. Table 12). This section quantifies the macroeconomic effects of increasing the R&D intensity according to the announced national targets. The new R&D expenditure targets set for 2010 by member states' show often far lower national targets than the 3% of GDP agreed upon in the Barcelona Summit in 2002. Greece (1.5%), Portugal (1.8%), Spain (2%) and Italy (2.5%) together with Ireland (2.5% by 2013) and UK (2.5% by 2014) have scaled down their goals while the other MS have kept the original targets. The new goals require a 0.8 percentage point increase in the R&D intensity from its 2004 value of 1.9% to the targeted average of 2.7%.

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[30] The baseline is the *business-as-usual* scenario reflecting the economic policies and the business environment in place in 2005. The base year is 2001 and the model is calibrated to the macro variables observed until 2004. After 2005, the dynamics of the model result from demographics (population and aging), labour supply, technological change, and capital accumulation. In as such the baseline reflects a world with no changes in its policy environment throughout the modelling horizon until 2020.

[31] Given that WorldScan is a simulation model these results have to be interpreted as mere approximations. However, as opposed to many macro(-econometric) models, the analysis using WorldScan not only allows for an inspection of macroeconomic results for the aggregate EU-25 region, but also for the inspection of more disaggregated national and sectoral effects.

[32] The effect on GDP in 2010 (the final year of the gradual reduction of administrative costs between 2006 and 2010) is about 0.1 percentage points lower then at the end of the simulation period (2025), which is due to the capital accumulation that follows the higher efficiency of labour. However, in this model version of WorldScan without explicit R&D investment decision by firms and R&D spillovers we do not observe the full effect of a 1.6% increase in labour efficiency until 2025. Note that all changes reported are level effects and not accumulative effects over time. Although these level effects do not vary substantially when comparing the final year of implementation (2010) and the terminal year of simulation (2025), we report results for 2025 to demonstrate the persistence of the positive effects of a perpetual reduction in the administrative burden.

6.1 QUEST II simulation results

This exercise will concentrate only on the EU15 as a whole, and estimates the impact of reaching the newly announced national R&D targets in the framework of a semi-endogenous single-country version of the QUEST III model (see Box 4). Our simulation shows a 4.4 % GDP increase in 2025 relative to the baseline level if all EU15 MS achieve their target in 2010. It is, nevertheless, important to note that the current version of the model cannot take into account the spillovers from non-EU15 countries, though it implicitly incorporates the spillovers within the EU15. Simulations with the multi-country QUEST II model show higher estimates.

Box 4: A description of the QUEST III R&D-model

In order to model the effect of R&D stimulating policies in the European Union an EU aggregate version of DG ECFIN's QUEST III model with endogenous R&D is used. R&D investment is introduced following the literature on semi-endogenous growth models (see Jones (1995)). The model distinguishes final, intermediate and R&D producing sectors. Final goods are produced in a monopolistically competitive environment using labour and intermediate inputs according to a Cobb-Douglas production function. The intermediate sector is composed of monopolistically competitive firms that purchase designs from the R&D sector. Designs are produced by an R&D sector via a knowledge production function using labour and the existing stock of knowledge. Technical progress is generated via the introduction of new goods based on designs produced in the R&D sector. Resources are mobile across these three sectors up to some adjustment costs and factors are rewarded according to their marginal efficiency. The QUEST III model provides a rich environment to model the R&D promoting fiscal policy measures taking into account the cost of higher R&D spending and subsidies. In the simulations presented here it is assumed that EU governments promote R&D expenditure by subsidising the intermediate goods sector.

6.1.1 Methodology

Endogenous growth embraces an immense body of theoretical and empirical work that emerged in the 1980s. This paradigm distinguishes itself from the neoclassical model by emphasizing that economic growth is an endogenous outcome of the economic system, not the result of forces determined from outside. These theories are of interest to policymakers because they allow the discussion of policies to foster economic growth and they also allow the calculation of costs associated with higher R&D spending. In order to model the effect of R&D stimulating policies in the European Union, we augmented ECFIN QUEST III model with a semi-endogenous growth setting developed by Jones (1995, 2005). The model follows the aggregate version of the QUEST III model extended by an additional R&D sector providing new varieties of designs which increase the productivity in the final goods sector[33]. The intermediate sector is composed of monopolistically competitive firms that have purchased a design from the R&D sector. The R&D expenditures of intermediate sectors are interpreted as R&D investments. The QUEST III model provides a rich environment to model the R&D promoting fiscal policy measures. From the financing point of view, subsidies can be paid from tax revenues on consumption, on capital and labour income or on lump-sum taxes. From the expenditure side there are four possibilities to introduce R&D promoting subsidies: 1) subsidy on the wages paid by the R&D sector; 1) price subsidy on the R&D sector's products; 3) reduction of taxes paid by the R&D sector; 4) reduction of taxes paid by the intermediate sector. In the following simulation we will examine the effect of tax reduction favouring the intermediate sector where subsidies are financed by lump-sum taxes.

[33] See Roeger at al (2007) for detailed description of the model.

6.1.2 Simulation results

We designed the simulation to gradually close the gap between the current R&D spending and the EU15 target by 2010. The applied policy measure for stimulating the R&D expenditures is a lump-sum tax financed subsidy in the form of tax-reduction to the intermediate sector which uses R&D products to introduce more goods in the market. We assume that the EU15 wants to maintain the achieved target between 2010 and 2020. This scenario is close to the one applied in the CPB simulations and the most appropriate for comparing the results. Table 1 presents the simulation results on GDP, consumption, total factor productivity, total and R&D employment at EU15 level in 2025. The simulation shows a 4.4% increase in GDP relative to the baseline under the implied conditions. Consumption goes up by 5.2 % and real wage increases by 5.1 %. Employment devoted to research activities must increase by 40 percent in order to reach the target. This result is in line with the findings of Sheenan and Wyckoff (2003) which estimated that in order to reach the Lisbon R&D targets, the EU15 needs to employ 30% to 60% additional researchers. It is important to note that we do not analyse the feasibility of the modified national targets, therefore we do not model whether it is possible to increase the R&D personnel by 40% within a decade as the national programs would require it or not. Although total factor productivity is increasing by 7.6 percent, GDP is up by only 4.4 percent. This gap is explained by the proportional decrease in capital and labour input[34].

Table 1. Macroeconomic impact of R&D targets

Year	Y	C	L	LRD	K	TFP	WR
2025	4,4	5,2	-0,7	40,0	-2,2	7,6	5,1

Source: QUESTRD simulations. Y: GDP, C: consumption, L: total employment, LRD: R&D employment, K: Capital, TFP: total factor productivity, WR: real wages. Results are per cent deviations from baseline levels.

6.1.3 Comparison with exogenous growth version of QUEST model

Studies that measure the impact of R&D intensity on total factor productivity have generally shown larger benefits in GDP, but those simulations exclude financing costs. Recent QUEST simulations based on the multicountry, exogenous growth version of QUEST and using the TFP estimations from ULB (2006) provided larger results closer to the upper bound of the CPB estimations showing around 7% GDP increase for Germany in case of reaching the national target in time for 2020. GreenMod simulations showed even higher, 8.8% GDP increase for Germany[35]. The present semi-endogenous version of QUEST does not take into account the spillover effects from non-EU15 countries, therefore it can still represent a lower-bound scenario compared to the case when all EU25 countries can achieve their national targets by 2010.

[34] If we change to inelastic labour supply as in Gelauf and Lejour (2006) and neutralize the impact on labour, we would get proportionally higher effect on GDP (around 5 %).

[35] See ULB (2006). The simulations were carried out only for Germany, France, Italy, Spain and UK, therefore the possible spillovers from other EU countries could probably still increase these estimates.

6.2 WorldScan simulation results

This exercise provides an update on Lejour et al. (2006) and Gelauff and Lejour (2006) who analyse, using the WorldScan[36] model, a proportional increase of all national R&D expenditure based on the overall EU target of 3%.[37] We therefore re-estimate the effects of all Member States achieving the self-set targets on R&D expenditure by 2010. Furthermore, we compare the results with the estimates for a second scenario, in which all Member States achieve the announced targets, but with a certain delay that corresponds to the relative effort individual Member States are facing in achieving their respective goal.

Our expectation of a delay in achieving the self-set targets on R&D expenditure are in line with earlier studies by the European Commission (cf. Arundel and Hollanders, 2005). The study results suggest that a sufficient increase in business R&D expenditure (BERD), which are assumed to contribute two-third to the overall 3% target, is rather unlikely to be achieved by 2010. Only under a very ambitious scenario based on the highest observed growth rates for all 13 countries studied, a 2% BERD intensity would be reached as early as 2015.

6.2.1 Methodology

Our analysis is of a "What If" type, which means that we only calculate the consequences of policy measures, but do not make an evaluation of the feasibility of these measures and the corresponding costs of realizing them. As can be seen from Table 1, the level of R&D expenditure across Member States in 2004 is extremely diverse ranging from half a percent to almost four percent. Although Member States with lower levels have in general announced more modest targets for 2010, the additional R&D expenditure to be achieved in percentage points of GDP also vary substantially between 0.3% and 1.4%. The relative increase of these additional R&D expenditure with respect to the 2004 levels thus range from 7% to 240% illustrating the tremendous effort that some Member States are facing in reaching their targets. However, we acknowledge that it is potentially easier for a small economy to achieve a certain percentage point increase in R&D expenditure than it is for a larger economy (especially considering the additional financing, scientific personnel, and innovative ideas as well as the decrease in marginal return to R&D expenditure). Therefore, we adjust the relative increase in R&D expenditure using logarithmic values of the individual countries' GDP that range from 0.67 for the smallest to 1.64 for the largest economy to determine the *relative effort* in achieving the self-set R&D expenditure target. We then assume that the three Member States with the lowest relative effort achieve their target in 2010, while all other Member States achieve their respective target between 2011 and 2020 depending on the magnitude of relative effort they have to master. By doing so, we impose a neutral assessment and acknowledgement of the effort ahead of each Member State and the community as a

[36] The WorldScan version applied for the R&D simulations features endogenous firm decision on R&D spending and R&D spillovers. It has been developed at The CPB Netherlands Bureau for Economic Policy Analysis (www.cpb.nl).

[37] Gelauff and Lejour (2006) implement the increase by setting an upper limit to R&D expenditure of 4.5% of GDP and a gradual increase of R&D expenditure from 2005 to 2010 decreasing the gap between actual R&D expenditure shares in 2004 and the announced country targets for 2010 such that the increases are proportional across Member States and in sum reach the community target of 3%.

whole, where individual economies will have to compete not only for financial, but also (and maybe more importantly) for human capital.

Table 12: R&D targets and the relative effort of achievement

Member State	R&D expenditure in 2004[1]	R&D expenditure targets for 2010[1,2]	Relative increase in %	Relative country size (log100[GDP])	Relative effort[4]	Potential year of achievement[5]
Austria	2,3	3,0	33	1,15	0,38	2011
Belgium+Luxembourg	1,9	3,0	57	1,20	0,68	2013
Czech republic	1,3	2,1	61	0,91	0,55	2012
Germany	2,5	3,0	20	1,64	0,34	2011
Denmark	2,6	3,0	15	1,11	0,17	2010
Spain	1,1	2,0	87	1,40	1,22	2015
Finland	3,5	4,0	14	1,06	0,15	2010
France	2,2	3,0	39	1,57	0,61	2012
UK	1,8	2,5	40	1,59	0,63	2012
Greece	0,6	1,5	159	1,06	1,68	2018
Hungary	0,9	1,8	102	0,89	0,91	2014
Ireland	1,2	2,5	108	1,04	1,13	2015
Italy	1,1	2,5	119	1,53	1,82	2018
Netherlands	1,8	3,0	69	1,29	0,90	2014
Poland	0,6	1,7	184	1,15	2,12	2020
Portugal	0,8	1,8	131	1,03	1,35	2016
Baltics + Malta + Cyprus	0,6	1,6	164	0,83	1,36	2016
Slovakia	0,5	1,8	240	0,69	1,65	2017
Slovenia	1,6	3,0	86	0,67	0,58	2012
Sweden	3,7	4,0	7	1,18	0,08	2010
EU-25[3]	1,9	2,7	58		0,81	

1 Source: Presidency Conclusion of the Brussels European Council 23/24 March 2006, Annex 1
2 IE target for 2013, PL target for 2008, UK target for 2014
3 EU-25 figures are GDP-weighted averages
4 Relative effort = Relative increase in R&D expenditure * log100[GDP] /100
5 We choose the relative effort of DK (0.17) as cut-off point. Consequently, DK, FI, and SE are assumed to achieve their respective target in 2010. All other Member States are spread proportionally to their relative effort beyond the cut-off point between 2011 and 2020.

Table 12 presents the R&D expenditure in % of GDP as reported for 2004 (data column 1), the announced targets for 2010 (data column 2) and the relative increase it takes to achieve the target (data column 3). We use this relative increase and the relative (logarithmic) country size (data column 4)—which is distributed around 1—to determine the *relative effort* (data column 5) it takes the individual Member States to achieve their respective target. Taking into account this relative effort, we assign, for the second scenario, new potential years of achievement (data column 6).

6.2.2 Simulation results

Table 13 presents the immediate effects of increased R&D expenditure for the EU as a whole and a number of selected countries. The choice of countries was based on GDP size and trade openness. Germany is with 33% imports plus exports over GDP the most open of the largest five EU economies, while the United Kingdom is (with 25%) less open. The Czech Republic

as a medium size EU economy is extremely open (71%), while Poland's trade openness (27%) is at comparable levels with the UK. We also selected Sweden as a representative of the group of Member States with the best performance in R&D expenditure levels and the lowest relative effort in achieving their announced targets (DK, FI, SE). Apart from the results for the two scenarios described above, the individual country blocks in Table 13 also present the results for comparative scenarios, in which *only* the respective country increases R&D expenditures as in the first scenario, but no other Member State.

Table 13: Impact of higher R&D expenditure on productivity (% changes in levels from the baseline for 2020 unless indicated otherwise)

	R&D expenditure (Δ in % of GDP)	**R&D stock**	**Total factor productivity**	**Share of R&D in total GDP (Δ in % of GDP)**	**Labour productivity in med.-tech industry**	**Labour productivity in high-tech industry**
EU	1,1	50,4	1,9	0,7	4,4	5,5
- delay	1,1	47,3	1,8	0,7	4,2	5,3
Czech Republic	0,9	61,8	2,7	0,5	4,7	5,3
- delay	0,9	60,0	2,5	0,5	4,4	5,0
- only	0,9	60,8	1,4	0,5	2,1	2,8
Germany	1,0	33,9	1,4	0,6	3,8	4,1
- delay	1,0	33,4	1,4	0,6	3,7	4,0
- only	1,0	33,5	0,9	0,6	2,7	3,1
United Kingdom	0,8	33,5	1,2	0,5	3,5	3,4
- delay	0,8	34,8	1,2	0,5	3,5	3,4
- only	0,8	33,2	0,9	0,5	2,6	2,3
Poland	1,1	139,5	3,1	0,6	5,1	5,5
- delay	1,1	104,0	2,6	0,6	4,3	4,6
- only	1,1	138,8	2,5	0,6	4,0	4,2
Sweden	0,5	7,2	0,9	0,3	2,3	3,1
- delay	0,5	7,2	0,9	0,3	2,2	3,1
- only	0,5	6,8	0,3	0,3	0,8	1,4

Note: The first row of each country block presents results for the first scenario, i.e. all MS achieve their target in 2010 (except for IE in 2013, PL in 2008 and UK in 2014. The rows "delay" presents results for the second scenario using the potential years of achievement for all MS. The rows "only" present results for additional scenarios, in which *only* the respective country increases R&D expenditure as in the first scenario, while all other MS do not increase their R&D expenditure.

The increased R&D expenditure raise EU-25 R&D capital stock levels in 2020 by 50% if all countries achieve their target by 2010 (or as announce). If the achievement of the targets is delayed and occurs only gradually between 2010 and 2020, the effect is slightly dampened to 47%, accounting for the compound effects in capital accumulation. The increase in R&D stocks, however, not only differs substantially across individual countries, but for some Member States also when comparing the two speeds of achievement. Given the high initial R&D expenditure level and the already high R&D stock level of Sweden, the increase in stocks is rather small. Germany and the UK manage to increase their already well-developed stocks by one third, which is considerable. Poland, on the other hand, more than doubles its R&D stocks until 2020 vis-à-vis the baseline and the speed of achievement clearly matters. While achieving the target in 2010 leads to an increase in R&D stocks of 140%, the delayed achievement in 2020 reduced the increase of stocks to 104%, which makes a substantial difference in achieving R&D stocks by 2020 that support an innovative and internationally competitive economy.

The improvements in total factor productivity mainly follow the relative increases in R&D stocks. The only substantial difference between the two different speeds of adjustments occurs in the case of Poland with half a percentage point. Most interestingly, the results for the scenarios where *only* individual countries increase their R&D expenditure reveal the substantial spillovers that stem from the joint efforts by all Member States in achieving their R&D targets. These spillovers are largely linked to the trade openness of the respective economy. For the Czech Republic, for example, additional TFP growth as compared to the baseline in 2020 would only be half in the "Czech only" scenario (1.4%) of what it will be in the case when all Member States achieve their targets in 2010 (2.7%).

Table 13 also presents the percentage point shifts in the share of the R&D sector in total GDP, which are quite substantial. Furthermore, the table reports on the labour productivity gains realized in the medium and high tech industry sectors, which benefit the most from increased R&D stocks as compared to other sectors (4.4% and 5.5% respectively for the EU-25). The results show that increased R&D expenditure and the enhanced accumulation of R&D capital stocks will have a remarkable impact on the potential performance and the international competitiveness of some key European industry sectors.

Table 14 presents the main results concerning the alternative speeds of achievement of the R&D target. The level of GDP for the EU as a whole will be 2.6% higher in 2025 if all Member States achieve their targets by 2010. At aggregate EU level, the delay in achieving the target is notable, but not substantial, mainly because some large economies are achieving their target rather early even in the delayed scenario (cf. DE, FR and UK in Table 12). At individual country level, however, the differences are substantial for those Member States who face the largest effort in achieving their target, which for the group of countries shown is the case for Poland (3.6% vs. 2.8%).

While a delay in R&D performance does not change the economic performance of some EU economies (cf. DE, UK, and SE in Table 3), achieving their respective target alone matters a lot, as already suggested by the declines in total factor productivity discussed above (cf. Table 13). In the case of the Czech Republic, 40% of the additional GDP gain in 2025 is due to spillovers that occur if all Member States achieve their targets jointly (3.3% vs. 1.9%). For Germany the spillovers account still for 25% of the overall gains in GDP, while for the UK and Poland it is less than 20%. Given the relatively low effort Sweden needs to undertake itself, the economy will mostly gain through spillovers from an EU-wide achievement of the R&D targets accounting for more than 60% of the country's additional GDP in 2025.

Table 14: Impact of higher R&D expenditure on main economic performance indicators (% changes in levels from the baseline for 2025 unless indicated otherwise)

	GDP	Consumption	Exports	Real wages
EU	2,6	1,0	4,8	2,4
- delay	2,4	0,9	4,6	2,3
Czec Republic	3,3	1,9	5,0	3,4
- delay	3,1	1,7	4,7	3,2
- only	1,9	0,5	2,5	1,8
Germany	2,3	0,8	4,4	2,1
- delay	2,3	0,8	4,2	2,1
- only	1,7	0,2	3,1	1,4
United Kingdom	1,7	0,6	3,7	1,6
- delay	1,7	0,6	3,8	1,6
- only	1,4	0,2	3,0	1,2
Poland	3,6	1,8	5,2	3,4
- delay	2,8	1,5	4,4	2,7
- only	3,0	1,2	3,7	2,8
Sweden	1,1	0,7	2,3	1,1
- delay	1,1	0,6	2,3	1,0
- only	0,4	0,0	0,9	0,3

Note: The first row of each country block presents results for the first scenario, i.e. all MS achieve their target in 2010 (except for IE in 2013, PL in 2008 and UK in 2014. The rows "delay" presents results for the second scenario using the potential years of achievement for all MS. The rows "only" present results for additional scenarios, in which the respective country *only* increases R&D expenditure as in the first scenario, while all other MS do not increase their R&D expenditure.

The gains not only occur through the R&D spillovers directly, but also through a general improvement of Europe's terms of trade vis-à-vis its international trading partners. The increase in international competitiveness is evident from the higher relative increases in exports as compared to overall GDP growth. Higher R&D expenditure lead to innovative and more efficient production processes that are particularly characterised by increased labour efficiency. However, these gains in efficiency apply to the entire economy and through factor movements across sectors also to all production processes. Hence the sectors that have the highest export shares are particularly favoured since their efficiency gains not only work vis-à-vis other sectors of the domestic economy, but in particular vis-à-vis their respective world markets. The extent of the increase in comparative advantage will of course diminish if other non-European economies also increase their R&D performance and consequently their own labour efficiency.

Overall, the welfare gains for European citizens are considerable. Productivity gains through increase efficiency are translated into higher real wages that are proportional to the gains in GDP (which approximately coincides with national income). However, due to the higher investment demand (through increased R&D expenditure) the increase in private consumption is markedly lower than the growth in GDP. Nevertheless, the citizens in New Member States in particular gain almost an additional 2% in terms of consumption on top of the improved economic developments in the baseline. Noteworthy, the additional economic gains from spillovers directly translate into higher consumption as they do not require any additional investment.[38]

[38] Note that the percentage point differences between the first scenario and the respective "country only" scenario are about the same for *GDP* and *Consumption* (e.g. for the Czech Republic 3.3-1.9=1.4 for *GDP* and 1.9-0.5=1.4 for *Consumption*).

From the analysis above we conclude that despite the enormous efforts European economies have to undertake in achieving their individual as well as the joint community target in R&D expenditure, the economic gains will be considerable. First and foremost improved economic performance will be generated through developments in the medium and high tech sectors, which gain the most from R&D-driven innovations. Given the high export shares of these sectors and the relative improvements in labour efficiency vis-à-vis the rest of the world, the gains trough improved international competitiveness are substantial.[39]

Additional gains through spillovers across European economies are substantial and confirm the need for joint efforts among all EU Member States in achieving their respective R&D targets. The welfare gains for EU citizens are substantial across all Member States, but particularly pronounced for those economies, which (i) start from a relatively low level of R&D stocks, (ii) have to master the highest effort in achieving the set R&D targets, and (iii) are characterized by a high degree of trade openness.

7. Concluding remarks

The results of the modelling exercise presented in this paper confirm the potential of the structural reforms which make part of the GJS to significantly boost growth and contribute to generating jobs. The exercise is certainly not an attempt to provide a comprehensive assessment of reforms falling under the heading of the GSJ, however. There are numerous reform areas that are important for boosting growth and employment, such as enhancing quality of human capital or completing the integration of European financial markets, which were not included in the simulations undertaken for this paper. Similarly, it was not possible to give full justice to all measures undertaken within the individual areas, such as active labour market policies or life-long learning schemes, and thus the reported effects should be seen as lower bounds of the actual impacts.

This exercise was undertaken as background for the annual assessment exercise of the GJS and fed into the 2007 Annual Progress Report of the Commission.[40] As a follow-up to this first attempt, the Commission services intend to continue developing their modelling capacity in the field of structural reforms and expand the simulations in several directions.

First, there is a significant scope for a more refined specification of inputs into the models. Arguably, the reliability of the modelling results crucially depends on the policy shocks that are fed into the models. In the academic literature, it is common to define stylised shocks to exogenous variables such as TFP or mark-up which are considered as the main transition

[39] It needs to be kept in mind that this analysis assumes R&D expenditure of other economies not to increase beyond their general developments in the baseline. An increase in other world regions would clearly diminish the gains from R&D expenditures in Europe, especially those following from enhanced export performance. A respective analysis would be particularly interesting in the context of the further emerging of the economies of China and India, but this aspect is clearly beyond the scope of the current analysis. On the other hand, one should consider that although R&D investments in this modelling framework do have an impact on total factor productivity and in as such capture technological progress in a stylized manner, they neither lead to an actual shift in technologies (new generations of production technologies) nor to the development of new products (only new varieties of existing products). In as such, the modelling framework applied does not capture the full dynamics of the R&D investment and innovation process. Consequently, the potential gains from R&D investments in this analysis may be underestimated in comparison to the actual potential benefits.

[40] http://ec.europa.eu/growthandjobs/annual-report-1206_en.htm

channels of structural reforms and to explore the steady-state outcome as well as adjustment dynamics. However, the assessment of the Lisbon structural reform agenda requires modelling of effects of concrete reforms, either already implemented or foreseen. Effects of some reform measures can be modelled directly (e.g. a tax reform can be modelled in a straightforward way in a model which contains a rich enough description of the government sector). However, impact of other reforms can only be simulated indirectly through establishing a link with the exogenous variables in the models.

The future work can improve the reliability of the simulation results either through explicit modelling of reform or improvements in the background analysis specifying the link between reforms and exogenous variables. Both of the approaches can, in any case, benefit from better information on structural reforms which have been implemented by Member States. Such information is still relatively scarce but there has been significant progress recently. For example, the LABREF database (Arpaia et al., 2005) developed by the European Commission in cooperation with Member States provides a comprehensive and consistent information on labour market reforms implemented in the EU25 in the period 2000-2006.

Second, there is scope to broaden the coverage of the simulations by including other reform areas. The modelling options are increasing with the continuous development of the modelling tools. Therefore, a wider range of issues can be explored with their help. For example, a deeper analysis of various reforms in European labour markets can prove very useful for policy considerations. Similarly, as policies to enhance human capital or promote production and use of ICT have potentially significant impact on growth and employment more detailed analysis of these issues is highly relevant. Other possibility might be to extend our understanding of implications of reforms in the environmental field such as energy and climate change.

Finally, there is a considerable scope to explore specific aspects of structural reforms. Recently, economic literature has started to pay increased attention to the issues of interlinkages and complementarities between reforms. This debate revives the "second best" theory in predicting that only comprehensive and well-designed packages of reforms can unambiguously deliver increases in social welfare. Large macroeconomic general equilibrium models are suitable tools to examine these issues allowing analysis of (packages of) reforms across areas and across countries. In addition, such analysis can provide insights into the interactions between the EU-wide policies and those conducted at national level.

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Appendix A: Table 2A

Table 2

Policy induced changes in the unemployment rate

	specification 1			specification 2			specification 3			specification 4		
	URT1564	policy+ogap	policy	URT1564	policy+ogap	policy	URT1564	policy+ogap	policy	URT1564	policy+ogap	policy
AUS	-2.4	-2.3	-1.4	-2.4	-2.0	-1.1	-2.4	-1.8	-1.0	-2.4	-1.7	-0.7
AUT	0.6	-0.9	-1.4	0.6	-0.8	-1.3	0.6	-1.8	-2.3	0.6	0.1	-0.4
BEL	-1.7	-1.1	-1.0	-1.7	-1.5	-1.3	-1.7	-0.4	-0.2	-1.7	-0.7	-0.5
CAN	-1.8	-1.0	-0.4	-1.8	-1.5	-0.9	-1.8	-1.1	-0.5	-1.8	-1.4	-0.7
CHE	0.8	-1.2	-0.6	0.8	-1.1	-0.5	0.8	-1.3	-0.8	0.8	-0.6	0.0
DEU	1.2	-1.7	-2.2	1.2	-1.6	-2.1	1.2	-1.2	-1.7	1.2	-0.7	-1.3
DNK	-1.6	-3.0	-3.2	-1.6	-2.0	-2.2	-1.6	-3.2	-3.4	-1.6	-1.2	-1.4
ESP	-11.5	-3.8	-2.5	-11.5	-3.7	-2.4	-11.5	-4.6	-3.4	-11.5	-2.4	-1.0
FIN	-6.5	-5.2	-1.7	-6.5	-5.1	-1.6	-6.5	-5.5	-2.1	-6.5	-4.7	-0.8
FRA	-1.9	-0.6	-0.7	-1.9	-0.6	-0.7	-1.9	-0.7	-0.8	-1.9	-0.9	-1.0
GBR	-3.9	-3.5	-3.0	-3.9	-3.3	-2.8	-3.9	-3.3	-2.8	-3.9	-1.0	-0.4
IRL	-7.9	-7.1	-5.1	-7.9	-7.0	-5.0	-7.9	-7.2	-5.3	-7.9	-3.7	-1.4
ITA	-2.9	-2.6	-2.3	-2.9	-4.9	-4.6	-2.9	-1.3	-1.0	-2.9	-0.3	0.1
JPN	2.2	2.7	1.3	2.2	2.4	0.9	2.2	2.7	1.3	2.2	1.1	-0.5
NLD	-2.8	-0.4	-1.5	-2.8	-0.4	-1.5	-2.8	-0.2	-1.3	-2.8	-0.9	-2.1
NOR	-0.5	0.5	0.7	-0.5	0.4	0.6	-0.5	0.5	0.7	-0.5	-0.4	-0.2
NZL	-1.6	-1.2	-1.2	-1.6	-1.0	-1.1	-1.6	-1.2	-1.2	-1.6	-0.9	-0.9
PRT	-0.8	-0.5	-1.5	-0.8	-0.7	-1.7	-0.8	-0.6	-1.6	-0.8	0.4	-0.7
SWE	-3.3	-2.4	-1.3	-3.3	-2.4	-1.3	-3.3	-2.3	-1.2	-3.3	-1.9	-0.7
USA	0.4	-2.4	-2.5	0.4	-2.2	-2.3	0.4	-2.4	-2.4	0.4	0.4	0.3
Unweighted average oecd	-2.3	-1.9	-1.6	-2.3	-2.0	-1.6	-2.3	-1.9	-1.6	-2.3	-1.1	-0.7
Unweighted EU average	-3.0	-2.4	-2.0	-3.0	-2.5	-2.1	-3.0	-2.4	-2.0	-3.0	-1.3	-0.8
weighted EU average	-2.7	-2.2	-2.1	-2.7	-2.5	-2.3	-2.7	-2.0	-1.9	-2.7	-1.0	-0.8

Source: Own's calculation on Bassanini and Duval (2006) data.

Note: The first column reports the change in the actual unemployment between 1995 and 2003; the second column reports the contribution of policy variables and of the output gap to the change in the unemployment rate; the third columns reports the contribution of policy variable.

Contribution to changes in unemployment rate: Specification 1

	ARR	Tax Wedge	Union density	PMR	High corporatism	Output gap	RR 1st year	Benefit duration	(RR 1st)*(duration)	EPL regular	EPL temporary	**Total policies**
AUT	-0.11	-0.38	0.00	-0.93	0.00	0.51						-1.4
BEL	0.4	-0.3	0.0	-1.1	0.0	-0.2						-1.0
CHE	0.4	-0.4	0.0	-0.7	0.0	-0.5						-0.6
DEU	0.1	-1.1	0.0	-1.2	0.0	0.5						-2.2
DNK	-1.9	-0.2	0.0	-1.1	0.0	0.2						-3.2
ESP	-0.6	-0.7	0.0	-1.3	0.0	-1.3						-2.5
FIN	0.0	-1.3	0.0	-0.4	0.0	-3.5						-1.7
FRA	0.2	0.1	0.0	-1.1	0.0	0.1						-0.7
GBR	-0.2	-2.4	0.0	-0.4	0.0	-0.5						-3.0
IRL	1.4	-5.7	0.0	-0.8	0.0	-2.0						-5.1
ITA	1.7	-2.6	0.0	-1.4	0.0	-0.3						-2.3
NLD	0.0	-0.3	0.0	-1.2	0.0	1.1						-1.5
PRT	0.7	-0.8	0.0	-1.3	0.0	1.0						-1.5
SWE	-0.3	-0.4	0.0	-0.6	0.0	-1.1						-1.3
EU Un-weighted average	0.12	-1.24	0.00	-0.99	0.00	-0.41						
EU weighted average	0.21	-1.23	0	-1.04	0	-0.12						-2.1

Contribution to changes in unemployment rate: Specification 2

	ARR	Tax Wedge	Union density	PMR	High corporatism	Output gap	RR 1st year	Benefit duration	(RR 1st)*(duration)	EPL regular	EPL temporary	**Total policies**
AUT	0.0	-0.4	0.2	-1.0	0.0	0.5	-0.1	0.0	0.0			-1.3
BEL	0.0	-0.3	0.0	-1.2	0.0	-0.2	0.0	0.2	0.0			-1.3
CHE	0.0	-0.4	0.0	-0.7	0.0	-0.5	0.5	0.0	0.0			-0.5
DEU	0.0	-1.1	0.2	-1.3	0.0	0.5	0.1	0.0	0.0			-2.1
DNK	0.0	-0.2	0.1	-1.3	0.0	0.2	-0.4	-0.5	0.1			-2.2
ESP	0.0	-0.6	0.1	-1.4	0.0	-1.3	-0.3	-0.1	0.0			-2.4
FIN	0.0	-1.2	0.0	-0.4	0.0	-3.5	0.0	0.0	0.0			-1.6
FRA	0.0	0.1	0.0	-1.2	0.0	0.1	0.3	0.0	0.0			-0.7
GBR	0.0	-2.3	0.1	-0.4	0.0	-0.5	-0.3	0.2	0.0			-2.8
IRL	0.0	-5.5	0.3	-0.9	0.0	-2.0	0.6	0.4	0.1			-5.0
ITA	0.0	-2.5	0.1	-1.6	0.0	-0.3	3.8	-1.8	-2.7			-4.6
NLD	0.0	-0.3	0.1	-1.4	0.0	1.1	0.1	0.0	0.0			-1.5
PRT	0.0	-0.8	0.1	-1.5	0.0	1.0	0.4	0.1	0.0			-1.7
SWE	0.0	-0.4	0.2	-0.7	0.0	-1.1	-0.4	0.0	0.0			-1.3
EU un-weighted average	0.00	-1.19	0.12	-1.11	0.00	-0.41	0.30	-0.12	-0.19			
EU weighted average	0.00	-1.19	0.11	-1.16	0.00	-0.12	0.53	-0.24	-0.37			-2.3

Contribution to changes in unemployment rate: Specification 3

	ARR	Tax Wedge	Union density	PMR	High corporatism	Output gap	RR 1st year	Benefit duration	(RR 1st)*(duration)	EPL regular	EPL temporary	**Total policies**
AUT	-0.1	-0.4	0.0	-1.1	0.0	0.5				-0.7	0.0	-2.3
BEL	0.4	-0.3	0.0	-1.3	0.0	-0.2				0.1	0.9	-0.2
CHE	0.4	-0.4	0.0	-0.8	0.0	-0.5				0.0	0.0	-0.8
DEU	0.1	-1.1	0.0	-1.5	0.0	0.5				0.0	0.7	-1.7
DNK	-1.9	-0.2	0.0	-1.4	0.0	0.2				0.0	0.0	-3.4
ESP	-0.6	-0.6	0.0	-1.6	0.0	-1.3				-0.5	-0.1	-3.4
FIN	0.0	-1.2	0.0	-0.5	0.0	-3.4				-0.4	0.0	-2.1
FRA	0.2	0.1	0.0	-1.3	0.0	0.1				0.2	0.0	-0.8
GBR	-0.2	-2.3	0.0	-0.5	0.0	-0.4				0.2	-0.1	-2.8
IRL	1.4	-5.5	0.0	-1.0	0.0	-2.0				0.0	-0.2	-5.3
ITA	1.7	-2.5	0.0	-1.7	0.0	-0.3				0.0	1.5	-1.0
NLD	0.0	-0.3	0.0	-1.5	0.0	1.1				0.0	0.5	-1.3
PRT	0.7	-0.8	0.0	-1.6	0.0	1.0				0.0	0.2	-1.6
SWE	-0.3	-0.4	0.0	-0.7	0.0	-1.1				0.0	0.2	-1.2
EU un-weighted average	0.12	-1.19	0.00	-1.21	0.00	-0.41				-0.09	0.28	
EU weighted average	0.21	-1.19	0.00	-1.27	0.00	-0.12				-0.01	0.40	-1.9

Contribution to changes in unemployment rate: Specification 4

	ARR	Tax Wedge	Union density	PMR	High corporatism	Output gap	RR 1st year	Benefit duration	(RR 1st)*(duration)	EPL regular	EPL temporary	**Total policies**
AUT	-0.1	0.4	0.0	-0.8	0.0	0.6						-0.4
BEL	0.3	0.1	0.0	-0.9	0.0	-0.2						-0.5
CHE	0.3	0.3	0.0	-0.6	0.0	-0.6						0.0
DEU	0.1	-0.4	0.0	-1.0	0.0	0.6						-1.3
DNK	-1.2	0.8	0.0	-0.9	0.0	0.2						-1.4
ESP	-0.4	0.5	0.0	-1.1	0.0	-1.5						-1.0
FIN	0.0	-0.4	0.0	-0.3	0.0	-4.0						-0.8
FRA	0.2	-0.3	0.0	-0.9	0.0	0.2						-1.0
GBR	-0.1	0.0	0.0	-0.3	0.0	-0.5						-0.4
IRL	0.9	-1.6	0.0	-0.7	0.0	-2.3						-1.4
ITA	1.2	0.1	0.0	-1.2	0.0	-0.4						0.1
NLD	0.0	-1.1	0.0	-1.0	0.0	1.3						-2.1
PRT	0.4	0.0	0.0	-1.1	0.0	1.1						-0.7
SWE	-0.2	0.0	0.0	-0.5	0.0	-1.2						-0.7
EU un-weighted average	0.08	-0.15	0.00	-0.83	0.00	-0.47						
EU weighted average	0.14	-0.12	0.00	-0.87	0.00	-0.13						-0.8

Appendix B: Production in the QUEST III Model

Output (*Y*) is produced with capital (*K*) and labour (*L*). Firms make decisions on capital and labour as well as the degree of capacity utilisation (*UCAP*). They also have to use a fraction of their employees for administrative tasks (overhead labour: *LO*) which are not productive. The variable *U* represents the level of technology. The production function is Cobb Douglas and given by

$$Y_t = (UCAP_t K_t)^{1-\alpha} (L_t - LO_t)^{\alpha} U_t^{\alpha} \quad (1)$$

In the following we show that a reduction in over head labour ($\Delta LO < 0$) reduces the marginal product of labour (keeping *K* and *U* fixed) but increases average labour. This can be seen directly from the definition of marginal productivity.

$$\frac{\partial Y}{\partial L} = \frac{\alpha K_t^{1-\alpha} U_t^{\alpha}}{(L_t - LO_t)^{1-\alpha}} \quad (2)$$

A reduction of *LO* increases the denominator of (2). An intuitive explanation for this is that a reduction of fixed costs reduces the scale elasticity of production. A reduction of overhead labour does, however, increase the average productivity of labour. This can be seen from expression (3), which defines average productivity in terms of the inputs used for production.

$$\frac{Y}{L} = \frac{K_t^{1-\alpha} (L_t - LO_t)^{\alpha} U_t^{\alpha}}{L_t} \quad (3)$$

An intuitive explanation is that overhead labour is completely unproductive. Reducing *LO* allows producing the same level of output with fewer workers. Finally notice, employment decisions by firms are made by equating the marginal value product of workers to the real wage (*W/P*), which yields the following labour demand equation

$$L = \left(\frac{(1 - mup)\alpha K^{1-\alpha} U^{\alpha}}{W / P} \right)^{\frac{1}{1-\alpha}} + LO \quad (4)$$

Here, the variable *mup* is the mark up that is charged by firms on the product market. As can be seen from equation (4), the direct effect of reducing overhead labour on total labour demand is negative. The negative effect may however be compensated by an increase in competition, i. e. a reduction in the mark up.