Corporate tax policy and unemployment in Europe: an applied general equilibrium analysis

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March 30, 2007

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[4]The authors thank André Nibbelink for his support on the stylised model.

Abstract

This paper analyzes the impact of corporate taxes on structural unemployment, using an applied general equilibrium model for the European Union. We find that the unemployment and welfare effects of corporate taxes differ considerably among European countries. The magnitude of these effects rises in particular in the broadness of the corporate tax base of a country, and the strength of international spillover effects through foreign direct investment. The effect on unemployment is smaller if the substitution elasticity between labour and capital is large, if international spillover effects operate primarily via multinational profit shifting, and if equilibrium forces on the labour market are strong. Although the effect of corporate taxes on unemployment may be smaller than the effect of labour and value-added taxes (e.g. under relatively strong real wage resistance), the welfare costs of corporate taxation are typically larger for most European countries under plausible parameters, especially under strong international spillovers.

JEL codes: D58; H25; J64.
Keywords: Corporate Tax; Structural Unemployment; Applied General Equilibrium; European Union.

1 Introduction

Research on corporate taxation and research on unemployment are two very distinct fields. On the one hand, several studies have tried to explain the high and persistent levels of unemployment in Europe on the basis of distortive institutions, see e.g. Nickell et al. (2005). On the other hand, there has emerged a large literature on corporate taxation, focusing on distortions in investment, location and international profit shifting, see e.g. Sørensen (2006). There is only little research, however, on the labour market implications of corporate taxation, and virtually no papers on corporate taxes and unemployment. Yet, corporate taxes may well contribute to involuntary unemployment through their impact on labour demand. This paper aims to fill this gap in the literature by analyzing the impact of corporate taxation on unemployment in the context of an imperfect labour-market model.

Previous studies that have analyzed the relationship between corporate taxes and employment have typically assumed a perfect labour market. For instance, Gordon (1986) explores corporate taxation in a model where capital is mobile internationally while labour is not. The open economy is small and takes the world interest rate as given. The corporate tax raises the cost of capital, which reduces capital demand. Given the exogenous after-tax rate of return to capital, workers suffer from this because less capital reduces the marginal product of labour and, therefore, the before-tax wage. Consequently, the incidence of the corporate income tax falls on labour. As the labour market clears, the corporate tax only distorts labour supply.

Phelps (1994) has emphasised the role of the real interest rate in explaining equilibrium unemployment. A higher interest rate is expected to shift the labour demand curve inwards, thereby contributing to Europe's unemployment problem. Broer et al. (2000) and van der Horst (2003) have taken up this idea and empirically analyze the impact of the real interest rate on the equilibrium rate of unemployment in a number of European countries. Their results suggest that this is indeed important. Although these papers have not explicitly dealt with corporate taxation, their results imply that an increase in the cost of capital matter for unemployment.[1]

This paper analyzes the relationship between corporate taxation and unemployment in a general equilibrium framework. It adopts a union bargaining model to explain equilibrium unemployment on the basis of several institutional variables. The bargaining framework is embedded in an applied general equilibrium model for the European Union that is designed for analyzing corporate tax policies. This so-called CORTAX model en-

[1] In their empirical analysis of the impact of taxation on unemployment, Daveri and Tabellini (2000) find that labour taxes partly explain high unemployment rates, whereas consumption taxes exert no significant effect. Corporate taxes are not included in their regressions.

compasses various distortions of corporate taxation, including the marginal investment distortions, international spillovers from foreign direct investment and profit shifting by multinationals, and distortions in the financial structure of companies.[2] The model is inspired by the OECDTAX model developed by Sørensen (2001). That model has been used for the welfare analysis of corporate tax reform and corporate tax harmonisation in Europe and the OECD (see Sørensen (2001, 2002, 2004a,b)). OECDTAX also contains an imperfect labour market. However, compared to the analyses presented by Sørensen, we focus more on labour-market performance and unemployment and the precise mechanisms that drive these impacts. In addition, we explore the welfare effects of corporate taxes under alternative assumptions regarding the value of time during unemployed hours.

The analysis of this paper may have important policy implications. For instance, to the extent that increases in the cost of capital contribute to high structural unemployment rates, European countries may find it attractive to pursue policies that reduce taxes at the margin of new investment. Recent developments in European corporate tax policy, however, suggest that a number of countries have been reducing their corporate tax rates along with a broadening of their tax bases – perhaps in response to the forces of tax competition. Such policies have raised, rather than reduced, marginal effective tax rates. Indeed, computations of marginal effective tax rates by the Institute for Fiscal studies reveal that the cost of capital has increased during the past decade in Finland, Spain and Italy. By raising the cost of capital, tax competition may have contributed to the high structural unemployment problems in these countries.

The rest of this paper is organised as follows. Section 2 develops a simple general equilibrium model that contains a wage bargaining framework. The model is used to illustrate the key mechanisms through which corporate taxes affect unemployment and welfare. Section 3 discusses the main properties of the so-called CORTAX model, which is a more comprehensive and calibrated model designed to explore corporate tax reforms in Europe. Section 4 shows simulations with CORTAX on corporate tax policies. Finally, section 5 concludes.

[2] A previous version of CORTAX has been used to explore the welfare effects of tax rate competition and tax base consolidation in the EU, see Bettendorf et al. (2006) and van der Horst et al. (2007). That version of CORTAX does not contain imperfections on the labour market.

2 Corporate tax and unemployment in a simple frame

We develop a stylised general equilibrium model that captures the main interactions between corporate taxation and unemployment. The model starts from neoclassical production and utility functions and derives behavioural equations from profit maximizing firms and utility maximizing households. The corporate tax affects firm behaviour through the cost of capital. A specific feature of the model is a union bargaining framework, which explains equilibrium unemployment on the basis of the tax-benefit system and the cost of capital. The product market is characterised by monopolistic competition, implying economic rents. These are subject to corporate tax. The model is used for numerical simulations of tax changes. To that end, it is calibrated for a typical European country. Elasticities are based on empirical estimates from the literature. Note that the model is of a static nature and captures no saving distortions or dynamic adjustments. Moreover, it starts from a representative agent and thus ignores distributional issues. The focus is, therefore, on the interaction between corporate taxation and structural unemployment.

2.1 A stylised model

The stylised model contains five building blocks: firm behaviour, household behaviour, wage formation, the government sector and the foreign sector. First, firms maximise profits subject to a neoclassical CES production function with labour and capital as inputs. Profits can be positive due to monopolistic competition and the absence of free entry. Indeed, firms set prices as a mark-up over marginal production costs, which gives rise to positive rents. From the first-order conditions, we obtain expressions for labour and capital demand as a function of relative prices and output. The corporate tax affects the demand for capital because the financial cost of investment is not deductible from taxable profits. Hence, corporate taxes not only reduce economic rents, but also increase the cost of the capital.[3] In calibrating the model, we take a labour income share of 0.8 and a capital income share of 0.2. Economic rents are set at 8% of the total value of production. The substitution elasticity between capital and labour is set at 0.7, which is the same as the value in the CORTAX model (see section 3). A number of empirical studies, however, report lower values (De Mooij, 2005). We therefore perform a sensitivity analysis on the substitution parameter with a value of 0.3.

Labour supply is derived from utility maximisation by a representative agent subject to a budget constraint. The utility function contains consumption and leisure as arguments.

[3] If the cost of capital would be deductible from taxable firm profits – e.g. when capital is financed by debt and the interest payments are deductible – the corporate tax is a tax on pure profits and exerts no effect on the demand for capital.

Expenditures are taxed by the value-added tax and financed by after-tax labour income, lump-sum transfers from the government and profit income. Households are rationed in their labour supply due to the presence of involuntary unemployment. For unemployed labour hours, households receive unemployment benefits, which are indexed to the after-tax wage. The net replacement rate is set at 50%. We assume that households take into account the risk that they will be unemployed when deciding about their labour hours.[4] Labour supply decisions are governed by the standard income and substitution effects. The uncompensated elasticity of labour supply is set at 0.2, which is based on a meta analysis of existing empirical estimates (Evers et al., 2005). The income elasticity is set at 0.05. In the sensitivity analysis, we look at an uncompensated labour supply elasticity of 0.4 instead of 0.2.

Real producer wages are determined by a right-to-manage model that gives rise to an empirically testable wage equation. The model reflects a process between employers and a trade union who bargain over wages, while the employer determines employment. Due to monopoly power, the trade union is able to claim a share of profits, thereby driving wages above the market-clearing level. This gives rise to involuntary unemployment. As in van der Horst (2003), the fall-back position of the union contains not only unemployment benefits (which are indexed to after-tax wages), but also income from informal activities such as household production and black-market activities. The value of these informal activities is untaxed and depends on consumer prices and labour productivity. Using this setup, we get the following linearised wage equation:

$$\ln \frac{w}{p_y} = \ln \frac{Y}{L} + \alpha \ln \left(\frac{1+\tau_c}{1-\tau_l} \right) + \beta \, \ln rr - \gamma \, u \tag{1}$$

where w/p_y is the real producer wage, Y/L stands for labour productivity, τ_c is the value-added tax, τ_l denotes the labour income tax, rr stands for the net replacement rate, and u is the unemployment rate.[5] Expression (1) suggests that a higher labour productivity

[4] Under this assumption, unemployed hours exert the same disutility as employed hours, see also the welfare analysis below. An alternative assumption is that households consider the market wage when deciding about hours worked. Under that assumption, unemployed hours exert the same utility as leisure hours, albeit that these hours are evaluated at shadow prices under rationing, i.e. at a lower value (see e.g. Neary and Roberts, 1980). We have also simulated the model under this alternative assumption. The effects on economic variables change only marginally. The welfare effects, however, differ markedly. Therefore, we also report the welfare cost of taxation under this alternative regime in section 2.2.

[5] Graafland and Huizinga (1999) distinguish between average and marginal income taxes and find that the marginal tax exerts a negative impact on wages in the Netherlands. This result is also found for other European countries, see e.g. Sørensen (1997) for an overview. Intuitively, high marginal taxes make it attractive for trade unions to reduce wage demands, since the government takes a larger share of it in the form of taxes. Thus, unions choose for higher employment and lower wages. The empirical results of

proportionally raises the real producer wage. A higher unemployment rate reduces it due to equilibrium forces. The institutional variables, such as direct and indirect taxes and the replacement rate, are expected to raise the wage rate. They thus exacerbate labour-market imperfections and raise the equilibrium rate of unemployment. The positive impact of the tax variables on producer wages is generally referred to as real wage resistance. It means that the incidence of labour and value-added taxes is shared across workers and firms.[6] Based on the average estimate for four European countries by van der Horst (2003), we set $\alpha = 0.5$ and $\gamma = 1.5$. These values will be used also in the CORTAX model in the next section. We perform a sensitivity analysis on real wage resistance by considering $\alpha = 0.25$. The semi-elasticity for the unemployment rate would correspond to an ordinary elasticity of 0.1 if evaluated at an unemployment rate of 6.7%. A value of 0.1 is reported as a consensus estimate from the literature in e.g. Blanchflower and Oswald (2006). To illustrate the relevance of this parameter, we also show the effects under $\gamma = 3$, which would correspond to an elasticity of 0.1 if the unemployment rate were 3.3%.

Government behaviour is exogenous. Public revenues from corporate taxes, labour taxes and value-added taxes are used to finance public consumption, unemployment benefits and lump-sum transfers. The value-added tax is initially set at 20%, the labour tax at 40% and the corporate tax at 30%. Public expenditures comprise 46% of total output.

Finally, the model contains a foreign sector. Walras law implies that the balance of payments is in equilibrium. We assume that capital is perfectly mobile internationally so that the return to capital is exogenously determined on the world market. Moreover, all capital is owned by foreigners and imported from abroad. Labour is immobile internationally. Domestically produced products can be exported, where an export elasticity of -5 is used. This implies that the domestic economy can exert only a small effect on world market prices and, therefore, improve its terms of trade through tax policies. The export share is calibrated at 40% of GDP.

We compute the compensating variation to measure the welfare effects of taxation. The compensating variation is equal to the transfer that should be provided to households to maintain their utility at the pre-reform level. Hence, a positive compensating variation implies a welfare loss, i.e. an excess burden from taxation. The compensating variation (CV) can be expressed by the following three terms:

$$CV = -s_l \Delta Y_l - (1 - s_l)\Delta Y_{nl} - (w - w^*)\Delta L \tag{2}$$

Graafland and Huizinga, however, suggest that this effect is small compared to the positive impact of the average income tax on wages.

[6] The replacement rate is constant in our analysis as we index unemployment benefits to the after-tax wage. Hence, the parameter for the replacement rate in the wage equation is irrelevant for our analysis.

where s_l denotes the share of labour-related income, $(1 - s_l)$ is the share of non-labour income, w is the actual wage rate and w^* is the opportunity cost of leisure due to rationing in labour supply. ΔY_l, ΔY_{nl} and ΔL reflect changes in, respectively, labour-related income, non-labour related income, and employment. The first two terms on the right hand side of (2) reflect the change in aggregate income. Labour-related income consists of wages and unemployment benefits. Non-labour income consists of profits and lump-sum transfers. The income term captures the welfare effects associated with tax distortions in labour supply and investment. The last term on the right-hand side of (2) captures the distortion induced by imperfections on the labour market. Here, we consider two alternative assumptions. First, we assign a disutility to the hours spent in unemployment similar as working hours. This would reflect a situation where a small group of individuals would be fully unemployed and that they would be eligible for unemployment benefits only if they participate in an active labour market program or if they actively search for a new job during their unemployed hours. In this case, $w^* = 0$ in expression (2). We refer to this as $CV_{activate}$ because the time spent in unemployment involves a similar effort as the time in work. Under the second alternative, the hours spent in unemployment are interpreted as leisure. This assumes that unemployment is equally divided among the workforce, i.e. all people work fewer hours than desired. Due to rationing, the value of these hours is below the after-tax wage, though. In particular, the difference between the market wage, w, and the opportunity cost of leisure in the rationed equilibrium, w^*, can be interpreted as a virtual tax on employment that is induced by the non-tax distortion in wage bargaining. We refer to this version of the compensating variation as the CV_{enjoy}, since the hours spent in unemployment can be enjoyed as leisure time. The difference between CV_{enjoy} and $CV_{activate}$ is that the social cost of unemployment is larger under the latter.

2.2 The impact of corporate taxation

We use the stylised model to quantitatively explore the implications of a corporate tax increase. In particular, the corporate tax is raised so as to yield a revenue of 0.5% of GDP ex-ante, i.e. before behavioural effects are taken into account. The revenue is recycled to households in a lump-sum fashion so as to keep the government budget balanced ex-post, i.e. after behavioural effects are included. Hence, if behavioural responses erode the tax base, the increase in lump-sum transfers will be smaller than 0.5% of GDP. The focus in our study is on the implications for the labour market and welfare. Table 1 shows the simulation outcomes. The first column captures the outcomes under the benchmark calibration. The other three columns show the sensitivity of the outcomes for alternative parameter values. These columns illustrate the robustness of our numerical findings and

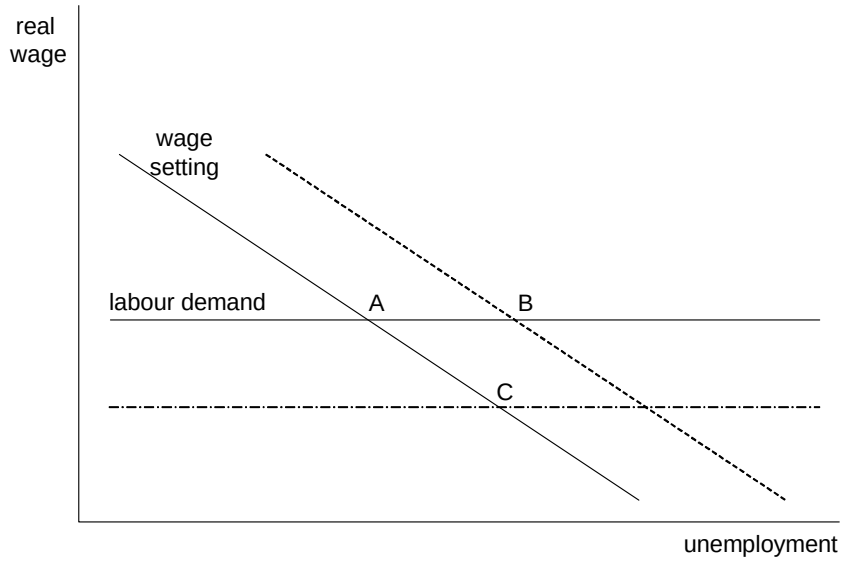
show the key parameters in the model.

The corporate tax affects the economy via a number of channels. First, it increases the cost of capital. This raises marginal production costs and, through mark-up pricing, the output price. Accordingly, the demand for domestically produced goods falls, which exerts a negative output effect on capital and labour demand. Secondly, the higher cost of capital induces substitution from capital to labour in production. This renders the negative impact on capital larger, but partly offsets the negative effect on employment. The strength of this latter effect depends on the substitution elasticity between capital and labour. In particular, if the substitution elasticity would be equal to one, the substitution effect would precisely offset the adverse output effect so that employment would remain unchanged. With smaller substitution, however, the output effect dominates so that employment falls. In our calibration, we use a substitution elasticity of 0.7. Accordingly, employment falls by 0.45%. For capital demand, output and substitution effects work in the same direction. As a result, capital demand falls by 2.29%. The sharp decline in capital reduces labour productivity and, therefore, wages. This induces households to substitute leisure for consumption since the uncompensated wage elasticity is positive. Indeed, we see that labour supply falls by 0.18%. The decline in labour demand exceeds the reduction in labour supply, however, so that the unemployment rate rises by 0.25%. Intuitively, market forces are not sufficiently strong to reduce wages. Hence, by raising the cost of capital, corporate taxes increase the equilibrium rate of unemployment in the model.

The adverse impact of the capital cost on unemployment reflects the findings of Broer et al. (2000). Figure 1 illustrates the intuition. It plots combinations of unemployment and real producer wages according to two equations in the model: wage setting and labour demand. According to the wage setting curve, there is a negative relationship between wages and unemployment, which is reflected by the downward sloping curve. The position of this curve depends on labour taxes and value-added taxes in the presence of real wage resistance: higher taxes shift the curve outward, i.e. the equilibrium from A to B. The labour demand curve does not directly depend on unemployment. Rather, real producer wages can be expressed as a function of labour productivity and the cost of capital. In figure 1, it is therefore represented by the horizontal line. A higher labour productivity will shift this curve upward. In figure 1, the corporate tax directly shifts the demand curve as it raises the cost of capital and reduces labour productivity. By moving the curve downward, the equilibrium moves from A to C, i.e. it raises the unemployment rate.

The first column in Table 1 shows that, while the ex-ante revenue of the corporate tax increase is 0.5% of GDP, the ex-post impact is almost zero due to the erosion of the tax

Figure 1: Labour market equilibrium



base. Moreover, the corporate tax causes a sizable welfare cost, despite that it is partly a non-distortionary tax on pure profits. Indeed, the compensating variation equals 0.61% of GDP under $CV_{activate}$. With a tax-to-GDP ratio of 0.46, this comes down to a deadweight loss of 133 eurocent per € of revenue. This welfare cost is the result of three effects. First, there is a distortion in production efficiency. The corporate tax raises the cost of capital, thereby distorting the input mix in production by reducing the capital/labour ratio. Second, to the extent that the incidence of the corporate income tax is shifted unto labour in the form of a lower wage, it exacerbates distortions in labour supply. Finally, the corporate tax raises involuntary unemployment and, therefore, tightens the rationing on the labour market. If the hours spent during unemployment yield a positive utility from leisure as under CV_{enjoy}, we find that the compensating variation is smaller, i.e. 0.43% of GDP. Hence, the welfare cost of the corporate tax fall by about one quarter if we value the hours spent in unemployment at the shadow price of ordinary leisure in the rationed equilibrium, rather than at zero.

Columns 2 - 4 in Table 1 show the impact of the corporate tax increase under alternative parameter values. In the second column, we set the substitution elasticity between capital and labour at 0.3 instead of 0.7. This reduces substitution from capital to labour in response to the higher cost of capital. Less substitution means that employment falls more, namely by 0.65% instead of 0.45%. As a result, the unemployment rate increases by 0.43%, compared to 0.25% in the benchmark. The welfare cost expands to 0.64% of GDP under

Table 1: Effects of a corporate tax increase by 0.5 percent of GDP (ex-ante)

	Benchmark	$\sigma_{kl} = 0.3$	$\varepsilon_{ll} = 0.4$	$\gamma = 3$
Lump-sum transfer (% GDP)	0.00	−0.02	−0.08	0.08
Prices				
Production price	0.35	0.26	0.39	0.32
Consumption price	0.24	0.18	0.27	0.22
Producer wage	−0.50	−0.53	−0.44	−0.55
Quantities				
Production	−1.04	−0.89	−1.21	−0.91
Capital	−2.29	−1.45	−2.43	−2.18
Employment	−0.45	−0.65	−0.63	−0.31
Private consumption	−1.28	−1.35	−1.60	−1.04
Labour supply	−0.18	−0.20	−0.36	−0.18
Unemployment rate	0.25	0.43	0.26	0.12
Values				
GDP	−0.69	−0.63	−0.82	−0.59
$\text{CV}_{activate}$ (% GDP)	0.61	0.64	0.77	0.49
CV_{enjoy} (% GDP)	0.43	0.38	0.51	0.38

The figures reflect relative changes, unless indicated otherwise. The revenues of the tax are recycled in a lump-sum fashion so as to keep the government budget balanced, ex-post. The benchmark takes the following values for the key parameters: Substitution elasticity between labour and capital $\sigma_{kl} = 0.7$; Elasticity of labour supply $\varepsilon_{ll} = 0.2$; Wage curve $\gamma = 1.5$.

$CV_{activate}$, which is caused by the larger increase in unemployment. If we look at CV_{enjoy}, the welfare cost of the corporate tax is smaller with the lower substitution elasticity, despite the larger distortion in unemployment: the compensating variation falls from 0.43% to 0.38% of GDP. The reason is that the tax causes less distortions in the input mix, which shows up in a higher labour productivity and a smaller income loss for households. Hence, a lower substitution elasticity in production tends to exacerbate unemployment distortions from corporate taxation, but whether it also magnifies its welfare costs depends on the assumption regarding the valuation of unemployed hours.

The third column of table 1 shows the impact of the corporate tax if the uncompensated elasticity of labour supply is 0.4 instead of 0.2. It reinforces the adverse labour supply effect in response to the lower wage and magnifies the labour supply distortion. Both compensating variations increase in light of the larger distortion in labour supply.

The final column of table 1 shows the implications of a doubling of the semi-elasticity of unemployment in (1). If the feedback of the unemployment rate on wages is stronger, this mitigates the increase in the unemployment rate on account of the corporate income tax. In terms of Figure 1, the wage setting curve becomes steeper, which implies that a shift in the labour demand curve yields a smaller effect on unemployment. Also the compensating variations are smaller. Hence, stronger market forces induced by excess labour supply will help to mitigate the distortionary effect of corporate taxation.

2.3 Comparing corporate with other taxes

With the model, we also explore the labour-market and welfare implications of value-added taxes and labour income taxes. Table 2 shows these simulations. Again, each tax raises an ex-ante revenue of 0.5% of GDP and the government budget is balanced ex-post through lump-sum transfers. The table compares the results with those for the corporate income tax under the benchmark parameters. For the labour income tax and the value-added tax, we also explore an alternative parameterisation for the tax parameter in the wage equation (1), i.e. the real wage resistance.

The labour income tax and the value-added tax affect the economy in similar ways. First, they both exert a positive impact on producer wages according to (1). This raises production prices, thereby reducing the demand for domestic products. Accordingly, production and input demand fall. Contrary to the corporate income tax, there is no substitution effect that mitigates the adverse implications for labour demand. Accordingly, employment drops more than under the corporate income tax. Second, both taxes reduce the after-tax real consumer wage, thereby adversely affecting labour supply. Labour supply drops more than under the corporate income tax as the incidence is borne to a larger degree by labour income and to a lesser degree by profit income. On balance, the rise in unemployment under both taxes is larger than under the corporate income tax. In terms of figure 1, the two taxes shift the wage setting curve to the right, which increases the unemployment rate (i.e. from A to B).

If we compare the value-added tax with the labour income tax, we see that the labour income tax is more distortionary than the value-added tax. This is because the labour income tax applies to wages and income from unemployment benefits, while the value-added tax in addition applies to non-labour income, i.e. expenditures from pure profits and lump-sum transfers. To the extent that the value-added tax reduces these non-labour incomes, it is non-distortionary.

Table 2 reveals that $CV_{activate}$ of the labour income tax and the value-added tax equals 0.65% and 0.55% of GDP, respectively. It implies a deadweight loss per € revenue of these

Table 2: Effects of alternative tax increases by 0.5 percent of GDP

		$\alpha = 0.5$		$\alpha = 0.25$	
	CT	LT	VAT	LT	VAT
Lump-sum transfer in % GDP	0.00	0.06	0.12	0.22	0.26
Prices					
Production price	0.35	0.17	0.14	0.12	0.10
Consumption price	0.24	0.12	0.10	0.08	0.07
Producer wage	−0.50	0.25	0.21	0.17	0.14
Quantities					
Production	−1.04	−0.72	−0.61	−0.49	−0.41
Capital	−2.29	−0.60	−0.51	−0.41	−0.35
Employment	−0.45	−0.77	−0.65	−0.53	−0.45
Private consumption	−1.28	−1.37	−1.16	−0.94	−0.79
Labour supply	−0.18	−0.32	−0.27	−0.31	−0.26
Unemployment rate	0.25	0.43	0.37	0.21	0.18
Values					
GDP	−0.69	−0.55	−0.46	−0.38	−0.32
$\text{CV}_{activate}$ (% GDP)	0.61	0.65	0.55	0.45	0.38
CV_{enjoy} (% GDP)	0.43	0.35	0.30	0.24	0.21

Figures reflect relative changes, unless indicated otherwise. The revenues of the tax are recycled lump-sum so as to keep the government budget balanced, ex-post.
CT = corporate income tax; LT = labour income tax; VAT = value-added tax;
α stands for the tax elasticity in equation (1), measuring real wage resistance.

taxes of 141 and 119 eurocents, respectively. For the corporate income tax, the $CV_{activate}$ equals 0.61% of GDP. On the one hand, labour income taxes and value-added taxes cause relatively large labour market distortions. It renders their compensating variations larger than that of the corporate tax. On the other hand, the corporate income tax induces a larger distortion in production efficiency, i.e. it reduces investment and, therefore, labour productivity more substantially. For the labour income tax, the more severe labour-market distortion dominates so that its welfare costs is larger than of the corporate tax. For the value-added tax, the loss in production efficiency dominates, so that the welfare cost is smaller than under the corporate tax.

The welfare ranking of taxes differs under CV_{enjoy}. In that case, the social cost of higher unemployment is smaller than under $CV_{activate}$. Accordingly, the welfare cost of

the corporate tax now exceeds those of both labour and value-added taxes.

Table 2 also shows the simulation outcomes under a different parameterisation of real wage resistance in the wage equation, namely if the coefficient for α in equation (1) is set at 0.25 instead of 0.5. We see that, under this alternative parameterisation, labour income taxes and value-added taxes exert a smaller effect on the producer wage. Accordingly, output and employment fall less substantially and, as a result, the unemployment rate increases less. In fact, the impact of the three taxes on unemployment is now more or less equal. The compensating variation of the corporate tax always exceeds that of labour and value-added taxes. This illustrates the importance of this parameter for the relative size of the distortions induced by labour and value-added taxes. Empirical studies are highly inconclusive about the importance of real wage resistance. Moreover, they suggest that country differences are enormous. For instance, Tyrvainen (1995) finds the following values for α: 1.0 for Germany and Finland, 0.4 for France and 0 for Sweden. Van der Horst (2003) finds 0.7 for Germany, 0.2 for Spain and the United Kingdom, 0.1 for the Netherlands and 0 for France. Graafland and Huizinga (1999) arrive at α= 0.6 for the Netherlands. Given this considerable dispersion in empirical estimates for α, the ranking of corporate versus other taxes with respect to their unemployment effect is highly uncertain. Moreover, the conclusion based on the benchmark simulations is conditional on our assumptions regarding α.

2.4 Shortcomings

The stylised model demonstrates the key relationships between corporate taxation, unemployment and welfare in general equilibrium. While the exercise is instructive to understand the basic mechanisms, it suffers from various weaknesses in doing a comprehensive policy analysis. First, the model is calibrated for a typical European country by simply using plausible shares and parameters. In Europe, however, there are substantial differences between countries, e.g. regarding labour supply, unemployment, institutions, openness and the like. Second, the static model simply captures a price of capital that increases with the corporate tax. However, the relationship between corporate taxes and the cost of capital is more subtle due to deductible costs such as interest and fiscal depreciation. A third omission of the stylised model is that corporate taxes only affect the economy via the cost of capital. However, corporate taxes cause several other distortions, e.g. in the financial structure of companies, foreign direct investment by multinationals and the allocation of profits by international firms. Including these other elements may change the labour-market and welfare effects of corporate taxes. To cope with this, the next section will adopt the CORTAX model which is more comprehensive in all these respects.

3 CORTAX: an AGE model for the EU

CORTAX is an applied general equilibrium model for the European Union designed for simulating corporate tax policies.[7] The model is inspired by the OECDTAX-model of Sørensen (2001). CORTAX contains 17 EU-countries: the 15 old member states (with Belgium and Luxembourg joined) and the three largest new member states (Czech Republic, Hungary and Poland). Compared to the stylised model, CORTAX is richer in terms of behavioural responses to corporate taxation, it models the cost of capital more properly, it is based on intertemporal instead of static optimizing behaviour, it includes international spillover effects via foreign direct investment and international profit shifting, and it contains a more elaborate calibration on actual data for European countries. The key mechanisms for the labour market are, however, similar to those in the stylised model. Hence, the analysis with CORTAX can be seen as an extension of the analysis of the previous section. The calibration of structural parameters in CORTAX is the same as in the stylised model so that differences between the two models are driven only by differences in model structures and differences in the calibration on the economic data. CORTAX contains the wage equation (1) with the same uniform calibration for each European country, i.e. we do not differentiate between wage equations due to a lack of empirical consensus. Below, we discuss the features of CORTAX in more detail.

3.1 Households

Following the standard overlapping generations model of Diamond, households are assumed to live for two periods.[8] Household decisions on consumption and leisure are derived from the maximisation of lifetime utility. An individual only supplies labour when young (i.e. the first period), taking into account that he will be unemployed for a fraction of his time. Young households receive wage income (after taxes), unemployment benefits and lump-sum transfers. This income is allocated over consumption (including taxes) and savings. Savings are invested in a mix of bonds and stocks, which are assumed to be imperfect substitutes. In the second period, households are retired. Their consumption is financed by capital income (net of taxes), pure profits and lump-sum transfers.

[7] A detailed description of the structure and parametrisation of the model can be found in Bettendorf and van der Horst (2006).

[8] Dividing active life in two parts means that a period spans 40 years. We want to express the variables in annual terms while keeping the model tractable. We therefore impose that behaviour is the same in each year of the period when young and when old.

The calibration of the household model is based on data for 2002. For each country, the model thus reproduces consumption shares, employment (in hours) and unemployment rates in that year. Values for the main parameters are given in Table B.1.

3.2 Firms

CORTAX distinguishes between two types of firms: domestic firms and multinationals. A domestic firm operates in the home country. A representative multinational headquarter is located in each country. Multinationals own one subsidiary in each foreign country.[9] Firms are assumed to maximise the value of the firm. Production in each firm uses three primary factors: labour, capital and a location-specific factor (e.g. land). Labour is internationally immobile so that wages are determined on national labour markets. Capital is assumed to be internationally mobile so that the return to capital after source taxes is given for each country on the world capital market. This fixed return to capital implies that the user cost of capital depends on country-specific corporate taxes, which thus affect investment behaviour. The location-specific factor is supplied inelastically and is internationally immobile. Its return, being a rent, is subject to corporate tax. Income from rents earned by subsidiaries accrues to the parent country. Accordingly, countries can partly export the tax burden abroad through the corporate income tax.

Firms finance their investment by issuing bonds and by retaining profits (issuing new shares is excluded). The equity capital of a subsidiary, defined as foreign direct investment (FDI), is provided by its parent. The optimal financial structure of companies depends on the difference between the cost of debt financing (deductible for corporate taxation) and the required return on equity. The latter is determined by the marginal equity holder, which is assumed to live in the home country. As a consequence, the required return on firms' equity depends on the personal income tax on equity. As debt financing is tax-favoured in corporate tax systems, extreme debt positions are avoided by specifying financial distress cost that increases in the debt ratio of a company.

Production in a subsidiary needs in addition an intermediate input that is provided by its parent company. A headquarter can charge a transfer price for these inputs that deviates from an arms-length price. In particular, with separate accounting, a multinational has an incentive to shift profits to low-tax countries by setting an artificially low transfer price. Profit shifting remains bounded by specifying convex costs arising from manipulated transfer pricing.

The calibration of the firm sector is summarised in Table B.2. The capital and labour

[9] The location decision of a subsidiary is thus not modelled. In the absence of entry costs, multinationals only decide on the size of their subsidiaries.

parameters in the production functions are determined by country-specific labour income shares. The amount of the location specific factor used by subsidiaries is calibrated from data on bilateral FDI-stocks.

3.3 Government

Tax revenues consist of source-based taxes on corporate income[10] and residence-based taxes on labour income, dividends, capital gains, interest income and consumption. The expenditure side contains government consumption, unemployment benefits, interest payments on public debt and lump-sum transfers. Government behaviour is exogenous. We keep government consumption and public debt constant as fractions of GDP.

The corporate tax base is defined as the value of output (for a headquarter including the value of intermediate inputs supplied and for a subsidiary minus the value of intermediate inputs used), minus wage costs, interest payments on debt, and tax allowances. Tax allowances capture more than fiscal depreciation and are specified proportional to the capital stock. Country-specific corporate tax rates and tax allowances are presented in Table 3. Statutory tax rates are taken from Devereux et al. (2002), except for the new member states (Finkenzeller and Spengel, 2004). The first column in Table 3 shows that statutory tax rates range from 12.5% in Ireland to 39.6% in Germany (in 2002). The rate of tax allowances is calibrated so as to reproduce marginal effective tax rates (METR) reported by Devereux et al. (2002) (see the third column of Table 3). Thereby, we take the METR for domestic firms for the case where 25% of a new investment is financed with debt and 75% with equity.[11] The allowance rates thus identified are presented in the second column of Table 3. It suggests that Portugal, Italy and Greece feature relatively narrow tax bases, while Ireland and Germany feature relatively broad tax bases. Note that in countries with a narrow tax base, the METR is typically small as the corporate tax is largely a tax on rents, rather than a tax at the margin of new investment. As we will see, this will have implications for the distortionary effect of corporate tax increases. In contrast, countries with a broad tax base, like Germany and the Netherlands, feature a higher initial METR. In Ireland, the METR is relatively low due to a low corporate

[10] The focus on this pure regime can be motivated by the observation in Devereux (2004) that 'Although in many countries the legal basis of taxation is on a residence basis, in practice the vast bulk of the international taxation of company equity income is on a source basis'.

[11] This is lower than the observed debt-equity ratio, which is about 2/3. Our choice, however, ensures that we obtain reasonable values for tax allowances. In particular, our calibration avoids the so-called 'taxation paradox', implying a negative marginal effective tax rate (see e.g. Sørensen, 2002). Our calibration, however, implies that the model does not reproduce observed values for the corporate tax to GDP ratios. Indeed, our calibration implies an average ratio of 2.6% while the actual number is 3.0%.

tax rate, not because of a narrow tax base. The last two columns in Table 3 show the initial labour and consumption tax rates, which represent effective taxes computed from tax revenue data of the OECD. The initial rates matter for the distortions of labour and value-added taxes, which will be analyzed in section 4.4.

3.4 Miscellaneous

Equilibrium must hold on each market. On the labour market, wages are set above the market-clearing level according to equation (1). This leads to equilibrium unemployment. The coefficients are the same as in the stylised model, i.e. $\alpha = 0.5$ and $\gamma = 1.5$ and the same for each country. On the goods market, we assume perfect competition and a tradable homogenous good. Hence, countries cannot exert market power on world markets so that the terms of trade is fixed. The goods price acts as a numeraire. On asset markets, bonds of different origins are perfect substitutes and they can be freely traded on world markets. Accordingly, the return to these assets is fixed for an individual country. The same holds for equity. Debt and equity are, however, imperfect substitutes. The current account equals the change in the net foreign asset position for each country (including rest of the world), due to Walras law. The welfare effects in CORTAX are computed as the compensating variation. Thereby, we assume that the time spent in unemployment yields no value of leisure. Hence, the compensating variation in CORTAX is similar to $CV_{activate}$ in the small model. CORTAX does not report CV_{enjoy}.

Table 3: Tax systems in 2002

	corporate tax rate	rate of tax allowances	metr	labour tax rate	consumption tax rate
AUT	34.0%	7.7%	6.2%	38.7%	24.7%
BLU	34.0%	6.1%	8.0%	38.1%	22.9%
CZE	28.0%	6.9%	6.1%	35.3%	23.8%
DEU	39.6%	5.0%	12.4%	34.1%	19.6%
DNK	30.0%	7.1%	6.3%	34.1%	47.5%
ESP	35.0%	7.7%	6.2%	27.9%	16.6%
FIN	29.0%	5.7%	8.1%	38.2%	35.0%
FRA	35.4%	7.6%	6.5%	38.2%	22.4%
GBR	30.0%	5.7%	8.4%	21.3%	19.7%
GRC	35.0%	10.0%	3.6%	25.6%	21.2%
HUN	17.7%	5.2%	5.1%	32.6%	33.2%
IRL	12.5%	5.0%	3.4%	16.8%	33.3%
ITA	38.3%	10.0%	4.0%	34.1%	17.3%
NLD	34.5%	5.8%	9.6%	30.7%	28.1%
POL	19.0%	5.5%	5.2%	25.0%	21.1%
PRT	33.0%	8.4%	5.1%	24.2%	25.8%
SWE	28.0%	7.8%	4.9%	46.2%	36.4%

4 Simulating corporate tax reform with CORTAX

This section uses CORTAX to explore the impact of an increase in the corporate tax on labour market performance and welfare in different European countries. The simulated increase in the corporate tax yields an ex-ante revenue of 0.5% of GDP in each country. We adjust the lump-sum transfers to the old generation to balance the government budget ex-post, i.e. after behavioural responses. We start in subsection 4.1 with an unilateral increase in the corporate tax in each EU country. Subsection 4.2 considers the same policy under an alternative specification of the wage equation, namely where the semi-elasticity of wages to the unemployment rate depends on the level of unemployment. Subsection 4.3 discusses the importance of international spillover effects by comparing the unilateral tax increase with a simultaneous increase in corporate taxes all over the EU. Finally, subsection 4.4 compares the corporate tax with labour and value-added taxes.

4.1 Unilateral corporate tax

To raise a revenue of 0.5% GDP, the necessary average corporate tax increase in EU countries is 8.0% points. Due to different tax bases, the corporate tax increase differs across countries: it ranges from 5.8% for Germany to 12.1% for Greece. The economic effects are reported in Table B.3. Here, we focus on the implications for the labour market and welfare.

Figure 2 presents the effects on labour supply, employment and unemployment in all 17 countries. Figure 3 reports the effects on the compensating variation. The countries in both figures are ranked according to their initial METR (the one that applies to domestic firms), i.e. we start on the left with the country that features the lowest initial METR. The reason is that the initial METR determines in an important way the distortionary effect of corporate tax increases. Indeed, if the initial METR is close to zero, e.g. due to generous fiscal allowances, corporate taxes induce negligible distortions at the margin of new investment as they largely bear on rents. If the initial METR is large, in contrast, corporate taxes exert large investment distortions at the margin.

The way in which the corporate income tax affects the outcomes is similar as in the stylised model of section 2. First, the corporate tax raises the cost of capital, especially if the corporate tax base is broad. Indeed, the METR rises by between 1% in Italy and Greece and 3.5% in Belgium/Luxembourg (see Table B.3).[12] The higher cost of capital reduces output and induces substitution from capital to labour. On balance, employment

[12] A higher marginal effective tax rate is associated with a higher cost of capital. Hence, we use the terms interchangably.

falls in all countries, which is shown in Figure 2. Substitution from capital to labour reduces labour productivity, thereby also reducing wages. This harms the incentives for labour supply. However, as pure profits (and for some countries also lump-sum transfers) decline as well, households also feature a negative income effect. This induces them to raise labour supply. In most countries, the first effect dominates so that labour supply contracts (see Figure 2). In all countries, the drop in employment is larger than the reduction in labour supply so that unemployment expands. Intuitively, in the bargaining model, wages do not fall sufficiently to prevent an increase in the unemployment rate. The rise in unemployment runs between 0.08% in Greece and 0.35% in Ireland. The average increase is about 0.2%, which is similar to what we find in the stylised model.

Figure 3 reveals a positive compensating variation, reflecting the marginal welfare cost of the corporate tax. The compensating variation runs between 0.3% of GDP in Greece to more than 1% in Belgium/Luxembourg. For most countries, the welfare cost is around 0.6%, which is similar to $CV_{activate}$ in the stylised model. Figure 3 also compares the model of the imperfect labour market with a version of the model that features a perfect labour market. The difference shows that labour market imperfections raise the welfare cost of the corporate tax. The reason is that the corporate tax exacerbates the preexisting labour-market distortion as it raises the unemployment rate (see also column 4 in Table 1).

Although the average impact of the corporate tax in CORTAX resembles the effects from the stylised model, Figures 2 and 3 also suggest that there is substantial variation among countries. This can be explained by two main factors. First, countries differ with respect to the rise in the cost of capital. For instance, the cost of capital in Italy and Greece rises by only 1%. This is because the narrow tax base in these countries renders the higher corporate tax little distortionary at the margin of new investment. Countries starting from a broader tax base face a more substantial rise in the cost of capital. For instance, the cost of capital in Ireland and Germany rises by 2.5%, in the Netherlands by 3% and in Belgium/Luxembourg by 3.5%. Figures 2 and 3 indicate that the unemployment effects and the welfare costs tend to rise with the initial value of the METR.

In Figures 2 and 3, we observe exceptionally large welfare costs for Ireland, Belgium/Luxembourg and the Netherlands. This can be understood by international spillover effects. Indeed, these three countries are relatively open in terms of hosting a large share of foreign capital within their borders. Accordingly, a higher corporate tax exerts a relatively large effect on profit shifting and/or foreign direct investment. Whether a multinational responds to a higher corporate tax rate by means of profit shifting or FDI depends on the initial corporate tax rate. In particular, if the initial corporate tax rate is low compared

to other countries (such as in Ireland, Hungary and Poland), multinationals will have already exhausted most of the opportunities for profit shifting. This is due to the convex cost of manipulating transfer pricing, which renders the marginal cost of further shifting of profits high. A moderate increase in the corporate tax rate will then not exert a big change in transfer pricing policies. Instead, the multinational will respond by reducing FDI. This happens to Ireland, Hungary and Poland. Indeed, Table B.3 reveals that these countries lose a considerable amount of FDI due to the higher corporate tax. This causes a relatively large reduction in employment and, therefore, a relatively large increase in unemployment.

In countries with a high or moderate corporate tax rate, the response by multinationals is different. Indeed, a higher corporate tax rate may create new opportunities for profit shifting as the marginal cost of manipulating transfer prices is still small. This opportunity to shift profits implies that multinationals can largely escape the higher corporate tax rate. Accordingly, they do not cut back on FDI. As a result, open countries with moderate to high statutory corporate tax rates, like the Netherlands, Belgium/Luxembourg, Portugal, Italy and Greece, see a relatively small effect on FDI.[13] The drop in employment and the increase in unemployment are, therefore, also relatively small. The substantial amount of profit shifting does, however, erode the corporate tax base in these countries, thereby reducing public revenue. The corporate tax increase thus allows only for a small increase in lump-sum transfers, ex-post. In Belgium/Luxembourg and the Netherlands, tax revenue even declines so that lower lump-sum transfers are necessary to balance the government budget.

Figure 3 shows that the welfare cost of the corporate tax is relatively large for open economies. Hence, the distortions associated with the international spillovers render corporate taxes distortionary, irrespective of whether initial corporate tax rates are low or high. In low-tax countries like Ireland, spillovers typically exacerbate real distortions through FDI, which also show up in a relatively large increase in unemployment. In high-tax countries like Belgium/Luxembourg and the Netherlands, spillovers occur through profit shifting. While the associated unemployment effects are small in these countries, the erosion of the corporate tax base renders the welfare cost of the tax relatively high.

[13] The figures in Tabel B.3 reflect inward FDI. For Belgium/Luxembourg, this effect is relatively large. However, outbound FDI by headquarters rises only sligthly so that the aggregate loss in foreign owned capital is still small compared to other countries.

Figure 2: Changes on the labor market after unilateral increase in τ_p (% of basecase labour supply)

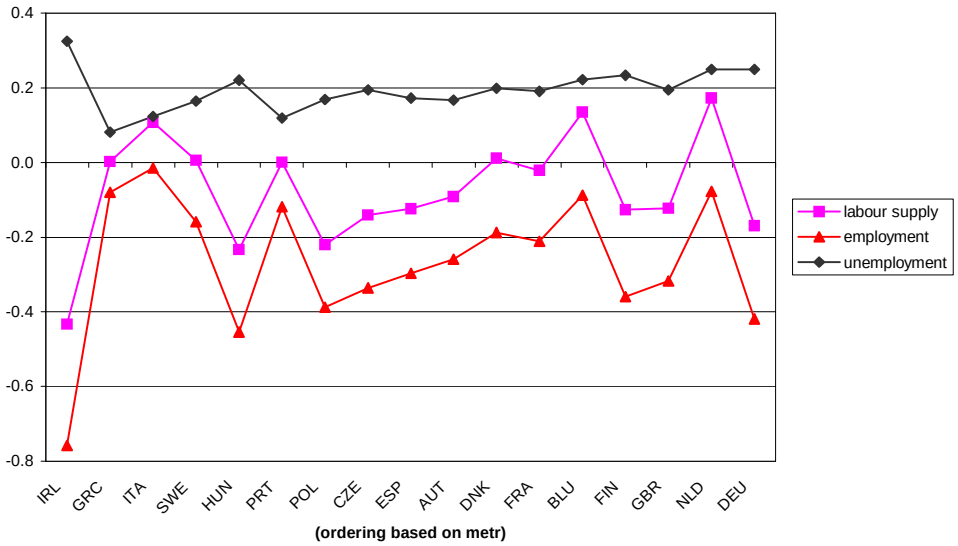
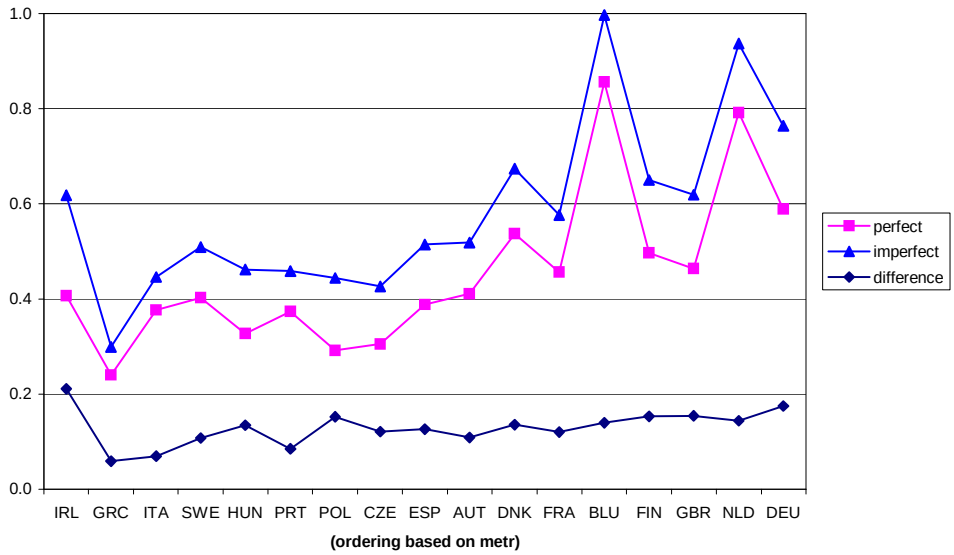


Figure 3: Compensating variations from unilateral increase in τ_p (%GDP)



4.2 Sensitivity to the wage equation

The previous section assumes that all countries feature the same wage equation (1). Hence, the semi-elasticity of the unemployment rate on wages ($\gamma = d\ln w/du$) equals 1.5 for each European country, implying that a 1%-point higher unemployment rate exerts a 1.5% reduction in the wage rate. This effect is independent of the initial level of unemployment. It means, however, that the ordinary elasticity, $d\ln w/d\ln u$, rises in the initial unemployment rate. This contrasts with Blanchflower and Oswald (2006), who argue that a consensus estimate from the literature for the ordinary elasticity of the unemployment rate in wage equations is around 0.1, independent of the country that is studied. If this were true, it would mean that the semi-elasticity, $d\ln w/du$, would have to fall in the level of unemployment. For instance, with an ordinary elasticity of 0.1, the semi-elasticity is 3 if evaluated at an unemployment rate of 3.3%, 1.5 if evaluated at $u = 6.7\%$ and 1 if evaluated at $u = 10\%$.

This section assumes a fixed ordinary elasticity for the wage curve of 0.1 as suggested by Blanchflower and Oswald (2006). Accordingly, countries with a low unemployment rate feature a large semi-elasticity γ in equation (1), while countries with a high unemployment rate feature a small γ. A larger value of γ means that labour-market imperfections are smaller at the margin as increases in excess labour supply exert larger reductions in wages, thereby mitigating the unemployment effect. Figures 4 and 5 present the effects of the same increase in corporate tax rates as in the previous section for unemployment and welfare, respectively, but under the alternative assumption about the wage curve. Countries are now ranked according to their initial unemployment rate.

Figure 4 shows that, compared to the previous subsection, the increase of unemployment in response to a higher corporate tax rate is smaller in the low unemployment countries (i.e. on the left) and larger in the high unemployment countries (i.e. on the right). The break-even point is where the unemployment rate is 6.7%, i.e. where the semi-elasticity is equal to that of the previous section. The largest difference with the benchmark of the previous section is found for Poland, where the initial unemployment rate is 17%. This high rate renders the semi-elasticity only 0.6 for Poland. Accordingly, the welfare cost of the corporate tax become 0.2% of GDP larger than under the constant semi-elasticity of 1.5 and the unemployment effect more than doubles. For the Netherlands, with an unemployment rate of 3.3%, the welfare costs becomes almost 0.1% of GDP smaller and the unemployement effect halves. These effects are consistent with the results of the sensitivity analysis in Table 1, which shows that stronger market forces on the labour market (i.e. a larger γ) render the adverse impact of the corporate tax on unemployment and welfare smaller.

Figure 4: Changes in the unemployment rate after unilateral increase in τ_p (% of basecase labour supply)

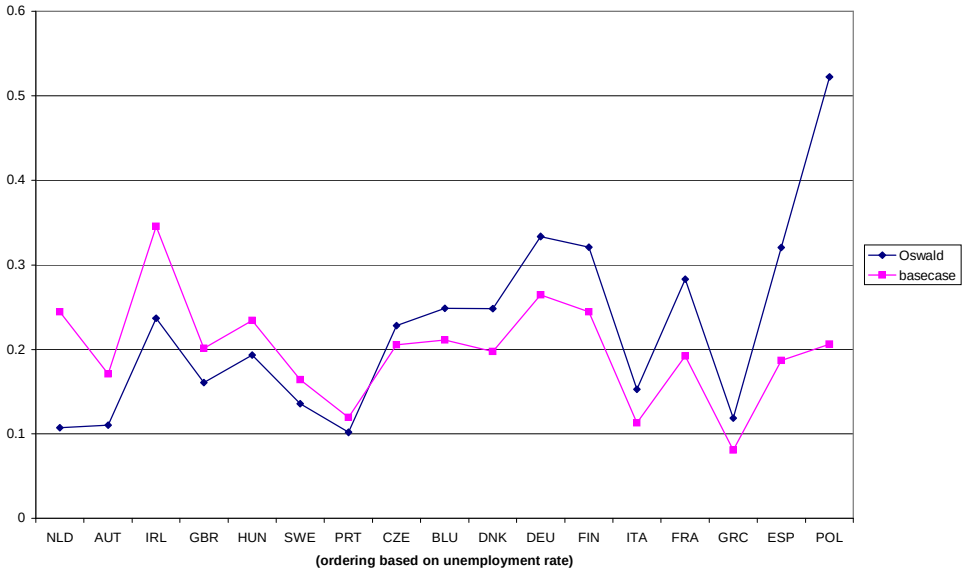
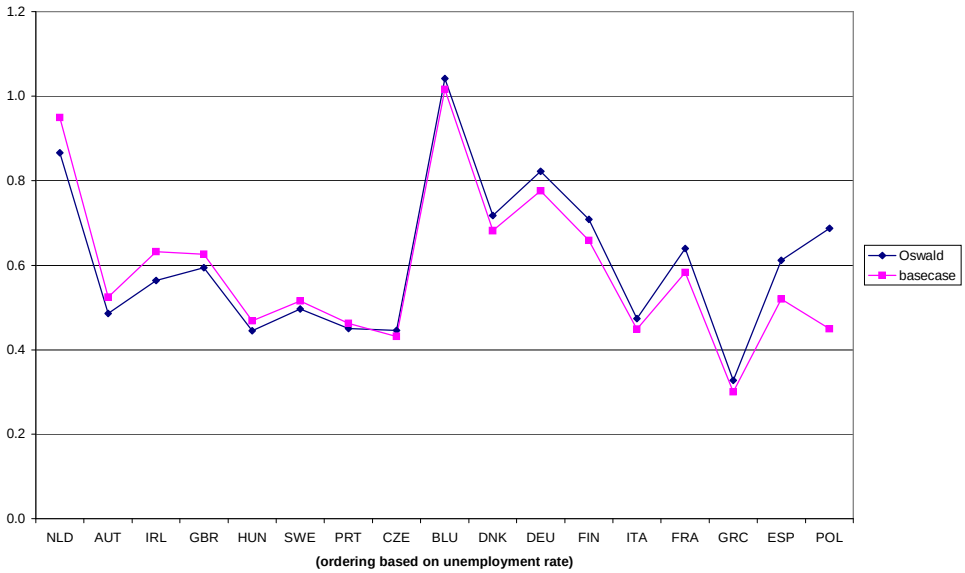


Figure 5: Compensating variations from unilateral increase in τ_p (%GDP)



4.3 Multilateral corporate tax increase

Section 4.1 suggests that international spillovers matter for the effects of corporate taxes in open economies, most notably in Ireland, the Netherlands and Belgium/Luxembourg. Indeed, profit shifting and foreign direct investment render corporate taxes relatively distortionary in these countries in terms of welfare and/or unemployment. This section further illustrates the importance of spillovers. To that end, we compare the unilateral increase in corporate tax rates with a multilateral, i.e. simultaneous, increase in all EU member states. In both simulations, the corporate tax is now increased by 8% points (i.e. the average increase in the EU in section 4.1). Hence, the tax increase is somewhat different for many countries, but this uniform tax increase better reflects a coordinated reform in which the incentives for profit shifting remain unchanged. As to FDI incentives, these aresubstantially mitigated as compared to the benchmark of section 4.1.

Figures 6 and 7 show the difference in effects of corporate taxes under the two regimes, i.e. the unilateral and the multilateral tax increase. Again, countries are ranked according to their METR. Figure 6 shows that the unemployment effects of a corporate tax increase are very similar for most countries under the two regimes. Yet, differences appear for Ireland and Belgium/Luxembourg. In Ireland, we see that the unemployment rate rises less under the simultaneous tax increase. This can be explained by the smaller loss in FDI from subsidiaries in Ireland. In contrast, the drop in unemployment in Belgium/Luxembourg is larger because subsidiaries can no longer escape the higher tax by shifting profits to their parents abroad. Instead, multinationals reduce their investment, which hurts employment more and raises the unemployment effect. Figure 7 shows that the welfare cost of corporate taxation is always smaller under the simultaneous tax increase than under the unilateral reform. The largest difference is found for the open economies, Ireland, the Netherlands and Belgium/Luxembourg, where the compensating variation is around 0.2% of GDP smaller. Hence, the smaller spillover effects make corporate taxes less distortionary in these countries as compared to the unilateral tax increase.

Figure 6: Difference between the unemployment rate after unilateral and multilateral increase of τ_p (pp)

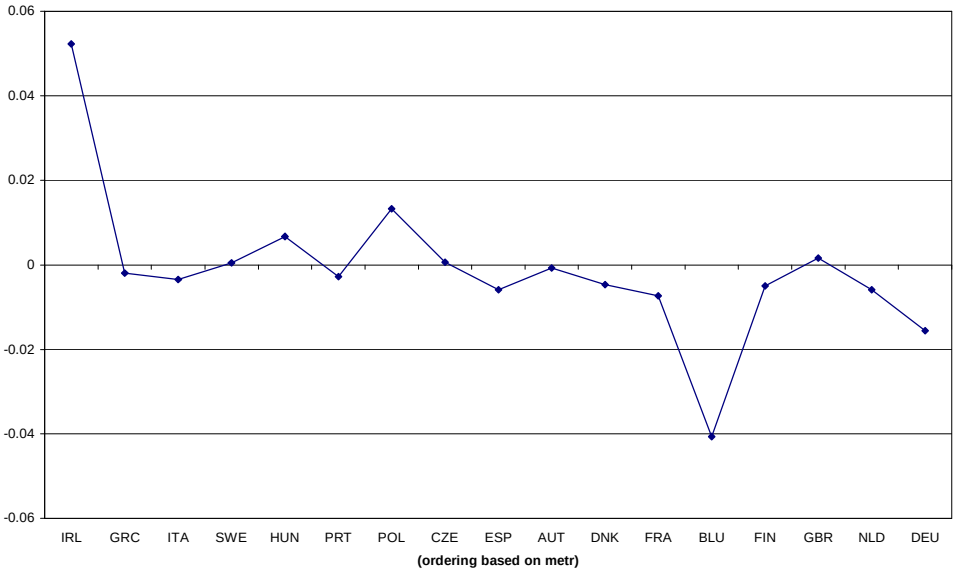
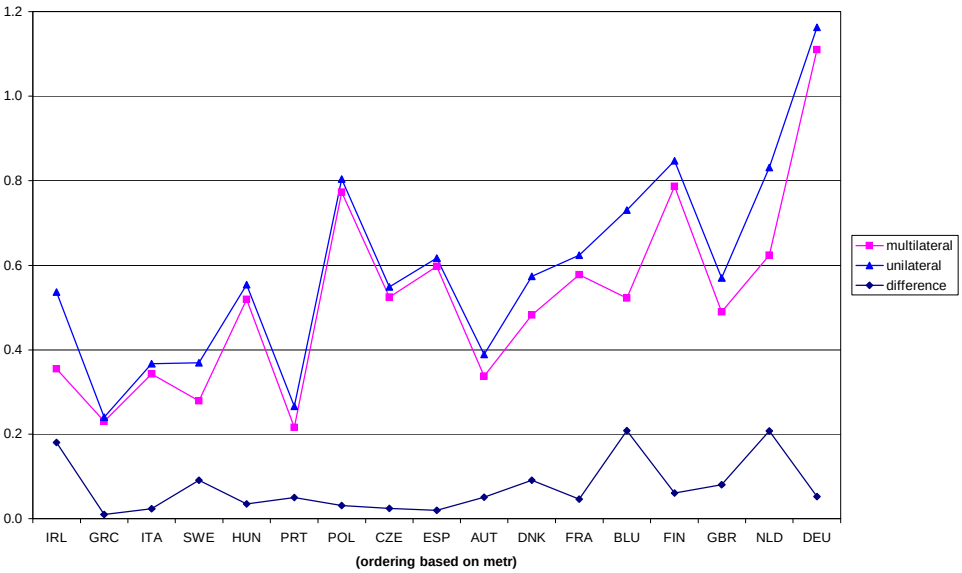


Figure 7: Compensating variations of unilateral and multilateral increase of τ_p (%GDP)



4.4 Comparing corporate with labour and consumption taxes

This subsection compares the unilateral corporate tax increase from section 4.1 with an increase in labour and value-added taxes. For each tax, we consider an ex-ante revenue of 0.5% of GDP in each country. As tax bases differ across countries (see Table 3), the increase in tax rates differ as well. On average in Europe, the labour tax rate is raised by 0.8%, with a spread between 0.74% and 0.94%. The average increase in the value-added tax is 1.1%, with a range between 1% and 1.4%. Figures 8 and 9 show the effects on unemployment and the compensating variation. In the figures, countries are ranked according to their initial METR. Tables B.4 and B.5 present the effects on other variables as well.

The findings are reminiscent to the results obtained with the stylised model (see section 2.3). Indeed, Figure 8 suggests that the corporate tax is the least distortive for unemployment in most countries, while the labour tax raises the unemployment rate most. This result is driven by the strength of real wage resistance in equation (1). As was argued in section 2, there is considerable empirical ambiguity on the magnitude of this effect and on the differences between countries. Our ranking of the three taxes, therefore, depends on the calibration of $\alpha = 0.5$. It is interesting to see, however, how the three taxes are ranked with respect to welfare, even under the relatively strong real wage resistance.

Figure 9 suggests that the value-added tax is least distortionary in terms of welfare and the corporate tax is most distortionary for most countries. Again, this is consistent with the findings in Table 2. On the one hand, the corporate tax is relatively costly because it distorts the production mix. On the other hand, the value-added tax and the labour income tax are relatively costly because they cause larger distortions on the labour market. Thereby, the value-added tax is somewhat more efficient because it partly acts as a tax on rents received by households, which renders it more efficient than the labour income tax. On balance, Figure 9 shows that corporate taxes are typically more distortionary at the margin in countries with a high METR (i.e. countries on the right hand side of Figure 9) and in countries that suffer from severe international spillovers, like Ireland, Belgium/Luxembourg and the Netherlands. Labour income taxes are more distortionary, however, in countries with a low METR and a high initial labour income tax, such as Sweden.

Figure 8: Changes in unemployment rate in unilateral scenario (% points)

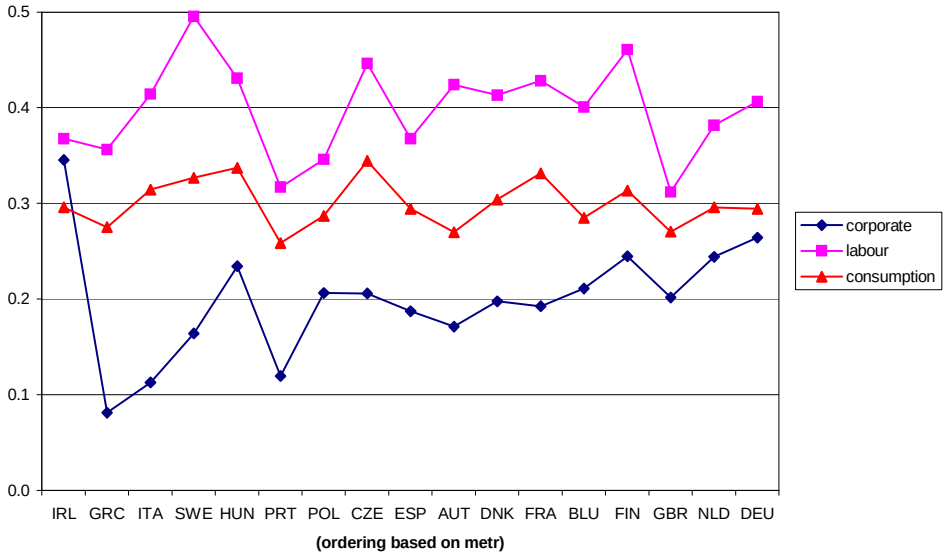
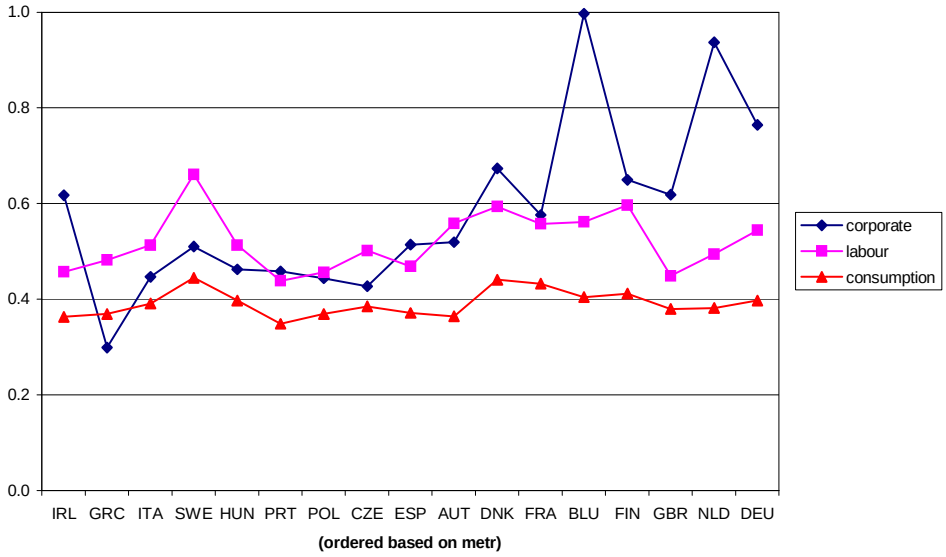


Figure 9: Compensating variations in unilateral scenario (%GDP)



5 Conclusion

This paper explores the impact of corporate taxes on unemployment in a general equilibrium model that is calibrated for the European Union. We find that, by increasing the cost of capital, corporate taxes raise equilibrium unemployment. The magnitude of this effect declines with the substitution elasticity between labour and capital in production and the strength of the wage curve. It rises with the initial marginal investment distortion associated with the corporate tax system. For instance, a broad tax base renders the corporate tax relatively distortionary at the margin of new investment, which magnifies the labour-market effects of corporate tax increases.

The analysis reveals that corporate taxes are more costly for welfare in European countries that are relatively open in terms of hosting a large share of multinational companies. In particular, with openness corporate taxes create relatively large distortions in multinational decisions such as foreign direct investment and international profit shifting. If spillovers work primarily through foreign direct investment, like in Ireland, corporate taxes hurt welfare especially via exacerbating unemployment. This is because multinationals have largely exploited the opportunities for profit shifting because of a low intitial corporate tax rate in combination with convex cost of the manipulation of transfer prices. If spillovers operate primarily through profit shifting, like in Belgium/Luxembourg and the Netherlands, corporate taxes exert smaller effects on unemployment. This is because multinationals can largely escape the higher corporate tax by exploiting new opportunities for profit shfiting. This reduces the need for reducing their foreign investments in these countries. Still, the welfare costs of corporate taxes are large also under profit shifting because of the substantial erosion of the corporate tax base.

Compared to labour and value-added taxes, we find that corporate taxes are less harmful in terms of labour market performance. Labour supply drops less since part of the corporate tax is borne by the owners of the firm who receive pure profits. Unemployment rises more only under the assumption of relatively strong real wage resistance. This effect is subject to considerable empirical ambiguity. Yet, even though the corporate tax causes smaller labour-market distortions, it induces larger welfare costs in many European countries due to distortions in production efficiency. It holds in particular for the open economies Ireland and the Benelux, where international spillovers make corporate taxes relatively distortionary.

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Appendix A The stylised model

Appendix B Simulations with CORTAX

Table B.1: Key parameters and (semi-)elasticities for households

Population growth		0.5%
Real return on bonds		2.0%
Real return on equity		4.0%
Rate of time preference		1.0%
Elasticities of substitution		
Intertemporal		0.5
Intratemporal (consumption-leisure)		1.0
Bonds-Equity		4.0
Implied (semi-)elasticities	min	max
Labour supply to wage	0.11	0.31
Labour supply to income	−0.08	−0.02
Savings to interest rate	0.29	0.65

Table B.2: Key parameters and (semi-)elasticities of production

Technological growth		1.5%
Economic rate of depreciation		5.0%
Income share of location-specific capital		2.5%
Income share intermediate inputs in subsidiaries		10.0%
Elasticity of substitution		
Labour-capital		0.7
Implied semi-elasticities	min	max
Capital stock to statutory CIT	−0.46	−0.11
Incoming FDI to statutory CIT	−1.87	−0.57
Debt to statutory CIT	0.23	0.38
Incoming transfer price to statutory CIT	0.74	2.15

Table B.3: Unilateral increase of the corporate tax rate

	metr	w	l	l^s	u	k	fdi	gdp	tr^o	cv
AUT	2.23	−0.92	−0.27	−0.09	0.17	−2.57	−7.68	−1.06	0.05	0.52
BLU	3.47	−1.36	−0.09	0.13	0.21	−3.79	−10.09	−1.92	−0.16	1.02
CZE	1.71	−1.09	−0.36	−0.14	0.21	−2.39	−7.24	−1.17	0.08	0.43
DEU	2.53	−1.43	−0.46	−0.17	0.26	−3.46	−3.96	−1.51	0.02	0.78
DNK	2.50	−1.06	−0.20	0.01	0.20	−2.80	−6.92	−1.20	0.01	0.68
ESP	1.80	−1.01	−0.34	−0.12	0.19	−2.37	−5.42	−1.09	0.11	0.52
FIN	2.32	−1.30	−0.39	−0.13	0.24	−3.05	−5.98	−1.40	0.02	0.66
FRA	1.94	−1.04	−0.23	−0.02	0.19	−2.41	−4.91	−1.04	0.06	0.58
GBR	2.88	−1.06	−0.34	−0.12	0.20	−3.25	−8.17	−1.23	0.15	0.63
GRC	0.96	−0.44	−0.09	0.00	0.08	−1.09	−4.25	−0.44	0.08	0.30
HUN	2.13	−1.23	−0.48	−0.23	0.23	−2.90	−10.33	−1.40	0.08	0.47
IRL	2.53	−1.64	−0.79	−0.43	0.35	−3.71	−14.33	−2.31	0.31	0.63
ITA	1.05	−0.61	−0.02	0.11	0.11	−1.21	−0.17	−0.48	0.04	0.45
NLD	2.97	−1.32	−0.08	0.17	0.24	−3.25	−5.10	−1.37	−0.16	0.95
POL	2.17	−1.09	−0.47	−0.22	0.21	−2.82	−10.33	−1.27	0.10	0.45
PRT	2.31	−0.67	−0.13	0.00	0.12	−2.29	−5.69	−0.83	0.09	0.46
SWE	2.14	−0.88	−0.17	0.01	0.16	−2.36	−8.40	−1.06	0.02	0.52

Note: $metr$: marg. eff. tax rate of domestic firms; w: wage; l: employment; l^s: labour supply; u: unempl. rate; k: capital stock; fdi: inward FDI; tr^o: lump-sum transfers; cv: CV.
All variables are %-changes from basecase, except for $metr$ & u (% points) and cv & tr^o (%GDP).

Table B.4: Unilateral increase of the labour tax rate

	wedge	w	l	l^s	u	k	fdi	gdp	tr^o	cv
AUT	1.33	0.03	−0.82	−0.38	0.42	−0.80	−0.73	−0.79	0.04	0.56
BLU	1.26	0.03	−0.77	−0.33	0.40	−0.75	−0.70	−0.74	0.02	0.57
CZE	1.39	0.03	−0.75	−0.27	0.45	−0.73	−0.66	−0.72	0.05	0.51
DEU	1.27	0.03	−0.80	−0.36	0.41	−0.78	−0.70	−0.77	0.04	0.55
DNK	1.29	0.02	−0.67	−0.22	0.41	−0.66	−0.60	−0.65	−0.01	0.60
ESP	1.15	0.03	−0.71	−0.29	0.37	−0.69	−0.62	−0.68	0.07	0.47
FIN	1.44	0.03	−0.83	−0.33	0.46	−0.81	−0.73	−0.80	0.01	0.60
FRA	1.34	0.03	−0.78	−0.31	0.43	−0.76	−0.69	−0.76	0.03	0.56
GBR	0.97	0.02	−0.58	−0.26	0.31	−0.57	−0.52	−0.57	0.12	0.45
GRC	1.12	0.03	−0.73	−0.33	0.36	−0.71	−0.64	−0.70	0.08	0.49
HUN	1.35	0.03	−0.75	−0.30	0.43	−0.73	−0.66	−0.72	0.05	0.52
IRL	1.15	0.03	−0.69	−0.30	0.37	−0.67	−0.61	−0.66	0.13	0.46
ITA	1.30	0.03	−0.82	−0.37	0.41	−0.80	−0.72	−0.79	0.06	0.52
NLD	1.19	0.02	−0.67	−0.28	0.38	−0.65	−0.60	−0.65	0.06	0.50
POL	1.08	0.02	−0.66	−0.24	0.35	−0.64	−0.58	−0.64	0.06	0.46
PRT	0.99	0.02	−0.55	−0.21	0.32	−0.54	−0.49	−0.53	0.08	0.44
SWE	1.54	0.03	−0.84	−0.31	0.50	−0.81	−0.74	−0.81	−0.02	0.67

Note: w: wage; l: employment; l^s: labour supply; u: unemployment rate; k: capital stock; fdii: inward FDI; gdp: GDP; tr^o: lump-sum transfers; cv: CV.

All variables are %-changes from basecase, except u (% points) and cv & tr^o (%GDP).

Table B.5: Unilateral increase of the consumption tax rate

	wedge	w	l	l^s	u	k	fdi	gdp	tr^o	cv
AUT	0.84	0.02	−0.51	−0.23	0.27	−0.50	−0.46	−0.50	0.17	0.37
BLU	0.89	0.02	−0.54	−0.23	0.28	−0.53	−0.50	−0.52	0.12	0.41
CZE	1.07	0.02	−0.58	−0.21	0.34	−0.57	−0.52	−0.56	0.09	0.39
DEU	0.92	0.02	−0.58	−0.26	0.29	−0.56	−0.51	−0.56	0.12	0.40
DNK	0.94	0.02	−0.49	−0.16	0.30	−0.48	−0.44	−0.48	0.10	0.44
ESP	0.92	0.02	−0.57	−0.24	0.29	−0.56	−0.50	−0.55	0.13	0.37
FIN	0.98	0.02	−0.56	−0.22	0.31	−0.54	−0.49	−0.54	0.12	0.41
FRA	1.03	0.02	−0.61	−0.24	0.33	−0.59	−0.53	−0.59	0.11	0.44
GBR	0.84	0.02	−0.52	−0.23	0.27	−0.50	−0.46	−0.50	0.17	0.38
GRC	0.86	0.02	−0.57	−0.26	0.28	−0.55	−0.50	−0.55	0.12	0.37
HUN	1.05	0.02	−0.60	−0.24	0.34	−0.58	−0.53	−0.58	0.08	0.40
IRL	0.93	0.02	−0.56	−0.25	0.30	−0.54	−0.50	−0.54	0.21	0.37
ITA	0.99	0.02	−0.63	−0.28	0.31	−0.61	−0.55	−0.60	0.12	0.39
NLD	0.92	0.02	−0.52	−0.22	0.30	−0.51	−0.47	−0.50	0.14	0.38
POL	0.90	0.02	−0.56	−0.21	0.29	−0.54	−0.49	−0.54	0.07	0.37
PRT	0.80	0.01	−0.46	−0.18	0.26	−0.45	−0.41	−0.44	0.12	0.35
SWE	1.02	0.02	−0.55	−0.20	0.33	−0.53	−0.49	−0.53	0.10	0.45

Note: w: wage; l: employment; l^s: labour supply; u: unemployment rate; k: capital stock; fdi: inward FDI; gdp: GDP; tr^o: lump-sum transfers; cv: CV.

All variables are %-changes from basecase, except for u (% points) and cv & tr^o (%GDP).