

# **Selective Reductions in Labour Taxation : Labour Market Adjustments and Macroeconomic Performance ?**

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Discussion Paper 2007-1

Département des Sciences Économiques  
de l'Université catholique de Louvain



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# Selective Reductions in Labour Taxation: Labour Market Adjustments and Macroeconomic Performance \*

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February 2007  
(First draft January 2006)

## Abstract

Significant differences in unemployment in Europe have been observed across skill groups, with the least skilled suffering the highest and most persistent unemployment rates. To identify policies alleviating this problem, we study the impact of reductions in employer social security contributions. We construct a general equilibrium model with three types of workers and firms, matching frictions, wage bargaining and a rigid minimum wage. We find evidence in favour of narrow tax cuts targeted at the minimum wage, but we argue that it is most important to account for the effects of such reductions on both job creation and job destruction. The failure to do so may explain the gap between macro- and microeconomic evaluations of such policies in France and Belgium. Policy impact on welfare and inefficiencies induced by job competition, ladder effects and on-the-job search are quantified and discussed.

Keywords: Minimum Wage, Job Creation, Job Destruction, Job Competition, Search Unemployment, Taxation, Computable General Equilibrium Models

JEL-Code: C68, E24, J64

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\*This project was part of research funded by the Belgian Federal Science Policy Office within the programme "Actual problems concerning social cohesion" (2001-2005). We also thank programmes ARC (grant 03-08/235) and PAI (grant P5/21) for generous support. Special thanks to Bruno Van der Linden for invaluable discussion and remarks. Comments by the participants of workshops at UCL, TAU, EDP Jamboree at EUI, IZA Summer School, annual meetings of ESPE, SED and EEA, as well as two anonymous referees at WCSS, Kyoto, were of significant help and are most appreciated.

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# 1 Introduction

The rise of unemployment in Europe since 1970s has been well documented. Unemployment rates in the European OECD countries have persistently exceeded the OECD average and, in spite of some reversion at the end of 1990s, remained high till the present day. It has been especially the case in the four largest European countries: France, Spain, Germany and Italy, as well as Belgium (Nickell [2003]). Blanchard [2006] provides a comprehensive survey of facts and theory pertaining to the European unemployment dilemma.

Although the contribution of low skilled unemployment to overall unemployment has been debatable (see Gottschalk and Smeeding [1997] or Krueger and Pischke [1997] for discussion), the problem of low skilled unemployment has attracted a great deal of attention from researchers and policymakers in Europe. Figure 1 shows the evolution of low skilled unemployment rate relative to total unemployment rate in the USA, France and Belgium. It is apparent that, while the ratio has moderated and stabilised in the USA in the 1980s, it exploded and have remained high in Europe. Plethora of studies have attempted to account for this phenomenon along with the increase in wage inequality in Anglo-Saxon countries, as opposed to Europe. Most explanations have been centred around the notions of technological change, technological adoption or organisational change, and their interaction with institutional, trade and supply-demand factors (see Acemoglu [2002] for a broad survey).

Targeted reductions in employer taxation have been considered as one of good measures of stimulating demand for the low skilled without provoking a resurgence in wage inequality. Indeed in Europe, persistent unemployment have co-existed with very high labour taxation. Compared to the USA, as shown in Figure 2, employer social security contributions were almost three times higher in France and Belgium in 2002 and total tax wedges have been growing steadily since 1970s (Nickell [2004]). As in Figure 3, in Belgium, employer social security contributions drifted markedly upwards in mid-1980s and might have encouraged firms to substitute labour for alternative production factors, leading to an even larger increase in low skilled unemployment in the time of technological change.

Since late 1990s France and Belgium have implemented a reduction in employer social security contributions, targeted at minimum wages. Until 2003, the estimated value of such subsidies in Belgium amounted to some 3 billion euro — approximately 1% of GDP (Pierrard [2004]). Because of the significant policy cost, there has been interest among economists in France and Belgium to estimate the impact of such a policy on employment, output, productivity, welfare and government budget. The Mortensen-Pissarides search and matching model (Mortensen and Pissarides [1994], Pissarides [2000]) featuring job creation and job destruction — a convenient set-up for studying unemployment in a frictional labour market and labour market policy — has been widely used for this purpose.

Through this study, we would like to fill some gaps in the existing policy evaluation research. Firstly, we ask what really drives the effects of tax cuts

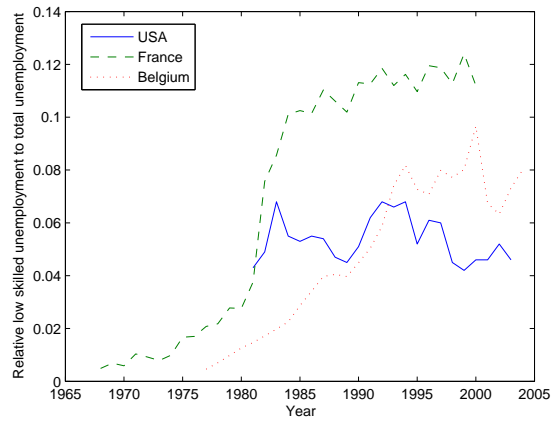


Figure 1: Low skilled unemployment rates in proportion to total unemployment rates: Europe and the USA. *Source: Pierrard 2004.*

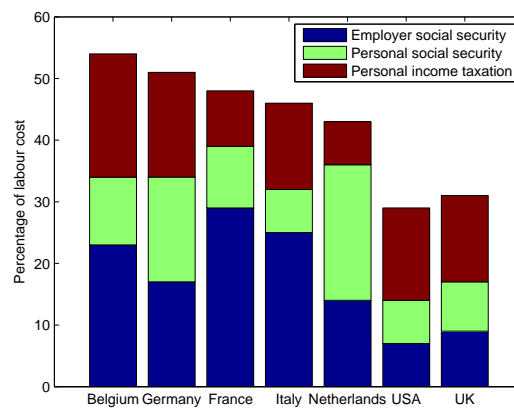


Figure 2: Labour taxation: Europe and the USA. *Source: OECD Taxing Wages 2002-2003.*

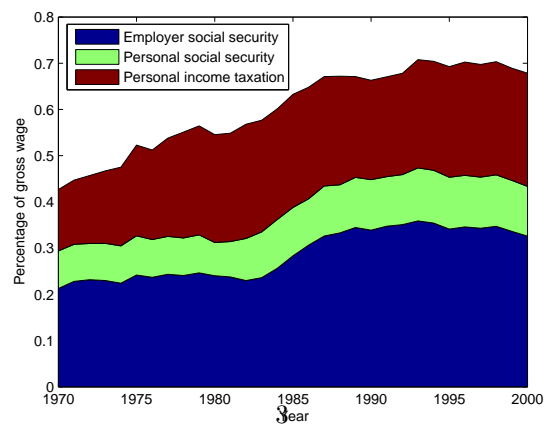


Figure 3: Labour taxation: Belgium 1970-2000. *Source: HERMES.*

in calibrated macroeconomic models *à la* Mortensen and Pissarides: is it the targeting of subsidies at minimum wages or accounting for job destruction in search and matching models? Answering this question seems crucial in the light of this type of models being very widely used to evaluate policies *ex ante*. In this context, we investigate labour market adjustments, macroeconomic performance and welfare implications under the policy of selective reductions in labour taxation. Secondly, we are particularly interested in quantifying the inefficiencies induced by job competition, ladder effects and on-the-job search, since these are popular extensions to the standard Mortensen-Pissarides model.

Specifically, tax cuts targeted at a labour market segment where minimum wages are paid are believed to be particularly successful in stimulating employment. On one hand, the elasticity of demand for low skilled labour with respect to wage cost is empirically high (Hammermesh [1993]). On the other, the existence of a minimum wage makes the wage setting curve flat in the concerned labour market segment. Hence the impact of tax cuts on employment can be significant: employment increase due to a shift of demand is large, while the offsetting wage pressure due to labour market tensions is low with rigid wages.

However, the feedback onto employment and other variables due to a policy is expected to be intensified even more when job destruction is endogenous. Job destruction in Mortensen and Pissarides [1994] exhibits more volatile dynamics than job creation. Moreover, Mortensen and Pissarides [1998] show that, in a time of an economic shock, if firms have a choice either to destroy a job or adjust it against a fixed cost, the former will be chosen. Skill heterogeneities are explicitly treated in Mortensen and Pissarides [1999], where the matches arise between firms and workers that are perfectly suited for each other and turbulence is modeled as shocks to match productivity. Simulations for a welfare (European) and a *laissez-faire* (USA) economies reveal a more convex unemployment-skill profile for Europe.

Mortensen and Pissarides [1999] do not consider spillover effects due to job competition between different skill groups. A skill dimension and job competition is introduced to a partial equilibrium framework by Albrecht and Vroman [2002]. Although the crowding out, whereby the skilled occupy low skilled jobs, leads to longer duration of low skilled unemployment spells, it also causes the overall expansion in the supply of low skilled vacancies. On the other hand, the duration of skilled vacancies rises. Blazquez and Jansen [2003] explicitly analyse the efficiency of an equilibrium with job competition and find that equilibrium with *ex post* bargaining is never efficient under Hosios [1990] condition. The skilled are undervalued in equilibrium and thereby firms create too few unskilled jobs, which results in suboptimally high unemployment rates for the low skilled. The unemployment rate of the high skilled is optimal but too many skilled are employed on low productivity jobs<sup>1</sup>.

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<sup>1</sup>Blazquez and Jansen [2003] build upon literature on inefficiencies due to agent heterogeneities. Sattinger [1995] shows that heterogeneity gives rise to multiple and inefficient equilibria. Shimer and Smith [2001] find that decentralised equilibrium is not efficient without search subsidies since the skilled do not search hard enough and accept too many simple jobs. In similar spirit, Blazquez and Jansen [2003] propose that the government should levy a lump

Pissarides [1994] constructs a first model of on-the-job search. Dolado et al. [2003] extend the model with heterogenous agents to on-the-job search and look at the inefficiencies if job competition takes place. They find that higher quit rate of mismatched workers exerts further negative externality on the unskilled and so weakens their labour market position. Gautier [2002] proposes separate matching functions for heterogenous firms and workers in a model with on-the-job search. He finds that under some conditions the low skilled can benefit from job competition. In particular, they benefit from the increased productivity of the high skilled but suffer from their quit rate on low skilled jobs.

In this work, in order to be able to investigate both narrow tax cut targeting and the importance of ladder effects, we construct a general equilibrium model with three, rather than two — as commonly done in search literature, skill groups (high skilled, skilled and low skilled) and firm types (high-tech, tech and low-tech). Different skills are complements in production. We account for labour market frictions and wage bargaining *à la* Mortensen-Pissarides supplemented by a rigid minimum wage. Job destruction is kept exogenous, which will allow us to set our result against the predictions of models with endogenous job destruction. Two scenarios are considered: with job competition, on the job search and endogenous search effort, and without. Linear tax reductions are considered. We calibrate our economy for Belgium which is an example of a European country particularly plagued by unemployment, especially among the low skilled, but bear in mind that our analysis could easily be extended to other countries.

The paper is structured as follows. Section two overviews the literature on labour taxation in a search and matching framework, and how it relates to our study. Section three describes the model, calibration and the nature of simulations. Section four discusses the long run effects of reductions in employer social security contributions for the economies with and without job competition. Transitional dynamics are presented in section five. In section six we look at the long run effects of different subsidy rates in the context of employment changes, policy cost, policy financing methods and welfare. In section seven we discuss some empirical considerations. Section eight concludes.

## 2 Related Literature

Literature on labour taxation is abundant. Specifically in imperfect labour markets, it has been demonstrated that tax progression is good for employment (Koskela and Vilmunen [1996], Pissarides [1998], Boone and Boverberg [2002] among others). Koskela and Vilmunen [1996] focus on unionised economies. Pissarides [1998] shows more broadly that when wages are determined by bargaining, revenue neutral reforms that strengthen tax progression (e.g. through tax cuts at low wages) tend to be good for employment since they discourage

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sum tax on the low skilled unemployed and implement a lump sum subsidy to the high skilled unemployed, or alternatively levy a hiring tax on skilled jobs.

wage rises, however the formation of unemployment benefits is crucial. If benefits are fixed (or do not adjust perfectly) with respect to after tax wages, or if benefits and wages are not taxed at the same rate, employment effects can be large since the tax changes will unlikely be absorbed by a wage rise.

In our model of search and matching, tax reductions are linear but they do affect employment. First reason behind that is the presence of a rigid minimum wage in the low-tech sector. The minimum wage depends on the general level of wages in the economy, hence its effective independence from economic conditions and labour market tensions in that specific low-tech sector. Since the minimum wage is not instantaneously bargained, even in the presence of fixed replacement ratios (or put differently, benefits proportional to wages) for the low-skilled, the impact on employment is significant. Secondly, with spillovers due to skill complementarities, policies in one sector affect labour productivity, and hence wages, in the others (Cardullo [2005]). With segmented labour markets, where the benefits of the high-skilled and skilled are exactly proportional to their wages, employment effects on those groups are very small indeed. With ladder effects, unemployment benefits of the high skilled and skilled are not exactly proportional to their specific sectoral wage, but rather to a weighted average of wages in sectors where a given skill group can be employed. Therefore the adjustment of wages and benefits is not exactly proportional and employment effects do exist but must be very small due to near-linearity. The employment effects in the latter case are rather due to the impact an enlarged applicant pool has on job creation.

Boone and Bovenberg [2002], apart from confirming that higher marginal tax rates reduce wages in bargaining, study the optimality of labour taxation in a search model and establish that whether taxes should be imposed on labour supply or demand depends on their relative elasticities — the less elastic component should be taxed. Furthermore, taxes can be used to correct for externalities in imperfect labour market when Hosios [1990] condition does not hold. Imperfection-correcting and revenue-raising tasks of the government remain independent. A comprehensive analysis of taxes and subsidies in a search and matching model can be found in Mortensen and Pissarides [2001]. Their quantitative results show that wage and employment subsidies are particularly successful in alleviating low skilled unemployment, and we confirm that prediction. However, we also find that the degree to which the policy is successful depends on the degree of job competition in the economy.

Some research points to the downsides of tax progressivity. Sorensen [1999] argues that although tax progression might indeed reduce unemployment, it might as well reduce work effort and labour productivity. Hence there might exist an optimal degree of tax progression that equalises the marginal welfare gain against welfare loss from tax rescheduling. In the same spirit, Kleven and Sorensen [2004] claim that shifting tax burden away from low wages leads to the reallocation of labour towards less productive jobs, harms economy's productivity and in the end its effect on aggregate employment might be ambiguous. Moreover, the presence of on-the-job search in the time of a tax reform towards higher progression might worsen total employment and welfare. These are the

phenomena which also arise in our study.

In principle, there is a conflict between the literature quoted above — broadly in favour of low average and marginal tax rates on the low skilled — and the optimal taxation literature *à la* Mirrlees which typically concludes that high marginal tax rates are required at the bottom of the distribution of abilities (see a user’s guide to new dynamic public finance by Golosov, Tsyvinski and Werning [2006]). This literature focuses on the consumption-leisure trade-off and asymmetric information about abilities. An exception is Hungerbuhler et al. [2006] in a search and matching framework, that provide an argument in favour of stimulating employment at the bottom of the skill distribution.

Specific policy evaluations confirm that policy measures targeted at the low skilled are more successful in reducing their unemployment than non-targeted ones. There are, however, big discrepancies in the policy effects predicted by macroeconomic and microeconomic studies. Using general equilibrium models with heterogeneous agents and exogenous job destruction, Cahuc [2003] and Chéron *et al.* [2002, 2004] for France, and Burggraefe and Du Caju [2003], Stockman [2002], Hendricks *et al.* [2003], Pierrard and Sneessens [2003] for Belgium, suggest a modest impact of such policies on employment and a rather significant cost *ex post* per job created. Microeconomic studies, on the other hand, find very large employment effects to an extent that the cost of the subsidy is more than compensated by the reduction in spending on unemployment benefits and the increase in revenues from labour taxation<sup>2</sup>.

This difference has occasionally been attributed to possibly large substitution effects between subsidised and non-subsidised jobs, if a job created in a firm leads to a lower activity at a competing firm. In such circumstances, extrapolating microeconomic results to the aggregate level by summing up the number of posts created would largely overestimate the realistic effects of the subsidy. A study by Pierrard [2005] has revealed that a general equilibrium search model with job competition and on-the-job search, featuring minimum wages and endogenous job destruction, produces similar quantitative results as predicted by microeconomic models. In fact, as Laroque and Salanié [2000] and Crépon and Desplatz [2001] have shown for France, Pierrard establishes for Belgium the importance of tax cut targeting at minimum wages and, along the lines of Crépon and Desplatz [2002] and Kramarz and Philippon [2000], shows that a reduction in social security contributions affects employment mainly through its impact on job destruction. In this work, we corroborate the finding that endogenising job destruction is indeed a focal determinant of general equilibrium models’ quantitative predictions, but our contribution is to disentangle the relative importance of targeting at minimum wages from that of endogenising job destruction.

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<sup>2</sup>Macroeconomic studies predict that with a subsidy of 1% of GDP *ex ante*, some 30 000 - 100 000 jobs would be created in Belgium at the annual cost *ex post* in the region of an annual gross wage paid to a low skilled, roughly 25 000 euro. Microeconomic studies would predict, on the other hand, some 250 000 - 300 000 additional jobs created at a negative cost *ex post*.



### 3 The Model

We construct an intertemporal dynamic general equilibrium model. This setup allows to model agents' savings and consumption that interact with the evolutions of employment, to evaluate the effects of policy on welfare and, by accounting for the role of expectations, to make a distinction between the short and long run. The effects of policy differ in the short and long run as the result of frictions which exist in the labour market and are embodied in a matching function *à la* Pissarides [2000] for vacancies and job seekers. Our approach is drawn from literature that reconciles the theory of real business cycles with search in the labor market (for instance Merz [1995], Andolfatto [1996]). We extend the methodology developed by Pierrard and Sneessens [2004] who incorporate a skill heterogeneity into a dynamic general equilibrium search model. Agents in our model are: (1) workers who are subject to job competition, search on the job and choose endogenously their search effort, (2) intermediate firms and (3) a final representative firm. Time is discrete. Two separate economies, with and without job competition, are built.

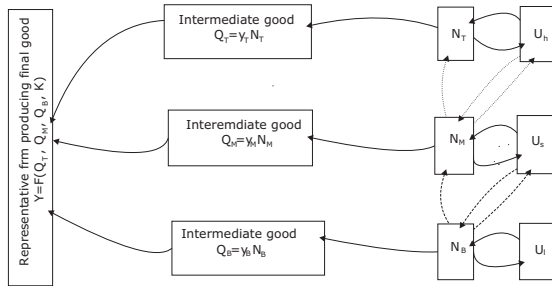


Figure 4: Labour market flows and production. Job competition and on-the-job search are represented by dotted and dashed lines for the high skilled and skilled, respectively.

#### 3.1 Labour market flows

Consider an economy with a constant population. There exist three professional categories, each corresponding to a distinct qualification or skill level, that constitute constant fractions of the population, are indexed by  $i = h, s, l$  for the high skilled, skilled and low skilled, respectively, and whose members at time  $t$  can be either employed or unemployed. This skill partition is exogenous, determined by the prior investment in human capital. There are three types of intermediate one-worker firms indexed by  $j = T, M, B$  for top, medium and bottom technologies that define the complexity of tasks involved on the job. Since in the presence of job competition the high skilled and skilled can search for

jobs in the sector for which they are one level overqualified, as shown by dotted and dashed lines in Figure 4, skill populations have the following composition:

$$U_{i,t} + N_{ij,t} + N_{ik,t} = \alpha_i, \quad (1)$$

with the fractions of agents in each skill group that are unemployed, employed in their optimal sector  $j$  and employed in their alternative sector  $k$ .  $\sum_i \alpha_i = 1$ . Clearly, there are no overqualified low skilled.

Although the unemployed devote all their time to job search, they spend fractions  $e_{i,t}^u$  and  $1 - e_{i,t}^u$  of search time exploring, respectively, the optimal and suboptimal labour markets. Search intensities are increasing and concave functions of those time allocations:  $s_{i,t} = s_i(e_{i,t}^u)$  and  $s'_{i,t} = s'_i(1 - e_{i,t}^u)$ . When overqualified, workers devote a fraction  $e_{i,t}^o$  of their spare time to search on the job for better matches, which translates into a search efficiency  $s_{i,t}^o$  by the means of an increasing function  $s_i^o(e_{i,t}^o)$ . Since the least skilled are restricted to seek jobs only in the bottom labor market, their only search intensity as unemployed is normalised to unity.

Let  $M_{j,t}$  be new matches in sector  $j$  formed in a given period according to a constant-returns-to-scale matching function. The function  $M_{j,t} = m_j M(V_{j,t}, \Omega_{j,t})$  represents matching frictions that arise due to co-ordination problems in the labour market and it is increasing in exogenous matching efficiency  $m_j$ , vacancies  $V_j$  and the pool  $\Omega_j$  of efficient job seekers in sector  $j$ . Within  $\Omega_j$  the numbers of unemployed or employed job seekers are adjusted by their respective search efficiencies. Specifically, in the high-tech sector  $\Omega_T = U_{h,t} s_{h,t} + N_{hM,t} s_{h,t}^o$ , in the mid-tech sector  $\Omega_M = U_{h,t} s'_{h,t} + U_{s,t} s_{s,t} + N_{sL,t} s_{s,t}^o$  and in the low-tech sector  $\Omega_B = U_{l,t} + U_{s,t} s'_{s,t}$ . Defining sectoral market tightness as  $\theta_j = \frac{V_j}{\Omega_j}$ , the probability for any eligible candidate to find a job in market  $j$  becomes:

$$p_{j,t} = \frac{M_{j,t}}{\Omega_{j,t}} = m_j \varphi(\theta_{j,t}), \quad (2)$$

where  $\varphi$  is a positive function of tightness. The probability to fill a vacancy in given sector becomes:

$$q_{j,t} = \frac{M_{j,t}}{V_{j,t}} = m_j \psi(\theta_{j,t}), \quad (3)$$

where  $\psi$  is a negative function of tightness. In the presence of job competition, intermediate firms face probabilities  $\omega_{j,t} q_{j,t}$  and  $(1 - \omega_{j,t}) q_{j,t}$  of hiring, respectively, a qualified or an overqualified worker.  $\omega_{j,t}$  is the qualified fraction of efficient job seekers in sector  $j$ . In the top segment all applicants are perfectly qualified.

The flows in the labour market are determined by the rates of job destruction and job creation. The duration of an employment spell is the function of all possible developments that can occur and incite either a firm or a worker to end the contract, which we take into account by assuming that a fraction  $\phi_j$  of existing jobs is destroyed each period. Total employment in a given sector remains constant if the number of jobs destroyed equals the number of jobs created in that sector (stationary equilibrium).

Labour market flows for individual worker types can be defined as follows. The number of the members of category  $i$  that are employed by and perfectly qualified for sector  $j$  evolves over time according to:

$$N_{ij,t+1} = (1 - \phi_j) N_{ij,t} + \omega_j q_{j,t} V_{j,t}, \quad (4)$$

and the number of the members of category  $i$  that are employed by and overqualified for an alternative sector  $k$  is:

$$N_{ik,t+1} = (1 - \phi_k) N_{ik,t} + (1 - \omega_k) q_{k,t} V_{k,t}. \quad (5)$$

Total employment in each sector is  $N_{j,t} = \sum_i N_{ij,t}$ .

With perfectly segmented labour markets, each worker type can be employed exclusively by a firm corresponding to her skill level. The unemployed devote all their time to job search in their skill-specific labour market and we normalise their search efficiencies to unity. There is no on-the-job search. All firms face perfectly qualified applicants and in all cases the fraction  $\omega_j$  of qualified applicants is unitary.

### 3.2 Intermediate firms

Each intermediate firm is a one-worker entity that produces an intermediate good  $y_j$  and maximises the present value of expected profits. Productivity  $y_j$  varies across sectors but, when overqualified, workers have the same productivity on lower jobs as those who are perfectly qualified. It is common in literature to assume lower productivity on low-skilled jobs (e.g. Mortensen and Pissarides [1999], [2001]), but Gautier *et al.* [2002] show that skilled workers are no more productive on simple jobs than the low skilled. The market for intermediate goods is perfectly competitive. In the presence of job competition firms, with the exception of the top segment where only (6) applies, may fill a vacancy with more than one type of workers. The present value of expected profits from a match of some firm  $k$  with some employee  $l$  who is perfectly qualified for it is:

$$W_{lk,t}^F = \rho_{k,t} y_k - (1 + \tau) w_{lk,t} + E_t \left[ (1 - \phi_k) \frac{W_{lk,t+1}^F}{1 + r_{t+1}} + \phi_k \frac{W_{k,t+1}^V}{1 + r_{t+1}} \right], \quad (6)$$

where  $\rho_{k,t}$  is the market price of the intermediate good,  $\tau$  is the rate of employer social security contribution,  $w_{lk,t}$  is the bargained gross wage and  $r_t$  is the rate of interest. The present value of expected profits from a match with an overqualified worker  $i$  is defined as:

$$W_{ik,t}^F = \rho_{k,t} y_k - (1 + \tau) w_{ik,t} + E_t \left[ (1 - \phi_k - s_{i,t}^o p_{j,t}) \frac{W_{ik,t+1}^F}{1 + r_{t+1}} + (\phi_k + s_{i,t}^o p_{j,t}) \frac{W_{ik,t+1}^V}{1 + r_{t+1}} \right], \quad (7)$$

where  $w_{ik,t}$  stands for the gross wage bargained with an overqualified worker. The wages bargained with qualified and overqualified workers may differ since the firm takes into account the probability that an overqualified worker might

quit, which depends on her on-the-job search efficiency and the probability to contract a match in sector  $j$  which is optimal for her. Finally, the present value of a vacancy is:

$$W_{k,t}^V = -a_k + E_t \left[ \omega_k q_{k,t} \frac{W_{lk,t+1}^F}{1+r_{t+1}} + (1-\omega_k) q_{k,t} \frac{W_{ik,t+1}^F}{1+r_{t+1}} + (1-q_{k,t}) \frac{W_{k,t+1}^V}{1+r_{t+1}} \right], \quad (8)$$

with  $a_k$  being a per-period recruitment cost. Firms post vacancies until no-entry condition holds, that is until the present value of a vacancy reaches zero. A job is created when the firm finds a job seeking worker with a satisfying qualification level.

With no job competition, (7) clearly does not apply and (8) simplifies thanks to unitary  $\omega_k$ .

### 3.3 Representative final good firm

The majority of economic models aimed at analysing the mismatch between the supply of and the demand for skills assume that all firms produce the same good regardless of the technology and the type of labour employed (Albrecht and Vroman [2002] and Dolado *et al.* [2002]). Hence the total production of the economy becomes the sum of productions of individual firms. Such a setting means that the workers of different skills are perfect substitutes. Empirical evidence suggests otherwise (Manacorda and Petrongolo [1999]).

Since we distinguish between three intermediate goods, we allow now the representative final good to be produced using these intermediate inputs and capital. Because intermediate inputs are associated with three different technologies and skill levels required in their production, this specification introduces an interdependence between the three types of intermediate firms and, consequently, the three labour markets, and leads to finite elasticities of substitution between skills

Moreover, by augmenting their marginal productivity, a rise in demand for one intermediate input stimulates the demand for the others and subsequently for the workers of the remaining skills. Specifically, the final firm chooses the optimal levels of capital  $K_t$  and intermediate inputs  $Q_{j,t}$  to maximises its profits:

$$W_t = F(K_t, Q_t) - \sum_j \rho_{j,t} Q_{j,t} - (r_t + \delta)K_t + E_t \left[ \frac{W_{t+1}}{1+r_{t+1}} \right], \quad (9)$$

where  $F > 0$  is a production function satisfying standard assumptions  $F' > 0$  and  $F'' < 0$ .  $Q_t = (Q_{T,t}, Q_{M,t}, Q_{B,t})$ ,  $Q_{j,t} = y_j N_{j,t}$  and  $\delta$  is the depreciation rate of capital. The first order conditions follow:

$$F_{K_t} = r_t + \delta, \quad (10)$$

$$F_{Q_{j,t}} = \rho_{j,t} \quad \forall j. \quad (11)$$

### 3.4 Households

We distinguish three categories of households, one for each skill group. The traditional assumption of a representative household ensures that the workers of each skill insure mutually against the risk of unemployment. This approach allows us to easily model savings and investment. The assumption of such a perfect insurance is rather strong but indispensable if we wish to avoid modeling difficulties associated with the heterogeneity of income due to the risk of unemployment in the absence of perfect insurance. The assumption is not damaging since the two categories of workers that save face relatively low probabilities of unemployment.

We assume that the least skilled in each period consume their disposable income from wages and unemployment benefits<sup>3</sup>. The skilled and high skilled households, on the other hand, are the owners of intermediate firms, have access to capital markets and choose investment  $I_{i,t}$  and search times  $e_{i,t}^u$  and  $e_{i,t}^o$  to maximise their current and expected future welfare:

$$W_{i,t}^H = U(C_{i,t}) - D(N_{ij,t}) - D^o(N_{ik,t}) + \beta E_t[W_{i,t+1}^H] \quad (12)$$

subject to (4), (5) and the budget constraint

$$C_{i,t} = \pi_{i,t} + b_{i,t}U_{i,t} + (1 - \tau_j)w_{ij,t}N_{ij,t} + (1 - \tau_k)w_{ik,t}N_{ik,t} + (r_t + \delta)K_{i,t} - I_{i,t} - T_{i,t} \quad (13)$$

and

$$I_{i,t} = K_{i,t+1} - (1 - \delta)K_{i,t}. \quad (14)$$

$U$  (logarithmic),  $D$  and  $D^o$  (linear) represent respectively the utility of consumption and the disutility of qualified and overqualified employment. Unemployment benefit is given by  $b_{i,t}$ ,  $\beta$  is a subjective discount factor,  $\tau_j$  and  $\tau_k$  are the rates of personal taxation depending on the wages received,  $T_{i,t}$  stands for lump sum government transfers and the household has a share  $\pi_i$  in intermediate firm profits, so that  $\pi_{i,t} = \pi_i \sum_j \pi_{j,t}$ . The resulting first order conditions are:

$$U_{C_{i,t}} = \beta E_t[U_{C_{i,t+1}}(1 + r_{t+1})], \quad (15)$$

$$E_t[s_{i,t}^u p_{j,t} W_{N_{ij,t+1}}^H - s_{i,t}^{1-u} p_{k,t} W_{N_{ik,t+1}}^H] = 0, \quad (16)$$

$$\beta s_{i,t}^o p_{j,t} E_t[W_{N_{ij,t+1}}^H - W_{N_{ik,t+1}}^H] - D_{e_{i,t}^o}^o = 0. \quad (17)$$

(15) is standard. (16) captures a trade-off between investing in search for a best-suited or a lower job, while (17) sets the marginal benefit from upgrading the job against the marginal cost of on-the-job search. Marginal welfare values evolve according to:

$$\begin{aligned} W_{N_{ij,t}}^H &= U_{C_{i,t}}[(1 - \tau_j)w_{ij,t} - b_{i,t}] - D_{N_{ij,t}} + \beta(1 - \phi_j - s_{i,t} p_{j,t})E_t[W_{N_{ij,t+1}}^H] \\ &\quad - \beta s_{i,t}^{1-u} p_{k,t} E_t[W_{N_{ik,t+1}}^H], \end{aligned} \quad (18)$$

<sup>3</sup>In the light of this category of workers being paid a minimum wage and living from hand to mouth, this hypothesis seems reasonable. The welfare function of the low skilled is nevertheless represented in the parallel way to other skill groups.

$$W_{N_{ik,t}}^H = U_{C_{i,t}}[(1 - \tau_k)w_{ik,t} - b_{i,t}] - D_{N_{ik,t}}^o + \beta p_{i,t}(s_{i,t}^o - s_{i,t})E_t[W_{N_{ij,t+1}}^H] \\ + \beta (1 - \phi_k - s_{i,t}^o p_{j,t} - s'_{i,t} p_{k,t})E_t[W_{N_{ik,t+1}}^H]. \quad (19)$$

Accumulated savings constitute the stock of capital lent to the representative final firm. The market for capital rental is perfectly competitive. Equilibrium between the supply of and demand for capital is ensured by the instantaneous adjustment of the interest rate. The aggregate capital stock is given by  $K_t = \sum_i K_{i,t}$ .

When labour markets are segmented, there is no overqualified employment, the resulting wages or disutility. (12) and (13) simplify accordingly and only the first order condition (14) holds. Marginal welfare reduces to:

$$W_{N_{i,t}}^H = U_{C_{i,t}}[(1 - \tau_j)w_{j,t} - b_{i,t}] - D_{N_{i,t}} + \beta (1 - \phi_j - p_{j,t})E_t W_{N_{i,t+1}}^H. \quad (20)$$

### 3.5 Wage formation

The presence of informational problems and matching frictions in the labour market is synonymous with imperfect competition. Moreover, we assume that salaries are no longer determined in the equilibrium of the supply of and demand demand for labour, but are negotiated between firms and workers. The most common representation of wage bargaining is based on the sharing between a firm and a worker of an economic surplus that arises from a successful match. The firm makes instantaneous profit (the wage paid is lower than the worker's marginal productivity), while the worker is remunerated above his reservation wage. The key to the partition of the surplus lies in the respective bargaining powers of the firm and the worker, and their outside options. The surplus itself can vary over time in response to variables such as productivity or interest rates. Wages are renegotiated each period. This set-up is widely used in literature and allows to conveniently assess of the effects of tax policy.

Formally, the result of wage negotiations is represented for perfect matches by the maximisation with respect to wages  $w_{ij}$  of a Nash product:

$$\left(\frac{W_{N_{ij,t}}^H}{U_{C_{i,t}}}\right)^\eta (W_{ij,t}^F - W_{j,t}^V)^{1-\eta}. \quad (21)$$

The first and the second term of the two above stand for the valuation of the match surplus by the worker and the firm respectively. Parameter  $\eta$  is the bargaining power of the worker. We use this representation of wage bargaining to determine gross salaries in the two upper labour market segments<sup>4</sup>.

In the recent decades, the ratio of the lowest to the highest wages has remained stable in Europe (OCDE [1996]). We therefore assume that minimum wages paid in the bottom intermediate sector are indexed on the wage in the top sector and evolve with time inertia:

$$w_{b,t} = \bar{w} (\alpha_0 w_{t,t} + \alpha_1 w_{t,t-1} + \alpha_2 w_{t,t-2} + \alpha_3 w_{t,t-3} + \alpha_4 w_{t,t-4}). \quad (22)$$

<sup>4</sup>In the presence of job competition bargaining results in two wages  $w_{sM,t}$  and  $w_{hM,t}$  paid in the middle sector, and one wage  $w_{hT,t}$  in the top sector, that can be written as  $w_{T,t}$  for simplicity. Without job competition, bargained wages are simply  $w_{M,t}$  and  $w_{T,t}$ .

Benefits for each skill category are expressed as a weighted average of benefits that would be received if a worker  $i$  were employed in optimal  $j$  and suboptimal  $k$  job:

$$b_{i,t} = \frac{N_{ij,t} \varrho_{ij} w_{ij,t} + N_{ik,t} \varrho_{ik} w_{ik,t}}{N_{ij,t} + N_{ik,t}}, \quad (23)$$

where  $\varrho_{j,t}$  and  $\varrho_{k,t}$  are respective replacement ratios.

### 3.6 Government

For simplicity, we assume that government balances its budget each period and account purely for the elements of the budget associated directly with the labour market<sup>5</sup>. In each period, government spending on government consumption and unemployment benefits equals the revenues from proportional and lump sum taxation:

$$G_t + \sum_i b_{i,t} U_{i,t} = \sum_{j=B,T} (\tau_j + \tau) w_{j,t} N_{j,t} + (\tau_m + \tau) \sum_{i=s,h} w_{iM,t} N_{iM,t} + \sum_i T_{i,t}, \quad (24)$$

where  $G_t$  stands for public consumption. Unemployment benefits  $b_{i,t}$  are determined for each skill type  $i$  by replacement ratios  $\varrho_i$  with respect to average gross salaries paid to that skill type.

Without job competition, the budget constraints simplifies to:

$$G_t + \sum_i b_{i,t} U_{i,t} = \sum_j (\tau_j + \tau) w_{j,t} N_{j,t} + \sum_i T_{i,t}. \quad (25)$$

### 3.7 Calibration

The model is calibrated on quarterly data for Belgian economy in the mid-nineties. The calibrated parameters fall into three categories: (i) standard values found in all models of this type; (ii) parameters specific to this particular model for which we have empirical information; (iii) parameters specific to this model for which we do not have direct information; their values are fixed so that the model reproduces the state of the economy similar to that of the mid-nineties with respect to a number of endogenous variables such as unemployment rate, probability to find a job, probability to fill a vacancy, wage ratios and alike.

As in RBC models, we set the quarterly depreciation rate of capital at 2.5% and the psychological discount factor at 0.99 implying the quarterly rate of interest of 1%. The final good production function is a constant-returns-to-scale Cobb-Douglas form, as shown appropriate by Manacorda and Petrongolo [1999]:

$$F(K_t, Q_t) = \varepsilon (K_t)^\vartheta (Q_{T,t})^\mu (Q_{M,t})^\nu (Q_{B,t})^{1-\vartheta-\mu-\nu}.$$

<sup>5</sup>The introduction of public debt would not change our results since the assumption of perfect capital markets imply the Ricardian equivalence: taxation today or tomorrow does not change the consumption or capital accumulation profile.

The elasticity of final output with respect to capital is 0.33 commonly seen in literature. The coefficients associated with other intermediate inputs are based on the estimation of Sneessens and Shadman [2000]. In particular, we adopt their value of 0.51 for the elasticity of output with respect to the most complex input. The elasticity of output with respect to the least complex input of 0.05 implies the absolute value of 1.05 of the wage elasticity of demand for the least qualified labour, which seems very reasonable.

The composition of the active labour force (defined broadly to include the workers of pre-retirement age and the aged unemployed) plays a crucial role. Our objective is to evaluate the impact of very narrow targeting of reductions in employer social contributions, more narrow than that considered so far in literature<sup>6</sup>. Most commonly, previous studies of general equilibrium with heterogeneous agents distinguish only two qualification levels, the low and the high skilled. We specify three groups by dividing the low skilled into two subgroups: one with low (primary education diploma) and the other with medium (lower secondary education diploma) qualification attainment. These two groups represent respectively 15% and 21% of the active work force (INS [1997]). Accounting for the unemployed, this partition corresponds well to the percentage of employees paid (sectoral) minimum wages in Belgium, approximately 10% of the salaried population (Pierrard [2005]). The high skilled (with at least an upper secondary degree) constitute 64% of the work force. Their average share in the economy's savings and firm ownership is set at 77% (INS [1996-97]).

Empirical evidence (Petrongolo and Pissarides [2001]) suggests a constant-returns-to-scale Cobb-Douglas matching functions:

$$M_{j,t} = m_j(V_{j,t}, \Omega_{j,t}) = m_j(V_{j,t})^{\lambda_j} (\Omega_{j,t})^{1-\lambda_j}.$$

Empirical studies find the values for the elasticity of matches with respect to vacancies between 0.4 and 0.6. Van der Linden and Dor [2001] estimate it at 0.4 for Belgium, which we adopt here for all intermediate sectors. Little information existing on the values of matching efficiencies  $m_j$ , we fix them at 0.45, 0.33 and 0.24 for  $j = \{T, M, B\}$ , respectively, to reproduce the job finding probabilities  $p_j$  from mid-nineties, estimated by Cockx-Dejemeppe [2002] to be accordingly 0.40, 0.25 and 0.15.

The salaries of the skilled and high skilled are bargained. The bargaining powers for those workers are fixed to be 0.6, a value commonly used in the models of this type. The least skilled are paid a minimum wage which represents approximately 50% ( $\bar{w} = 0.5$ ) of the high skilled wage (INS [1995-97], OECD [1996]) and evolves proportionally to it. This adjustment is subject to time inertia, with  $\alpha_0 = 0$ ,  $\alpha_1 = 0.1$ ,  $\alpha_0 = 0.1$ ,  $\alpha_0 = 0.3$  and  $\alpha_0 = 0.5$  as in Pierrard [2005]. Gross replacement ratios between an average unemployment benefit and gross wages have been calculated based on the wage data from INS [1995-99], the benefits data from ONEM [1997] and the information on the taxation

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<sup>6</sup>Specifically for Belgium, see papers by Sneessens and Shadman [2000], Pierrard and Sneessens [2003, 2004] and Pierrard [2005].



of benefits from OECD [1997]. We fix them at 0.28, 0.36 and 0.57 for the employed on high-tech, tech and low-tech jobs. We take the rate of employer social contributions equal 34% for all intermediate firms, the value drawn from the model HERMES [2000]. The sum of the rates of employee social contributions (13.07%) and personal income taxation, taken from *Bulletin Social* [1997], gives on average personal tax rates of 38%, 33% and 24% for the high skilled, skilled and low skilled.

Job destruction rates have been chosen to respect the lower bound estimated by Van der Linden and Dor [2001] at 3.9% per quarter and to reproduce the unemployment rates in the mid-nineties of 7.9%, 17% et 28% respectively for the high skilled, skilled and low skilled (INS [1997]). In this way, we obtain job destruction rates of 3.45%, 5.15% and 5.8% for top, medium and bottom sectors, respectively. Output per workers  $y_j$ , regardless of skill level, in the three intermediate sectors is set at 1, 0.8 and 0.6 in line with previous literature. According to Delmotte et al. [2001], 52% of vacancies were filled in the course of a quarter in 2000. Their study does not show any systematic differences in these probabilities subject to job complexity. We therefore calibrate the cost of opening a vacancy in the way to obtain a 50% probability of filling a vacancy for all types of jobs. This recruitment cost represents approximately 10% of the total wage cost per period (Abowd-Kramarz [2003]) and is such that it is more costly to recruit more qualified workers:  $a_T = 0.11$ ,  $a_M = 0.09$  and  $a_B = 0.055$ .

For simplicity, we assumed a standard logarithmic utility of consumption and a linear disutility of employment and overqualified employment:

$$U(C_{i,t}) = \ln C_{i,t} \quad D(N_{ij,t}) = d_i N_{ij,t} \quad D^o(N_{ik,t}) = d_i^o N_{ik,t}.$$

To close the model and ensure the non-negativity of marginal welfare values in the wage bargaining equations, parameter  $d_i^o = 0.1$  is uniform for all skills, while the values of  $d_i$  are fixed at 0.27, 0.57 and 0.75 for  $i = \{h, s, l\}$ , respectively, in the job competition case and at 0.29, 0.90 and 1.20 in segmented markets. The difference in parameters in the two cases results from the differences in marginal welfare equations which in the two scenarios must be made compatible with the baseline steady state. This is to be expected, given the result of Blazquez and Jansen [2003] on the properties of equilibrium with and without job competition.

Finally, we must specify the relationship between search time and search efficiency. The existing information on the subject is rather modest. To limit the number of additional parameters, we represent search intensity as a concave function (implying a decreasing marginal productivity of search time) for all workers and markets:

$$s_{i,t} = s_{i,0} + s_{i,1} \sqrt{e_{i,t}^u} \quad s'_{i,t} = s'_{i,0} + s'_{i,1} \sqrt{1 - e_{i,t}^u} \quad s_{i,t}^o = s_{i,0}^o + s_{i,1}^o \sqrt{e_{i,t}^o}.$$

The parameters for each of these functions are chosen to reproduce the percentage of overqualified workers close to that suggested by empirical studies (Hartog [2000]), in the region of 10% and the realistic fractions of time spent on search (around 80% for the search in the optimal and the remaining 20% in the suboptimal market, and around 10% of spare time devoted to

the on-the-job search). We set for  $i = h, s, l$  respectively:  $s_{i,0} = \{0.75, 0.6, 1\}$ ;  $s_{i,1} = \{0.175, 0.3, 0\}$ ;  $s'_{i,0} = \{0\}$ ;  $s'_{i,1} = \{0.45, 0.5, 0\}$ ;  $s^o_{i,0} = \{0.15, 0.1, 0\}$  and  $s^o_{i,1} = \{0.2, 0.1, 0\}$ . When markets are perfectly segmented, all search intensities  $s_{i,t}$  are normalised to one and hence for  $i = \{h, s, l\}$ , respectively, we obtain  $s_{i,0} = \{1\}$  and  $s_{i,1} = \{0\}$ .

Changes in the parameters of disutility or search intensity functions are of no major importance for quantitative results. As expected, some quantitative but not qualitative differences do arise if central parameters of the model are altered, for example the bargaining power of workers or the degree of inertia in minimum wages. This particular parametrisation is consistent with that of earlier studies for France and Belgium and allows us to compare our results with previous literature. Finally, calibrations of our economy with and without job competition being on the same baseline steady state, our exercise meets the interest of our particular agenda to assess reliably the effects induced by job competition and ladder effects.

### 3.8 Simulations

The values of endogenous variables obtained in the model, calibrated in the manner outlined above for the two economies, will serve as a reference point in the calculation of the effects of different economic policies. The first scenario involves a reduction in employer social security contributions targeted at the lowest wages. The reduction  $x_B$  in employer taxation rate  $\tau$  is financed by a lump sum tax  $T_{h,t}$  on the high skilled in such a manner that the government budget remains balanced. Moreover,  $x_B$  is such that the *ex ante* cost of the subsidy represents 1% of GDP<sup>7</sup>. Alternative policies are defined in a parallel way, but are targeted at different sectors:  $x_M$ ,  $x_T$  and  $x_{B+M}$ . In all the cases, the *ex ante* cost of the reduction remains 1% of GDP.

Alternative methods of policy financing will be considered. Next to lump sum taxation, financing of the policy by proportional taxation on high-tech firms or proportional income taxation on the high skilled will be examined.

## 4 Long run effects of reductions in employer social security contributions

Table 1 summarises long run simulation results for an economy with perfectly segmented labour markets. The number of jobs created lies in the region of 90 000 when tax cuts are targeted at minimum wages. The rise in employment and the level of economic activity is sufficiently strong to render the measure self-financing via a reduction in the outlay on unemployment benefits and a rise in the revenues from labour taxation.

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<sup>7</sup>That is to facilitate quantitative comparison with previous studies.

Table 1: Effects of a reduction in payroll taxation valued at 1% GDP, financed by lump sum taxation. No job competition.

		Targeted sector			
		(a)	(b)	(c)	(d)
		B	B+M	M	T
Tax cut (%)		26.7	8.5	12.5	2.7
<i>Ex ante</i> wage cost* (% change)	B	-20.0	-6.0		
	M		-6.0	-9.0	
	T				-2.0
<i>Ex post</i> wage cost (% change)	B	<b>-18.8</b>	<b>-5.8</b>	0.2	1.8
	M	1.3	<b>-0.3</b>	<b>-1.2</b>	0.0
	T	1.3	0.6	1.2	<b>-0.2</b>
Additional employment**	B	<b>89 229</b>	<b>28 171</b>	30	-7 984
	M	348	<b>6 061</b>	<b>8 845</b>	84
	T	895	345	144	<b>2 708</b>
	TOTAL	<b>90 472</b>	<b>34 577</b>	<b>9 019</b>	<b>-5 193</b>
Cost per job created ('000 euro per year)		<b>-1.86</b>	<b>14.9</b>	<b>112</b>	-
Production (% change)		1.36	0.58	0.17	-0.06
Productivity (% change)		-1.03	-0.33	-0.06	0.08
Welfare (% change)	<i>l</i>	<b>0.77</b>	0.29	0.05	0.52
	<i>s</i>	0.70	<b>0.46</b>	<b>0.30</b>	-0.11
	<i>h</i>	1.37	0.63	0.08	<b>-0.23</b>

\*Total as faced by employers, including payroll taxation.

\*\*Active labour force (of which unemployed) is as follows:  
low skilled 642 394 (173 978), skilled 935 343 (157 162),  
high skilled 2 813 722 (221 097). *Source: INS [1997].*

Table 2: Effects of a reduction in payroll taxation valued at 1% GDP, financed by lump sum taxation. Job competition and on-the-job search.

		Targeted sector			
		(a)	(b)	(c)	(d)
		B	B+M	M	T
Tax cut (%)		26.7	8.5	12.5	2.7
<i>Ex ante</i> wage cost (% change)	B	-20.0	-6.0		
	M		-6.0	-9.0	
	T				-2.0
<i>Ex post</i> wage cost (% change)	B	<i>l</i> <b>-19.0</b>	<b>-5.3</b>	1.1	1.6
		<i>s</i> -19.0	-5.4	1.1	1.6
	M	<i>s</i> 2.8	<b>-3.2</b>	<b>-4</b>	1.2
		<i>h</i> 2.6	-3.5	-6.2	-1.5
	T	<i>h</i> 1.2	1.1	1.1	<b>-0.4</b>
Additional employment	B	<i>l</i> <b>69 855</b>	<b>35 810</b>	20 392	-2 018
		<i>s</i> 36 594	-9 054	-26 328	-4 725
	M	<i>s</i> -22 629	<b>13 276</b>	<b>27 419</b>	5 859
		<i>h</i> 8 296	16 592	22 436	-13 920
	T	<i>h</i> -4 525	-11 715	-16 699	<b>15 382</b>
	TOTAL	<b>87 590</b>	<b>44 908</b>	<b>27 219</b>	<b>578</b>
Cost per job created (‘000 euro per year)		<b>2.0</b>	<b>9.3</b>	<b>25.1</b>	<b>1 377.6</b>
Overqualified workers (% change)	B	4.0	-2.1	-4.9	-0.8
	M	1.3	1.7	2.1	-1.7
	B+M	2.5	0.2	-0.6	-1.3
Production (% change)		0.99	0.64	0.4	0.21
Productivity (% change)		-1.31	-0.74	-0.32	0.19
Welfare (% change)	<i>l</i>	<b>0.84</b>	0.59	-0.47	-0.45
	<i>s</i>	-0.72	<b>-0.71</b>	<b>-0.93</b>	-0.94
	<i>h</i>	-1.65	-1.63	-2.02	<b>-2.17</b>

The effect on employment is more than halved when targeting is broader on sectors B and M jointly, as adopted in earlier simulations for Belgium<sup>8</sup>. Those studies obtain some 50 000 additional jobs, as opposed to our 35 000, with an identical policy. The difference between the two estimations arises essentially as the result of a different effect on wages  $w_M$  in the middle sector and wages rise in our scenario. By distinguishing only two categories of workers, previous studies assume that the salaries of both the low skilled and skilled are indexed on the highest wages, while we assume more correctly that  $w_M$  is negotiated. Contrary to our result, they find a positive and non-trivial cost per job created.

We observe that policy targeting at relatively high wages (sectors M or T individually) has an employment effect only weakly positive (column (c)), or even negative (column (d)). This is the case because the negotiated gross wages rise, absorbing the majority of the tax cut. The minimum wage, being indexed on high wages, rises as well and leads to a rather significant reduction in the number of simple jobs. Scenario (d) is especially intuitive: the reduction of social security contributions targeted at the most complex jobs turns out counterproductive since it leads to higher expenses associated with the recruitment activity in the sector where such expenses, in the light of labour market tightness in that sector, are not profitable at the margin.

It is worth noticing that scenario (a) obtains an increase in the welfare of all workers, at least in the long run. A rise in the high skilled welfare is even larger than that observed in scenario (d). As pointed out by literature on tax progression, although employment and final production increase, the productivity of the economy declines.

We therefore find, *mutatis mutandis*, the same result as in a general equilibrium model with endogenous job destruction and minimum wages<sup>9</sup>: policy targeting at the 10% of workers paid the lowest wages stimulates employment to the extent that the policy measure is self-financing. The effect on employment is, nevertheless, still three times weaker. Because we specify job destruction process as exogenous and not depending on the wage cost borne by the bottom-end firms, we can infer that the two channels of both job creation and job destruction, through which are passed the effects of a tax cut are rather important: the former is sufficient to guarantee self-financing, however the latter seems to be the more powerful one, in line with Mortensen and Pissarides [1994, 1998, 1999].

Simulation details for a scenario with job competition and on-the-job search are displayed in Table 2. As previously, the targeting of social security reductions at the lowest wages leads to the creation of jobs in the region of 90 000. This similarity in terms of numbers is however misleading: search behaviour and ladder effects result in a non-negligible fraction of newly created simple jobs being occupied by overqualified workers. Employment changes in column (a) show clearly the importance of ladder effects. The reduction of social security con-

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<sup>8</sup>For example Pierrard and Sneessens [2003].

<sup>9</sup>Pierrard [2005] for Belgium.

tributions targeted at the lowest wages is, therefore, less effective in alleviating low skilled unemployment than when labour markets are perfectly segmented.

Moreover, with job competition present, the measure is no longer self-financing. Cost per job created remains however rather low, around 2 000 euro per year. On the other hand, the measure does not benefit all workers: the welfare of the low skilled rises but that of the other two groups, who constitute 85% of the population, falls, which is not without importance in terms of political decision making.

As earlier, a broader targeting (B+M) stimulates employment of both the low skilled and the skilled but the number of jobs created is again much lower. Cost per job created remains reasonable. A reduction targeted at the high skilled (column (d)) reduces job competition and the ladder effects recede, resulting in a better employment result than in the scenario with segmented labour markets. The number of jobs created is positive but the cost per new job is exorbitant.

In spite of a rise in average productivity, employment and aggregate production, skilled and high skilled enjoy lower welfare! That is due to some of them now being paid lower wages on jobs for which they are overqualified, and having disutility of on-the-job search. It must be remembered that, in a more realistic setting, a reduction of social security contributions would also have a positive effect on employment through lower job destruction, which has not been taken into account here. It might then as well be that the measure is indeed self-financing. While this channel of transmission has been neglected, the cost of the policy is very low in the long run: less than 0.2% of GDP leading to a reduction in the unemployment rate of the least skilled by some 10%.

## 5 Transitional dynamics

Graphs in Figure 5 show for the perfectly segmented labour markets the evolution over time (measured in quarters) of the most significant variables (unemployment rates, wages, policy cost and consumption) in response to a reduction in employer social security contributions targeted at minimum wages and financed by lump sum taxation. The rate of unemployment of the low skilled falls gradually. Consequently, the cost of the measure remains positive for a few quarters. The workers who bear this cost in the meantime are, however, rational agents. Since they have access to capital markets, they can immediately increase their level of consumption and welfare<sup>10</sup>. Therefore we do not observe a fall in the quality of life, neither in the long run or during the transition.

These transition dynamics are very fast, too fast to be credible. The only elements that prevent instantaneous adjustment of variables are the accumulation of capital, labour market frictions and the evolution of the minimum wage with a five-period inertia. Otherwise, nominal rigidities of wages and prices are absent and our analysis is in real terms only. A decrease in payroll taxes targeted at minimum wages lowers the cost of labour in a sector where labour is

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<sup>10</sup>The latter is not shown in the graphs just yet but the evolution of welfare follows closely that of consumption.

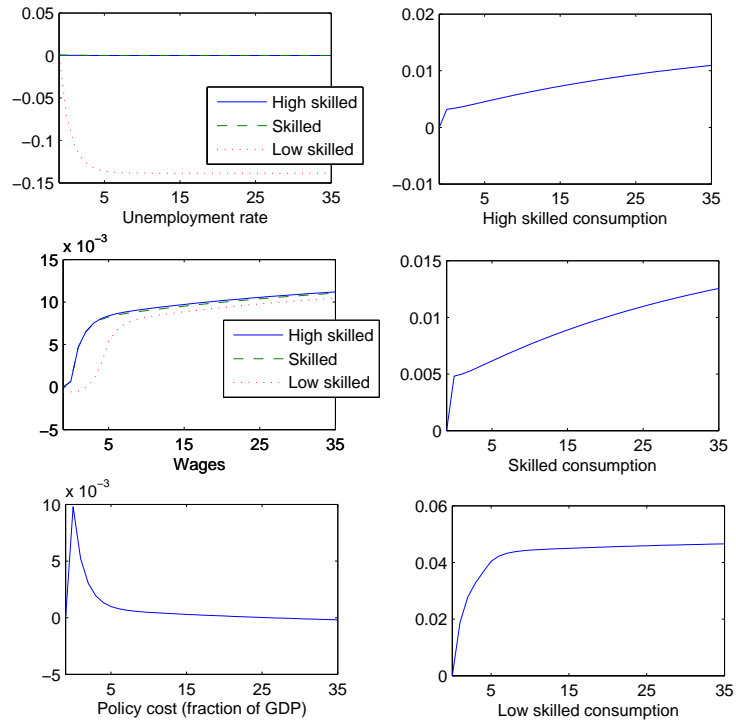


Figure 5: Transitional dynamics. Lump sum taxation. No job competition.

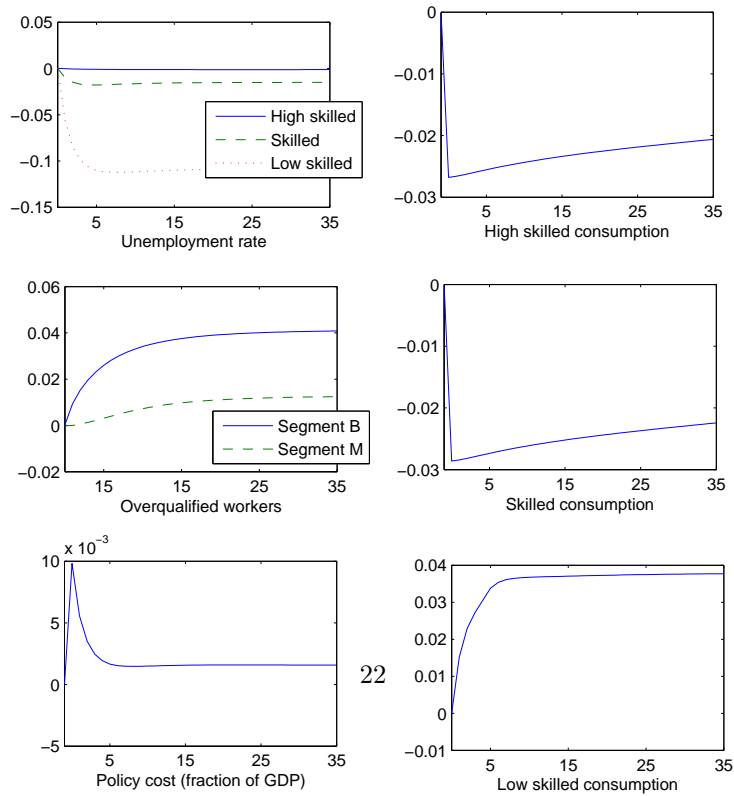


Figure 6: Transitional dynamics. Lump sum taxation. Job competition and on-the-job search.

abundant. This policy assures the profitability of labour intensive firms and increases the supply of goods which they produce, thereby improving the marginal productivity and the supply of other intermediate inputs. Ignoring further wage and price rigidities is equivalent to assuming that this supply is instantly met by demand as the result of an immediate adjustment of relative prices and wages. It is generally believed, however, that the presence of nominal rigidities tends to slow down adjustment to full employment. Recent developments in macro- and monetary economics are based on an intertemporal general equilibrium but they emphasise the importance of nominal rigidities in short- and medium-term. In order to possibly see anything close to realistic transition dynamics, our setting would need to include both structural and broader nominal rigidities. Nevertheless, although rather fast the transition, long run analysis is not affected.

Figure 6 shows, for the case of job competition and on-the-job search, the dynamics of the most crucial variables, including the size of the ladder effect, following a tax cut targeted as before at minimum wages and financed by lump sum taxation on the high skilled. In comparison with Figure 6, two points should be emphasised. First, we observe a gradual rise in the proportion of overqualified workers, which increases from 10 to 12% and 14% on mid-tech and low-tech jobs, respectively. Intuitively, it seems realistic, given that little precise information exists on the actual size of his phenomenon. Second, consumption of the high skilled and skilled falls by some 2.5% and even slightly more than that in the short run. This occurs not only because the policy cost is positive, but also because a fraction of the high skilled and skilled are now employed on less complex jobs which pay lower wages.

## 6 Long run effects of different subsidy rates at minimum wages

### 6.1 Employment

Focusing on social security reductions targeted at minimum wages, Figure 7 allows for the comparison of employment responses to the policy with and without the presence of job competition and on-the-job search. It looks as if job competition played insignificant role: the number of additional jobs created is almost identical. However, we have seen in Tables 1 and 2 that this similarity of gross numbers disguises the true skill composition of the newly employed. Moreover, a larger number of simple jobs are created when job competition is present (106 449 as opposed to 89 229). Since with job competition the pool of potential job applicants is larger, the cost of having a vacancy open falls, which in addition to the subsidy encourages job creation. On the other hand, improvement in labour demand in the low-tech sector increases the probability of contracting a simple job and attracts skilled workers who are ready to accept lower wages while they continue searching for more suited positions in the meantime. Although optimal from an individual point of view, this is not so collectively. By causing a transfer of labour towards low-tech sectors, the policy



leads to the destruction of profitable complex posts.

## 6.2 Policy cost

Figures 8 and 9 show the evolution of the cost *ex post* of a policy aimed at stimulating the demand for the low skilled. The maximum tax reduction is 34%, which amounts to the total suppression of social security charges at minimum wages. The cost *ex post* is measured in terms of the total cost in % of GDP and the annual average cost per post created in thousands of euro.

With segmented labour markets, the annual average cost per job created is first negative and decreasing, then negative and increasing and finally becomes positive when the subsidy reaches the region of 33 percentage points. A reduction of 26.7%, as in our scenario (a) in Table 1, implies a significant reduction of the low skilled unemployment (from 28 to 14%) at a negative cost to the budget. Higher demand for low skilled labour is progressively hindered by the tensions in the labour market (there are less unemployed people available for jobs) and the growing cost of keeping a vacancy open. The marginal effect (in terms of jobs created, as well as tax revenues and saving on unemployment benefits that arise in higher employment) diminishes and, when the average cost reaches zero, it is no longer possible to further increase employment without increasing the financing tax levied on the high skilled.

The effect of job competition on the skill composition of employment matters also with respect the policy cost *ex post*. For reductions beyond 12% the measure is no longer self-financing. The transfer of labour towards low-tech and low paid jobs reduces the revenues from labour taxation. This cost remains, nevertheless, moderate (at most 0.2% of GDP or 3 000 euro per year per job created).

In either case, our analysis is in line with the prediction of theoretical literature that there exists an optimal degree of tax progression that balances gains against the losses from tax rescheduling.

## 6.3 Different methods of policy financing

Until now we have assumed that the reductions of social security contributions have been financed by a lump sum tax (possibly a negative one when the reduction generates more resources than it costs) imposed on the high skilled household whose members earn the highest wages. We will now compare the effect of various financing methods: a lump sum tax, an additional proportional income tax on the high skilled or an increase in employer social contributions paid by the most complex firms (sector T). Regardless of the financing method, we observe *grosso modo* the same employment profile, as in Figure 10. The number of jobs created evolves approximately linearly. The result is very similar for the cases with and without job competition, hence only the latter is presented.

Table 3 looks into the effects of social security reductions valued *ex ante* at 1% of GDP and targeted at the lowest wages in the case without job competition: because the measure is self-financing, the required rate of financing tax

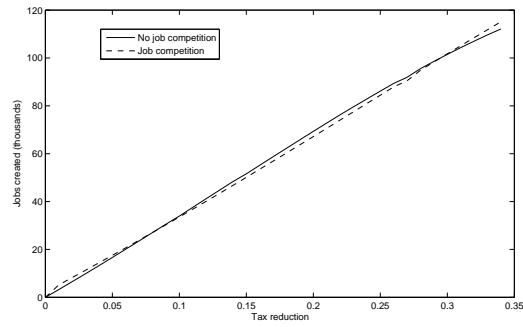


Figure 7: Number of jobs created depending on the size of a payroll tax cut targeted at minimum wages. Without and with job competition and on-the-job search.

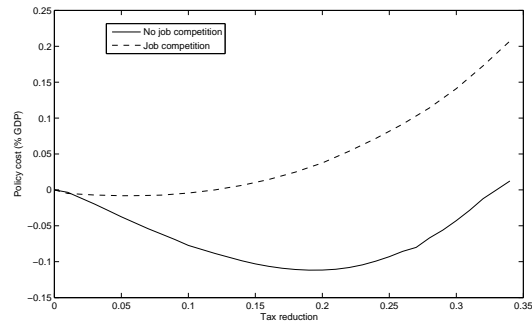


Figure 8: Policy cost *ex post*, in % of GDP, depending on the size of a tax cut targeted at minimum wages.

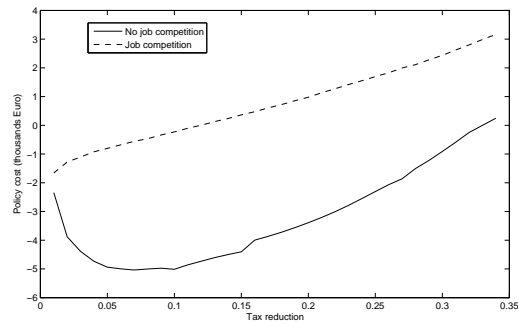


Figure 9: Average policy cost *ex post* per job created, in  $10^3$  euro per year, depending on the size of a tax cut targeted at minimum wages.

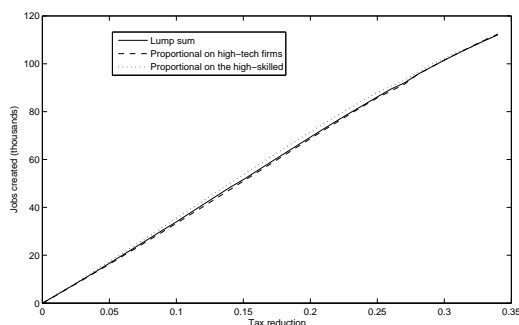


Figure 10: Number of jobs created depending on the size of a tax cut targeted at minimum wages. Different financing methods. No job competition.

is very low (and negative), which renders the three modes of policy financing almost equivalent, in segmented markets as well as job competition scenario. We may nevertheless stress two points. First, the redistribution of surplus via a decrease of personal income tax on the high skilled or employer social security in the high-tech sector (columns (b) and (c) respectively) stimulates employment in the high-tech sector by more than a simple lump sum redistribution to households. This arises because the reduction affects the highest wages at a margin. Second, the effects of cuts in columns (b) and (c) differ. In (b) a lower income taxation leads to a moderation of the bargained wages. On the other hand, a cut in employer social security induces a rise in the bargained wages. Hence, fiscal revenues from labour taxation are higher when firms are subsidised, which allows for a larger tax cut (-0.43% rather than -0.25%). This very mechanism is reflected in the comparison of policy costs with different financing methods, as in Figures 11 and 12.

## 6.4 Welfare

For the case of segmented labour markets, Figure 13 depicts, for each category of workers, the steady-state evolution of welfare (essentially the function of the level of consumption and leisure, and hence the wage income and the probability of being unemployed) depending on the size of a cut in employer social security contributions targeted at minimum wages. Since the measures are largely self-financing, the figures with different methods of policy financing are not significantly different and, hence, not reported here. Worth noticing is that the welfare of all worker groups increases with respect to the initial steady state, even when the measure is no longer self-financing, i.e. for very large tax cuts. It is the high skilled who enjoy the largest welfare gain although the redistributed budget surplus is close to zero. That arises precisely due to the fact that employment improvement due to a policy targeted at one sector spills over

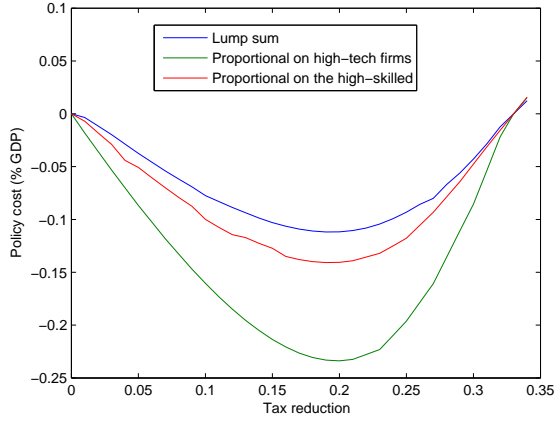


Figure 11: Policy cost *ex post*, in % of GDP, depending on the size of a tax cut targeted at minimum wages, with different policy financing. No job competition.

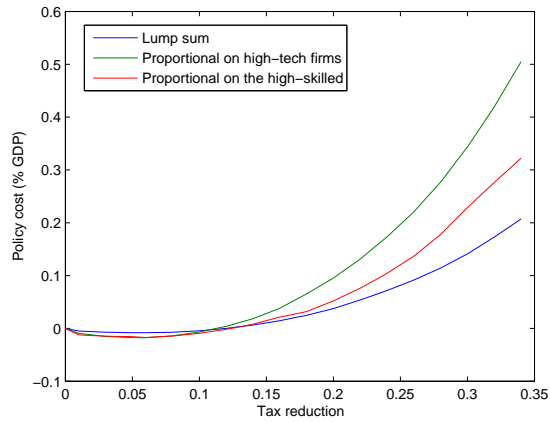


Figure 12: Policy cost *ex post*, in % of GDP, depending on the size of a tax cut targeted at minimum wages, with different policy financing. Job competition and on-the-job search.

Table 3: Effects of a reduction in payroll taxes, valued at 1% GDP, targeted at minimum wages. Different financing methods. No job competition.

		Financing tax		
		(a)	(b)	(c)
		Lump sum	Proportional High skilled	Proportional High-tech firms
<i>Ex post</i> financing tax (%)			-0.25	-0.43
<i>Ex ante</i> wage cost (% change)	B	-20.0	-20.0	-20.0
	M			
	T			
<i>Ex post</i> wage cost (% change)	B	-18.82	-18.83	-18.57
	M	1.32	1.35	1.32
	T	1.33	1.32	1.63
Additional employment	B	89 229	89 379	88 267
	M	348	357	339
	T	895	1 878	1 332
	<b>TOTAL</b>	<b>90 472</b>	<b>91 614</b>	<b>89 938</b>
Cost per job created (‘000 euro per year)		<b>-1.86</b>	<b>-2.11</b>	<b>-3.62</b>
Production (% change)		1.36	1.39	1.36
Productivity (% change)		-1.03	-1.03	-1.01
Welfare (% change)	<i>l</i>	0.77	0.77	0.85
	<i>s</i>	0.70	0.72	0.70
	<i>h</i>	1.37	1.43	1.35

to other labour market segments because of certain degree of complementarity between skills, embodied in the final good production function.

The welfare for the three categories of workers when ladder effects are present is depicted in Figure 14. Again, similar profiles are obtained for all methods of policy financing. The difference with respect to the no-job-competition case is striking. Only the welfare of the low skilled improves. The welfare of the skilled falls, although employment has increased, since these workers proceed towards jobs on which they are both overqualified and underpaid. The high skilled experience similar situation when tax cuts exceed some 7% as the budget surplus is too small to compensate them for the loss of revenue and the disutility of on-the-job search due to de-qualification. We hence observe that, when ladder effects are introduced, it is no longer true that structural reductions in social security targeted at minimum wages benefit all worker groups. The introduction of such a policy causes a significant redistribution of revenues and requires that the interests of different skill groups are taken into account. This difference should not, however, be overestimated. The policy cost per job created is rather low comparing to previous literature and it is most likely to be overestimated in our scenario where job destruction has not been endogenised.

## 7 Empirical Considerations

The degree to which on-the-job search and job competition are a real feature of the labour market is debatable. General evidence for the existence of on-the-job search can be found in Pissarides and Wadsworth [1994]. Moreover, since the supply of skilled labour in continental Europe has seen a marked increase, there exists some indication that job competition — whereby skilled workers evict the less skilled from their jobs — has strengthened. Dolado, Felgueroso and Jimeno [2000] examine Spanish labour market and find symptoms of over-education and low intensity of on-the-job search. Dolado, Jansen and Jimeno [2003] also analyse Eurostat data and find evidence of over-education and crowding-out. Interestingly, Van Ours and Ridder [1995], based on the estimation of a matching model, show that in the Netherlands job competition indeed takes place but only at high levels of education and training. However, Gautier, Van den Berg, Van Ours and Ridder [2002], using a data set on workers, jobs and firm characteristics in Holland, find no evidence of crowding-out. Competition is only present at the outflow rather than inflow of jobs: in downturn, the low skilled are fired first.

Hence, there does not exist a clear empirical consensus with respect to the importance of ladder effects for the low skilled unemployment rate. In reality a relatively small fraction of jobs seems to be occupied by overqualified workers. However, the implications of the presence of such phenomena for the effectiveness of policies aimed at reducing low skilled unemployment could be significant. In particular, if job competition indeed takes place — apart from the lower effectiveness of subsidies to unskilled jobs — training is also an ineffective policy against unemployment and rather the creation of skilled jobs should be

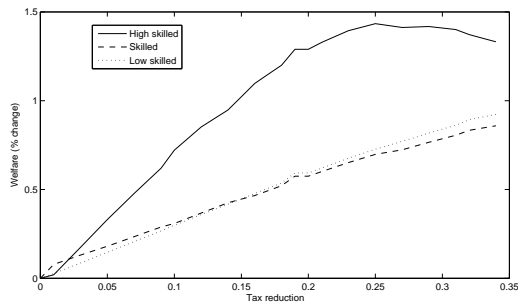


Figure 13: Change in welfare for different categories of workers, depending on the size of a tax cut targeted at minimum wages. No job competition.

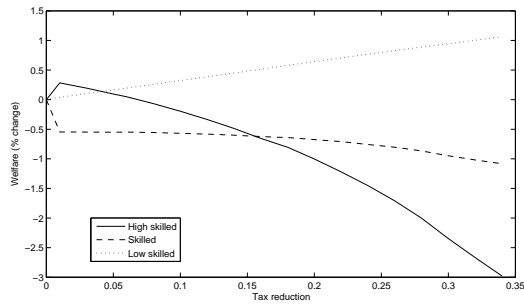


Figure 14: Change in welfare for different categories of workers, depending on the size of a tax cut targeted at minimum wages. Job competition and on-the-job search.

encouraged.

A number of aspects could be augmented in the model to better reflect those empirical considerations. Endogenising job destruction would provide a broader picture of margins where job competition might be taking place. However, this is beyond the scope of this study. Moreover, job competition could be introduced only at the higher echelon of the labour market, or a stickiness factor for labour mobility could be introduced. Nevertheless, having seen two extreme cases of the model with and without ladder effects, and the mechanics involved, it is easy to envisage the effects of a policy on the labour market in an intermediate scenario.

## 8 Conclusions

In order to simulate and compare the effects of structural reductions in employer social security contributions, we have employed a stylised search and matching model based on a representative behaviour of rational agents and accounting for interactions between different markets. Model has been build and calibrated in such a way that its predictions could be directly compared with the findings in previous studies.

We have found that narrow targeting of social security reductions at minimum wages is crucial to the success of the policy of tax cuts and that there exists an optimal rate of subsidy from the viewpoint of government budget. Particularly, in the case of no job competition, job creation is significant because, in the concerned labour market segment, gross wages are not sensitive to tax cuts, labour is abundant and recruitment costs are low. Moreover, the policy measure is largely self-financing and benefits all categories of workers. Based on a comparison with earlier theoretical and empirical literature, and in line with the reasoning of Mortensen and Pissarides [1994], the policy effects are likely to be reinforced if endogenous job destruction were introduced.

The presence of job competition and on-the-job search introduces some inefficiency. The policy is now less effective in reducing the low skilled unemployment due to the overqualified evicting the unskilled from low-tech jobs. Moreover, a shift towards less productive and low paid employment reduces the productivity of the economy, as predicted in theoretical literature, and increases the policy cost, hence rendering the policy no longer self-financing. As a result, the welfare of the more skilled groups is likely to fall. Nevertheless, the policy cost is low comparing to previous empirical studies and the positive result would most likely be re-established with the introduction of endogenous job destruction.

A number of dimensions have of course remained absent from our analysis. Our division into skill groups is exogenous. It has been suggested that skill upgrading could alter predictions of the model. It could be also useful to enlarge the analysis to account for both skill and age groups. A large number of the least qualified workers are the old and this affects their search behaviour and



wage bargaining. Moreover, a shift in demand for the low skilled, resulting from a reduction in wage costs, is larger the more growth dynamics it causes. Hence a rise in the low skilled employment stimulates and is itself stimulated by a subsequent rise in the high skilled employment and investment. Since the low skilled unemployed tend to be clustered in declining regions, with relatively little skilled labour and capital, these growth dynamics might not be very powerful. Furthermore, we have considered a closed economy. Looking at an open economy would involve two modifications: one of secondary and the another of primary importance. The secondary change concerns capital mobility which would alter the transitional dynamics, while the crucial modification touches upon the problem of competitiveness, which is frequently presented as an argument in favour of non-targeted tax cuts. This argument poses a fundamental question: are reductions in social security contributions the most appropriate means of lowering wage costs and stimulating competitiveness? The analysis in a closed economy provides at least an elementary answer: a targeted measure is not problematic as long as it benefits the majority of workers.

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