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EXPLORING THE MACROECONOMIC IMPACT OF SUBSIDIZED EMPLOYMENT

BY

EGBERT L.W. JONGEN*, EDWIN VAN GAMEREN**, AND JOHAN J. GRAAFLAND***

Summary

Spending on subsidized employment programmes has taken a high flight in the Netherlands over the past decade. We consider the impact of subsidized employment for low-productive workers in a stripped-down version of the MIMIC model. In our stylized model employment subsidies in the private sector lead to a marginal increase in employment and output. Subsidized employment programmes in the public sector lead to a larger increase in overall employment, but crowding out of regular employment leads to a fall in overall output. We further show that judging programmes on the basis of individual effects can be quite misleading, as the effects on the aggregate level can be quite different. Finally, given the steep rise in expenditures it is disturbing to see how little empirical knowledge we have on the impact of actual programmes on the individual level.

Key words: active labour market policies, general equilibrium effects

1 INTRODUCTION

To fight the rise and persistence of (long-term) unemployment in the Netherlands the Dutch government has implemented and intensified various active labour market policies (ALMPs) over the past decade.[1] Despite the steep rise in expenditures on ALMPs in the Netherlands little is known about the impact of these ALMPs on both the individual and aggregate level.

ALMPs give rise to a host of effects, some promoting variables like employment and output (e.g. human capital formation) and some discouraging employ-

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1 See Gravesteijn-Ligthelm et al. (1998) for an overview of past ALMPs in the Netherlands.

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ment and output (e.g. lock-in, fiscal substitution). The overall impact of ALMPs is typically ambiguous in theory (see Calmfors (1994) for an excellent overview of the diverse effects). Hence, the overall impact of ALMPs has to be determined empirically.

There are three (related) strands of literature that seek to determine the effects of ALMPs. First, micro-level studies use cross-section or panel data on individuals' employment status and wages to determine the so-called 'treatment effect' on the probability of finding (regular) employment and the impact on wages (see Heckman et al. (1999) for an overview of micro-level studies). Second, macro-econometric studies use aggregate panel data to determine the impact of ALMPs on (regular) employment and wages (see Calmfors et al. (2001) for an overview of macro-econometric studies). Finally, a handful of papers study the impact of ALMPs in the context of an applied general equilibrium (AGE) model, e.g. Heckman et al. (1998) and Davidson and Woodbury (1993). General equilibrium models can complement the micro-level studies to determine the overall impact of the programmes on the economy at large. Indeed, Heckman et al. (1999, p. 2043) note that 'any policy with a large target population is likely to have general equilibrium impacts. Reliance on microeconomic treatment effect approaches to evaluate such policies produces potentially misleading estimates. ... we urge the use of general equilibrium methods to produce more accurate assessments of the true impacts of the programmes ... .' However, '[T]he cost of this enhanced knowledge is the difficulty in assembling all of the behavioral parameters required to conduct a general equilibrium evaluation.' The AGE approach may further complement the macro-econometric estimates that are plagued by short time series and may suffer from reverse causality (see e.g. Forslund and Krueger (1997)).

In this paper we explore the impact of subsidized employment in an AGE model for the Netherlands. Specifically, we consider the impact of subsidized employment in a stripped down version of MIMIC, the applied general equilibrium model of CPB Netherlands Bureau for Economic Policy Analysis. We focus on subsidized employment because of the various ALMPs subsidized employment has seen the most dramatic increase in expenditures in the Netherlands.

We consider the impact of three stylized types of subsidized employment: a) an employer subsidy for hiring an individual on welfare, b) relief jobs in the public sector for individuals on welfare, and c) training programmes in the public sector for individuals on welfare. Due to a lack of data we lack a rigorous underpinning of the treatment effect of relief jobs and public training programmes in the Netherlands. The goal of this exercise then is not too draw any definitive conclusions on actual programmes but rather to consider the role of general equilibrium effects in the overall impact of our stylized subsidized employment programmes. Our stylized relief jobs and training programmes are supposed to capture the two polar cases of subsidized employment in the public sector: i) relief job workers do not (re)gain any lost skills but produce some output, ii) public training programme participants fully regain lost skills and become as productive as job seekers on unemployment benefits but do not produce any output during the training period. To see how these polar cases relate to actual programmes we relate the impact on the individual employment probability and subsequent wages to the findings of rigorous studies on the treatment effects of programmes abroad. Furthermore, we also consider how sensitive the overall results are to changes in key parameters.

The paper has the following outline. Section 2 considers the development of expenditures on subsidized employment in the Netherlands and the corresponding EU and OECD averages. Section 3 gives an informal description of the model we use for the analysis. The model equations and parameter values are given in the appendix and discusses the calibration of the model and relate the individual outcomes to the findings of micro-level studies. Section 4 gives the simulation outcomes, relates the aggregate outcomes to the findings of macro-econometric studies and discusses some sensitivity analyses. Section 5 summarizes the main findings and concludes.

2 SUBSIDIZED EMPLOYMENT IN THE NETHERLANDS, THE EU AND THE OECD: 1990-1998

Figures 1 and 2 below give the expenditures on subsidized employment for the Netherlands, the EU and the OECD over the period 1990-1998. Figure 1 gives the expenditures on subsidized employment in the private sector, Figure 2 gives the expenditures on subsidized employment in the public and non-profit sectors.[2] We report expenditures as a percentage of GDP. Data are taken from the 'OECD Database on labour market policies.'

Expenditures on employment subsidies in the private sector in the Netherlands have risen to the OECD average over the past decade, but are still below the EU average. Programs that fall into this category are the *'Vermindering Langdurig Werklozen'* (*'VLW'*, Reduction Long-Term Unemployment) and the *'Melkert-2'* program. The *'Speciale Afdrachtskorting'* (*SPAK*, Special Premium Deduction) falls outside the definition of active labour market policies of the OECD (the *SPAK* has unlimited duration and targets all low-earnings workers).[3] When we

2 Unfortunately we do not have information on subsidized employment in all OECD (and EU) countries. Furthermore, for some countries we only have information on one type of subzidized employment, e.g. subsidized employment in the private sector. Below we list the countries of which we take the average in Figures 1 and 2, respectively. EU in Figure 1 consists of: Austria, Belgium, Denmark, France, Germany, Greece, Luxembourg, the Netherlands, Spain, Finland and Sweden. OECD consists of EU and Australia, Canada, Czech Republic, Hungary, Japan, Norway, and the US. EU in Figure 2 consists of: Austria, Belgium, Denmark, Finland, France, Germany, Portugal, the Netherlands, Spain, and Sweden. OECD consists of EU and Australia, Canada, Czech Republic, Hungary, Norway and the US. The data for EU and OECD are unweighted averages.

3 The Dutch 'SPAK'-programme falls outside the scope of this paper. It targets all low income workers in the Netherlands. We focus on subsidized employment for individuals (previously) on welfare benefits only. For an analysis of the impact of the Dutch 'SPAK' see Graafland et al. (2001). For

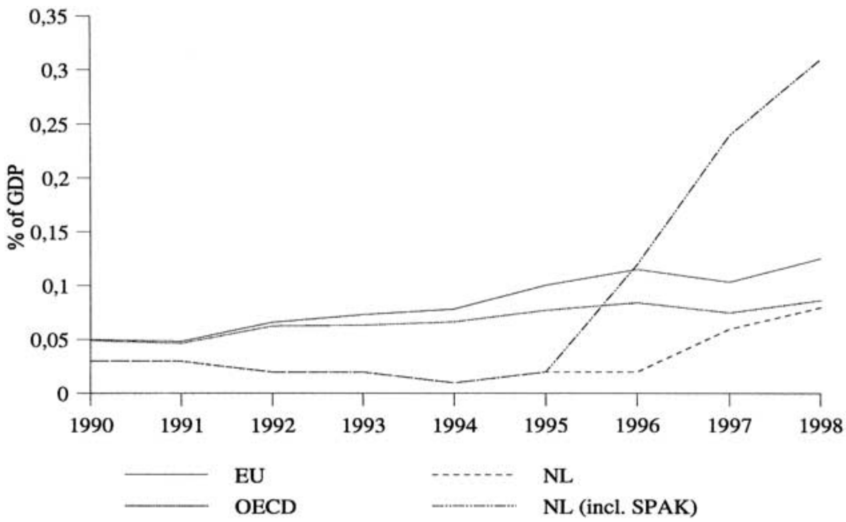

Figure 1 – Subsidized employment in the private sector, as a percentage of GDP
Source: OECD Database on labour market policies

include the expenditures on the *SPAK*, introduced in 1996, expenditures in the Netherlands rise steeply above both the OECD and EU average.

Expenditures on subsidized employment in the public and non-profit sector in the Netherlands also show a marked increase over the past decade. Starting well below the EU and OECD average, expenditures in the Netherlands take a high flight in the latter part of the 1990s, rising above the EU and OECD average. Note that while expenditures on subsidized employment in the public sector take a high flight in the Netherlands after the mid 1990s, spending on these programmes as a percentage of GDP falls for the EU and OECD from the mid 1990s onwards (although 1997-1998 shows a small increase in spending as a percentage of GDP for both EU and OECD). Dutch programmes that fall in the category of subsidized employment in the public sector are the *'Wet Inschakeling Werkzoekenden'* (*WIW*, Unemployed Activation Act) and the *'In- en Doorstroombanen'* (*ID-jobs*, Inflow and Flow-Through Jobs).

3 MODELLING SUBSIDIZED EMPLOYMENT

We consider the impact of subsidized employment programmes in a stripped-down version of the MIMIC model, the applied general equilibrium model of CPB Netherlands Bureau for Economic Policy Analysis (see Graafland et al.

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the impact of wage cost reductions for low income workers in Belgium see Sneessens and Shadman (2000), and for France see Crépon and Desplatz (2001). Furthermore, for some theoretical considerations on wage cost reductions for low income workers see Drèze (2002).

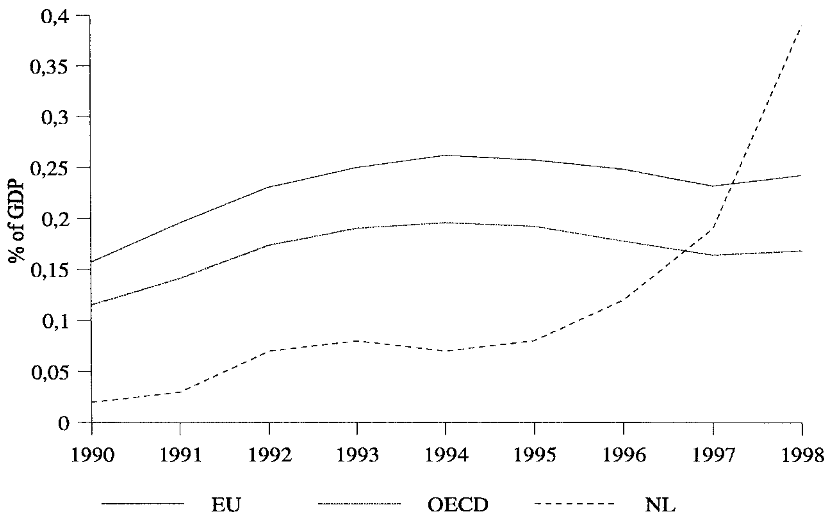

Figure 2 – Subsidized employment in the public and non-profit sector, as a percentage of GDP
Source: OECD Database on labour market policies

(2001) for a description of the full MIMIC model). We use a stripped-down version to keep the results tractable and to limit the computational burden. The main simplifications are an exogenous labour force, no physical capital, no schooling decision, and no division by sector. What remains is an aggregate CES production structure with intermediate inputs produced by unskilled, low-skilled and high-skilled labour, the flow models with the search and selection strategies of firms and workers as inputs, the wage bargain, and a collective body (the 'government') that sets tax and premium rates. These submodels are supposed to capture the main channels through which subsidized employment affects the labour market. We expand these submodels to account for the presence of subsidized employment. An informal discussion of the adapted model is given below, the model equations and parameter values are given in the appendix. We start the informal discussion with the flow model that lies at the heart of the analysis.

3.1 *The Flow Model*

The flow model determines the flows in and out of the different states on the labour market, see Figure 3. We distinguish between the following states on the labour market: low and high-productive employment, E_l and E_h, respectively, low and high-productive unemployment, U_l and U_h respectively, relief jobs, R, and training programmes, T.

First, consider the states of employment and unemployment. Individuals in low and high-productive unemployment move into (regular) employment at rates $\pi_{ul,el}$

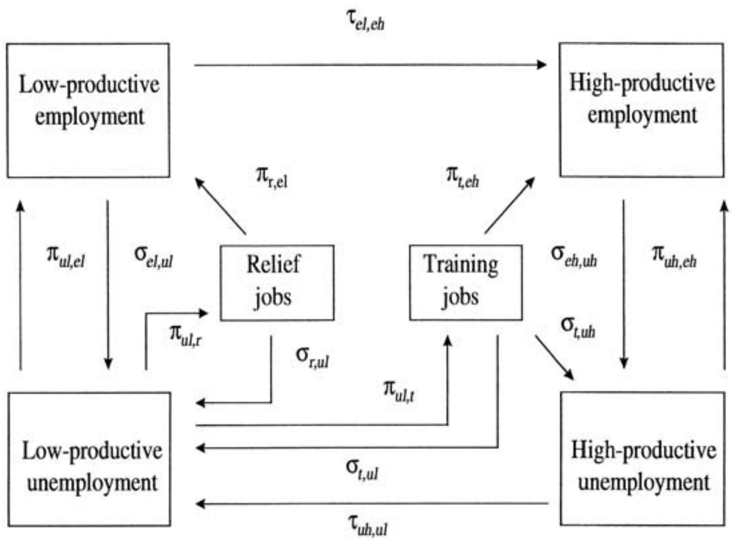

Figure 3 – Flows and stocks

and $\pi_{uh,eh}$, respectively. Individuals in low- and high-productive employment become unemployed at rates $\sigma_{el,ul}$ and $\sigma_{eh,uh}$, respectively. Furthermore, we assume that high-productive individuals run a risk $\tau_{uh,ul}$ of becoming low-productive unemployed when they are unemployed, i.e. they run the risk of losing part of their skills. On the other hand, we assume that low-productive individuals that have entered into low-productive employment become high-productive again at rate $\tau_{el,eh}$, i.e. they may regain their lost skills.

Now consider the states of relief jobs and training programmes. Only low-productive unemployed individuals (in the calibration we associate low-productive unemployed individuals with individuals on welfare) are eligible for these programmes, and they flow into these states at rates $\pi_{ul,r}$ and $\pi_{ul,t}$, respectively. Our stylized relief jobs and training programmes are meant to capture two polar cases of subsidized employment for low-productive unemployed in the public sector, where actual programmes may contain elements of both. Individuals in relief jobs do not regain lost skills but produce some output. As relief job workers do not regain lost skills, exit is either back to low-productive unemployment, at rate $\sigma_{r,ul}$, or to a regular low-productive job, at rate $\pi_{r,el}$. Individuals that have completed the training programme have fully regained their lost skills. Individuals in the training programme do not produce output. Individuals that have completed the training program move into high-productive employment, at rate $\pi_{t,eh}$. Individuals that return to unemployment before the training was finished move to low-productive unemployment, at rate $\sigma_{t,ul}$. Individuals that have completed the training programme but have not found employment move into high-productive unemployment, at rate $\sigma_{t,uh}$.

The rates at which workers flow back to either low or high-productive unemployment are exogenous in the model. The rates at which individuals lose and regain their skills are also exogenous. The rates at which individuals move into employment, relief jobs, and the training programme are endogenous. The endogenous flow rates result from the behaviour of profit maximizing firms and utility maximizing workers, given technology and policy.

The analysis is restricted to steady states. Hence, we do not consider the transition from the initial steady state to the new steady state with changed policy parameters. The results should therefore be interpreted as 'long-run'. In a steady state the inflow into a particular state equals the outflow, for all states. In a steady state we can express the stocks in terms of the flow rates (independent of initial conditions), see the appendix.

3.2 *Matching Technology*

The technology underlying the endogenous flow rates are given by so-called 'matching functions.' Like a production function a matching function is an empirical relation between output, the number of new job-worker matches, and inputs, the number of searching units. The matching function is typically assumed to exihibit constant returns to scale (see e.g. Petrongolo and Pissarides (2000)). We consider how an aggregate matching function for regular employment, relief jobs, and the training programme can be recovered from the technology underlying the individual transition rates.

The specification of the endogenous flow rates given in the appendix is repeated below for easier reference. For regular employment the rate at which a job seeker of type i moves into employment type j is given by

$$\pi_{i,j} = \mu s_{i,j} f(\underline{\alpha}_i, \underline{\alpha}_j)\, \theta_{pr}{}^{\gamma}, \quad (i,j) \in \{(ul,el), (uh,eh), (r,el), (t,eh)\}, \qquad (1)$$

where μ denotes a mismatch indicator. The flow rate for individual i depends positively on his or her search effort $s_{i,j}$ for state j and the probability that a contact with a vacancy results in a match $f(\underline{\alpha}_i, \underline{\alpha}_j)$. When a worker and a vacancy meet they draw a match-specific productivity from a potential productivity distribution. α_i and α_j denote the minimum productivity required by the worker and the firm, respectively. Vacancies and competing job seekers enter via θ_{pr}, labour market tightness in the private sector. θ_{pr} is given by $\theta_{pr} = V_{pr} / (s_{ul,el} U_{ul} + s_{uh,eh} U_{uh} + s_{r,el} R + s_{t,eh} T)$, where V_{pr} denotes private sector vacancies. More vacancies raise the rate at which individual i finds employment, but more competing job seekers reduce the rate at which individual i finds employment (*ceteris paribus*). The aggregate matching function for regular employment follows from the sum of the individual transition rates for job seekers multiplied by the respective stocks.

Vacancies for relief jobs and training programmes are posted in another segment of the labour market but the flow rates into these states are specified in a similar way[4]

$$\pi_{ul,j} = \mu s_{ul,j} \theta_j^{\gamma}, \quad j \in \{r, t\}, \tag{2}$$

with $\theta_j = V_j / (s_{ul,j}\, U_{ul})$. The probability that a contact results in a match is missing from the transition rates into relief jobs and training programmes. Indeed, policy dictates that all low-productive job seekers are accepted in these states, whereas compensation is set sufficiently high to make low-productive job seekers willing to enter these programmes. The aggregate matching functions can be found by multiplying the flow rates with the stocks of low-productive unemployed.

Below we outline how the inputs into the matching functions are determined through profit maximization by firms and utility maximization by workers.

3.3 *Firms*

Firms determine the number of vacancies that come into the market and a minimum productivity required from a match with a low or high-productive job seeker. The presence of minimum wage legislation implies that not all matches are profitable.

Final output is a CES function of intermediate inputs produced by unskilled, low-skilled and high-skilled labour. Per skill type firms enter until wage and search costs per skill type exhaust the marginal product per skill type (zero-profit condition). A rise in wage and search costs will reduce labour demand.

The share of contacts between a job seeker and a vacancy accepted by firms depends on the share of contacts with a match-specific productivity greater or equal to minimum wage costs. As the potential productivity distribution of a contact with a high-productive job seeker stochastically dominates the potential productivity distribution of a contact with a low-productive job seeker (the potential productivity distribution of a contact with a low-productive unemployed is 'shifted leftward') a contact between a worker and a vacancy is less likely to result in a match when the job seeker is low-productive. The lower acceptance rate of low-productive job seekers by firms is somewhat limited by the fact that

4 The assumption of segmented markets for regular employment, relief jobs, and training programmes is more innocious than it may appear at first sight. Suppose that we create two segments in a market that is initially not segmented. Both markets contain 50 percent of vacancies, and workers divide their search effort equally over both segments. By constant returns to scale in the matching function the total number of matches will be the same.

low-productive unemployed may become high-productive again. Firms share in this productivity gain. The capital gain which results implies that productivity draws for a contact with a low-productive unemployed just below minimum wage costs are also accepted. An increase in the share of low-productive job seekers raises search costs for firms as they have to search longer for acceptable workers.

Finally, an employer's subsidy for low-productive workers lowers their labour costs.[5] Firms claim part of the subsidy via the wage bargain. Furthermore, some contacts with a low-productive worker will now result in a profitable match, lowering search costs.

3.4 *Workers*

Workers determine how much time to spend on job search, and hold a reservation wage for each employment state which determines the share of job offers accepted.

Workers maximize their utility by varying their search effort. The search intensity of the job seeker depends positively on the time spent on job search, but is subject to diminishing returns. More time spent on job search increases the probability of finding a job but reduces leisure time.

Low-productive job seekers are less productive in generating output once employed, and transforming search effort into search intensity when searching. As a result, the utility maximizing search intensity for low-productive job seekers is less than for high-productive job seekers. Furthermore, the marginal value of leisure increases when the amount of leisure falls. As individuals in low-productive unemployment spend some time on locating relief jobs and training programmes this further reduces their search effort for regular employment.

Individuals in a relief job have a lower search intensity than individuals in low-productive unemployment. They have to devote part of their valuable leisure time to production which leaves less time available for locating a regular job. Furthermore, higher compensation in relief jobs than in low-productive unemployment further reduces the search effort of relief job workers relative to the low-productive unemployed. Individuals get 'locked-in' in a relief job.

Individuals that have completed the training programme may have a higher or a lower search intensity for regular employment than low-productive unemployed. On the one hand they have to spend part of their valuable leisure time on training and receive higher compensation in the training programme than in low-productive unemployment, which lowers their search intensity. On the other hand

5 Whether the subsidy is given to the employer or the worker is inconsequential for the results. In the wage bargain workers and firms split any subsidy 50/50. Furthermore, at the margin the most restrictive factor will receive the full subsidy. As the minimum wage is more restrictive than the reservation wage of low-productive job seekers, in the calibrated model the firm will take all of the subsidy at the margin.

they search for more productive jobs and are more productive in generating search intensity, which increases their search intensity. In our calibrated model their search intensity is higher than the search intensity of the low-productive unemployed.

Next to selecting the utility-maximizing search effort, workers have to decide which job offers to accept and which to decline. As mentioned above, the compensation in relief and training jobs is set sufficiently high to make low-productive unemployed individuals willing to enter these programmes. This leaves the share of regular job offers accepted by job seekers. The low-productive unemployed have a lower reservation wage than high-productive unemployed. Low-productive unemployed have a lower benefit level, search over a less favourable wage offer distribution and are less likely to find alternative employment. Whether or not the share of job offers accepted is higher for low-productive unemployed than for high-productive unemployed depends on the respective positions of the reservation wages relative to the respective wage offer distributions. In our calibrated model the low-productive unemployed accept more job offers.

Relief job workers are less likely to accept a job offer than low-productive unemployed. Compensation in relief jobs is sufficiently high to make a low-productive unemployed better off in a relief job. As they hold a higher reservation wage and face the same wage offer distribution as low-productive unemployed, relief job workers accept less wage offers than the low-productive unemployed.

Individuals in the training programme are also better off than low-productive unemployed, hence they too hold a higher reservation wage than low-productive unemployed. However, they face a more favourable wage offer distribution which makes them accept more offers for a given reservation wage. In the calibrated model training programme participants accept less job offers than the low-productive unemployed.

The overall share of job offers accepted by firms and workers is given by a CES-weighted function of the share of job offers accepted by firms and workers. The parameterization of the CES function basically implies that the ‘short side’ of the market determines the share of contacts resulting in a match.

3.5 *Wage Determination*

Wage costs per skill type result from a generalized Nash bargain between a representative worker and a firm. The representative worker is a worker with average productivity per skill type. The representative firm is the firm that employs this worker. Average wages per skill type follow from deducting employers’ and employees’ tax and premium rates per skill type from wage costs per skill type. The wage for a match with a particular productivity realization follows from multiplying the average wage by the productivity realization over the average productivity of accepted matches.[6]

The wage bargain strikes a level of wage costs in between labour productivity (including any subsidy for workers) and the outside option of workers. The outside option of firms is the value of a vacancy, which is zero in equilibrium.

The outside option of workers is a weighted average of compensation in formal and informal employment outside current employment. Informal (i.e. non-taxable) employment is essential in the wage bargain for it implies that taxes and premiums are not fully born by labour, in line with empirical findings for the Netherlands (see e.g. Graafland et al. (2001)).

Formal compensation outside current employment is a weighted average of compensation in employment, the unemployment states and relief jobs and the training programme, with the shares of these states in the labour force as weights. As the compensation in relief jobs and the training programme is higher than in low-productive unemployment, a rise in the number of relief jobs or training programme participants will improve the outside option of workers. As a result, an increase in relief jobs and/or training programmes will increase wage costs in regular employment.

3.6 *Government Policy*

The government sets the replacement rates (benefit levels relative to wages) in low- and high-productive unemployment, relief jobs and the training programme. Furthermore, the government sets tax and premium rates for workers and employers and determines the level of the subsidy for employers that hire a low-productive worker. Finally, the government sets the number of vacancies for relief jobs and the training programme to reach a target number of participants in these programmes.

Taxes and premiums levied on employers and workers determine government receipts. Expenditures by the government are on benefits for the unemployed, compensation in relief jobs and the training programme, vacancy costs for vacancies for relief jobs and the training programme, subsidies for low-productive workers in regular employment, wage costs for public sector workers, and autonomous spending. Wage costs in the public sector are proportional to private sector wage costs. We include a fixed number of public sector workers to allow higher wage costs in the private sector to feed into higher wage costs for workers in the public sector. In the calibration we take actual tax and premium rates in the calibration year in the Netherlands. Autonomous spending is set at the level which balances the budget.

6 Wages are proportional to productivity for analytical and computational convenience.

3.7 *Calibration of the Model*

The base year for the calibration is 1993 (in line with the original MIMIC model). Scaling parameters are set so as to reproduce prices and quantities on the Dutch labour market in 1993. Key parameter values are given in Table 5 in the appendix.

The stocks of employment, unemployment and vacancies per skill type are given by Central Bureau of Statistics (CBS) data. We associate the stocks of low and high-productive unemployed with the stocks of welfare recipients (in the labour force) and unemployment insurance recipients, respectively. We use data from Broersma et al. (2001) for the flow rate from unemployment insurance and welfare, and data from Broersma et al. (2001) and CBS to determine the flow rates from low and high-productive unemployment into employment per skill type (see Jongen et al. (2000) for the numerical values of the different flow rates). The rate at which individuals rebuild skills in low-productive employment ($\tau_{el,eh}$ in Figure 3) is set lower than the rate at which individuals lose skills in high-productive unemployment ($\tau_{uh,ul}$ in Figure 3) to obtain a higher job destruction rate in low-productive employment than in high-productive employment (e.g. de Beer (1996) finds that welfare recipients have a higher flow rate back to unemployment once employed than unemployment benefits recipients). When the rates at which individuals lose and rebuild skills are set, job destruction rates in low and high-productive employment follow from the steady state condition. For 1993 we associate the stock of relief job workers with the number of participants in the so-called 'Banenpool' (Labour Pool), and the stock of training job workers with the number of participants in the so-called 'Jeugdwerkgarantieplan' (JWG, Youth Employment Guarantee) to get some realistic starting values for the number of participants in our stylized programmes. The flow rates from the 'Banenpool' back to welfare and the flow rates from the 'Jeugdwerkgarantieplan' to welfare and unemployment insurance and the stocks are taken from Gravesteijn-Ligthelm et al. (1998).

We also have data on the flow rates from the 'Banenpool' and 'JWG' into regular employment. Ministry of Social Affairs (1997a, 1997b) report an annual outflow rate to regular employment of only 3 percent for the 'Banenpool' and 21 percent for the 'JWG'. For comparison, the annual outflow rate for welfare recipients to regular employment is over 30 percent a year. As noted above, there is no study for the Dutch labour market that separates the treatment effect from the selection effect. Hence, whether the low outflow rates from the 'Banenpool' and 'JWG' are the result of the 'treatment' or because the least able individuals join the programme remains unclear. Rather than forcing these low outflow rates on our stylized programmes we let the model determine the outflow rates and compare the resulting outcome in terms of flow rates to regular employment and wages with studies that do separate the treatment effect from the selection effect. Excellent surveys of the individual effect of relief jobs and public training programmes on employment probabilities and wages are given in Calmfors et al. (2001), Heckman et al. (1999) and Fay (1996). Our reading of the literature is that relief jobs do not increase the transition rate into regular employment, and are more likely to reduce it. Studies on the impact of relief jobs typically do not consider the impact on subsequent wages earned by individuals that moved into regular employment. Participation in our stylized relief jobs reduces an individuals job finding rate by 48 percent on average. This drop seems rather large relative to the findings of micro-level studies abroad. For example, Kluve et al. (1999) find a drop of 17 to 24 percent in the transition rate for men in public works. Hence, our stylized relief programme may overstate the lock-in effect of actual programmes.

The findings on public training programmes are less robust. The effect on the subsequent employment probabilities and wages can be either significantly negative, insignificant, or significantly positive. Findings are often not robust even across different specifications used in the same paper. Although we have little guidance from the literature on public training programmes it seems fair to conclude that our assumptions concerning the stylized training program are rather favourable, the individual job finding rate and wages increase by 40 and 28 percent, respectively. Hence, our stylized training programme may overstate the effectiveness of actual training programmes. We emphasize that our stylized programmes are supposed to capture polar cases, with actual programmes containing both relief work and training elements.

The technology and preference parameters in the production function, the matching technology, utility functions, and wage bargain are taken straight from the original MIMIC model. Due to a lack of space we refer the reader to Graafland et al. (2001) for a discussion of the calibration of these parameters.[7]

Finally, we consider the productivity of relief job workers and the training costs. We use a conservative value of output produced by a relief job worker net of overhead costs of 25 percent of minimum wage costs. Little is known about the actual output produced by relief job workers as relief jobs are typically in the public sector. We consider the impact of a higher level of output produced by relief job workers in the sensivity analysis following the base simulations. The

7 However, we briefly discuss the calibration of two parameters that differ from the original MIMIC model. First, whereas the original MIMIC model distinguishes between short- and long-term unemployment we distinguish between unemployment insurance recipients and welfare recipients. We calibrate the loss of skills per skill type on the outflow rates to regular employment of individuals receiving welfare benefits relative to individuals receiving unemployment insurance (loss of skills is consistent with empirical studies that indicate that individuals with a longer unemployment duration are less likely to find regular employment due to genuine duration dependence (as opposed to heterogeneity, see e.g. Groot (1990) and Kerckhoffs et al. (1994)). Second, we introduce a parameter δ_w in the wage bargain (see equation (50) in the appendix) that discounts the difference between the income in the state of low-productive unemployment, relief jobs and the training programme and the income in regular employment so as to obtain the same reduced form elasticities as the wage equation of the original MIMIC model.

information on training costs is scarce. De Koning et al. (1995) find that the average training cost for training programmes was 22 percent of the gross minimum wage in 1993. Forslund and Krueger (1997) report an average training cost of around 60 percent of benefits for Sweden and 96 percent of benefits for Germany. We set the training cost including overhead costs at 25 percent of minimum wage costs. We consider higher costs for the training programme in the sensitivity analysis.

We set the compensation in relief jobs and the training programme conservatively at the minimum wage. Actual programmes pay minimum wages or more (see Jongen et al. (2000) for an overview). We discuss the impact of higher compensation in relief jobs and the training programme in the sensitivity analysis.

4 SIMULATIONS

We are interested in the impact of increasing the number of relief jobs, places in the training programme and/or the employer subsidy for hiring a low-productive worker. Furthermore, we are also interested in how the programmes affect key variables relative to each other. To make the results comparable we present simulation results for an equal '*ex ante*' impuls of 115 million euro (250 million Dutch guilders) into each type of subsidized employment. By '*ex ante*' we mean for relief jobs and the training programme that we increase vacancies for these programmes to obtain an increase in the stocks of these programmes which accords with an additional 115 million euro spent on compensation, for given outflow rates of and the initial number of searching units for these programmes. For the employer subsidy we set the subsidy at the level for which the initial stock of the low-productive employed multiplied by the subsidy equals the '*ex ante*' impulse.

The discussion of the simulation outcomes is structured as follows: first we consider the induced changes in behaviour, then we consider how these behavioural changes are reflected in some macro-economic variables, and finally we consider the impact on government expenditures and receipts. For the macro-economic variables and government expenditures/receipts we give the results both with and without changes in income tax rates to balance the budget. Comparing the outcomes with and without changes in tax rates gives an indication of the extent of fiscal substitution.

4.1 *Relief Jobs*

First consider the impact of increasing the number of relief jobs. To increase the number of relief jobs the government posts more vacancies for relief jobs.

Table 1 below gives the induced changes in the behaviour of workers and firms. As more vacancies for relief jobs come into the market, individuals in low-productive unemployment devote more time to locating these vacancies. This goes at the expense of time devoted to locating private sector vacancies and vacancies for the training programme. The flow rate into relief jobs rises. We observe a mild drop in private sector vacancies. Relief job workers devote less time to job search than low-productive unemployed and are more reluctant to accept job offers than low-productive unemployed. Hence, search costs for firms rise. As we will see below, wage costs rise as well. The rise in search and wage costs implies a rise in labour costs. Higher labour costs lead to crowding out of private sector employment. The drop in the entry of private sector vacancies is somewhat masked by the increase in the vacancy duration.[8]

Next, consider how the changes in these inputs of the matching process affect the outputs: the endogenous flow rates. Clearly, the flow rate from low-productive unemployment into relief jobs increases. Individuals in low-productive unemployment spend less time on locating vacancies in the private sector, their flow rate into regular employment falls.

Turning to the stocks, observe that participation in relief jobs rises more than the fall in low-productive unemployment. Indeed, this reflects the effect that individuals get 'locked-in' in the relief programme, with a reduced outflow into regular employment. The drop in the effective supply of labour combined with higher wage costs lowers private sector employment. The number of relief jobs rises by almost 14 thousand persons, whereas regular employment falls by 7 thousand persons, i.e. 50 percent crowding out of regular employment. These numbers are generated assuming that the budget is not balanced via additional taxation. We consider how fiscal substitution affects crowding out below.

Table 2 below gives the impact of an increase in relief jobs on some key macro-economic variables, both with and without compensating taxation to balance the budget. Wages rise as higher compensation in relief jobs than in low-productive unemployment implies that the outside option of workers improves when we increase the number of relief jobs. Productivity in the private sector rises as less individuals in the low-productive segment are in regular employment. The drop in private sector employment is reflected in the drop in output.

Turning to the receipts and expenditures of the government, the wage bill of the government rises. This is mostly due to the rise in relief job expenditures, but also due to the rise in regular labour costs for the government, labour costs for the government are linked to private sector labour costs. Overall, expenditures do rise but less than the '*ex ante*' impulse of 115 million euro. There are savings on welfare benefits (and unemployment insurance) whereas relief job workers produce some output.

Table 2 also gives the corresponding effects on the macro level and government expenditures when the government finances the rise in expenditures by a rise in income tax rates. This further raises labour costs, which adversely affects private sector employment and output. With compensating taxation, crowding out

8 The changes in the acceptance rates, i.e. the share of contacts accepted, mainly reflect changes in the composition of unskilled, low-skilled and high-skilled workers.

of private sector employment rises from 50 percent without additional taxation to 69 percent with additional taxation.

4.2 *Training Programme*

Tables 1 and 2 also give the changes induced by an '*ex ante*' impulse of 115 million euro into the training programme. With more vacancies for the training programme in the market, low-productive unemployed devote more search effort to locating these vacancies. This goes at the expense of search effort devoted to locating vacancies in the private sector.

However, whereas the relief programme slows down the process by which an individual moves into regular employment, the training programme has the opposite effect. Increased participation in the training programme results in an increase in the effective supply of labour. Trained individuals search more intensely for a job than low-productive unemployed, and a contact between a worker and a vacancy is more likely to result in a match for a trained individual than for a low-productive unemployed person. The private sector vacancy duration (and stock) falls, which lowers search costs for firms.

Turning to the flow rates and stocks, the flow rate into the training programme rises. For the additional individuals in the training programme the flow rate into regular employment rises, the stock of low-productive unemployed falls more than the rise in the training programme. But for all other individuals the flow rate into regular employment falls. Indeed, as we will see below, the higher compensation in the training programme relative to low-productive unemployment pushes up wages. The rise in wages dominates the fall in search costs and the rise in the average productivity of applicants. Despite the positive 'treatment effect' of the training programme on the individual level, regular employment falls! Without additional taxation crowding out of regular employment is 26 percent of the rise in training programme participation.

Table 2 gives the resulting changes in key macro-economic variables. Labour costs rise with the increase in training jobs. The rise in labour costs is partly due to a composition effect, i.e. the increase in average productivity, and partly due to the more favourable outside option of workers.

Private sector employment falls as labour costs rise. However, production is unaffected due to the increase in human capital of trained individuals. Unemployment falls more than under relief jobs, but the 'inactivity ratio,' defined as the sum of unemployment, relief jobs and the training program over the labour force, increases. Government expenditures rise due to the higher expenditures on the training program. Expenditures on unemployment insurance benefits rise with high-productive unemployment. However, the government saves on welfare benefits and relief jobs expenditures and receives more taxes due to the rise in wages. Overall, expenditures fall short of receipts, even more than the '*ex ante*' expenditures. Expenditures are higher '*ex post*' due to the training costs.

TABLE 1 – RELIEF JOBS, THE TRAINING PROGRAMME AND EMPLOYMENT SUBSIDIES – CHANGES IN BEHAVIOUR, FLOWS AND STOCKS[a]

Simulation	relief jobs	training programme	employment subsidy[b]		relief jobs	training programme	employment subsidy[b]
Individual level				Aggregate level			
Job seekers		percentage changes		Overall accept. rates		percentage changes	
Search intensity							
$s_{uh,eh}$	− 0.1	− 1.9	− 1.7	fm_h	0.0	− 1.1	− 1.3
$s_{ul,el}$	− 1.2	− 10.8	3	fm_l	0.3	1	10.8
$s_{ul,r}$	36.4	− 10.8	− 6.4	fm_r	0.6	− 3.8	18.3
$s_{ul,t}$	− 0.1	45.8	− 4.1	fm_t	0.3	− 1.8	− 1.7
$s_{r,el}$	0.8	− 2.7	10.8				
$s_{t,eh}$	− 0.0	− 3.8	− 3.5	Flow rates			
Acceptance rate				$\pi_{uh,eh}$	0.2	− 4.3	− 3.9
				$\pi_{ul,el}$	− 0.7	− 11.3	13.7
fu_h	− 0.3	− 0.6	− 1.1	$\pi_{ul,r}$	93.3	1.8	2.4
fu_l	− 0.1	− 0.3	− 0.3	$\pi_{ul,t}$	2.3	154.	3.1
fu_r	0.7	2	2.5	$\pi_{r,el}$	1.2	− 7.9	23.7
fu_t	− 0.3	− 1.1	− 2	$\pi_{t,eh}$	0.6	− 9.2	− 6.5
Firms				Stocks		absolute changes (x1000)	
Vacancies							
				U_h	− 0.5	8.9	5.8
V_{pr}	− 0.5	− 6.6	− 3.1	U_l	− 6	− 18.7	− 10.3
V_r	125.	0.0	0.0	R	13.7	− 0.7	− 2.8
V_t	0.0	210.	0.0	T	− 0.2	14.4	0.1
				$U_h + U_l + R + T$	7.0	3.8	− 7.2
Acceptance rate							
fr_h	0.2	− 0.9	− 1				
fr_l	0.3	1	11.4				
fr_r	0.6	− 3.9	19.2				
fr_t	0.3	− 1.7	− 1.7				

[a]Outcomes denote differences between the simulation and the base projection, without compensating taxation. Variables are weighted averages of un-, low- and high-skilled.

[b]Employer subsidy per low-productive worker. Subsidy per time unit equals 7% of the net benefit level in low-productive unemployment.

TABLE 2 – RELIEF JOBS, THE TRAINING PROGRAMME AND EMPLOYMENT SUBSIDIES - MACRO-ECONOMIC VARIABLES AND GOVERNMENT EXPENDITURES[a]

Simulation	no compensating taxation			with compensating taxation		
	relief jobs	training programme	employment subsidy[b]	relief jobs	training programme	employment subsidy[b]
Prices		percentage changes			percentage changes	
Labour costs[c]	0.12	0.13	− 0.08	0.15	0.18	− 0.06
Labour productivity	0.04	0.08	− 0.06	0.04	0.07	− 0.06
Volumes						
Production	− 0.11	0.00	0.09	− 0.16	− 0.07	0.07
Employment (total)[d]	0.12	0.19	0.09	0.09	0.14	0.07
Employment (firms)[d]	− 0.15	− 0.08	0.16	− 0.20	− 0.15	0.14
Ratio's		absolute changes			absolute changes	
Unemployment rate (%-points)	− 0.11	− 0.17	− 0.08	− 0.08	− 0.13	− 0.07
- including R and T[e]	0.12	0.07	− 0.13	0.16	0.12	− 0.11
Tax and premium rate (%-points)	0.00	0.00	− 0.08	0.07	0.10	− 0.05
Government budget	absolute changes in billions of euro			absolute changes in billions of euro		
Expenditures						
Wage bill	0.11	0.19	− 0.03	0.13	0.20	− 0.02
- relief jobs	0.10	0.00	− 0.02	0.11	0.00	− 0.02
- training programme	0.00	0.18	0.00	0.00	0.19	0.00
Unemployment insurance[f]	0.00	0.09	0.06	0.00	0.10	0.06
Welfare benefits[f]	− 0.04	− 0.12	− 0.07	− 0.03	− 0.11	− 0.06
Employment subsidies	0.00	0.00	0.12	0.00	0.00	0.12
Receipts						
Taxes	− 0.02	0.04	0.05	0.10	0.20	0.10
Government budget ('ex post')[g]	− 0.10	− 0.13	− 0.04	0.00	0.00	0.00

[a]Outcomes denote differences between the simulation and the base projection. [b]Employer subsidy per low-productive worker. Subsidy per time unit equals 7% of the net benefit level in low-productive unemployment. [c]Labour costs excluding search costs. [d]Total employment includes relief jobs and the training program, employment by firms denotes private sector employment. [e]The stock of unemployment plus the stocks of relief and training participants divided by the labour force. [f]High-productive unemployed individuals receive unemployment insurance, low-productive unemployed individuals receive welfare benefits. [g]'*Ex ante*' expenditures are 115 million euro (or .12 billion euro).

Table 2 also gives the corresponding changes in macro-economic variables and government expenditures and receipts when we finance the rise in the deficit with higher income tax rates. With compensating taxation labour costs rise further. Now production falls, and private sector employment falls further. With additional taxation, crowding out rises from 26 percent to 52 percent. Despite the higher '*ex post*' cost for the training programme before compensating taxation, after compensating taxation the training programme still significantly outperforms the relief jobs in terms of employment and production.

4.3 *Employment subsidies for low-productive workers*

Another type of subsidized employment that has witnessed a significant rise in spending is temporary subsidies for employers that employ a low-productive worker (typically long-term unemployed individuals with low education or disadvantaged youths). We consider the impact of a temporary subsidy for an employer that employs a low-productive worker.[9] The budget of 115 million euro '*ex ante*' implies a subsidy of 7 percent of welfare benefits for the initial stock of low-productive workers per period.

The impact on the individual level is once again given in Table 1. The subsidy for low-productive workers lowers labour costs, which stimulates labour demand. Furthermore, the subsidy for low-productive workers effectively lowers the minimum wage for low-productive workers. The minimum productivity required from the low-productive applicant is reduced. Higher labour demand leads to more vacancies entering the market, but the lower minimum productivity required lowers the vacancy duration in the private sector. Overall vacancies fall.

Turning to the workers side, low-productive job seekers are more likely to be accepted in a job and therefore spend more time on job search. Less time is devoted to locating relief jobs or placement in the training programme. High-productive unemployed and training job workers face tougher competition and reduce their search effort.

Now consider the changes in the stocks and flow rates. More individuals flow from low-productive unemployment and the relief programme into regular employment. The flow rates for high-productive unemployment and the training programme fall due to the increase in competition. The fall in the stocks of low-productive unemployment and relief jobs dominates the rise in high-productive unemployment and participation in the training programme. Both total *and* regular employment rise.

Whereas the net effect of relief jobs and (public) training programmes on employment is typically analyzed in terms of crowding out, the net effect of private

9 For simplicity we model the temporary character of the subsidy by letting the employer receive the subsidy as long as the worker is in low-productive employment. As the transition rate into high-productive employment is exogenous this simplification is innocious.

sector vacancies is typically analyzed in terms of 'deadweight,' 'substitution' and 'displacement.' 'Deadweight' is defined as the share of subsidized individuals that would have found employment in the absence of the subsidy. 'Substitution' is defined as the number of job seekers outside the target group that would have been hired instead of a subsidized individual over the number of subsidized individuals. 'Displacement' is defined as the number of incumbent workers that is displaced by a subsidized individual over the number of subsidized individuals. The model does not allow for displacement, which is typically limited relative to 'deadweight' and 'substitution' (see Jongen and Graafland (1998) for some explorations of employment subsidies with displacement). Without additional taxation we find that 'deadweight' and 'substitution' come to 95% and 2% of subsidized individuals.

Table 2 once again gives the changes in macro-economic variables. Labour costs fall due to the subsidy. Labour productivity falls as low-productive employment rises more than overall employment. Production rises less than employment, due to the reduced average productivity. The fall in the 'inactivity rate' is more pronounced than the fall in unemployment due to the fall in participation in relief jobs.

Turning to the effects on government expenditures, the wage bill falls. Furthermore, the government saves on welfare benefits. However, this effect is nullified by an equivalent rise in unemployment insurance benefits. Subsidy expenditures rise slightly above the level expected '*ex ante*' as more individuals are drawn into low-productive employment. Tax receipts rise with the rise in production. Savings on wages by the government and additional tax receipts lead to an '*ex post*' deficit that is only approximately one third of the '*ex ante*' expenditures. Table 2 also gives the corresponding changes with compensating taxation. After compensating taxation the rise in employment and production is less pronounced. However, whereas the training programme and in particular relief jobs lead to a fall in private sector employment and output after compensating taxation, employment subsidies in the private sector still increase private sector employment and output after compensating taxation. After compensating taxation the net employment effect drops from 3 to 2 percent of placements.

4.4 *Relief jobs, the training programme and employment subsidies - a comparison*

We briefly consider how the different types of subsidized employment affect our model economy relative to each other. Both before and after compensating taxation, employment rises more when we increase spending on relief jobs and the training programme than when we increase spending on the employment subsidy for low-productive workers in the private sector. However, relief jobs crowd out private sector employment because individuals are discouraged to continue searching for regular employment and because the higher compensation in relief jobs than in low-productive unemployment leads to upward wage pressure. Although the training programme speeds up the rate at which the individual finds employment, higher compensation in the training programme relative to low-productive unemployment leads to a negative net effect on private sector employment due to additional wage pressure. After compensating taxation, both relief jobs and the training programme reduce overall output, most notably relief jobs. Employment subsidies for low-productive workers in the private sector increase both private sector employment and output. Although the training programme is more effective for the individual for regaining skills than being in low-productive employment, the fact that individuals in low-productive employment produce output right away, and spending is on subsidies that lower labour costs rather than on improving workers' outside option, makes it more effective in promoting output than the training programme.

4.5 *Comparison with findings of other studies*

Table 3 below gives the findings of some studies on subsidized employment abroad. These studies typically focus on the net employment effect only. As mentioned above we analyze two stylized subsidized employment programmes in the public sector: relief jobs and training programmes. Actual programmes are likely to contain elements of both, for example the 'subsidized employment' programme analyzed by Dalhberg and Forslund (1999) in Table 3 and the studies on 'Youth Programmes' which combine work experience with formal training. Sweden has been very active in subsidized employment in the public sector. Indeed, most studies on crowding out of subsidized employment in the public sector are on Swedish data. The studies on subsidized employment in the public sector in Table 3 use time series or panel data on aggregate (regional) employment and participation in the public employment schemes in Sweden. The net employment effect ranges from 35 percent of the 'subsidized employment' programme analyzed by Dahlberg and Forslund (1999) to 0 percent in the early study by Gramlich and Ysander (1981) on relief jobs. Our stylized relief jobs have a net employment effect of 31 percent, close to the upper bound of the findings of the studies reported in Table 3. Our stylized training programme has a net employment effect of 48 percent, above the upper bound of the reported studies. Indeed, our stylized training programme makes the favourable assumption that all trained individuals become as productive as high-productive workers. As noted in the calibration of the 'treatment effect' of the training programme in section 3, this seems too optimistic (in the sensitivity analysis below we consider the impact of a less favourable 'treatment effect'). Furthermore, we conservatively assume that the compensation in relief jobs and the training programme equals the minimum wage. Many programmes actually pay wages in excess of this level, which generates more wage pressure when we increase subsidized employment in the public sector, crowding out more private sector employment (in the sensitivity analysis below we also consider the impact of increasing compensation in relief jobs and the training programme). Overall, in terms of the net employment effect the programmes analyzed by the studies in Table 3 come closer to our stylized relief jobs than our relatively favourable stylized training programme.

The studies on employment subsidies for low-productive workers in the private sector typically do not employ aggregate time series or panel data on employment but use survey methods to determine the net employment effect. Employers are asked to indicate whether a subsidized individual would have been hired in the absence of the subsidy ('deadweight'), whether an unsubsidized individual would have been hired instead ('substitution') and the extent to which they were able to gain a larger market share (indicator of 'displacement' of other incumbent workers). The net employment effect so obtained of the studies reported in Table 3 range from 21-33 percent for the Australian 'Jobstart' programme to 4 percent for the Irish 'Employment Incentive' programme. Presuming that the survey results reflect the actual level of the net employment effect on the individual firm level, the 2 percent net employment effect we find for our stylized employment subsidies for low-productive workers does not strike us as particularly low. Indeed, additional wage pressure and fiscal substitution are likely to lower the overall employment effect relative to the effect on the individual firm level.

4.6 *Sensitivity analysis*

Table 4 below gives some sensitivity analyses on assumptions for relief jobs and the training programme (for a more extensive sensitivity analysis we refer the interested reader to Jongen et al. (2000)). All effects are with compensating taxation to balance the budget.

First consider the effect of changing some key assumptions on our stylized relief jobs. In our base simulations we assume that production by relief job workers net of overhead costs equals 25 percent of minimum wage costs. The second column in Table 4 gives the results when we add overhead costs equal to compensation (100 percent of the minimum wage) per participant. With (higher) overhead costs taxes have to rise more to balance the budget when we increase the number of relief jobs. Higher taxes raise labour costs and lower net wages, as a result regular employment and production fall more than in the base simulation. The net employment effect drops from 31 percent to 10 percent.

On the other hand, one might also argue that production net of overhead costs for relief job workers is more than 25 percent of minimum wage costs. Column 3 reports the results when production net of overhead costs equals the compensation for relief job workers, i.e. the programme is run at no immediate cost to the government. Even with this rather favourable assumption more relief jobs lead to a fall in overall production. More relief jobs still raise wage and search costs for firms. Furthermore, even though participants produce output equal to the mini-

TABLE 3 – COMPARISON WITH OTHER STUDIES ON AGGREGATE EMPLOYMENT EFFECTS

Study	Programme	Country	Net employment effect
Subsidized employment in the public sector			
This paper[a]	Relief jobs	the Netherlands	31%
This paper[a]	Training programme	the Netherlands	48%
Dahlberg and Forslund (1999)	Relief jobs	Sweden	34%
Dahlberg and Forslund (1999)	Subsidised employment	Sweden	35%
Edin et al. (1999)	Youth programmes	Sweden	24%
Forslund (1996)	Relief jobs	Sweden	16%
Forslund and Krueger (1997)	Relief jobs	Sweden	31%
Gramlich and Ysander (1981)	Relief jobs	Sweden	0%
Lofgren and Wikstrom (1997)	Youth programmes	Sweden	6%
Subsidized employment in the private sector			
This paper[a]	Employment subsidies	the Netherlands	2%
Atkinson and Meager (1994)[b]	Employment subsidies (Workstart)	United Kingdom	$<$ 20%
De Koning et al. (1995)[b]	Employment subsidies (VMA)	the Netherlands	$<$ 10-15%
De Koning et al. (1995)[b]	Employment subsidies (RAP)	the Netherlands	$<$ 11%
OECD (1993)[b]	Employment subsidies (Jobstart)	Australia	$<$ 21-33%
OECD (1993)	Employment subsidies (Empl. Incentive)	Ireland	4%
Van der Linden (1995)[b]	Employment subsidies (Empl. Program)	Belgium	$<$ 11%

[a]After compensating taxation to balance the budget.
[b]Excluding displacement.

TABLE 4 – SENSITIVITY ANALYSIS RELIEF JOBS AND TRAINING PROGRAMME[a]

Simulation	relief jobs			training programme				both
	base sim.	overhead = wml[b]	product. r = wml[c]	base sim.	overhead = wml[b]	μ_t -50%[d]	μ_t +50%[d]	w_r and w_t +.15 wml[e]
Prices	percentage changes							
Labour costs[f]	0.15	0.21	0.11	0.18	0.24	0.18	0.14	0.26
Labour productivity	0.04	0.03	0.04	0.07	0.07	0.06	0.07	0.06
Volumes								
Production	-0.16	−0.25	−0.10	−0.07	−0.16	−.15	−0.07	−0.26
Employment (total)[g]	0.09	0.03	0.12	0.14	0.08	0.07	−0.19	−0.16
Employment (firms)[g]	−0.20	−0.28	−0.15	−0.15	−0.22	−0.22	−0.01	−0.32
Ratio's	absolute changes							
Unemployment rate (%-points)	−0.08	−0.12	−0.08	−0.13	−0.07	−0.07	−0.17	0.15
- including R and T[h]	0.16	0.12	−0.13	0.12	0.18	0.17	0.01	0.26
Government budget	absolute changes in billions of euro							
Wage bill	0.13	0.29	0.01	0.20	0.37	0.20	0.17	0.13
- relief jobs	0.11	0.26	0.00	0.00	0.00	0.00	−0.04	0.07
- training programme	0.00	0.00	0.00	0.19	0.34	0.18	0.20	0.04
Unemployment insurance[i]	0.00	0.00	0.00	0.10	0.10	0.04	0.19	0.01
Welfare benefits[i]	−0.03	−0.01	−0.04	−0.11	−0.10	−0.05	−0.19	0.04
Government budget ('ex post')	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a]Outcomes denote differences between the simulation and the base projection after compensating taxation. 'Ex ante' cost of 115 million euro except for last column; [b]Next to compensation we include an overhead cost of 100% of the minimum wage per participant; [c]Productivity in relief jobs net of overhead costs equals compensation in relief jobs; [d]Mismatch indicator for training programme participants drops/rises by 50%; [e]Increase in compensation in relief jobs and the training programme from 100% to 115% of t he minimum wage; [f]Labour costs excluding search costs; [g]Total employment includes relief jobs and the training programme, employment by firms denotes private sector employment; [h]The stock of unemployment plus the stocks of relief and training participants divided by the labour force; [i]High-productive unemployed individuals receive unemployment insurance, low-productive unemployed individuals receive welfare benefits.

mum wage they are still more productive in the private sector. The net employment effect rises from 31 percent to 44 percent.

Next we turn to some sensitivity analyses on the assumptions for the training programme. Introducing overhead costs equal to the minimum wage implies that after compensating taxation crowding out of regular employment rises and overall output drops more, see column 5. The net employment effect falls from 48 to 27 percent.

In our base simulation we make the rather favourable assumption that training programme paricipants become as productive as high-productive workers. When individuals gain no skills in the training programme the results are comparable with those of relief jobs, which generates a net employment effect of 31 percent versus the 48 percent in our base simulation of the training program. Another way to consider the impact of a different 'treatment effect' is to change the outflow rate from the training program to high productive employment directly via the mismatch indicator μ in the flow rate from the training programme into regular employment (see equation (11) in the appendix). Columns 6 and 7 give the results when the mismatch indicator drops and rises by 50 percent, respectively. When the mismatch indicator drops by 50 percent, and hence the flow rate from the training programme into regular employment drops as well, the net employment effect drops from 48 to 24 percent (more in line with the findings of the studies reported in Table 3). For completeness we also report the impact of increasing the mismatch indicator for training programme participants by 50 percent. Now the net employment effect rises from 48 percent to a dramatic 95 percent. However, as noted above, our stylized training programme already appears too optimistic on the training effect on the flow rate into regular employment in the base simulation.

The final column in Table 4 considers the effect of increasing the compensation in relief jobs and the training programme from 100 percent in our initial situation to 115 percent of the minimum wage (without increasing the number of vacancies for relief jobs and the training programme like in the other simulations). Indeed, most programmes actually pay wages in excess of the minimum wage (see Jongen et al. 2000). Increasing compensation in relief jobs and the training programme leads to a rise in the participants but crowds out regular employment. Indeed, overall employment falls, the net employment effect of the rise in relief jobs and training programme participation is negative, -33 percent.

5 CONCLUDING REMARKS

Subsidized employment programmes in both the public and private sector have taken a high flight in the Netherlands over the past decade. Unfortunately, little is known about the impact of these programmes on both the individual and aggregate level.

We consider the impact of subsidized employment programmes targeted at low-productive workers in a stripped down version of the MIMIC model. The focus of the stripped down model is on the wage bargain and the flow model which capture the main channels through which subsidized employment affects the workings of the economy. In the stripped down model we introduce: a) relief jobs in the public sector, where participants produce some output but do not regain skills, b) training programmes, where low-productive individuals become as productive as high-productive individuals but produce no output while on training, and c) temporary employment subsidies in the private sector. The relief jobs and the training programme are supposed to capture the two polar cases of subsidized employment in the public sector, with actual programmes containing elements of both. Indeed, comparing the individual wage and employment effect of our stylized programmes we find that our stylized relief jobs are too pessimistic and our stylized training programme is too optimistic when compared to the findings of micro-level studies on the impact of actual programmes abroad.

In the simulations we consider the effect of increasing the budget for relief jobs, the training programme and the employment subsidy by 115 million euros. When individuals move into a relief job they reduce their search effort for regular employment, this increases search costs for regular firms. Furthermore, higher compensation in relief jobs than in low-productive unemployment and the financing of this higher compensation raises wage costs as well. As a result the net employment effect of relief jobs is only 31 percent of placements. Although relief job workers produce some output, the crowding out of regular employment leads to an overall fall in output. The training programme speeds up the process by which participants find employment. This lowers search costs for firms. However, higher compensation in the training programme than in low-productive unemployment, and the financing of this higher compensation plus training costs push up wage costs. Overall, higher participation in the training programme crowds out regular employment, hence the favourable effect of training on the individual level is reversed on the aggregate level for the average job seeker. The net employment effect is 48 percent of placements. Output falls. Finally, employment subsidies in the private sector encourage rather than discourage private sector employment. Although the net employment effect is only 2 percent of placements, output rises. Although the training programme enhances human capital formation, the fact that expenditures are used to reduce labour costs rather than (partly) improving labour's fall back option, combined with the fact that individuals produce output right away still makes employment subsidies more effective in enhancing output and regular employment than the training programme.

Compared to macro-econometric studies on subsidized employment programmes in the public sector abroad (more specifically Sweden) the net employment effect of relief jobs seems on the upper bound of the reported findings, whereas the net employment effect of the training programme is above the upper bound of the reported findings. In our base simulations we set the compensation in relief jobs and the training programme conservatively at the minimum wage, whereas actual programmes typically pay wages above the minimum wage. When we increase the compensation to 115 percent of minimum wages, subsidized employment in the public sector crowds out more regular employment. Furthermore, when we make less favourable assumptions on the effect of the training programme on human capital formation or the employment probability we also find more crowding out of regular employment. The results then move closer to the overall findings of the macro-econometric studies on the net employment effect of subsidized employment in the public sector.

Studies on employment subsidies in the private sector typically do not employ aggregate data but rely on survey studies instead. Employers are asked to indicate to what extent subsidized individuals constitute net employment gains. Presuming that the reported net employment effects accord with the actual employment effects on the individual firm level, our net employment effect of employment subsidies is below the lower bound of the reported findings. However, as the survey studies do not consider the effect on wage pressure and taxes they are likely to overstate the overall net employment effect.

Finally, the main lessons we draw from this analysis are the following. First, the lack of knowledge on the individual effect of subsidized employment programmes on variables like wages and employment probabilities is disturbing given the dramatic rise in expenditures on these programmes. Second, the impact of subsidized employment may be quite different on the aggregate level than on the individual level, see e.g. the impact of the training programme on the transition rate into regular employment for participants *versus* the average job seeker. Third, subsidized employment for low-productive workers is perhaps best viewed as a redistribution of income and employment opportunities towards low-productive workers rather than enhancing regular employment and output. Indeed, employment subsidies for low-productive workers in the private sector have only a marginal effect on employment and output, whereas subsidized employment programmes in the public sector seem to crowd out regular employment and reduce overall output.

APPENDIX

This Appendix gives the model equations and parameter values.

Stocks and flows

Figure 3 in the main text gives an overview of the stocks and flows of the model. In a steady state we can express the stocks in terms of the flow rates[10]

$$U_h = \frac{\sigma_{eh,uh}(\tau_{el,eh}\,\rho_t\,\rho_{lr} + \rho_r\,\rho_{el}\,\pi_{ul,t}\,(\pi_{t,eh} + \sigma_{t,uh}))}{D} L, \tag{3}$$

$$U_l = \frac{\sigma_{eh,uh}\,\tau_{uh,ul}\,\rho_t\,\rho_r\,\rho_{el}}{D} L, \tag{4}$$

$$R = \frac{\sigma_{eh,uh}\,\tau_{uh,ul}\,\pi_{ul,r}\,\rho_t\,\rho_{el}}{D} L, \tag{5}$$

$$T = \frac{\sigma_{eh,uh}\,\tau_{uh,ul}\,\pi_{ul,t}\,\rho_r\,\rho_{el}}{D} L, \tag{6}$$

$$E_l = \frac{\sigma_{eh,uh}\,\tau_{uh,ul}\,\rho_t\,\rho_{lr}}{D} L, \tag{7}$$

$$E_h = L - U_h - U_l - R - T - E_l, \tag{8}$$

where $D = \rho_t[\sigma_{eh,uh}\,\tau_{uh,ul}\,\rho_{el}\,(\rho_r + \pi_{ul,r}) + \rho_{lr}\,(\sigma_{eh,uh}\,(\tau_{uh,ul} + \tau_{el,eh}) + \rho_{uh}\tau_{el,eh})] + \pi_{ul,t}\,\rho_r\,\rho_{el}\,[\sigma_{eh,uh}\,(\pi_{t,eh} + \sigma_{t,uh} + \tau_{uh,ul}) + (\pi_{uh,eh} + \tau_{uh,ul})\pi_{t,eh} + \pi_{uh,eh}\,\sigma_{t,eh}]$, $\rho_r = \pi_{r,el} + \sigma_{r,ul}$, $\rho_t = \pi_{t,eh}\,\sigma_{t,ul} + \sigma_{t,uh}$, $\rho_{lr} = \pi_{ul,el}(\pi_{r,el} + \sigma_{r,el}) + \pi_{ul,r}\,\pi_{r,el}$, $\rho_{el} = \tau_{el,eh} + \sigma_{el,ul}$, and $\rho_{uh} = \tau_{uh,ul} + \pi_{uh,eh}$.

The flow rates from regular employment, relief jobs and the training programme to unemployment, and the flow rates from high to low-productive unemployment and from low- to high-productive employment are exogenous. The endogenous flow rates of workers into private sector employment are given by

$$\pi_{i,j} = \mu s_{i,j}\,f\,(\underline{\alpha}_i,\underline{\alpha}_j)\;\theta_{pr}^{\gamma}, \qquad (i,j) \in \{(ul,el), (uh,eh), (r,el), (t,eh)\}, \tag{9}$$

where $s_{i,j}$ denotes the search effort by a worker from state i for state j and $f\,(\underline{\alpha}_i, \underline{\alpha}_j)$ denotes the acceptance rate of job-worker contacts between a worker from state i and job type j (see below). Furthermore, labour market tightness in the private sector is given by $\theta_{pr} = V_{pr}/(s_{ul,el}\,U_{ul} + s_{uh,eh}\,U_{uh} + s_{r,el}\,R + s_{t,eh}\,T)$.

10 The model features three skill types: unskilled, low-skilled and high-skilled. For each skill type we construct a flow model. To limit the number of subscripts we suppress an index for skill type in the stock and flow expressions.

The rate at which private sector vacancies, V_{pr}, are filled is given by

$$mv_{pr} = (\pi_{ul,el}\, U_{ul} + \pi_{uh,eh}\, U_h + \pi_{r,el}\, R + \pi_{t,eh}\, T)/V_{pr}. \tag{10}$$

The flow rates of low-productive unemployment into relief jobs and the training programme are given by

$$\pi_{ul,\,j} = \mu s_{ul,\,j}\, \theta_j^{\gamma}, \qquad j \in \{r, t\}, \tag{11}$$

with $\theta_j = V_j/(s_{ul,\,j}\, U_{ul})$. The rate at which relief and training vacancies are filled are given by

$$mv_j = \pi_{ul,\,j}\, U_{ul}\, /V_j. \tag{12}$$

Determination of inputs of the endogenous flow rates

Vacancies

Demand for inputs

$$Q_d = A_d c^{r-\psi}, \tag{13}$$

where c denotes unit input costs. Inputs are produced by a CES aggregate of unskilled, low-skilled and high-skilled labour in efficiency units

$$Q = \left(\sum_k a_k^{1+\phi}\, Q_k^{-\phi}\right)^{-1/\phi}, \qquad k \in \{u, l, h\}. \tag{14}$$

Demand for input type k is given by

$$Q_k = a_k (c_k/c)^{-\phi\, Q_d}, \tag{15}$$

where c_k denotes unit labour costs of skill type k (see below) and $\phi = 1/(1 + \phi)$. c is given by

$$c = \left(\sum_k a_k c_k{}^{1-\phi}\right)^{1/(1-\phi)}. \tag{16}$$

Employment corresponding with Q_k is

$$E_k = Q_k\, /\, \overline{\alpha}_k. \tag{17}$$

In equilibrium private sector vacancies for labour type k corresponding with E_k are

$$V_{pr,k} = \overline{\sigma}_k\, E_k / mv_{pr,k}, \tag{18}$$

where $\overline{\sigma}_k = (\overline{\sigma}_{el,ul,k}\, E_{el,k} + \overline{\sigma}_{eh,uh,k}\, E_{eh,k})/E_k$ denotes the average job destruction rate for labour type k. Vacancies for relief jobs and the training programme are policy parameters.

Share of applicants accepted

When a private sector vacancy and a worker meet they take a random draw from a lognormal potential productivity distribution[11]

$$g(\alpha_j) \sim N(\log(\overline{\alpha}_u^j) - .5sd_j^2,\, sd_j^2), \qquad E[\alpha_j] = \overline{\alpha}_u^j, \qquad j \in \{el, eh\}, \tag{19}$$

where $\overline{\alpha}_j^u$ denotes the unconditional expectation of the match specific productivity index, unconditional upon acceptance ($\overline{\alpha}_j$ denotes the expected productivity conditional upon acceptance), and $\overline{\alpha}_{el}^u = \omega\, \overline{\alpha}_{eh}^u$ and $\omega \leq 1$. The presence of minimum wages wmc implies the following minimum productivity standards for a high-productive unemployed or a training programme participant

$$\underline{\alpha}_{eh} = \overline{\alpha}\; wmc/wc, \tag{20}$$

and for a low-productive unemployed or a relief job participant

$$\underline{\alpha}_{el} = \overline{\alpha}\, \frac{\omega(\sigma_{eh,uh} + r)}{\omega(\sigma_{eh,uh} + r) + \tau_{el,eh}\left(1 - \dfrac{1}{1 + \chi(\overline{\sigma} + r)/mv}\right)}\, \frac{wmc - v}{wc}, \tag{21}$$

where $\overline{\alpha}$, wc and v denote the average productivity index of all workers, average labour costs and a subsidy to the employer for a low-productive worker, respectively. The corresponding share of applicants accepted into state j is

$$h(\underline{\alpha}_j) = 1 - G(\log(\underline{\alpha}_j)/sd_j + .5sd_j). \tag{22}$$

Vacancies for reliefs and the training programme accept all low-productive unemployed. Relief jobs and the training programme have constant productivities $\overline{\alpha}_r wmc$ and 0, respectively.

11 To limit the number of subscripts we once again suppress an index for skilltype.

Search effort by job seekers

The value functions of individual n in the various states are

$$\delta V_{el,n}(\alpha_{el}) = q ln((1-t)\, w(\alpha_{el})/c) + ln(T - l_0) + \sigma_{el,ul}(V_{ul} - V_{el,n}(\alpha_{el})) + \tau_{el,eh}\,(V_{eh,n}(\alpha_{el}/\omega) - V_{el,n}(\alpha_m)), \tag{23}$$

$$\delta V_{eh,n}(\alpha_{eh}) = \eta ln((1-t)\, w(\alpha_{eh})/c) + ln(T - l_0) + \sigma_{eh,uh}(V_{uh} - V_{eh,n}(\alpha_{eh})), \tag{24}$$

$$\delta V_{ul,n} = \eta ln(b_{ul}(1-t)\, \overline{w}/c) + ln(T - ts_{ul,el,n} - ts_{r,n} - ts_{t,n}) + \kappa_{ul} + \pi_{ul,el,n}(E[V_{el,ul,n}] - V_{ul,n}) + \pi_{ul,r,n}(V_r - V_{ul,n}) + \pi_{ul,r,n}(V_t - V_{ul,n}), \tag{25}$$

$$\delta V_{uh,n} = \eta ln(b_{uh}(1-t)\, \overline{w}/c) + ln(T - ts_{uh,eh,n}) + \pi_{uh,eh,n}(E[V_{eh,uh,n}] - V_{uh,n}) + \tau_{uh,ul}(V_{ul,n} - V_{uh,n}), \tag{26}$$

$$\delta V_{r,n} = \eta ln(b_r(1-t)\, wm/c) + ln(T - l_0 - ts_{r,el,n}) + \kappa_r + \pi_{r,el,n}(E[V_{el,r,n}] - V_{r,n}) + \sigma_{r,ul}(V_{uh,n} - V_{r,n}), \tag{27}$$

$$\delta V_{t,n} = \eta ln(b_t(1-t)\, wm/c) + ln(T - l_0 - ts_{t,eh,n}) + \pi_{t,eh,n}(E[V_{eh,t,n}] - V_{t,n}) + \sigma_{t,ul}(V_{ul,n} - V_{t,n}) + \sigma_{t,uh}(V_{uh,n} - V_{t,n}), \tag{28}$$

Where δ, η and κ_x denote the subjective discount rate, the relative weight of income in the utility function and a 'disutility' in state x not accounted for by income or leisure, respectively. $w(\alpha_j)$ denotes gross wages corresponding with productivity α_j, b_j denotes the replacement rate in state j, $\overline{w}$ denotes average gross wages, wm denotes the gross minimum wage, and t denotes the tax rate. The individual search effort is related to the time spent on job search via

$$s_{i,j,n} = \overline{\alpha}_j ts_{i,j,n}{}^{1/\zeta}, \qquad (i,j) \in \{(ul, el), (uh, eh), (r, el), (t, eh), (ul, r), (ul, t)\}, \tag{29}$$

and the individual transition rate is

$$\pi_{i,j,n} = (s_{i,j,n}/\,\overline{s}_{i,j})\, \overline{\pi}_{i,j}, \tag{30}$$

where $\overline{s}_{i,j}$ and $\overline{\pi}_{i,j}$ denote the average search intensity and flow rate of the respective group. Maximizing utility with respect to search effort gives the optimal search intensities

$$s_{ul,el} = \overline{\alpha}_{el}\left[\frac{(T-(s_{ul,r}/\,\overline{\alpha}_{el})^{\zeta}-(s_{ul,t}/\,\overline{\alpha}_{ul})^{\zeta})\;\pi_{ul,el}(E\,[V_{el,ul}]-V_{ul})}{\zeta+\pi_{ul,el}\,(E\,[V_{el,ul}]-V_{ul})}\right]^{\frac{1}{\zeta}}, \quad (31)$$

$$s_{ul,r} = \overline{\alpha}_{el}\left[\frac{(T-(s_{ul,el}/\,\overline{\alpha}_{el})^{\zeta}-(s_{ul,t}/\,\overline{\alpha}_{el})^{\zeta})\;\pi_{ul,r}(V_r-V_{ul})}{\zeta+\pi_{ul,r}(V_r-V_{ul})}\right]^{\frac{1}{\zeta}}, \quad (32)$$

$$s_{ul,t} = \overline{\alpha}_{el}\left[\frac{(T-(s_{ul,el}/\,\overline{\alpha}_{el})^{\zeta}-(s_{ul,r}/\,\overline{\alpha}_{el})^{\zeta})\;\pi_{ul,t}(V_t-V_{ul})}{\zeta+\pi_{ul,t}(V_t-V_{ul})}\right]^{\frac{1}{\zeta}}, \quad (33)$$

$$s_{uh,eh} = \overline{\alpha}_{eh}\left[\frac{T\pi_{uh,eh}(E\,[V_{eh,uh}]-V_{uh})}{\zeta+\pi_{uh,eh}(E\,[V_{eh,uh}]-V_{uh})}\right]^{\frac{1}{\zeta}}, \quad (34)$$

$$s_{r,el} = \overline{\alpha}_{el}\,(T-l_0)\;\pi_{r,el}(E\,[V_{el,r}]-V_r)\zeta+\pi_{r,el}(E\,[V_{el,r}]-V_r)\tfrac{1}{\zeta}, \quad (35)$$

$$s_{t,eh} = \overline{\alpha}_{eh}\left[\frac{(T-l_0)\;\pi_{t,eh}(E\,[V_{eh,t}]-V_t)}{\zeta+\pi_{t,eh}(E\,[V_{eh,t}]-V_t)}\right]^{\frac{1}{\zeta}}, \quad (36)$$

once we set $\bar{s}_{i,j} = s_{i,j} = s_{i,j,n}$.

Share of jobs accepted

Let $\alpha_{i,j}$ denote the productivity associated with the reservation wage of an individual from state i for employment state j. The reservation wages of workers for private sector employment are

$$w(\underline{\alpha}_{uh,eh}) = \frac{1}{\eta}\,(T-l_0)\;e^{\frac{1}{\eta}\,\delta V_{uh}}, \quad (37)$$

$$w(\underline{\alpha}_{t,eh}) = \frac{1}{\eta}\,(T-l_0)\;e^{\frac{1}{\eta}\,(\delta V_t\,-\,\sigma_{eh,uh}\,(V_{uh}\,-\,V_t))}, \quad (38)$$

$$w(\underline{\alpha}_{r,el}) = \frac{1}{\eta}(T - l_0)\, e^{\frac{1}{\eta}(\delta V_r - \sigma_{el,ul}(V_{ul} - V_r) - \tau_{el,eh}(V_{eh}(\underline{\alpha}_{r,el}/\omega) - V_r))}, \tag{39}$$

$$w(\underline{\alpha}_{ul,el}) = \frac{1}{\eta}(T - l_0)\, e^{\frac{1}{\eta}(\delta V_{ul} - \tau_{el,eh}(V_{eh}(\underline{\alpha}_{ul,el}/\omega) - V_{ul}))}, \tag{40}$$

and the corresponding share of job offers accepted are

$$h(\underline{\alpha}_i) = 1 - G(\log(\underline{\alpha}_{i,j})/sd_j + .5sd_j), \quad (i, j) \in \{(ul, el), (uh, eh), (r, el), (t, eh)\}. \tag{41}$$

Compensation in relief jobs and the training programme is not match specific. The compensation in these programmes is in all simulations sufficient to ensure that all low-productive unemployed accept an offer to enter one of these programmes.

Overall share of contacts accepted and average productivity index

The overall share of contacts resulting in a match when a worker of state i and a private sector vacancy meet is given by

$$f(\underline{\alpha}_i, \underline{\alpha}_j) = (h(\underline{\alpha}_i)^\lambda + h(\underline{\alpha}_j)^\lambda)^{\frac{1}{\lambda}}, \quad (i, j) \in \{(ul, el), (uh, eh), (r, el), (t, eh)\}. \tag{42}$$

The corresponding overall minimum productivity standard is given by

$$\underline{\alpha}^o_{i,j} = e^{sd_j\, G\text{-}1(1 - f(\underline{\alpha}_i, \underline{\alpha}_j)) - .5sd_j^2}, \tag{43}$$

and the corresponding average productivity index of accepted contacts is

$$\overline{\alpha}_{i,j} = (1 - G(\log(\underline{\alpha}^o_{i,j})/sd_j - .5sd_j))\, / f(\underline{\alpha}_i, \underline{\alpha}_j). \tag{44}$$

The average productivity index in low-productive employment conditional upon acceptance is

$$\overline{\alpha}_{el} = \frac{\pi_{ul,el} U_{ul} \overline{\alpha}_{ul,el} + \pi_{r,el} R\, \overline{\alpha}_{r,el}}{\pi_{ul,el} U_{ul} + \pi_{r,el} R}, \tag{45}$$

and the average productivity index in high-productive employment conditional upon acceptance is

$$\overline{\alpha}_{eh} = \frac{\tau_{el,eh}\left(\pi_{ul,el} U_{ul} \frac{\overline{\alpha}_{ul,el}}{\omega} + \pi_{r,el} R \frac{\overline{\alpha}_{r,el}}{\omega}\right) / (\sigma_{el,ul} + \tau_{el,eh})) + \pi_{uh,eh} U_{uh} \overline{\alpha}_{uh,eh} + \pi_{t,eh} T \overline{\alpha}_{t,eh}}{\tau_{el,eh}(\pi_{ul,el} U_{ul} + \pi_{r,el} R) / (\sigma_{el,ul} + \tau_{el,eh}) + \pi_{uh,eh} U_{uh} + \pi_{t,eh} T},$$

so the average productivity index of accepted matches (per skill type) is

$$\overline{\alpha_k} = (E_{el,k}\overline{\alpha}_{el,k} + E_{eh,k}\overline{\alpha}_{eh,k}) / E_k, \qquad k \in \{u, l, h\}. \tag{47}$$

Wages and labour costs

Gross wages for the average worker per skill type follow from the generalized Nash bargain

$$max_w\ \Omega = (h - w)^{1\text{-}\beta}\ (w(1 - t) - w_o)^{\beta}, \tag{48}$$

where h denotes the marginal product of labour (per skill type) consistent with w (and the wages of the other skill types), and w_o denotes the outside option of labour. This yields

$$w = \beta w_o / (1 - t) + (1 - \beta)\ h. \tag{49}$$

The outside option is a weighted sum of formal, w_o^f, and informal, w_o^i, outside opportunities $w_o = \chi_w w_o^f + (1 - \chi_w)\ w_o^i$, where $w_o^i = \rho_w h$ and

$$\begin{aligned} w_o^f = (&w(1 - t)\ E + b_{uh}\ w(1 - t)\ U_{uh} + (\delta_w b_{ul} + (1 - \delta_w))\ w(1 - t)\ U_{ul} \\ &+ (\delta_w b_r + (1 - \delta_w))\ w(1 - t)\ R \\ &+ (\delta_w b_t + (1 - \delta_w))\ w(1 - t) T) / L. \end{aligned} \tag{50}$$

Wage costs are the sum of gross wages and depreciation on search costs

$$wc = w + (r + \overline{\sigma})\ \chi w / mv, \tag{51}$$

where χw denotes the per time unit vacancy costs. Unit labour costs for labour type k are

$$c_k = wc_k / \overline{\alpha}_k. \tag{52}$$

Government

Receipts:

$$GR = \sum_k t_k (E_k + b_{uh,k} U_{uh,k} + b_{ul,k} U_{ul,k} + b_{r,k} R_k + b_{t,k} T_k)\, \overline{w}_k + \overline{\alpha}_r wmc\, R_k. \tag{53}$$

Expenditures:

$$\begin{aligned} GE = GE_a &+ \sum_k (b_{uh,k} U_{uh,k} + b_{ul,k} U_{ul,k})\, \overline{w}_k + \rho_{pl} \overline{wc}_k \overline{E}_{pl,k} \\ &+ (b_r R_k + (b_t + c_t) T_k)\, wm \\ &+ (\chi b_r V_{r,k} + \chi b_t V_{t,k})\, wm + v E_{el,k}, \end{aligned} \tag{54}$$

where $GE_a = GR_0 - GE_0$ denotes initial autonomous government expenditures, $\rho_{pl} \overline{wc}_k \overline{E}_{pl,k}$ denote public sector wage costs (public sector employment $\overline{E}_{pl,k}$ is fixed), $c_t wm$ denotes the per time unit training costs, χb_x denotes the per unit vacancy costs, and v denotes the employment subsidy per low-productive worker.

TABLE 5 – BASELINE VALUE OF PARAMETERS[a]

Flow model	$\sigma_{eh,uh}$	$\sigma_{el,ul}$	$\sigma_{t,uh}$	$\sigma_{t,ul}$	$\sigma_{r,ul}$	$\tau_{uh,ul}$	$\tau_{el,eh}$	μ	γ	λ	
hgh-skilled	0.03	0.05	0.03	0.13	0.08	0.21	0.16	3.88	0.65	− 5.00	
low-skilled	0.04	0.18	0.04	0.18	0.09	0.21	0.11	3.33	0.65	− 5.00	
unskilled	0.04	0.28	0.04	0.18	0.08	0.21	0.11	17.0	0.65	− 5.00	
Firms	$\overline{\alpha}_u^{eh}$	ω	sd	χ		γ	ϕ	r			
high-skilled	1.00	0.50	0.25	0.75		1.50	1.50	0.06			
low-skilled	1.00	0.60	0.20	0.75							
unskilled	1.00	0.93	0.15	0.75							
Workers	b_{uh}	b_{ul}	b_r	b_t	κul	κ_r	δ	η	ϑ	T	l_o
high-skilled	0.74	0.33	1.00	1.00	− 2.00	− 1.00	0.25	2.00	2.00	2.40	1.00
low-skilled	0.73	0.43	1.00	1.00	− 2.00	− 1.00	0.25	2.00	2.00	2.40	1.00
unskilled	0.75	0.67	1.00	1.00	− 2.00	− 1.00	0.25	2.00	2.00	2.40	1.00
Wage bargain	δ_w	ρ_w	χ_w	β							
high-skilled	0.45	0.44	0.94	0.05							
low-skilled	0.45	0.44	0.94	0.05							
unskilled	0.45	0.44	0.94	0.05							
Policy parameters	V_r	V_t	t	ρ_g	α_r	c_t	υ				
high-skilled	0.07	0.01	0.47	1.05	0.25	0.25	0.00				
low-skilled	0.12	0.32	0.45	0.88	0.25	0.25	0.00				
unskilled	0.01	0.01	0.41	1.47	0.25	0.25	0.00				

[a]Numerical values of scaling parameters available upon request. The numerical outcomes for the endogenous variables are given in Jongen et al. (2000).

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