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Vouchers for the long-term unemployed:
a simulation analysis with MIMIC

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Contents Page

1	Introduction		7
2	Snower versus the evidence		7
	2.1	Vouchers versus uniform wage subsidies	8
	2.2	The analysis of Snower (1994a)	11
	2.3	Deadweight, displacement and substitution in practice	13
3	Short- and long-term unemployment in MIMIC		18
	3.1	The flow model	19
	3.2	Search and selection: the employer	23
	3.3	Search and selection: the unemployed	26
	3.4	The aggregate matching process	32
4	Calibration of the adapted MIMIC model		35
	4.1	The search and selection strategy of the firm	35
	4.2	Search and selection strategy of the unemployed	36
	4.3	The aggregate matching process	41
5	Vouchers: simulation results		45
	5.1	Vouchers in the adapted MIMIC model	45
	5.2	Implementing the voucher scheme	48
	5.3	Simulation results	50
	5.4	Voucher trivia	59
6	Conclusions		60

References 61

Appendix 1 Long-term unemployment and collective wage formation 64

Abstract 65

1 Introduction[1]

This paper explores the potential impact of a voucher system for the long-term unemployed as suggested by Professor Snower (1994a). His proposal intends to divert the flow of unemployment funds, using them instead as recruitment subsidies for the long-term unemployed. According to Professor Snower, the voucher system will dramatically reduce (long-term) unemployment at *no additional budgetary costs*. Clearly, this makes the voucher scheme an intriguing policy option to fight long-term unemployment. However, intriguing as the voucher scheme may be, the original analysis of Snower (1994a) appears to be biased towards favorable employment effects. This paper argues that the employment effects of a voucher scheme are likely to be considerably smaller. We do so by considering the empirical results from voucher-related subsidy schemes for the long-term unemployed already implemented, as well as some simulation results with an adapted version of MIMIC, the applied general equilibrium (AGE) model of CPB Netherlands Bureau for Economic Policy Analysis for labor market analysis.

The outline of this study is as follows. Section 2 considers the original analysis of Professor Snower, and confronts the assumptions with the available evidence. Next, Section 3 presents an adapted MIMIC. In this model we explicitly distinguish between short-term and long-term unemployment. In particular, the model of the search and selection strategies by employers and unemployed persons and the matching process between vacancies and unemployment is extended. In the model it is assumed that long term unemployed face a lower probability of getting a job, because they have suffered a loss in human capital because of the long unemployment duration. Section 4 presents the calibration of the adapted MIMIC model for the base year 1993. The simulation results with the voucher scheme as well as a non-technical summary of the impact of the voucher scheme in the model are given in Section 5. Readers eager for results may skip Sections 3 and 4 without loss of essential information. Finally, in Section 6 we present the main conclusions of the study.

2 Snower versus the evidence

Professor Snower proposes "*to give unemployed people - particularly the long-term unemployed - the opportunity to use part of their unemployment benefits to provide vouchers to the firms that hire them.* The vouchers would amount to employment

[1]We are grateful to Peter Broer, Joan Muysken and Erik de Regt for helpful comments and useful suggestions.

subsidies for the unemployed. ... . Specifically, the longer a person had been unemployed (up to some maximum), the larger would be his initial voucher; after getting a job, the voucher would gradually fall as the period of employment proceeds."[2] In this way Snower intends to divert the passive flow of funds to the (long-term) unemployed, using part of them for employment subsidies.

The voucher system, or 'Benefit Transfer Program' (BTP) as Professor Snower coins his voucher system, differs from other employment subsidy schemes. Specifically, under a voucher scheme the wage subsidy (the voucher) rises with the (completed) duration of unemployment. According to Professor Snower the voucher system therefore potentially has a different impact than uniform employment subsidy schemes for the unemployed. It is essential that the voucher system has a different impact, for, as Snower notes, "[I]t is a common experience of economic policy makers that wage subsidies are expensive and, given their cost, their employment impact is often disappointingly small."[3]

2.1 Vouchers versus uniform wage subsidies

The costs and benefits of any wage subsidy scheme for the unemployed[4] critically depend on the five factors listed below:

a. *Deadweight*

Subsidies are spent on individuals who would have found employment in the absence of the subsidy scheme.

b. *Displacement*

Subsidized previously unemployed individuals displacing incumbent workers. Displacement can further be subdivided into direct and indirect displacement. Anti-

[2] Snower, 1994a, pp.65-66, italics in original text.

[3] Snower, 1994b, p.6.

[4] Note that we consider the factors of any wage (cost) subsidy scheme for the unemployed. A uniform subsidy scheme for all workers clearly does not generate displacement and subsitution as it targets all workers. However, clearly this does not make uniform subsidy schemes for all workers more attractive than schemes that only target the inflow, i.e. the unemployed. Under a uniform subsidy scheme for all workers the extent of deadweight will be dramatic indeed. Furthermore, note that substitution and displacement are likely to put downward pressure on wages, enhancing the employment effect. This effect will be lost under a uniform subsidy for all workers.

displacement provisions typically limit the extent of direct displacement, i.e. subsidized individuals displacing incumbent workers in the same firm. However, this still leaves indirect displacement, subsidized individuals increasing the output of the subsidized firm at the expense of the output of firms that do not benefit from the subsidy.

c. *Substitution*

Subsidized targeted unemployed individuals displacing non-targeted unemployed individuals.

d. *Wage pressure*

Subsidy induced changes in employment and labor costs affect the fall-back positions of (future) employees and employers in the wage bargain.

e. *Net employment*

Though most subsidies are paid to workers who displace or substitute other workers insofar as they would not have found employment anyway, the extent of side-effects (i.e. displacement and the like) typically leave some room for net employment gains. However, the impact of wage subsidy schemes on overall employment is typically rather small (see Section 2.3 below).

Having noted the five crucial elements in any wage subsidy scheme, we may now consider why the voucher scheme potentially has a different impact than uniform wage subsidy schemes by considering the different impacts on the factors mentioned above.

First, consider deadweight. Under a voucher scheme most subsidies are targeted at those at longer durations. This is likely to reduce the deadweight costs relative to a uniform subsidy for the unemployed, as the job-prospects for those at longer durations are less favorable.

Next, consider displacement and substitution. Under a voucher scheme the displacement of incumbent workers and non-targeted job-seekers (short-term unemployed) can potentially be limited. Indeed, the voucher scheme is potentially efficient relative to a uniform subsidy for the unemployed, in the sense that we do not overly subsidize individuals at shorter durations.[5] Furthermore, note that insofar as the long-term unemployed suffer from stigmatization on the individual level substitution

[5]We may savely assume that the subsidy still leaves most short-term unemployed and incumbent workers more attractive to the firm. Furthermore, the long-term unemployed are also less likely to be close substitutes to other workers than short-term unemployed job-seekers.

is not necessarily a bad thing.[6] Indeed, bringing the exit probability of the long-term unemployed more in line with those at shorter durations (at the expense of those at shorter durations) may be one of the main policy goals of any subsidy scheme for the long-term unemployed. However, also note that increased spell lengths for those at shorter durations under the voucher scheme is believed to be associated with a loss of skills, i.e. we are effectively subsidizing human capital losses at shorter durations.

Turning to wage formation, like any wage cost subsidy scheme the subsidy will reduce wage costs for the employer. However, the subsidy may also improve the fall-back position of the employee. In particular, when 'insider-outsider' considerations play a role in the wage bargain, the voucher is likely to put less upward pressure on wages than a uniform wage subsidy scheme for the unemployed. Specifically, let the fall-back position of the insiders, i.e. the incumbent workers, be short-term unemployment. The effect of the voucher scheme on utility in short-term unemployment is twofold. Insofar as subsidized long-term unemployed substitute short-term unemployed job-seekers, the fall-back position of the insiders worsens. For, not only are the short-term unemployed less likely to regain employment (associated with a utility gain), they are also more likely to move into long-term unemployment (associated with a utility loss). Furthermore, displacement will put further downward pressure on wages as the incumbent workers are willing to reduce their wage claims in the face of an increase in the level of turnover. Indeed, substitution and displacement in fact encourage employment by reducing wage claims. However, if the voucher scheme is successful it will reduce the spell lengths at longer durations, making the state of long-term unemployment more attractive to the short-term unemployed. This will put upward pressure on wages.[7] From the outset it is unclear whether or not the voucher scheme will decrease or increase the fall-back position of the employees if the wage-bargain is 'insider-dominated'. However, if the wage-bargain is not 'insider dominated', that is the fall-back position of the (long-term) unemployed directly influences the bargaining outcome, the subsidy scheme is likely to put upward pressure on wages. Below we argue that in The Netherlands the wage-bargain does not appear to be 'insider-dominated'.

Finally, consider the extent of net employment gains. The voucher scheme potentially has a larger net employment impact, since it is likely to generate less displacement and substitution. However, there is one pitfall here. The barriers for

[6]Note that because we target the long-term unemployed, non-participants can not apply for the subsidy. Subsitution of non-participants reduces benefit expenditures, which reduces the costs of the subsidy scheme (from a financing point of view).

[7] It should be noted however that the utility gain in the state of long-term unemployment is discounted by the incumbent workers, reducing upward wage pressure.

employing long-term unemployed may be so high for employers that even large wage subsidies for this group may still have a limited impact on their job-prospects (see. e.g. Van Beek et al. (1997), Calmfors (1994), OECD (1993) and Layard et al. (1991)). In that case the employment effect will be smaller relative to a general wage subsidy.

Summarizing, the voucher scheme looks favorable on the cost side relative to a uniform subsidy, as discriminating the wage subsidy over unemployment durations is likely to reduce the extent of deadweight, displacement, and substitution. Furthermore, if 'insider-outsider' considerations play a role in the wage bargain, the voucher scheme potentially puts less upward pressure on wages than uniform wage subsidy schemes. We also observe a potential pitfall on the benefits side. Targeting those at longer durations may reduce the employment impact of the subsidy scheme for the unemployed. Insofar as the cost savings under the voucher scheme outweigh the potentially smaller employment impact, the voucher scheme appears more attractive than a uniform wage subsidy scheme for the unemployed.

2.2 The analysis of Snower (1994a)

Professor Snower calculates the voucher level for which the whole scheme may in fact be budgetary neutral, i.e. a 'free lunch' to the average tax-payer, and subsequently determines its impact on the unemployment level. In the analysis of Snower the impact is quite dramatic, since at no additional budgetary cost unemployment in The Netherlands could potentially come down by a third! However, it should be noted that Professor Snower emphasizes that his calculations are 'just rough ball-park figures'.[8]

Snower (1994a) calculates the potential impact of a budgetary neutral non-discriminatory (i.e. uniform) subsidy for the long-term unemployed from a simple model. The maximal subsidy ratio is given by

$$s = (1 - d - \delta_{su} - \delta_{I})\, r. \qquad (1)$$

In equation (1) s and r denote the maximal subsidy ratio and the replacement rate, defined as the voucher and the benefit level over the wage rate, respectively. Furthermore, d, δ_{su} and δ_{I} denote the deadweight, substitution and displacement coefficient, respectively. The deadweight coefficient is defined as the ratio between the long-term unemployed hired without the voucher to those hired with the voucher (i.e.

[8] The estimated decline in the unemployment rate with a voucher system in place is estimated to be 79.9%(!) in Germany.

the total number of matched long-term unemployed per period). The substitution and displacement coefficient are defined as the number of unemployed substituted and displaced as a proportion of the long-term unemployed hired with the voucher scheme in place. If (1) is satisfied, the voucher will be budgetary neutral, for the voucher costs per individual (*s* times the wage rate) equal the savings on unemployment benefits per individual (*r* times the wage rate).

Next, Snower calculates the unemployment impact of the voucher scheme as

$$\Delta u / u' = (1 - u')/u' \; \theta \; \eta \; s. \qquad (2)$$

In equation (2) Δu and u' denote the change in the unemployment rate due to the voucher and the unemployment rate in the absence of the voucher system, respectively. Furthermore, θ and η denote the 'subsidy effectiveness coefficient' and the wage-elasticity of labor demand. Note that Snower converts the voucher into an equivalent permanent wage cost reduction, so as to be able to use the elasticity of labor demand. However, for reasons discussed below (like its temporary character), the voucher is not as effective in reducing labor costs as an equivalent reduction in wages. This is captured in the term θ, the so-called subsidy effectiveness coefficient.

Now we come to some arbitrary assumptions. Snower (1994a) assumes that half of the funds will be wasted on deadweight, substitution and displacement, hence the maximal subsidy rate is set at half the replacement rate. The replacement rate is assumed to be .7 in the Netherlands, hence the maximal subsidy rate is .35. Next, Snower calculates the unemployment impact of this maximal subsidy rate under the assumption that the voucher will be half as effective as a *permanent* wage cost reduction. Finally, Professor Snower takes the (average) short-run labor demand elasticity for The Netherlands reported in Bean *et al.* (1986), *i.e.* η is set at .18. Filling in the numbers assumed by Snower we obtain the following expected unemployment impact of a budgetary neutral voucher scheme

$$\Delta u/u' = (1 - 0.083)/(0.083)\ 0.5\ (-0.18)\ 0.5\ 0.7 = -0.348. \qquad (3)$$

Under the assumptions of Snower (1994a) the impact is quite dramatic, as total unemployment comes down by over a third! Furthermore, as the 'wage cost' elasticity

of labor demand is larger in the long-run, this potentially implies an even larger unemployment effect in the long-run.

If the assumptions underlying Snower are correct, unemployment, long-term unemployment in particular, could come down substantially *at no additional budgetary costs*. However, how realistic are the assumptions underlying Snower (1994a)? We will consider the different assumptions underlying Snower (1994a) below. First we consider the assumption on the extent of deadweight, substitution and displacement by looking at the results of actually implemented employment subsidy schemes. Next, we consider the other assumptions underlying the analysis of Snower (1994a).

2.3 Deadweight, displacement and substitution in practice

The findings on the extent of deadweight, displacement and substitution of various voucher-related programmes are given in Table 1 below.

Some of the side-effects of the Dutch 'Vermeend-Moor Act' were first reported in Gravesteijn-Ligthelm et al. (1988). Under the 'Vermeend-Moor Act' participating employers were partly exempted from social security contributions for 4 years upon hiring a very long-term unemployed (duration in excess of 3 years), amounting to a wage cost reduction of approximately 20% on an annual basis. Furthermore, they received a one-time hiring subsidy. The extent of deadweight and substitution was estimated to be some 64 per cent of total placements under the programme (Ligthelm et al. (1988)). However, further study of the data revealed that deadweight and substitution were likely to be much higher, some 80 to 85 per cent of total placements under the programme (see De Koning et al. (1995)). Furthermore, 28 per cent of participating firms indicated that they were able to win more business due to the subsidy, which leaves some room for indirect displacement in other firms. Overall, the 'Vermeend-Moor Act' appears to have had a limited net impact on employment.

The Dutch 'RAP' (Reguliere Arbeidsplaatsenvariant) scheme was the successor of the 'Vermeend-Moor Act'. The 'RAP' scheme exempts the employer from paying part of social security contributions for a period of 4 years. Furthermore, the 'RAP' scheme looks more like a voucher scheme than the 'Vermeend-Moor Act', as the employer can get a one-time subsidy of 4000 Dutch guilders upon hiring a person who has been unemployed for over 2 years, and a one-time subsidy of 6000 Dutch guilders upon hiring a person who has been unemployed for over 3 years. The results of the scheme are reported in De Koning et al. (1993). The extent of deadweight, displacement and substitution are very similar to its predecessor the 'Vermeend-Moor Act'. Deadweight and substitution amounted to some 89 per cent of total placements under the scheme. Furthermore, 36 per cent of the participating were able to win more business due to the subsidy scheme, indicating more 'indirect displacement' under the

'RAP' scheme than under the 'Vermeend-Moor Act'. This is potentially due to the extended coverage of the programme. Once again, the net employment impact of the scheme appears to have been limited.

The effects of the British 'Workstart' pilot schemes are reported in Atkinson and Meager (1994). Under the Workstart pilot schemes (initiated in Spring 1993) a time-limited wage subsidy of 2,430 British pounds was provided for each full-time recruit who had been unemployed for two years.[9] The Workstart pilots were conducted in Devon, Cornwall, East Kent and West London. Atkinson and Meager (1994) report estimates of the extent of deadweight, substitution and indirect displacement.

Regarding deadweight, the study reports that of all vacancies posted under the Workstart scheme 53% would have been posted anyway (or were already posted). Furthermore, another 27% of the vacancies posted under the Workstart pilots represented 'partial deadweight'. Atkinson and Meager (1994) coin the term partial

[9] Several areas covered only the very long-term unemployed, in the present case those unemployed for over 4 years.

Table 1 Deadweight, displacement and substitution

Programme name	Country	Dead-weight	Displace-ment	Substi-tution	Total	Reference
Vermeend-Moor Act	Netherl.	80-85%[a]	28%[b]	–	>80%	Gravesteijn-Ligthelm *et al (1998),* De Koning *et al.* (1988)
RAP	Netherl.	42%	36%[b]	47%	>89%	De Koning *et al.* (1993)
Workstart	UK	28-55%	33%[b]	25%	>86%	Atkinson and Meager (1994)
Jobstart	Australia	67-79%[a]	?	–	>67%	OECD (1993)
Employment Incentive	Ireland	70%	4%	21%	95%	OECD (1993)
Employment Programme	Belgium	53%	?	36%	>89%	Van der Linden (1995)
Vouchers	All countries	25%	12.	12.	**50%**	Snower (1994a)

[a] Sum of `deadweight' and `substitution'.
[b] Participating firms able to win more business due to the wage subsidy, as a persentage of the total number of participating firms.

deadweight for vacancies that would have been declared but for fewer hours, that would have been declared for a shorter period, and the like. Therefore, total deadweight was somewhere in between 53 and 80 percent (note that deadweight as defined by Atkinson and Meager (1994) would be termed deadweight and substitution in the definition of Snower (1994a)). Considering substitution, the study reports that in 23 per cent of the cases the vacancy would have been filled by a non-targeted unemployed, and in another 19 per cent of the cases the vacancy would have been filled by an employed job-seeker. Finally, 33% of the participating firms report that due to the Workstart subsidy scheme they had been able to win more business then otherwise, implying potential substantial indirect displacement in competing firms. Considering that according to the study reports only 17% of the vacancies would not have been declared in the absence of Workstart, and adding some indirect displacement in other firms, leaves little room for net employment gains.

Similar findings are reported on the Australian ‘Jobstart’ programme and the Irish ‘Employment Incentive’ programme (OECD (1993)), and the Belgian employment programme (Van der Linden (1995)). These programmes differ somewhat in scope from the programmes mentioned above. Specifically, whereas the programmes mentioned

above target the (very) long-term unemployed, the latter target those at even shorter durations (up to some minimum, like 6 months under the Australian 'Jobstart' programme). Of the latter, the Australian 'Jobstart' scheme most closely resembles the voucher scheme proposed by Professor Snower. Indeed, under the 'Jobstart' scheme subsidy levels differ for three different unemployment duration classes (and several age groups as well). The results of the scheme are very similar to the results from the other schemes mentioned in the table. Only 21 per cent of total placements under the 'Jobstart' scheme did not represent deadweight or substitution. Furthermore, this figure is likely to be an overstatement, for selection bias is likely in the study on the 'Jobstart' scheme (see OECD (1993)). Taking into account some additional indirect displacement, the net employment impact of 'Jobstart' seems rather small. The Belgian employment programme and the Irish 'Employment Incentive' programme show the same results. The Irish 'Employment Incentive' programme in particular appears to have had a rather negligible impact on net employment.

Given the results of voucher related wage subsidy schemes for the (long-term) unemployed, the assumptions of Professor Snower regarding deadweight, displacement and substitution appear rather unrealistic. Indeed, assuming that the sum of these effects constitute 50 per cent of total placements is well below the figures found on voucher related wage subsidy schemes. Note that the Dutch 'RAP' scheme and the Australian 'Jobstart' scheme do discriminate between different duration classes, still their results appear very similar to the other studies. Furthermore, some of these schemes, like the Dutch 'Vermeend-Moor Act' and 'RAP' scheme, involve subsidies over 50 per cent of their unemployment benefits. This basically indicates two things. According to the analysis of Professor Snower, these subsidy schemes do not satisfy the maximal subsidy constraint (equation (1)), and hence are not self-financing. Furthermore, even for subsidies in excess of the maximal subsidy rate, the schemes do not appear to have a dramatic impact on net employment.[10]

Other assumptions underlying Snower (1994a)

In the light of existing studies, the extent of deadweight, substitution and displacement appears to be rather low in the analysis of Snower (1994a). How about the other assumptions underlying the analysis? Specifically, studies on voucher related wage subsidy schemes typically find a negligible impact on net employment. In light of this the net employment impact in the analysis of Snower (1994a) appears rather high.

[10] Note that this does not necessarily mean that these subsidy schemes are not cost effective, for net employment, i.e. the benefit of the subsidy scheme is likely to fall as the subsidy level is reduced.

Basically, the dramatic employment impact results from the rather favorable impact of the subsidy scheme relative to an equivalent permanent wage (cost) reduction. There are several factors that make the voucher scheme less effective in raising employment as an equivalent wage (cost) reduction. First, the voucher is only temporary whereas the wage (cost) reduction is permanent, reducing the impact on labor costs. Second, the wage (cost) elasticity of employment for the long-term unemployed may be relatively low because of their productivity. Indeed, the most productive and least selective workers are expected to leave unemployment first. Furthermore, prolonged unemployment is believed to reduce skills and weaken working habits, making the long-term unemployed less attractive to the employer, and making employment less attractive to the long-term unemployed. Third, Snower assumes no backward shifting of the subsidy to the long-term unemployed applicant. Specifically, Snower assumes a replacement rate of .7. As the social assistance level of the long-term unemployed equals 70% of the minimum wage level this would imply that (approximately) one third of the unemployed would be willing to accept a job paying no more than the minimum wage.[11] Clearly, only part of the long-term unemployed will be willing to accept a job paying no more than the minimum wage. Consequently, part of the voucher will be used to pay wages in excess of the minimum wage level. Hence, as part of the subsidy will be shifted backward to the worker, only part of the subsidy will result in a reduction of the wage costs of subsidized individuals.[12]

Given the factors mentioned above, the voucher scheme is likely to have a much smaller effect than an equivalent wage (cost) reduction. Professor Snower assumes the voucher to be half as effective as an equivalent wage (cost) reduction. However, any of the factors mentioned above is likely to make the voucher scheme half as effective. Hence, the assumption that the voucher scheme is half as effective does not seem very plausible (see also Coe (1997) and Drèze (1997)). For example, Professor Drèze suggests to use a figure of .15 instead of .5 for the ‘subsidy effectiveness coefficient’. The effects are then more in line with the studies on related schemes for the unemployed given in Table 1.

Finally, consider the assumption that the voucher will have no impact on wages. In an 'insider-dominated' wage bargaining context this may in fact be true. However, though ‘insider-outsider’ considerations play a role in The Netherlands, studies indicate

[11]This only applies to job-seekers with no dependent partner. For job-seekers with a dependent partner the social assistance level equals the minimum wage (less than one-third of individuals receiving social assistance have a dependent partner). However, the same argument might still hold, as they are therefore more likely to have a higher reservation wage.

[12] Also note that the benefit level of the long-term unemployed is less than their short-term unemployed counterparts, making substitution and displacement more costly.

that in The Netherlands (see e.g. Lever (1995), Graafland (1992) and Appendix 1) employment wage dynamics depend on both firm-specific variables (like the lay-off rate) and on aggregate variables (like the unemployment rate). Furthermore, in The Netherlands the long-term unemployed appear to generate the same downward pressure on wages as the short-term unemployed. Hence, if the voucher was to have a dramatic impact on the job-finding prospects of the long-term unemployed, the voucher system would likely be limited by its own success, as long-term unemployment comes down, increasing wage pressure. Consequently, the marginal employment effect will be smaller. Furthermore, as the marginal employment effect becomes smaller, the costs associated with deadweight, substitution and displacement will increase relative to the savings on benefit expenditures.

Concluding, the extent of deadweight, displacement and substitution assumed by Professor Snower appears rather low relative to related subsidy schemes, whereas the employment impact of any subsidy level seems rather high in his analysis. Hence, it appears doubtful that the voucher scheme will have a dramatic impact on unemployment, especially if the scheme is supposed to be self-financing (which may not be the case for any subsidy level, given substantial costs relative to savings). In Section 5 below we illustrate our points by considering some simulation results with a voucher scheme in an adapted version of MIMIC. In the adapted MIMIC model we may study the factors that affect the extent of side-effects (like deadweight). Furthermore, in the general equilibrium context we gain further insight into the macro-feedback effects of the voucher scheme, like the impact on the aggregate wage level. Before we turn to the simulation results we first outline the structure and calibration of the adapted MIMIC model.

3 Short- and long-term unemployment in MIMIC

In this section we present an adapted version of MIMIC. In the adapted version of MIMIC we model the duration structure of unemployment explicitly, by distinguishing between short- and long-term unemployment. We focus on the impact of the duration structure of unemployment on the matching process. We did not adapt the wage bargaining model, for empirical results indicate that Dutch wage formation is insensitive to the duration structure of unemployment (see e.g. Graafland (1990, 1992), Lever (1995) and Appendix 1).

The outline of this section is as follows. Section 3.1 presents the flow model of the labor market that lies at the heart of the adapted model. The different transition rates between the different states on the labor market depend on the search and selection strategy of the firms and the unemployed, and on the matching technology. We consider

the search and selection strategy of the firm and the unemployed in Sections 3.2 and 3.3, respectively. Finally, in Section 3.4 we consider the aggregate matching process.

3.1 The flow model

The core of the adapted MIMIC model is a steady-state flow model[13]. Consider Figure 1 below. There are L individuals in the labor force.[14] The L individuals are distributed over four different states, i.e. short-term unemployment (U_s), long-term unemployment (U_l), regular employment (E_s) and low-productive employment (E_l). The long-term unemployed can regain their previous level of human capital only after working some time in low-productive employment. We assume that the long-term unemployed have lost some human capital during the unemployment spell.

The distribution of the L individuals over the four states in the labor market depends on the different transition rates between the different states. In the model we assume the transition rates from low-productive to regular employment (ϵ) and from employment to unemployment (σ_s and σ_l), i.e. the separation rates (job destruction), to be constant. The transition rates from short- and long-term unemployment to regular and low-productive employment (π_s and π_l, respectively), and from short- into long-term unemployment (τ), are determined endogenously by the search and selection strategy of the firms and the unemployed.

By the steady-state assumption outflow from a given state equals inflow, per unit time period. Specifically, the steady-state constraints are given by

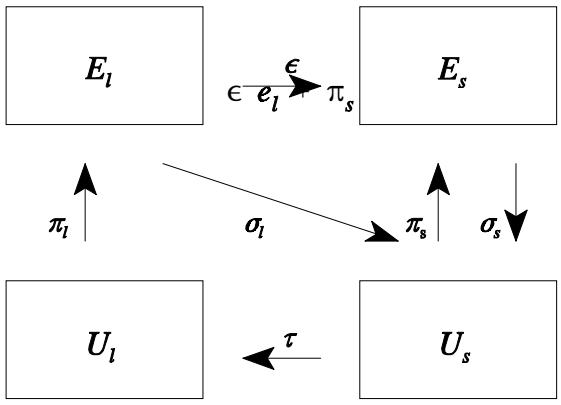
$$\sigma_l \, e_l + \sigma_s \, e_s = (\pi_s + \tau) \, u_s, \tag{4}$$

$$\tau \, u_s = \pi_l \, u_l, \tag{5}$$

[13] The flow model is akin to the models outlined in e.g. Holmlund and Lindén (1993), Miller (1996) and Pissarides (1990).

[14] The impact of the distribution of unemployment on labor supply is indirect, i.e. via the wage level. For the moment we ignore the impact of long-term unemployment on the transition rate into and out of nonparticipation.

$$\pi_l \, u_l = (\sigma_l + \epsilon) \, e_l, \tag{6}$$



(7)

Figure 1 *Stocks and flows*

in which e_l, e_s, u_s and u_l denote the low-productive employment rate (E_l/L), the regular employment rate (E_s/L), the short-term unemployment rate (U_s/L) and the long-term unemployment rate (U_l/L), respectively. Furthermore, we have the identity

$$e_l + e_s + u_s + u_l = 1. \tag{8}$$

From equations (4-8) we may express the stocks in the different flows

$$e_s = \frac{\pi_l \, (\pi_s \, (\epsilon + \sigma_l) + \epsilon \, \tau)}{(\epsilon + \sigma_s) \, \pi_l \, \tau + (\epsilon + \sigma_l) \, (\pi_l \, (\pi_s + \sigma_s) + \tau \, \sigma_s)}, \tag{9}$$

$$e_l = \frac{\pi_l \, \tau \, \sigma_s}{(\epsilon + \sigma_s) \, \pi_l \, \tau + (\epsilon + \sigma_l) \, (\pi_l \, (\pi_s + \sigma_s) + \tau \, \sigma_s)}, \tag{10}$$

$$u_s = \frac{\pi_l \, \sigma_s \, (\epsilon + \sigma_l)}{(\epsilon + \sigma_s) \, \pi_l \, \tau + (\epsilon + \sigma_l) \, (\pi_l \, (\pi_s + \sigma_s) + \tau \, \sigma_s)}, \tag{11}$$

$$u_l = \frac{\tau \, \sigma_s \, (\epsilon + \sigma_l)}{(\epsilon + \sigma_s) \, \pi_l \, \tau + (\epsilon + \sigma_l) \, (\pi_l \, (\pi_s + \sigma_s) + \tau \, \sigma_s)}. \tag{12}$$

Furthermore, we obtain the share of low-productive employment in total employment and long-term unemployment in total unemployment as

$$\frac{e_l}{e} = \frac{\sigma_s \, \tau}{(\epsilon + \sigma_s) \, \tau + (\epsilon + \sigma_l) \, \pi_s}, \tag{13}$$

and

$$\frac{u_l}{u} = \frac{\tau}{\tau + \pi_l}, \tag{14}$$

respectively. Finally, note that by setting $\pi_l = \pi_s = \pi$ and $\sigma_l = \sigma_s = \sigma$ we obtain the familiar stock-flow relationship for the unemployment and employment rate (see e.g. Pissarides (1990), Chapter 1)

$$u = \frac{\sigma}{\sigma + \pi}, \tag{15}$$

and

$$e = \frac{\pi}{\sigma + \pi}, \tag{16}$$

as a special case.

Some comparative statics results are given in Table 2 below. The unemployment rate depends positively on the inflow rates (σ_s and σ_l) and negatively on the outflow rates (π_s and π_l). Furthermore, the unemployment rate depends negatively on the outflow rate from low-productive employment to regular employment (ϵ) if the job destruction rate in low-productive employment is higher than in regular employment ($\sigma_l > \sigma_s$). Finally, the unemployment rate depends positively on the transition rate from short- into long-term unemployment (τ) if the transition rate from long-term unemployment into low-productive employment is less than the transition rate from short-term unemployment into regular employment ($\pi_l < \pi_s$), and if the job destruction rate in low-productive employment exceeds the job destruction rate in regular employment ($\sigma_l > \sigma_s$).

Next, consider the share of long-term unemployment in total unemployment and the share of low-productive employment in total employment. The share of long-term

Table 2 *The flow model: comparative statics*

	σ_s	σ_l	ϵ	τ	π_s	π_l
u	+	+	?[a]	?[b]	-	-
u_l/u	0	0	0	+	0	-
e_l/e	+	-	-	+	-	0

[a] The unemployment rate depends negatively on ϵ if $\sigma_l > \sigma_s$, i.e. when the previously long-term unemployed workers have a higher turnover rate once employed than their previously short-term unemployed and low-productive employed counterparts.

[b] The unemployment rate depends positively on τ if $\pi_s > ((\epsilon + \sigma_s)/(\epsilon + \sigma_l))\ \pi_l$. This condition is likely to be satisfied.

unemployment depends solely onthe inflow rate from short-term unemployment (τ) and the outflow rate from long-term unemployment into low-productive employment (π_l), positively and negatively, respectively. Finally, the share of low-productive employment in total employment depends positively on the job destruction rate in regular employment (σ_s) and negatively on the job destruction rate in low-productive employment (σ_l). Furthermore, the share of low-productive employment in total employment depends positively on the transition rate from short- into long-term unemployment (τ), as more individuals become long-term unemployed and hence are no longer (directly) available for regular employment. An increase in the transition rates into regular employment (ϵ and π_s) reduces the share of low-productive employment in total employment.

In the subsequent sections we consider the determination of the endogenous transition rates π_s, π_l and τ. Specifically, we consider how, given the search and matching technology, these endogenous transition rates are the outcomes of the behavior of utility maximizing short- and long-term unemployed job-seekers and profit maximizing employers.

3.2 Search and selection: the employer

The search and selection strategy of the employer consists of the number of vacancies (search), and the minimum productive standard used to screen for acceptable applicants (selection). First, consider the number of vacancies.

Search strategy of the employer

New employees have to be acquired through a costly search process by which vacant jobs are matched to unemployed job-seekers. Search costs are assumed to be spent on services of other firms (e.g. labor offices, newspapers). Search costs per unit time period are assumed to be a fraction of the average wage level. The number of vacancies depends on the employers' demand for new employees and the rate at which vacancies are filled. Job-worker combinations dissolve at the exogenous rates σ_s and σ_l, for regular and low-productive job-worker combinations respectively. The resulting number of vacancies equals

$$v = \frac{del/dt + \sigma_s e_s + \sigma_l e_l}{z}, \tag{17}$$

in which z denotes the average rate at which vacancies are filled. z depends positively on the wage rate offered by the employer compared (w) to the average wage rate ($\bar{w}$), and the average rate at which vacancies are filled ($\bar{z}$)

$$z = \left(\frac{w}{\bar{w}}\right)^{\beta} \bar{z}. \tag{18}$$

Hence, the employer is assumed to have some monopsony power in the labor market, because of a limited ability to influence the average rate at which vacancies are filled. The employer will vary the incidental wage component so as to minimize labor costs (wage and search costs). For a derivation of the resulting optimal wage level see Gelauff and Graafland (1994).

Selection strategy of the employer

In the presence of search costs, employers will hire all suitable candidates. Not all job-worker combinations are suitable, because the productivity of individual job-worker combinations is heterogeneous and because of the existence of minimum wage levels.

To screen for suitable job-worker combinations the employer uses a minimum productivity standard. Only those job-worker combinations that meet this minimum productivity level are accepted. Assuming perfect substitution between individual workers, the minimum productivity standard can be derived from the condition that marginal labor costs per efficiency unit must be equal for workers with different labor productivity in the job. The minimum productivity (he) can then be related to the

average productivity of all new employees, and the ratio between the minimum wage rate and the marginal labor costs for new employees

$$he = hn \frac{wm}{w\ (1 + \frac{\gamma}{z}(r + \sigma)) + \frac{d\lambda_e}{dt}}, \tag{19}$$

where *hn* and *w* denote the average productivity and wage level, respectively. Furthermore, *wm* and *r* denote the minimum wage level and the long-run interest rate. The average rate at which job-worker combinations dissolve is denoted by σ. The denominator in equation (19) reflects marginal labor costs. Marginal labor costs are the sum of wage and search costs (discounted by the respective quit rate and the long-term interest rate). Furthermore, $d\lambda_e/dt$ reflects the change in search costs over time. Note that suitable candidates do not have to meet minimum labor *costs*, for search costs are sunk (and born by inframarginal job-worker combinations).

The productivity of potential individual job-worker combinations in low-productive and regular employment follow a lognormal distribution *g*, with standard deviation sd_i, and average productivity h_i

$$g(h_i) = N(\log\overline{h_i} - 0.5sd_i^2,\ sd_i^2), \quad E(h_i) = \overline{h_s}, \quad i = s,\ l, \tag{20}$$

where h_i denotes the average productivity of potential job-worker combinations in the respective employment class, i.e. h_s in regular employment and h_l in low-productive employment. Average productivity of potential job-worker combinations in regular employment (h_s) is normalized to 1. Furthermore, we assume that the average productivity of potential job-worker combinations in low-productive employment (h_l) is a fraction 1 - *sl* (for skill-loss) of the average productivity of potential job-worker matches in regular employment (h_s)

$$\overline{h_l} = (1 - sl)\ \overline{h_s}, \quad 0 < sl < 1. \tag{21}$$

Hence, we assume that upon outflow into long-term unemployment the potential job-worker productivity distribution relevant for the individual shifts downwards.

The share of contacts that is acceptable for the employer can then be derived as

$$fe_i = 1 - G((loghe_i)/sd + 0.5sd), \quad i = s, l. \tag{22}$$

Labor productivity being too low to match the minimum wage level is not the only reason why a job-worker contact may fail to result in a match. Indeed, a job-worker contact may not yield a productivity level sufficient to meet the reservation wage of the job-seeker. The formula for the minimum productivity standard combining the minimum productivity standard of the employer and the job-seeker, as well as the average productivity of filled job-worker combinations, are derived in the section on the average matching process discussed below.

3.3 Search and selection: the unemployed

In the search and selection strategy of the unemployed we have two choice variables: time spent on job-search and the reservation wage. First, consider the search intensity of the short- and long-term unemployed.

Search intensity of the unemployed

The search intensity of the unemployed (s_i) is positively related to the amount of time spent on job-search (ts_i), but less than proportionally

$$s_i = ts_i^{\frac{1}{\varsigma}}, \quad \varsigma > 1, \; i = s, l, \tag{23}$$

The unemployed job-seekers choose their utility maximizing search intensity. Denote discounted lifetime utility in short-term unemployment, long-term unemployment, regular employment and low-productive employment by V_{us}, V_{ul}, V_{es} and V_{el}, respectively. Furthermore, let b_s, b_l, w_s and w_l denote the per unit time period benefit level of the short-term unemployed, the benefit level of the long-term unemployed, the wage level in regular employment and the wage level in low-productive employment, respectively.[15] Denote total time available for the individual per unit time period by T, and the (collectively agreed) number of working hours by l_0. Finally, let δ, η and α

[15] In the calibrated model wages and benefits differ per level of education.

denote the subjective discount rate, the relative weight of utility derived from income in the utility function and a parameter denoting 'disutility in unemployment', respectively. The 'disutility of unemployment' parameter stems from the premise that the lower discounted lifetime utility in unemployment does not solely result from the lower permanent lifetime income in unemployment relative to employment. More specifically, the unemployed may feel rejected, socially isolated and intruded in his or her privacy (see e.g. Van den Berg (1990)) .

From the dynamic programming approach (see e.g. Diamond (1982), Holmlund and Lindén (1993) and Pissarides (1990)) it can be shown that we have the following so-called value functions in the different states as

$$\delta V_{us} = \eta \ln\left(\frac{b_s}{pc}\right) + \ln(T - ts_s) - \alpha + \pi_s(V_{es} - V_{us}) + \tau(V_{ul} - V_{us}), \quad (24)$$

$$\delta V_{ul} = \eta \ln\left(\frac{b_l}{pc}\right) + \ln(T - ts_l) - \alpha + \pi_l(V_{el} - V_{ul}), \quad (25)$$

$$\delta V_{es} = \eta \ln\left(\frac{w_s}{pc}\right) + \ln(T - l_0) + \sigma_s(V_{us} - V_{es}), \quad (26)$$

$$\delta V_{el} = \eta \ln\left(\frac{w_l}{pc}\right) + \ln(T - l_0) + \epsilon(V_{es} - V_{el}) + \sigma_l(V_{us} - V_{el}). \quad (27)$$

The value functions in the different states consist of four components in unemployment, and three components in employment. The first two components in each state denote the per unit time period utility derived from income and leisure, respectively. In unemployment, the third component (α) denotes 'disutility in unemployment' (see above). The final component in each state denotes the expected 'capital gain' from changing state times the transition rate into that state (the 'probability' of changing state per unit time period).

The individual transition rates (for individual *j*) into employment depend positively on the ratio between individual search intensity and the search intensity of the respective duration class, and the average transition rate of the respective duration class[16]

$$\pi_{i,j} = \frac{s_{i,j}}{\overline{s_i}} \overline{\pi_i}, \qquad i = s, l. \tag{28}$$

In the perception of the individuals in the different states, time proceeds in (discrete) yearly steps.[17] Consequently, we assume the perceived (yearly) transition rate into long-term unemployment (τ) to equal (1 - π_s). Substitution of (28) into (24) and (25), and taking the partial derivative to $s_{i,j}$ yields the following first-order conditions for the optimal search intensity of the short- and long-term unemployed

$$s_s = \left[\frac{T \pi_s (V_{es} - V_{ul})}{\varsigma + \pi_s (V_{es} - V_{ul})} \right]^{\frac{1}{\varsigma}}, \tag{29}$$

and

$$s_l = \left[\frac{T \pi_l (V_{el} - V_{ul})}{\varsigma + \pi_l (V_{el} - V_{ul})} \right]^{\frac{1}{\varsigma}}, \tag{30}$$

respectively (assuming a representative agent).

One can easily check that the optimal search intensity of the short- and long-term unemployed depends positively on the average exit rate into employment, the utility

[16] Note that for simplicity we assume that individuals do not consider the impact of the reservation wage on the individual transition rate.

[17] As opposed to the matching function, where transition rates are in continuous time (see below). We assume discrete yearly steps in the perception of the unemployed for otherwise we would have to model the nonstationarity of the optimal search and selection strategy of the unemployed in short-term unemployment, i.e. in continuous time the optimal strategy differs between an individual who has been unemployed for 1 day and an individual who has been unemployed for 364 days.

difference between the state of employment and unemployment[18] and total time available for the individual, per unit time period. Furthermore, the optimal search intensity depends negatively on the technology parameter ς. An increase in this parameter is associated with a decrease in the marginal increase in the transition rate due to an increase in search intensity. Note that as we assume the search technology and total time available for the individual to be the same for the short- and long-term unemployed, a reduced search intensity in long-term unemployment has to result from a decrease in the transition rate into employment (i.e. $\pi_s > \pi_l$) over the unemployment spell, or a decrease in the utility difference between the state of employment and unemployment (i.e. $V_{es} > V_{el}$).

Reservation wage of the unemployed

In the previous paragraph we considered the value functions of discounted lifetime utility in the different states. The reservation wage of the unemployed is the wage for which the unemployed job-seeker is indifferent between the state of employment and unemployment, i.e. $V_{es}(wr_s) = V_{us}$ for the short-term unemployed and $V_{el}(wr_l) = V_{ul}$ for the long-term unemployed. We consider the reservation wage of the short- and long-term unemployed, given the utility in the different states and the different transition rates between them, below. Furthermore, combining the reservation wage with the wage-distribution of job-offers we obtain the acceptance rate of the representative short- and long-term unemployed individual, i.e. the proportion of job-offers acceptable for the unemployed job-seeker.

First, consider the reservation wage of the short-term unemployed. For a short-term unemployed individual discounted lifetime utility in employment when taking a job at the reservation wage is given by

$$\delta V_{es}(wr_s) = \eta \ln\left(\frac{wr_s}{pc}\right) + \ln(T - l_0) + \sigma_s(V_{us} - V_{es}(wr_s)). \qquad (31)$$

[18] Furthermore, note that as time is perceived to proceed in discrete yearly steps, the short-term unemployed consider the benefits of search (an increase in the expected transition rate into regular employment) relative to the utility in the state of long-term unemployment.

Substitution of (31) and (24) into the condition $V_{es}(wr_s) = V_{us}$ yields the following expression for the reservation wage of the representative short-term unemployed[19]

$$wr_s = b_s \left(\frac{T - ts_s}{T - l_0} \right)^{\frac{1}{\eta}} e^{\frac{1}{\eta}(\pi_s(V_{es} - V_{us}) - \tau(V_{us} - V_{ul}) - \alpha)} . \qquad (32)$$

From (32) it follows that the reservation wage of the short-term unemployed depends positively on the benefit level in short-term unemployment (b_s), leisure time in short-term unemployment relative to leisure time in employment ($(T\text{-}ts_s)/(T\text{-}l_0)$) and the expected 'capital gain' in the state of unemployment ($\pi_s(V_{es}\text{-}V_{us})$). Furthermore, the reservation wage depends negatively on the 'capital loss' associated with a transition into the state of long-term unemployment ($\tau(V_{us}\text{-}V_{ul})$), and the 'disutility of unemployment' parameter (α).[20]

Next, consider the reservation wage of a long-term unemployed job-seeker. For a long-term unemployed individual discounted lifetime utility in employment when taking a job at the reservation wage is given by

$$V_{el}(wr_l) = \eta \ln\left(\frac{wr_l}{pc}\right) + \ln(T - l_0) + \epsilon(V_{es} - V_{el}(wr_l)) + \sigma_l(V_{us} - V_{el}(wr_l)) \qquad (33)$$

Substitution of (33) and (25) into the condition $V_{es}(wr_l) = V_{ul}$ yields the following expression for the reservation wage of the representative long-term unemployed individual

[19] Note that we do not derive an explicit expression for the reservation wage of the short-term unemployed expressed solely in the exogenous variables. Given the different states and transition rates the explicit expression becomes inherently complex, especially for the long-term unemployed. Still some key insights can be derived from the non-explicit expressions given in the text.

[20] Note that the reservation wage of the (representative) short-term unemployed potentially lies below the benefit level provided that either the 'disutility of unemployment' (α) and leisure time in short-term unemployment are sufficiently large and small, respectively, or the 'capital loss' associated with moving into the state of long-term unemployment is sufficiently large (and $\pi_s(V_{es}\text{-}V_{us})$, *i.e.* the expected 'capital gain' in short-term unemployment, is sufficiently small).

$$wr_l = b_l \left(\frac{T - ts_l}{T - l_0} \right)^{\frac{1}{\eta}} e^{\frac{1}{\eta}(\pi_l(V_{el} - V_{ul}) - \epsilon(V_{es} - V_{ul}) - \sigma_l(V_{us} - V_{ul}) - \alpha)} . \qquad (34)$$

From (34) it follows that the reservation wage of a long-term unemployed job-seeker depends positively on the benefit level in long-term unemployment (b_l), leisure time in long-term unemployment relative to leisure time in employment ((T-ts_l)/(T-l_0)) and the expected 'capital gain' in the state of unemployment ($\pi_l(V_{el}$-$V_{ul})$). Note that V_{el} denotes discounted lifetime utility of a job-offer offering the *average* expected wage in low-productive employment. Furthermore, the reservation wage of the long-term unemployed individuals depends negatively on the transition rate into regular employment and short-term unemployment from low-productive employment, the 'disutility of unemployment' parameter (α), the difference between discounted lifetime utility in regular employment and long-term unemployment (V_{es}-V_{ul})[21], and the difference between discounted lifetime utility in short-term unemployment and long-term unemployment (V_{us}-V_{ul}). These last two terms in (34) have a negative impact on the reservation wage of the long-term unemployed as one can only exit from long-term unemployment into short-term unemployment and regular employment through the state of low-productive employment.[22]

The reservation wage of the long-term unemployment lies below the reservation wage of the short-term unemployment, provided that the benefit level in long-term unemployment lies below the benefit level in short-term unemployment ($b_l < b_s$), the expected 'capital gain' in the state of short-term unemployment exceeds the expected 'capital gain' in the state of long-term unemployment ($\pi_s > \pi_l$), and the difference between discounted lifetime utility in the state of regular employment ($\epsilon(V_{es}$-$V_{ul})$) and short-term unemployment ($\sigma_l(V_{us}$-$V_{ul})$) are sufficiently large.

Acceptance probability of the unemployed

[21] For the formerly long-term unemployed, the wage level is expected to increase with tenure. This will lower the reservation wage, as the unemployed is willing to give up more present income to obtain a higher income in the future (see e.g. Van den Berg (1990)).

[22] Once again, the reservation wage of the long-term unemployment potentially lies below the benefit level in long-term unemployment, provided that either the 'disutility of unemployment' (α) and leisure time in long-term unemployment are sufficiently large and small, respectively, or the 'capital gain' associated with moving into the state of regular employment or in the state of short-term unemployment from low-productive employment is sufficiently large (and $\pi_l(V_{el}$-$V_{ul})$, i.e. the expected 'capital gain' in long-term unemployment, is sufficiently small).

Combining the reservation wage of the short- and long-term unemployed with their respective (lognormal) potential wage-offer distributions yields the respective acceptance rates of the short- and long-term unemployed job-seekers.

First we translate the reservation wage of the short- and long-term unemployed into a minimum productivity standard implied by the reservation wage. Specifically, the minimum productivity standard implied by the reservation wage of the short- (hr_s) and long-term unemployed (hr_l) is given by

$$hr_i = \frac{wr_i}{w_i}\, hn_i, \tag{35}$$

where i again denotes an index for short- and long-term unemployed job-seekers. The share of contacts acceptable for the short- (fu_s) and long-term unemployed (fu_l) job-seekers can then be expressed as

$$fu_i = 1 - G\left(\frac{\ln\left(\frac{hr_i}{\overline{h}_i} \right)}{sd_i} + 0.5sd_i \right), \quad i = s,\ l. \tag{36}$$

3.4 The aggregate matching process

The final element in our flow model is the aggregate matching function. The matching function relates the number of matches to the number of vacancies relevant for the different duration classes and the effective number of job-seekers in the respective duration class, i.e. the matching function can be viewed as a 'neoclassical production function' of the matching process (see e.g. Mortensen and Pissarides (1996)).

We assume a constant returns to scale Cobb-Douglas matching function. The constant returns to scale Cobb-Douglas matching function is typically not rejected in empirical studies (for an overview of estimates of the aggregate matching function in The Netherlands see e.g. Broersma (1996)).

The number of matches for the short- and long-term unemployed (m_i) is assumed to be positively related to the number of vacancies and the number of effective job-seekers

($s_sU_s + s_lU_l$). Furthermore, the number of matches depends positively on a mismatch parameter (ψ, an increase in ψ indicating a decrease in mismatch), and the 'overall acceptance rate' of a given job-worker contact (fm_i).

The overall acceptance rate of contacts for the short- and long-term unemployed is assumed to be given by the following CES-weighted function of the share of contacts acceptable for the employer (fe_i) and the unemployed (fu_i)

$$fm_i = (fe_i^{-\lambda} + fu_i^{-\lambda})^{\frac{-1}{\lambda}}, \quad i = s, l. \tag{37}$$

The number of matches for the short- and long-term unemployed are then given by

$$m_i = \psi \left(\frac{v}{s_sU_s + s_lU_l}\right)^{\phi} s_iU_i\, fm_i, \quad i = s, l. \tag{38}$$

From the matching function for the different duration classes we may derive the transition rate out of unemployment, average vacancy duration and the average productivity of filled job-worker combinations in regular and low-productive employment. The transition rate into regular and low-productive employment, π_s and π_l respectively, are defined as m_s/U_s and m_l/U_l, respectively.[23] The average vacancy filling rate z is defined as $(m_s + m_l)/v$.

Furthermore, from π_s (the flow rate from short-term unemployment to regular employment) we obtain the yearly transition rate into long-term unemployment in continuous time. Specifically, we define the transition rate from short- into long-term unemployment as the proportion of short-term unemployed individuals that does not find employment before their duration equals one year. Under the steady-state assumption, and assuming that the hazard rate into regular employment (π_s) is constant during the first year of unemployment we may express the stock of short-term unemployed individuals as

[23] From (39) it can be seen that the average transition rates into regular and low-productive labor depend positively on the respective mismatch parameters, the respective number of vacancies, the respective average search intensity and overall acceptance rate, and negatively on the number of respective job-seekers (U_s and U_l, respectively).

$$U_s = \int_{t=0}^{1} e^{-\pi_s t} (\sigma_s E_s + \sigma_l E_l)\, dt = \frac{1}{\pi_s}(1 - e^{-\pi_s})(\sigma_s E_s + \sigma_l E_l). \qquad (39)$$

Hence, the number of short-term unemployed is simply the sum of the survivors between t=0 (the start of the unemployment spell) and t=1 (spell duration equals one year), at a given moment in time. For a given duration t (t<1) the fraction that will not find employment before t=1 is simply the probability to survive until t=1 (= $e^{-\pi s(1-t)}$). The share of short-term unemployed individuals that do not find employment before t=1 can then be expressed as (the 'transition rate' into long-term unemployment)

$$\tau = \frac{\int_{t=0}^{1} e^{-\pi_s} e^{-\pi_s(1-t)} (\sigma_s E_s + \sigma_l E_l)\, dt}{\int_{t=0}^{1} e^{-\pi_s} (\sigma_s E_s + \sigma_l E_l)\, dt} = \frac{e^{-\pi_s}}{\frac{1}{\pi_s}(1 - e^{-\pi_s})}. \qquad (40)$$

Finally, from the CES-weighted share of contacts acceptable for the employer and the short- and long-term unemployed we find the macro minimum productivity standard relevant for contacts between short- and long-term unemployed job-seekers (hm_s and hm_l) and firms as

$$hm_i = e^{sd_i G^{-1}(1 - fm_i) - 0.5 sd_i^2}, \quad i = s, l. \qquad (41)$$

Subsequently, we find the average productivity of filled job-worker combinations in high- and low-productive employment (hn_s and hn_l) as

$$hn_i = E(hs_i | hs_i > hm_i) = \frac{\left[1 - G\left[\frac{(\log hm_i)}{sd_i} - 0.5 sd_i\right]\right]}{fm_i}, \quad i = s, l. \qquad (42)$$

The determination of the average productivity in regular and low-productive employment complete the adapted model. In the next section we consider its calibration.

4 Calibration of the adapted MIMIC model

We calibrate the adapted MIMIC model on 1993 data. Parameters and variables are set in accordance with the available statistical data, so as to allow MIMIC to replicate the main findings on the impact of the duration structure of unemployment on the workings of the labor market, and vice versa.

Section 4.1 considers the calibration of the search and selection strategy of the firm. Paragraphs 4.2 and 4.3 consider the calibration of the search and selection strategy of the unemployed and the calibration of the aggregate matching process, respectively.

4.1 The search and selection strategy of the firm

The specification and calibration of the search and selection model of the firm are given in Table 3 below. The parameter values for sd_s, the standard deviation of the log normal productivity/wage distribution relevant for the short-term unemployed per skill type of labor, are set in line with the original MIMIC model (see Gelauff and Graafland (1994)). We distinguish between three skill levels: unskilled individuals, low-skilled individuals and high-skilled individuals. The productivity/wage distribution relevant for the unskilled and low-skilled individuals is less dispersed than for high-skilled individuals. We further assume the productivity/wage distribution relevant for the long-term unemployed to be more dispersed than for the short-term unemployed, i.e. $sd_l < sd_s$.

The parameters σ_i, the yearly turnover rate (job destruction rate) in regular (σ_s) and low-productive employment (σ_l) are set so as to obtain average escape rates for the different duration classes that correspond roughly with CBS (Statistics Netherlands) data (see also the calibration of the matching process, discussed below). Note that the job destruction rate is higher in low-productive employment, and is higher for the unskilled and low-skilled job-worker combinations.

The loss in human capital from prolonged unemployment (*sl*) is calibrated so as to obtain plausible values for the acceptance rate of the employer. The relative low productivity of long-term unemployed individuals and their relatively high productivity spread imply that the minimum wage level is in a rather unfavorable position relative to their productivity distribution, making less of the long-term unemployed job-seekers acceptable for the employer. This is reflected by their lower acceptance rate (fe_l). This especially holds for the unskilled long-term unemployed (note that the short- and long-term unemployed job-seekers have to meet the same minimum productivity level.)

Note the rather low acceptance rate of the employer towards unskilled unemployed job-seekers. The model required a rather low acceptance rate for this group of workers so as to get acceptable results on the transition rates of the different groups. Specifically, given the data on transition rates from unemployment, we require the unskilled to have the lowest exit rate.

4.2 Search and selection strategy of the unemployed

The specification and calibration of the search and selection model of the unemployed are given in Table 4 below. In the model of the search and selection strategy of the unemployed parameters were set so as to reflect the main empirical findings concerning the search intensity and the reservation wage, i.e.
both declining over the unemployment spell. The parameters η, the relative weight of consumption in the utility function, and ζ, the search technology parameter relevant for the transformation of time spent on job-search into `search intensity, are taken from the original MIMIC model (see Gelauff and Graafland (1994)). The parameter δ, the yearly discount rate, is set at .25. The model required a rather high subjective discount rate to arrive at an acceptable reservation wage relative to the average wage (Layard et al. (1991) also conclude that the subjective discount rate is rather high for

Table 3 *Specification and calibration of the search and selection model of the employer*

(1)	number of vacancies	v	=	$(de/dt + \sigma_s e_s + \sigma_l e_l) / z$
(2)	labor costs per worker	wc	=	$w(1 + \gamma(\sigma_s + r) / z)$
(3)	productivity index long-term unemployed	h_l	=	$(1 - sl)\, h_s$
(4)	minimum productivity standard employers	he	=	$hn\ wm / wc$
(5)	acceptance rate employers	fe_i	=	$1 - (1 + \exp(-1.7\ (\ln(he/h_i)/sd_i + 0.5\ sd_i)))^{-1}$

parameters	σ_s	σ_l	γ	sd_s	sd_l	sl
unskilled	.08	.20	.75	.15	.20	.10
low-skilled	.07	.15	.75	.20	.35	.20
high-skilled	.05	.06	.75	.25	.50	.20

endogenous variables	he	fe_s	fe_l
unskilled	1.15	.15	.10
low-skilled	.59	.99	.77
high-skilled	.49	.99	.78

the unemployed).[24] Furthermore, for the same reason the 'disutility of unemployment' parameter α is set at 1.

Consider the endogenously determined value functions of discounted lifetime utility in the different labor market states (V_{us}, V_{ul}, V_{es} and V_{el}), the numerical values of the utility functions being less important than their relative position. For all levels of education we find that being in the state of employment yields a higher discounted lifetime utility than being in the state of unemployment ($V_{el} > V_{us}$). More importantly, being in the state of short-term unemployment or regular employment yields a higher discounted lifetime utility than being in the state of long-term unemployment and low-

[24] Van den Berg (1990) estimates a discount rate of .12, though this is still well below the .25 discount rate assumed in the model. Further evidence on the subjective discount rate comes from the 'spikes' found in hazard function studies. As unemployment benefits run out we observe an (dramatic) increase in the hazard rate (which is otherwise generally falling in the region of the elapsed duration where benefits run out). This is consistent with a rather high discount rate.

productive employment, respectively. Next, consider the time spent on job-search (ts_s and ts_l).We find that the time spent on job-search declines over the unemployment spell. This reflects the decrease in the marginal benefits of job-search, declining over the unemployment spell (i.e. $\pi_s > \pi_l$) which dominates the increase in the expected 'capital' gain when moving in employment from the state of long-term unemployment ((V_{es} - $_{Us}$) < (V_{el} - V_{ul})). The decline in time spent on job-search is consistent with the findings of Layard et al. (1991) and Van der Aalst and Hermsen (1994) (see Table 5 below).

Turning to the reservation wage (wr_s and wr_l), the reservation wage of the long-term unemployed is lower than their short-term unemployed counterparts. A declining reservation wage over the unemployment spell is in accordance with empirical findings (see, for example, Van den Berg (1990) and Devine and Kiefer (1991)).The decline in the reservation wage in the different studies ranges from .3 per cent a month to 4 per cent a week.

The drop in the reservation wage reflects the decline in the benefit level as well as the decrease in the transition rate into employment. Furthermore, the decline in the reservation wage also reflects the lower average wage level in low-productive employment and the assumption that the (formerly) long-term unemployed can only exit into regular employment from the state of low-productive employment. In fact, for all skill levels the reservation wage of the long-term unemployed actually lies below the average benefit level of the long-term unemployed ($wr_l < b_l$), most of the long-term unemployed receiving only social assistance. This reflects our assumption that the long-term unemployed are willing to trade a lower income in the present for a higher income in the future, as well as our disutility in unemployment parameter. Still, the drop in the reservation wage seems rather high, due to our simplifying assumption that the lower average potential productivity of the long-term unemployed is due to a loss of skills, whereas in real life this also results from heterogeneity between the two duration classes. We have only one source of heterogeneity, i.e. the level of eduction. If, contrary to what we assume, the decline in the exit rate is mostly due to heterogeneity previously long-term unemployed individuals are less likely to transit into regular employment, as it is likely to be more difficult to acquire new skills than to regain skills. Hence, the gain from moving directly into low-productive employment, and hence be given the opportunity to move into high-productive employment again, is likely to be overstated. Also note that the reservation wage of the unskilled short-term unemployed also lies below their respective benefit level. This reflects the disutility of being unemployed and the probability of becoming long-term unemployed.

Finally, as the downward shift in the reservation wage distribution over the unemployment spell exceeds the decline in the reservation wage for the low-skilled, the acceptance rate of the low-skilled long-term unemployed is lower than the acceptance

rate of their short-term unemployed counterparts, and vice versa for the unskilled (the acceptance rate of the high-skilled short- and long-term unemployed is the same).

Table 4 Specification and calibration of the search model of the unemployed

(1) discounted lifetime utility
short-term unemployed $V_{us} = (\eta \ln(b_s/pc) + \ln(T - s_s^{\zeta}) - \alpha + \pi_s V_{es} + \tau V_{ul}) / (\delta + \pi_s + \tau)$

(2) discounted lifetime utility
long-term unemployed $V_{ul} = (\eta \ln(b_l/pc) + \ln(T - s_l^{\zeta}) - \alpha + \pi_l V_{el}) / (\delta + \pi_l)$

(3) discounted lifetime utility
regular employment $V_{es} = (\eta \ln(w_s/pc) + \ln(T - l_0) + \sigma_s V_{us}) / (\delta + \sigma_s)$

(4) discounted lifetime utility
low-productive employment $V_{el} = (\eta \ln(w_l/pc) + \ln(T - l_0) + \epsilon V_{es} + \sigma_l V_{us}) / (\delta + \epsilon + \sigma_l)$

(5) search intensity
short-term unemployed $s_s = ((T \pi_s (V_{es} - V_{ul})) / (\zeta + \pi_s (V_{es} - V_{ul})))^{(1/\zeta)}$

(6) search intensity
long-term unemployed $s_l = ((T \pi_l (V_{el} - V_{ul})) / (\zeta + \pi_l (V_{el} - V_{ul})))^{(1/\zeta)}$

(7) reservation wage
short-term unemployed $wr_s = b_s ((T - ts_s)/(T - l_0))^{1/\eta} \exp(\pi_s(V_{es} - V_{us}) - \tau(V_{us} - V_{ul}) - \alpha) / \eta)$ (8)
reservation wage
long-term unemployed $wr_l = b_l ((T - ts_l)/(T - l_0))^{1/\eta} \exp(\pi_l(V_{el} - V_{ul}) - \epsilon(V_{es} - V_{ul}) - \sigma_s(V_{us} - V_{ul}) - \alpha) / \eta)$

(9) minimum productivity
standard unemployed $hr_i = hn_i \, wr_i / w_i$

(10) acceptance rate
unemployed $fu_i = 1 - (1 + \exp(-1.7 (\ln(hr_i/h_i) / sd_i + 0.5 \, sd_i)))^{-1}$

parameters	η	α	δ	ϵ	ζ	*sl*
unskilled	2.00	1.00	.25	.30	10.0	.10
low-skilled	2.00	1.00	.25	.30	10.0	.20
high-skilled	2.00	1.00	.25	.35	10.0	.20

	T	l_0
all skill levels	3.20	1.00

input from wage and matching model	b_s	b_l	π_s	τ	π_l
unskilled	18.3	15.9	.58	.42	.40
low-skilled	23.5	18.4	.60	.40	.55
high-skilled	28.7	21.3	.58	.42	.55

endogenous variables	V_{us}	V_{ul}	V_{es}	V_{el}	ts_s	ts_l

unskilled	24.7	24.1	26.3	26.0	.28	.18
low-skilled	27.7	27.0	29.6	28.9	.34	.25
high-skilled	29.4	28.7	31.3	30.9	.33	.27
	wr_s	wr_l	hr_s	hr_l	fu_s	fu_l
unskilled	17.8	12.9	.95	.69	.62	.89
low-skilled	26.1	17.3	.79	.53	.86	.85
high-skilled	32.1	20.2	.84	.53	.73	.73

Table 5 Search intensity of the unemployed

	short-term unemployment (<1 year)	long-term unemployment (1< x <3 years)	very long-term unemployment (>3 years)
non-searchers			
non-available or moving into employment	4%	5%	7%
stopped searching	9%	18%	33%
searchers			
average monthly number of job applications			
0	31%	32%	31%
0-1	21%	21%	17%
1-3	16%	12%	7%
3-5	9%	7%	2%
5-10	6%	4%	2%
>10	4%	1%	1%
Total	100%	100%	100%

Source: Van der Aalst and Hermsen (1994), p. 16.

4.3 The aggregate matching process

The specification and calibration of the aggregate matching process are given in Table 6 below. The CES parameter λ in the average acceptance rate function, and the parameter value for ϕ, the relative weight of vacancies in the matching function, are taken from the original MIMIC model (see Gelauff and Graafland (1994)). Furthermore, the mismatch parameter ψ has been set so as to let the total number of vacancies and the share of long-term unemployment in total unemployment correspond with the data. Furthermore, the share of low-productive employment in total employment (e_l/e) and the transition rate from low-productive to regular employment (ϵ) have been set so as to obtain plausible values for the job destruction rate in low- and high-productive employment, and across the different levels of education. Given the parameter values and given the number of short- and long-term unemployed individuals and the number

of vacancies, the model generates the values for the endogenous variables given in Table 6 below.

First, consider the endogenously determined values of the share of acceptable job-offers (fm_s and fm_l for contacts with short- and long-term unemployed job-seekers, respectively). The overall acceptance rate relevant for the short-term unemployed is dominated by the acceptance rate of the unemployed (the overall acceptance rate of unskilled job-seekers being the notable exception). Hence, for the short-term unemployed, the reservation wage of the unemployed is the most restrictive factor in the overall acceptance rate. However, once these individuals become long-term unemployed, the roles are reversed. That is, the employer's acceptance rate becomes

Table 6 Specification and calibration of the matching model

(1) overall acceptance rate	fm_i	=	$(fe_i^{-\lambda} + fu_i^{-\lambda})^{-1/\lambda}$
(2) number of matchings	m_i	=	$\psi (v / (s_s U_s + s_l U_l))^{\phi} fm_i \, s_i U_i$
(3) transition rate into employment	π_i	=	m_i / U_i
(4) transition rate into long-term unemployment	τ	=	$\pi_s \, e^{-\pi s} / (1 - e^{-\pi s})$
(5) average vacancy duration	z	=	$(m_s + m_l) / v$
(6) minimum productivity standard	hm_i	=	$h_i \exp(sd_i (\log((1-fm_i)^{-1}) - 1) / (-1.7) - 0.5\, sd)$
(7) productivity index of new hirees	hn_i	=	$h_i (1-(1 + \exp(-1.7 (\log(hm_i/h_i) / sd_i - 0.5\, sd_i)))^{-1}) / fm_i$
(8) share of long-term unemployment in total unemployment	u_l / u	=	$\tau / (\tau + \pi_l)$
(9) share of low-productive employment in total employment	e_l / e	=	$\sigma_s \, \tau / ((\epsilon + \sigma_s) \, \tau + (\epsilon + \sigma_l) \, \pi_s)$

parameters	λ	ϕ	ψ	σ_s	σ_l	ϵ
unskilled	5.00	.60	24.7	.08	.20	.30
low-skilled	5.00	.60	3.87	.07	.15	.30
high-skilled	5.00	.60	4.35	.05	.06	.35

exogenous variables	U_s	U_l	v	e_l/e
unskilled	34.5	41.8	7.00	0.08
low-skilled	49.1	37.7	12.5	0.07
high-skilled	106.	84.2	25.0	0.06

input from search and selection models	fe_s	fu_s	fe_l	fu_l	s_s	s_l
unskilled	.15	.62	.10	.89	.88	.84
low-skilled	.99	.86	.77	.85	.90	.87
high-skilled	.99	.73	.78	.73	.90	.88

endogenous variables	fm_s	fm_l	hm_s	hm_l	hn_s	hn_l
unskilled	.15	.10	1.15	1.15	1.24	122
low-skilled	.79	.70	.84	.63	1.06	.92
high-skilled	.71	.66	.85	.58	1.11	100

	π_s	π_l	z
unskilled	.87	.52	7.37
low-skilled	.93	.79	6.03
high-skilled	.87	.80	6.39

the most restrictive factor in the overall acceptance rate, as many long-term unemployed individuals have a productivity profile that falls short of the minimum wage level.

Combining the share of contacts acceptable to both the employer and the unemployed job-seekers with the productivity distributions of the respective duration classes, we obtain the minimum productivity standard relevant for job-worker contacts with short- and long-term unemployed job-seekers (hm_s and hm_l, respectively). The lower overall acceptance rate relevant for the long-term unemployed implies that the overall minimum productivity standard decreases less than the wage/productivity distribution. The downward shift in both the minimum productivity standard and the wage/productivity distribution imply a lower average productivity of acceptable job-worker combinations relevant for the long-term unemployed, i.e. $hn_s > hn_l$.

The transition rate from unemployment into employment decreases over the unemployment spell, i.e. $\pi_s > \pi_l$, most notably for the unskilled unemployed job-seekers. The decline in the escape rate results from a decrease in the search intensity over the unemployment spell, reducing the number of job-worker contacts, and a lower overall acceptance rate relevant for the long-term unemployed, reducing the number of job-worker contacts that result in a match. The decline in the escape rate is consistent with the findings of so-called 'hazard function studies' (see e.g. Devine and Kiefer (1991), Gorter et al. (1993), Van den Berg and Van Ours (1994)). The studies generally find that most of the decline is due to heterogeneity in the composition of the group of short- and long-term unemployed, though some studies report a 'true' duration dependence effect (see e.g. Kerckhoffs et al. (1994), Van Opstal and Van de Pol (1991), Groot (1990)). In the model we have one source of heterogeneity, i.e. the skill level. The remainder of the lower escape rate can be traced back to the skill-loss assumption. Hence, we assume that there is 'true' (negative) duration dependence in the escape rate from unemployment. This is also consistent with the findings of empirical studies on long-term unemployment and the outward shift of the so-called UV-curve in The Netherlands (see e.g.

Graafland (1990), Mulder and Van Schaik (1989) and Van Ours (1991)[25]).[26] Consistent with the data, an increase in the share of long-term unemployed individuals in the unemployment pool will increase overall unemployment, due to the lower average escape rate.

Finally, consider the average vacancy duration per skill level (z).The average vacancy duration is the lowest for vacancies looking for an unskilled worker. This reflects the relatively high number of job-seekers relative to vacancies, and the relatively low degree of mismatch for this group (ψ). For the same reasons the average vacancy duration for vacancies looking for a high-skilled worker is lower than the average vacancy duration of a vacancy looking for a low-skilled worker.

5 Vouchers: simulation results

This section presents the simulation results on the voucher scheme in the adapted MIMIC model. Section 5.1 explores how the voucher is to affect the workings of the labor market in the model. Next, Section 5.2 outlines the implementation of the voucher scheme. Subsequently, we turn to the simulation results in Section 5.3. Finally, Section 5.4 briefly relates the simulation outcomes to the original analysis of Snower (1994a) and the studies on voucher-related schemes.

5.1 Vouchers in the adapted MIMIC model

The structure of the labor market in the adapted model is given in Figure 2 below.

First, consider the 'demand' side. Employment for all types of labor depends negatively on labor costs. Labor costs consist of wages and search costs. An increase in the average vacancy duration will increase search costs as well as wage costs. Wages are mainly determined by collective wage formation, where wages depend negatively on unemployment. Furthermore, the individual employer is assumed to have some monopsonistic power on the labor market. Hence, he or she has some discretion in setting the wage offer so as to influence the rate at which vacancies are filled (i.e. the employer can raise the wage offer when labor market tightness increases).

[25] In the Van Ours (1991) study, the parameter estimate of the impact of long-term unemployment on the position of the UV-curve is borderline significant.

[26] It should be noted that the outward shift in the UV-curve in The Netherlands is relatively mild from an international perspective (see e.g. Jackman et al. (1990)).

Minimum wages restrict the number of job-worker combinations that are profitable, by imposing a minimum productivity standard. Job-worker combinations are assumed to be heterogeneous in the productivity level. Only job-worker combinations that meet the minimum productivity standard will result in a job match. The minimum productivity standard depends positively on the minimum wage level and negatively on search costs (which, in turn, depends on the average vacancy duration).

Next, consider the 'supply' side. Unemployed job-seekers maximize utility by choosing the optimal search intensity and reservation wage. The reservation wage depends positively on the transition rate into employment, wages, and the benefit level. Search intensity depends positively on the transition rate into employment and wages, and negatively on the benefit level. Labor supply depends positively on the official wage rate.[27]

The 'supply' and 'demand' side determine the 'inputs' in the labor market. Given the search technology, vacancies, the number of effective job-seekers and their overall acceptance rates we obtain the resulting average vacancy duration, the exit rate from short- and long-term unemployment into employment, as well as the flow rate from short- to long-term unemployment. The

[27] Due to a lack of space we do not elaborate on the labor supply model here, which is by no means crucial to the simulation results we will discuss below.

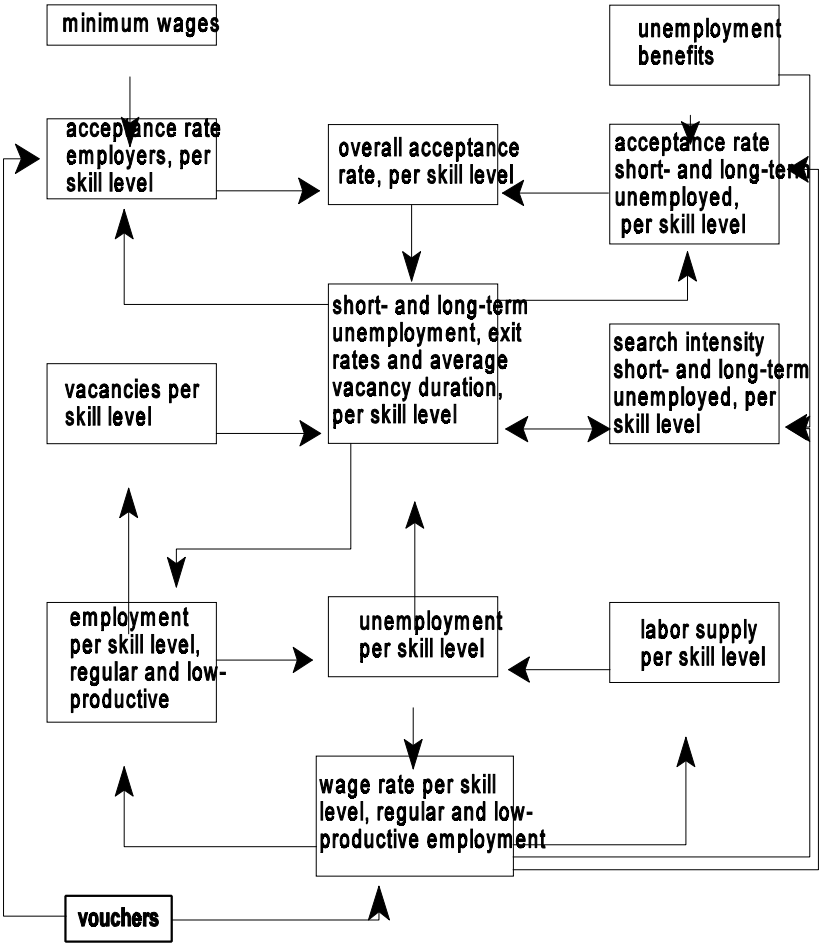


Figure 2 *Vouchers in the adapted MIMIC model*

duration structure of unemployment affects employment through search costs. An increase in the share of long-term unemployed in the pool of unemployed will reduce the number of matches at given unemployment. This will increase labor costs and hence have a detrimental effect on employment. Note that the share of long-term unemployment does not influence the wage bargain at given unemployment.

After this sketch of the model we now turn to the impact of the voucher scheme on this system. The voucher scheme is going to affect the workings of our model through

two channels. First, it will lower the minimum productivity standard of the employer relevant for the long-term unemployed, as more job-worker combinations will become profitable. As a result the acceptance rate of the employer will increase for this group. Since the acceptance rate of the employer is the most restrictive factor in the overall acceptance rate of long-term unemployed applicants, the voucher will increase the number of matches at given unemployment. This reduces search costs and increases employment.

Second, the voucher will reduce wage costs at given unemployment, hence employers will expand the demand for labor and post more vacancies. Furthermore, as part of the voucher is shifted backward to the worker (see below), the subjective wage distribution of the unemployed will shift upward. This will increase the search effort of the long-term unemployed, increasing the effective supply of labor and hence the number of matches. However, the subsidy is also likely to increase the reservation wage, as the long-term unemployed is more likely to find employment. This will somewhat limit the decline in the overall acceptance rate, reducing the number of matches. A more elaborate discussion of the different effects is given in Section 5.3 below.

5.2 Implementing the voucher scheme

We implement the voucher assuming that the employer is not allowed to fire the subsidized employee once the subsidy expires. Furthermore, we assume that the subsidized long-term unemployed do not displace incumbent workers.[28]

The voucher will affect employment mainly through its effect on the minimum productivity standard of the employer for potential job-worker combinations relevant for the long-term unemployed. Due to the voucher, more job-worker contacts will result in a match.

We convert the voucher into an equivalent reduction of the minimum wage in the state of low-productive employment by using the following formula

[28] We also experimented with endogenous quits, i.e. the employer is allowed to fire the low-productive employee once the voucher expires (if it is in his best interest to do so). With endogenous quits the unemployment effect is smaller because the increase in turnover dominates the increase in hirings. Furthermore, with endogenous quits the scheme is more costly as savings on benefits fall. We further experimented with the assumption that part of the subsidized long-term unemployed displace incumbent workers. The effect is the same as with endogenous quits, the flow into unemployment increases the unemployment effect decreases, whereas costs increase.

$$\frac{\int_{t=0}^{2} o\ \frac{1}{2} vo\ e^{-(\sigma_l + r)t} dt}{\int_{t=0}^{\frac{1}{\epsilon}} wm\ e^{-(\sigma_l + r)t} dt} = vo'. \tag{43}$$

Equation (43) expresses the discounted value of the voucher (*vo*) as a fraction of the discounted value of the minimum wage level in the state of low-productive employment. The subsidy is assumed to be spread over two years, hence during the first two years of employment the employer receives half of the subsidy for each year. Furthermore, we assume that a quarter of the voucher is shifted backward to the employee. Hence, we set o at .75. The forward shifting of taxes in the wage bargaining model is assumed to be 50%. However, this applies for all workers. Most workers are either in regular employment or in short-term unemployment. For workers in regular employment and short-term unemployment the reservation wage is the most restrictive factor in the aggregate matching process. For the long-term unemployed the minimum productivity standard of the employer (which reflects the minimum wage level) is the most restrictive factor. Hence, we assume that long-term unemployed will be less effective (half as effective) in shifting part of the subsidy backward than short-term unemployed would if they were given the same subsidy, for the long-term unemployed job-seekers have a rather unfavorable bargaining position.

We compare the discounted value of the subsidy with the discounted value of the minimum wage level for the time period the long-term unemployed remains in the state of low-productive employment, i.e. $1/\epsilon$ periods on average. We discount the subsidy and the minimum wage level by the exogenous quit rate and long-term interest rate. The minimum productivity standard of the employer relevant for the long-term unemployed then becomes (compare with equation (19) in Section 3)

$$he_l = hn\ \frac{wm(1 - vo')}{wc}, \tag{44}$$

where *hn*, *wm* and *wc* once again denote the average productivity of employees, the minimum wage level and the average wage cost of employees.

5.3 Simulation results

We simulate the voucher scheme for different subsidy levels. Below we present the simulation results of the voucher scheme for subsidy levels of 25, 50 and 100% of the social assistance level.

Impact on employers behavior

The impact of the voucher scheme on the search and selection behavior of the employer is given in Table 7 below.

Labor costs fall due to the subsidy on new low-productive labor. The effect is somewhat counteracted by the rise in wage pressure (see Paragraph 5.3.4 below). The impact of the subsidy on labor costs is most pronounced for unskilled labor, as the subsidy gives rise to a more or less dramatic increase in the inflow of unskilled long-term unemployed individuals into employment for this skill level. The impact falls with the skill level, becoming virtually none for high-skilled labor.

For all skill levels the discounted value of the voucher as a percentage of the discounted value of the minimum wage is approximately one tenth of the voucher over the social assistance level. This reflects several factors: 1) the voucher is available for a limited time only, 2) the social assistance level is lower than the minimum wage level and 3) part of the voucher is shifted backward to the employee.

The increase in the acceptance rates of the employer relevant for job-worker contacts with long-term unemployed job-seekers reflects the decrease in the minimum productivity standard of the employer due to the voucher. The increase in the acceptance rate is by far the most pronounced for the unskilled. This reflects the relatively low productivity spread of potential low-productive unskilled job-worker combinations. Furthermore, the ‘density’ of potential job-worker combinations increases for the unskilled as the minimum productivity standard shifts leftward (this is reflected in the nonlinear increase of the acceptance rate in the voucher level), whereas it falls for the low- and high-skilled. The acceptance rate relevant for the short-term unemployed falls, as search costs for alternative employees fall.

The impact of the voucher on the minimum productivity standard is the single most important determinant of the employment effects for the different skill levels. The

relatively large increase in low-productive unskilled employment reflects this. Note that regular employment increases both for the unskilled and low-skilled, as more individuals transit from low-productive to regular employment.

Table 7 Search and selection behavior: employers[a]

Subsidy level al a fraction of social assistance level	.25	.50	1.00
labor costs[b]			
- unskilled	-0.5	-0.9	-1.8
- low-skilled	-0.0	-0.1	-0.1
- high-skilled	0.0	-0.0	-0.0
voucher/minimum wage[c]			
- unskilled	2.5	5.1	10.
- low-skilled	2.4	4.8	9.5
- high-skilled	2.8	5.6	11.
acceptance rate			
- unskilled			
- short-term	-8.1	-15.	-27.
- long-term	14.	30.	73.
- low-skilled			
- short-term	-0.0	-0.1	-0.2
- long-term	2.4	4.6	8.9
- high-skilled			
- short-term	-0.0	-0.0	-0.1
- long-term	1.5	3.0	5.9
employment			
- unskilled			
- regular	0.7	1.5	3.0
- low-productive	6.5	13.	24.
- low-skilled			
- regular	0.1	0.2	0.4
- low-productive	0.2	0.4	0.6
- high-skilled			
- regular	-0.0	-0.1	-0.1
- low-productive	0.6	1.1	1.9

[a] Cumulated percentage changes in the 20th period between simulation and base projection.
[b] Labor costs per efficiency unit of labor.
[c] 3/4 of the subsidy over the minimum wage level.

Impact on behavior of the unemployed

The impact of the voucher scheme on the search and selection behavior of the unemployed is given in Table 8 below.

The voucher raises the reservation wage of the long-term unemployed. First, their reservation wage increases because part of the subsidy is shifted backward to the new hire. This shifts the subjective wage distribution upwards, increasing the utility of being

in the state of long-term unemployment and hence increasing the reservation wage. Second, the voucher leads to an increase in the transition rate from long-term unemployment into low-productive employment, increasing the outside option of the long-term unemployed job-seekers even further. The effect is most pronounced at the unskilled level. This is mainly due to the dramatic increase in their transition rate into employment relative to the other skill levels.

The reservation wage of the short-term unemployed also rises due to the voucher, though the rise is rather mild relative to the long-term unemployed. The change in the reservation wage of the short-term unemployed reflects the net outcome of two opposing effects. On the one hand, the subsidy for the

Table 8 Search and selection behavior: unemployed[a]

Subsidy level as a fraction of social assistance level	.25	.50	1.00
reservation wage			
- unskilled			
- short-term	0.3	0.6	1.6
- long-term	3.9	7.9	16.
- low-skilled			
- short-term	0.2	0.3	0.7
- long-term	0.5	1.0	1.9
- high-skilled			
- short-term	0.0	0.1	0.2
- long-term	0.1	0.2	0.4
acceptance rate			
- unskilled			
- short-term	-1.5	-3.4	-7.8
- long-term	-2.1	-4.9	-12.
- low-skilled			
- short-term	-0.1	-0.2	-0.4
- long-term	-0.3	-0.6	-1.0
- high-skilled			
- short-term	0.1	0.2	0.3
- long-term	0.0	0.0	-0.0
search intensity			
- unskilled			
- short-term	-1.0	-2.1	-4.1
- long-term	0.6	1.1	1.9
- low-skilled			
- short-term	-0.1	-0.1	-0.2
- long-term	0.1	0.1	0.2
- high-skilled			
- short-term	-0.0	-0.0	-0.1
- long-term	0.0	0.0	0.0

[a] Cumulated percentage changes in the 20th period between simulation and base projection.

long-term unemployed job-seekers leads to some displacement of short-term unemployed job-seekers. This reduces the transition rate from short-term unemployment into regular employment and increases the transition rate from short-term unemployment into long-term unemployment. Both effects tend to lower utility in the state of short-term unemployment. However, on the other hand, becoming long-term unemployed now tends to be less dramatic for the short-term unemployed (see the discussion on the reservation wage of the long-term unemployed above). The overall effect on discounted utility in short-term unemployment is positive. Hence, the reservation wage of the short-term unemployed increases.

The change in the acceptance rates of the long-term unemployed reflects the (upward) change in their reservation wage and the (upward) change in their subjective wage distribution. As their reservation wage increases by more than the subjective wage distribution (due to the increase in the transition rate), their acceptance rate falls.

The change in the reservation wage of the unskilled and low-skilled short-term unemployed reflects the upward shift in their reservation wage. As their subjective wage distribution is hardly affected, their acceptance rate also falls. The acceptance rate of the high-skilled short-term unemployed slightly increases, since their reservation wage rises by less than the average wage.

Finally, consider the impact of the voucher schemes on the search intensity of the short- and long-term unemployed. The increase in the transition rate from long-term unemployment to low-productive employment increases the search effort of the long-term unemployed, as the marginal returns from additional time spent on job-search rise. The search intensity of the short-term unemployed falls. This reflects the decrease in their transition rate into regular employment (and to some extent the increase in discounted lifetime utility in short-term unemployment relative to discounted lifetime utility in low-productive employment).

Simulation results: aggregate matching process

The impact of the voucher scheme on the aggregate matching process is given in Table 9 below.

First, consider the impact of the different voucher schemes on the overall acceptance rate of the long-term unemployed. For the unskilled and low-skilled the acceptance rate of the employer is the most restrictive factor in the overall acceptance rate relevant for the long-term unemployed. Hence, the increase in the overall acceptance rate for the long-term unemployed reflects the increase of the acceptance rate of the employer for

these groups.[29] In the overall acceptance rate relevant for the high-skilled long-term unemployed the acceptance rate of the unemployed is the most restrictive factor. Hence, the increase in the acceptance rate of the employer only mildly affects the overall acceptance rate relevant for the high- skilled long-term unemployed.

The overall acceptance rate of the short-term unemployed falls. The effect mainly operates via the 'demand' side. The voucher reduces search costs for firms. This will increase the hiring standard both for the short- and long-term unemployed job-seekers. However, the long-term unemployed benefit from the voucher, whereas the short-term unemployed do not. Consequently, the acceptance rate of the employer towards the long-term unemployed rises due to the subsidy, whereas the acceptance rate of the employer towards the short-term unemployed clearly falls. For the unskilled and low-skilled this effect is reinforced by the fall in the acceptance rate of the short-term unemployed. Whereas for the high-skilled, the rise in the acceptance rate of the short-term unemployed is by no means sufficient to counteract the decrease in the acceptance rate of the employers relevant for this group.

The change in the (overall) minimum productivity standard reflects the change in the overall acceptance rate. As the overall acceptance rate for the long-term unemployed rises, the minimum productivity standard for this group falls. As a consequence, average productivity of low-productive filled job-worker combinations also falls (not shown in the table). Low-productive employment constitutes only a fraction of total employment, the impact on total productivity is therefore rather small (not shown in the table). Turning to the change in the endogenous transition rates, the increase in the overall acceptance rate relevant for the long-term unemployed and their search intensity increases the transition rate from long-term unemployment into low-productive employment. The decline in the overall acceptance rate of the short-term unemployed and their search intensity leads to a decline in the transition rate from short-term unemployment into regular employment.

The decline in the transition rate from short-term unemployment into regular employment also causes the transition rate from short- to long-term unemployment to increase. The changes in short- and long-term unemployment reflect the changes in these transition rates. Short-term unemployment increases as the decrease in the transition rate into regular employment (always) dominates the increase in the transition rate into long-term unemployment. Long-term unemployment falls as the increase in the

[29] Were we to raise the voucher level beyond the social assistance level, the marginal effect on the overall acceptance rate would be mitigated. Indeed, for higher voucher levels the acceptance rate of the long-term unemployed job-seeker becomes the most restrictive factor in the overall acceptance rate.

transition rate into low-productive employment dominates the increase in the inflow from short-term unemployment. The notable exception is high-skilled labor, where both short- and long-term unemployment rise due to the voucher. The reduction in labor costs due to the voucher is most pronounced for unskilled employees. Hence, labor demand will shift away from high-skilled to unskilled labor. This causes both high-skilled short- and long-term unemployment to rise (though the rise in short-term unemployment is most pronounced).

Finally, consider the change in the number of matchings over the number of vacancies. The voucher increases the overall acceptance rate of job-worker contacts. Hence, the average vacancy duration falls (defined as vacancies over matchings). The effects are most pronounced at the unskilled level.

Table 9 Aggregate matching process[a]

Subsidy level as a fraction of social assistance level	.25	.50	1.00
overall acceptance rate			
- unskilled			
- short-term	-8.1	-15.	-27.
- long-term	14.	30.	73.
- low-skilled			
- short-term	-0.2	-0.3	-0.7
- long-term	1.5	2.9	5.4
- high-skilled			
- short-term	-0.1	-0.2	-0.4
- long-term	0.7	1.4	2.5
minimum productivity standard			
- unskilled			
- short-term	0.9	1.7	3.3
- long-term	-1.7	-3.4	-7.1
- low-skilled			
- short-term	0.1	0.2	0.4
- long-term	-1.1	-2.1	-3.8
- high-skilled			
- short-term	0.0	0.1	0.2
- long-term	-0.6	-1.2	-2.3
transition rate into employment			
- unskilled			
- short-term	-6.2	-12.	-20.
- long-term	18.	41.	103.
- low-skilled			
- short-term	-0.1	-0.2	-0.3
- long-term	1.8	3.6	6.8
- high-skilled			
- short-term	-0.6	-1.2	-2.0
- long-term	0.3	0.7	1.5
transition rate into long-term unemployment			
- unskilled	2.6	4.8	8.6
- low-skilled	0.1	0.1	0.1
- hifh-skilled	0.3	0.6	1.1
unemployment			
- unskilled			
- short-term	3.9	7.7	15.
- long-term	-10.	-20.	-39.
- low-skilled			
- short-term	0.1	0.2	0.4
- long-term	-1.6	-3.1	-5.9
- high-skilled			
- short-term	0.2	0.5	0.8
- long-term	0.3	0.4	0.5
matchings/vacancies			
- unskilled	1.2	2.4	4.5
- low-skilled	0.5	0.8	1.4
- high-skilled	0.5	1.0	1.6

[a] Cumulated percentage changes in the 20th period between simulation and base projection.

Macro outcomes

The impact of the different voucher schemes on macro outcomes is given in Table 10 below.

The impact of the voucher scheme on the macro wage rate depends on its impact on unemployment. As unemployment comes down, wage pressure will build up. However, given the limited impact of the different voucher schemes on unemployment we have to look at the two-digit level to observe a slight increase in wages. It should be noted that the increase in additional wage pressure is somewhat masked by a composition effect, i.e. the share of low-productive workers increases. The change in the wage rate is most pronounced for the low-skilled unemployed. This is mainly due to a composition effect. Turning to the average production and consumption price, we observe a decline due to the subsidy on labor. Note that the fall in consumption prices is smaller than the fall in production prices, as labor is but one input in the production process (though an important one).

The subsidy on low-productive labor increases employment (most notably unskilled employment), production and private consumption. Furthermore, it becomes more profitable for firms to invest, hence investment goes up. The increase in production increases the demand for imports, whereas the fall in production prices increases exports. The overall effect on the current account is negligible. Labor sup- ply is mainly affected by the wage rate and the marginal burden of taxes and premiums. The impact on both is rather small, hence labor supply is hardly affected by the voucher scheme.

Turning to the different ratio's, we find that unemployment falls in line with the subsidy. On a two-digit level the elasticity of unemployment with respect to the subsidy level is decreasing. It becomes increasingly difficult to create additional job-worker matches, whereas additional wage pressure is biting the employment effect. The impact on unemployment is most pronounced for the unskilled workers, as labor costs decline most pronounced for this skill level. If we set the subsidy level at 100 per cent of the social assistance level unemployment falls by some 8 per cent of total unemployment, which appears neither insignificant nor spectacular.

As noted in the previous paragraph, unskilled and low-skilled long-term unemployment decline, whereas high-skilled long-term unemployment increases as demand shifts away from high-skilled labor. For all skill levels short-term unemployment rises. On the macro level, short-term unemployment rises in line with the voucher. However, the rise is less than proportionally, as some short-term unemployed job-seekers profit from the increase in the demand for labor (i.e. vacancies increase). Long-term unemployment falls in line with the voucher level.

On average, the replacement rate is unaffected by the subsidy for unemployment benefits and social assistance are linked to gross wages. Hence, the wage increase

Table 10 Macro outcomes

Subsidy level as a fraction of social assistance level	.25	.50	1.00
prices[a]			
wage rate	0.0	0.0	0.0
– unskilled	-0.3	-0.6	-1.1
– low-skilled	0.1	0.2	0.4
– high-skilled	0.1	0.2	0.4
production price	-0.0	-0.1	-0.1
consumption price	-0.0	-0.0	-0.1
volumes[a]			
private consumption	0.1	0.2	0.3
investments	0.1	0.1	0.2
exports	0.0	0.1	0.2
imports	0.0	0.1	0.2
production	0.1	0.1	0.3
employment	0.2	0.3	0.6
– unskilled	1.2	2.5	4.9
– low-skilled	0.1	0.2	0.4
– high-skilled	-0.0	-0.0	-0.0
labor supply	0.0	0.0	0.0
ratioo's[b]			
unemployment rate total	-0.1	-0.2	-0.5
official unemployment	-0.1	-0.1	-0.3
– unskilled[d]	-4.7	-9.5	-19.
– low-skilled[d]	-0.7	-1.3	-2.5
– high-skilled	0.6	1.0	1.5
short-term unemployment[d]	2.0	3.8	7.2
long-term unemployment[d]	-6.8	-14.	-27.
replacement ratio	0.0	0.0	0.0
average burden	-0.1	-0.2	-0.4
marginal burden	-0.0	-0.1	-0.2
public deficit[c]	0.1	0.1	0.3
current accaount[c]	-0.0	-0.0	-0.0

[a] Cumulated percentage changes in the 20th period between simulation and base projection.
[b] Absolute changes in the 20th period between simulation and base projection.
[c] As a percentage of net national income.
[d] Changes in thousands of persons.

resulting from the backward shifting of the subsidy into higher wages also raises benefits.[30] whereas the average and marginal burden are slightly reduced.

Finally, the voucher scheme does not appear to constitute a 'free-lunch' for the government. Savings on benefit expenditures (and additional receipts for the government) do not outweigh the costs of the scheme. As the subsidy rises, the scheme becomes increasingly costly.

5.4 Voucher trivia

Voucher trivia are given in Table 11 below. Deadweight is defined as $(\pi_{l,p}u_{l,p}-\pi_{l,b}u_{l,p})/(\pi_{l,p}u_{l,p})$, where the subscript *b* and *p* denote values in the base simulation path, respectively. Hence, deadweight is defined as the share of subsidized long-term unemployed individuals that would have employment anyway in total matches for the subsidized long-term unemployed. Substitution is defined as $(\pi_{s,b}u_{s,p}-\pi_{s,p}u_{s,p})/(\pi_{l,p}u_{l,p})$. Hence, substitution is defined as the share of matches for the subsidized long-term unemployed that displace short-term unemployed job-seekers in total matches for the subsidized long-term unemployed (in the 20th period).

As the impact of the voucher schemes on employment and unemployment is rather small we arze not surprised to find that the extent of 'deadweight' (subsidizing individuals that would have found employment anyway) and substitution (subsidized individuals displacing non-targeted job-seekers) is substantial.[31] The results are more or less in line with the results on voucher related schemes (see Section 2). Most of the subsidized individuals represent 'deadweight' or substitute other job-seekers. This leaves little room for net employment gains. However, note that relative to the studies on voucher related schemes, the extent of 'deadweight' appears to be rather high, whereas the 'extent' of 'substitution' appears to be rather low. However, in our model 'substitution' increases the outflow from short-term unemployment to long-term unemployment. This reduces the effective number of job-seekers, which makes the other short-term unemployed job-seekers better off. This effect limits the decline in their transition rate into employment.

[30]The average replacement rate is not affected by the subsidy, as benefits are linked to wages. However, the replacement rate of the long-term unemployed job-seekers falls, as part of the subsidy is shifted backwards. The replacement rate of the short-term unemployed rises, as their benefits rise and their wages do not.

[31] As the turnover rates in regular and low-productive employment are exogenous, there is no displacement of incumbent workers. The impact of introducing displacement is straightforward. The increased turnover will reduce the employment/unemployment effect and will increase costs as savings on benefits fall. However, displacement will reduce wage pressure, which limits the increase in costs.

Table 11 Voucher trivia

Subsidy level as a fraction of social assistance level	.25	.50	1.00
deadweight	95%	90%	82%
substitution	2.0%	3.9%	6.9%
sum of dezdweight and substitution	97%	94%	89%

6 Conclusions

This paper investigates the impact of the so-called voucher scheme for the long-term unemployed. According to Snower (1994a), the voucher scheme could potentially reduce unemployment by a third. Moreover, the scheme would pay for itself, as voucher expenditures equal savings on unemployment benefits. Due to its explicit targeting on the long-term unemployed, side-effects under the voucher scheme can potentially be limited. The voucher is therefore less likely to waste funds on people who would have found unemployment anyway, and subsidized long-term unemployed are less likely to displace non-targeted job-seekers and incumbent workers. Furthermore, as the voucher scheme targets the long-term unemployed, and hence the short-term unemployed and incumbent workers cannot directly benefit from the subsidy, the scheme is less likely to generate additional wage pressure if wages are set by 'insiders'. Clearly, this makes the voucher scheme an intriguing policy option.

In this paper we argue that this judgement is too optimistic. First, Snower's analysis is at variance with the results on actually implemented subsidy schemes for the unemployed. Especially, the side effects like deadweight and substitution with non-targeted groups appear to be much larger than assumed by Snower. Hence, these schemes are typically more expensive and less effective in reducing overall unemployment.

This result is also shown by simulation analysis with MIMIC, the applied general equilibrium model of CPB Netherlands Bureau for Economic Policy Analysis. In order to simulate the voucher system, this model is adapted to include the duration structure of unemployment. In particular, the model of the search and selection strategies of firms and unemployed people and the matching process between vacancies and unemployment is extended. The model is calibrated on data for 1993. The simulation results show that the impact of vouchers on unemployment is neither spectacular nor negligible. Although the voucher is rather effective in reducing long-term unemployment, the overall impact on unemployment is rather modest. Furthermore, the voucher system does not pay itself back. The main explanation is that explicitly targeting at the long-term unemployed comes at a price. The same reasons that are likely to limit the side-effects are also likely

to limit the employment impact of the scheme. Because of the large dispersion in the productivity distribution and the relative low average productivity of long term unemployed people, the employability of a relative small number of long-term unemployed people is improved. Moreover, as employers use the voucher to attract people with an, otherwise, too low productivity, labor costs per efficiency unit of labor hardly falls. Hence, the wage elasticity of employment used by Snower to calculate the employment effects, does not hold in the case of the voucher. A second reason reason for why the impact on unemployment is smaller than suggested by Snower stems from the fact that part of the subsidy will be shifted backwards to the employee. Snower assumes no shifting of the subsidy at all. Finally, we find that the temporary subsidy constitutes a smaller permanent wage cost reduction than assumed by Snower.

The results from micro-economic studies on voucher-related schemes and the simulation results in Section 5 lead us to believe that the impact of the voucher scheme is significantly smaller than appears from the analysis of Snower. That is, the potential impact of the voucher scheme on unemployment appears to be limited, and does not constitute a 'free lunch' for the average tax payer.

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Appendix 1 Long-term unemployment and collective wage formation

To test whether or not long-term unemployment exerts the same downward pressure on wages as short-term unemployment we estimated the wage equation below. The equation is similar to the equation outlined in Graafland and Huizinga (1996), except for the distinction between short- and long-term unemployment (series for u_s and u_l are constructed from several issues of the 'AKT' and the 'Sociale Nota' (Ministry of Social Affairs and Employment)). The estimated equation reads

$$\begin{aligned} \log w = {} & \log q + \log p + \log (1 + (\delta / (1 - \nu + \delta)) (p_c / p (1 - t_m) - 1)) \\ & - \log (1 + (\nu / (1 - \nu)) ((1 - t) / (1 - t_m)) \\ & (1 - \kappa + \kappa (u_s + \omega u_l) (1 - r)))) + \epsilon, \end{aligned} \tag{A1.1}$$

where $\delta = \nu(1-\kappa)\varphi$ and $\epsilon = \log(1+\delta/(1-\nu))$, and u_s and u_l denote the short- and long-term unemployment rate. The parameter of interest is ω. If ω differs significantly from 1 we reject the null hypothesis that long-term unemployment exerts the same (downward) pressure on wages as short-term unemployment. The estimation results of this wage equation in error correction form (using nonlinear 2SLS), as well as the original estimates of Graafland and Huizinga (1996) are given in Table A1 below.

We cannot reject the null hypothesis that long-term unemployment has the same downward pressure on wages as short-term unemployment, the parameter estimate for ω does not differ significantly from 1. Furthermore, distinguishing between short- and long-term unemployment does not appear to add in explaining the variance in the wage level. Although this result seems to contradict that long-term unemployment are less employable than short-term unemployed, the finding can be explained by the relatively unfavorable fall-back position of the long-term unemployed (see Graafland (1990)).

Table A1 Estimation results

	Equation (A1.1)		Graafland and Huizinga (1997)	
long-term coefficients[a, b]				
ν	0.943	(71.3)	0.949	(126.9)
κ	0.947	(74.3)	0.953	(118.6)
δ	0.019	(6.00)	0.017	(10.4)
ϵ	0.698	(5.00)	0.704	(4.90)
ω	1.216	(0.65)[c]	-	
adjusted R^2	0.993		0.999	
adjusted standard error (*100)	0.386		0.382	

[a] t-values in parenthesis.

[b] Short-term coefficients estimates available on request.

[c] From the null hypothesis that $\omega = 1$.

Abstract

This paper investigates the impact of a voucher scheme for the long-term unemployed as proposed by professor Snower. For this purpose, the applied general equilibrium model of the CPB Netherlands Bureau for Economic policy is adapted to include the duration structure of unemployment. In particular, the model of the search and selection strategies of firms and unemployed people and the matching process between vacancies and unemployment is extended.

The simulation results show that the voucher is rather effective in reducing long-term unemployment but that the effects are not as spectacular as the analysis of Snower suggests.