CESifo *Working Paper Series*

INTERGRATION AND SEARCH UNEMPLOYMENT: AN ANALYSIS OF EASTERN EU ENLARGEMENT

Ben J. Heijdra
Christian Keuschnigg*

Working Paper No. 341

October 2000

CESifo
Poschingerstr. 5
81679 Munich
Germany
Phone: +49 (89) 9224-1410/1425
Fax: +49 (89) 9224-1409
http://www.CESifo.de

* We appreciate helpful comments by seminar participants at the University of Copenhagen (EPRU), the Austrian Economic Association meeting, and the CEPR workshop ERWIT 2000, and in particular by A. L. Bovenberg, M. Keuschnigg, and P.B. Sørensen.

CESifo *Working Paper No. 341*
October 2000

INTERGRATION AND SEARCH UNEMPLOYMENT: AN ANALYSIS OF EASTERN EU ENLARGEMENT

Abstract

The paper develops a unified general equilibrium model including savings with overlapping generations, investment and search unemployment. Long-run analytical results for the small open economy identify capital accumulation as a prime transmission channel. The effects of integration on unemployment, however, depend importantly on the nature of wage taxation and unemployment compensation. As a separate methodological contribution, we extend a dynamic CGE model for Germany to allow for search unemployment of high- and low-skilled labour. Simulating the effects of Eastern EU enlargement, we find quantitatively small effects of integration but more pronounced labour market effects from immigration.

Keywords: Finite lives, search unemployment, capital accumulation, trade, immigration

JEL Classification: C68, F13, F15

Ben J. Heijdra
University of Groningen
Department of Economics
P.O. Box 800
9700 AV Groningen
The Netherlands
email: b.j.heijdra@eco.rug.nl

Christian Keuschnigg
University of Saarland
Department of Economics
P.O. Box 151 150
66041 Saarbruecken
Germany
email: c.keuschnigg@rz.uni-sb.de

1 Introduction

With the advent of free trade areas spanning high and low wage countries, and globalization of the world economy in general, economicts started to debate intensively over the effects of trade and integration on labour markets in industrialized economies. The North American Free Trade Area (NAFTA) and the upcoming Eastern enlargement to the European Union (EU) both caused much concern over the effects on wages and employment in the rich, industrialized countries. While in North America the attention focuses primarily on relative wages, Europe with its rigid labour markets is concerned more with unemployment. In particular, high unemployment among low-skilled workers feeds deep reservations against Eastern EU enlargement. A related and even more hotly debated issue is immigration which directly adds to aggregate labour supply and might partly crowd out domestic workers or reduce their wages.[1] Free movement of labour belongs to the basic principles of the EU. In Germany, the problem is particularly acute since millions of ethnic Germans still live in Eastern European countries. Germany most probably would attract a large part of Eastern immigrants.

The trade literature dealt with the case of tariffs as a second-best instrument to address labour market distortions such as minimum wages or workers' unionization [see Rama (1997), or the partial equilibrium analysis of Mezzetti and Dinopoulos (1991)]. Rama (1997) pointed out that the argument depends on the particular labour market institutions in place. Nation-wide unions tend to favour wage moderation since they largely internalize the effects of their actions. In contrast, decentralized wage bargaining restricts employment in the unionized sector, but protection could expand labour demand again to restore employment at the efficient level [see also Rama and Tabellini (1998) in a political economy context]. Unemployment, however, is not explicitly modeled since all excess labour is absorbed by a perfectly competitive export sector, or agriculture. Davis (1998a,b) pointed to the importance of differing labour market institutions in explaining the diverging effects of trade and technological progress on relative wages and employment

[1] Razin and Sadka (1992) discuss benefits and costs of migration and its relationship with trade.

in Europe and the U.S. In particular, he compared the effects of flexible and fixed minimum wages for (un-)employment of unskilled workers in Europe. The trade literature, however, has largely neglected the analysis of integration and unemployment in explicitly dynamic models with capital accumulation [Matusz (1996), Davidson, Martin and Matusz (1999) and Jansen and Turrini (2000) discuss trade in search and efficiency wage models without capital accumulation]. Relying on a search-theoretic framework, this paper emphasizes capital accumulation as a prime transmission mechanism, arguing that integration affects unemployment mainly by stimulating investment.

In line with the empirical evidence by Davis and Haltiwanger (1992), a large part of the literature emphasizes job creation and job destruction as a principal source of unemployment. The core theory along these lines are the models of search unemployment pioneered by Diamond (1982), Pissarides (1990), Hosios (1990) and Mortensen and Pissarides (1994) which spawned a prolific theoretical and empirical literature [see Mortensen and Pissarides (1999) for a survey]. It has proved difficult to integrate the theory of search unemployment with meaningful models of savings and investment. When individual unemployment spells are stochastic, agents become heterogeneous with respect to their past unemployment and savings history. In the absence of a tractable aggregation procedure, an income pooling assumption is unavoidable. The literature on growth and unemployment [e.g. Aghion and Howitt (1994)] and on real business cycles [e.g. Andolfatto (1996), Merz (1999), Den Haan, Ramey and Watson (1997), and Shi and Wen (1997, 1999)] adopts such an assumption of perfect insurance and income pooling within the extended family. This approach opens up the way to combine the search model with capital accumulation and allows to address the consequences of unemployment for average income and macroeconomic equilibrium. With the few exceptions noted above, the growing literature on search unemployment has not found its way into trade theory.

The contributions of this paper are threefold. First, we study the effects of integration and immigration in a small open economy with capital accumulation and search unemployment. As it turns out, the effects of integration on unemployment depend importantly

on fiscal policy rules relating to unemployment benefits and wage taxation. We also show how the welfare gains from integration depend on labour market imperfections. Second, we merge search unemployment with an overlapping generations model as in Blanchard (1985), allowing demographics and population dynamics to influence the unemployment rate. We find that immigration may have important transitional effects on unemployment that depend on the age structure of immigrants. Third, as a separate methodological contribution, we extend a numerically solved, dynamic general equilibrium model of the German economy [see Keuschnigg, Keuschnigg and Kohler (2000)] by including search unemployment, separately for high- and low-skilled labour. This is the first computable general equilibrium (CGE) model of this kind. We apply it to obtain quantitative results on labour market and general equilibrium effects in Germany, resulting from Eastern enlargement of the EU. We find that the quantitative effects of integration on unemployment are relatively modest while immigration can give rise to more pronounced labour market effects. The paper develops the model in section 2 together with an analysis of the efficiency properties of the market equilibrium.[2] Section 3 derives basic analytical results, and section 4 proceeds with quantifying the effects of Eastern enlargement, including immigration. Section 5 offers a brief summary and some conclusions.

2 The Model

2.1 Households

We extend an overlapping generations model pioneered by Blanchard (1985) by incorporating search unemployment and immigration. At each instant of time a large number of identical "families" or "dynasties" is born. Each dynasty counts infinitely many members who practice income pooling. Regardless of age, dynasties face a constant probability of extinction. To keep the population constant, the number of new dynasties is exactly

[2] More details are given in a separate Mathematical Appendix which is available on request.

matched by the number of deaths. Immigration, however, makes the population expand in ways that depend on the specific assumptions regarding mortality and arrival rates.

2.1.1 Individual Dynasties

A dynasty consists of infinitely many members with mass one. Members care only about lifetime utility of the dynasty. Individual labour income risk is fully insured within the dynasty, or household. Thus, household income is non-stochastic.[3] Expected lifetime utility of the representative household of vintage v is

$$\Lambda_{v,t} \equiv \int_t^\infty \Phi\left(C_{v,\tau}\right) e^{(\rho+\beta)(t-\tau)} d\tau, \tag{1}$$

where β is the instantaneous probability of death ($\beta \geq 0$), ρ is the pure rate of time preference ($\rho > 0$) and $C_{v,\tau}$ is consumption of a composite good including domestic and foreign commodities. The instantaneous utility function satisfies $\Phi' > 0 > \Phi''$ and $\lim_{C\to 0} \Phi' = +\infty$ as usual. The dynasty's time endowment equal to unity is allocated to work ($L_{v,\tau}$) and job search ($U_{v,\tau}$):

$$U_{v,\tau} + L_{v,\tau} = 1. \tag{2}$$

At each instant of time, idiosyncratic shocks destroy a constant proportion of the pre-existing matches between firms and workers. Part of the employed lose their jobs while unemployed household members find employment. Given a matching rate f_τ, equal to the fraction of unemployed individuals finding a job, and an exogenous job destruction rate s,[4] and defining $\dot{L}_{v,\tau} \equiv dL_{v,\tau}/d\tau$, the stock of employed agents evolves according to[5]

$$\dot{L}_{v,\tau} \equiv f_\tau U_{v,\tau} - s L_{v,\tau}. \tag{3}$$

[3] See Andolfatto (1996), Merz (1999), Galí (1996), Den Haan et al.(1997), and Shi and Wen (1997,1999).

[4] At the cost of further complexity, we could make the job destruction rate endogenous as in Mortensen and Pissarides (1994, 1999). While none of the qualitative results hinge on this, the effects on unemployment would be magnified, see also Jansen and Turrini (2000).

[5] Lang, Palivos and Wang (1995) offer an overlapping generations model where workers, after an initial schooling effort, search for jobs. Once a job is found, workers remain employed during their entire lifetime. Our framework, in contrast, allows for repeated unemployment spells.

Dynasties face a budget identity

$$\dot{A}_{v,\tau} \equiv (r+\beta)A_{v,\tau} + W^*_\tau L_{v,\tau} + B^U_\tau U_{v,\tau} + T_\tau - C_{v,\tau}, \tag{4}$$

where $\dot{A}_{v,\tau} \equiv dA_{v,\tau}/d\tau$, $A_{v,\tau}$ stands for a stock of tangible assets yielding a real interest of r, W^*_τ is the after-tax wage rate, B^U_τ is the unemployment benefit, and T_τ is a lump-sum transfer per capita, or tax if it is negative. These variables are defined in real terms, i.e. in units of the composite good.[6] The dynasty purchases (reverse) life insurance in the form of actuarially fair annuities. These annuities yield $\beta A_{v,\tau}$ during lifetime but, in exchange, the dynasty must cede the entire estate to the life insurance company upon death. Below we shall refer to $r+\beta$ as the annuity rate of interest. Finally, we assume the existence of a dual income tax. While capital income is taxed proportionally, wage taxation is indirectly progressive. After-tax wages are defined as

$$W^*_\tau \equiv \left(1-t^L\right) W_\tau + B^L_\tau, \tag{5}$$

where W_τ is the gross real wage and t^L is the marginal wage tax rate. Given a basic tax credit equal to B^L_τ, an employed agent runs up a tax liability of $t^L W_\tau - B^L_\tau$. Alternatively, B^L_τ may be understood as an employment subsidy.

The household maximizes lifetime utility (1) by choosing time paths of consumption, search time and tangible assets subject to the accumulation identities (3)–(4) and a solvency condition. The initial stocks $A_{v,t}$ and $L_{v,t}$ are taken as given. With details spelled out in a separate Mathematical Appendix, the key conditions characterizing optimal household behaviour are:

$$\dot{C}_{v,\tau} = C_{v,\tau}\sigma\left(r-\rho\right), \tag{6}$$

$$C_{v,t} = \bar{c}\left(A_{v,t} + H_{v,t} + Z_t\right), \tag{7}$$

$$\lambda^L_t = \int_t^\infty \left[W^*_\tau - \left(B^U_\tau + f_\tau \lambda^L_\tau\right)\right] \exp\left[-\int_t^\tau \left(r+\beta+s\right) d\mu\right] d\tau, \tag{8}$$

[6] Its price index $P\left(p^h, p^m\right)$ reflects prices p^h and p^m of home goods and imports. We choose the import good as the *numeraire* and normalize its world market price to unity. The interest parity condition $r = i - \dot{P}/P$ ties the domestic real interest to the world interest rate i. If the home country is small, goods prices and the world interest rate are exogenously given and constant, implying $r = i$.

where $\sigma \equiv -\Phi'/(C\Phi'')$ is the (constant) intertemporal substitution elasticity for consumption. The shadow price λ_t^L reflects the pecuniary value of an additional member taking up a job at time t and is equal to the expected present value of the "dividend" earned on the job. The job dividend reflects the excess of the after-tax wage over the reservation wage which is the unemployment benefit plus the expected gain from finding employment somewhere else. Apart from the mortality rate β, the instantaneous discount rate also reflects the risk of job separation. According to (6), agents optimally postpone consumption to the future when the real interest exceeds the pure rate of time preference. The closed-form solution (7) shows that the household consumes a constant proportion $\bar{c}$ of its total wealth.[7] Human wealth and the annuity value of lump-sum transfers are denoted by $H_{v,t}$ and Z_t, respectively:

$$H_{v,t} \equiv \int_t^\infty \left(W_\tau^* L_{v,\tau} + B_\tau^U U_{v,\tau}\right) e^{(r+\beta)(t-\tau)} d\tau, \qquad Z_t \equiv \int_t^\infty T_\tau e^{(r+\beta)(t-\tau)} d\tau. \tag{9}$$

Higher unemployment subtracts from average human wealth. The dynasty thus attaches a differential value λ_t^L to an additional member switching from search to employment. Appendix A shows how human wealth may be written in terms of shadow prices.

2.1.2 Aggregate Household Sector

At each instant of time, a number $N_{t,t}$ of new dynasties arrive, and mortality eliminates a fraction β of the existing population. The population thus evolves as $\dot{N}_t = N_{t,t} - \beta N_t$. With constant population, births must balance with deaths, $N_{t,t} = \beta N_t$. Frequencies and probabilities coincide when numbers are large. Since the death rate is constant among all dynasties, the cohort size of generation v at time t is $N_{v,t} \equiv N_{v,v} e^{\beta(v-t)}$ $(t \geq v)$. Adding up gives a total population of $N_t \equiv \int_{-\infty}^t N_{v,t} dv$ dynasties. Define aggregate variables as $x_t \equiv \int_{-\infty}^t x_{v,t} N_{v,v} e^{\beta(v-t)} dv$, implying $\dot{x}_t = x_{t,t} N_{t,t} - \beta x_t + \int_{-\infty}^t \dot{x}_{v,t} N_{v,v} e^{\beta(v-t)} dv$. The Mathematical Appendix derives a number of key expressions that characterize aggregate household sector behaviour. Assuming that new dynasties are born bare of any assets

[7] The marginal propensity to consume $\bar{c}$ is constant if the real interest rate is fixed.

($A_{t,t} = 0$), we first aggregate (4) across all generations:

$$\dot{A}_t \equiv rA_t + W_t^* L_t + B_t^U U_t + T_t N_t - C_t. \tag{10}$$

Aggregate savings attract the market interest rate rather than the annuity rate. Insurance payments βA_t merely redistribute death estates to surviving dynasties and therefore cancel out in the aggregate savings identity.

Second, the overall population splits into $L_t + U_t = N_t$ from (2). New dynasties are assumed to start life without a job ($U_{t,t} = 1$ and $L_{t,t} = 0$). Individual job accumulation (3) thus implies aggregate labour market flows

$$\dot{L}_t = f_t U_t - (s + \beta) L_t, \qquad \dot{U}_t = N_{t,t} + sL_t - (f_t + \beta) U_t. \tag{11}$$

Employment expands as unemployed workers find jobs, and it falls either because jobs are destroyed (at rate s) or workers die (at rate β). Using $L_t + U_t = N_t$ and $\dot{N}_t = N_{t,t} - \beta N_t$, unemployment dynamics just mirrors the evolution of employment. The flow into unemployment results from the arrival of new dynasties and the destruction of existing jobs, whereas the flow out of unemployment consists of workers finding a job or dying. Without loss of generality, we may assume that population size is unity prior to an immigration shock ($N_t = 1$). In the absence of migration, levels and rates of (un-)employment thus coincide.

2.2 Firms

The production structure rests on two types of perfectly competitive firms. *Investment* firms accumulate physical capital. *Production* firms use labour and rent capital services to produce a homogeneous good. The output price is taken as given in world markets. Both types of firms are owned by domestic households.

2.2.1 Investment Firms

The investment firm purchases I_τ units of the composite good and builds up a stock of capital K_τ subject to the accumulation constraint

$$\dot{K}_\tau = I_\tau - \delta K_\tau, \tag{12}$$

where δ is the depreciation rate. The firm's objective is the present value of cash flows:

$$A_t^I \equiv \int_t^\infty \left[(1-t^K)R_\tau K_\tau - I_\tau\right] e^{r(t-\tau)} d\tau, \tag{13}$$

where t^K is the tax rate on capital income and R_τ is the real rental rate of capital, measured in units of the composite good. In equilibrium, investment equates the marginal value product net of taxes with the user cost of capital:

$$\left(1-t^K\right) R_\tau = r + \delta. \tag{14}$$

2.2.2 Production Firms

While there are many production firms, each one is assumed large enough to have deterministic flows relating to its total labour force. Even though hiring of and separation from individual workers is stochastic, these risks wash out over the firm's total labour force as in Pissarides (1990). The firm loses a given proportion of its workforce either due to idiosyncratic shocks or due to death of agents (see also (11) above). To find new workers, it must post a sufficient number of vacancies V:

$$\dot{L}_\tau = q_\tau V_\tau - (s+\beta) L_\tau, \tag{15}$$

where q is the instantaneous probability of successful hiring. To find new workers, the firm must allocate part of its pre-existing workforce to search and recruitment activities. Each vacancy requires a labour input of κ for search activities.[8] The representative firm is

[8] This formulation of search costs is required to reconcile the search framework with the multisectoral structure of the simulation model.

perfectly competitive and uses a linearly homogeneous production technology to produce Y units of the homogeneous good from capital K and labour L^D:

$$Y_\tau = F\left(K_\tau, L_\tau^D\right), \qquad L_\tau^D = L_\tau - \kappa V_\tau. \tag{16}$$

The firm's objective function is the present value of its real cash flow:

$$A_t^P = \int_t^\infty \left\{\left(1-t^K\right)\left[p_\tau^h Y_\tau/P_\tau - R_\tau K_\tau - W_\tau L_\tau\right]\right\} e^{r(t-\tau)} d\tau, \tag{17}$$

where p_τ^h is the relative price of the domestic good and P_τ the price index for the composite good. The firm chooses time paths for output, capital rentals, vacancies and employment in order to maximize (17) subject to the production function (16) and the accumulation identity for workers (15), taking as given its initial labour force L_t. The Mathematical Appendix derives optimal firm behaviour which is characterized by:

$$R_\tau = p_\tau^h F_K/P_\tau, \tag{18}$$

$$\mu_\tau^L q_\tau = \kappa \cdot \left(1-t^K\right) p_\tau^h F_L/P_\tau, \tag{19}$$

$$\mu_t^L = \int_t^\infty \left(1-t^K\right)\left(p_\tau^h F_L/P_\tau - W_\tau\right) e^{(r+\beta+s)(t-\tau)} d\tau. \tag{20}$$

Capital is rented until the marginal value product of capital is equal to its rental rate as in (18). According to (19), the firm posts new vacancies until the marginal cost of recruitment per worker in terms of foregone output equals the expected value of that worker. The value of a filled job in (20) is the expected present value of the rent which the firm earns on that job. The instantaneous discount rate also reflects the risk of job termination due to death, β, and separation for other reasons, s.

2.3 Wage Bargaining

Vacancies and searching workers participate in an anonymous matching process. With U unemployed workers and V vacancies, the number of contacts at each instant of time is

$$X_\tau = G\left(U_\tau, V_\tau\right), \tag{21}$$

where $G(\cdot)$ is linearly homogeneous and satisfies the usual Inada-style properties. Defining labour market tightness as $\theta \equiv V/U$ we derive:

$$f(\theta_\tau) \equiv X_\tau/U_\tau, \qquad q(\theta_\tau) \equiv X_\tau/V_\tau. \tag{22}$$

The properties of the matching function imply $f = \theta q$, $f' > 0 > f''$, and $q' < 0 < q''$. We define ϵ as the elasticity of the function $q(\theta)$, i.e. $0 < \epsilon \equiv -\theta q'(\theta)/q(\theta) < 1$, implying that $1-\epsilon$ is the elasticity of the $f(\theta)$ function. Henceforth, we specialize, without loss of generality, to $X = x_0 U^\epsilon V^{1-\epsilon}$ and thereby take the elasticity to be constant.

Following Pissarides (1990), we assume that the two parties share the job rent created by a new match according to the generalized Nash bargaining solution. When they agree on a higher wage, the job value to the worker (8) rises while the job value to the firm (20) falls. The i-th worker-firm pair divides the job surplus by agreeing on a wage $W_t = \arg\max \left[\lambda_t^L(i)\right]^\zeta \left[\mu_t^L(i)\right]^{1-\zeta}$, where ζ and $1-\zeta$ are the bargaining weights of workers and firms. The bargaining solution satisfies $\zeta\left(1-t^L\right)\mu_t^L = (1-\zeta)\left(1-t^K\right)\lambda_t^L$ and results in a net wage $(1-t^L)W_t = \zeta(1-t^L)p_t^h F_L/P_t + (1-\zeta)(B_t^U - B_t^L + f_t\lambda_t^L)$. The wage is a weighted average of the marginal value product of the job net of the wage tax and the worker's outside option which is the unemployment benefit [less the employment subsidy] plus the expected gain from finding a job elsewhere. With a larger bargaining power, the worker appropriates more of the surplus. Using the bargaining solution again, we obtain:

$$W_t = \zeta \cdot \frac{p_t^h F_L}{P_t} + (1-\zeta)\cdot\frac{B_t^U - B_t^L}{1-t^L} + \zeta\cdot\frac{f_t\mu_t^L}{1-t^K}. \tag{23}$$

2.4 Equilibrium

In the absence of public debt, the government budget identity is given by:

$$T_t N_t + B_t^U U_t + T_t^E = \left(t^L W_t - B_t^L\right) L_t + t^K\left(p_t^h Y_t/P_t - W_t L_t\right), \tag{24}$$

where T^E represents net contributions to the European Union (EU). Revenues stem from a dual (capital and labour) income tax, and are spent on unemployment benefits, transfers to the household sector and net EU contributions.[9]

[9] The simulation model also includes tariff revenues plus more taxes, spending items and public debt.

Households invest savings in three perfectly substitutable assets. Asset market equilibrium ensures that household sector wealth equals the real value of outstanding assets, $A_t = A_t^I + A_t^P + A_t^F$, where A^I and A^P are, respectively, shares in investment and production firms, and A^F is net foreign assets. We obtain the current account

$$\dot{A}_t^F = rA_t^F + \left(p_t^h Y_t/P_t - C_t - I_t\right) - T_t^E, \tag{25}$$

where the term in brackets is the trade balance. Net exports are equal to domestic real income less absorption. The transversality condition for the entire economy is $\lim_{\tau\to\infty} e^{r(t-\tau)}A_\tau^F = 0$, giving:

$$A_t^F = -\int_t^\infty \left(p_\tau^h Y_\tau/P_\tau - C_\tau - I_\tau - T_\tau^E\right) e^{r(t-\tau)}d\tau. \tag{26}$$

To the extent that the country is a net creditor to the rest of the world ($A_t^F > 0$) it can afford to run current account deficits in the future.

Replacing I by $\dot{K} + \delta K$ and integrating by parts, equation (26) yields the present value of consumption, $\int_0^\infty C_\tau e^{r(t-\tau)}d\tau = A_0^F + K_0 + \Lambda^*$, where

$$\Lambda^* \equiv \int_0^\infty \left[\left(1 - t^E\right) p_\tau^h Y_\tau/P_\tau - (r+\delta) K_\tau\right] e^{-r\tau}d\tau. \tag{27}$$

Net contributions, in real terms, amount to $T^E = t^E p^h Y/P$ where t^E is the net contribution rate. Given a constant real interest rate, and ignoring issues of intergenerational redistribution, we can take the present value of domestic consumption as our aggregate welfare measure. Welfare changes along with Λ^* since $K_0 + A_0^F$ is predetermined.[10]

2.5 Efficiency

To characterize efficiency of the market equilibrium, appendix B considers the socially optimal allocation. Comparing (B.1) with (14) and (18) implies $t^K = 0$ for optimality. Private investment decisions are socially optimal if they are not distorted by capital taxation. Due to search externalities and non-competitive wage setting, however, recruitment

[10] In the absence of adjustment costs, the domestic capital stock may jump instantaneously which is financed by an asset swap with foreign bonds, keeping $K_0 + A_0^F$ constant.

of firms and search activities of households are not optimal in general. Since the opportunity costs of recruitment in (B.3) and (19) are the same, the number of privately posted vacancies is optimal if social and private job values, μ and μ^L, satisfy

$$(1-\epsilon)\,\mu = \mu^L. \tag{28}$$

In taking the probability q as given, private firms expect to successfully hire q workers per vacancy announced. In equilibrium, however, the number of matches $G = Vq(\theta)$ depends on labour market tightness. Posting a new vacancy contributes to tighter labour markets. Other firms will thus find it more difficult to fill their own vacancies while workers will obtain jobs more easily, $f'(\theta) > 0 > q'(\theta)$. Instead of q workers, firms in fact will be able to hire only $(1-\epsilon)\,q$ workers per vacancy announced. Since firms fail to take into account this detrimental effect on labour market tightness, they tend to post too many vacancies. This externality could be internalized if the private value of a job μ^L were reduced below the social value μ by a factor $1-\epsilon$ that corresponds to the reduction in the hiring probability in equilibrium. Appendix B shows that this can be achieved if fiscal policy suitably controls the result of wage bargaining by setting search and employment subsidies B^U and B^L according to

$$\frac{B^U - B^L}{1-t^L} = (\epsilon - \zeta)\,\frac{1+\theta\kappa}{1-\zeta}\frac{p^h F_L}{P}. \tag{29}$$

Equation (B.2) relates to labour market participation. Participation will be optimal if the value η of having an additional household member search for a job equals the expected social return on search, $\mu f \epsilon$. As is stated in the separate Mathematical Appendix, the private participation decision must satisfy $\eta = B^U + f\lambda^L$ which equates the value of time endowment with the expected private return on search which is the unemployment benefit plus the expected capital gain from finding a job with probability f. In the absence of taxes, the valuation of a job by households and firms is related by the bargaining condition $\zeta\mu^L = (1-\zeta)\,\lambda^L$. Using this, the private and social returns of search are equated if

$$B^U + f \cdot \mu^L \zeta / (1-\zeta) = \mu f \epsilon. \tag{30}$$

There are two natural distortions again. First, private agents take the probability f as given and ignore the fact that their own search activity reduces the chances of other households to locate a job, but raises the chances of firms to fill vacancies. In equilibrium, the probability of finding a job is reduced with increased market participation. The perceived private return on search is thus too high on this account, and should be lower by a factor ϵ. Second, the firms' bargaining power squeezes wages below the workers' marginal value product and thereby depresses the private return on search. According to (30), the social and private rewards on search may be equated if fiscal policy succeeds to control wage formation by means of an appropriate tax or subsidy on search. Replacing μ^L by (28), rearranging, and using (B.3) on this result, we obtain:

$$B^U = (\epsilon - \zeta)\frac{\mu f}{1-\zeta} = (\epsilon - \zeta)\frac{\theta\kappa}{1-\zeta}\frac{p^h F_L}{P}. \tag{31}$$

Proposition 1 *The first best social optimum is decentralized if the Hosios condition holds, $\epsilon = \zeta$, employment and unemployment subsidies are zero, $B^U = B^L = 0$, and taxes on capital income are absent, $t^K = 0$.*

Note that wage taxes are not distorting if the Hosios (1990) condition holds which states that the search equilibrium is efficient if the bargaining power of workers is equal to the matching elasticity relating to vacancies. These parameters result in a wage rate that just internalizes the search externalities.

Proposition 2 *If the Hosios condition fails and the matching elasticity is constant, the social optimum is decentralized by $t^K = t^L = 0$ and B^L and B^U as in (29) and (31).*

3 Integration and Unemployment

We analyze a stylized integration scenario that captures some essential aspects of Eastern enlargement of the European Union from the viewpoint of present EU member states, say

Germany. Integration reduces import prices in the EU but also creates export opportunities as Central and Eastern European countries obtain better access to EU produced commodities. The effects of integration may partly be felt as an improvement of the terms of trade vis-á-vis the entrants. As Baldwin et al. (1997) have argued, membership may increase the growth prospects in applicant countries much more than in the EU which should improve the terms of trade. On the negative side, financing enlargement will put a considerable fiscal burden on present member states. Finally, one of the most controversial aspects of extending full membership is the free movement of labour. The expected labour market effects of immigration cause deep reservations against enlargement in present member states. Will it depress wages and increase unemployment among domestic workers? We first provide some analytical results.

3.1 Capital Intensity

Removing trade barriers squeezes domestic prices $p^m = 1 + \tau$ for imports. Depending on the import share γ, lower trade barriers favourably affect the price index for the composite good which is defined as $P = \min\left\{p^h c^h + p^m c^m \quad s.t. \quad C(c^h, c^m) \geq 1\right\}$. Indicating percentage changes by a hat, $\hat{p}^h = dp^h/p^h$, $\hat{\tau} = d\tau/(1+\tau)$, trade costs and output prices feed into the price index as

$$\hat{P} = (1-\gamma)\,\hat{p}^h + \gamma\hat{\tau}. \tag{32}$$

We use $R^K \equiv \left(1-t^K\right)p^h F_K/P$ and $R^L \equiv \left(1-t^K\right)p^h F_L/P$ as a short-hand for real rental rates net of taxes. According to (14) and (18), $R^K = r + \delta$. Investment conditions improve on two accounts: better terms of trade (i.e. higher output prices) and lower import barriers. The capital labour ratio $k = K/(L - \kappa v)$ increases accordingly by[11] $\hat{k} = \left(\hat{p}^h - \hat{\tau}\right)\gamma\sigma^K/(1-\alpha)$. The net real rental rate of labour, in turn, increases along

[11] The elasticity of substitution in production is $\sigma^K = -(1-\alpha)f'/(kf'')$ and capital's share in value added is $\alpha = kf'/f$ where $f(k)$ denotes the production function in intensive form.

with higher capital intensity:

$$\hat{R}^L = \hat{p}^h + \hat{F}_L - \hat{P} = \left(\hat{p}^h - \hat{\tau}\right)\gamma/\left(1-\alpha\right). \tag{33}$$

3.2 Labour Market Tightness

The supply side is now solved quite simply in a recursive way. With the capital labour ratio and, thus, the net rental price of labour fixed once and for all, the wage equation (23), the free entry condition (19) and the asset price equation (20) solve for the value of a filled job μ^L, the labour market tightness θ, and the wage rate W *independently* of the levels of employment and capital. This implies that the asset price instantaneously jumps to its stationary value, $\dot{\mu}^L = 0$ at all dates.

The nature of the labour market equilibrium depends very much on the specific fiscal policy rules in place. We emphasize three cases:[12] (a) real benefits B^L and B^U constant, (b) indexation where $B^U = b^U\left(1-t^Y\right)W$ and $B^L = b^L\left(1-t^Y\right)W$, and (c) progressive wage taxation with unemployment benefits indexed, $B^U = b^U\left(1-t^Y\right)W$, but real tax allowance B^L constant. One could argue that the tax allowance is indexed, if at all, to a broader definition of income than just net wages. Fiscal policy rules are important since they affect wage formation which determines producer rents and incentives to post vacancies. Integration impacts on labour markets by raising the rental cost of labour,

$$(a)\ \hat{\theta} = \frac{(1-\zeta)(B^U-B^L)}{[(r+\beta+s)\epsilon+\zeta f]\mu^L}\hat{R}^L, \quad (b)\ \hat{\theta} = 0, \quad (c)\ \hat{\theta} = \frac{-(1-\zeta)\Psi''B^L}{[(r+\beta+s)\epsilon+\zeta f\Psi'']\mu^L}\hat{R}^L, \tag{34}$$

where $\Psi'' > 0$ is defined in (C.1), see appendix C for details.

Proposition 3 *The labour market effects of integration depend on fiscal policy rules.*
(a) Market tightness increases when unemployment benefits B^U and tax allowance B^L are kept constant in real terms, with $B^U > B^L$.
(b) Market tightness remains constant when B^U and B^L are fully indexed to net wages.

[12] From now on, we restrict ourselves, for reasons of simplicity only, to a common marginal tax rate $t^L = t^K = t^Y$. We continue to assume that the basic tax allowance applies only to wage income.

(c) Market tightness falls when benefits B^U are indexed and the wage tax is progressive with the tax allowance B^L constant in real terms.

Being a weighted average of rental labour cost and workers' reservation wages, net wages increase less than in proportion to the rental rate R^L if net unemployment benefits $B^U - B^L$ are kept constant. Producer rents, and thus the asset price of a filled job, accordingly increase more than proportionately. The fact that job values increase relatively more than the opportunity costs of recruitment, $\hat{\mu}^L > \hat{R}^L$, boosts incentives to create vacancies. The labour market becomes tighter. The increase in market tightness makes it easier to find jobs and thereby raises workers' reservation wages. Higher wage demands and lower producer rents retard incentives to create vacancies whence the increase in market tightness is eventually stopped at a higher equilibrium level. With complete indexation as in case (b), net wages, producer rents and asset price of filled jobs all increase proportionately. As the expected value of posting a vacancy increases by the same amount as the firms' search cost, there is no reason to revise recruitment. When unemployment benefits are indexed but the tax allowance, or working subsidy, is kept constant, wages increase relatively more than rental costs, leave smaller producer rents, and contribute to weaker market tightness.

3.3 Employment Dynamics

For the rest of this section, we confine our discussion to case (a) of constant real benefits.[13] Cases (b) and (c) may be inferred by inspection. In raising labour market tightness θ, a reduction of trade barriers and an improvement of the terms of trade reduces the length of unemployment spells and thereby contributes to lower unemployment. While θ jumps instantaneously to its steady state value, the reduction in unemployment is gradual as in (11) with an adjustment speed equal to $\beta + s + f$. Since the vacancy ratio jumps up

[13] This case conforms best to the notion of wage rigidity. Being partly tied to constant benefits, wages fluctuate less than the rental price of labour. Benefit indexation, in contrast, implies full wage flexibility as it keeps the wedge between rental price and wage fixed and makes them change proportionately.

instantaneously, labour use in production, $L^D = L - \kappa V$, first declines and picks up only afterwards as firms build up their labour force. Taking the solution for the unemployment rate in (D.2), the short- and long-run effects are

$$\hat{L}_0^D = -\frac{\kappa\theta U}{L^D} \cdot \hat{\theta} < 0, \qquad \hat{L}_\infty^D = \frac{U}{L^D} \cdot \frac{\chi}{\beta + s + f} \cdot \hat{\theta}, \tag{35}$$

where $\chi \equiv (1 + \kappa\theta)(1 - \epsilon) f - \kappa\theta(\beta + s + f)$. Employment in production thus follows

$$\hat{L}_t^D = \hat{L}_\infty^D - \left(\hat{L}_\infty^D - \hat{L}_0^D\right) e^{-(\beta+s+f)t}. \tag{36}$$

With productive employment determined and the effect on the capital labour ratio noted prior to (33), we derive an output response

$$\hat{Y} = \hat{L}^D + \alpha\hat{k}, \qquad \hat{k} = \frac{\gamma\sigma^K}{1 - \alpha} \cdot \left(\hat{p}^h - \hat{\tau}\right) > 0. \tag{37}$$

The employment rate first falls as firms allocate more of their labour force to recruitment activities. Since the capital labour ratio picks up instantaneously, the output response is ambiguous in the short-run.

3.4 Welfare

We report the change in welfare, based on the welfare measure given in (27), as an annuitized flow in percent of real GNP, $\hat{\Lambda}^* \equiv \frac{r \cdot d\Lambda^*}{(1-t^E)p^h Y/P}$. Using (D.3) gives

$$\hat{\Lambda}^* = \gamma\left(\hat{p}^h - \hat{\tau}\right) - \hat{t}^E + r\int_0^\infty \left[(1 - \alpha)\hat{L}_t^D + \frac{t^K - t^E}{1 - t^E}\alpha\hat{K}_t\right] e^{-rt} dt, \tag{38}$$

where $\hat{t}^E = t^E / \left(1 - t^E\right)$ defines the relative change in the net contribution rate. The expression captures the major sources of the gains from integration: First, welfare improves upon better terms of trade and lower real trade costs.[14] Second, the home country directly loses from a higher *net* contribution rate to the EU budget. Third, welfare potentially improves upon more employment being allocated to production. And fourth, the country gains from induced investment to the extent that it is suppressed initially by a distorting

[14] The simulation model also captures the loss in tariff revenue that results from the Europe agreements.

capital income tax.[15] Note that, for any given capital labour ratio, investment must pick up to accommodate employment gains, $\hat{K}_t = \hat{k} + \hat{L}_t^D$.

The potential welfare gains from induced employment are a more intricate matter. Using (D.4), the appendix computes

$$r \int_0^\infty \hat{L}_t^D e^{-rt} dt = \left(\frac{(\zeta - \epsilon)(1 + \kappa\theta) f + (1 - \zeta) f \left(B^U - B^L \right) / R^L}{r + \beta + s + f} \right) \left(\frac{U}{L^D} \right) \hat{\theta}. \quad (39)$$

This reveals the wedges $\zeta - \epsilon$ and $B^U - B^L$. If the bargaining power of workers exceeds the matching elasticity with respect to searchers, bargaining results in too high wages, insufficient job creation and, consequently, excessive unemployment. Unemployment benefits further exacerbate the problem since they also boost wages and retard job creation. Indeed, Proposition 2 implies that excessive bargaining power should be addressed with taxes on unemployed rather than benefits to discipline wage demands. Under these circumstances, any shock that stimulates employment promises first order welfare gains.

Proposition 4 *Welfare gains from induced employment increase with net unemployment benefits and the workers' bargaining power relative to the matching elasticity.*

3.5 Immigration

We consider two scenarios. Assuming a fixed world population and location choice restricted to newborns only, a permanently larger share of newborns worldwide locate in the home country. Thus, the number $N_{t,t}$ of new arrivals is permanently higher and leads to a gradual increase in the domestic population according to $\dot{N}_t = N_{t,t} - \beta N_t$ until the stock converges to $N = N_{t,t}/\beta$. There will be long-lasting transitional effects on aggregate labour supply. As an alternative scenario, we assume that immigration augments all age cohorts by the same factor which precludes any transitional effects on the demographic

[15] The simulation model allows for monopolistic competition and markup pricing of specialized capital goods. For this reason, capital accumulation is too low in equilibrium, and investment stimulation yields first order welfare gains even without tax distortions.

structure. In this subsection we confine to this stock approach and develop some analytical results. The simulation section will compare the transitional effects of the two scenarios. In all cases, we assume that migrants arrive bare of any financial assets.

In the small open economy, the capital labour ratio depends exclusively on real interest and prices as fixed on international markets. Factor rentals thus remain constant and wage formation is not disturbed. According to (34), immigration does not affect labour market tightness. With the stock approach to immigration, the number of newborns, $N_{t,t} = \beta N_t$, increases in line with the overall population which splits between employed and unemployed agents, $N = L + U$. According to (11), the number of unemployed converges to $U = N(\beta + s)/(\beta + s + f)$, leaving the long-run unemployment rate U/N unaffected. Immigration increases the number of employed and unemployed agents, the number of vacancies, labour input in production, capital stock and output all proportionately without effect on the capital-labour and vacancy-unemployment ratios. Immigration holds important transitional effects, however, since migrants find work only via search in the labour market. With L_0 being predetermined, immigration raises the number of job searchers instantaneously by $dU_0 = dN$ giving $\hat{U}_0 = \hat{N}/U$ and a short-run overshooting of the unemployment rate of $\hat{U}_0 - \hat{N} = \hat{N}(1 - U)/U$.

These arguments miss out on a basic channel that works to reduce unemployment. The simulation model features a monopolistically competitive production sector with product differentiation due to free entry of specialized firms. As immigration swells the labour force and induces investment to keep capital intensity constant, output expands proportionately, at least in the long-run. With the scale of individual firms fixed, output comes in the form of additional product varieties giving rise to increasing returns due to specialization. The variety effect reduces the price index for the composite capital good which raises capital intensity and the rental rate of labour. If unemployment benefits are kept constant in real terms, labour market tightness increases and unemployment falls.[16]

[16] While we stress the base case (a) of constant benefits, cases (b) and (c) discussed in section 3.2 relating to fiscal policy rules apply to immigration as well.

Proposition 5 *In the small open economy, immigration does not affect the capital labour and vacancy unemployment ratios. Immigration raises short-run unemployment but leaves the long-run unemployment rate unaffected. If production is subject to increasing returns due to specialization, the output gains from immigration boost investment and labour rentals and thereby reduce long-run unemployment rates if real benefits are kept constant.*

4 Eastern Enlargement of the EU

The stylized model leaves open many questions that we now investigate with the help of a CGE model of the German economy. To the best of our knowledge, this is the first multisectoral CGE model combining savings and investment with search unemployment in segmented markets for high and low skilled labour. Appendix E describes the most important elements of the model and its calibration.

4.1 The Scenario

The EU presently negotiates with five Central and Eastern European Countries (CEEC5s): Poland, Czech Republic, Hungary, Slovenia, and Estonia. At some point, membership may be extended to all ten CEEC10s including Romania and Bulgaria. Germany is more exposed to potential entrants from the East than most other present EU member countries. The share of CEECs in 1996 German merchandise exports is 6.6 percent, up from 1.59 percent in 1989, while merchandise imports amount to 6.3 percent. By way of contrast, in countries like France or Spain, the 1996 shares are less than 2 percent. Only for Austria is trade with CEECs equally important. Given the large number of ethnic Germans still living in Poland and other CEECs, the immigration pressure poses another threat to the German labour market, on top of East West migration within Germany.

We briefly describe the specific policy scenario to be evaluated but refer to Baldwin et al. (1997) and Keuschnigg et al. (2000) for a more elabourate discussion. We include the Europe Agreements as part of the overall scenario because they are understood as a first

step towards full membership. They extend to all CEEC10s and enact a bilateral *tariff liberalization* in non-agricultural sectors. The agreements hold a somewhat more powerful stimulus on the export side which tends to favour an increase in domestic equilibrium prices. Tariffs on German exports to CEEC5s amount to 6.7% on average, and those to the rest of the CEEC10s 11%. In contrast, EU tariffs on imports to Germany are more moderate at 6.3%, or 7.6% from the rest of the CEEC10s. These tariff cuts involve considerable sectoral variation with agriculture, textiles and food being the most protected sectors. Equally important, full EU membership extends internal market access which involves both a complete removal of all remaining (agricultural) tariffs on east-west trade and a variety of non-tariff barriers. Baldwin et al. (1997) stipulate a reduction of real trade costs in the amount of 10 percent uniform across all sectors. We are more conservative in assuming that the savings in real resource use for cross border transactions is only 5 percent on average for CEEC5s. Enlargement also holds a special negative demand shock for EU farmers. The Common Agricultural Policy (CAP) implies that eastern farmers will come under the protective umbrella afforded by the EU price support system.[17] Relying on an estimate of Anderson and Tyers (1995), the increase in productivity and agricultural output in CEECs is assumed to reduce world farm prices by 2 percent. Our scenario holds that the EU will not raise its variable import levies and export subsidies to protect its farmers against this erosion of world market prices.

Apart from being a key issue in the popular debate, the fiscal cost of enlargement is also a dominant factor in determining the magnitude of the simulation results. Our scenario implements financial projections by the European Commission in the Agenda 2000. The *net cost* of enlargement to CEEC5s is Euro 10.48 Billion or .113 percent of EU15 GNP. Taking account of contributions and return flows, we arrive at an increase in Germany's *net* contribution to the EU from .595% to .645% of GDP. Finally, EU membership guarantees free movement of labour. Germany already attracts most of the immigrants from CEECs, many of them with ethnic German origin. Naturally, the expectation of further immigration and the implications for wages and unemployment,

[17] Keuschnigg et al. (2000) and Anderson and Tyers (1995) offer more detail on CAP effects.

in particular among the low skilled, leave many Germans severely worried. We assume further immigration of 2.5 percent of the total labour force, or roughly one million in the long-run. In the light of recent experience in Germany, this number seems an upper bound.[18] In one scenario, we will assume that immigration is concentrated among low-skilled workers. Since only about 17 percent of the workforce is classified as low-skilled in our data, the unskilled labour force would then expand by 15 percent approximately.

4.2 Quantitative Results

Since the simulation model endogenizes the terms of trade by means of downward sloping export demand functions, the overall scenario becomes ambiguous a priori. The abolition of trade barriers tends to expand the economy while higher net transfers to the EU are contractionary [see Keuschnigg and Kohler (1996)]. Our results indicate that the mutual trade liberalization and improved market access clearly dominates the picture. The supply and demand reactions following enlargement are easily pointed out. Despite of the more complex economic structure, the numerical results reported in Table 1 largely confirm the basic insights of the analytical sections. We start in some detail with the base case scenario of column (1), keeping real benefits and tax allowance constant.

Real Benefits Constant: Cheaper capital and intermediate goods improve supply conditions. Home producer prices get under pressure with buyers favouring imports of eastern origin. The mutual elimination of tariff and non-tariff barriers creates vigorous export and import growth in trade with CEECs. The scenario, however, holds a slightly more powerful leverage on the export side since the CEECs had noticeably higher tariffs at the outset than the EU. German exports to CEECs expand by about 57%, creating excess demand for home goods. To restore equilibrium, domestic producer prices increase on average although the effect is rather small compared to the reduction in price indices on

[18] De New and Zimmermann (1999) and Gang and Rivera-Batiz (1999) discuss the German experience with trade and immigration. Quaisser et al.(2000, pp.117) review estimates of migration potentials.

account of lower protection rates.[19] Higher prices choke off demand for home goods and at the same time reinforce the supply side expansion by strengthening incentives to invest. The economy experiences an investment led expansion with capital stocks accumulating by .64%. The increase in capital intensity strengthens marginal rents to job creation and tightens labour markets, leading to a small reduction in unemployment in the base case where real unemployment benefits are kept constant [column (1) of Table 1]. The reduction in the unemployment rate is slightly larger for unskilled workers, although the initial rate is much higher for them. With a total labour force of 40 million in Germany, the reduction in the average unemployment rate creates about 28.000 new jobs. While the gains in employment are relatively minor, workers benefit from higher wages. Wages of skilled workers, deflated by the consumer price index, are up by .92% in real terms. Integration contributes to a slightly wider wage spread.[20]

The output expansion largely occurs via firm entry and thus contributes to productivity gains due to specialization and diversification of industrial production. Such productivity gains translate into lower price indices which further stimulate investment and other final demand, thereby magnifying the gains in output and real income. Real GDP, deflated by the consumer price index, is up by .7%. It is assumed that the government passes on the fiscal burden of enlargement to households by cutting transfer payments. On the other hand, the overall expansion considerably swells the tax bases which, for given rates, boosts revenues from both direct and indirect taxes. This revenue effect allows in the end for a remarkable increase in transfers to households other than unemployment benefits (.62%, or .92% in real terms). The fiscal returns from enlargement are, thus, more than enough to pay for the increase in net contributions. Wage growth, lower unemployment and higher transfers all boost average disposable wage income which is up

[19] The large terms of trade gains vis-á-vis the CEEC5s (7%) are due to the fact that vanishing trade costs are direct equivalents to a terms of trade improvement. Since cheaper imports reflect savings in resource use on the part of eastern suppliers, there is no offsetting terms-of-trade loss for the east!

[20] The effect on the wage spread is understood only by investigating in more detail the structural effects of enlargement, see Keuschnigg et al. (2000).

by .89% in real terms and must exactly correspond to the increase in consumption in the long-run. The aggregate welfare gain amounts to almost half a percent of GDP.[21]

Alternative Fiscal Policy Assumptions: We now address the alternative cases discussed in Proposition 3. Column (2) of Table 1 refers to the case where both unemployment benefits and basic tax allowance are indexed to net of tax wages. In this case, wages are fully flexible and integration remains without consequences for labour market tightness and unemployment. The difference in the other macroeconomic variables is hardly discernible. The exception is government transfers which are roughly half the size since indexation requires to increase unemployment benefits in face of higher wages. For this reason, the gains in average disposable wage income and aggregate consumption are somewhat lower. The welfare gain is eroded as well since the shock is now less expansionary which tends to subdue the gains from specialization and induced capital accumulation. Column (3) turns to a more progressive wage tax with higher marginal tax rates which combine with a larger personal allowance to replicate the data on tax revenues. Unemployment benefits are indexed but the real value of the basic tax allowance is kept constant. As shown in Proposition 3, the unemployment rates (slightly) increase. Column (4) again turns to the base case scenario where benefits and tax allowance are kept constant in real terms. In addition, we now keep constant real household sector transfers as well (which decline along with the consumer price index by -.32%) and, instead, adjust the wage tax to finance the government budget. The expansionary nature of EU enlargement swells the tax bases and yields a considerable fiscal dividend which allows for a reduction in the marginal wage tax rate by about one percentage point. The lower tax burden on labour reinforces the effects of integration and further squeezes unemployment. Compared to the base case scenario in the first column of Table 1, the reduction in the unemployment rate is now more than double, creating employment for about 63000 people.

[21] We compute the equivalent variations of life-time wealth for each cohort and sum them over present and future generations with due discounting and weighing by cohort size. For comparison with annual GDP, we convert the resulting wealth measure into an annuity by multiplying with the interest rate.

Immigration: One of the Union's basic principles is free movement of labour. If Eastern Europeans seize the opportunity to migrate to the richer Western part of the enlarged union, in search of higher real wages and better public services, Germany is expected to attract a considerable wave of immigration. There is disagreement about the magnitude of the migration potential and the Union's policy response to it. We thus compute the effects of immigration separately from the other elements of enlargement. Immigration amounts to 2.5 percent of the labour force, or 15 percent of unskilled workers. In column (5) of Table 1, immigration adds proportionally to both skill groups while in column (6) it is entirely concentrated among the low-skilled.[22] The effects reported in column (5) are anticipated in Proposition 5. In an open economy with a constant real interest rate, immigration doesn't hold any direct incentives to adjust capital intensity. The increase in manpower is largely accommodated by investment to hold the capital labour ratio constant. Consequently, immigration translates into an equally large output expansion. In the presence of a monopolistically competitive market structure with endogenous diversification, however, the output gains come in the form of increased firm entry resulting in more specialized production techniques. The gains from diversification squeeze price indices which makes investment goods cheaper and contributes to higher capital intensity and labour rentals. With constant real benefits, higher labour rentals increase job values by more than wages, encouraging firms to post more vacancies. Tightening labour markets eventually reduce unemployment rates in both skill groups. Due to the size of the shock, the effect is much stronger than in the base scenario of column (1). The welfare gains relate only to the domestic population and are worth one and a half percent of GDP.

Finally, column (6) points to strong distributional effects when immigration is concentrated among the low-skilled. The unemployment rate among them picks up by roughly one and a half percentage points to 11.4% while real wages decline by almost 9.5%! Skilled workers, in contrast, benefit from wage increases amounting to 2.9% in real terms, while

[22] One may doubt that immigrants from CEEC5s are low-skilled. One could argue that despite of generally high education levels, these skills are largely inappropriate for Germany's technologically advanced production techniques, or at least require considerable retraining.

their unemployment rate at the same time falls by two tenths of a percentage point. Most of the shock thus translates into wages rather than (un-)employment. Even though the number of migrants is the same, the welfare gain is considerably lower if immigration is concentrated among the low-skilled only. Figures 1a-b compare the transitional effects on group specific unemployment rates under two alternative scenarios, the stock and flow approaches discussed in section 3.5. Immigration is concentrated among the low-skilled as in column (6) of Table 1. The flow approach assumes a permanently higher arrival rate of new generations at home. The resulting adjustment process is smooth but extends over several decades until the stationary demographics is attained. The stock approach, in contrast, assumes that immigration inflates all age cohorts proportionally without any extended demographic effects. Since all migrants find employment only by searching in the (low-skilled) labour market, the unemployment rate shoots up instantaneously to more than double its initial value. Due to the very fast labour market dynamics, however, the long-run unemployment rate of about 11.4% is approximately attained within a few quarters! Figure 2 shows how the slow demographic dynamics translates into extended adjustment of aggregate savings and foreign debt [percent change from initial values]. Debt adjustment takes much longer under the flow approach where population grows over an extended period to attain a stationary level only later on. Note also that net foreign assets first decline because rising wage profiles weaken savings incentives of early generations. The trend gets reversed when wage growth slows at a higher level and full savings incentives of future generations are restored again.

Sensitivity: Unfortunately, some key behavioural parameters that may importantly determine the quantitative results of CGE analysis, are not always precisely estimated in the econometrics literature. This necessitates a sensitivity analysis to gauge a plausible range of results. It is particularly difficult to find reliable values for the bargaining power of workers, making ζ a prime candidate for sensitivity analysis. In Table 2, we recompute the results for values of $\zeta \in \{.3, .5, .7\}$ where the bold faced entries in the first line reproduce the base case in column (1) of Table 1. The first entry in each two cells relating to the

same value of bargaining power reports the long-run unemployment rate of high-skilled workers, and the second the change in the aggregate welfare measure. In all cases, real unemployment benefits and the real tax allowance are kept constant. Surprisingly, as bargaining power of workers increases the reduction in high skilled unemployment becomes larger. A variation in this parameter, however, is quantitatively rather unimportant in determining how unemployment rates respond to integration. Also, the effect of raising the matching elasticity ϵ relating to job searchers from .4 to .5 is without much impact. The reduction of the unemployment rate is slightly smaller for a higher elasticity. Interestingly, unemployment rates are much more sensitive to other parameters that determine the magnitude of the response of trade flows, investment and domestic output. The Armington trade elasticities vary across sectors between 2.7 and 5.3 initially. Scaling them up by a factor of 1.3 in the third line of Table 2, e.g. from 4 to 5.2, contributes to a more pronounced reduction in unemployment. Even more important is the magnitude of markup m which is related to the elasticity of substitution between differentiated brands of each sectoral good according to $m = \sigma/(\sigma - 1)$. Markups vary between 1.06 to 1.43 with an output weighted average of 1.15. We double the average markup giving an overall price cost margin of almost 1.3 and, accordingly, scale down the substitution elasticities. The productivity gains from firm entry are now much stronger and vigorously reinforce the macroeconomic response to integration. According to the last line of Table 2, the unemployment rate of the high skilled would then decline to about 5.86%.

In line with Proposition 4, the welfare gains from integration increase with workers' bargaining power but the effect is moderate simply because the induced employment effects are small. Only when markups and the returns to specialization are larger, does bargaining power make a larger difference for the welfare gains from integration. More powerful specialization effects and a higher Armington elasticity work to magnify the investment and unemployment response and, thus, propel the welfare gains from induced employment, capital accumulation, and terms of trade improvement.

5 Conclusions

Based on a dynamic general equilibrium model with overlapping generations, search unemployment and capital accumulation, this paper studied the labour market and general equilibrium effects of integration and immigration. The model is the first of its kind and was applied to an analysis of Eastern EU enlargement. We found that the effects of integration depend on the fiscal policy rules in place as they relate to unemployment compensation and wage taxation. Our base case scenario keeps unemployment benefits and the wage tax allowance constant in real terms which installs some degree of wage rigidity. In raising capital intensity, integration boosts the marginal productivity of labour. With constant benefits, job values increase by more than wages, leading firms to post more vacancies. Labour market tightness increases and unemployment declines. If the economy suffers from excessive bargaining power of workers or is stuck with high unemployment benefits, resulting in high wages and unemployment, then integration yields further welfare gains, apart from the traditional ones, by stimulating employment.

We also found that the expansionary effects of enlargement yield a remarkable fiscal dividend that could be used to cut the wage tax rate, despite of the need to finance higher net contributions to the EU. This considerably reinforces the reduction in the unemployment rate. Immigration that augments all skill types proportionally, does not directly affect long-run unemployment. Any transitional increase in unemployment disappears rather rapidly due to the fast labour market turnover. However, if the expansion of aggregate output in response to immigration results in firm entry and productivity gains from increasing diversification and specialization, the ensuing investment boom raises capital intensity and squeezes long-run unemployment. If immigration is concentrated among the low-skilled, both their wages and employment prospects are directly impaired while the high-skilled gain on both accounts. We found the quantitative effect of integration to be modest compared to the labour market effects of immigration.

Appendix:

A Shadow Prices and Human Capital: Equation (8) defines the differential value λ_t^L of accepting a job while the value of being unemployed is given by

$$\lambda_t^U \equiv \int_t^\infty \left[B_\tau^U + f_\tau \lambda_\tau^L\right] e^{(r+\beta)(t-\tau)} d\tau. \tag{A.1}$$

The value of searching equals the present value of the unemployment benefit plus the expected gain of locating a valuable job, using the annuity rate of interest for discounting. Our shadow prices are uniquely related to the asset prices of employed and unemployed states as usually defined in the search literature, $v^U \equiv \lambda^U$ and $v^L \equiv \lambda^U + \lambda^L$. Using these definitions, equations (A.1) and (8) imply no-arbitrage conditions

$$(r+\beta)\, v^L = W^* - s\left(v^L - v^U\right) + \dot{v}^L, \tag{A.2}$$

$$(r+\beta)\, v^U = B^U + f\left(v^L - v^U\right) + \dot{v}^U. \tag{A.3}$$

The Mathematical Appendix shows that human wealth can be written in terms of shadow prices, i.e. $H_{v,t} = \lambda_t^L L_{v,t} + \lambda_t^U$. Aggregate human wealth is, thus,

$$H_t = \lambda_t^L L_t + \lambda_t^U N_t. \tag{A.4}$$

Using the appropriate differential equations, the time derivative is $\dot{H}_t = \lambda_t^U N_{t,t} + rH_t - W_t^* L_t - B_t^U U_t$. Since new dynasties are born without a job, their human wealth is equal to the value of searching, i.e. $H_{t,t} = \lambda_t^U$. The same equation is derived by time differentiating (9) and explicitly aggregating the result.

B Social Optimum: The socially optimal allocation maximizes (27) subject to (15), (22) and the labour constraint $N = L + U$. The Hamiltonian $\mathcal{H} = p^h F\left(K, L - \kappa V\right)/P - (r+\delta)\, K + \mu\left[Vq\left(V/U\right) - (\beta+s)\, L\right] + \eta\left[N - L - U\right]$ yields optimality conditions for the

controls K, U, and V, and a costate equation for the stock L:

$$\begin{aligned} p_t^h F_K/P_t &= r+\delta, && \text{(B.1)}\\ \eta_t &= \mu_t f(\theta_t)\epsilon, && \text{(B.2)}\\ \mu_t q_t(1-\epsilon) &= \kappa \cdot p_t^h F_L/P_t, && \text{(B.3)}\\ p_t^h F_L/P_t - \eta_t &= (r+\beta+s)\mu_t - \dot{\mu}_t, && \text{(B.4)} \end{aligned}$$

where the shadow prices μ and η relate to the employment stock and the time constraint.

To make sure that the social and private job values satisfy (28), we multiply (B.4) by $1-\epsilon$ and compare it with the differential form of (20) to obtain $\left(p^h F_L/P-\eta\right)(1-\epsilon) = p^h F_L/P - W$. Using (B.2) and (B.3), we replace $\eta = \mu f\epsilon = \left(p^h F_L/P\right)\epsilon\theta\kappa/(1-\epsilon)$ to rewrite the social job rent. After substituting (19) for μ^L, (23) replaces W to rewrite the private job rent. Some rearranging gives (29).

C Labour Market Tightness: The fiscal policy rules noted in section 3.2 give rise to three alternative versions of the wage equation in (23):

$$\begin{aligned} &(a)\quad \left(1-t^Y\right)W = \zeta R^L + (1-\zeta)\left(B^U - B^L\right) + f\zeta\mu^L,\\ &(b)\quad \left(1-t^Y\right)W = \left[\zeta R^L + \zeta f\mu^L\right]\Psi', \quad \Psi' \equiv \tfrac{1}{1-(b^U-b^L)(1-\zeta)},\\ &(c)\quad \left(1-t^Y\right)W = \left[\zeta R^L - (1-\zeta)B^L + \zeta f\mu^L\right]\Psi'', \quad \Psi'' \equiv \tfrac{1}{1-b^U(1-\zeta)}. \end{aligned} \qquad \text{(C.1)}$$

The asset price capitalizes net producer rents according to the stationary version of (20), $(r+\beta+s)\mu^L = R^L - \left(1-t^Y\right)W$. Substituting (C.1) yields:

$$\begin{aligned} &(a)\quad [r+\beta+s+\zeta f(\theta)]\mu^L = (1-\zeta)\left(R^L + B^L - B^U\right),\\ &(b)\quad [r+\beta+s+\zeta f(\theta)\Psi']\mu^L = (1-\zeta\Psi')R^L,\\ &(c)\quad [r+\beta+s+\zeta f(\theta)\Psi'']\mu^L = (1-\zeta\Psi'')R^L + (1-\zeta)\Psi''B^L. \end{aligned} \qquad \text{(C.2)}$$

Equation (C.2) together with the free entry condition (19), $\mu^L q = \kappa R^L$, simultaneously determine the vacancy ratio, or labour market tightness, and the asset price. Log-linearization of (C.2a) yields $(r+\beta+s+\zeta f)\mu^L\hat{\mu}^L + \zeta\mu^L f\hat{f} = (1-\zeta)R^L\hat{R}^L$. Expand and use (C.2a) to obtain $(r+\beta+s+\zeta f)\mu^L\left(\hat{\mu}^L - \hat{R}^L\right) + \zeta\mu^L f\hat{f} = (1-\zeta)\left(B^U - B^L\right)\hat{R}^L$.

Using $\hat{f} = (1-\epsilon)\,\hat{\theta}$ from (22), and the differential of (19), $\hat{\mu}^L - \hat{R}^L = \epsilon\hat{\theta}$, gives the equilibrium effect of integration on labour market tightness in (34). Cases (b) and (c) are derived the same way.

D Unemployment and Welfare: With a constant population of size one, the mass of labour market entrants is $N_{t,t} = \beta N_t = \beta$, unemployment dynamics in (11) is $\dot{U}_t = \beta + s - [\beta + s + f(\theta_t)]\,U_t$ with $U_\infty = \frac{\beta+s}{\beta+s+f(\theta)}$. Log-linearization yields an analytical solution in terms of deviations from the initial equilibrium. The relative change in the length of the unemployment spell is $\hat{f} = (1-\epsilon)\,\hat{\theta}$, implying:

$$\dot{\hat{U}}_t = -(1-\epsilon)\,f\;\hat{\theta} - (\beta + s + f)\,\hat{U}_t, \tag{D.1}$$

where $\hat{U} \equiv dU/U$ and $\dot{\hat{U}} \equiv d\dot{U}/U$. Starting with $\hat{U}_0 = 0$ and noting $\hat{\theta}$ from (34), the transitional solution is:

$$\hat{U}_t = \hat{U}_\infty \left[1 - e^{-(\beta+s+f)t}\right], \qquad \hat{U}_\infty = -\frac{(1-\epsilon)\,f}{\beta+s+f}\hat{\theta}. \tag{D.2}$$

Since recruitment absorbs part of the labour force, employment in production is only $L^D = L - \kappa V$ and changes according to $\hat{L}^D_t = -\left[(1+\kappa\theta)\,\hat{U}_t + \kappa\theta\hat{\theta}\right] U/L^D$.

Using (27), the change in welfare is defined as $\hat{\Lambda}^* \equiv \frac{r\cdot d\Lambda^*}{(1-t^E)p^h Y/P} = r\int_0^\infty \hat{Y}^C_t e^{-rt}dt$ with

$$\hat{Y}^C_t = \hat{p}^h_t - \hat{P}_t - \hat{t}^E + (1-\alpha)\,\hat{L}^D_t + \left[F_K - \frac{(r+\delta)P}{(1-t^E)p^h}\right]\frac{K}{Y}\hat{K}_t. \tag{D.3}$$

Using (14) together with (18) and (32), we obtain (38). To compute the welfare gains from induced employment, we use (35) and (36),

$$r\int_0^\infty \hat{L}^D_t e^{-rt}dt = \hat{L}^D_\infty - \frac{r\left(\hat{L}^D_\infty - \hat{L}^D_0\right)}{r+\beta+s+f} = \frac{U}{L^D}\frac{[\chi - r\kappa\theta]}{r+\beta+s+f}\hat{\theta}. \tag{D.4}$$

Divide (C.2a) by R^L, use $\mu^L q = \kappa R^L$ from (19) and multiply by $f = \theta q$ to get $(r+\beta+s)\,\kappa\theta + \zeta f\kappa\theta = (1-\zeta)\,f - (1-\zeta)\,f\frac{B^U - B^L}{R^L}$. Using this and the definition of χ in (35) to replace the square bracket in (D.4), and get (39).

E The Computational Model: This paper differs from Keuschnigg and Kohler (1996, 2000) by allowing for search unemployment but shares other model elements. We repeat only the most important features that add to the core elements introduced in section 2 and refer to these authors for a more detailed presentation of the other aspects. Production occurs in twelve sectors that are connected by interindustry shipments of intermediate goods. Free entry subject to a zero profit condition determines the equilibrium number of firms and differentiated goods within each sector, giving rise to increasing returns due to specialization. Demand stems from Dixit-Stiglitz (1977) preferences, i.e. different brands are imperfectly substitutable. The composition of investment, government and export demand similarly reflects allocation of expenditure across differentiated, sectoral commodities. Demand is regionally differentiated with imports coming from CEECs, the rest of the EU and the rest of the world. On the supply side, investment is subject to installation costs, making transitional dynamics more realistic. Employment and capital stocks are accumulated separately in each sector. Labour supply and demand distinguish high and low skilled labour with job matching taking place in two segmented markets. Sectoral export demand functions for each regional destination make the country large in output markets and endogenize domestic prices, i.e. the terms of trade relative to given foreign producer prices. The domestic real interest rate reflects changes in terms of trade over time but is otherwise tied to a constant rate determined on world capital markets.

The model is calibrated to 1996 benchmark data of the German economy. We select certain taste and technology parameters from the econometrics literature and also draw on parameters commonly used in the real business cycle literature [see Andolfatto (1996), Burda and Weder (1998), Mortensen and Pissarides (1999) etc.]. Other parameters are calibrated such that the stationary solution reproduces the benchmark data set. The model is implemented quarterly to get meaningful lengths of unemployment spells. In the stationary state, unemployment rates of high and low skilled workers are set at 6 and 10 percent, respectively. Unemployment benefits amount to 70 percent of net wages. The bargaining power ζ is set at .5 for both skill types, and the matching elasticity ϵ with respect to the unemployed at .4 [see Broersma and Van Ours (1999) for a survey]. In line

with the empirical search literature, and drawing on German evidence by Schmidt (1999), we set the transition rates such that average unemployment duration $1/f$ of high (low) skilled labour is 1.75 (3) quarters. Vacancy duration $1/q$ is 1.4 (1.3) quarters. Together with a quarterly mortality rate of $\beta = 1/60$,[23] these values then imply a quarterly split rate s to replicate the labour market equilibrium. The calibrated value implies a job duration of about 27 quarters for both skill types. Calibration generates a search coefficient κ such that roughly two (three) percent of the skilled (unskilled) labour force is absorbed in recruitment. Calibration of the rest of the model is standard and not repeated.

References

[1] Anderson, Kym and Rod Tyers (1995), Implications of EU Expansion for European Agricultural Policies, Trade and Welfare, in: Baldwin, R.E., P. Haaparanta and J. Kiander (eds.), *Expanding Membership of the European Union*, Cambridge: Cambridge University Press, 209-237.

[2] Aghion, Philippe and Peter Howitt (1994), Growth and Unemployment, *Review of Economic Studies* 61, 477-494.

[3] Andolfatto, David (1996), Business Cycles and Labour-market Search, *American Economic Review* 86, 112-132.

[4] Baldwin, Richard E., Joseph F. Francois and Richard Portes (1997), The Costs and Benefits of Eastern Enlargement: The Impact on the EU and Central Europe, *Economic Policy*, 127-176.

[5] Blanchard, Olivier (1985), Debt, Deficits, and Finite Horizons, *Journal of Political Economy* 93, 223-247.

[6] Broersma, Lourens and Jan C. Van Ours (1999), Job Searchers, Job Matches and the Elasticity of Matching, *Labour Economics* 6, 77-93.

[7] Burda, Michael C. and Mark Weder (1998), *Endogenes Wachstum, gleichgewichtige Arbeitslosigkeit und persistente Konjunkturzyklen*, Humboldt University of Berlin, Discussion Paper.

[23] An expected life-time of 15 years or 60 quarters may seem rather low. This parameter is, however, not to be interpreted literally since it applies equally to both young and old generations. It rather reflects disconnectedness of dynasties and discounting of future wage incomes.

[8] Davidson, Carl, Lawrence Martin and Steven Matusz (1999), Trade and Search Generated Unemployment, *Journal of International Economics* 48, 271-299.

[9] Davis, Donald R. (1998a), Technology, Unemployment, and Relative Wages in a Global Economy, *European Economic Review 42*, 1613-1633.

[10] Davis, Donald R. (1998b), Does European Unemployment Prop Up American Wages? National Labor Markets and Global Trade, *American Economic Review 88*, 478-494.

[11] Davis, S.J. and J. Haltiwanger (1992), Gross Job Creation, Gross Job Destruction, and Employment Reallocation, *Quarterly Journal of Economics* 107, 819-864.

[12] De New, John P. and Klaus F. Zimmermann (1999), Wage and Mobility Effects of Trade and Migration, in: Mathias Dewatripont, Andre Sapir and Khalid Sekkat (eds.), *Trade and Jobs in Europe: Much Ado about Nothing?*, Oxford: Oxford University Press, 139-160.

[13] Den Haan, Wouter J., Garey Ramey and Joel Watson (1997), *Job destruction and propagation of shocks*, University of California, San Diego, Discussion Paper 97-23.

[14] Diamond, Peter A. (1982), Aggregate demand management in search equilibrium, *Journal of Political Economy* 90, 881-894.

[15] Dixit, Avinash and Joseph E. Stiglitz (1977), Monopolistic Competition and Optimum Product Diversity, *American Economic Review* 67, 297-308.

[16] Gali, Jordi (1996), Unemployment in dynamic general equilibrium models, *European Economic Review* 40, 839-845.

[17] Gang, Ira N. and Francisco L. Rivera-Batiz (1999), *Immigrants and Unemployment in the European Community*, Discussion Paper No. 70, IZA, Bonn.

[18] Hosios, A. J. (1990), On the efficiency of matching and related models of search and unemployment, *Review of Economic Studies* 57, 279-298.

[19] Jansen, Marion and Alessandro Turrini (2000), *Job Creation, Job Destruction, and the International Division of Labour*, Discussion Paper No. 2472, CEPR, London.

[20] Keuschnigg, Christian and Wilhelm Kohler (2000), Eastern Enlargement of the EU: How Much Is It Worth For Austria?, *Review of International Economics*, forthcoming.

[21] Keuschnigg, Christian and Wilhelm Kohler (1996), Commercial Policy and Dynamic Adjustment Under Monopolistic Competition, *Journal of International Economics* 40, 373-409.

[22] Keuschnigg, Christian, Mirela Keuschnigg and Wilhelm Kohler (2000), *The German Interest in Eastern EU Enlargement*, Discussion Paper, University of Saarland.

[23] Lang, Derek, Theodore Palivos and Ping Wang (1995), Learning, Matching and Growth, *Review of Economic Studies* 62, 115-129.

[24] Matusz, Steven (1996), International Trade, the Division of Labour, and Unemployment, *International Economic Review* 37, 71-84.

[25] Merz, Monika (1999), Heterogeneous job-matches and the cyclical behaviour of labour turnover, *Journal of Monetary Economics* 43, 91-124.

[26] Mezzetti, Claudio and Elias Dinopoulos (1991), Domestic Unionization and Import Competition, *Journal of International Economics* 31, 70-100.

[27] Mortensen, D. T. and C. A. Pissarides (1999), Job reallocation, employment fluctuations and unemployment, in: Taylor, J. B. and M. Woodford (eds), *Handbook of Macroeconomics*, vol. 1B, Amsterdam: North-Holland.

[28] Mortensen, Dale T. and Christopher Pissarides (1994), Job Creation and Job Destruction in the Theory of Unemployment, *Review of Economic Studies* 61, 397-416.

[29] Pissarides, Christopher A. (1990), *Equilibrium Unemployment Theory*, Oxford: Basil Blackwell.

[30] Quaisser, Wolfgang, Monika Hartmann, Elmar Hönekopp, and Michael Brandmeier (2000), *Die Osterweiterung der Europäischen Union: Konsequenzen für Wohlstand und Beschäftigung in Europa*, Bonn: Friedrich Ebert Stiftung.

[31] Rama, Martin (1997), Labour Market Institutions and the Second-Best Tariff, *Scandinavian Journal of Economics* 99, 299-314.

[32] Rama, Martin and Guido Tabellini (1998), Lobbying by Capital and Labour Over Trade and Labour Market Policies, *European Economic Review* 42, 1295-1316.

[33] Razin, Assaf and Efraim Sadka (1992), *International Migration and International Trade*, NBER Working Paper No. 4230.

[34] Schmidt, Christoph M. (1999), *Persistence and the German Unemployment Problem: Empirical Evidence on German Labour Market Flows*, Discussion Paper No. 31, IZA, Bonn.

[35] Shi, S. and Q. Wen, (1997), Labour Market Search and Capital Accmulation: Some Analytical Results, *Journal of Economic Dynamics and Control* 21, 1747-1776.

[36] Shi, S. and Q. Wen (1999), Labour Market Search and the Dynamic Effects of Taxes and Subsidies, *Journal of Monetary Economics* 43, 457-495.

Table 1: Long-Run Effects of EU Enlargement

Variables, changes in percent *)		(1)	(2)	(3)	(4)	(5)	(6)
P	consumer price index	-0.301	-0.290	-0.296	-0.315	-0.456	-0.155
P^I	investment price index	-0.152	-0.140	-0.140	-0.168	-0.482	-0.260
$\bar{p}$	dom. producer prices	0.047	0.050	0.047	0.045	-0.046	0.115
$\bar{p}^E$	terms of trade with CEECs	7.143	7.151	7.151	7.134	-0.244	-0.210
E^E	exports to CEECs	57.309	57.197	57.205	57.449	2.841	2.411
E	total exports	3.962	3.891	3.897	4.050	2.711	2.114
U^s	unempl.rate, skilled (6)*)	5.935	6.000	6.016	5.853	5.897	5.805
U^u	unempl.rate, unsk. (10)*)	9.903	10.000	10.028	9.778	9.848	11.436
U	unempl.rate, av. (6.668)*)	6.598	6.668	6.686	6.509	6.558	6.861
K	$\sum_j$ capital stocks	0.636	0.545	0.559	0.750	4.045	3.078
$\bar{n}$	number of firms	0.665	0.582	0.597	0.769	3.665	2.758
Y	gross domestic production	0.392	0.329	0.339	0.472	2.873	2.280
w^s	wage rate, skilled	0.616	0.607	0.646	0.626	1.001	2.723
w^u	wage rate, unskilled	0.555	0.589	0.647	0.508	0.894	-9.509
z	government transfers	0.621	0.342	0.568	-0.315	7.251	5.409
ω	average disposable income	0.593	0.479	0.499	0.739	5.267	4.100
C	average consumption	0.896	0.771	0.797	1.051	5.750	4.265
EV	aggr.welfare, % of GDP	0.476	0.411	0.421	0.553	1.561	1.125

Notes: (1): Real unemployment benefits B^U and real tax allowance B^L constant. (2): B^U and B^L both indexed. (3): B^U indexed, real B^L constant. (4): Real B^U, B^L and z constant, wage tax rate endogenous. (5): Proportional immigration. (6): Immigration of low-skilled labour. A bar (e.g. $\bar{p}$) denotes weighted averages of sectoral values. *) Labour market variables in absolute terms, initial values in brackets.

Table 2: Sensitivity Analysis

Bargaining power	$\zeta = .3$		$\zeta = .5$		$\zeta = .7$	
Base case	5.938	0.450	**5.935**	**0.476**	5.933	0.488
Matching elasticity	5.950	0.427	5.947	0.458	5.945	0.472
Armington elasticity	5.892	0.944	5.885	1.001	5.882	1.028
Markup	5.874	1.179	5.861	1.307	5.854	1.370

Notes: In each column, first entry reports unemployment rate of high skilled and second entry aggregate welfare in percent of GDP. Matching elasticity ε reset from .4 to .5. Armington trade elasticities scaled by 1.3. Markups doubled from .15 to .3 on average.

Figure 1a: Unemployment Rate Skilled

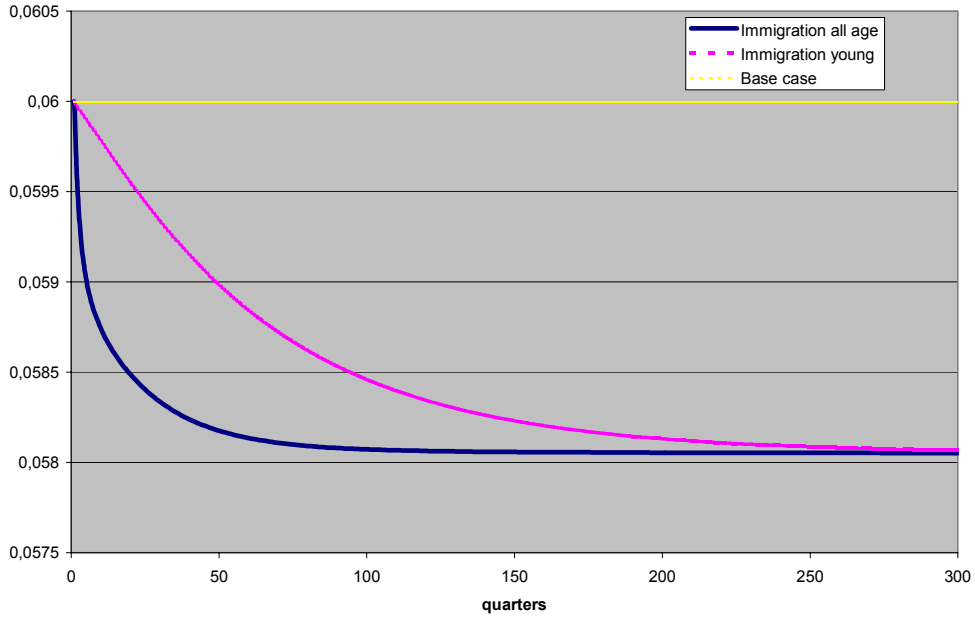

Figure 1b: Unemployment Rate Unskilled

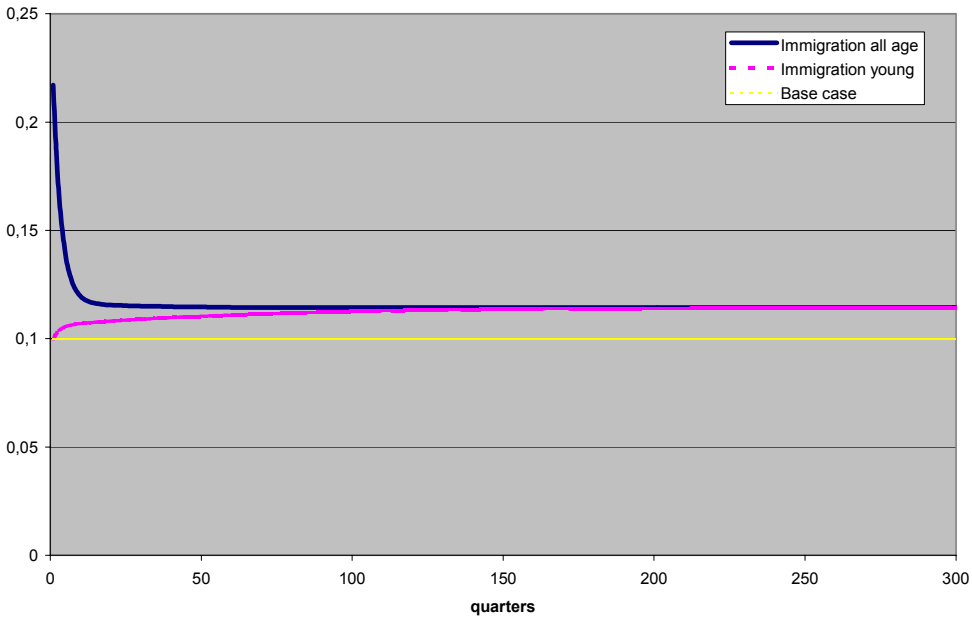

Figure 2: Foreign Debt Dynamics