International Labour Mobility and Unemployment

Michael Bleaney and Mark A. Roberts

University of Nottingham[1]

Key words: *international labour mobility, unions, wage bargaining, globalisation, unemployment.*

JEL Nos: F22, F42, J51, J61.

Abstract

We develop a two-country labour-market model characterised by union wage-bargaining, in which the unemployed incur individual-specific costs of seeking work abroad. We explore the effects on equilibrium unemployment and population in each country of changes in union bargaining strength, taxation, and employers' willingness to hire foreign workers. Weaker unions and lower taxation reduce both local and foreign unemployment and induce net immigration. If unions take account only of local (and not foreign) job opportunities of unemployed workers, symmetrical opening of labour markets to foreigners reduces global unemployment. Unilateral opening induces net immigration, but its impact on unemployment is uncertain.

[1] Postal address: School of Economics, University of Nottingham, Nottingham NG7 2RD.
e-mail: mark.roberts@nottingham.ac.uk.

1. Introduction

Labour-market institutions vary quite markedly across the OECD, and it has often been claimed that these differences are at least partly responsible for differences in economic performance (Blanchard and Wolfers, 2000; Bleaney, 1996; Bruno and Sachs, 1985; Nickell, 1997; Siebert, 1997). Because international labour flows have tended to be small in the modern era, little attention has been paid to the effects on one country of wage-bargaining arrangements in another. This is the issue which we address here. It seems likely that international labour flows will increase in importance in the future, particularly as the majority of OECD countries are members of the European Union, which forbids employment discrimination against nationals of other member states.[2] Indeed in some areas (such as Southeast England) international labour flows are already of the same order of magnitude as inter-regional flows.

There is no body of theoretical work that (to our knowledge) addresses these issues. The impact of monetary union on wage-setting and employment has been considered in a number of papers (e.g. Calmfors, 2001; Cukierman and Lippi, 2001), whilst Sibert and Sutherland (2000) analyse its effect on policy-makers' incentives to undertake labour-market reform. In these models the critical issue is the choice of currencies. In order to focus on issues of international labour mobility independently of countries' choice of currency, we develop a two-country adaptation of a standard flow-equilibrium model of the labour market.

The model includes a social security system which balances in each time period, so that taxes on current wages finance current unemployment benefits. Wages are set as a bargain between firms and utilitarian unions that care about both employed and unemployed members. There is an exogenously given turnover rate of jobs in each country, and job separations result in a spell of unemployment. The equilibrium rate of unemployment is given by the condition that job separations equal new hires. We then introduce the possibility of hiring from abroad. This sets up an interaction between home and foreign labour markets, so that any factor which alters the home

[2] Although cultural and linguistic barriers currently restrict such flows, these barriers are likely to diminish over time. We show that international labour mobility can have a significant impact on the labour-market outcomes of particular institutional arrangements in any one country.

equilibrium will, in general, affect the foreign equilibrium as well. In the steady state net international labour flows are zero.[3]

An assumption of the model that is important for some aspects of the results is that unions are *concerned with the utilities of stay-at-home individuals*. A possible rationale is that part of the fee for joining a local union may include a subscription to a national-level labour institution, so that globally-minded workers may not be inclined to join at all, and opt for outsider status. The two-country aspect of the model is necessary for any explanation of labour inflows and outflows, but renders the model three-dimensional with (i) quit-hire equilibria, (ii) wage determination and (iii) two-country interactions. This results in an unavoidable degree of complexity, which we endeavour to unravel by considering special cases, and by relegating some of the details of the model to Appendices. The symmetric case, with identical parameters in the two countries, reveals the main intuition of the paper: that the global opening up of labour markets reduces long-run unemployment if unions focus only on the local employment prospects of their unemployed members.

The main results are as follows. There are positive spillovers from one country to another – policy changes that reduce unemployment rates in one country also reduce them in the other. There are also important population effects – unemployment-reducing policies induce net immigration. The positive spillovers mean that one country can to some extent free-ride on policy shifts abroad, although only at the expense of a loss of population through emigration. Symmetrical opening of national labour markets to foreign applicants reduces global unemployment, because it improves the employment prospects of internationally mobile workers relative to internationally immobile ones. Since unions only care about the latter, they choose a lower level of wages.

The paper has the following structure. Section 2 presents the model and derives hiring and unemployment rates from a matching equilibrium and a labour market

[3] The reader should note that the paper focuses on aggregate employment and unemployment, and does not address important aspects of labour migration such as its impact on the skill structure or demographic composition of the population.

bargaining solution for each country. Sections 3 and 4 present the basic and further analysis, namely the comparative statics of the full equilibrium. Section 5 restates the main conclusions of the paper.

2. The model

The model is a two-country generalisation of that of Layard and Nickell (1990).[4] The two economies are defined as *domestic* and *foreign*. The domestic and foreign economies have stocks of U and U^* unemployed individuals respectively. [Henceforth, the foreign counterpart is denoted by an *asterisk*.] There are assumed to be individual-specific costs of moving to another country, which only some of the unemployed choose to pay. Of the U home-based individuals, the proportion, $1-\lambda$, would look only at home for work, while the proportion, λ, would seek jobs both at home and abroad. We may refer to these as *type-1* and *type-2* individuals, because they choose to seek work respectively in one and two countries. There are also type-1 and type-2 individuals abroad, in the respective proportions, $1-\lambda^*$, λ^*, of the foreign stock of unemployment. Although for simplicity we initially treat λ and λ^* as exogenous, at a later stage of the analysis we shall allow them to be determined endogenously (i.e. with each individual choosing his/her type in order to maximise expected utility).

The quit or turnover rate of employment (δ) is assumed exogenous and identical in each country. Workers cannot move directly from one job to another, either to one at home or to one abroad, without a spell of unemployment. Those who leave employment become unemployed in the same country. The unemployed migrate abroad only if they are offered employment in the other country. Shifts in the distribution of population between the two countries can therefore only occur as a result of an imbalance between countries in job offers to the foreign unemployed. The respective labour populations, employment levels and numbers of quitters for each country are M and M^*, $M-U$ and M^*-U^* and $\delta(M-U)$ and $\delta(M^*-U^*)$.

[4] These authors use this structure in order to explore the possibility of different unemployment effects from bargaining over employment as well as wages.

In a matching equilibrium where quits equal new hires in each country:

$$\delta(M-U)=\theta_D U+\theta_F \lambda^* U^*, \tag{1}$$

$$\delta(M^*-U^*)=\theta_D{}^* U^*+\theta_F{}^* \lambda U \tag{1*}$$

Consider equation (1). At any moment, $\delta(M-U)$ of the workers employed in the domestic labour market quit due to exogenous factors. Simultaneously, the domestic labour market gets U job applications from home-based unemployed individuals of both types and $\lambda^* U^*$ job applications from type-2 unemployed individuals who are based abroad. A proportion, θ_D, of the home-based applicants are accepted to become re-employed at home, while a proportion, θ_F, of the foreign-based applicants are accepted, which involves relocation to another country. The possibility that $\theta_D \neq \theta_F$ reflects discrimination, and generally we might expect a preference for home-based workers, $\theta_D > \theta_F$.[5] The same reasoning applies symmetrically to equation (1*).

We use the following definitions:

$$\theta_D \equiv \theta, \qquad \theta_F \equiv \eta\theta \qquad \text{where} \quad 0 \leq \eta \leq 1 \tag{2}$$

$$\theta_D{}^* \equiv \theta^* \qquad \theta_F{}^* \equiv \eta^* \theta^* \quad \text{where} \quad 0 \leq \eta^* \leq 1 \tag{2*}$$

so that we can refer to η and η^* as the (non-)discrimination factors in each country, which we regard as exogenous. The parameters θ and θ^* are the endogenous acceptance rates for local job applicants in each country. Increasing discrimination against individuals based abroad is captured by a declining η. Although the value of η reflects the decisions of individual firms, government policies may also play a role (e.g. by altering the legal status of employees with foreign nationality). Substitution from (2) and (2*) into (1) and (1*) yields:

$$\delta(M-U)=\theta(U+\eta\lambda^* U^*) \tag{3}$$

$$\delta(M^*-U^*)=\theta^*(U^*+\eta^*\lambda U) \tag{3*}$$

[5] This is not necessarily discrimination based on country of origin, but on country of recent residence, since a home-based foreign national would be favoured over a domestic national returning from abroad.

The same equations may also be expressed in terms of a relationship between the acceptance rates of job applications (θ, θ*), relative populations and unemployment rates at home and abroad (u, u*):

$$\theta = \frac{\delta(1-u)}{u + \eta\lambda^* u^* M^*/M} \tag{4}$$

$$\theta^* = \frac{\delta(1-u^*)}{u^* + \eta^* \lambda u M/M^*} \tag{4*}$$

Higher unemployment at home implies a lower individual acceptance rate (θ), because of greater competition for jobs and fewer job openings (as a result of lower employment), while higher unemployment abroad has a negative effect by increasing job competition ***alone***. The home unemployed's probability of being offered a job at home (θ) is increasing in the job turnover rate (δ), and decreasing in the extent of non-discrimination against foreign applicants (η), the proportion of foreign unemployed seeking jobs at home (λ*), the respective unemployment rates (u, u*) and the population ratio (M^*/M).

So far we have only imposed the condition that quits equal hires in each country. This does not imply equality of immigration and emigration, so relative populations can still change. Through this effect, net immigration will influence equations (4) and (4*). A full steady-state equilibrium requires zero net immigration. Consider the effect of reduced discrimination against foreigners (a rise in η). *Ceteris paribus*, it will increase the proportion of domestic job opportunities taken by foreigners, pushing domestic unemployment up and foreign unemployment down, and setting up a net population flow from abroad to home. Net international migration will then continue until the following condition for the equality of immigration and emigration is re-established:

$$\eta\theta\lambda^* U^* = \eta^*\theta^*\lambda U \tag{5}$$

This states that the numbers leaving/entering the two countries are the same.

Equation (5) can also be expressed in terms of relative population,

$$\frac{M^*}{M} = \frac{\eta^*\theta^*\lambda u}{\eta\theta\lambda^* u^*}, \tag{6}$$

which can be used to eliminate relative populations from equations (4). The steady-state acceptance rates for local job applicants may then be expressed as:

$$\theta = \delta\left(u^{-1} - 1\right) - \eta^* \lambda \theta^* \qquad \text{subject to } 0 < \theta \leq 1 \qquad (7)$$

$$\theta^* = \delta\left(u^{*-1} - 1\right) - \eta \lambda^* \theta \qquad \text{subject to } 0 < \theta^* \leq 1 \qquad (7^*)$$

Equations (6), (7) and (7*) reflect the three steady-state conditions: the quit-hire equilibrium in each country, and the zero net migration condition. On the other hand, they are not behavioural, because they do not take into account the impact of the employment prospects of the unemployed on the wage bargain, which we discuss below. In equations (7) and (7*) there is negative interaction between the two countries' acceptance rates for the home unemployed (for given unemployment rates) in the steady state because of the endogeneity of the relative size of the two economies. Since unemployment rates are given, a higher foreign acceptance rate effectively means a higher share of population and of total world unemployment in the foreign country. This implies more foreign applications for jobs in the home country, and therefore a lower acceptance rate for home applicants.

Solving (7) and (7*) simultaneously gives

$$\theta = \frac{\delta}{1 - \eta\eta^* \lambda\lambda^*}\left(\left(u^{-1} - 1\right) - \eta^* \lambda\left(u^{*-1} - 1\right)\right), \qquad \text{subject to } 0 < \theta \leq 1$$

$$\frac{\partial \theta}{\partial u} < 0, \qquad \frac{\partial \theta}{\partial u^*} > 0 \quad \textbf{\textit{if}} \quad \eta^* \lambda > 0 \qquad (8)$$

$$\theta^* = \frac{\delta}{1 - \eta\eta^* \lambda\lambda^*}\left(\left(u^{*-1} - 1\right) - \eta\lambda^*\left(u^{-1} - 1\right)\right) \qquad \text{subject to } 0 < \theta^* \leq 1$$

$$\frac{\partial \theta^*}{\partial u^*} < 0, \qquad \frac{\partial \theta^*}{\partial u} > 0 \quad \textbf{\textit{if}} \quad \eta\lambda^* > 0 \qquad (8^*)$$

A rise in domestic unemployment lowers the domestic acceptance rate, as one might expect, but a rise in the foreign unemployment rate - in also lowering the foreign hiring rate - will raise the domestic acceptance rate for the reason given immediately above.

An interesting comparison is with the case where labour is immobile, because $\eta^* = 0$ or $\lambda = 0$, in which case $\theta = \delta\left(u^{-1} - 1\right)$. In the mobile labour case, because $\eta^* \lambda > 0$,

the negative effect of own-unemployment on the hire rate is of a greater magnitude, and there is a positive effect of foreign unemployment. In symmetric equilibrium $\eta = \eta^*$, $\lambda = \lambda^*$, $u = u^*$, and $\theta = \frac{\delta}{1+\eta\lambda}\left(u^{-1} - 1\right)$, so there will be a lower acceptance rate for local job applicants than in the immobile case for the same level of unemployment.

The relationships explored above merely reflect the steady-state conditions connecting the levels of unemployment and population and the employment prospects of the local unemployed in the two countries. In standard models of the labour market, however, unemployment affects the wage bargain, which then feeds back to the unemployment rate. For example, in the efficiency wage model of Shapiro and Stiglitz (1984), if globalisation implied longer spells of employment for the local unemployed, that would lower the efficiency wage and reduce unemployment. This is the question to which we now turn.

We model the wage along the lines of the bargaining model of Layard and Nickell (1990). We assume that there is one union per firm, and that unions care about their unemployed as well as their employed members, but only their type-1 members who seek work only at home. We are effectively assuming that stay-at-home individuals have an insider status with their firm**.** This last assumption also makes the model considerably more tractable. It may be justified on the grounds that a worker who moves abroad is moving out of the union's jurisdiction, and so foreign job opportunities may not be taken into account in the union's decisions.

The details of the wage bargain are somewhat laborious and are discussed in Appendix 1. Here we merely give an outline of it. There is Nash bargaining between the union and the firm, and the parameter ϕ $(1 \le \phi \le \infty)$ is a measure of the union's bargaining strength, which is increasing in ϕ. Unemployment benefits are financed by a proportional tax on wages (τ), which is set so that the tax just finances the benefits. Consequently τ is a measure of the generosity of the welfare system. The unions have a discount rate of *r*, and their bargaining surplus is equal to one minus the unemployment rate multiplied by the difference between the expected lifetime utilities

of currently being employed and of currently being unemployed. This difference in expected lifetime utilities depends on (1) the difference between the post-tax wage and unemployment benefits, (2) the discount rate, and (3) the per-period probability of switching to the other state, which in turn is influenced by the job separation rate (δ) and the job offer rate for the unemployed (θ). Essentially, if the difference in expected lifetime utilities gets smaller (larger), the unions press for a higher (lower) wage, and unemployment increases (decreases). The parameters, ϕ and ϕ *, are measures of union bargaining strength with lowest possible values at unity, which is interpreted as the case of a competitive labour market.

The outcome of the wage bargain described in Appendix 1 may be expressed in terms of the unemployment rates in the two countries:

$$u = \frac{1+r}{\left(\frac{1}{\tau}-1\right)\left(\frac{r+\delta+\theta}{\phi}+1-\delta-\theta\right)+1+r}, \qquad \frac{\partial u}{\partial \theta} \geq 0 \text{ for } \phi \geq 1 \tag{9}$$

$$u^* = \frac{1+r}{\left(\frac{1}{\tau^*}-1\right)\left(\frac{r+\delta+\theta^*}{\phi^*}+1-\delta-\theta^*\right)+1+r}, \qquad \frac{\partial u^*}{\partial \theta^*} \geq 0 \text{ for } \phi^* \geq 1 \tag{9*}$$

Equation (9) gives the unemployment rate for a *given* acceptance rate (θ), and shows that increases in taxes, union strength or the acceptance rate all increase unemployment. Thus greater union bargaining strength or higher taxes increase wages and unemployment, as one might expect. In the special case where unions have no bargaining power at all ($\phi = 1$), the unemployment rate is just equal to the tax rate. A higher acceptance rate implies higher wages and unemployment because the reduced average length of unemployment spells cuts the cost of being in the unemployed state.

Equations (8), (8*), (9) and (9*) represent four separate relationships between the acceptance and unemployment rates in each country that must each hold in equilibrium. Equations (8) and (8*) determine how unemployment rates affect acceptance rates through labour market flows, and equations (9) and (9*) show how acceptance rates influence unemployment through the wage bargain. These four

equations must therefore be solved jointly to determine the unemployment and acceptance rates. First, equations (8) and (8*) can be used to eliminate the acceptance rates from (9) and (9*). This yields two equations that express each country's unemployment rate in terms of exogenous variables and the other country's unemployment rate:

$$u = \frac{(1-\eta\eta^*\lambda\lambda^*)\phi\tau(1+r)+(1-\tau)(\phi-1)\delta}{(1-\eta\eta^*\lambda\lambda^*)\big((1-\tau)\big(r+\delta+(1-\delta)\phi\big)+\phi\tau(1+r)\big)+(1-\tau)(\phi-1)\delta\big(1+\eta^*\lambda(u^{*-1}-1)\big)} \tag{10}$$

$$u^* = \frac{(1-\eta\eta^*\lambda\lambda^*)\phi^*\tau^*(1+r)+(1-\tau^*)(\phi^*-1)\delta}{(1-\eta\eta^*\lambda\lambda^*)\big((1-\tau^*)\big(r+\delta+(1-\delta)\phi^*\big)+\phi^*\tau^*(1+r)\big)+(1-\tau^*)(\phi^*-1)\delta\big(1+\eta\lambda^*(u^{-1}-1)\big)} \tag{10*}$$

There is a similar pair of equations relating the acceptance rates in each country to each other:

$$\theta = \frac{\big(\tau^{-1}-1\big)\left(\frac{r+\delta}{\phi}+1-\delta\right)-\eta^*\lambda\big((\tau^{*-1}-1\big)\left(\frac{r+\delta+\theta^*}{\phi^*}+1-\delta-\theta^*\right)}{\big(1-\eta\eta^*\lambda\lambda^*\big)\left(\frac{1+r}{\delta}\right)+\big(\tau^{-1}-1\big)\left(1-\frac{1}{\phi}\right)} < 1 \tag{11}$$

$$\theta^* = \frac{\big(\tau^{*-1}-1\big)\left(\frac{r+\delta}{\phi^*}+1-\delta\right)-\eta\lambda^*\big((\tau^{-1}-1\big)\left(\frac{r+\delta+\theta}{\phi}+1-\delta-\theta\right)}{\big(1-\eta\eta^*\lambda\lambda^*\big)\left(\frac{1+r}{\delta}\right)+\big(\tau^{*-1}-1\big)\left(1-\frac{1}{\phi^*}\right)} < 1 \tag{11*}$$

A special case arises if $\theta = 1$ or $\theta^* = 1$, but neither is economically realistic, since they imply that all the unemployed are guaranteed a job offer in the next period.

3. Analysis

We now analyse the comparative statics of the model, based on equations (10) and (10*). Equation (10) defines the unemployment rate in the home country in terms of domestic variables, foreign discrimination against domestic job applicants, the proportion of type-2 workers in the foreign labour market, and the foreign unemployment rate. Thus other foreign variables which do not appear directly in (10)

(such as the tax rate or union bargaining strength) affect home unemployment only through foreign unemployment, and *vice versa*.

The positive interdependence of the countries' unemployment rates

Equations (10) and (10*) show a positive interdependence between the two countries' unemployment rates. In other words, if exogenous variables that do not appear in equation (10) raise foreign unemployment, there is a spill-over effect that also increases unemployment in the home country. A particular case is that $u^* \to 0$ as $u \to 0$ if $\eta^* \lambda > 0$, and $u \to 0$ as $u^* \to 0$ if $\eta\lambda^* > 0$. What is really happening in this case is that, as foreign unemployment tends to zero, emigration from that country also tends to zero, but domestic migration into the foreign country will persist - for as long as $\eta^* \lambda > 0$ - until there are no unemployed in the domestic country.

In general, the effect of unemployment in one country on unemployment in the other is:

$$\frac{\partial u}{\partial u^*} = \frac{(1-\tau)(\phi-1)\delta\eta^*\lambda\left((1-\eta\eta^*\lambda\lambda^*)\phi\tau(1+r)+(1-\tau)(\phi-1)\delta\right)u^{*-2}}{\left((1-\eta\eta^*\lambda\lambda^*)\left((1-\tau)\left(r+\delta+(1-\delta)\phi\right)+\phi\tau(1+r)\right)+(1-\tau)(\phi-1)\delta\left(1+\eta^*\lambda(u^{*-1}-1)\right)\right)^2} > 0$$

(12)

$$\frac{\partial u^*}{\partial u} = \frac{(1-\tau^*)(\phi^*-1)\delta\eta\lambda^*\left((1-\eta\eta^*\lambda\lambda^*)\phi^*\tau^*(1+r)+(1-\tau^*)(\phi^*-1)\delta\right)u^{-2}}{\left((1-\eta\eta^*\lambda\lambda^*)\left((1-\tau^*)\left(r+\delta+(1-\delta)\phi^*\right)+\phi^*\tau^*(1+r)\right)+(1-\tau^*)(\phi^*-1)\delta\left(1+\eta\lambda^*(u^{-1}-1)\right)\right)^2} > 0$$

(12*)

The effects of union power and tax/benefit rates on unemployment

The effects of domestic variables on domestic unemployment are much as in a closed-economy model. As would be expected, increased union power raises unemployment in each country,

$$\frac{\partial u}{\partial \phi} = \frac{(1-\tau)\tau(1+r)(1-\eta\eta^*\lambda\lambda^*)\left((1-\eta\eta^*\lambda\lambda^*)(r+\delta)+\delta\eta^*\lambda(u^{*-1}-1)\right)}{\left((1-\eta\eta^*\lambda\lambda^*)\left((1-\tau)\left(r+\delta+(1-\delta)\phi\right)+\phi\tau(1+r)\right)+(1-\tau)(\phi-1)\delta\left(1+\eta^*\lambda(u^{*-1}-1)\right)\right)^2} > 0$$

(13)

$$\frac{\partial u^*}{\partial \phi^*} = \frac{(1-\tau^*)\tau^*(1+r)(1-\eta\eta^*\lambda\lambda^*)\left((1-\eta\eta^*\lambda\lambda^*)(r+\delta)+\delta\eta\lambda(u^{-1}-1)\right)}{\left((1-\eta\eta^*\lambda\lambda^*)\left((1-\tau^*)\left(r+\delta+(1-\delta)\phi^*\right)+\phi^*\tau^*(1+r)\right)+(1-\tau^*)(\phi^*-1)\delta\left(1+\eta\lambda^*(u^{-1}-1)\right)\right)^2} > 0$$

(13*)

So also do higher tax/benefit rates:

$$\frac{\partial u}{\partial \tau} = \frac{\phi(1+r)(1-\eta\eta^*\lambda\lambda^*)\left((1-\eta\eta^*\lambda\lambda^*)(r+\delta)+(\phi-1)\eta^*\lambda(u^{*-1}-1)\right)}{\left((1-\eta\eta^*\lambda\lambda^*)\left((1-\tau)\left(r+\delta+(1-\delta)\phi\right)+\phi\tau(1+r)\right)+(1-\tau)(\phi-1)\delta\left(1+\eta^*\lambda(u^{*-1}-1)\right)\right)^2} > 0$$

(14)

$$\frac{\partial u^*}{\partial \tau^*} = \frac{\phi^*(1+r)(1-\eta\eta^*\lambda\lambda^*)\left((1-\eta\eta^*\lambda\lambda^*)(r+\delta)+(\phi^*-1)\eta\lambda(u^{-1}-1)\right)}{\left((1-\eta\eta^*\lambda\lambda^*)\left((1-\tau)\left(r+\delta+(1-\delta)\phi^*\right)+\phi^*\tau^*(1+r)\right)+(1-\tau^*)(\phi^*-1)\delta\left(1+\eta\lambda^*(u^{-1}-1)\right)\right)^2} > 0$$

(14*)

Equations (10) and (10*) show that each of these policies has positive spill-over effects abroad, as

$$\frac{\partial u^*}{\partial \tau} = \frac{\partial u^*}{\partial u}\frac{\partial u}{\partial \tau} > 0\,, \qquad \frac{\partial u^*}{\partial \phi} = \frac{\partial u^*}{\partial u}\frac{\partial u}{\partial \phi} > 0 \tag{15}$$

$$\frac{\partial u}{\partial \tau^*} = \frac{\partial u}{\partial u^*}\frac{\partial u^*}{\partial \tau^*} > 0\,, \qquad \frac{\partial u}{\partial \phi^*} = \frac{\partial u}{\partial u^*}\frac{\partial u^*}{\partial \phi^*} > 0 \tag{15*}$$

Thus higher taxes or greater union power in one country also raise unemployment in the other country. The concavity of u in u^* in equation (10) and vice versa in equation (10*) imply that policy effects are greater at home than abroad.[6]

The effect of discrimination on unemployment

The signs of the single-country responses of unemployment responses to the discrimination and mobility variables are complex, since they appear in both (10) and (10*). An interesting – and, notwithstanding, tractable – case is that of symmetry, where the two countries have identical parameters. Setting $\tau = \tau^*, \phi = \phi^*$, $\eta = \eta^*$ and $\lambda = \lambda^*$ in equations (10) and (10*) gives

$$u = u^* = \frac{(1+\eta\lambda)\phi\tau(1+r)+(1-\tau)(\phi-1)\delta}{(1+\eta\lambda)\left((1-\tau)\left(r+\delta+(1-\delta)\phi\right)+\phi\tau(1+r)\right)+(1-\tau)(\phi-1)\delta} \tag{16}$$

[6] This implies $\frac{\partial u^*}{\partial \phi} < \frac{\partial u}{\partial \phi}$, $\frac{\partial u^*}{\partial \tau} < \frac{\partial u}{\partial \tau}$ and $\frac{\partial u}{\partial \phi^*} < \frac{\partial u^*}{\partial \phi^*}$, $\frac{\partial u}{\partial \tau^*} < \frac{\partial u^*}{\partial \tau^*}$.

where

$$\frac{\partial u}{\partial \eta} = \frac{\partial u^*}{\partial \eta} = \frac{-\lambda(1-\tau)^2(\phi-1)\delta\left(r+\delta+(1-\delta)\phi\right)}{\left((1+\eta\lambda)\left((1-\tau)\left(r+\delta+(1-\delta)\phi\right)+\phi\tau(1+r)\right)+(1-\tau)(\phi-1)\delta\right)^2} < 0 \quad (17)$$

In other words an opening of labour markets to foreign applicants is unambiguously unemployment-reducing.

Likewise, a symmetrical rise in the proportion of type-2s is employment-reducing:

$$\frac{\partial u}{\partial \lambda} = \frac{\partial u^*}{\partial \lambda} = \frac{-\eta(1-\tau)^2(\phi-1)\delta\left(r+\delta+(1-\delta)\phi\right)}{\left((1+\eta\lambda)\left((1-\tau)\left(r+\delta+(1-\delta)\phi\right)+\phi\tau(1+r)\right)+(1-\tau)(\phi-1)\delta\right)^2} < 0 \quad (18)$$

The reason for these results can be ascertained by looking at the symmetric case for the acceptance rate from equations (11) and (11*):

$$\theta = \theta^* = \frac{r+\delta+(1-\delta)\phi}{\left(\frac{(1+r)(1+\eta\lambda)\tau}{\delta(1-\tau)}+1\right)\phi-1} \quad (19)$$

It is clear that a reduction in discrimination will reduce the acceptance rate of the local unemployed, as will an increase in the proportion of type-2 individuals, union strength and the tax/benefit rate. In the case of discrimination, we have:

$$\frac{\partial \theta}{\partial \eta} = \frac{\partial \theta^*}{\partial \eta} = \frac{-\left(r+\delta+(1-\delta)\phi\right)}{\left(\left(\frac{(1+r)(1+\eta\lambda)\tau}{\delta(1-\tau)}+1\right)\phi-1\right)^2}\left(\frac{(1+r)\phi\lambda\tau}{\delta(1-\tau)}\right) < 0 \quad (20)$$

The result that reducing the discrimination against foreign-based - necessarily type-2 - individuals lowers the unemployment rate is purely the effect of the special status of type-1 members within labour unions. Clearly, if global wage rates and unemployment stay the same, the lifetime utility of the average unemployed person must be unchanged. If, however, there is less discrimination against foreign job applicants, type-2 workers enjoy greater lifetime utility at the expense of type-1 workers. Unions only consider type-1 workers' utility, so globalisation induces wage moderation and lower unemployment.

In addition, we find:

$$\frac{\partial\theta}{\partial\lambda}=\frac{\partial\theta^*}{\partial\lambda}=\frac{-\left(r+\delta+(1-\delta)\phi\right)}{\left(\left(\frac{(1+r)(1+\eta\lambda)\tau}{\delta(1-\tau)}+1\right)\phi-1\right)^2}\left(\frac{(1+r)\phi\eta\tau}{\delta(1-\tau)}\right)<0 \tag{21}$$

$$\frac{\partial\theta}{\partial\phi}=\frac{\partial\theta^*}{\partial\phi}=\frac{-\left(1-\delta+(r+\delta)\left(\frac{(1+r)(1+\eta\lambda)\tau}{\delta(1-\tau)}+1\right)\right)}{\left(\left(\frac{(1+r)(1+\eta\lambda)\tau}{\delta(1-\tau)}+1\right)\phi-1\right)^2}<0 \tag{22}$$

$$\frac{\partial\theta}{\partial\tau}=\frac{\partial\theta^*}{\partial\tau}=\frac{-\left(r+\delta+(1-\delta)\phi\right)}{\left(\left(\frac{(1+r)(1+\eta\lambda)\tau}{\delta(1-\tau)}+1\right)\phi-1\right)^2}\left(\frac{(1+r)\phi\lambda}{\delta(1-\tau)^2}\right)<0 \tag{23}$$

The effects of union strength and taxation on global unemployment under the symmetric assumption mirror the usual results from a one-country model.

4. Further analysis

Relative population

In this model, shifts in parameters can have marked effects on the distribution of population between the two countries. Relative populations do not appear explicitly in equations (10) and (10*). Where there is international mobility, equations (6), (7) and (7*) can be solved endogenously to give

$$M/M^*=\frac{\eta\left(u^{-1}-1-\eta^*\lambda(u^{*-1}-1)\right)u^*}{\eta^*\left(u^{*-1}-1-\eta\lambda^*(u^{-1}-1)\right)u} \tag{24}$$

This determines the population ratio as a function of unemployment rates and migration variables in the two countries. Union bargaining strength and tax rates will affect the population ratio through their effect on unemployment rates.

Relative labour market reform in one country should raise its relative population in the steady state**.** Clearly, equation (24) implies $\frac{\partial(M/M^*)}{\partial u}<0$ and $\frac{\partial(M/M^*)}{\partial u^*}>0$.

Furthermore, at least where there is approximate symmetry,

$$\left|\frac{\partial(M/M^*)}{\partial u}\right| \approx \frac{\partial(M/M^*)}{\partial u^*}$$

$$\frac{d(M/M^*)}{d\phi} = \frac{\partial(M/M^*)}{\partial u}\frac{\partial u}{\partial \phi} + \frac{\partial(M/M^*)}{\partial u^*}\frac{\partial u^*}{\partial \phi} < 0 \qquad (25)$$

$$\frac{d(M/M^*)}{d\phi^*} = \frac{\partial(M/M^*)}{\partial u^*}\frac{\partial u^*}{\partial \phi^*} + \frac{\partial(M/M^*)}{\partial u}\frac{\partial u}{\partial \phi^*} > 0 \qquad (25^*)$$

$$\frac{d(M/M^*)}{d\tau} = \frac{\partial(M/M^*)}{\partial u}\frac{\partial u}{\partial \tau} + \frac{\partial(M/M^*)}{\partial u^*}\frac{\partial u^*}{\partial \tau} < 0 \qquad (26)$$

$$\frac{d(M/M^*)}{d\tau^*} = \frac{\partial(M/M^*)}{\partial u^*}\frac{\partial u^*}{\partial \tau^*} + \frac{\partial(M/M^*)}{\partial u}\frac{\partial u}{\partial \tau^*} > 0 \qquad (26^*)$$

Relative population in the domestic country is decreasing in its own union power and level of welfare provision and increasing in these same variables pertaining to the foreign country. Other things being equal, the model predicts net immigration in response to policy shifts in a laissez-faire direction. It also implies that a country which is concerned about population flows may wish to react to policy changes in foreign countries that induce domestic workers to move abroad. A shift towards more competitive labour markets in one country may tempt other countries to move in the same direction in response to the incipient loss of population.

The effect of discrimination on relative population is slightly more complex, because this variable appears in equation (24). There are *direct* effects, and *indirect* effects through unemployment. The direct effects are clearly signed as follows:

$$\frac{\partial(M/M^*)}{\partial \eta} > 0, \qquad \frac{\partial(M/M^*)}{\partial \eta^*} < 0,$$

We conjecture

$$\frac{\partial u}{\partial \eta} < \frac{\partial u^*}{\partial \eta}\left[< 0\right] \text{ and } \frac{\partial u^*}{\partial \eta^*} < \frac{\partial u}{\partial \eta^*}\left[< 0\right]$$

so that the indirect effects should reinforce the direct effects to give

$$\frac{d(M/M^*)}{d\eta} = \frac{\partial(M/M^*)}{\partial \eta} + \frac{\partial(M/M^*)}{\partial u}\frac{\partial u}{\partial \eta} + \frac{\partial(M/M^*)}{\partial u^*}\frac{\partial u^*}{\partial \eta} > 0, \qquad (27)$$

$$\frac{d(M/M^*)}{d\eta^*} = \frac{\partial(M/M^*)}{\partial \eta^*} + \frac{\partial(M/M^*)}{\partial u}\frac{\partial u}{\partial \eta^*} + \frac{\partial(M/M^*)}{\partial u^*}\frac{\partial u^*}{\partial \eta^*} < 0 \qquad (27^*)$$

Thus a reduction in discrimination (an increase in η) results in immigration.

Endogenising the proportions of type-2 agents (λ, λ^*)

All the results above are obtained by fixing the proportion of type-2 agents. We now relax this assumption and allow the proportion to be determined endogenously. Each worker is assumed to have an individual-specific cost of searching for employment abroad, and to pay that cost only if being a type-2 individual yields a higher expected lifetime utility than being a type-1 individual. In general, a shift in one of the exogenous parameters may induce some individuals to shift type. We show in Appendix 2 that endogenising λ and λ^* tends to reinforce the results derived above, essentially because these two variables, respectively, are positively related to η^* and η.

In other words:

$$\frac{\partial \lambda}{\partial \tau} < 0 \tag{28}$$

$$\frac{\partial \lambda}{\partial \phi} < 0 \text{ [7]} \tag{29}$$

$$\frac{\partial \lambda}{\partial \eta} > 0 \text{ [8]} \tag{30}$$

Higher taxes reduce the incentive to seek a job abroad and thus the proportion of type-2s. Increased union power also reduces the proportion of type-2s, because the probability of an acceptance, $\eta\theta$, falls proportionally more than the rise in the income differential from finding employment. Finally, a fall in discrimination (a rise in η) raises the proportion of type-2s, because θ falls but with an elasticity less than one, so that $\eta\theta$ rises.

The derivative signs in (28)-(30), along with the response $\partial u/\partial \lambda < 0$ in equation (18), imply that the responses in (13), (14) and (17) are amplified:

[7] If $\tau = 0$, $\gamma^* = \eta\left((r+\delta)\phi^{-1} + 1 - \delta\right)$, while as τ increases the relative value of the negative coefficient from ϕ in the denominator increases.

[8] If $\phi = 1$, $\gamma^* = \dfrac{\delta(1-\tau)}{(1+r)\tau}\left(\dfrac{\eta}{1+\lambda\eta}\right)$, while as ϕ increases the relative value of the negative coefficient from η in the denominator increases.

$$\frac{\partial u}{\partial \tau} + \frac{\partial u}{\partial \lambda}\frac{\partial \lambda}{\partial \tau} > \frac{\partial u}{\partial \tau}\Big|_{\lambda=\bar{\lambda}} > 0$$

$$\frac{\partial u}{\partial \phi} + \frac{\partial u}{\partial \lambda}\frac{\partial \lambda}{\partial \phi} > \frac{\partial u}{\partial \phi}\Big|_{\lambda=\bar{\lambda}} > 0$$

$$\frac{\partial u}{\partial \eta} + \frac{\partial u}{\partial \lambda}\frac{\partial \lambda}{\partial \eta} < \frac{\partial u}{\partial \eta}\Big|_{\lambda=\bar{\lambda}} < 0$$

Endogenous mobility generally amplifies the effects of policy changes.

5. Conclusions

This paper has addressed some macroeconomic issues in relation to the topical question of international labour mobility. We have examined a two-country model in which stay-at-home workers have a form of insider status with labour unions. In this sense the unions are nationally rather than globally oriented. The exogenous variables in the model are union bargaining strength, tax rates, the degree of discrimination against foreign job applicants, and the proportion of internationally mobile workers. The endogenous variables are wage rates, unemployment rates, and the relative working populations of the two countries. Union bargaining strength and tax rates have the usual effects on unemployment in the home country, but also have spill-over effects on the foreign country, moving unemployment in the same direction as in the home country. As well as increasing unemployment in both countries, stronger unions and higher taxes tend to be associated with a movement of population to the foreign country. If a country introduces unemployment-reducing reforms, a neighbouring country benefits from some reduction in its own unemployment rate, but also suffers net emigration.

Opening the home labour market unilaterally to applicants from the foreign country induces net immigration, but it is not possible in general to sign the effects on the home unemployment rate. We have investigated a symmetric model with identical parameters in both countries. A symmetrical opening of labour markets to foreign applicants reduces unemployment in each country, because nationally oriented unions set wages lower in response to the greater expected length of unemployment spells of the internationally immobile workers that they represent. They fail to take account of

the compensating reduction in the expected length of unemployment spells of internationally *mobile* home workers, as a consequence of the opening of foreign labour markets.

The heterogeneous nature of the population is captured in the fact that some, but not all, individuals are open to international job offers. They may choose an outsider status if local union membership also involves a commitment to national union affiliation. The globalisation of labour markets, in increasing the options open to internationally mobile individuals relative to immobile ones, is analogous to a weakening of insider power relative to that of outsiders, and brings about commensurate employment benefits.

References

Blanchard, O.J. and J. Wolfers. 2000. The role of shocks and institutions in the rise of European unemployment: the aggregate evidence, *Economic Journal* 110, C1-C33.

Bleaney, M.F. 1996. Central bank independence, wage-bargaining structure, and macroeconomic performance in OECD countries, *Oxford Economic Papers* 48, 20-38.

Bruno, M. and J.D. Sachs. 1985. *Economics of Worldwide Stagflation*, Oxford: Basil Blackwell.

Calmfors, L. 2001. Unemployment, labour market reform and monetary union, *Journal of Labor Economics* 19, 265-89.

Cukierman, A. and F. Lippi. 2001. Labour markets and monetary union: a strategic analysis, *Economic Journal* 111, 541-65.

Layard, R. and Nickell, S. 1990. Is unemployment higher if unions bargain over employment? *Quarterly Journal of Economics* 105, 773-787.

Nickell, S. 1997. Unemployment and labor market rigidities: Europe versus North America, *Journal of Economic Perspectives* 11 (3), 55-74.

Nickell, S. and Andrews, M. 1983. Unions, real wages and employment in Britain, *Oxford Economics Papers* 35 (Supplement), 183-206.

Shapiro, C. and J.E. Stiglitz. 1984. Equilibrium unemployment as a worker discipline device, *American Economic Review* 74, 433-444

Sibert, A. and A. Sutherland. 2000. Monetary union and labor market reform, *Journal of International Economics* 51, 421-35.

Siebert, H. 1997. Labor market rigidities: at the root of unemployment in Europe, *Journal of Economic Perspectives* 11 (3), 37-54.

Appendix 1 – The wage bargain

The lifetime utilities of varies states

Define the expected lifetime utility of an employed and unemployed worker respectively as V_E and V_U. These expected lifetime utilities take account not only of likely transitions in and out of employment but also of possible transitions from unemployment to employment in the other country. The expected utility at time *t* of the employed of type $i = 1,2$ in firm z who expects to be of type $j = 1,2$ in the next period (whether $i = j$ or $i \neq j$) is:

$$V^i_{EZ,t} = (1-\tau)W_{Z,t} + \frac{1}{1+r}\left((1-\delta)V^j_{EZ,t+1} + \delta V^j_{UZ,t+1}\right) \qquad i = 1,2 \quad j = 1,2 \qquad \text{(A1)}$$

where $W_{Z,t}$ is the wage currently paid by firm z, τ is the labour income tax rate, $1-\delta$ is the probability of remaining employed in firm z in the next period and δ is the probability of a spell of unemployment. For the unemployed of types 1 and 2 respectively, we obtain:

$$V^1_{UZ,t} = B_t + \frac{1}{1+r}\left(\theta V^j_{E,t+1} + (1-\theta)V^j_{UZ,t+1}\right), \quad \text{if } i = 1 \qquad \text{(A2.1)}$$

$$V^2_{UZ,t} = B_t + \frac{1}{1+r}\left(\theta V^j_{E,t+1} + \eta^*\theta^* V^j_{E,t+1} + (1-\theta-\eta^*\theta^*)V^j_{UZ,t+1} - C\right), \text{ if } i = 2 \qquad \text{(A2.2)}$$

where B_t is an *untaxed* unemployment benefit and, to recap, θ is the probability of being rehired by some firm at home in the next period and $\eta^*\theta^*$ is the probability of being hired abroad. Although searching in both countries increases the probability of a home-based individual finding employment, this must be weighed against the extra cost of searching abroad, C (which is net of a union membership fee if the internationally minded choose outsider status).

Finally, equation (A1) and the symmetry assumption imply that the expected utility of individuals who are employed in domestic firms other than z is

$$V^i_{E,t} = (1-\tau)W_{Z,t} + \frac{1}{1+r}\left((1-\delta)V^j_{E,t+1} + \delta V^j_{U,t+1}\right) \qquad i = 1,2 \qquad j = 1,2 \qquad \text{(A3)}$$

and, likewise, the expected utilities of each type quitting from a firm other than z are respectively:

$$V^1_{U,t} = B_t + \frac{1}{1+r}\left(\theta V^j_{E,t+1} + (1-\theta)V^j_{U,t+1}\right), \quad i = 1 \qquad \text{(A4.1)}$$

$$V_{U,t}^{2} = B_t + \frac{1}{1+r}\left(\theta V_{E,t+1}^{j} + \eta * \theta * V_{E,t+1}^{j} * + (1-\theta-\eta * \theta *) V_{U,t+1}^{j} - C\right), \quad i = 2 \qquad \text{(A4.2)}$$

The above six equations constitute the intertemporal utilities of those based in the domestic economy; there are also implied, six, equivalent equations for those based in the foreign economy.

The wage bargain

We consider the right-to-manage model, as applied in Nickell and Andrews (1983), where the firm unilaterally determines employment by exerting its right to manage after the wage has been determined by bargaining (such a model is attractive because it seems a good approximation to reality and is relatively simple in structure). There is a prior, bilateral bargain over the wage in each firm, where both parties anticipate this unilateral, Nash response by firms. There is exactly one union per firm.

We also assume that the employment of each worker is a random draw. The probability of a type-1 being employed at home is the same as that for any other worker, whether a type-1 or type-2, so that the common probability is $L_{Z,t} / M_{Z,t}$ where $L_{Z,t}$ is total firm employment and $M_{Z,t}$ is total union membership, where $L_{Z,t} < M_{Z,t}$. The type-2 individuals enjoy shorter spells of unemployment, however, because they have the chance of a job abroad as well as the same chance of a job at home as the type-1 individuals, and a higher expected lifetime utility in either state.

The utility of an individual of type-1, *who always remains so*, may be determined by the simultaneous solution of only four of these equations [(A1), (A2.1), (A3) and (A4.1)]. However, the utility of a type-2 individual would require the simultaneous solution of up to twelve equations, because of anticipated transitions between home and abroad. This is compounded by the fact that marginal individuals, outside a steady-state, may expect to change type according to the incentives offered at any future time. To capture the outsider status of internationally mobile workers, we assume that unions are concerned with only the welfare of doggedly type-1 members, who will be those with perpetually relatively high extra search costs for whom:

$$\eta * \theta * \left(V_{E,t+1}^{j} * - V_{U,t+1}^{j}\right) \leq C(i), \qquad \eta\theta\left(V_{E,t+1}^{j} - V_{U,t+1}^{j} *\right) \leq C * (i*) \tag{A5}$$

We now solve the model in the steady state with a symmetric equilibrium between firms in each country where unemployment benefits are financed by a proportionate tax on wages (τ, τ*). Tax revenue is assumed to equal benefit payments in each period. The tax rates (τ, τ*) may be regarded as a measure of the generosity of unemployment benefits.[9]

The union is concerned with the expected utility of the representative type-1 member, who gets $\left(L_{Z,t}/M_{Z,t}\right)V_{EZ,t}^{1} + \left(1 - L_{Z,t}/M_{Z,t}\right)V_{UZ,t}^{1}$ in the event of an agreement and $V_{UZ,t}^{1}$ in the event of a disagreement, because in the latter case we assume that all members go into unemployment. The expected surplus of the representative type-1 worker, using equations (A1) and (A2.1) is

$$S_{Z,t}^{U} = \left(L_{Z,t}/M_{Z,t}\right)\left(V_{EZ,t}^{1} - V_{UZ,t}^{1}\right) = \left(L_{Z,t}/M_{Z,t}\right)\left((1-\tau)W_{Z,t} - B_t + H_{t+1}\right)$$

$$\text{where } H_{t+1} \equiv \frac{1}{1+r}\left((1-\delta)V_{EZ,t+1}^{1} - \theta V_{E,t+1}^{1} - (1-\delta-\theta)V_{U,t+1}^{1}\right) \tag{A6}$$

The firm has a Cobb-Douglas technology of labour alone, so the profit function is

$$\pi_{Z,t} = A_{Z,t} l_{Z,t}^{\alpha} - W_{Z,t} l_{Z,t} - f \tag{A7}$$

Production ceases in the disagreement state, so that the firm's profit is zero, which gives its bargaining surplus as

$$S_{Z,t}^{F} = A_{Z,t} l_{Z,t}^{\alpha} - W_{Z,t} l_{Z,t}. \tag{A8}$$

The right-to-manage assumption implies that employment is set after the wage bargain and to maximise profits for the predetermined wage. Labour is on its demand curve:

$$\alpha A_{Z,t} l_{Z,t}^{\alpha-1} = W_{Z,t} \tag{A9}$$

[9] These assumptions imply that, for a given tax rate, the unemployment benefit rate depends on the unemployment rate. For technical reasons it is preferable to treat the tax rather than the benefit rate as exogenous.

Note that leaving the employed state is a random draw and not conditional on being a type-1 or a type-2. Consequently the union does not choose who enters unemployment at any time

Equations (A7) and (A8) give

$$S_{Z,t}^{F} = (1-\alpha)\alpha^{\alpha/1-\alpha} A_{Z,t}{}^{1/1-\alpha} W_{Z,t}{}^{-\alpha/1-\alpha}, \qquad \text{(A10)}$$

which is the firm's bargaining surplus, as we are assuming there is neither output nor wage payments in the event of a disagreement. The outcome of the Nash wage bargain is equivalent to maximizing the "Nash function", $N_{Z,t} = \left(S_{Z,t}^{U}\right)^{\varpi}\left(S_{Z,t}^{F}\right)^{1-\varpi}$, with respect to the wage, where $0 \leq \varpi \leq 1$ is the union's bargaining power. The outcome of the Nash wage bargain, with surpluses of the union and firm respectively as given in equations (A6) and (A10), is:

$$W_{Z,t} = \phi\left(\frac{B_t - H_{t+1}}{1-\tau}\right), \text{where} \quad \phi \equiv 1 + \varpi\left(\alpha^{-1} - 1\right) \geq 1 \quad \text{as} \quad \alpha \leq 1 \qquad \text{(A11)}$$

The model is solved both in the steady-state where,

$$V_{Z,t} = V_Z, \qquad V_t = V \qquad \forall t \qquad \text{(A12)}$$

and in symmetric equilibrium where,

$$V_Z = V, \qquad W_Z = W \qquad \forall z \qquad \text{(A13)}$$

Under these conditions, equations (A1) and (A2.1) are solved simultaneously to give

$$V_U^1 = \left(\frac{1+r}{r}\right)\left(\frac{(r+\delta)B + \theta(1-\tau)W}{r+\delta+\theta}\right) \qquad \text{(A14)}$$

$$V_E^1 = \left(\frac{1+r}{r}\right)\left(\frac{\delta B + (r+\theta)(1-\tau)W}{r+\delta+\theta}\right) \qquad \text{(A15)}$$

Substituting equations (A14) and (A15) into (A7) and (A11) yields

$$H = \left(\frac{1-\delta-\theta}{r+\delta+\theta}\right)\left((1-\tau)W - B\right) \qquad \text{(A16)}$$

and

$$(1-\tau)W = \phi B - \phi\left(\frac{1-\delta-\theta}{r+\delta+\theta}\right)\left((1-\tau)W - B\right) \qquad \text{or}$$

$$W = \left(\frac{1+r}{\phi^{-1}(r+\delta+\theta)+1-\delta-\theta} \right) \frac{B}{1-\tau} \tag{A17}$$

so that in the absence of any union bargaining power, where $\phi = 1$, $W = B/(1-\tau)$.

Equation (9) in the main text may be derived from (A17) using the assumption that government budget is balanced in each period:

$$(1-u)\tau W = uB \tag{A18}$$

Appendix 2 – Endogenising the proportion of individuals who seek work abroad

The expected utility of the type $i = 1,2$ quitting from firm z is $V^i_{UZ,t} = \max\left(V^1_{UZ,t}, V^2_{UZ,t}\right)$, where $V^1_{UZ,t}$ and $V^2_{UZ,t}$ are as given in (A2.1) and (A2.2). From those equations, it follows that a domestic unemployed individual, i, will be type-2 if the expected wealth increase from finding a job abroad exceeds the extra cost of searching for a job abroad:

$$\eta * \theta * \left(V_E * - V_U\right) > C(i) \tag{A19}$$

We determine λ in symmetric equilibrium from equation (19) and from equations (A14) and (A15) in the Appendix, giving:

$$\frac{\eta\left(r + \delta + (1-\delta)\phi\right)}{\left(\frac{(1+r)(1+\eta\lambda)\tau}{\delta(1-\tau)} + 1\right)\phi - 1}\left(1 - \phi^{-1}\right)(1-\tau)W > C(i) \tag{A20}$$

if the cost of making the move in the steady state for each individual, *i*, is proportional to the wage[10],

$$C(i) = \gamma(i)W \tag{A21}$$

the condition becomes

$$\frac{\eta\left(r + \delta + (1-\delta)\phi\right)}{\left(\frac{(1+r)(1+\eta\lambda)\tau}{\delta(1-\tau)} + 1\right)\phi - 1}\left(1 - \phi^{-1}\right)(1-\tau) > \gamma(i) \tag{A22}$$

Defining $\gamma *$ as the value of γ for the agent who is just indifferent between being a type-1 and type-2

$$\gamma^* \equiv \frac{\eta\left(r + \delta + (1-\delta)\phi\right)}{\left(\frac{(1+r)(1+\eta\lambda)\tau}{\delta(1-\tau)} + 1\right)\phi - 1}\left(1 - \phi^{-1}\right)(1-t) \tag{A23}$$

the proportion of type-2s is given by

$$\lambda = \int_{\gamma_{MIN}}^{\gamma^*} \gamma(i)\, f(i)\, di \quad \text{where} \int_{\gamma_{MIN}}^{\gamma_{MAX}} \gamma(i)\, f(i)\, di = 1, \qquad \frac{\partial \lambda}{\partial \gamma *} > 0 \tag{A24}$$

[10] The alternative is of a steady-state where $\lambda = 0,1$, where, with the alternative of differential growth in wages and costs, $c/w \to 0, \infty$.

As equation (A23) has the property that $\frac{\partial \gamma^*}{\partial \lambda} < 0$, it follows that within the simultaneous solution of λ and γ^*, $sign\left(\frac{\partial \lambda}{\partial x}\right) = sign\left(\frac{\partial \gamma^*}{\partial x}\right)$ for any variable x. The results shown in equations