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Unions, International Factor Mobility and Indeterminacy

By M. Aloi and T. Lloyd-Braga

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The Authors

Marta Aloi is a Lecturer in the School of Economics, University of Nottingham and Teresa Lloyd-Braga is Associate Professor, FCEE, Universidade Catolica Portuguesa, Lisbon.

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Abstract

We consider simple overlapping generation models for two countries with capital externalities and one output. Preferences and technologies are identical across countries. However countries differ in labour market structure. In one economy there is perfect competition in the labour market, while in the other employment and wages are determined through efficient bargaining between unions and firms. Our parameterisation is such that in autarkic equilibrium the unionised country exhibits indeterminacy while the other has a stable determinate steady state. We show that if free trade and free capital movements exist, then indeterminacy is likely to appear in the world market. However if international labour movements are allowed indeterminacy may disappear.

Outline

Non-Technical Summary

In today's world economy we observe heterogeneous countries increasingly engaged in free trade agreements. This goes hand-in-hand with the so-called process of globalisation, a major feature of which is that capital is internationally very mobile while labour is only to a limited extent. In the 'ideal' world of perfect competition and free factor movements, free trade and liberalisation of capital and labour markets should always be supported since all countries may gain from it. In fact, divergences across countries due to differences in factor endowments and/or productivity will be levelled out by liberalisation of international trade and factor movements. In the 'real' world, however, countries' differences go far beyond differences in factor endowments and/or productivity; moreover, today's process of globalisation is asymmetric (i.e. oriented only towards free capital movements).

Our work is aimed mainly at analysing the effect of such asymmetry in a world where the main source of heterogeneity across countries lies in labour market institutions. The focus on differences in labour market institutions is motivated by the observation that while capital owners, in both developed and emerging countries, strongly support liberalisation of trade and capital movements, labour owners are increasingly concerned about the impact of globalisation on wages, job security, labour and social standards. Workers' concern about the impact of globalisation is a world wide phenomenon (see, e.g. ILO (1999) and Edwards and Lusting (1997)) but is particularly evident in developed countries where union coverage is undoubtedly more extensive.

The main questions addressed in this paper are of two types. First, to what extent does today's globalisation (which consists of mainly freer trade and capital movements) affect economic stability both domestically and globally? Secondly, what happens to economic stability if one also allows for international labour mobility. We address these issues by developing a dynamic model in which there is no trade based on comparative advantages à la Heckscher-Ohlin and the world is made up of two countries that differ only in their labour market structure. In one country the labour market is perfectly competitive while in the other country workers are unionised. One could think, for instance, of Turkey versus Germany, or Latin American countries versus the US. We assume perfect competition in the capital markets and analyse three different scenarios. In the first countries are closed to trade; in the second countries are open to trade and capital, but not workers, is free to move; in the third scenario we relax the assumption of no labour mobility. We analyse the local dynamic properties around the stationary solution for the perfect foresight equilibrium in these models. As is well known (see for instance Guesnerie and Woodford (1992), when the steady state is locally indeterminate equilibrium variables may become volatile due to changes in expectations, that end up being self-fulfilling (stochastic endogenous fluctuations, i.e. sunspots). As a consequence the system may display persistent equilibrium fluctuations

in main macro-aggregates.

We find that in the autarkic equilibrium the unionised country may display indeterminacy (i.e. sunspots) while, under the same parameter conditions on the fundamentals, the non-unionised country converges to a stable stationary state. Under autarky, in the non-unionised country equilibrium labour supply is reached when real wages are identical to the marginal product of labour which, in turn, is tied to the marginal return to capital. Insofar as the latter obeys the law of decreasing returns the economy monotonically converges to a steady state. On the other hand, in the unionised country, where employment and wages are decided through efficient bargaining, the equilibrium level of employment in each period is influenced by expectations of future interest rates through the workers' reservation wage. Indeed, it is the existence of a positive reservation wage in the unionised country that makes indeterminacy possible, since in this case underemployment, and thereby employment fluctuations, may exist.

Opening up the economy and allowing for factor mobility implies the following two main results. The first result is that free capital movements, coupled with labour immobility, imply that the unionised country exports instability to the rest of the world. As referred, in the unionised country the equilibrium level of employment in each period is influenced by expectations of future interest rates through the workers' reservation wage which, in turn, make equilibrium employment fluctuations possible. In our model, allowing for free capital movements implies that the non-unionised country becomes a net importer of capital, and therefore it may become more vulnerable to employment fluctuations. This is precisely the case if the non-unionised country is poorer than the unionised country. This result supports the view, shared by many researchers, that instability in the world market is essentially linked to globalisation and free capital movements, see e.g. Bhagwati (1998), Krugman (1998), Rodrik (1997, 1999), Stiglitz (1999). Capital flows are by their nature volatile; hence, capital mobility increases the level of exposure to volatility. A direct implication of the increased volatility brought by international capital market liberalisation is that the macroeconomic risk is mainly borne by internationally immobile factors of production (namely, labour). Hence, the rise in volatility of workers' real income, and possibly in job insecurity and wage inequality.

The second main result is that if labour mobility is also allowed the equilibrium property of the system may be altered. In particular, if workers are mobile and face repatriation costs it is possible to reach economic stability in the world market. What is crucial here is that these labour movements counteract the effects of capital movements on expectations about future interest rates that are the source of instability in our model.

1 Introduction

In today's world economy we observe heterogeneous countries increasingly engaged in free trade agreements.[1] This goes hand-in-hand with the so-called process of globalisation, a major feature of which is that capital is internationally very mobile while labour is only to a limited extent. In the 'ideal' world of perfect competition and free factor movements, free trade and liberalisation of capital and labour markets should always be supported since all countries may gain from it. In fact, divergences across countries due to differences in factor endowments and/or productivity will be levelled out by liberalisation of international trade and factor movements. In the 'real' world, however, countries' differences go far beyond differences in factor endowments and/or productivity; moreover, today's process of globalisation is asymmetric (i.e. oriented only towards free capital movements).

This paper is aimed mainly at analysing the effect of such asymmetry in a world where the main source of heterogeneity across countries lies in labour market institutions. The focus on differences in labour market institutions is motivated by the observation that while capital owners, in both developed and emerging countries, strongly support liberalisation of trade and capital movements, labour owners are increasingly concerned about the impact of globalisation on wages, job security, labour and social standards. Workers' concern about the impact of globalisation is a worldwide phenomenon (see, e.g. ILO (1999) and Edwards and Lusting (1997)) but is particularly evident in developed countries where union coverage is undoubtedly more extensive. It is well known that in the richest countries workers and their organisations are increasingly opposing policies aimed at further liberalisation of international trade, immigration, and foreign direct investment, see e.g. Jay Mazur (2000). When firms threaten to relocate worldwide, workers feel greater wage pressure and also experience greater wage and/or employment volatility. As stressed by Rodrik (1997, p.24), "International capital mobility alters the nature of the relationship between workers and contributes to the weakening of unions. To the extent that wages are determined in bargaining between workers and employers, then, an increase in the substitutability of workers results in a lower share of the enterprise surplus ending up with workers". It is also well documented - at least for the US - that increased volatility in

[1] Good examples of trading arrangements involving heterogenous countries are NAFTA and APEC.

labour market conditions also accounts for part of the rise in wage inequality (see Gottschalk and Moffitt (1994) and other studies referred to in Rodrik (1997, Ch. 2) and Slaughter (1998)). All these things together, contribute to the perception of many workers that globalisation is a race to the bottom (see e.g. the evidence given by Scheve and Slaughter (2001)), and it also explains why unions are so wary about globalisation.[2]

The main questions addressed in this paper are of two types. First, to what extent does today's globalisation (which consists of mainly freer trade and capital movements) affect economic stability both domestically and globally? Secondly, what happens to economic stability if one also allows for international labour mobility?[3]

In this paper we develop a dynamic model in which there is no trade based on comparative advantages a la Heckscher-Ohlin and the world is made up of two countries that differ only in their labour market structure. In one country the labour market is perfectly competitive while in the other country workers are unionised. One could think, for instance, of Turkey versus Germany, or Latin American countries versus the US. We assume perfect competition in the capital markets and analyse three different scenarios. In the first countries are closed to trade; in the second countries are open to trade and capital, but not workers, is free to move; in the third scenario we relax the assumption of no labour mobility. We analyse the local dynamic properties around the stationary solution for the perfect foresight equilibrium in these models. As is well known[4], when the steady state is locally indeterminate endogenous variables may become volatile due to changes in expectations, that end up being self-fulfilling.

We find that in the autarkic equilibrium the unionised country (which we denote as country A) may display indeterminacy (i.e. sunspots) while, under the same parameter conditions on the fundamentals, the non-unionised country (country B) converges to a stable stationary state. Under autarky, country B's equilibrium labour supply is reached when real wages are identical to the marginal product of labour which, in turn, is tied to the marginal return to capital. Insofar as the latter obeys the law of decreasing returns the econ-

[2]It must be aknowledged that unions are not against globalisation a priori, but they are rather advocating core labour rights and standards everywhere to limit speculative booms and busts brought by globalisation, see e.g. Jay Mazur (2000).

[3]Note that free trade and international capital and labour movements was indeed the dominant model at the height of the gold standard in the early 20th century.

[4]See for instance Guesnerie and Woodford (1992).

omy monotonically converges to a steady state. On the other hand, in country A, where employment and wages are decided through efficient bargaining, the equilibrium level of employment in each period is influenced by expectations of future interest rates through the workers' reservation wage. Indeed, it is the existence of a positive reservation wage in country A that makes indeterminacy possible, since in this case underemployment, and thereby employment fluctuations, may exist.

Opening up the economy and allowing for free capital movements may bring indeterminacy to world markets and, therefore, country B may also experience employment fluctuations. In our model this happens as long as there is an upper level for savings and for the use of capital in production in country B as a share of world savings, or if the wage bill is lower in country B than in country A. We also show that, at the steady state, country B always becomes a net importer of capital. In other words, if the non-unionised country is poorer than the unionised country, allowing for free capital movements implies that the poor country becomes a net importer of capital and therefore more vulnerable to employment fluctuations. This result supports the view, shared by many researchers, that instability in the world market is essentially linked to globalisation and free capital movements, see e.g. Bhagwati (1998), Krugman (1998), Rodrik (1997, 1999), Stiglitz (1999). Capital flows are by their nature volatile; hence, capital mobility increases the level of exposure to volatility in GNP.[5] A direct implication of the increased volatility brought by international capital market liberalisation is that the macroeconomic risk is mainly borne by internationally immobile factors of production (namely, labour). Hence, the rise in volatility of workers' real income, and possibly in job insecurity and wage inequality. In other words, international capital mobility imposes a negative externality on labour.

This last observation leads us to the second issue addressed in this paper, i.e. what happens if we relax the assumption of internationally immobile labour. Is international mobility of workers likely to reduce the chance of macroeconomic volatility? We depart from the model with no labour mobility by assuming that workers are free to move provided they are offered a work contract in the host country. This is intended to represent what some countries do at present and what most countries will be inclined to do

[5]Empirical evidence also supports the link between macroeconomic instability in developing/emerging countries and capital flows. See, for instance, the studies reviewed in Rodrik (1999).

in the future as regards immigration of workers. If there are no repatriation costs, then indeterminacy arises for parameter configurations identical to those implying indeterminacy in the autarkic equilibrium of country A. However, if there are (utility) repatriation costs our results change: under plausible conditions, it is possible to reach worldwide economic stability, i.e. the integrated equilibrium is a saddle (determinate).

2 Autarkic Equilibrium

2.1 Unionised Country A

In country A a constant number N_A of identical agents, living for two periods, are born each period t. Therefore population is constant over time (identical to $2N_A$), and there are N_A young individuals and N_A old individuals in every period. There is a single output, used as consumption or capital good, which is considered the numeraire. There are m identical firms and the output market is perfectly competitive.

Agents can only work when young and they only consume when old. If a young individual is unemployed, he/she is supposed to engage in 'home' production which generates an amount a of output, available to consume when old. A young employed worker supplies a fixed number of hours, which we normalise to 1, and save wage income through investment in productive capital goods, which are rented to firms in the next period. The market for capital services is perfectly competitive, r_t being the real rental rate at period t. Capital is totally depreciated in one period, so that r_t is also the interest factor. Working in a firm or at 'home' does not involve labour disutility. Accordingly we consider that preferences of an individual born at t are described by the simple linear utility function, c_{t+1}. Hence, a worker will prefer to be employed by a firm, in any period t, if wages are above a certain reservation wage $\bar{w}_t$ given by the following expression:

$$\bar{w}_t = a/\ r_{t+1}, \tag{1}$$

where r_{t+1} is the expected value, evaluated at period t, of the interest rate in the next period, which is identical to the realised value under perfect foresight.

All young agents are unionised and there is one union per firm. Workers are exogenously and uniformly matched with unions. Therefore each union represents $n_A = N_A/m$ agents. Employment at a firm, l_t, and wages, w_t, are decided through efficient bargaining between each union and the corresponding firm. We consider that unions are utilitarian[6]. Hence, unions seek to maximise consumption of their members, given by:

$l_t w_t r_{t+1} + a\left(n_A - l_t\right).$

Firms seek to maximise profits. We assume the existence of multiplicative capital externalities in production, whose degree is v, and a private production function of a Cobb-Douglas type. Considering that A is a scale parameter, that $\bar{k}_t$ is the country average level of capital available for production at the outset of period t, which is taken as given by each firm, and that k_t is the level of capital rented by the representative firm, the production function of a typical firm is then given by:

$A\overline{k}_t^v k_t^\theta l_t^{1-\theta}$, where $0 < \theta < 1$ and $v > 0$.

We use the generalised Nash bargaining solution to obtain the outcome of the bargaining process. We consider that firms have already committed to rent a certain level of capital when the bargain over wages and employment takes place. Hence, we have to maximize over l_t and w_t, and subject to $l_t \leq n_A$, the following objective function:

$\left(\bar{k}_t^v k_t^\theta l_t^{1-\theta} - w_t l_t\right)^\alpha \left(r_{t+1} l_t \left(w_t - \bar{w}_t\right)\right)^{(1-\alpha)}, \;\; 0 < \alpha < 1$

Note that the rental cost of capital is netted out in the firms' objective function (and that the term a does not appear in the unions objective function) since it is the fall back element of firms (and unions), i.e., something they have to pay (get) whether an agreement is reached or not (l_t being zero in this last case). Note also that $(1-\alpha)$ is the unions' bargaining power. The first order conditions for w_t and l_t to maximize the above objective function

[6]We could instead have assumed the following. If a young individual is unemployed, he/she is supposed to engage in 'home' production which generates an amount a of output, available to consume when old. This amount is supposed to be ordered by the union to any unemployed member. We consider that unions decide who is employed and use a redistributive scheme such that all members have identical consumption, i.e, each individual receives the same share of wages income used to buy capital goods, and the same share of home production used for direct consumption. Hence, consumption of a representative household which unions seek to maximise, is given by: $c_{t+1} = w_t \frac{l_t}{n_A} r_{t+1} + a\left(\frac{n_A - l_t}{n_A}\right)$. The autarkic equilibrium would be the same. Also, it can be checked later on that under free trade and capital mobility the equilibrium would still be the same.

are:

$$\bar{w}_t = (1-\theta)\, A\bar{k}_t^v k_t^\theta l_t^{-\theta} \tag{2}$$

$$w_t = (1-\theta\alpha)\, A\bar{k}_t^v k_t^\theta l_t^{-\theta} \tag{3}$$

We assume that l_t solving the equations above is such that $l_t < n_A$. Note that wages are set as a markup over the reservation wage: $w_t/\bar{w}_t = (1-\theta\alpha)/(1-\theta)$. The markup is higher than 1 if there is some union bargaining power, i.e., $\alpha < 1$. See figure 1.

Fig. 1 here

Anticipating the bargaining outcome, the firm chooses to rent the level of capital that maximises profit net of rental cost, $\alpha A\bar{k}_t^v k_t^\theta l_t^{1-\theta} - \alpha\bar{w}_t - r_t k_t$, which yields the first order condition:

$$\alpha\theta A\bar{k}_t^v k_t^{\theta-1} l_t^{1-\theta} = r_t \tag{4}$$

In the limit case of $\alpha = 1$ we have the perfectly competitive equilibrium, where the wage and the rental cost of capital are determined by the marginal productivity of labour and capital, respectively. Noting that, at a symmetric equilibrium $\bar{k}_t = k_t$, investment in capital goods at period t available for production at the outset of the following period is $mk_{t+1} = mw_t l_t$, recalling the definition of $\bar{w}_t$, and using these last equations we obtain the equilibrium dynamic system in terms of the two state variables (k, l):

$$k_{t+1} = (1-\theta\alpha)\, Ak_t^{v+\theta} l_t^{1-\theta} \tag{5}$$

$$l_{t+1} = hk_t^{-(v+\theta)^2/(1-\theta)} l_t^{-\left(v+\theta-1-\frac{\theta}{1-\theta}\right)} \tag{6}$$

where $h \equiv \left[\frac{(a/\alpha\theta)}{(1-\theta)(1-\theta\alpha)^{(v+\theta-1)}A^{(1+v+\theta)}}\right]^{1/(1-\theta)}$.

The steady state (k, l) of the above dynamic system is:

$k = \left[(1-\alpha\theta)Al^{1-\theta}\right]^{\frac{1}{1-(\theta+\nu)}}$

$l = h^{\frac{(1-\theta)(1-\theta-\nu)}{\nu}} \left[(1-\alpha\theta)A\right]^{\frac{-(\nu+\theta)^2}{\nu}}$

By taking the logarithms of the state variables the system (5) and (6) becomes linear with a Jacobian matrix given as follows:

$$\begin{bmatrix} v+\theta & 1-\theta \\ -\frac{(v+\theta)^2}{1-\theta} & (1-v-\theta)+\frac{\theta}{1-\theta} \end{bmatrix} \tag{7}$$

The stability properties of the steady state depend on the eigenvalues of the Jacobian matrix whose values are determined by the trace T and the determinant D of the matrix in (7):

$T = \frac{1}{1-\theta}$

$D = \frac{v+\theta}{1-\theta}$

Note that k is a predetermined variable, its value at any period t being determined by past savings. However l is a non-predetermined variable and its value at any period t is influenced by expectations of future interest rates, as can be seen using (1) and (2). If, at period t, the expected interest rate decreases then there is an increase in the reservation wage. Given a fixed value of capital, this induces an increase in unemployment (decrease in l_t) and wages. See figure 1.

Indeterminacy will arise when both eigenvalues, in absolute value, are lower than 1, a case that will be obtained when simultaneously $-1 < D < 1$, $D > T - 1$ and $D > -T - 1$. As is well known in this case there are sunspots, i.e., stationary stochastic equilibria driven by volatile self-fulfilling expectations.

It is easy to check that indeterminacy of the steady state in autarkic equilibrium of this country is obtained when:

$$0 < \theta < \frac{1}{2} \qquad \text{and} \qquad 0 < v < 1 - 2\theta. \tag{8}$$

We shall assume from now on that v and θ satisfy the above requirements, which are reasonable from an empirical point of view.[7]

[7]Estimates of the degree of increasing returns to scale are usually low and the capital share of output, which in this model is $\alpha\theta$, is usually a value lower than 0.4.

2.2 Country B

The structure of the economy of this country is similar to country A, except for the labour market, which we assume to be perfectly competitive. Since there are no unions, (symmetric) equilibrium in the labour market is reached when real wages are identical to the marginal productivity of labour at $l_t = N_b/m \equiv n_B$. Obviously, in this economy the interest factor, i.e., the real rental cost of capital is given by the marginal productivity of capital:

$\theta A k_t^{v+\theta-1} n_b^{1-\theta} = r_t$

For this economy it is possible to summarise dynamic equilibrium by a unique dynamic equation, namely the capital accumulation equation $k_{t+1} = w_t n_B$. Substituting wages by the marginal productivity of labour yields:

$k_{t+1} = (1-\theta) A k_t^{v+\theta} n_B^{1-\theta}$.

Since capital is a predetermined variable, there is no indeterminacy. Given that the above equation is loglinear, all the equilibrium trajectories either converge to the steady sate or become explosive.

The steady state level of capital is $k = \left[(1-\theta) A n_B^{1-\theta}\right]^{\frac{1}{1-(v+\theta)}}$.

We shall assume that the social marginal productivity of capital is a decreasing function, i.e., $\theta + v < 1$, a requirement compatible with (8). Hence the steady state is a stable equilibrium.

3 Equilibrium with free trade and free international capital movements

Free trade implies that output prices are identical in both countries. Also, liberalisation of capital movements among both countries implies that interest rates become identical in both countries. Hence, at equilibrium, the world capital stock, available for production in every period t, must be distributed among firms of both countries in a way such that:

$k_t = k_{A,t} + k_{B,t}$
$\alpha\theta A k_{A,t}^{v+\theta-1} l_{A,t}^{1-\theta} = \theta A k_{B,t}^{v+\theta-1} n_B^{1-\theta} = r_t$

These equations can be used in order to obtain the level of capital rented by a representative firm in each country, $k_{A,t}$ and $k_{B,t}$, as a function of k_t and $l_{A,t}$:

$$k_{A,t} = k_t \frac{1}{1+z_t} \tag{9}$$

$$k_{B,t} = k_t \frac{z_t}{1+z_t}, \tag{10}$$

where:

$$z_t = \left[\alpha \left(\frac{l_{A,t}}{n_B} \right)^{1-\theta} \right]^{\frac{1}{v+\theta-1}} \tag{11}$$

Capital accumulation in the world is driven by the sum of wage income in both countries, $k_{t+1} = w_{A,t} l_{A,t} + w_{B,t} n_B$. Since there is no change in the labour market structure with respect to the autarkic situation, wages in country A should still be given as in autarky and in country B by the marginal productivity of labour. Using the above expressions for $k_{A,t}$ and $k_{B,t}$, we then may obtain the dynamic equilibria system in terms of world capital level, k, and employment in country A, l_A:

$$k_{t+1} = A k_t^{\theta+v} \left[(1-\theta\alpha)\, l_{A,t}^{1-\theta} \left(\frac{1}{1+z_t} \right)^{\theta+v} + (1-\theta)\, n_B^{1-\theta} \left(\frac{z_t}{1+z_t} \right)^{\theta+v} \right] \tag{12}$$

The other equation is obtained by using the equilibrium condition for country A, stating that $\bar{w}_t = a/\, r_{t+1}$, where as we have seen in the symmetric autarkic equilibrium for country A, $\bar{w}_t = (1-\theta)\, A k_{A,t}^{v+\theta} l_{A,t}^{-\theta}$, and r_{t+1} is the world interest factor whose expression is given above. Using (19), we thus obtain:

$$(1-\theta)\, A k_t^{v+\theta} \left(\frac{1}{1+z_t} \right)^{v+\theta} l_{A,t}^{-\theta} = a/\{ \alpha\theta A k_{t+1}^{v+\theta-1} l_{A,t+1}^{1-\theta} \left(\frac{1}{1+z_{t+1}} \right)^{v+\theta-1} \} \tag{13}$$

Equations (12) and (13) describe the dynamic equilibria of our model written in terms of the predetermined variable k, whose value is determined by the

world past savings, and by the non-predetermined variable l_A, whose value is again influenced by current expectations of future real rental rates.

Using (11) and substituting k_{t+1} in (13) by its value as given in expression (12), we obtain a two dimensional non linear dynamic map $(k_{t+1}, l_{A,t+1}) = G(k_t, l_A)$ which can be implicitly written as follows:

$$k_{t+1} = Ak_t^{\theta+v} l_{A,t}^{1-\theta} \frac{X_t}{H_t^{\theta+v}} \tag{14}$$

$$l_{A,t+1}^{\theta-1} H_{t+1}^{v+\theta-1} = (1-\theta)(\alpha\theta/a) A^{v+\theta+1} k_t^{(\theta+v)^2} l_{A,t}^{(1-\theta)(v+\theta)-1} \frac{X_t^{v+\theta-1}}{H_t^{(\theta+v)^2}} \tag{15}$$

where H and X are functions of l_A:

$$X_t = (1-\theta\alpha) + (1-\theta)\alpha^{\frac{\theta+v}{\theta+v-1}} n_B^{\frac{\theta-1}{\theta+v-1}} l_{A,t}^{\frac{1-\theta}{\theta+v-1}}$$

$$H_t = 1 + \left(\alpha n_B^{\theta-1}\right)^{\frac{1}{v+\theta-1}} l_{A,t}^{\frac{1-\theta}{v+\theta-1}}$$

For later reference note that the elasticity of X and H with respect to l_A can be written as:

$$\frac{d\ln X}{d\ln l_A} = \frac{1-\theta}{\theta+v-1} \frac{w_B n_B}{w_A l_{A+} w_B n_B} = \frac{1-\theta}{\theta+v-1} s_s^B(l_A, n_B, \alpha, \theta, v) \tag{16}$$

$$\frac{d\ln H}{d\ln l_A} = \frac{1-\theta}{\theta+v-1} \frac{k_B}{k} = \frac{1-\theta}{\theta+v-1} s_k^B(l_A, n_B, \alpha, \theta, v) \tag{17}$$

In the above expressions s_s^B denotes the country B savings share of world savings, and s_k^B is the country B capital (used in production process) share of world capital.

The existence of a given steady state (k, l) for the system (14) and (15) will be ensured by assuming that the scale parameters (A, a) take the appropriate values. For later reference, note that at the steady state country B is a net capital importer, since savings in country B are lower than the respective

stock of capital used in production. Indeed the ratio of s_s^B over s_k^B at the steady state is lower than 1. Using the definitions for these shares as in (16) and (17), and using (9), (10), (11), (3), the fact that wages in country B are given by the marginal productivity at full employment and that $k = k_A + k_B$, we obtain :

$$\frac{s_s^B}{s_k^B} = \frac{(1-\theta)\,\alpha l_A^{1-\theta} n_B^{\frac{(1-\theta)(v+\theta)}{\theta+v-1}} + (1-\theta)\,\alpha^{\frac{(v+\theta)}{\theta+v-1}} l_A^{\frac{(1-\theta)(v+\theta)}{\theta+v-1}} n_B^{(1-\theta)}}{(1-\theta\alpha)\,l_A^{1-\theta} n_B^{\frac{(1-\theta)(v+\theta)}{\theta+v-1}} + (1-\theta)\,\alpha^{\frac{(v+\theta)}{\theta+v-1}} l_A^{\frac{(1-\theta)(v+\theta)}{\theta+v-1}} n_B^{(1-\theta)}} < 1 \Longleftrightarrow \alpha < 1 \tag{18}$$

The local stability analysis will be conducted by using the linear map associated with the Jacobian matrix, evaluated at the steady state, of the system (14)-(15).[8] By log linearising the system[9] we can obtain the Jacobian matrix J associated with the linearised dynamics for the deviations of $d\ln k_t = \ln k_t - \ln k$ and $d\ln l_{A,t} = \ln l_{A,t} - \ln l_A$:

$$\begin{bmatrix} d\ln k_{t+1} \\ d\ln l_{A,t+1} \end{bmatrix} = J \begin{bmatrix} d\ln k_t \\ d\ln l_{A,t} \end{bmatrix}$$

The matrix J is given as follows:

$$J = \begin{bmatrix} \theta + v & (1-\theta) + \frac{d\ln X}{d\ln l_A} - (\theta+v)\frac{d\ln H}{d\ln l_A} \\ \frac{(\theta+v)^2}{(\theta-1)+(\theta+v-1)\frac{d\ln H}{d\ln l_A}} & \frac{[(1-\theta)(v+\theta)-1]+(v+\theta-1)\frac{d\ln X}{d\ln l_A} - (\theta+v)^2\frac{d\ln H}{d\ln l_A}}{(\theta-1)+(\theta+v-1)\frac{d\ln H}{d\ln l_A}} \end{bmatrix} \tag{19}$$

with $\frac{d\ln X}{d\ln l_A}$ and $\frac{d\ln H}{d\ln l_A}$ given, respectively, as in (16) and (17) and where s_s^B is the country B savings share of world savings and s_k^B is the country B capital (used in production process) share of world capital, both evaluated at the steady solution under study. We can obtain the following expressions for the trace and determinant of J:

$$T = \frac{[1-(\theta+v)]\left[1-(1-\theta)\,s_s^B\right] - (\theta+v)\,(1-\theta)\,s_k^B}{[1-(\theta+v)]\,(1-\theta)\,(1-s_k^B)}$$

[8] Hartman Grobman theorem

[9] The local stability properties for trajectories $\{\ln \mathrm{k}_t\}$ and $\{\ln \mathrm{l}_t\}$ near the steady state $(\ln k, \ln l)$ are identical to the local stability properties of the $\{k_t\}$ and $\{l_t\}$ near the steady state (k, l) . Studying the system in logarithmic terms renders the computations easier.

$$D = \frac{(\theta+v)\left[1-(\theta+v)\right]-(\theta+v)(1-\theta)s_s^B}{\left[1-(\theta+v)\right](1-\theta)(1-s_k^B)}$$

Assuming that (8) is satisfied we obtain that:

$$D > T-1 \Longleftrightarrow \left[2(\theta+v)-1\right]\left(s_s^B - s_k^B\right) < \frac{v}{1-\theta}\left[1-(\theta+v)\right] \tag{20}$$

$$D < 1 \Longleftrightarrow s_k^B - \frac{\theta+v}{1-(\theta+v)}s_s^B < \frac{(1-2\theta)-v}{1-\theta} \tag{21}$$

$$D > -1 \Longleftrightarrow s_s^B < \frac{\left[1-(\theta+v)\right]\left[1+v-s_k^B(1-\theta)\right]}{(1-\theta)(\theta+v)} \tag{22}$$

$$D > -T-1 \Longleftrightarrow s_s^B + s_k^B < \frac{\left[1-(\theta+v)\right](2+v)}{1-\theta} \tag{23}$$

It is then easy to check that indeterminacy arises under the following parameter configuration:

$$\begin{aligned}
(i)\ 0 &< \theta < \frac{1}{2} \\
(ii)\ 1-2\theta &> v > \frac{1-2\theta}{2} \\
(iii)\ s_s^B + s_k^B &< \frac{\left[1-(\theta+v)\right](2+v)}{1-\theta} \\
(iv)\ s_s^B &\leq s_k^B < \frac{(\theta+v)}{1-(\theta+v)}s_s^B + \frac{(1-2\theta)-v}{1-\theta}
\end{aligned} \tag{24}$$

The condition (24i) and the left hand side of (24ii) are the requirements

already established if (8) is satisfied. Then the rhs of (20) is positive.[10] If $v > \frac{1-2\theta}{2}$ as in (24ii) then the lhs of (20) is negative, since as shown above by (18) $s_s^B < s_k^B$. It can be checked that (22) is always verified. Indeed the rhs of (22) is always higher than 1, once $s_k^B < 1$. Finally one may notice that conditions (24iii) and (24iv) are equivalent to (21) and (23). Condition (24iii) sets an upper level for savings and for the use of capital in production in country B as a share of world savings (or capital, both being identical) at the steady state. It is appropriate here to interpret country B, in which unions have no power and home production is negligible, as being a poor country compared to country A. Indeed, besides B being a net importer of capital, condition (24iii) imposes an upper limit for its economic share in the world. Condition (24iv) sets an upper bound for the capital imports share of world savings, i.e., for $s_k^B - s_s^B$. This seems to be a reasonable condition, since we may expect free capital movements to exist as long as the capital importing country sustains its balance of payments imbalance.

It can also be seen that, for instance, if, besides (24i) and (24ii), s_s^B and s_k^B satisfy

$$(a)\ s_s^B < \frac{1-(\theta+v)}{1-\theta} \qquad (b)\ s_s^B \leq s_k^B < \frac{(\theta+v)}{1-(\theta+v)} s_s^B$$

then indeterminacy will arise. Indeed (a) and (b) together ensure that (23) is satisfied, while (b) alone is just a particular case of (24iv). Note that $\frac{1-(\theta+v)}{1-\theta} > \frac{1}{2}$ as long as $\theta > 1/3$ and $v < 1/2$, which are plausible values from an empirical point of view.[11] In this case condition (a) is always satisfied as long as $s_s^B < 1/2$, which means that the wage bill should be smaller in

[10] We may note that if $s_k^B > \frac{(\theta+v)}{1-(\theta+v)} s_s^B + \frac{(1-2\theta)-v}{1-\theta}$ then $D > 1$ and the steady state would be a source. In this case trajectories for the state variables would become explosive or they could become bounded by an invariant closed curve. Indeed note that the system is no longer linear and bifurcations may occur. If a supercritical Hopf bifurcation occurs that would mean that a stable invariant closed curve generically appears at least for values of D higher than but close to 1. If explosiveness was not avoided before l_A reaches n_A then the system would experience a change of regime, since in country A labour demand would be constrained.

[11] The conditions stated in (24) can be met by our system. To see this proceed as follows. First fix values for $\theta > 1/3$ and $v < 1/2$ satisfying (i) and (ii). Note that if $\theta > 1/3$ and $v < 1/2$ then $\frac{1-(\theta+v)}{1-\theta} > \frac{1}{2}$ so that if $s_s^B < \frac{1}{2}$ the condition iii) is satisfied. So fix steady state values for k and l_A.

By fixing any value for α and choosing n_B such that $n_B < \frac{1-\theta\alpha}{1-\theta} \alpha^{\frac{\theta+v}{(1-\theta)v}} l_A^{\frac{\theta+v-2}{v}}$ we obtain

country B as compared to country A, a requirement that, in principle, is in accordance with the assumption of country B being relatively poor.

Note that indeterminacy in the world market means that expectations about future interest rates are revelant to the determination of equilibrium in both countries. For instance, a decrease in the expected interest rate has an immediate effect, as we have seen before, on the level of employment in country A, which will also decrease. This, by means of (4), will induce a decrease in the interest rate of country A leading to capital outflows towards country B. As a result there is an increase in wages of country B, although employment is constant.

One should note that the conditions stated in (24) could still be verified if the labour market were perfectly competitive also in country A, that is if $\alpha = 1$. In that case $s_s^B = s_k^B$ and the condition (24)(iv) is surely satisfied. Indeed it is the existence of a positive reservation wage ($a > 0$) in country A that renders indeterminacy possible, since in that case underemployment, and thereby employment fluctuations, may exist. However, in this case with $\alpha = 1$ there would be no capital movements at the steady state, since investment in capital goods (through savings) were just identical to the amount of capital goods used in production within each country.[12]

Since there was indeterminacy in the unionised country at the autarkic equilibrium and the steady state was determinate at the non unonised country, we see that the unionised country, being a net exporter of capital, has also exported indeterminacy to world markets. As discussed in the Introduction, this view has indeed been advanced by many analysts and economic

a value for s_s^B lower than $\frac{1}{2}$. Finaly note that in order to have condition (iv) fulfilled we only need to set a value for α such that: $z(\alpha) \equiv \alpha^{\frac{v+\theta}{1-v-\theta}} \{(1-\theta-v) - \alpha[\theta + (1-2\theta)(\theta+v)]\} < (1-\theta)(1-\theta-v) l_A^{\frac{1-\theta}{v+\theta-1}} n_B^{\frac{\theta-1}{v+\theta-1}}$.

It can be seen that, at least for α close to one that condition is satisfied since $z(1) < 0$.

[12]Note that it is the difference in the labour market structure that drives the existence of capital movements at the steady state. If both countries enjoyed the same level of home production, a, and the same unions bargaining power, α, then they would have the same amount of employment and capital at equilibria. Moreover in this case under free capital movements, and therefore identical interest rates in both countries, the reservation wage would be the same and adding free labour mobility would not change equilibria. The equilibrium system would be similar to the one presented for the autarkic equilibria in country A, where $k_{A,t}$ should be substitued for k_t. The local stability properties would be the same and therefore the liberalization of capital movements would not bring new results with respect to indeterminacy.

researchers, who claim that world market instability is essentially linked to globalisation and free capital movements.

4 Integrated Equilibrium: migration conditional on a work contract

Here we consider that, besides free trade and free capital mobility between countries, free international mobility for young active workers is allowed. A young agent, able to get a job in his/her home country, can then emigrate if he/she is able to get employment in the host country. Accordingly, since in country B there is no unemployment, we shall assume that young natives of country A who may move to country B are those who would have obtained an income of w_A had they stayed in their home country. Also, young natives from B can only stay in A if they are able to get employment there. Otherwise they are repatriated[13]. We assume that if repatriated they can still find a job in their original country B, so that the world labour force remains constant over time. Unions in country A bargain with firms in order to get a certain level of employment per firm $l_{A,t}$, taking as given the number of young residents, without distinguishing their origin[14]. As before, we assume the existence of underemployment in country A, and therefore employment and wages in country A are still given as in equations (2) and (3). In country B wages are still given by the marginal productivity labour.

To simplify we ignore the travel costs of migration. However, with respect to repatriation costs we shall analyse two different cases: in the first these costs are absent and in the second there are utility costs associated with repatriation.

4.1 Absence of repatriation costs

Workers are willing to migrate as long as this is an alternative that brings an incremental value in terms of expected utility (consumption in their old

[13] A repatriate is someone who ends up in his/her home country not because he/she has chosen that option but because he/she could not get employment abroad.

[14] Since unemployed native workers from B are repatriated, all those unemployed in country A are natives from A and are engaged in home production. Therefore, the assumption of unions that their members are either employed, receiving a wage w_A, or unemployed and engaged in home production is satisfied at equilibrium.

age). Hence, a native worker from country A wishes to migrate as long as $w_{A,t} < w_{B,t}$.[15]

Consider for now that $mn^*_{A,t}$ is the number of young households living in country A at time t. Underemployment in country A means that $l_{A,t} < n^*_{A,t}$. Therefore, the probability of getting a job in country A is $l_{a,t}/n^*_{A,t}$. A native worker from country B wishes to migrate to country A when: $w_{B,t} < (l_{A,t}/n^*_{A,t})w_{A,t} + (1 - l_{A,t}/n^*_{A,t})w_{B,t} \Leftrightarrow w_{B,t} < w_{A,t}$.

Equilibrium within each period requires that no further worker movements are observed; hence, equilibrium requires that $w_{A,t} = w_{B,t}$, i.e.:

$$(1 - \theta\alpha)\, k_A^{\theta+v} l_A^{-\theta} = (1 - \theta)\, k_B^{\theta+v} l_B^{-\theta}$$

Given perfect capital mobility, equations (9), (10) and (11) are still valid if we substitute n_B with $l_{B,t}$. Using (9) and (10) we obtain:

$$(1 - \theta\alpha)\, l_{A,t}^{-\theta} = (1 - \theta)\, l_{B,t}^{-\theta} z_t^{\theta+v}$$

Using (11) to substitute for z_t we obtain:

$$l_{B,t} = h.l_{A,t}, \quad h \equiv \frac{(1-\theta\alpha)}{(1-\theta)} \alpha^{\frac{1}{1-v-\theta}} \left[\frac{(1-\theta\alpha)}{(1-\theta)} \alpha^{\frac{1}{1-v-\theta}} \right]^{\frac{1-\theta-v}{(1-\theta)^2+\theta v}}$$

Using this expression in (11) we obtain a value for z constant over time: $z = \left(\frac{h^{1-\theta}}{\alpha} \right)^{\frac{1}{1-v-\theta}}$

The capital accumulation equation is now given by: $k_{t+1} = w_{A,t}(l_{B,t} + l_{A,t})$. Using (3) and (9) and the expression above, $l_{B,t} = h.l_{A,t}$, we obtain:

$$k_{t+1} = \frac{(1-\theta\alpha)}{(1+z)^{\theta+v}} A k_t^{\theta+v} l_{A,t}^{1-\theta}$$

The other equilibrium equation is derived, as in the previous section, from (12) and (13) where z_t and z_{t+1} are now constants equal to z.

One can easily check that the equilibrium dynamic system becomes similar to the autarkic equilibrium in country A, up to some multiplicative constants (that do not change the qualitative dynamics around the steady state),

[15] In this case the worker gives up a potential work contract and union membership.

and in which instead of the state variable $k_{A,t}$ we have k_t. Therefore, the conditions for world indeterminacy in the case of integrated equilibrium with no repatriation costs coincide with those for the autarkic equilibrium in country A. In this case, with free factor movements, the unionised country always exports indeterminacy to the world markets, assuming (8) is satisfied.

As noticed before, if agents expect a decrease in future interest rates then the immediate effect is a decrease in employment of country A. Wages in country A would increase and interest rates would fall. Given the existence of free labour and capital movements it is likely that this will induce capital flows from counry A to country B and migration flows in the opposite direction. Both movements help and reinforce the re-establishment of the arbitrage conditions for wages and interest rates. The fact that labour movements reinforce the effects of capital movements on interest rates may be an additional contribution to the occurrence of indeterminacy.

4.2 Presence of repatriation costs

In this section we assume that, in every period t, young natives from country B living in country A that are unemployed and repatriated to their home country face a utility cost. We shall assume that natives from B that attempted to emigrate to country A, and were not able to get a job there, are repatriated to their home country and work at a wage $w_{B,t}$, but derive zero utility in this event[16].

Here we shall focus on equilibria where in the labour force of each country there are some natives, and where there exists some immigration in country A. We consider that natives from B can never get full citizenship in country A, so that their descendants can only have a permit of residence in country A if they are also able to get a job[17].

[16] Only natives from B face the event of repatriation. Immigrants native from B not getting a job are either repatriated or are illegally engaged in home production in country A. In both cases, the shame and the cost (of being repatriated and of not having been able to find a job, or of running away from the police to avoid repatriation) is as if they enjoy zero utility. Formally, we are assuming that utility of a native from country B is: $c_{t+1} - A\delta c_{t+1}$ where $\delta = 1$ if he/she is repatriated and $\delta = 0$ if he/she is not repatriated. In the case where there are no repatriation costs $A = 0$ and in the case where there are repatriation costs $A = 1$.

[17] We need this assumption to ensure that, at the steady state, there are some immigrants from country B in country A.

At equilibrium, in each period, no further worker movements can be observed. Assume that $mn^*_{A,t}$ is the number of young (unionised) residents in country A. A native worker from B working in B wish to stay there, and is not willing to try to get a job in country A if $w_{B,t} > (l_{A,t}/n^*_{A,t})w_{A,t}$. A native worker from A wishes to stay in country A if $w_{A,t} > w_{B,t}$. If there are some immigrants from country B in country A it must be the case that some natives from B are willing to try to get a job in country A, which will happen if $w_{B,t} \leq (l_{A,t}/n^*_{A,t})w_{A,t}$. Hence at equilibrium we must have[18]: $w_{A,t} > w_{B,t} = (l_{A,t}/n^*_{A,t})w_{A,t}$. Given that we consider $(l_{A,t}/n^*_{A,t}) < 1$, the equilibrium condition becomes:

$$w_{B,t} = w_{A,t}l_{A,t}/n^*_{A,t} \tag{25}$$

Note that in this case there are no natives from country A working in country B. Indeed this could only happen if $w_{B,t} > (l_{A,t}/n^*_{A,t})w_{A,t} + (a/r_{t+1})(1 - l_{A,t}/n^*_{A,t})$ which is not possible when $w_{B,t} = (l_{A,t}/n^*_{A,t})w_{A,t}$.[19]

At equilibrium $n^*_{A,t} = N_A/m + N_B/m - l_{B,t}$, since the number of young residents in country A are those not working in country B.

The wage in country B is still given by the marginal productivityof labour, which depends on $l_{B,t}$ and $k_{B,t}$, and wages in country A are given by the same expression as the in autarkic equilibrium, depending on $l_{A,t}$ and $k_{A,t}$. Therefore the above arbitrage condition can be written in terms of $l_{B,t}$ and $k_{B,t}$, $l_{A,t}$ and $k_{A,t}$.

The equilibrium levels of $k_{B,t}$ and $k_{A,t}$ are still given as in the equilibrium with free capital movements as functions of k_t and of z_t, now depending on $l_{A,t}$ and $l_{B,t}$. Using this and the above arbitrage condition, plus the expressions defining wages in both countries as in the autarkic equilibrium we are able to derive $l_{A,t}$ as a function of $l_{B,t}$:

[18]The same equilibrium condition would be obtained if, instead of utility costs of repatriation we had assumed that those repatriated could not engage in the current labour market of their home country. This is because the level of n^*_A does not influence the bargaining solution given our assumption of underemployment.

[19]Natives from A are free to become a union member and engage in home production if unemployed. Given $w_{B,t} = (l_{A,t}/n^*_{A,t})w_{A,t}$, they would prefer that option rather than working in country B and receive $w_{B,t}$, since
$w_{B,t} < (l_{A,t}/n^*_{A,t})w_{A,t} + (a/r_{t+1})(1 - l_{A,t}/n^*_{A,t})$.

$$l_{A,t} = \left(\frac{1-\theta\alpha}{1-\theta}\right)^{\frac{v+\theta-1}{1-\theta}} \frac{l_{B,t}^{\frac{v}{1-\theta}}}{\alpha^{\frac{v+\theta}{1-\theta}}} \left(\frac{1}{N_A/m + N_B/m - l_{B,t}}\right)^{\frac{v+\theta-1}{1-\theta}} \equiv c\left(l_{B,t}\right) \quad (26)$$

Then, the capital accumulation equation, plus the equilibrium condition for country A, stating that $\bar{w}_t = a/\, r_{t+1}$, define our dynamic equilibrium in terms of a predetermined variable, k, and a non predetermined variable[20] l_B :

$$k_{t+1} = Ak_t^{\theta+v}\left[(1-\theta\alpha)\, c\left(l_{B,t}\right)^{1-\theta}\left(\frac{1}{1+z_t}\right)^{\theta+v} + (1-\theta)\, l_{B,t}^{1-\theta}\left(\frac{z_t}{1+z_t}\right)^{\theta+v}\right] \quad (27)$$

$$(1-\theta)\, Ak_t^{v+\theta}\left(\frac{1}{1+z_t}\right)^{v+\theta} c\left(l_{B,t}\right)^{-\theta} = a/\left\{\alpha\theta Ak_{t+1}^{v+\theta-1} c\left(l_{B,t+1}\right)^{1-\theta}\left(\frac{1}{1+z_{t+1}}\right)^{v+\theta-1}\right\} \quad (28)$$

where here:

$$z_t = \left[\alpha\left(\frac{c\left(l_{B,t}\right)}{l_{B,t}}\right)^{1-\theta}\right]^{\frac{1}{v+\theta-1}} \quad (29)$$

We assume that $n_A = n_B = n/2$. Our equilibria must satisfy (27) and (28) together with $l_{B,t} \leq n/2$ for every t since, as we have seen, there is no emigration from country A. The steady state solution (k, l_B) is given by:

$$k = \left[A\alpha^{-1}\left(\frac{1}{1+z}\right)^{\theta+\nu} z^{\theta+\nu-1}[(1-\theta\alpha) + (1-\theta)\alpha z]\right]^{\frac{1}{1-\theta-\nu}} \quad (30)$$

$$l_B = A^{-\nu}\alpha^{-\frac{1-(2+\theta)(\nu+\theta)}{\nu(1-\theta)}}\left(\frac{a}{(1-\theta)\theta}\right)^{\frac{1-\theta-\nu}{\nu}}[(1-\theta\alpha) + (1-\theta)\alpha z]^{\frac{1}{\nu}}\left(\frac{1}{1+z}\right)^{\frac{1-\theta-\nu}{\nu}} z \quad (31)$$

[20]Note that l_B is related to employment in country A through (25), which is still influenced by the expectations of future interest rates through the reservation wage.

We ensure the existence of a steady state equilibrium $(k, l_B\ )$ with $0 < l_B < n/2$ by choosing suitable values of the scale parameters A and a. Hence, if $l_B < n/2$ at the steady state then also $l_{B,t} \leq n/2$ for trajectories nearby the steady state.

In order to study the local stability properties we shall use the equilibrium dynamic system written in terms of k and l_A. Note that the equilibrium system (27)-(28) is identical to (12) and (13), or (14) and (15), obtained in the previous section where n_B should now be read as l_B, and where l_B is now a function of l_A through the implicit relation (26). As in (14) and (15) n_B is only relevant for the expressions H and X; the Jacobian matrix of the linearised system evaluated at the steady state is still given by (19), and we still have that at the steady state $s_s^B \leq s_k^B$ for $0 < \alpha \leq 1$.

However now l_B also depends on l_A through (26). Hence the elasticity of X and H with respect to l_A should now take into account the elasticity of l_B with respect to l_A. From (26) we obtain:

$$\frac{dc\left(l_B\right)/c\left(l_B\right)}{dl_B/l_B} = \left\{v - \left[1 - (\theta + v)\right]\frac{l_B}{n - l_B}\right\}\frac{1}{1-\theta} = \frac{v - \left[1 - (\theta + v)\right]s_P^B(l_B)}{1-\theta} \tag{32}$$

where $s_P^B(l_B)$ denotes the ratio of young active population leaving in country B versus young active population living in country A. Denoting by s_P^B its value evaluated at the steady state, and noting that at the steady state $0 < l_B < n/2$, we have that:

$$0 < s_P^B < 1 \tag{33}$$

From the definition of H and X and from (32) we obtain:

$$\frac{d\ln X}{d\ln l_A} = \frac{1-\theta}{\theta + v - 1}s_s^B\left[1 - \frac{1-\theta}{v + (v + \theta - 1)\,s_P^B}\right] \tag{34}$$

$$\frac{d\ln H}{d\ln l_A} = \frac{1-\theta}{\theta + v - 1}s_k^B\left[1 - \frac{1-\theta}{v + (v + \theta - 1)\,s_P^B}\right] \tag{35}$$

Using (34) and (35), we can now obtain the determinant and trace of our relevant Jacobian matrix (19):

$$D = \frac{(\theta+v)\left[v-(1-\theta-v)\,s_P^B\right]+(\theta+v)(1-\theta)\left(1+s_P^B\right)s_s^B}{(1-\theta)\left\{v-(1-\theta-v)\,s_P^B+(1-\theta-v)\left(1+s_P^B\right)s_k^B\right\}} \tag{36}$$

$$T = \frac{\left[v-(1-\theta-v)\,s_P^B\right]+(\theta+v)(1-\theta)\left(1+s_P^B\right)s_k^B+(1-\theta)\left(1+s_P^B\right)(1-\theta-v)\,s_s^B}{(1-\theta)\left\{v-(1-\theta-v)\,s_P^B+(1-\theta-v)\left(1+s_P^B\right)s_k^B\right\}} \tag{37}$$

Let us assume from now on that θ and v satisfy (24) i) and ii) and that:

$$s_P^B < \frac{v}{(1-\theta-v)} \tag{38}$$

This last requirement simply states a minimum level of emigration at the steady state.

In this case the denominator of the expressions for the trace and determinant are positive. Moreover $D > 0$. Since $T > 0$ we also have that $D > -T-1$. The necessary and sufficient conditions for indeterminacy are then:

$$\begin{aligned} D &< 1 \Longleftrightarrow \left(1+s_P^B\right)(1-\theta)\left[s_s^B(\theta+v)-s_k^B(1-\theta-v)\right] < \\ &< (1-2\theta-v)\left[v-(1-\theta-v)\,s_P^B\right] \end{aligned} \tag{39}$$

$$D > T-1 \Longleftrightarrow s_k^B - s_s^B < \frac{\left[v-(1-\theta-v)\,s_P^B\right]v}{(1-\theta)\left(1+s_P^B\right)\left[2(\theta+v)-1\right]} \tag{40}$$

We may then notice that indeterminacy will arise under the following configuration of parameters:

$$\begin{aligned} (i)\ 0 &< \theta < \frac{1}{2} \\ (ii)\ 1-2\theta &> v > \frac{1-2\theta}{2} \\ (iii)\ s_P^B &< \frac{v}{(1-\theta-v)} \\ (iv)\ s_s^B\tfrac{(\theta+v)}{(1-\theta-v)} - \tfrac{\left[v-(1-\theta-v)s_P^B\right](1-2\theta-v)}{(1-\theta)\left(1+s_P^B\right)(1-\theta-v)} &< s_k^B < \\ s_s^B + \tfrac{\left[v-(1-\theta-v)s_P^B\right]v}{(1-\theta)\left(1+s_P^B\right)[2(\theta+v)-1]} & \end{aligned} \tag{41}$$

Conditions (41i)-(24iii) are simply (24i), (24ii) and (38). The condition (41iv) ensures that (39) and (40) are both satisfied. One may notice that the latter is quite restrictive. First, since $\frac{(\theta+v)}{(1-\theta-v)} > 1$, it imposes an upper bound for s_s^B. If we want to interpret country B as the poor country this could be reasonable. However, the values for s_k^B such that indeterminacy arises would have to fall in a very small interval. One may check that if, for instance, $\theta = \frac{1}{3}$, $v = 0.2$ then s_s^B should take values smaller than 0.3286 in order for the interval defined in (41iv) not to vanish. Taking for instance the value $s_s^B = 0.3$, then s_k^B should satisfy $0.33877 < s_k^B < 0.34285$ for indeterminacy to arise. As soon as s_k^B takes values higher than 0.34285 the steady state becomes a saddle, hence determinate. Indeed the conditions for determinacy ($D < T - 1$) are:

$$\begin{aligned} (i)\ 0 &< \theta < \frac{1}{2} \\ (ii)\ 1-2\theta &> v > \frac{1-2\theta}{2} \\ (iii)\ s_P^B &< \frac{v}{(1-\theta-v)} \\ (iv)\ s_k^B &> s_s^B + \frac{\left[v-(1-\theta-v)\,s_P^B\right] v}{(1-\theta)\,(1+s_P^B)\,[2\,(\theta+v)-1]} \end{aligned} \tag{42}$$

Since $s_k^B > s_s^B$, the condition (24)(iv) is easily satisfied at least if the second term on the rhs is not too big. Indeed this condition requires a minimum level of capital imports by country B. Therefore, as long as a sufficient amount of labour migration and a sufficient amount of capital imports from the net capital importing country occurs at the steady state, we may expect determinacy to arise.

The difference with respect to the results of the case of no repatriation costs can be understood as follows. A shock to expectations about future interest rates has the same, immediate, effect on country A, as before. However, capital flows from A to B, following a decrease in the expected value of r_{t+1}, will now have an additional effect on the labour arbitrage condition. Indeed, besides inducing an increase in wages of country B, the probability of getting employment in country A will decrease. It may happen that $w_{A,t}l_{A,t}/n_{A,t}^*$ becomes lower than $w_{B,t}$. In this event there would be a movement of workers (natives from B) from country A towards country B. These

labour movements would counteract the effects of capital movements on interest rates, which may explain why indeterminacy is more difficult to occur.

5 Conclusions

In this paper we have developed a dynamic two-country model where the source of cross-country heterogeneity lies on labour market institutions. We have focussed our attention on the issue of factor mobility and derived two main results. The first result is that free capital movements, coupled with labour immobility, implies that the unionised country exports instability to the rest of the world. In the unionised country the equilibrium level of employment in each period is influenced by expectations of future interest rates through the workers' reservation wage which, in turn, make equilibrium employment fluctuations possible. In our model if the non-unionised country is poorer than the unionised country, allowing for free capital movements implies that the poor country becomes a net importer of capital and therefore more vulnerable to employment fluctuations. The second main result is that if labour mobility is also allowed the equilibrium property of the system may be altered. In particular, if workers are mobile and face repatriation costs it is possible to reach economic stability in the world market. What is crucial here is that these labour movements counteract the effects of capital movements on expectations about future interest rates that are the source of instability in our model.

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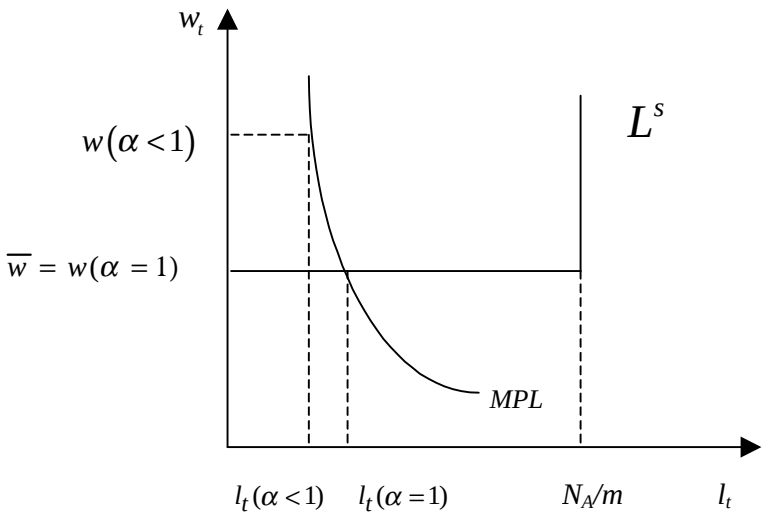

Figure 1: The labour market in the unionised country