Economic growth, international labour mobility, and unanticipated non-monetary shocks

George M. Agiomirgianakis\textsuperscript{a,}\textsuperscript{*}, Athina Zervoyianni\textsuperscript{b}

\textsuperscript{a}Department of Economics, City University, Northampton Square, London EC1V 0HB, UK
\textsuperscript{b}Department of Economics, University of Patras, Patras, Greece

Received 1 September 1997; accepted 1 December 1999

Abstract

Economic growth models often assume that the labour force of a country is fixed and unaffected by international conditions. In recent years, however, observed large labour flows internationally have questioned this assumption. In this paper, we extend a standard economic-growth model and examine the adjustment of a small open economy, operating under conditions of international labour mobility (ILM) in the presence of two unanticipated shocks: an asset-market shock and a goods-market shock. Our findings suggest that the presence of ILM affects the dynamic adjustment of the economy, in response to the two unanticipated shocks. In particular, we show that ILM reduces the variability of the real exchange rate following each shock. However, ILM may worsen or improve conditions of economic growth depending upon the nature of the unanticipated shock. This result has straightforward policy implications for open economies facing asymmetric shocks: countries prone to asset-market shocks stand to loose under ILM and should, therefore, adopt measures hindering ILM while countries prone to goods-market shocks stand to gain from ILM and should thus try to adopt measures encouraging ILM.

JEL classification: O1; F41; F22

Keywords: Economic growth; Open economy macroeconomics; International labour mobility
1. Introduction

Economic-growth models often assume that the labour force of a country is fixed and unaffected by international conditions. In recent years, however, we have observed large labour flows that question the above assumption. On the other hand, while the issue of international labour mobility (ILM) has been given much attention recently, it has been very little analysed in the context of a full macroeconomic framework. Few exemptions to this, are Agiomirgianakis (1996, 1997) and Zervoyianni and Agiomirgianakis (1997).

In this paper, we extend a standard economic-growth model and examine the adjustment of a small open economy, operating under conditions of ILM to two unanticipated non-monetary shocks, namely (unanticipated) exogenous increases in the demand for (real) bonds and for domestic goods. Our analysis shows that the presence of ILM is associated with three effects: “an employment effect”, “an output effect”, and “a real exchange rate effect”. That is, the presence of ILM, by increasing the sensitivity of labour supply to changes in the real exchange rate, will increase the sensitivity of domestic employment and domestic output to changes in the real exchange rate, induced by the two unanticipated shocks. In the context of our model, our findings suggest that the presence of ILM reduces the variability of the real exchange rate following each shock. Finally, the presence of ILM may worsen or improve conditions of economic growth depending upon the nature of the unanticipated shock.

The structure of the paper is as follows. Section 2 discusses the production side of the economy. The domestic economy is assumed to produce a single good. This single good is not the only output available for consumption but also an input for gross capital formation. Since our focus is on the macroeconomic effects of ILM, we relax the assumption of an inelastic labour supply, often made by the literature on economic growth, in favour of a labour supply depending upon the domestic real wage and foreign real wage. In Section 3, we present the macroeconomic model and examine the adjustment of the domestic economy to an exogenous increase in the demand for real bonds and in the demand for domestic output. In Section 4, the role of ILM in the results is investigated. Finally, Section 5 contains concluding comments.

2. The production side of the economy

A common assumption of much of the literature on capital formation, including Burmeister (1980), Chen (1975), Frenkel and Rodriguez (1975),

---

1 See, for example, Russell and Teitelbaum (1992), Turnovsky (1996), Van Tuijl, de Groof, and Kolnaar (1997), Widgren (1987), and Withers (1994).

2 Although recently, more emphasis is given to the macroeconomic consequences of ILM, see for example, Banerjee and Newman (1995), Canova and Ravn (1996), Francois and Nelson (1997), Gilles (1997), and Razin and Sadka (1995).
Murphy (1989), Obstfeld and Stockman (1985), and Pikoulakis (1981) is that, at any moment, the available supplies of all factors are inelastically supplied and fully utilised. This means that the quantities of factor services do not vary with changes in factor prices or other shorter-run economic considerations: at any moment, all existing labour or capital offers itself for use regardless of what wage or rental rates prevail. Therefore, factor rewards are determined from demand or productivity considerations. Here, we adopt a more general framework of analysis: we consider a small open economy with a flexible exchange rate that faces the possibility of a mobile domestic workforce that has two alternatives; i.e., to work in the home market or to work abroad. Thus, we relax the assumption of inelastic labour supply in favour of a labour supply function that depends upon two wages: the real domestic wage and the real foreign wage:\(^3\)

\[
L^s = \left( \frac{W}{P_i} \right)^{C_1} \left( \frac{W^*}{P_i} \right)^{-C_2}; \quad C_1 > C_2 > 0
\]  

where \(P (P^*)\) is the price of the home (foreign) good in domestic (foreign currency) units; \(W (W^*)\) the nominal domestic (foreign) wage in domestic currency (foreign currency) units; \(P_i\) is the consumer-price index (CPI) defined as (Eq. (2))

\[
P_i = P^\lambda (EP^*)(1-\lambda),
\]

where \(\lambda\) is the share of domestic goods in total domestic consumption and \(E\) is the nominal exchange rate (defined as units of domestic currency per unit of foreign currency).

Using the definition of \(P_i\) and also normalising the foreign nominal wage to one, we may rewrite Eq. (1) as

\[
L^s = \left( \frac{W}{P} \right)^{C_1} S^{-C_3}
\]

where \(S=(EP^*/P)\) is the real exchange rate and \(C_3=(1-\lambda) C_1 + \lambda C_2<0\) (Eq. (3)).

Labour supply is a positive function of the real product wage, \(W/P\), and a negative function of the real exchange rate, \(S\). Other things being equal, an increase in the real product wage induces home residents to increase their work-time. On the other hand, an increase in \(S\), a real exchange rate depreciation, reduces domestic labour supply through two distinct channels. First, it reduces the domestic real consumer wage. This effect is captured by the first term in the

---

\(^3\) A common assumption of the existing literature on labour migration is that wage differentials between countries generate international labour migration. See, for example, various papers in the May 1983 special issue of the Journal of International Economics on International Factor Mobility, as well as, Agiomirgianakis (1996), Burda (1993), Djajic (1985, 1987), Greenwood and McDowell (1986), Rodriguez (1976), Stark (1991), and Straubhaar and Zimmermann (1992). This assumption can in fact be traced back to Hicks (1932), who note that “...differences in net economic advantages, chiefly differences in wages, are the main causes of migration...”.
expression for $C_3$, i.e., $(1-\lambda)C_1$. Second, by increasing the foreign wage in terms of domestic currency units, it makes employment abroad more attractive than employment in the home economy. This effect, which is due to ILM, is captured by the second term in $C_3$, i.e., $(-\lambda C_2)$.

2.1. The optimisation conditions of the economy

Firms in the domestic economy operate under conditions of perfect competition and pursue maximisation of profits. Households own the stock of capital, which they rent to firms, and, for every unit of capital, there corresponds a claim to the ownership of that unit. Thus, the claims of ownership issued, to be called equities, are identically equal to the units of capital. We assume a Cobb–Douglas production function (Eq. (4)):

$$Q = L^\alpha K^{1-\alpha}$$  \hspace{1cm} (4)

where $Q$ is output, $K$ is capital, $L$ is labour, and $\alpha$ is the elasticity of output with respect to labour, $0<\alpha<1$.

The firms’ revenues are composed of sales of output net of investment, that is $L^\alpha K^{1-\alpha} - I$, and of sales of new shares resulting from new capital formation, that is $P_K \dot{K}$. The firms’ payments are composed of wages, i.e., $\omega L$, and the rental on capital $r_K K$. Therefore, profits are given by

$$\pi = L^\alpha K^{1-\alpha} - H(G) + P_K \dot{K} - \omega L - r_K K$$  \hspace{1cm} (5)

where $I$ is the units of output used in the production of $G$ units of installed capital; $I$ is a function of gross capital formation $G$, i.e., $I = H(G)$; $G \equiv \dot{K} + \delta K = \text{gross capital formation}$, $\dot{K}=(dK/dt)$; $P_K$ is the price of an equity, in terms of output; $\delta$ is the percentage rate of capital depreciation, a constant; $\omega = W/P$ is the real product wage rate; $r_K$ is the net rental on capital net of capital maintenance, measured in units of domestic output.

---

4 Today, it is increasingly recognised that international labour flows cannot be analysed in isolation from economic policies, see e.g., Agiomirgianakis (1998). As it would be clear shortly, in our macromodel, instead of considering ILM as a labour market phenomenon or a sectoral issue induced by fixed real wage differentials and hence unrelated to macroeconomic policies, we rather endogenise international labour flows. Hence, in the context of our macromodel, economic policies can affect international flows of labour that in turn can affect macroeconomic variables. For the role of macroeconomic policies and the real exchange rate in affecting migration flows, see e.g., Agiomirgianakis (1996, 1998), Bertola (1989), Francois and Nelson (1997), and Van der Ploeg (1995). Empirical evidence on the role of macroeconomic policies in inducing migration flows is provided by Ghosh (1992) and Okolski (1992). Ghosh, for example, notes that macroeconomic policies can affect migration flows in a variety of ways and he suggests a policy cooperation between countries in tackling migration flows. Okolski, for example, stresses the role of the (real) exchange rate: “...greatly overvalued Western currencies and the enormously high purchasing power at home of wages earned in EC countries by migrant workers from the Central and Eastern Europe were important stimuli to taking up temporary employment abroad...”.
The first-order conditions for a maximum of Eq. (5) are:

\[ \omega = \alpha \left( \frac{K}{L} \right)^{1-\alpha}, \]  
(5.1)

\[ r_K = (1 - \alpha) \left( \frac{K}{L} \right)^{-\alpha} \frac{-H'(\cdot)\delta}{}, \]  
(5.2)

\[ P_K = H'(\cdot). \]  
(5.3)

To derive a demand-for-labour function one may use Eq. (5.1) and the definition of \( \omega \):

\[ L^d = K \left( \frac{1}{\alpha} \left( \frac{W}{P} \right) \right)^{-\frac{1}{1-\alpha}}. \]  
(6)

Equilibrium in the labour market requires that \( L^d = L^s \). Solving Eqs. (3) and (6) for \( \omega \) and \( L \), one obtains (Eqs. (7)–(9))

\[ \omega = \alpha^{\psi_1} S^{\psi_2} K^{\psi_2} \]  
(7)

\[ L = \alpha^{C_1 \psi_1} S^{-\psi_1 C_3} K^{\psi_2 C_1} \]  
(8)

and,

\[ Q = \mu_0 S^{-\alpha \psi_1 C_3} K^{(1+C_1)\psi_2} \]  
(9)

where

\[ \mu_0 = \alpha^{\alpha C_1 \psi_1} > 0, \quad \psi_1 = \frac{1}{1 + C_1(1 - \alpha)} > 0 \text{ and } \psi_2 = (1 - \alpha) \psi_1 > 0. \]

Eq. (5.3) in the set of the first-order conditions (5.1)–(5.3), states that the marginal cost of installing capital, measured in output units equals the market price of capital, \( P_K \). Inverting Eq. (5.3), we get (Eq. (10))

\[ G \equiv \dot{K} + \delta K = h(P_K), \quad h'(P_K) = \frac{1}{H''(\cdot)} > 0, \quad h(1) = 0. \]  
(10)

Assuming no population growth, one can derive the evolution of the capital stock (Eq. (11)):

\[ \dot{K} = h(P_K) - \delta K. \]  
(11)
3. The macroeconomic model

The domestic economy can be described by the following set of equations:

\[ \frac{M}{P} = L(Q(S, K)), \quad L'(\cdot) > 0 \]  
\[ B = F(\rho, \rho^*)w + U_1, \quad F_1 < 0, \quad F_2 > 0 \]  
\[ w = B + P_K K \]  
\[ \rho = \frac{r_K K}{P_K K} + \frac{\hat{P}_K^e}{P_K} = \frac{Q_K}{P_K} - \delta + \frac{\hat{P}_K^e}{P_K} \]  
\[ Q(S, K) - I(P_K) = D(Q(S, K)) + X(S) + U_2 \]  
\[ X'(. \cdot) > 0, \quad D' > 0, \quad 0 < D' < 1, \quad I'(. \cdot) > 0, \]

where \( M \) is the money stock; \( w \) is real wealth; \( \rho \) is the market rate of return on domestic equity; \( B \) is the number of claims by residents on non-residents; \( \rho^* \) is the market rate of return on \( B \); \( U_1 \) is a shift variable in the bond demand function; \( U_2 \) is a shift variable in the aggregate demand function.

The short-run equilibrium of the model is described by Eqs. (12)–(15). Eq. (12) is the money-market equilibrium condition. Eq. (13) describes the demand for bonds. We assume that non-monetary wealth, \( w \), consists of the market value of the entire stock of capital (held in the form of equity by domestic residents alone) and claims on non-residents. These claims on non-residents, \( B \), are assumed to be real bonds expressed and denominated in units of the domestic consumption goods.

Eq. (14) is the definition of the domestic real interest rate, while Eq. (15) describes equilibrium in the market for the home produced goods.

In Eq. (12), we assume a quantity theory of money, i.e., real money balances depend positively on the volume of transactions proxied by domestic output. In Eq. (13), we adopt a portfolio-balance approach to model claims abroad. Accordingly, the part of non-monetary wealth held in the form of these claims is a decreasing function of the market rate of return on equities, \( \rho \), and an increasing function of its own market rate of return \( \rho^* \). By assumption, \( \rho^* \) is exogenous. In Eq. (14), the domestic real interest rate is the sum of two components: the rental component and the capital-gain component. The rental component is the ratio of the rental income on domestic capital, \( r_K K \) to the market value of this capital, \( P_K K \).

The left-hand side of Eq. (15) gives the supply of domestic output available for consumption, while the right-hand side gives the demand for domestic output for consumption purposes. Since the left-hand side of this equation has already been analysed in Section 2, we focus our attention on the right-hand side. Aggregate demand consists of two components: total domestic consumption \( D(\cdot \cdot) \) and net exports demand \( X(\cdot \cdot) \). Total domestic consumption is taken to depend
positively on the domestic output. Net exports demand are taken to be an increasing function of the real exchange rate.

At any point in time $K$ and $B$ are predetermined: the stock of real bonds can change only over time through current account imbalances and the stock of capital changes only over time through investment. In addition, $M$ is policy-determined. Therefore, given expectations, there are four equations in four unknowns: $P, P_K, S, \rho$.

Over time, the evolution of capital, is given by (Eq. (16))

$$\dot{K} = h(P_K) - \delta K.$$  \hspace{1cm} (16)

The current account can be described by (Eq. (17))

$$\dot{B} = X(S).$$ \hspace{1cm} (17)

The third dynamic equation describes the evolution of $P_K$ and is given by Eq. (14) that we rewrite here as (Eq. (18))

$$\dot{P}_K = (\rho + \delta)P_K - Q_K(S, K).$$ \hspace{1cm} (18)

Therefore, as the economy moves from one steady state to another, there are six equations to be considered, i.e., Eqs. (12) and (13) and Eqs. (15)–(18) in six endogenous variables: $P, P_K, S, \rho, K$, and $B$.

We make the assumption of rational expectations, which, in the context of our model amounts to perfect foresight (i.e., we set $\dot{P}_K = \dot{P}_K$) and we also focus on small deviations from an initial steady state. This allows us to write the model as a linear third-order differential equations system (Eq. (19)):

$$\begin{bmatrix} \dot{\hat{P}}_K \\ \dot{\hat{K}} \\ \dot{\hat{B}} \end{bmatrix} = \begin{bmatrix} V_3 & -V_2 & V_1 \\ \frac{1}{2} & -\delta & 0 \\ \sigma_2 & -\sigma_1 & 0 \end{bmatrix} \begin{bmatrix} \hat{P}_K \\ \hat{K} \\ \hat{B} \end{bmatrix} + \begin{bmatrix} -\frac{\overline{P}_K}{F_1 W} & -\frac{Z_4}{\theta_1} & 0 \\ 0 & 0 & 0 \\ 0 & \frac{X'(\cdot)}{\theta_1} & 0 \end{bmatrix} \begin{bmatrix} du_1 \\ du_2 \end{bmatrix}$$ \hspace{1cm} (19)

where

$$V_1 = \frac{\overline{P}_K[1 - F(\cdot)]}{F_1 W} < 0, \quad V_2 = Z_3 - Z_4\theta'_3 < 0, \quad V_3 = Z_2 - Z_4\theta'_2 \leq 0,$$

$$Z_2 = \frac{Q_K - \overline{P}_KF(\cdot)}{wF_1} > 0, \quad Z_3 = Q_{KK} - \frac{\overline{P}_K^2F(\cdot)}{wF_1} < 0, \quad Z_4 = Q_{KS} < 0,$$

$$\theta_2 = I'(\cdot) > 0, \quad \theta_3 = (1 - D')Q_K > 0, \quad \sigma_1 = X'(\cdot)\theta'_3 < 0, \quad \sigma_2 = X'(\cdot)\theta'_2 < 0,$$

$$\theta'_2 = \frac{I'(\cdot)}{(1 - D')Q_s - X'(\cdot)} < 0, \quad \theta'_3 = \frac{(1 - D')Q_K}{(1 - D')Q_s - X'(\cdot)} < 0.$$
4. The role of ILM in the short run and the dynamic adjustment of the economy to unanticipated shocks

At this point it should be noted that since ILM is simply generated by changes in the real exchange rate and since \( S \) remains unchanged from one steady state to another, the presence of ILM has no impact on the long-run properties of the model. However, because in the short run and over time the real exchange rate changes, it may affect the impact and the dynamic effects of the unanticipated shocks \( U_1 \) and \( U_2 \).

To investigate how the presence of ILM affects the short run and dynamic adjustment of the economy to the shocks, we consider three cases:

- “Low ILM”: \( C_1 = 1 \) and \( C_2 = 0.2 \),
- “Moderate ILM”: \( C_1 = 1 \) and \( C_2 = 0.5 \),
- “High ILM”: \( C_1 = 1 \) and \( C_2 = 1 \).

In Appendix A, we discuss the assumed values of the exogenous parameters of the model, we also report there the values taken by the model’s endogenous variables, while here we make use of their graphs. Our numerical results, suggest that the degree of ILM affects both the impact effects and the time paths of \( L, Q, \) and \( S \), as can be seen from Figs. 1(a–c) and 2(a–c). Indeed, we can distinguish here three effects of ILM: (a) the employment effect, (b) the output effect,\(^5\) and (c) the real exchange rate effect.\(^6\) Through these three effects, the presence of ILM is shown to affect the accumulation of capital as well as the accumulation of real bonds.

We shall analyse these effects for each shock. Consider first the impact effects of the change in \( U_1 \). An unanticipated increase in \( U_1 \) causes a real exchange rate depreciation in the short run. This induces workers to undertake work abroad rather than work at home, resulting in a fall in domestic employment. The higher the degree of ILM the stronger the response of the domestic workforce to the real exchange rate depreciation and thus the greater the fall in domestic employment. The “employment effect” is illustrated in Fig. 1(a), where \( L_1, L_2, \) and \( L_3 \) correspond to the case of low, moderate, and high ILM, respectively. In the first two cases of ILM, the short-run fall in domestic employment \( (L_1, L_2) \) is less than its fall over time (caused by the initial fall in the capital stock). With high ILM, the short-run fall in domestic employment exceeds its fall over time. In fact, having fallen to its lower point in the short run, domestic employment increases over time before returning to its initial steady-state value.

The “employment effect” in turn creates an “output effect”: increased ILM leads to a larger fall in output both in the short run and over time (see Fig. 1(b)).

\(^5\) As Ghosh (1996, p. 90) notes “empirical evidence in several labour-sending countries confirms the negative consequences of labour outflows on employment”. On the other hand, Smolny’s (1991) findings suggest that immigration in West Germany had positive employment and output effects.

\(^6\) For the real exchange rate effect on labour flows, see the references cited in footnote 4.
The "output effect" in turn creates a "real exchange rate effect". This effect works through the goods-market equilibrium condition: because increased ILM is associated with a larger fall in output, a smaller rise in $S$ is required to maintain equilibrium in the goods-market. The "real exchange rate effect" is illustrated in Fig. 1(c): as the value of $C_2$ increases, the size of the rise in $S$ in the short run and its fall over time decreases. Thus, exchange rate variability is lower under ILM.

The "output effect" and the "real exchange rate effect" will in turn affect both the accumulation of capital and the accumulation of real bonds. We shall examine first the accumulation of real bonds. Due to the "real exchange rate effect" of ILM the accumulation of real bonds will be lower. Indeed, increased ILM, by resulting a lower real exchange rate depreciation both on impact and over time, will lead to a lower current account surplus and thus to a lower accumulation rate of real bonds over time. Consider, next, the accumulation of capital. The "output effect" of ILM will result a larger fall in the capital stock. Indeed, increased ILM, by resulting a lower output supply both on impact and over time, will require a larger fall in $P_K$ to keep equilibrium in the goods-market, Eq. (15). Thus, increased ILM, by lowering the profitability of capital will result a larger fall in the capital stock.

We turn now to the impact effects of an aggregate demand shock. An unanticipated increase in $U_2$, by creating excess demand for domestic output, will cause a real exchange rate appreciation. This will induce workers to undertake more work in the home country rather than abroad, thus, resulting in a rise in domestic employment. As the degree of ILM increases the response of the domestic
workforce to the real exchange rate appreciation also increases resulting in a larger rise in domestic employment. This “employment effect” is illustrated in Fig. 2(a).

Over time, as the real exchange rate depreciates and the capital stock falls, employment is reduced. The “output effect” of ILM is illustrated in Fig. 2(b), that is, the higher the degree of ILM the larger the rise in domestic output in the short run and the larger the fall over time. The “output effect” of ILM reduces the magnitude of the short-run real exchange rate appreciation: see Fig. 2(c), where an increase in $C_2$ lowers the size of the fall in $S$. Once more, exchange rate variability is lower under ILM.

The “output effect” and the “real exchange rate effect” will in turn affect both the accumulation of capital and the accumulation of real bonds. Consider, first, the accumulation of real bonds. The “real exchange rate effect” of ILM will reduce the rate of decrease in the stock of real bonds. Indeed, increased ILM, by resulting a lower real exchange rate appreciation will lead to a relatively lower current account deficit and thus to a lower decrease in the stock of real bonds over time. Consider, next, the accumulation of capital. The “output effect” of ILM will result a lower fall in the capital stock. Indeed, increased ILM, by resulting to a higher output supply both on impact and over time, will require a lower fall in $P_K$ to keep equilibrium in this market. The lower fall in $P_K$ will in turn result a lower fall in the stock of capital over time.

Empirical evidence suggest that migration flows affect the capital stock, see e.g., Simon and Heins (1985).
Thus, although the exchange rate variability is less with ILM under both unanticipated shocks, economic growth is affected differently. Indeed, under a $U_1$ shock ILM worsens economic growth while under a $U_2$ shock ILM improves economic growth. The crux of the matter lies on the effect of each unanticipated shock on the real exchange rate. An unanticipated increase in $U_1$, by resulting a real exchange rate depreciation, leads to an outflow of labour and thus to a lower capital profitability. As a result, ILM worsens economic growth. On the other hand, an unanticipated increase in $U_2$, by resulting a real exchange rate appreciation, leads to an inflow of labour and thus to a higher capital profitability. As a result, ILM improves conditions of economic growth.

5. Conclusions

Economic-growth models often assume that the labour force of a country is fixed and unaffected by international conditions. In recent years, however, we have observed large labour flows internationally that question this assumption. Moreover, the recent revival of the literature on the theory of optimum currency areas (OCA) has stressed the role of ILM in affecting the adjustment of economies to shocks (see e.g., Bayoumi & Eichengreen, 1997, 1998; Frankel & Rose, 1996; Nikolakaki, 1997).

In this paper, we extend a standard economic-growth model and examine the adjustment of a small open economy, operating under conditions of ILM to two unanticipated non-monetary shocks namely, unanticipated exogenous increases in the demand for real bonds and for domestic goods.

Although the presence of ILM does not affect the long-run properties of the model, it affects the size of the impact effects as well as the dynamics of adjustment. In particular, we show that the presence of ILM is associated with three effects: “an employment effect”, “an output effect”, and “a real exchange rate effect”. That is, the presence of ILM, by increasing the sensitivity of labour supply to changes in the real exchange rate, will increase the sensitivity of domestic employment and output to changes in the real exchange rate, induced by the two unanticipated shocks.

In the context of our model, where capital is not mobile internationally, our findings suggest two policy implications of ILM. First, the presence of ILM reduces the variability of the real exchange rate following each shock. This result is along the lines of the OCA theory. Indeed, quoting Bayoumi and Eichengreen (1998) “…variables pointed out by theory of OCA help to explain patterns of exchange rate variability…”. Second, our analysis also shows that the presence of ILM may worsen or improve conditions of economic growth depending upon

---

8 Empirical evidence of the effects of migration flows on economic growth are examined in a number of studies, see e.g., Ghatak, Levine, and Price (1996) for an excellent review of the literature. For the negative effects of labour flows to the economic growth, see Dolado, Goria, and Ichino (1993).
the nature of the unanticipated shock. In particular, we show that under ILM, an asset-market shock leads to an outflow of labour and thus to lower capital profitability resulting in a worsening of economic growth. On the other hand, a goods-market shock, under ILM, will lead to an inflow of labour, resulting in an improvement of economic growth. This result has straightforward policy implications for open economies facing asymmetric shocks: countries prone to asset-market shocks stand to lose from ILM and should therefore adopt measures hindering ILM while countries prone to goods-market shocks stand to gain from ILM and should thus adopt measures encouraging ILM.

Acknowledgments

Thanks are due to the participants of the BESI Conference, Athens, Greece, 18–22 July 1997, for useful suggestions and comments on an earlier version of the paper.

Appendix A

For the numerical analysis we have assumed the following parameter values, which are similar to most existing papers using numerical analysis, see e.g., Bhandari and Genberg (1989) and Zervoyianni (1992).

Non-ILM parameters:

\[ \alpha = 0.5, \quad \bar{B} = 0.3733, \quad \bar{K} = 1, \quad \bar{S} = 1, \quad \delta = 0.06, \quad \bar{F}(\cdot) = 0.25, \]
\[ c_1 = 1, \quad \bar{w} = 1.49, \quad I'(\cdot) = \frac{H'(\cdot)}{H''(\cdot)} = \frac{\bar{P}_K}{2} = 0.56, \quad F_1 = -5 \]

\[ \bar{U}_1 = 1, \quad \bar{U}_2 = 0.09, \quad X'(\cdot) = 0.5, \quad D_2 = 0.9. \]

Numerical values for the paths of the endogenous variables are reported below, where for any reported variable \( X_{ij} \) the first subscript indicates the unanticipated shock, i.e., \( (1) = U_1 \) or \( (2) = U_2 \), while the second one indicates the case of international mobility, i.e., \( (1) = \text{low}, \) \( (2) = \text{moderate}, \) \( (3) = \text{high}. \)

<table>
<thead>
<tr>
<th>Time</th>
<th>( K_{11} )</th>
<th>( K_{12} )</th>
<th>( K_{13} )</th>
<th>( B_{11} )</th>
<th>( B_{12} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1</td>
<td>-0.31323</td>
<td>-0.31469</td>
<td>-0.31509</td>
<td>0.56513</td>
<td>0.56147</td>
</tr>
<tr>
<td>2</td>
<td>-0.25726</td>
<td>-0.25780</td>
<td>-0.25805</td>
<td>0.70240</td>
<td>0.69846</td>
</tr>
<tr>
<td>3</td>
<td>-0.21129</td>
<td>-0.21200</td>
<td>-0.21357</td>
<td>0.81514</td>
<td>0.81113</td>
</tr>
<tr>
<td>4</td>
<td>-0.17354</td>
<td>-0.17411</td>
<td>-0.17557</td>
<td>0.90774</td>
<td>0.90381</td>
</tr>
<tr>
<td>5</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.3333</td>
<td>1.3333</td>
</tr>
<tr>
<td>Time</td>
<td>( P_{K11} )</td>
<td>( P_{K12} )</td>
<td>( P_{K13} )</td>
<td>( S_{11} )</td>
<td>( S_{12} )</td>
</tr>
<tr>
<td>------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>0</td>
<td>-0.20607</td>
<td>-0.20626</td>
<td>-0.20657</td>
<td>0.22555</td>
<td>0.22333</td>
</tr>
<tr>
<td>1</td>
<td>-0.035120</td>
<td>-0.035304</td>
<td>-0.035603</td>
<td>0.0060490</td>
<td>0.006320</td>
</tr>
<tr>
<td>2</td>
<td>-0.028846</td>
<td>-0.029038</td>
<td>-0.029355</td>
<td>0.0049680</td>
<td>0.0049620</td>
</tr>
<tr>
<td>3</td>
<td>-0.023691</td>
<td>-0.023885</td>
<td>-0.024204</td>
<td>0.0040800</td>
<td>0.0040810</td>
</tr>
<tr>
<td>4</td>
<td>-0.019458</td>
<td>-0.019646</td>
<td>-0.019957</td>
<td>0.0027520</td>
<td>0.0033570</td>
</tr>
<tr>
<td>5</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>( Q_{11} )</th>
<th>( Q_{12} )</th>
<th>( Q_{13} )</th>
<th>( L_{11} )</th>
<th>( L_{12} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-0.033081</td>
<td>-0.048380</td>
<td>-0.073240</td>
<td>-0.066161</td>
<td>-0.096770</td>
</tr>
<tr>
<td>1</td>
<td>-0.20980</td>
<td>-0.21110</td>
<td>-0.21235</td>
<td>-0.10619</td>
<td>-0.10701</td>
</tr>
<tr>
<td>2</td>
<td>-0.17284</td>
<td>-0.17344</td>
<td>-0.17395</td>
<td>-0.089111</td>
<td>-0.089430</td>
</tr>
<tr>
<td>3</td>
<td>-0.14235</td>
<td>-0.14288</td>
<td>-0.14421</td>
<td>-0.072124</td>
<td>-0.072737</td>
</tr>
<tr>
<td>4</td>
<td>-0.11681</td>
<td>-0.11748</td>
<td>-0.11861</td>
<td>-0.058828</td>
<td>-0.059828</td>
</tr>
<tr>
<td>5</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>( \rho_{11} )</th>
<th>( \rho_{12} )</th>
<th>( \rho_{13} )</th>
<th>( K_{21} )</th>
<th>( K_{22} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.12703</td>
<td>0.12703</td>
<td>0.12702</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1</td>
<td>0.064243</td>
<td>0.064549</td>
<td>0.065052</td>
<td>-1.0784</td>
<td>-1.0709</td>
</tr>
<tr>
<td>2</td>
<td>0.052763</td>
<td>0.053093</td>
<td>0.053636</td>
<td>-2.0111</td>
<td>-1.9986</td>
</tr>
<tr>
<td>3</td>
<td>0.043335</td>
<td>0.043671</td>
<td>0.044004</td>
<td>-2.7772</td>
<td>-2.7616</td>
</tr>
<tr>
<td>4</td>
<td>0.035591</td>
<td>0.035920</td>
<td>0.03610</td>
<td>-3.4063</td>
<td>-3.3893</td>
</tr>
<tr>
<td>5</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-6.2981</td>
<td>-6.2981</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>( B_{21} )</th>
<th>( B_{22} )</th>
<th>( B_{23} )</th>
<th>( P_{K21} )</th>
<th>( P_{K22} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.018674</td>
<td>-0.018508</td>
</tr>
<tr>
<td>1</td>
<td>-2.8449</td>
<td>-2.8252</td>
<td>-2.7929</td>
<td>-0.17051</td>
<td>-0.16936</td>
</tr>
<tr>
<td>2</td>
<td>-5.1323</td>
<td>-5.1006</td>
<td>-5.0484</td>
<td>-0.27509</td>
<td>-0.27343</td>
</tr>
<tr>
<td>3</td>
<td>-7.0110</td>
<td>-6.9721</td>
<td>-6.9081</td>
<td>-0.36098</td>
<td>-0.35903</td>
</tr>
<tr>
<td>4</td>
<td>-8.5540</td>
<td>-8.5116</td>
<td>-8.4415</td>
<td>-0.43153</td>
<td>-0.42945</td>
</tr>
<tr>
<td>5</td>
<td>-15.9760</td>
<td>-15.9760</td>
<td>-15.9760</td>
<td>-0.75577</td>
<td>-0.75577</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>( S_{21} )</th>
<th>( S_{22} )</th>
<th>( S_{23} )</th>
<th>( Q_{21} )</th>
<th>( Q_{22} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-0.15547</td>
<td>-0.15398</td>
<td>-0.15116</td>
<td>0.022802</td>
<td>0.033362</td>
</tr>
<tr>
<td>1</td>
<td>-0.10080</td>
<td>-0.10020</td>
<td>-0.099205</td>
<td>-0.70416</td>
<td>-0.69222</td>
</tr>
<tr>
<td>2</td>
<td>-0.082788</td>
<td>-0.082414</td>
<td>-0.081796</td>
<td>-1.3286</td>
<td>-1.3145</td>
</tr>
<tr>
<td>3</td>
<td>-0.067995</td>
<td>-0.067788</td>
<td>-0.067443</td>
<td>-1.8415</td>
<td>-1.8264</td>
</tr>
<tr>
<td>4</td>
<td>-0.055845</td>
<td>-0.055757</td>
<td>-0.055608</td>
<td>-2.2627</td>
<td>-2.2474</td>
</tr>
<tr>
<td>5</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-4.1987</td>
<td>-4.1987</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>( L_{21} )</th>
<th>( L_{22} )</th>
<th>( L_{23} )</th>
<th>( \rho_{21} )</th>
<th>( \rho_{22} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.045603</td>
<td>0.066724</td>
<td>0.10104</td>
<td>-0.6250E-3</td>
<td>-0.6200E-3</td>
</tr>
<tr>
<td>1</td>
<td>-0.32990</td>
<td>-0.31355</td>
<td>-0.28672</td>
<td>0.23961</td>
<td>0.23795</td>
</tr>
<tr>
<td>2</td>
<td>-0.64609</td>
<td>-0.63048</td>
<td>-0.60481</td>
<td>0.43091</td>
<td>0.42824</td>
</tr>
</tbody>
</table>
References


