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Financial liberalization, openness and convergence

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Abstract

All industrialized nations relied on capital account controls for significant periods of their economic development and relaxations of capital account restrictions thought to be an integral aspect of economic development. Economists long advocated the removal of capital controls as a stabilizing factor of the development process to improve efficiency and return economies from distorted factor prices to production frontiers. Empirically, however, financial liberalizations have become associated with capital flow reversals, where initial capital inflows at the onset are subsequently offset by capital outflows resulting in higher levels of accumulated indebtedness. We investigate how capital flow reversals caused by financial liberalizations affect the speed of convergence of an economy. We show that financial liberalizations reduce short run convergence speeds, implying that open economies should experience significantly less output volatility but also longer transitions. The increased smoothness in response to initial shocks comes at a cost: as foreign borrowing rises to smooth domestic income fluctuations causing an increase in the domestic interest rate OECD data confirms our findings.

Keywords

Financial liberalization, openness, convergence

1. INTRODUCTION

All industrialized nations have relied on capital account controls for significant periods of their economic development. For example, Germany maintained strict capital controls until 1974, France and Italy imposed significant capital controls well into the 1980s, and Japan did not liberalize its capital account until 1979, sustaining EuroYen/Yen interest differentials in excess of 10 per cent per annum. Even the UK, as the centre of Euromarket activity, maintained strict controls until 1979 (Frankel, 1984;

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and Dooley and Isard, 1980). Today, quasi-governmental financial institutions and capital account restrictions continue to dominate financial sectors in many developing countries.

Privatizations of state-controlled banking systems and relaxations of capital account restrictions are generally accepted as integral aspects of economic development. Economists have long advocated the removal of capital controls as a *stabilizing* factor of the development process to improve efficiency and return economies from distorted factor prices to production frontiers. Ambitious and unconditional financial liberalization of the capital account was thought to be the *only* appropriate path to development (see World Bank, 1989) – at least until the advent of the financial crises in the 1990s.

Empirically, however, financial liberalizations have become associated with capital flow reversals, where initial capital inflows at the onset are subsequently offset by capital outflows resulting in higher levels of accumulated indebtedness (see Bacchetta and van Wincoop, 1998; and Eicher *et al*. 2000). Rodrik (1998, 2000) shows that financial liberalizations often generate subsequent financial crashes, and Stiglitz (1999) has long advocated limits to capital flows to moderate those boom-bust patterns that have been empirically linked to financial deregulation.[1]

In this paper we investigate how capital flow reversals caused by financial liberalizations affect the speed of convergence of an economy. Central to the analysis is the investigation of how openness (access to international capital markets) mediates the effects of financial liberalizations on the speed of convergence as the removal of capital account distortions induces the economy to transition to a new growth path.[2]

To our knowledge, the determinants of the interaction between financial liberalizations and the speed of convergence have not been studied in the financial liberalization literature. Previous growth models, such as the AK model, do not exhibit transition dynamics in the absence of adjustment/installation costs, while standard endogenous growth models produce transition paths with constant adjustment speeds (Bond *et al*., 1996). In this paper we follow the Eicher and Turnovsky (1999a) approach in which the open economy is rooted in the class of growth models that has been shown to best replicate the long run performance of industrialized nations.

The model we utilize falls into the class of so-called non-scale, or semi endogenous, growth models. The key feature of this class of models is that, while growth is endogenous, policy is not effective in altering the long-term growth rate. Specifically, a one-off change in tax rates will only have a level effect on income in a non-scale model, while an AK model predicts a permanently changed rate of growth. The implications of the non-scale model thus accord well with key features of OECD countries in the last century in terms of R&D intensity and convergence (see Jones, 1995; and

Eicher and Turnovsky, 1999c). This paper is the first to calibrate an open economy non-scale growth model, and to examine the effects of financial liberalizations on the transition convergence speed of an economy.

The general advantage of non-scale models is not only the ease with which they replicate key features of industrialized economies; they also allow for differential convergence speeds and non-monotonic transition paths. This feature permits speeds and directions of capital flows to differ in the short versus the long run. This clearly contrasts with previous open economy growth models where convergence speeds are constant and capital flows are in one direction only.

We show that financial liberalizations reduce short run convergence speeds, implying that open economies should experience significantly smaller swings in output but also longer transitions to the new equilibrium. The increased smoothness in response to initial shocks comes at a cost: as foreign borrowing increases to smooth domestic income fluctuations, the domestic interest rate rises to reflect an increase in the country-specific risk premium. OECD data presented in Section 4 support this finding.

2. A MODEL OF OPENNESS AND FINANCIAL LIBERALIZATION

In this section we present the Eicher and Turnovsky (1999a) model, which is to be calibrated below. Consider a small open economy that consumes and produces a single, traded commodity, Y. Individuals supply a fixed quantity of labour, L_i; population, N, grows at the rate, $\dot{N} = nN$. Each individual produces output, Y_i, according to

$$Y_i = \alpha' L_i^{1-\sigma} K_i^{\sigma} K^{\eta} \equiv a K_i^{\sigma} K^{\eta}, \; 0 < \sigma < 1, \; \eta \gtrless 0 \tag{1}$$

where, K_i, is the individual capital stock, and $K = NK_i$ then represents the aggregate capital. Capital does not depreciate rendering a net rate of capital accumulation at

$$\dot{K}_i = I_i - nK_i \tag{2}$$

Investment is subject to Hayashi (1982) type adjustment (installation) costs

$$\Phi[I_i, K_i] = I_i + h\frac{I_i^2}{2K_i} = I, \left(1 + \frac{h}{2}\frac{I_i}{K_i}\right) \tag{3}$$

The linear homogeneity of the adjustment costs is necessary to obtain sustained stationary growth rates in equilibrium.

Individuals maximize utility derived from consumption $C \,/\, N = C_i$:

$$\int_o^{\infty} \frac{1}{\gamma} C_i{}^{\gamma} \mathrm{e}^{-\rho t} \mathrm{d}t \tag{4}$$

which implies an intertemporal elasticity of substitution of $1/(1-y)$.

When demand for capital exceeds domestic savings, domestic agents can seek to borrow on the world capital market. To replicate the fact that countries are charged interest rates above the risk free London Interbank Borrowing Rate (LIBOR), our model features borrowing costs that depend on country-specific risk. We follow Eicher and Turnovsky (1999a) by incorporating the creditworthiness of the economy into the model, based on the world capital market's assessment of an economy's ability to service its aggregate debt, Z. Much like the *Standard and Poor's* credit ratings, the assumption is that the country-specific risk premium is a function of the country's specific debt-capital (equity) ratio:[3]

$$r[Z/K] = r^* + \omega[Z/K];\ \omega' > 0 \tag{5}$$

where r^* represent the world interest rate (LIBOR) and ω[Z/K]is the function that incorporates the country-specific borrowing premium, increasing in the nation's debt–capital ratio. Empirical evidence for this country-specific interest equation is provided in Edwards (1984), who shows a positive relationship between the spread over LIBOR (e.g. r^*) and the debt–GNP ratio. In addition, Sachs (1984) and Cooper and Sachs (1985) have suggested that countries that are adopting growth-oriented policies often face interest rates that incorporate risk premiums that depend on debt to equity levels.

In examining the effects of financial liberalization on the economy we start in a distorted economy. We introduce taxes on output, consumption and foreign debt, all of which are rebated lump sum to the individual agents by the government in form of transfers, T_i. Income from current production is taxed at the rate τ_y, consumption is taxed at the rate τ_c, and owed interest on debt is subsidized at the rate τ_z. The degree to which τ_z distorts the economy is taken to be a proxy of openness in this economy.[4]

The individual's budget constraint then represents that an increase in individual debt is the result of consumption, outstanding interest payments plus investment expenses exceeding income and transfers

$$\dot{Z}_i = (1+\tau_c)C_i + I_i\left(1 + \frac{h}{2}\frac{I_i}{K_i}\right) - 1 - \tau_y)Y_i + \left((1-\tau_z)r\left[\frac{Z}{K}\right] - n\right)Z_i - T_i \tag{6}$$

The present value Hamiltonian that characterizes the individual's optimization is given by

$$\frac{C_i{}^{\gamma}e^{-\rho t}}{\gamma}+q_i'\mathrm{e}^{-\rho t}\left(I_i-\dot{K}_i\right)$$

$$+\lambda_i e^{-\rho t}\left\{(1-\tau_y)\alpha K_i^{\sigma}\ K^{\eta}-\left(r\left[\frac{Z}{K}\right](t-\tau_2)-n\right)Z_i-(1+\tau_c)C_i-I_i\left(1+\frac{h}{2}\frac{I_i}{K_i}\right)+T_i+\dot{Z}_i\right\} \tag{7}$$

where λ_i is the shadow value of wealth in the form of internationally traded bonds and q_i' is the shadow value of the individual capital stock. We define $q_i \equiv q_i'/\lambda_i$ as the market value of capital in terms of the (unitary) price of foreign bonds. The optimality conditions yield a rate of capital accumulation of[5]

$$\frac{\dot{K}_i}{K_i}=\frac{I_i}{K_i}-n=\frac{q-1}{h}-n\equiv\phi_i \tag{8}$$

which implies a growth rate of the aggregate capital stock of

$$\frac{\dot{K}}{K}=\frac{I}{K}=\frac{q-1}{h}\equiv\phi \tag{9}$$

Along the equilibrium path, aggregate output and the capital stock grow at the same constant rate. To derive this stationary state as well as the transition in response to policy shocks, we sum over the individual production functions of all N agents to obtain the aggregate production function:

$$Y=\alpha K^{\eta+\sigma}\ N^{1-\sigma}\ \equiv\alpha K^{\sigma_K}\ N^{\sigma_N} \tag{10}$$

where: $\sigma_N \equiv 1-\sigma$ and $\sigma_K \equiv \sigma + \eta$ represent shares of labour and capital in aggregate output, respectively. The total returns to scale are then given by $\sigma_K+\sigma_N = 1+\eta$ of the social aggregate production function. Taking percentage changes of the aggregate production function and imposing the long-run condition of a constant Y/K ratio, the long-run equilibrium growth of capital and output, g, is given by[6]

$$g\equiv\left(\frac{\sigma_N}{1-\sigma_K}\right)n>0 \tag{11}$$

Eicher and Turnovsky (1999c) show that $\sigma_K < 1$ is required for stability.

The domestic government's balanced budget constraints implies that all tax revenues are rebated to individuals in the form of transfers[7]

$$T=NT_i=\tau_y\alpha K^{\sigma_K}\ N^{\sigma_N}-\tau_2 rZ+\tau_c C \tag{12}$$

which generates the nations aggregate rate of debt accumulation constraint:

$$\dot{Z} = C + I\left(1 + \frac{h}{2}\frac{I}{K}\right) - \alpha K^{\sigma_K} N^{\sigma_N} + r\left[\frac{Z}{K}\right]Z \tag{13}$$

which expresses the fact that aggregate debt accumulates as consumption, installation costs and interest payments exceed domestic income.

3. EQUILIBRIUM

The macroeconomic equilibrium requires the normalization of all growing variables around the steady state to attain a stationary equilibrium. The system can be expressed in terms of the market price of installed capital, q, and the 'scale-adjusted' per capita quantities for capital and debt:

$$c \equiv \frac{C}{N^{(\sigma_N/(1-\sigma_K))}};\ k \equiv \frac{K}{N^{(\sigma_N/(1-\sigma_K))}};\ z \equiv \frac{Z}{N^{(\sigma_N/(1-\sigma_K))}} \tag{14}$$

The optimality conditions can now be rearranged to yield the steady state values of c, k, z, q, denoted by tildes in the system

$$\tilde{q} = 1 + h\left(\frac{\sigma_N}{1-\sigma_K}\right)n = 1 + hg \tag{15}$$

$$\frac{1}{1-\gamma}\left(1-\tau_z)r\left[\tilde{z}/\tilde{k}\right] - \rho - \gamma n\right) = g \tag{16}$$

$$(1-\tau_y)\frac{\alpha\sigma\tilde{k}^{\sigma_K - 1}}{\tilde{q}} + \frac{(\tilde{q}-1)^2}{2h\tilde{q}} = (1-\tau_z)r\left[\tilde{z}/\tilde{k}\right] \tag{17}$$

$$\tilde{c} + \left(\frac{\tilde{q}^2 - 1}{2h}\right)\tilde{k} - \alpha\tilde{k}^{\sigma_K} + \left(r\left[\tilde{z}/\tilde{k}\right] - g\right)\tilde{z} = 0 \tag{18}$$

The steady state has a simple recursive structure. Given the run growth rate, g, as determined by equation (11), the steady-state price of installed capital is determined by equation (15). Once the steady state price of installed capital is known, the country's debt-to-capital ratio and cost of borrowing can be determined (equation (16)). Having determined the price and quantity of capital, equation (17) can be used to find the scale adjusted capital-labour ratio such that the after-tax rate of return on capital equals the after-tax equilibrium cost of debt. Finally, given these endogenous values, equation (18) yields the equilibrium scale-adjusted per capita consumption level. It is important to note that in this non-scale model the

scale adjusted capital-labour ratio is independent of τ_z, since the after tax real interest rate in equation (16) is constant.

The transition dynamics determine the adjustment of the economy to changes in financial liberalization, proxied by the removal of taxes on foreign borrowing/investment. The linearized dynamics to this system can be expressed as[8]

$$\begin{pmatrix} \dot{k} \\ \dot{z} \\ \dot{q} \\ \dot{c} \end{pmatrix} = \begin{pmatrix} 0 & 0 & \tilde{k}/h & 0 \\ \alpha_{21} & \tilde{r}[.] + \tilde{r}'[.]\tilde{z}/\tilde{k} - g & \tilde{q}k/h & 1 \\ \alpha_{31} & (1-\tau_z)\tilde{r}'[.]\tilde{q}/\tilde{k} & (1-\tau_z)\tilde{r}[.] - g & 0 \\ -\frac{(1-\tau_z)\tilde{r}'[.]\tilde{z}\tilde{c}/\tilde{k}^2}{1-\gamma} & \frac{(1-\tau_2)\tilde{r}'[.]\tilde{c}/\tilde{k}}{1-\gamma} & 0 & 0 \end{pmatrix} \begin{pmatrix} k-\tilde{k} \\ z-\tilde{z} \\ q-\tilde{q} \\ c-\tilde{c} \end{pmatrix} \tag{19}$$

where

$$\alpha_{21} \equiv \alpha(1-\sigma_K)\tilde{k}^{\sigma_K - 1} - \frac{\tilde{z}}{h}\left[\tilde{r}[.] + \tilde{r}'[.]\frac{\tilde{r}'[.]\tilde{z}}{h} - g\right] - \frac{\tilde{c}}{\tilde{k}}; \alpha_{31} \equiv \frac{-(1-\tau_z)\tilde{z}'[.]\tilde{z}\tilde{q}}{\tilde{k}^2} + (1-\tau_y)\alpha\sigma(1-\sigma_K)\tilde{k}^{\sigma_{K-2}}$$

The trace of the Jacobean is positive, implying either two or four eigenvalues with positive real parts. Various sufficient conditions can be established to ensure that there are two positive and two negative roots. The simplest sufficient condition to ensure a unique stable saddlepath is $C/Y > (1-\sigma_K)$. Labelling the two stable roots μ_1, μ_2, the stable solution is of the generic form

$$k(t) - \tilde{k} = B_1 e^{\mu_1 t) + B_2 e \mu_2 t} \tag{20}$$

$$z(t) - \tilde{z} = B_1 v_{21} \mathrm{e}^{\mu_1 t} + B_2 v_{22} \mathrm{e}^{\mu_2 t} \tag{21}$$

$$q(t) - \tilde{q} = B_1 v_{31} \mathrm{e}^{\mu_1 t} + B_2 v_{32} \mathrm{e}^{\mu_2 t} \tag{22}$$

$$c(t) - \tilde{c} = B_1 v_{41} \mathrm{e}^{\mu_1 t} + B_2 v_{42} \mathrm{e}^{\mu_2 t} \tag{23}$$

where B_1, B_2 are arbitrary constants obtained from initial conditions and the vector $(1\ v_{2i}\ v_{3i}\ v_{4i})'$ $i = 1,2$ (the prime denotes vector transpose) is the normalized eigenvector associated with the stable eigenvalue, μ_i. With the stable eigenvalues in hand, the stable solutions determine the evolution of capital, debt and consumption over time in our simulations below.

4. FINANCIAL LIBERALIZATION AND OPENNESS

We are ultimately interested in characterizing the effects on the economy when the country undergoes financial liberalization. Given that financial liberalizations are not only a central part of economic development, but are

also identified as sources of macroeconomic instability, we would like to understand what the response of the economy is to changes in openness and financial liberalization and especially how financial liberalizations affect the convergence speed.

Before we calibrate the model to obtain estimates of the convergence speeds under different openness and liberalization regimes, it is important to understand the capital flow dynamics of the model. A reduction in the tax on foreign borrowing leads to capital flow reversals. Evaluating the slope of the transition path in (z/k) space at $t = 0$, $t \to \infty$ shows that immediately after financial liberalizations net capital inflows should increase, but that the economy eventually approaches the new equilibrium experiencing capital outflows.[9] The intuition is that a reduction of taxes on foreign borrowing lowers the cost of capital in the short run, which causes an accumulation of additional debt. Given the specification of the domestic interest rate, equation (5), higher debt levels raise the debt service costs, leaving less output for investment so that capital accumulation slows and eventually declines. The reduction in capital accumulation raises debt costs even further, to offset the benefits of the initial tax reduction, to cause capital outflows.

In our calibrations below we proxy financial liberalization with a reduction in the tax on foreign borrowing. To account for openness we introduce a specific functional form for the interest function that allows openness to vary. Here we think of specific laws that prohibit the free flow of capital across borders that drive country-specific interest differentials as they pertain to external borrowing. Let _ proxy openness, since it drives a wedge between the world interest rate and the domestic interest rate at any given debt-to-equity ratio.

$$r[Z/K] = r^* + \xi(Z/K) \tag{24}$$

The non-scale open economy model has not been calibrated, and we introduce the first characterization of the model in the open economy. The numerical calibrations of output, which is eventually determined by the evolutions of equation (20)–(23), allow us to sketch qualitatively the transition path, and to understand the ability of the open, non-scale economy to replicate the values of key economic variables in industrialized countries.

The key domestic parameter values for our calibration are obtained primarily from the recent simulation study of the neoclassical growth model by Ortigueira and Santos (1997). Specifically, we assume that the technology coefficient is $\alpha = 3$; the rate of time discount is $\rho = 0.04$; intertemporal elasticity of substitution is 0.66 (from $\gamma = -0.5$); population growth rate is set at $n = 2$ per cent; the instalment adjustment cost parameter is $h = 16$; the elasticity of private capital in output $\sigma = 0.4$; the spillover from aggregate

capital in production $\eta = 0.2$. The foreign capital market variables are set as follows (Table 1): the risk-free foreign LIBOR real interest rate, $r^* = 0.04$, the initial income tax, τ_y, is 30 per cent[10] and our benchmark case assumes that capital gains involving foreign funds are taxed at the same rate as domestic income, implying $\tau_2 = -0.30$.[11] Commencing with a model of a relatively closed economy, we start with an initial parameter value for openness, ξ, of 2.

Given these parameter values, the implied solutions for the key variables are provided in Table 2.

The fit of the model with the real world is exceptional; all values replicate generally accepted magnitudes of observed variables. The asymptotic speed of adjustment is about 1.72 per cent per annum, close to the observed 2 per cent. The initial speed of convergence, which dominates the first periods of adjustment of 95.78 per cent is high for any transition. Here, the speed of convergence is measuring how much of the gap between $\tilde{k}$ and k_0 is eliminated at k_1 the short-run case and between $\tilde{k}$ and k_t is eliminated at k_{t+1} for large t for the long-run case.

In terms of convergence the model behaves more like an AK model in the sense that much of the transition takes place immediately, just about jumping to the new steady state. Given the high tax on foreign borrowing, little foreign borrowing occurs and the debt-to-output ratio is about 2.4 per

Table 1 The benchmark economy

Production	$\alpha = 3$, $h = 16$, $\sigma = 0.4$, $\eta = 0.2$
Preferences	$\rho = 0.04$, $\gamma = -0.5$
Population growth	$n = 2\%$
Interest	$r^* = 0.04$, $\xi = 2$
Taxes	τ_y, $\tau_z = -0.30$

Table 2 Key economic outcomes

	Benchmark
Convergence (SR)	95.78%
Convergence (LR)	1.72%
Interest over LIBOR	1.77%
Capital/Output	2.70
Debt/Output ratio	2.39%
Cons./Output Ratio	89.90%
Growth Rate	3%

cent. This implies a small interest differential over the LIBOR, of only about 1.77 per cent. The initially assumed 30 per cent tax on foreign borrowing then basically renders a closed economy in terms of capital flows with debt representing about 2 per cent of GDP.

The capital – output ratio of 2.70 closely approximates the observed level of 3 across countries, while the consumption – output ratio of 89.80 per cent is slightly higher than the observed 70 to 80 per cent observed in industrial and developing countries. The resulting growth rate of the economy is 3 per cent per annum. The fact that these numbers closely resemble the basic features of key variables across countries confirms that the open economy non-scale model replicates actual data with a similar ease as Eicher and Turnovsky's (1999b) closed economy non-scale model.

We are interested in simulating the effects of both openness and financial liberalization on key variables of the economy, and in analysing the transition path for the factors of production. This will allow us insights into the convergence speeds and dynamics of the open economy. At the same time these changes also provide insights into the robustness of our results in the benchmark simulation.

5. FINANCIAL LIBERALIZATIONS AND CONVERGENCE

First, we examine the effects of financial liberalization (the reduction of the distortion on foreign borrowing) on the economy. By setting the tax on foreign borrowing to zero, we allow the country to borrow freely in the world market, but we do maintain the limited openness as proxied by the $\xi = 2$. The second column in Table 3 indicates that financial liberalizations immediately lead to increased debt in the country.

The debt-to-output ratio doubles and the associated domestic interest rate is elevated to 3.5 per cent over LIBOR to account for the added risk

Table 3 Openness and financial liberalization

	Benchmark	*Benchmark change:* $\tau_2 = 0$	*Benchmark change:* $\xi = 1$ *and* $\tau = 0$
Convergence (SR)	95.78%	82.15%	57.27%
Convergence (LR)	1.72%	1.72%	1.72%
Interest over LIBOR	1.77%	3.5%	3.5%
Capital/Output	2.70	2.70	2.70
Debt/Output ratio	2.39%	4.7%	9.4%
Cons./Output Ratio	89.90%	89.75%	89.54%
Growth Rate	3%	3%	3%

in the country. Consumption and capital output ratios hardly change, showing the strength of the non-scale open economy model in replicating these key features of the economy with a similar robustness as that observed across countries that have diverse levels of financial liberalization. Consumption falls slightly to account for the higher debt service cost in the economy.

In terms of policy and convergence, the important insight gained is that the long run convergence speed is not altered. However, the short run convergence speed drops significantly to about 82 per cent per year. This implies that an open economy is exposed to smaller fluctuations in output than the distorted economy in the sense that it will experience a smaller boom in investment and output after the financial liberalization and a less dramatic recession during the ensuing contraction. This is because, in the distorted economy, agents cannot take advantage of the international capital market to smooth the transition. The increased smoothness in response to initial shocks comes at the price of a higher domestic interest rate, as foreign borrowing increased in terms of absolute levels and as a percentage of domestic output.

6. FINANCIAL LIBERALIZATIONS, OPENNESS AND CONVERGENCE

Financial liberalizations that are also associated with increased openness have an even more dramatic effect on the economy as shown in the far right column of Table 3. As the openness parameter drops to unity, the economy is now free to trade capital across borders in terms of differential taxation and interest differentials. The debt-to-output ratio doubles again to 9.4 per cent. This increase in debt did not come at the cost of an increased interest rate, as openness (the reduced ξ) actually lowers the interest differential for any given level of debt. In this case, the interest rate remains unchanged at 3.5 per cent above LIBOR from the levels experienced under financial liberalization, despite the dramatic increase in the debt level. As above, the significantly positive impact of openness is now a further reduced short run shock to output and investment of the country as it can take advantage of foreign capital to smooth short run fluctuations. The short run rate of convergence drops to 57.27 per cent.

7. MATCHING THE MODEL TO THE DATA

As mentioned in the introduction, almost all developed countries underwent financial liberalizations in the late 1970s and 1980s. These liberalizations of the capital account were followed by significant increases in global capital flows, particularly in the form of direct and portfolio investment. Global direct investment as well as portfolio investment flows increased fourfold

between 1988 and 1998 from $373 billion to over $1.5 trillion annually. Country-specific experiences in response to financial liberalizations, especially those relating to GDP growth, debt and convergence, varied significantly and have been notoriously hard to model (see Nsouli *et al*., 2002, for a review of the literature). In this section we provide an overview of developed countries' liberalization experiences and compare data on capital flows with the predictions of the model.

Financial liberalization comes in many shapes and forms such as removal of legal credit controls, entry barriers, interest rate controls, capital account restrictions, and dual exchange rates. At the same time the country may experience changes in openness, which are often measured by the trade volume in the data. Here we interpret openness broadly as reduced restrictions on the current account. Measuring openness or liberalization can be a difficult task and several alternative measures have proposed (see Eichengreen, 2002; and Edison *et al*. 2002). Most indicators are 0/1 dummy variables based on the existence rules that limit cross border capital flows. Others aggregate several measures of liberalization and openness into indices.

In this paper we choose an index that represents the broad areas in which openness and financial liberalization can occur. We utilize an updated version of Quinn (1997) who provides data for a wide range of countries. The data in Quinn (1997) are based on the IMF's Annual Report on Exchange Restrictions. Quinn assigns a number between zero and two to six categories of restrictions. The specific categories include openness proxies such as exports, imports and services or the impact of international agreements, as well as capital flow proxies. Ultimately Quinn's liberalization/openness scores range from zero (least open) to 14 (most open).

Liberalization experiences vary widely in terms of magnitude and timing. For our purposes, we define a liberalization period as a period, not exceeding 2 years, where the change in the liberalization index exceeded 30 per cent.[12] Table 4 indicates that there were six industrialized countries that experienced major financial liberalizations between 1977 and 1994.

Table 4 Financial liberalization indices

	% change in index	*year(s) of liberalization*
Portugal	54	86
Spain	33	85/86
New Zealand	35	82/84
UK	47	77/78
Belgium	40	90

7.1. Financial liberalization and capital flow reversals

Figure 1 plots net capital inflows (net inflows less net outflows) for the five countries in Table 4, utilizing the IMF's balance of payments statistics. The shaded regions indicate the periods of significant financial liberalizations.

The model predicts that liberalizations and increased openness should be followed by initial capital inflows and subsequent capital outflows. The magnitude of these flows is certainly impacted by the degree of openness and liberalization before the reforms were enacted; as mentioned above,

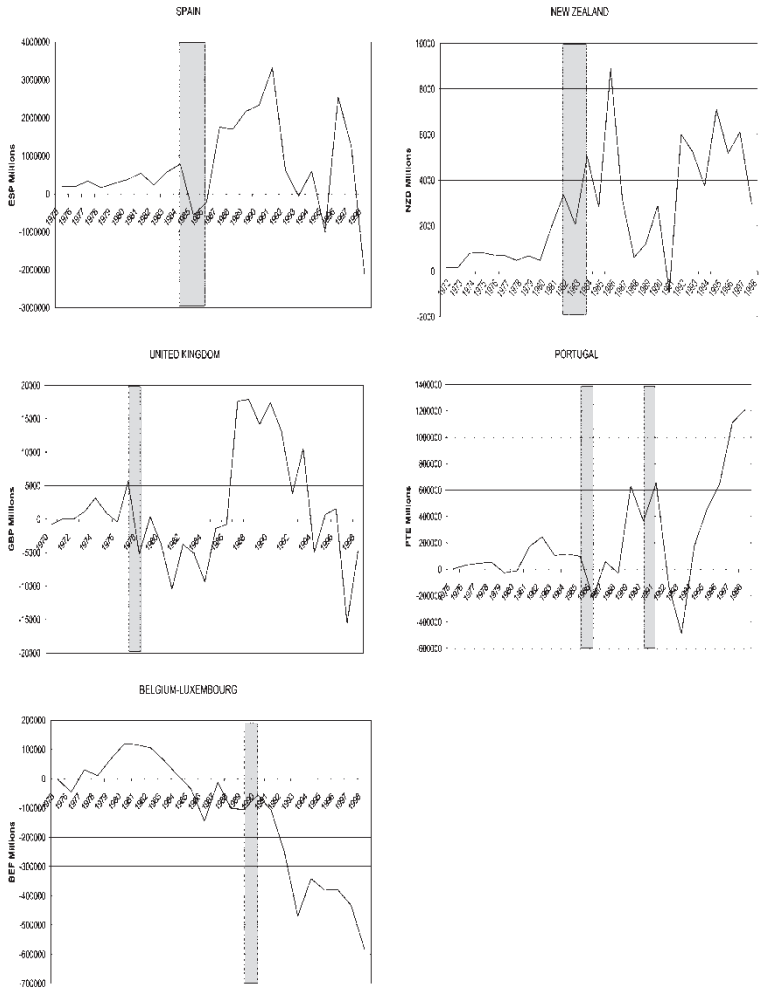

Figure 1 Net capital inflows

countries varied both in terms of their initial openness and degree of liberalization.

Portugal, Spain, and New Zealand maintained the greatest restrictions on the capital account and implemented the most wide-ranging liberalizations. Each of these countries experienced high capital inflows with subsequent reversals. The UK and Belgian data do not fit well with the predictions of the model. This may be because, as financial centres, their cross-border flows do not accurately reflect investment in the country *per se*. The economic meaning of capital flow statistics in the balance of payments in such financial centres may well be distorted, since they are based on residence rather than ownership criteria. A recent report (IMF, 2003) estimates that 40 per cent of UK-owned banks' claims are on foreign counterparties, but only half of these represent cross-border claims. Overseas funding for these claims would represent inflows, but because only half are cross border, there is not an outflow of the equivalent value. Bacchetta and van Wincoop (1998) provide evidence that the same pattern holds true for emerging markets.

7.2. Liberalization and convergence

The other key implication of the model is that access to capital markets helps smooth GDP fluctuations. Using annual IMF data on real GDP between 1960 and 2001[13] in Table 5 we report a coefficient of variation of real GDP growth before and after liberalization.

Table 5 Real GDP growth variability

	Pre-liberalization	*Post-liberalization*
Portugal	1.10	0.61
Spain	0.90	0.55
New Zealand	1.29	0.95
Australia	0.71	0.49
UK	1.04	0.87
Belgium	0.77	0.68
Norway	0.55	0.45
France	0.53	0.73
Ireland	0.52	0.49
Italy	0.71	0.62
Denmark	1.27	0.70
Sweden	0.74	1.45
Finland	0.61	2.02

In most cases, there is a notable reduction in the change in GDP growth. Exceptions include France, Sweden and Finland. In the early 1990s, Sweden and Finland suffered financial crises. The impact of the crises was realized in GDP growth in the period after liberalization, which brought down mean GDP growth, and raised the coefficients of variation for these two countries. The main driver of France's higher relative variability of output is its lower mean GDP growth in its post-liberalization period.

Also consistent with the model is the relative constancy (on average) of GDP growth before and after liberalizations. Average GDP growth per annum for these 13 countries was 2.89 per cent per annum prior to liberalization and 2.88 per cent in the years following liberalization.

8. CONCLUSIONS

We examine the characteristics of a non-scale open economy model to investigate the relationship between the speed of convergence and financial liberalization. The non-scale model calibrates observed key variables of the open economy well. Our simulations highlight that highly restricted capital accounts exposed an economy to significantly larger output shocks as the economy adjusts and converges from one stationary path to another. Opening capital markets to the outside world and reducing distortions that detract from foreign investment are shown to increase capital inflows and the level of indebtedness of a country. In addition, liberalizations are shown to allow for a longer and smoother transition, which reduces the output shocks.

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NOTES

1 See, for example, Corsetti *et al*. (1999), McKinnon and Pill (1997), Kaminsky and Reinhart (1999), and Schneider and Tornell (2001).
2 The speed of convergence is the speed at which the economy returns to its new equilibrium following a policy change.
3 Bardhan (1967) expresses the risk premium in terms of the absolute stock of debt; however, this formulation cannot sustain a balanced growth equilibrium.
4 Measures of openness are plentiful, ranging from the share of imports and exports in total output to estimates of black market premiums. In this model the degree of openness is measured by the degree to which interest arbitrage is interdicted. In that sense we focus more on the openness of the capital market,

or the degree of capital mobility.

5 First-order conditions and transversality conditions can be reviewed in Eicher and Turnovsky (1999a). They are suppressed here to focus on the key calibration equations.

6 Note that the rate of time preference affects only the growth rate of consumption, but not the growth rate of output in the model. Changes in the rate of time preferences would have a level effect on the per capita capital stock but not the rate of long run growth.

7 Alternatively, one could assume that the government budget is not balanced but that debt is accumulated whose return would ultimately be tied to the return on capital. This complicates the transition but not the qualitative results.

8 The detailed derivation can be found in Eicher and Turnovsky (1999a, see their equations (9a), (9b), (9c) and (14))

9 Eicher and Turnovsky (1999a) prove that the slope is given by $dz / dk > 0$ at $t = 0$ and $t = \infty$.

10 Values for average income tax rates depend on the country specific rates and progressiveness of the tax schedule. OECD (2001) reports income tax rates for countries which range from 6.5 per cent (Poland) to 35 per cent (Denmark).

11 Moore and Silvia (1995) list a variety of developing and developed countries' rates, ranging from zero in several developed countries to 48 per cent in Australia.

12 The liberalization periods under this definition do not differ significantly from those constructed in Abiad and Mody (2003). France and Italy cited in the introduction experienced changes in their liberalization indexes around 20 per cent and have similar in and outflows as the countries in Figure 1.

13 Data for Portugal runs from 1970 to 2000. The UK's liberalization occurred quite early, limiting the observations in the pre-liberalization period.

REFERENCES

Abiad, A. and Mody, A. (2003) 'Financial reform: what shakes it? What shapes it?' IMF Working Paper WP/03/70.

Bacchetta, P. and van Wincoop, E. (1998) 'Capital flows to emerging markets: liberalization, overshooting, and volatility', NBER Working Paper No. w6530.

Bardhan, P. K. (1967) 'Optimum foreign borrowing', In Shell, K. (ed), *Essays on the Theory of Optimal Economic Growth*. Cambridge, MA: MIT Press.

Bond, E. W., Wang, P. and Yip, C. K. (1996) 'A general two-sector model of endogenous growth with human and physical capital: balanced growth and transitional dynamics', *Journal of Economic Theory* 68, 149–73.

Cooper, R. N. and Sachs, J. (1985) 'Borrowing abroad: the debtor's perspective'. In Smith, G. W. and Cuddington, J. T. (eds) *International Debt and Developing Countries*. Washington, DC: World Bank.

Corsetti, G., Roubini, N. and Pesenti, P. (1999) 'What caused the Asian currency and financial crisis?' *Japan and the World Economy* 11(3), 305–73.

Dooley, M. P and Isard, P. (1980) 'Capital controls, political risk, and deviations from interest-rate parity', *Journal of Political Economy* 88(2) 370–84.

Edison, H. J., Klein, M., Ricci, L. and Sløk, T. (2002) 'Capital account liberalization and economic performance: survey and synthesis', IMF Working Paper WP/02/120.

Edwards, S. (1984) 'LDC foreign borrowing and default risk: an empirical investigation, 1976–1980', *American Economic Review* 74, 726–34.

Eichengreen, B. (2002) 'Capital account liberalization: what do cross-country studies tell us?' *The World Bank Economic Review*, March.
Eicher, T. S. and Turnovsky, S. J. (1999a) 'International capital flows and non-scale growth', *Review of International Economics* 7, 171–88.
Eicher, T. S. and Turnovsky, S. J. (1999b) 'Convergence in a two sector non-scale growth model', *Journal of Economic Growth* 4, 413–29.
Eicher, T. S. and Turnovsky, S. J. (1999c) 'A generalized model of economic growth', *Economic Journal* 109, 394–415.
Eicher, T. S., Turnovsky, S. J. and Walz, U. (2000) 'Optimal policy for financial market liberalizations: decentralization and capital flow reversals', *German Economic Review* 1(1), 19–42.
Frankel, J. A. (1984) *The Yen/Dollar Agreement: Liberalizing Japanese Capital Markets*, Cambridge: MIT Press.
Hayashi, F. (1982) 'Tobin's marginal q, average q: a neoclassical interpretation', *Econometrica* 50, 213–24.
International Monetary Fund (2003) *United Kingdom Financial System Stability Assessment*, February.
Jones, C. (1995) 'R&D based models of economic growth', *Journal of Political Economy* 103, 759–84.
Kaminsky, G. and Reinhart. C. (1999) 'The twin crises: the causes of banking and balance-of-payments problems', *American Economic Review* 89(3), 473–500.
McKinnon, R. and Pill, H. (1997) 'Credible economic liberalizations and overborrowing', *American Economic Review* 87(2), 189–93.
Moore, S. and Silvia, J. (1995) 'The ABCs of the capital gains tax', Cato Policy Analysis no 242.
Nsouli, S. M., Rached, M. and Funke, N. (2002) 'The speed of adjustment and the sequencing of economic reforms: a guide for policymakers', IMF Working Paper WP/02/132.
OECD (2001) '*OECD Tax Database*'.
Ortigueira, S. and Santos, M. S. (1997) 'On the speed of convergence in endogenous growth models', *American Economic Review* 87, 383–99.
Quinn, D. P. (1997) 'The correlates of change in international financial regulation', *American Political Science Review* 91, 531–51.
Rodrik, D. (1998) 'Who needs capital account convertibility?' In Fischer, S. *et al.* (eds) *Should the IMF Pursue Capital-Account Convertibility?, Essays in International Finance* No. 207. Department of Economics, Princeton University, May.
Rodrik, D. (2000) 'Governing the global economy: does one architectural style fit all?' *Brookings Trade Forum 1999*, Brookings Institution.
Sachs, J. (1984) 'Theoretical issues in international borrowing', *Princeton Studies in International Finance* 54.
Schneider, M. and Tornell, A. (2001) 'Boom-bust cycles and the balance sheet effect', Mimeo, UCLA.
Stiglitz, J. (1999) 'Bleak growth for the developing world', *International Herald Tribune* 10–11, 6.
World Bank (1989) *World Bank Development Report*, Oxford University Press.