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ABSTRACT

<u>Explaining Saving/Investment Correlations</u>

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National saving and investment rates are highly positively correlated in virtually all countries. This fact is often viewed as puzzling, as it apparently implies a low degree of international capital mobility. This paper shows that the observed positive correlation between national saving and investment rates arises naturally within a quantitatively–restricted equilibrium model with perfect mobility of financial capital and a very high degree of physical capital mobility. The model is consistent with the fact that saving/investment correlations are larger for larger countries, but are not zero for small countries. In addition, the model is consistent with Sachs's (1981) empirical results which show that current account deficits are associated with investment booms.

1. Introduction

In the field of international macroeconomics, temporally robust stylized facts are few and far between. One of the most stable regularities observed in the data is the fact that national savings rates are highly correlated with national investment rates. This empirical regularity has been documented by Feldstein and Horioka (1980), Feldstein (1983), Murphy (1984), Obstfeld (1986), Tesar (1988) and others. Taken as a group, these studies show that saving and investment rates are highly correlated both in time series analyses of individual countries and in cross sections in which each country is treated as a single data point. High saving/investment correlations arise in small economies as well as in large economies, although the correlations tend to be lower for smaller economies. These results are often viewed as puzzling, as they apparently imply a low degree of international capital mobility, yet most economists believe that the world economy is increasingly characterized by a high degree of capital mobility.

This paper shows that positive time-series correlations between national saving and investment rates arise naturally within a plausibly parameterized equilibrium model with perfect mobility of financial capital and a very high degree of physical capital mobility. We are not the first to suggest that it is theoretically possible to explain these correlations within a well-specified equilibrium model with capital mobility: see, for example, the analyses of Obstfeld (1986), Engel and Kletzer (1989), and Finn (1989). We are, however, the first to provide a quantitative analysis which suggests that ***high time series correlations between saving and investment are exactly what one should expect to observe in the data.***

Our analysis is carried out within the context of a two country one-sector stochastic growth model subject to exogenous shocks to productivity. The model is parameterized to generate realistic persistence and comovement of national outputs as well as realistic behavior of consumption and investment within each country. The relative size of the two countries can be varied parametrically to investigate the effects of country size on the macroeconomic phenomena of interest.[1]

As will become apparent, country size is an important determinant of saving/investment correlations. The reason, of course, is that larger countries have larger effects on the world interest rate. However it is generally not the case that one should expect a zero correlation between saving and investment in a small country. This widespread but mistaken view is due to a basic misunderstanding of the appropriate general equilibrium model of a "small country." It is true that a very small country faces an exogenous world interest rate, so that the small country can appropriately be viewed as facing a perfectly elastic supply of new capital at this interest rate. However, the level of this exogenous interest rate is not fixed over time. In fact, the level of the interest rate is likely to be high exactly when the small country experiences a temporary increase in the productivity of capital and would therefore like to increase domestic investment.

This is deduced from the following observations. First, the data reveal that output movements are positively correlated across countries. In the one-sector neoclassical model, this reflects positive international

[1]Our analysis of the effects of country size utilizes developments in Crucini (1989).

comovement in factor productivity.[2] When productivity is high in the small country and it therefore wishes to expand investment, productivity is likely also to be high in the large country, which is similarly trying to expand investment. Because the large country's attempt to increase investment drives up the world interest rate, the small country faces a high real interest rate precisely when it would most like to expand investment itself. This phenomenon is central to our explanation for high saving/investment correlations.

The paper is organized as follows. Section 2 briefly reviews the stylized facts concerning saving/investment correlations. Section 3 presents our model and discusses problems associated with definition and measurement of saving. Section 4 discusses the model's predictions along a number of dimensions, and provides an informal comparison of these predictions with the data. First, we present results on the model's predictions concerning saving/investment correlations. We find that positive saving/investment correlations are a robust prediction of the quantitatively restricted model, and that the model correctly predicts that these correlations tend to be higher for larger countries.

Second, we explore the link between output, investment and the current account. We find that our model is consistent with empirical results obtained by Sachs (1981). In a regression of the current account-to-GNP ratio on the GNP gap and the investment-to-GNP ratio, the coefficient on the investment ratio was negative for twelve of the fourteen countries in Sachs's

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[2]At this point, we do not specify the sources of shocks to factor productivity. Variations in productivity could, for example, arise from shifts in exogenous technological possibilities or from shifts in policy variables under control of the government, as in Abel and Blanchard (1983).

sample. Our model predicts this negative regression coefficient, supporting Sachs's view that international investment flows are important short-run determinants of current account movements. Further, our model predicts that this effect is stronger (the coefficient should be larger in absolute value) the smaller the country. This is also in line with Sachs's (1981) evidence. Sach's results have typically been interpreted as providing evidence that capital is highly internationally mobile, while high time-series correlations of saving and investment have typically been interpreted as evidence that capital is not highly mobile. Our analysis starts from the assumption that capital is highly mobile, and simultaneously provides an explanation for both of these phenomena.

However, the model does contain some counterfactual implications, the most striking being the prediction that consumption should be perfectly correlated across countries. In the concluding part of section 4 we discuss model extensions and modifications which would improve the model's predictions along these dimensions. Section 5 concludes the paper with a brief summary of our results, and a discussion of directions for future research.

2. The Correlation Between Saving and Investment

Many authors have investigated the size and robustness of the saving/investment correlation within a large sample of countries. This section briefly reviews this evidence. In a paper which sparked substantial subsequent research on this topic, Feldstein and Horioka (1980) reported that long averages of saving and investment were highly correlated in a cross-section of 16 OECD countries. Feldstein and Horioka regressed the investment/output ratio on the saving/output ratio, in which the average ratios were computed over both five-year and fifteen-year periods. The estimated regression coefficient on the saving/output ratio ranged from .85 to .95.

Murphy (1984) studied a cross-section of seventeen countries and found that saving/investment correlations were larger for larger countries. Using the Feldstein/Horioka methodology, Murphy finds that the average coefficient on the saving/investment ratio is only .59 for the ten smallest countries in his sample, compared with an average coefficient of .98 for the seven largest countries. Murphy reports that three countries—the U.S., Japan, and the U.K.—are responsible for the large average coefficient for the seven largest countries. With these three countries deleted from the sample, the overall average coefficient drops to .57.

In a more recent paper, Tesar (1988) provides additional evidence on cross-section saving/investment correlations. She demonstrates that the high coefficient on the saving ratio in the Feldstein/Horioka regressions is robust to changes in the length of the interval over which the average is taken. Her sample includes 24 OECD countries. For data averaged over twenty-five years (1960–1984) the coefficient of the savings ratio was .93. For data averaged over five-year intervals the coefficient ranged from .79 to .95, depending on the five-year interval under study. For three-year averages the coefficient ranged from .76 to .95, and for one-year averages the coefficient ranged from .67 to .97.

Tesar also provides time series plots of the saving and investment ratios over the sample period. Within each country for which plots are provided, it is clear that saving and investment are highly correlated at the annual frequency. Obstfeld (1986) computes time-series correlations between changes in saving and investment rates using quarterly data from seven OECD countries, and finds correlations ranging from .13 to .91. The time-series evidence presented by Tesar and Obstfeld demonstrates that the saving/investment correlation is not just a long-run or low frequency phenomenon, as has sometimes been suggested.

3. Saving/Investment Correlations in the One-Sector Model

In this section we demonstrate that an open economy one-sector model can easily rationalize the high time series correlations between saving and investment documented by Obstfeld (1986) and Tesar (1989), without resorting to assumptions that capital is immobile or that markets are incomplete. Our model is an open economy version of the familiar one sector stochastic growth model. Because of the single-good nature of the model, international trade takes place only to smooth consumption and to ensure that capital is installed in the most productive location. We consider a world in which there are two countries. Residents of each country value leisure and consumption of the single output good, and labor is immobile across countries. Firms in each country produce the single output good via identical constant returns to scale production functions. These firms are subject to exogenous shocks to total factor productivity, which may be partly country-specific in origin. Finally, there are small convex costs of adjustment associated with variations in the capital stock.[3]

This model is described in the equations below. There are two countries: the home country and the foreign country. The foreign country is

[3]As noted previously by Baxter (1988), Crucini (1989) and Backus, Kehoe and Kydland (1989) some type of friction inhibiting capital mobility is necessary to prohibit extreme and highly unrealistic swings in national capital stocks in response to the exogenous shocks. Crucini (1989) and Backus, Kehoe and Kydland (1989) use time-to-build technologies to slow the response of capital. We choose instead to use a flexible convex adjustment cost technology which contains time-to-build technologies as limiting special cases.

distinguished from the home country by means of a star attached to all foreign country variables. Where no star is attached in the case of the foreign country, the variable, parameter, or function in question is assumed to be identical across countries. All variables are in per capita terms unless otherwise stated. Where there is no danger of confusion, the model is discussed in terms of the home country alone.

Consumers in each country are endowed with a unit of time each period which they divide between work effort, N_t, and leisure, L_t. Consumers choose N_t, L_t, and consumption, C_t, to maximize

$$E(U) = E \sum_{t=0}^{\infty} \beta^t u(C_t, L_t) = E \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\sigma} \left[C_t^{\theta} L_t^{1-\theta}\right]^{1-\sigma} \quad \text{home country}$$

$$E(U*) = E \sum_{t=0}^{\infty} \beta^t u(C_t^*, L_t^*) = E \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\sigma} \left[C_t^{*\theta} L_t^{*1-\theta}\right]^{1-\sigma} \quad \text{foreign country}$$

subject to constraints that are spelled out below. Firms produce the single output good using constant returns to scale technologies:

$$Y_t = F_t(K_t, N_t) = A_t K_t^{1-\alpha}(X_t N_t)^{\alpha} \quad \text{home country}$$

$$Y_t^* = F_t^*(K_t^*, N_t^*) \quad A_t^* K_t^{*1-\alpha}(X_t^* N_t^*)^{\alpha} \quad \text{foreign country}$$

where Y_t denotes aggregate output. K_t denotes the capital stock utilized by the home country firm. It does not, in general, correspond to capital owned by residents of the home country, since individuals are permitted to rent capital to firms in either country. A_t and A_t^* are technology shocks. Letting a "hat" over a variable denote percentage deviations, ($\hat{A} = \Delta A/A$), the productivity shocks are assumed to follows the stationary Markov process given by:

$$\begin{pmatrix} \hat{A}_t \\ \hat{A}^*_t \end{pmatrix} = \begin{pmatrix} \rho_{AA} & \rho_{AA*} \\ \rho_{A*A} & \rho_{A*A*} \end{pmatrix} \begin{pmatrix} \hat{A}_{t-1} \\ \hat{A}^*_{t-1} \end{pmatrix} + \begin{pmatrix} 1 & \psi_{AA^*} \\ \psi_{A*A} & 1 \end{pmatrix} \begin{pmatrix} \epsilon_t \\ \epsilon^*_t \end{pmatrix}$$

where $E(\epsilon_t) = E(\epsilon^*_t) = 0$. This stochastic process was chosen so that productivity shocks which originate in one country (ϵ_t or ϵ^*_t) have the potential to be transmitted to the other country. The parameters ρ_{AA*} and ρ_{A*A} govern the transmission or diffusion of these shocks, and the parameters ψ_{AA*} and ψ_{A*A} determine the contemporaneous correlation of innovations to the productivity variables.

In order to focus on country size as a central determinant of a nation's cyclic response to exogenous productivity shocks, we build a great deal of symmetry into the specification of the forcing processes. Thus we set $\rho_{AA}=\rho_{A*A*}=\rho$. The "diffusion parameters" are set at $\rho_{AA*}=\rho_{A*A}=\rho^*$. The contemporaneous correlation of shocks is set at $\psi_{AA*}=\psi_{A*A}=\psi$, and the variances of ϵ_t and ϵ^*_t are both set equal to unity.

The variables X_t and X^*_t represent labor-augmenting technical change, and are assumed to grow at the common, constant (gross) rate γ_X. Capital accumulates over time according to

$$K_{t+1} = (1-\delta)K_t + \phi(I_t/K_t)K_t \qquad \text{home country}$$
$$K^*_{t+1} = (1-\delta)K^*_t + \phi(I^*_t/K^*_t)K^*_t \qquad \text{foreign country}$$

where δ is the depreciation rate of capital, and where the function $(1/\phi')$ is Tobin's "Q", which gives the number of units of output which must be foregone to increase the capital stock in a particular location by one unit. This formulation has been used by Uzawa (1969) and Lucas and Prescott (1971), and it is assumed that $\phi>0$, $\phi'>0$, and $\phi''<0$.[4] Note that the cost of adjustment is

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[4]This presentation of adjustment costs in the one-sector model draws heavily on material in King (1989).

borne whenever new investment goods are placed into use and whenever existing capital is moved from one country to the other.

A fraction π of the world population lives in the home country. The world resource constraint is therefore given by

$$\pi(Y_t - C_t - I_t - G_t) + (1-\pi)(Y_t^* - C_t^* - I_t^* - G_t^*) \geq 0 \quad .$$

In each country, work effort plus leisure cannot exceed the unit endowment of time, which is reflected in the constraints

$1 - L_t - N_t \geq 0$ home country

$1 - L_t^* - N_t^* \geq 0$ foreign country.

The government of the home country taxes national output at the rate τ_t (yielding tax revenues of $\tau_t Y_t$), purchases and disposes of goods in the amount G_t, and transfers goods to private individuals in the amount T_t. The government of the foreign country engages in similar activities. Thus the budget constraints for the two governments are:

$G_t + T_t = \tau_t Y_t$ home country

$G_t^* + T_t^* = \tau_t^* Y_t^*$ foreign country.

Agents in the two countries view themselves as too small to affect prices, and are allowed to trade any contingent claims they wish. Among other things, we permit international trade in contingent claims on labor income and on government taxes and transfers. This extreme degree of market integration ensures that the high saving/investment correlations generated by the model are not the result of artificial, externally-imposed restrictions on opportunities for risk-pooling.

Given complete freedom in parameterizing this model, it would be easy to generate temporal saving/investment correlations in the range observed in the data. However, our view is that the discipline imposed by cross-investigation consistency in model parameterization and evaluation procedures is of the first importance. For this reason we have chosen to parameterize our model so that it is consistent with the long run experience of the U.S. economy with respect to growth rates, factor shares, proportion of time devoted to market activities, the average level of the real interest rate, and the rate of depreciation of capital. In addition, we require that the model also be able to replicate the following patterns of correlation and relative volatility which have formed the basis for evaluation of other equilibrium business cycle models.[5] First, we observe that movements in national outputs are highly serially correlated and are positively correlated across countries.[6] Second, we observe that typically consumption is less volatile than output and investment is more volatile than output. As we shall see, a quantitatively restricted version of our model which is capable of producing these phenomena simultaneously predicts high saving/investment correlations, and can also replicate many other important "stylized facts" found in the data.

Model solution and parameterization

The model is solved and its approximate dynamics are computed using the method developed by King, Plosser, and Rebelo (1988). That paper, and its accompanying Technical Appendix, give the details of this procedure so we do not replicate their material here. We simply note that this approach allows us to compute approximate dynamics in distorted economies (such as this one) without a significant increase in technical or computational complexity.

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[5]See, for example, the analyses of Kydland and Prescott (1982), Prescott (1986), and King, Plosser, and Rebelo (1988).

[6]Appendix A provides data on these and other moments for a sample of 8 OECD countries.

We study a linear approximation to the economy in which the model's steady state is the point about which the linearization is taken. We use the parameterization of technology utilized by King, Plosser, and Rebelo (1988); these parameters were chosen so that the model economy displays behavior broadly consistent with that of macroeconomic aggregates in the United States, and are displayed in Table 1.

Our near-steady-state analysis does not require that we specify a functional form for the adjustment cost function, ϕ. We need only specify three parameters which describe the behavior of ϕ near the steady state. The first two of these parameters govern (i) the steady state value of Tobin's "Q" and (ii) the steady state share of investment in national product. Effectively, these amount to specifying $\phi(I/K)$ and $\phi'(I/K)$ at the steady state. We set these parameters so that the model with adjustment costs has the same steady state as the model without adjustment costs. Thus the steady state Tobin's "Q" is one, and the steady state share of investment is the same as in the model without adjustment costs. A third parameter which must be specified is the elasticity of the marginal adjustment cost function, which governs the response of (I/K) to movements in "Q". We use an adjustment cost elasticity which implies very low costs of adjustment.

Finally, we must also specify ψ, the contemporaneous correlation of technology shocks across countries, together with ρ, the serial correlation coefficient of the technology shock, and $\rho*$, the parameter which governs the rate of diffusion of technology shocks across countries. Our model predicts a strong positive correlation between national saving and national investment for a very broad range of ψ, ρ, and $\rho*$. Other characteristics of the model economy are more sensitive to these parameter values. We therefore choose parameters which are consistent with observed persistence and comovements of national outputs, and which are also consistent with observed volatilities of consumption and investment relative to output. These features require a fairly high degree of persistence in technology shocks within a country. In addition, either positive transmission of shocks across countries or a high degree of contemporaneous correlation of national technology shocks is necessary to replicate these features of the data. These points have been previously noted by Rebelo (1988) and Crucini (1989). In the results discussed below, we provide evidence on the robustness of the results to variation in assumptions about key parameter values.

Measurement of saving

In comparing the predictions of theory with data, we must be careful to ensure that our theoretical constructs measure the same economic variables as the data. As previously noted by Stockman and Svensson (1984) and Obstfeld (1986), the national income accounts (NIA) measure of saving can differ markedly from true saving. The difference arises when foreigners own shares in domestic firms and when firms finance expenditure from retained earnings. Under these conditions, the discrepancy is larger the larger is the share of foreign ownership.[7]

A simple measure of national saving—and the only one which is robust to different assumptions about firms' financing decisions—is the measure which defines national saving as national output minus the sum of private and government consumption. This measure can be readily computed for many countries in which the data are unavailable to construct other measures of saving. We call this measure "basic saving." The United States national

[7]See Obstfeld (1986) for a detailed explanation of these considerations.

income accounts measure of saving also subtracts from this basic saving measure net dividend payments to foreigners. It does not capture unrealized capital gains accruing to foreigners who own shares of domestic firms which finance corporate spending from retained earnings. It is straightforward to compute this NIA measure of saving in our theoretical model. But the NIA measure of saving is generally very different from "true saving" which is a measure of saving that appropriately accounts for changes in the value of existing capital and variations in ownership of capital located in different countries. We define "true saving" to be the measure of saving which appropriately accounts for these considerations.

In the next section we study the model's predictions for the behavior of all three definitions of saving. However, basic saving is the only measure of saving for which data are readily available for most countries. The other two measures of saving have no readily-available empirical counterparts. Constructing the NIA measure requires information on international flows of factor income. This information available for some, but not all, countries. Constructing the appropriate measure of true saving is prohibitively difficult, as it requires information on foreign ownership of shares on a firm-by-firm basis, and information on firms' financing decisions (i.e., whether investment is financed by retained earnings.) We nevertheless report the model's predictions for these measures of saving in order to illustrate potential difficulties with using the more readily available "basic saving" measure.

4. Model Predictions: Theory and Evidence

In this section we examine the implications of our model for saving/investment correlations and the relationship between output, investment, and the current account. We provide a comparison of the model's predictions with data from 8 OECD countries. Some of the most interesting characteristics of the model lie in its predictions of the way in which the response to shocks depends on a country's size. The data also show that important stylized facts depend in a systematic way on country size. We therefore have chosen to study two cases. The first case involves a world consisting of two equally-sized countries. (Within our sample of 8 OECD countries, the U.S. represents about half of total GDP.) The second case involves a world made up of a large country and a small country in which the large country accounts for 90% of the world's output and the small country accounts for the remaining 10%.

Table 2 contains a list of the eight countries in our sample and their economic size as measured by real GNP, together with the correlation between basic saving and investment for each country over the period 1960–1985. The saving and investment series for each country were filtered using the Hodrick–Prescott (1980) filter before the correlations were computed. In the remainder of the paper, all of the data and all of the model results have been HP filtered, unless otherwise stated. This was done to preserve comparability with the growing body of research which uses this filter. But one's view of the "facts" can be highly colored by the filter used, as noted in Baxter (1988). For this reason, the Data Appendix (Appendix A) and the Model Appendix (Appendix B) also present results using a loglinear detrending procedure.

Two equally-sized countries

In this subsection we consider two equally sized countries which are identical in all respects except that these countries are subject to exogenous productivity shocks which are not perfectly correlated across the two countries. As mentioned above, we found that the model's predictions are most sensitive to the parameterization of (i) the productivity shock process and (ii) the size of the adjustment cost parameter.

Saving/investment correlations

The model predicts high saving/investment correlations for a broad range of parameter values. Table 3 presents results for several cases which involve variation in (i) the parameter governing the elasticity of the adjustment cost function (recall that ξ is the inverse of the elasticity of the investment response to changes in Tobin's Q, so that a smaller absolute value of ξ corresponds to more elastic adjustment) and (ii) parameters governing the evolution of technology shocks (ρ, $\rho*$, and ψ). As discussed above, these are the parameters to which the model's predictions are most sensitive. Because data limitations have so far prevented accurate estimation of these parameters, we present results for a broad range of these parameters which preserve the model's consistency with key business cycle phenomena.[8] Specifically, the range of parameters for which we present results was selected so that the model's predictions concerning (i) persistence of national outputs, (ii) patterns of relative volatility of consumption and investment, and (iii) international correlation of outputs is roughly in line with what is observed in the data. As discussed by Rebelo (1988) and Crucini (1989), this requires that technology shocks be persistent

[8]Some recent attempts to estimate the coefficients in similar productivity shock processes have been undertaken by Costello (1989) and Backus, Kehoe, and Kydland (1989). These attempts have unfortunately been severely hindered by difficulty in obtaining accurate international data, especially for capital stocks.

(ρ>0) and either (i) contemporaneously correlated across countries (ψ>0) or (ii) diffused over time from the originating country to other countries (ρ*>0).

For the range of parameter values reported in Table 3, the model predicts correlations between basic saving and investment in the range .69 to .92. The correlation between saving and investment is higher for our NIA measure of saving: the corresponding range is .81 to .97. (Recall that the NIA measure is defined as basic saving plus net factor receipts from abroad.) The correlation between true saving and investment ranges from .69 to .99.

Notice, however, that parameter variation which leads to increases in the correlation between basic saving and investment does not necessarily mean a higher correlation between true saving and investment—this can be seen by comparing cases 1 and 5. Because of the complete risk-pooling in our model, true saving in a country is proportional to world saving, with the factor of proportionality being country size. Since world saving must equal world investment, this implies that true saving is proportional to world investment. Thus international investment behavior is the key to understanding the relationship between basic saving/investment correlations and true saving/investment correlations. In case 1, investment is highly correlated across countries due to the high contemporaneous correlation of shocks and very elastic adjustment (ψ=.5 and ξ=-.075). In case 5, on the other hand, the contemporaneous correlation of shocks is lower and adjustment is more costly, leading investment to be negatively correlated across countries.[9] These results mean that we cannot say, *a priori*, whether basic

[9]See Table B-3 for information on the model's implications for investment correlations and other moments not reported in Table 3.

saving/investment correlations overstate or understate true saving/investment correlations.

Table 3 also provides, for each case, relative volatility and persistence statistics which are commonly used as informal measures of model adequacy.[10] These predictions are in the range reported in Tables A-2 and A-4 in Appendix A, and are presented in Table 3 so that the reader may ascertain that we have not abandoned these other important model attributes in order to generate realistic saving/investment correlations.

Output, investment and the current account

Sachs (1981) presents regression analyses of the relation between current account deficits and investment. Using data from fourteen OECD countries, he regressed the current account-to-GNP ratio on two variables: (i) the GNP "gap" (computed as the deviation from a trend line), and (ii) the investment-to-GNP ratio. Sachs reports a negative coefficient on the investment ratio for twelve of the fourteen countries, and interprets this as evidence that international investment movements are the dominant short-run influence on the current account. Further, he finds a negative coefficient on the GNP "gap" for nine of the fourteen countries. We investigate a similar relationship within the context of our model. Specifically, we compute the model's predictions of the coefficients in a regression of the log of the current account ratio on (i) the log of the deviation of output from the steady state and (ii) the log of the investment ratio. The last columns of Table 3 present our results. To maximize comparability with Sach's analysis, the model-generated data have not been HP filtered. We find that

[10] See, for example, the analyses of Kydland and Prescott (1982), Prescott (1986), and King, Plosser, and Rebelo (1988).

the model is very robust in its prediction of negative coefficients on both the GNP "gap" and the investment ratio. The model predicts that current account deficits are associated with investment booms, after controlling for "cyclic" movements in output.

We view these results as being particularly important, since Sachs's evidence has traditionally been interpreted as evidence in favor of international capital mobility, while the evidence on saving/investment correlations has been interpreted as evidence against capital mobility. Our theoretical model starts from the assumption of highly mobile capital, and simultaneously accounts both of these phenomena.

A large country and a small country

The preceding section showed that national saving and national investment are highly positively correlated in our model economy. In response to a positive productivity shock, two effects take place. The first is a desire to increase investment in the country to take advantage of the enhanced productivity which is rationally expected to persist for some time. The second effect is an increase in desired saving by individuals who hold claims to the country's output—these individuals are made wealthier by the shock, and they wish to spread out over time the additional consumption made possible by this increase in wealth. Thus there is a natural mechanism relating saving to investment in a country, regardless of the country's size.

But in a large country, there is a secondary effect which stems from the fact that technology shocks in a large country have a nontrivial effect on the world interest rate. A large country faces an upward-sloping supply curve for new capital as a function of the interest rate, whereas the textbook "small country" faces a perfectly elastic supply curve for capital.

Because the large country faces an imperfectly elastic supply curve for capital, and because saving rises with the interest rate under our assumption about the form of consumers' preferences, national saving and national investment are more highly correlated, the larger is the country in question. This section explores the ways in which this and other implications of our model depend on country size, by studying a two-country world economy in which the smaller country (representing 10% of steady state world GNP) has a trivial effect on the world interest rate. Except for this change, the parameterization of the model is exactly the same as before.

Saving/investment correlations

Table 4 presents the predictions of this model for saving/investment correlations in the large country and in the small country, over the same range of parameter values used previously. We find that the model again provides a robust prediction of high saving/investment correlations across the range of parameter values, and further predicts that saving/investment correlations are lower for the smaller country for all measures of saving. Looking first at basic saving, we find a correlation of .99 for the large country, with this correlation ranging from .17 to .81 for the small country. Our NIA measure of saving exhibits correlations which are again very close to one for the large country, and which range from .40 to .89 for the small country. Finally, true saving and investment are very highly correlated for both countries for most sets of parameter values, although the correlation for the small country exhibits a great deal of dependence on ψ (the contemporaneous correlation of shocks) and ξ (the adjustment cost parameter) for reasons discussed above.

Looking back at the empirical saving and investment correlations in Table 2, we see that all of the countries in our sample exhibit positive saving/investment correlations, and this correlation is positively related to country size as predicted by the model (for the data in Table 2, there is a .53 correlation between the country size variable and the saving/investment correlation).

Output, investment and the current account

Sachs (1981) provides evidence that the negative correlation between investment movements and the current account is larger for smaller countries. Looking at a combined sample of OECD, NIC's, and LDC's, he discusses in detail the recent period in which swings in current account deficits have been particularly large for some of the smallest countries in his sample. He provides evidence that it is precisely the smaller and less-industrialized countries in which the most investment is taking place and which have simultaneously experienced the largest current account deficits. The final columns of Table 4 give the results for the model's predictions for the coefficients in the "Sachs regressions." Comparing Tables 3 and 4, we find that the smaller the country, the stronger is the relationship between international investment flows and current account deficits. This result is due to the fact that the smaller country faces a more elastic supply schedule for capital, leading to larger swings in investment in response to productivity shocks. When the small country encounters a favorable technology shock, it wishes to expand output. Output expands by means of capital inflows from abroad; capital is lured into the small country by the prospect of a higher rate of return than in the large country. Because the world interest rate changes so little in response to a favorable shock in the small country, capital inflows to the small country are substantial.

Compare this to the case of a favorable technology shock in the large country. The same initial effect takes place: the rate of return to capital is higher in the large country, inducing capital inflows. But there is very little capital available in the rest of the world (i.e., in the small country). The result is that most of the increase in investment will be financed by domestic savings. For this to be an equilibrium the world interest rate must rise by a sufficient amount to induce individuals to postpone consumption (i.e., increase savings). Thus the world interest rate rises by more when the favorable shock occurs in the large country.

An additional implication of the elastic supply of capital to the small country is that output should be more volatile in smaller countries. The resulting capital flow is larger, and the response of output is correspondingly larger. Table A-2 contains statistics on output volatility for our eight-country sample. These statistics provide weak evidence in support of this model prediction; the correlation between country size (as measured in Table A-2) and output volatility is -0.05.

Despite its success in providing simultaneous explanations for (i) high saving/investment correlations in a world with high capital mobility and (ii) Sachs's evidence that investment flows are important determinants of current account movements, the model does fall short in its ability to mimic certain important attributes of the data. First, and most striking, is the model's implication that consumption should be nearly perfectly correlated across countries (see Tables B-3 through B-6). In our single-good setting, this implication derives from the assumption that markets are complete, i.e., that all state-contingent trades are permitted. One modification of the model which would reduce cross-country correlations of consumption would involve limiting the types of insurance or risk-pooling which individuals were permitted to arrange. An alternative route would involve introducing nontraded goods into the analysis.

5. Summary and Conclusions

In this paper, we present evidence which refutes a widely held view that high time series correlations between saving and investment are inconsistent with a world in which capital is highly mobile. We have demonstrated that it would be very surprising if this correlation did not arise in a world with highly mobile capital. We have done this by showing that the observed high saving/investment correlations arise quite naturally within a plausibly parameterized equilibrium model with perfect mobility of financial capital and a very high degree of physical capital mobility. In fact, the model's prediction of a high correlation between saving and investment in both large and small countries is robust to variation in the key parameters of the model.

At the same time, our model provides theoretical support for Sachs's empirical findings that investment flows are important determinants of current account behavior. Sachs (1981) provides a regression analysis which shows that current account deficits are positively related to investment, once one takes into account cyclic movements in output. We used our model to generate theoretical regression coefficients, and found that the model contains a robust prediction of the relationship between output, investment, and the current account of exactly the sort documented by Sachs.

Our analysis has stressed that country size is an important determinant of macroeconomic behavior; this is easy to understand, since shocks to technology and fiscal policy in large countries such as the U.S. can and do affect world interest rates. But we have further stressed that, while a small country cannot affect the world interest rate, the small country does not face a fixed real interest rate. In particular, the small country will typically find itself facing a relatively high real interest rate precisely when it is experiencing relatively high productivity and would like to increase investment. The international comovement of productivity is behind the high correlation of national outputs which we observe in the data.

We believe that a model incorporating high capital mobility is the obvious model for conducting analysis of the international transmission of business cycles and changes in government policy. Our confidence in this model stems from the fact that the model simultaneously accounts for so many other features of the world macroeconomy, in addition to the saving/investment correlations we set out to study. In particular, the model is consistent with Sachs's findings that investment flows are an important determinant of current account movements, and that this is especially true for smaller countries.

In summary, we have shown that an equilibrium model with highly mobile capital is capable of explaining many features of international macroeconomic linkages. In particular, we have shown that one long standing "puzzle" is not a puzzle at all. However, we view this work as largely preliminary to the very important work of analyzing the international macroeconomic effects of monetary and tax policies. It is possible, for example, that future research will prove false some of Feldstein's (1983) predictions about the effects of policy interventions in an open economy: "Perfect capital mobility implies...that the burden of corporate income taxes falls primarily on labor, that government deficits do not crowd out private investment, that increases in saving do not raise domestic investment, and that monetary and tax policies cannot alter the real net rate of return on domestic capital." Whether these statements are true depends on size of the economy in which the policies originate, the character of international linkages in the world economy, and on the extent of international coordination of changes in fiscal policy. These questions will form the foundation for our future research.

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Table 1

Baseline Parameters

Symbol	Value	Description
r	0.0163	steady state quarterly real interest rate
γ_x	1.004	rate of exogenous technical progress
$\bar{N}$	0.20	fraction of time spent in the workplace
		<u>Preference Parameters</u>
β	0.9875	discount rate
σ	2.00	inverse of the intertemporal elasticity of substitution in consumption
		<u>Technological Parameters</u>
α	0.58	labor's share of output
$1-\alpha$	0.42	capital's share of output
δ	0.025	depreciation rate of capital (per quarter)
		<u>Share Parameters</u>
s_c	0.60	fraction of output devoted to consumption
s_i	0.20	fraction of output devoted to investment
s_g	0.20	fraction of output devoted to government consumption
τ	0.30	proportional tax rate on output
T	0.10	transfers as a fraction of output

Table 2

Rank	Country	GNP Million 1985 US Dollars	Correlation Between Basic Saving and Investment*
1	United States	3994	0.86
2	Japan	1365	0.80
3	Germany	667	0.68
4	France	527	0.31
5	Italy	372	0.61
6	Canada	347	0.39
7	Australia	171	0.54
8	Switzerland	106	0.65

*Data filtered with Hodrick-Prescott filter.

Table 3

Model Results
Two Equally-Sized Countries
(HP filtered)

	Parameters				Saving/Investment Correlations								
	Technology			Adj. Cost	Measure of Saving			Relative Volatility			Persistence	Sachs Regression $(\hat{CA/Y}) = \alpha_0 \hat{Y} + \alpha_1 (\hat{I/Y})$	
Case	ρ	ρ^*	ψ	ξ	Basic	NIA	True	C	I	CA/Y	ρ_y	α_1	α_2
1	0.8	0.15	0.5	–0.075	0.80	0.89	0.98	0.59	2.32	1.32	.65	–0.58	–0.24
2	0.8	0.15	0.5	–0.150	0.69	0.81	0.99	0.65	2.03	1.29	.64	–0.65	–0.21
3	0.9	0.05	0.0	–0.075	0.92	0.96	0.69	0.42	2.32	1.30	.69	–0.66	–0.34
4	0.9	0.05	0.0	–0.150	0.81	0.88	0.83	0.46	1.69	1.11	.68	–0.80	–0.19
5	0.9	0.05	0.2	–0.075	0.92	0.97	0.76	0.48	2.39	1.34	.70	–0.53	–0.40
6	0.9	0.05	0.2	–0.150	0.80	0.88	0.88	0.52	1.83	1.18	.69	–0.59	–0.35

Table 4

Model Results
A Large and a Small Country
(HP filtered)

	Parameters				Saving/Investment Correlations						Persistence	Sachs Regression	
	Technology			Adj. Cost	Measure of Saving			Relative Volatility				$\hat{(CA/Y)} = \alpha_0\hat{Y} + \alpha_1\hat{(I/Y)}$	
Case	ρ	ρ^*	ψ	ξ	Basic	NIA	True	C	I	CA/Y	ρ_y	α_1	α_2
					0.99	1.00	1.00	0.64	2.85	1.47	0.67	–0.96	0.01
1	0.8	0.15	0.5	–0.075	0.37	0.61	0.94	0.56	2.18	1.32	0.63	–0.39	–0.45
					0.99	0.99	1.00	0.73	2.52	1.37	0.66	–0.97	0.01
2	0.8	0.15	0.5	–0.150	0.17	0.40	0.98	0.60	1.95	1.27	0.62	–0.44	–0.42
					0.99	1.00	1.00	0.57	2.93	1.50	0.69	–0.99	0.01
3	0.9	0.05	0.0	–0.075	0.81	0.89	0.06	0.38	1.86	1.16	0.69	–0.64	–0.21
					0.99	0.99	1.00	0.66	2.52	1.38	0.69	–1.00	0.02
4	0.9	0.05	0.0	–0.150	0.45	0.58	0.54	0.41	1.23	1.02	0.68	–0.70	–0.34
					0.99	1.00	1.00	0.60	2.91	1.50	0.70	–0.97	0.03
5	0.9	0.05	0.2	–0.075	0.80	0.89	0.26	0.43	1.99	1.24	0.70	–0.47	–0.55
					0.99	1.00	1.00	0.69	2.52	1.39	0.70	–0.98	0.02
6	0.9	0.05	0.2	–0.150	0.46	0.61	0.65	0.46	1.42	1.11	0.68	–0.49	–0.52

Appendix A

Data Appendix

Table A-1
Savings and Investment Correlations

Countries Ordered by Economic Size

	Filtering Method	
Country	Linearly Detrended	HP filtered
USA	0.85	0.86
Japan	0.97	0.80
Germany	0.71	0.68
France	0.88	0.31
Canada	0.84	0.61
Italy	0.40	0.39
Australia	0.73	0.54
Switzerland	0.88	0.65

Table A-2
Standard Deviations

Linearly detrended									
	y	c	g	s	i	x	m	NX/Y	NFI/Y
USA	3.46	2.29	6.14	9.86	7.21	12.58	11.01	0.55	0.20
Japan	12.65	10.95	8.59	17.99	18.00	12.20	14.10	1.27	0.0003
Germany	3.42	2.53	6.41	8.07	8.33	5.13	4.89	1.23	NA
France	4.44	3.55	3.50	9.39	8.13	9.47	10.65	0.41	NA
Canada	5.27	3.51	8.30	12.03	11.30	7.93	10.35	1.27	0.005
Italy	2.42	2.02	4.86	9.52	6.04	8.17	11.30	2.04	NA
Australia	4.61	2.39	6.74	11.57	7.41	7.68	8.89	1.85	0.004
Switzerland	3.73	2.45	3.95	9.83	12.01	5.38	9.39	1.98	NA

HP filtered									
	y	c	g	s	i	x	m	NX/Y	NFI/Y
USA	1.84	1.24	2.04	7.41	5.52	6.94	5.55	0.41	0.10
Japan	1.71	1.92	2.20	4.50	3.95	6.88	9.88	0.93	0.0002
Germany	1.70	1.19	2.09	5.47	5.78	3.87	1.64	0.88	NA
France	0.99	0.88	1.23	3.62	1.90	4.06	6.14	0.81	NA
Canada	1.66	1.47	2.17	6.22	4.71	5.01	3.32	0.83	0.002
Italy	2.21	1.81	3.12	8.15	5.51	4.97	9.09	1.76	NA
Australia	1.70	1.17	2.80	5.79	3.69	6.09	7.62	1.46	0.002
Switzerland	2.15	1.64	1.81	5.72	6.20	4.42	7.29	1.50	NA

Note: Lower case variables, y, c, ..., m, refer to logarithms of variables while upper case variables NX/Y and NFI/Y refer to the ratio of levels.

Table A–3
Cross–Correlations with Output

Linearly detrended								
	c	g	s	i	x	m	NX	NFI
USA	0.95	0.70	0.79	0.73	0.04	0.08	0.11	0.18
Japan	0.97	0.75	0.96	0.97	0.74	0.45	–0.09	–0.40
Germany	0.80	0.68	0.75	0.69	0.30	0.32	–0.07	NA
France	0.96	0.83	0.94	0.96	0.88	0.80	0.06	NA
Canada	0.88	0.84	0.87	0.87	0.81	0.85	–0.61	0.73
Italy	0.72	0.10	0.76	0.75	0.36	0.73	–0.60	NA
Australia	0.90	0.67	0.95	0.79	0.50	–0.10	0.46	0.50
Switzerland	0.76	0.49	0.88	0.84	0.65	0.77	–0.61	NA

HP filtered								
	c	g	s	i	x	m	NX	NFI
USA	0.88	0.06	0.90	0.90	0.17	0.55	–0.39	0.43
Japan	0.47	–0.29	0.77	0.60	–0.10	–0.02	–0.04	0.14
Germany	0.64	–0.03	0.90	0.80	0.19	0.45	–0.22	NA
France	0.58	0.10	0.78	0.45	0.34	0.29	–0.10	NA
Canada	0.72	–0.21	0.82	0.62	0.67	0.77	–0.31	–0.18
Italy	0.70	0.17	0.80	0.80	0.42	0.81	–0.69	NA
Australia	0.62	–0.17	0.88	0.55	0.34	0.43	–0.09	–0.17
Switzerland	0.74	0.29	0.87	0.73	0.68	0.83	–0.66	NA

Note: Lower case variables y, c, ..., m, refer to logarithms while upper case variables, net exports (NX) and net factor income from abroad (FNI) refer to levels.

Table A-4
First-Order Autocorrelations

Linearly detrended									
	y	c	g	s	i	x	m	NX	NFI
USA	0.95	0.94	0.98	0.85	0.92	0.92	0.91	0.89	0.99
Japan	0.99	0.99	0.95	0.98	0.99	0.94	0.93	0.93	0.59
Germany	0.92	0.88	0.94	0.84	0.84	0.78	0.80	0.83	NA
France	0.99	0.96	0.96	0.95	0.98	0.94	0.91	0.80	NA
Canada	0.98	0.95	0.97	0.93	0.97	0.89	0.93	0.84	0.87
Italy	0.81	0.72	0.92	0.57	0.88	0.84	0.84	0.78	NA
Australia	0.95	0.87	0.91	0.90	0.93	0.79	0.82	0.84	0.82
Switzerland	0.90	0.78	0.81	0.79	0.94	0.83	0.89	0.82	NA

HP filtered									
	y	c	g	s	i	x	m	NX	NFI
USA	0.84	0.83	0.85	0.75	0.89	0.76	0.68	0.79	0.74
Japan	0.74	0.79	0.31	0.75	0.83	0.82	0.88	0.84	0.40
Germany	0.71	0.50	0.45	0.65	0.68	0.63	0.73	0.65	NA
France	0.79	0.49	0.10	0.67	0.70	0.72	0.75	0.72	NA
Canada	0.79	0.75	0.61	0.74	0.87	0.74	0.81	0.60	0.32
Italy	0.78	0.66	0.82	0.44	0.86	0.61	0.76	0.71	NA
Australia	0.67	0.47	0.49	0.63	0.74	0.67	0.77	0.75	0.26
Switzerland	0.70	0.52	0.11	0.41	0.81	0.76	0.83	0.71	NA

Note: Lower case variables y, c, ..., m, refer to logarithms while upper case variables, net exports (NX) and net factor income from abroad (FNI) refer to levels.

Table A-5
Cross-Correlations of Outputs

Linearly detrended								
	Aust.	Can.	Fra.	Ger.	Ita.	Jap.	Swi.	USA
Australia	1.00	0.85	0.69	0.83	0.17	0.86	0.05	0.66
Canada		1.00	0.79	0.83	0.41	0.77	0.15	0.76
France			1.00	0.79	0.47	0.48	0.12	0.29
Germany				1.00	0.47	0.73	−0.03	0.64
Italy					1.00	0.07	−0.10	0.45
Japan						1.00	0.01	0.78
Switzerland							1.00	0.02
United States								1.00

HP filtered								
	Aust.	Can.	Fra.	Ger.	Ita.	Jap.	Swi.	USA
Australia	1.00	0.41	0.36	0.47	0.35	0.15	0.34	0.24
Canada		1.00	0.36	0.43	0.57	0.28	0.38	0.77
France			1.00	0.65	0.59	0.52	0.51	0.50
Germany				1.00	0.57	0.55	0.51	0.44
Italy					1.00	0.30	0.67	0.47
Japan						1.00	0.32	0.42
Switzerland							1.00	0.28
United States								1.00

Table A–6
Cross–Correlations of Consumptions

Linearly detrended								
	Aust.	Can.	Fra.	Ger.	Ita.	Jap.	Swi.	USA
Australia	1.00	0.63	0.56	0.55	–0.11	0.71	–0.08	0.56
Canada		1.00	0.73	0.67	0.17	0.51	0.01	0.54
France			1.00	0.77	0.41	0.40	–0.13	0.12
Germany				1.00	0.06	0.54	–0.23	0.46
Italy					1.00	0.01	–0.04	0.17
Japan						1.00	–0.04	0.77
Switzerland							1.00	–0.17
United States								1.00

HP filtered								
	Aust.	Can.	Fra.	Ger.	Ita.	Jap.	Swi.	USA
Australia	1.00	0.23	0.11	0.21	–0.16	0.09	0.06	0.11
Canada		1.00	0.12	0.31	–0.05	0.24	0.03	0.65
France			1.00	0.32	0.32	0.15	0.21	0.28
Germany				1.00	0.02	0.40	0.22	0.45
Italy					1.00	–0.13	0.53	0.23
Japan						1.00	–0.04	0.41
Switzerland							1.00	0.22
United States								1.00

Appendix B

Model Appendix

Table B–1

Model Results
Two Equally Sized Countries

(Linearly detrended)

	Parameters				Saving/Investment Correlations						Persistence
	Technology			Adj. Cost	Measure of Saving			Relative Volatility			
Case	ρ	ρ^*	ψ	ξ	Basic	NIA	True	C	I	CA/Y	ρ_Y
1	0.8	0.15	0.5	–0.075	0.90	0.96	0.99	1.02	1.95	4.32	0.95
2	0.8	0.15	0.5	–0.150	0.86	0.93	1.00	1.04	1.81	4.09	0.95
3	0.9	0.05	0.0	–0.075	0.80	0.88	0.85	0.82	1.83	3.67	0.95
4	0.9	0.05	0.0	–0.150	0.74	0.84	0.93	0.85	1.59	3.41	0.94
5	0.9	0.05	0.2	–0.075	0.82	0.90	0.90	0.88	1.87	3.97	0.95
6	0.9	0.05	0.2	–0.150	0.76	0.86	0.95	0.91	1.66	3.71	0.95

Table B–2
Model Results
A Large and A Small Country

(Linearly detrended)

	Parameters				Saving/Investment Correlations						Persistence
	Technology			Adj. Cost	Measure of Saving			Relative Volatility			
Case	ρ	ρ^*	ψ	ξ	Basic	NIA	True	C	I	CA/Y	ρ_Y
					1.00	1.00	1.00	1.03	2.05	4.39	0.96
1	0.8	0.15	0.5	–0.075	0.70	0.85	0.98	1.01	1.93	4.33	0.95
					0.99	1.00	1.00	1.06	1.90	4.16	0.96
2	0.8	0.15	0.5	–0.150	0.61	0.78	0.99	1.02	1.80	4.11	0.94
					0.99	0.99	1.00	0.96	2.14	3.97	0.95
3	0.9	0.05	0.0	–0.075	0.56	0.68	0.55	0.78	1.59	3.62	0.94
					0.98	0.99	1.00	0.99	1.95	3.73	0.95
4	0.9	0.05	0.0	–0.150	0.40	0.55	0.79	0.81	1.37	3.39	0.93
					0.99	0.91	1.00	0.98	2.10	4.19	0.96
5	0.9	0.05	0.2	–0.075	0.59	0.72	0.67	0.84	1.68	4.93	0.95
					0.98	0.99	1.00	1.01	1.93	3.95	0.96
6	0.9	0.05	0.2	–0.150	0.45	0.62	0.85	0.87	1.49	3.69	0.94

Table B–3

Model Results
Two Equally–Sized Countries

(HP filererd)

	Parameters				Std. Dev.	Persistence		Contemporaneous Correlations						
	Technology			Adj. Cost										
Case	ρ	ρ^*	ψ	ξ	Y	I	C	Y,I	Y,C	Y,CA	C,C*	I,I*	S,S*	A,A*
1	0.8	0.15	0.5	–0.075	1.61	0.70	0.73	0.91	0.86	0.59	0.98	0.91	–0.16	0.61
2	0.8	0.15	0.5	–0.150	1.56	0.71	0.73	0.87	0.85	0.61	0.98	0.97	–0.30	0.61
3	0.9	0.05	0.0	–0.075	1.86	0.68	0.73	0.97	0.72	0.81	0.92	–0.05	–0.69	0.04
4	0.9	0.05	0.0	–0.150	1.82	0.70	0.73	0.92	0.70	0.83	0.93	0.38	–0.76	0.04
5	0.9	0.05	0.2	–0.075	1.80	0.69	0.74	0.97	0.76	0.75	0.95	0.15	–0.57	0.24
6	0.9	0.05	0.2	–0.150	1.75	0.70	0.73	0.92	0.74	0.77	0.95	0.54	–0.66	0.24

Table B–4

Model Results
Two Equally–Sized Countries

(Linearly detrended)

	Parameters				Std. Dev.	Persistence		Contemporaneous Correlations						
	Technology			Adj. Cost										
Case	ρ	ρ^*	ψ	ξ	Y	I	C	Y,I	Y,C	Y,CA	C,C*	I,I*	S,S*	A,A*
1	0.8	0.15	0.5	–0.075	4.47	0.94	0.99	0.93	0.95	0.26	1.00	0.98	0.46	0.89
2	0.8	0.15	0.5	–0.150	4.25	0.95	0.98	0.94	0.95	0.27	1.00	0.99	0.37	0.89
3	0.9	0.05	0.0	–0.075	4.51	0.91	0.99	0.91	0.81	0.61	0.99	0.46	–0.53	0.48
4	0.9	0.05	0.0	–0.150	4.24	0.93	0.98	0.91	0.82	0.61	0.99	0.73	–0.56	0.48
5	0.9	0.05	0.2	–0.075	4.61	0.92	0.99	0.92	0.85	0.53	0.99	0.61	–0.38	0.62
6	0.9	0.05	0.2	–0.150	4.34	0.94	0.98	0.92	0.86	0.54	0.99	0.81	–0.41	0.62

Table B–5

Model Results
A Large and a Small Country

(HP filtered)

	Parameters				Std. Dev.	Persistence		Contemporaneous Correlations						
	Technology			Adj. Cost										
Case	ρ	ρ^*	ψ	ξ	Y	I	C	Y,I	Y,C	Y,CA	C,C*	I,I*	S,S*	A,A*
					1.52	0.65	0.66	1.00	1.00	0.52	0.87	0.93	–0.11	0.61
1	0.8	0.15	0.5	–0.075	1.71	0.70	0.74	0.62	0.70	0.64				
					1.44	0.66	0.71	1.00	0.97	0.51	0.98	0.98	–0.21	0.61
2	0.8	0.15	0.5	–0.150	1.69	0.69	0.73	0.48	0.64	0.68				
					1.61	0.68	0.73	0.99	0.95	0.74	0.94	–0.03	–0.62	0.04
3	0.9	0.05	0.0	–0.075	2.13	0.69	0.74	0.91	0.27	0.85				
					1.53	0.68	0.71	1.00	0.97	0.75	0.95	0.49	–0.67	0.04
4	0.9	0.05	0.0	–0.150	2.13	0.71	0.73	0.65	0.18	0.88				
					1.59	0.69	0.73	0.99	0.96	0.67	0.96	0.17	–0.48	0.24
5	0.9	0.05	0.2	–0.075	2.02	0.69	0.74	0.92	0.39	0.81				
					1.51	0.69	0.72	1.00	0.97	0.68	0.96	0.60	–0.55	0.24
6	0.9	0.05	0.2	–0.150	2.01	0.71	0.73	0.69	0.32	0.83				

Table B–6

Model Results
A Large and a Small Country

(Linearly detrended)

	Parameters				Std. Dev.	Persistence		Contemporaneous Correlations						
	Technology			Adj. Cost										
Case	ρ	ρ^*	ψ	ξ	Y	I	C	Y,I	Y,C	Y,CA	C,C*	I,I*	S,S*	A,A*
					4.43	0.99	0.92	0.97	0.94	0.23	1.00	0.98	0.48	0.89
1	0.8	0.15	0.5	–0.075	4.51	0.94	0.99	0.86	0.92	0.29				
					4.20	0.93	0.98	0.96	0.98	0.22	1.00	0.99	0.41	0.89
2	0.8	0.15	0.5	–0.150	4.31	0.94	0.98	0.84	0.91	0.32				
					4.16	0.91	0.98	0.94	0.95	0.52	0.99	0.48	–0.39	0.48
3	0.9	0.05	0.0	–0.075	4.92	0.92	0.99	0.81	0.54	0.68				
					3.92	0.92	0.98	0.96	0.96	0.52	0.99	0.76	–0.41	0.48
4	0.9	0.05	0.0	–0.150	4.61	0.95	0.98	0.74	0.55	0.68				
					4.34	0.92	0.98	0.94	0.95	0.44	0.99	0.62	–0.23	0.62
5	0.9	0.05	0.2	–0.075	4.93	0.93	0.99	0.84	0.65	0.61				
					4.09	0.93	0.98	0.96	0.97	0.45	0.99	0.83	–0.25	0.62
6	0.9	0.05	0.2	–0.150	4.63	0.95	0.98	0.79	0.66	0.61				