WORKING PAPER SERIES

Trade, Investment, and International Borrowing in
Two-Country Business Cycle Models

Michael Pakko

Working Paper 1997-023A
<http://research.stlouisfed.org/wp/1997/97-023.pdf>

FEDERAL RESERVE BANK OF ST. LOUIS
Research Division
411 Locust Street
St. Louis, MO 63102

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December 1997

Abstract

Two country applications of equilibrium business cycle methodology have succeeded in matching some key features of international fluctuations. However, discrepancies between theory and data remain. This paper identifies a new anomaly related to a basic property of typical models: The prediction of countercyclical net exports is fundamentally related to a (counterfactual) implication for negative cross-country investment correlations. Although the introduction of investment adjustment costs can reverse this anomaly, it has the side-effect of inducing the wrong cyclical behavior for net exports. Possible resolutions to this puzzle are considered, including asset market restrictions and the role of the substitution elasticities.

Keywords: Current account, International business cycles, Terms of trade

JEL Classification: F32, F41, E32

Michael R. Pakko
Economist
Federal Reserve Bank of St. Louis
411 Locust Street
St. Louis, MO 63102
Phone-(314) 444-8564
E-mail--pakko@stls.frb.org

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1. Introduction

Two country applications of equilibrium business cycle methodology (a.k.a. “International RBC Models”) have met with some success in matching features of fluctuations and comovements across countries. Work by Cantor and Mark (1988), Baxter and Crucini (1993), Backus, Kehoe and Kydland (1992), and others has demonstrated that prototypical one-commodity, two-county models can do reasonably well in matching within-country patterns of volatility, persistence and comovement among macroeconomic variables. Two-good extensions of the baseline model, as in Backus, Kehoe and Kydland (1994, 1995) [hereafter, BKK] have extended these results to replicating some of the patterns of trade flows and exchange rate fluctuations. For example, the baseline two-good model in BKK (1995) has predictions which roughly mimic the data with respect to the persistence of terms-of-trade fluctuations, the correlation between the terms of trade and net exports, and the countercyclicality of net exports. BKK (1994) also show that the lagged cross-correlation function between the terms of trade and net exports implies a “J-curve” relationship, as is seen in the data.

Table 1 summarizes some of the empirical regularities that have been identified in the literature. For example, Table 1 shows that fluctuations in net exports are consistently countercyclical and generally negatively correlated with the terms of trade, but the terms of trade have no clear cyclicality. Output, consumption and investment are all positively correlated across countries.

Table 1 shows two properties of international business cycles which have been specifically noted as representing discrepancies between the data and existing models. BKK (1995) refer to these as a quantity puzzle and a price puzzle.¹ First, models tend to predict very high cross-country consumption correlations, whereas in the data consumption correlations tend to be lower than output correlations.¹² The price puzzle refers to the variability of the terms of trade. Models tend to predict a standard deviation for the terms of trade that is much lower than in the data.³

In this paper, I identify an additional anomaly that is related to a basic dynamic property of typical models. In particular, I show that model implications for countercyclical net exports and negative co-movement between net exports and the terms of trade are fundamentally related to a prediction that the correlation between investment across countries will be strongly negative. In contrast, the data summarized in Table 1 show that investment for each country examined is positively correlated with investment in the rest of the OECD countries. Table 1A amplifies the robustness of this finding with figures for bilateral cross country correlations.

In the model, relative productivity shocks tend to induce large investment flows toward the country with higher marginal product of capital. Meanwhile, high demand for

¹Pakko (forthcoming) suggests that comparing the correlations of consumption with domestic output to correlations of consumption with world output is a more robust characterization of the quantity puzzle.

²This consumption correlation anomaly has also been the topic of investigation by Devereux, Gregory and Smith (1993), and Pakko (1997). Baxter and Crucini (1993) examine the closely-related issue of generating realistically high savings-investment correlations within the basic prototypical model.

³The issue of terms of trade variability, how it has changed over time, and the possible role for oil price shocks is explored in Backus and Crucini (1996).

imported investment goods and an increase in the supply of domestically produced goods result in a deterioration in the terms of trade. Imports are strongly procyclical (producing countercyclical net exports), the terms of trade countercyclical, and investment moves in opposite directions in the two countries. When a small friction in the form of investment adjustment costs are introduced to dampen the flow of investment goods across countries, however, the model no longer produces countercyclical net exports or negative comovement between net exports and the terms of trade. In this sense, the ability of standard models to replicate key empirical regularities is fragile.

This paper also considers some possible modifications to the baseline model to reinforce robustness of results. The key question can be expressed as follows: What additional model characteristics can help account for countercyclical net exports when the volatility of investment good flows is dampened?

I consider first the implications of asset market completeness. In a one-commodity model, Baxter and Crucini (1995) show that the absence of complete financial integration can have important implications for the propagation of shocks across countries. In particular, restricted asset trade gives rise to relative wealth effects. The introduction of this additional channel connecting import demand with positive output shocks could, conceivably, tend to enhance the procyclicality of import demand.

A second factor I consider is the specification of the elasticity of substitution between foreign and domestic goods. If the two goods are compliments instead of being highly substitutable as in the baseline model, productivity shocks are associated with demands for domestic goods and imports moving more closely together. This magnifies the positive response of import demand when consumption rises following a positive

productivity shock, enhancing the tendency of the model to predict countercyclical trade balance behavior.

The outline of the paper's exposition is as follows: Section 2 describes the baseline model and shows how the introduction of investment adjustment costs produces a tradeoff between generating realistic cross-country investment correlations and realistic trade cyclicity. Section 3 examines the role of asset market incompleteness in the baseline model, and Section 4 focusses on the crucial substitution elasticity parameter. Concluding comments are contained in Section 5.

2. Baseline Economy

2.1 Preferences and Technology

The baseline model economy is that used by BKK (1994, 1995). It consists of two countries, each of which is inhabited by an infinitely-lived representative agent. Both agents have expected utility functions of the form

$$E_t \sum_{t=0}^{\infty} \beta^t U(C_t, 1 - N_t)$$

where C_t and N_t are consumption and work effort, and $U(C_t, 1 - N_t) = [C_t^\theta (1 - N_t)^{1-\theta}]^{1-\sigma} / (1-\sigma)$.

Production takes place in each country using capital and labor. The home country produces X_t of the x-good while the foreign country produces Y_t of the y-good:

$$\begin{aligned} A_t F(K_t, N_t) &= A_t K_t^\alpha N_t^{1-\alpha} = X_t, \\ A_t^* F(K_t^*, N_t^*) &= A_t^* K_t^{*\alpha} N_t^{*1-\alpha} = Y_t^*. \end{aligned}$$

Consumption and investment are composites of domestic goods and imports,

$$H(x_t, y_t) = C_t + I_t \quad (1)$$

$$H^*(x_t^*, y_t^*) = C_t^* + I_t^* \quad (1^*)$$

where $H(x,y)$ and $H^*(x^*,y^*)$ are Armington aggregator functions of the CES form:

$$H(x_t, y_t) = \kappa [ax_t^{1-\eta} + (1-a)y_t^{1-\eta}] \quad H^*(x_t^*, y_t^*) = \kappa [(1-a)x_t^{*1-\eta} + ay_t^{*1-\eta}]$$

The elasticity of substitution between domestic goods and imports is $1/\eta$. The parameter ω determines the steady-state ratio of imports to GDP, while κ is a scaling parameter which is set so that $H(\cdot)=H^*(\cdot)=X=Y^*$ in the steady state.

Capital stocks evolve according to

$$K_{t+1} = (1-\delta)K_t + I_t \quad (2)$$

$$K_{t+1}^* = (1-\delta)K_t^* + I_t^* \quad (2^*)$$

where δ is the depreciation rate of capital.

The equilibrium relative price of the home country's import (the terms of trade) can be computed from the marginal rate of substitution in the Armington aggregator:

$$P_t = [\partial H(x_t, y_t) / \partial y_t] / [\partial H(x_t, y_t) / \partial x_t] .$$

The trade balance for the home country can then be expressed in units of the domestic good:

$$NX_t = x_t^* - P_t y_t .$$

The technology shock variables A and A^* follow a joint AR(1) process:

$$\begin{bmatrix} A_{t+1} \\ A_{t+1}^* \end{bmatrix} = \begin{bmatrix} \rho_{xx} & \rho_{xy} \\ \rho_{yx} & \rho_{yy} \end{bmatrix} \begin{bmatrix} A_t \\ A_t^* \end{bmatrix} + \begin{bmatrix} \epsilon_t \\ \epsilon_t^* \end{bmatrix}$$

In the baseline case, agents have access to a complete array of state-contingent assets, so the equilibrium will be Pareto optimal and a social-planner's approach to finding allocations can be exploited. Assuming equal-sized countries, the social planner's objective can be represented as maximizing the simple sum of the two agents' discounted expected utility, subject to constraints (1), (1*), (2), (2*) and the resource constraints:

$$A_t F(K_t, N_t) = x_t + x_t^* \quad (3)$$

$$A_t^* F(K_t^*, N_t^*) = y_t + y_t^* \quad (3^*)$$

2.2 Model Dynamics

The first-order conditions from the social planner's maximization problem yield a nonlinear difference equation system. The approach taken for evaluating model dynamics in this paper involves taking log-linear approximations of the first order conditions, then using standard algorithms for solving linear difference equation systems. After specifying a variance-covariance process for the underlying disturbance terms, ϵ_t and ϵ_t^* , the solutions to the linear system can be used to generate a set of moments for the simulated economy.⁴ In all the results reported in this paper, second moments are Hodrick-Prescott filtered, using a frequency-domain approximation of the H-P filter's variance transfer function applied to the model's population moments [as in King and Rebelo (1993)].

⁴This is the approach followed by King, Plosser and Rebelo (1988), for example.

The model is calibrated using the baseline parameter values given in Table 2, with most parameter values taken from BKK (1995). Assuming quarterly time periods, the discount factor is set to imply a 4% real interest rate, and the annual depreciation rate on capital is 10%. The Cobb-Douglas parameters in utility and production are set to imply that the fraction of time spent working is 0.3 and that labor's share of output is 0.64. The Armington aggregator parameters are chosen to imply an import share of .15 and an elasticity of substitution between domestic goods and imports equal to 1.5. The parameters of the technology process are those estimated by BKK (1992): $\rho_{xx} = \rho_{yy} = 0.906$, $\rho_{xy} = \rho_{yx} = 0.088$, and $\text{var}(\epsilon) = \text{var}(\epsilon^*) = 0.08325$.

The row labeled "baseline" under the Complete Markets heading in Table 3 reports some of the key implications of the basic model. Consumption and investment are both strongly correlated with output, the cross-country output correlation is positive, and net exports are negatively correlated with both output and the terms of trade.⁵

The two puzzles proposed by BKK (1995) are also clear: Cross-country consumption correlations are higher than corresponding output correlations, and the standard deviation of the terms of trade is far lower than seen in the data. Also note that the model implies a strong negative correlation between investment in the two countries.

The interrelatedness of these features of the model is illustrated in Figure 1, which shows impulse-response functions for a positive technology shock to the home country. The increase in the home country's marginal product of capital attracts a huge increase in investment, absorbing resources from abroad (hence the countercyclical net exports). The

⁵Table 1 shows that the U.S. is the exception to the general regularity that net exports and the terms of trade are negatively correlated.

terms of trade respond to the increased demand for the foreign country's goods and the additional supply of the home countries goods, resulting in an increase in the import price facing the domestic agent (hence the negative correlations between net exports and the terms of trade). However, the simultaneous rise in investment in the home country and decline in investment in the foreign country -- and their subsequent prolonged return to the steady state -- induces a negative cross-country investment correlation. In essence, the model is fundamentally driven by fluctuations in relative marginal products of capital across countries.

2.3 Investment Adjustment Costs

The relationship among these features of the baseline model can be further examined by introducing a friction to dampen cross-country investment flows. I employ the specification for investment adjustment costs used by Baxter and Crucini (1993, 1995), modifying the capital accumulation equations to:

$$K_{t+1} = (1-\delta)K_t + \phi(I_t/K_t)K_t \quad (2a)$$

$$K_{t+1}^* = (1-\delta)K_t^* + \phi(I_t^*/K_t^*)K_t^* \quad (2a^*)$$

where the adjustment cost function has the properties $\phi(\cdot) > 0$, $\phi'(\cdot) > 0$, $\phi''(\cdot) < 0$. The adjustment cost function is calibrated so that the steady state investment/output ratio is the same as in the model without adjustment costs and the steady-state value of Tobin's q is 1, leaving one free parameter: the elasticity of the investment/capital ratio with respect to Tobin's q , $\zeta = [\phi'(\cdot)/\phi''(\cdot)](I/K)$. The results reported below use an elasticity value of $\zeta = -5$, which is sufficient to generate positive cross-country investment correlations.

The second row of numbers in Table 3 report the implied moments of the model with investment adjustment costs. Note that this added friction has the intended result: The volatility of investment is lower so the cross-country correlation of investment spending is now positive. The addition of investment adjustment costs also raises the variability of the terms of trade and lowers that of output. Moreover, cross country-consumption correlations are lower and cross-country output correlations are higher in the adjustment-cost economy. These modifications all work in the direction of resolving the two puzzles of BKK.

However, net exports are now significantly procyclical, and the terms of trade now covaries positively with net exports. A small dampening of the investment-flow channel of the model results in a complete reversal of the cyclical behavior of these two variables. Figure 2 illustrates how the introduction of investment adjustment costs alters the dynamic response of the model. A positive technology shock in the home country gives rise to a much smaller surge in investment (as expected). As a result, the increase in investment demand can now be financed out of domestic savings. Net exports now rise, rather than fall as an immediate consequence of the shock.

3. Incomplete Asset Markets

3.1 Rationale

Traditional partial-equilibrium models of trade flows incorporate important effects of changing income levels across countries. An increase in one country's income leads to a rise in import demand, which produces a tendency for net exports to behave

countercyclically. In addition, the increased demand for imports drives their relative price up, producing negative comovement between net exports and the terms of trade.

General equilibrium models with complete asset markets have no such channel of propagation. The risk-pooling accomplished through asset trade leaves relative wealth levels unchanged, so there are no relative wealth (or income) effects on commodity demands.

In this section, I examine a version of the model in which trade is limited to one-period loans (bonds). This introduces one additional state variable to the model: the relative wealth levels of the two agents. Baxter and Crucini (1995) and Kehoe and Perri (1997) have found that this type of asset restriction modifies the implications of a one-commodity model in several important respects.

3.2 Modification to Model

In the absence of a complete-markets assumption, the social planner paradigm can no longer be exploited. A decentralized solution to the model can be found by considering each of the agent's optimization problem, and imposing aggregate consistency (equilibrium) conditions. Equations (1) and (2) continue to be constraints on the agent's optimization problems, but individual optimizations are subject to the budget constraints:

$$A_t F(K_t, N_t) + B_t = x_t + P_t y_t + q_t B_{t+1} \quad (4)$$

$$A_t^* F(K_t^*, N_t^*) + B_t^* = x_t^* + P_t^* y_t^* + q_t^* B_{t+1}^* \quad (4^*)$$

where B_t represent bond-holdings from time $t-1$, and q_t is the price of a one period discount bond at time t .

The first-order conditions to the agent's maximization problems yield supply and demand functions in terms of the relative prices P_t and q_t . Equilibrium conditions (3), (3*) and the bond market condition $B+B^*=0$ can then be used to find solutions to these relative prices and hence to the model's equilibrium.

3.3 Results

The third row of numbers in Table 3 summarizes the implications of the baseline "bonds-only" model economy. The following row reports results for a variant of the model with the investment adjustment cost specification in equations (2a) and (2a*). Comparing these results to the complete markets version of the model, there is virtually no effect of asset market restrictions. The hypothesized relative wealth effects (or at least their importance) fail to materialize.

The apparent irrelevance of asset market restrictions can be interpreted as an extension of the results of Cole and Obstfeld (1991). They show that in a two-good endowment economy, terms of trade fluctuations act to pool consumption risk between two agents, leaving a limited role for explicit asset trade. In the model at hand, with a production sector, capital accumulation, and labor/leisure choice, this result appears robust. In fact, it seems quite likely that margins of adjustment in investment and labor supply decisions might reinforce the risk-pooling role of the terms of trade.

Some insight into the asset-market irrelevance result -- as well as into the dynamics of the underlying model -- can be obtained by examining the dynamic behavior of relative wealth levels. Figure 3 shows the response of the home country's net foreign asset position (as a percent of GDP) to a positive productivity shock in the home country.

In the baseline model, the home country initially runs a current account deficit as it finances investment. Only after the shock has worked its way through the model economy does the increase in the home country's relative wealth show up in its asset position as a positive balance. In the version of the model with investment adjustment costs, the home country accumulates assets gradually from the time of the shock. In both cases, the relative wealth effect -- revealed after the shock has worked its way through the economy -- is fairly small. A one percent innovation to home productivity, which results in an initial increase of just over one percent of home-country output, implies an increase in the home agent's wealth of about one-half percent of GDP.

In a world with endogenous production decisions and risk-pooling terms of trade movements, the relative income/wealth effects from partial-equilibrium models fail to have any material significance.⁶

4. The Role of the Substitution Elasticity

4.1 Low Elasticity Experiment

One of the modifications to the baseline model examined by BKK (1995) is a low-elasticity experiment. When domestic goods and imports are complements, we might expect to find more divergent patterns of consumption across countries. A low elasticity also increases the volatility of the terms of trade. BKK found that this modification tended to improve the model's performance with regard to both the quantity and price puzzles, but that the puzzles remained for reasonable elasticity parameter values.

⁶Other asset market restrictions may prove to be more important, however. Kehoe and Perri (1997) have demonstrated that a form of endogenous asset restriction based on enforcement constraints can reconcile the "quantity puzzle" in a one-commodity model.

In this section, I evaluate the effect of introducing investment adjustment costs in a version of the model calibrated with a low elasticity of substitution between domestic goods and imports, $1/\eta=0.5$. All the model's other parameters are the same as in the baseline case.

4.2 Results

The low-elasticity baseline case is similar in many respects to the high-elasticity version already considered. The performance of the model is improved marginally along the lines found by BKK, but their puzzles remain. Other implied second moments are roughly the same.

After introducing investment adjustment costs, there are some striking differences between the low-elasticity and high-elasticity economies. It is still true that adjustment costs lower the volatility of investment and can reverse the negative cross-country correlation between investment levels. In this case, however, net exports remain countercyclical and continue to covary negatively with the terms of trade. A low substitution elasticity appears to create the means for an additional countercyclical net-export channel, distinct from that due to cross-country investment-good flows.

Note also that the introduction of investment adjustment costs tends to reinforce the low-elasticity version's ability to remedy the BKK quantity and price puzzles. Consumption correlations are higher while output correlations lower; term of trade variability is higher while output variability is lower.⁷

⁷Pakko (1997) shows that a low-elasticity parameterization can reconcile the "quantity puzzle" in a two good endowment-exchange economy model. The relevance of low-elasticity parameterizations is also present in the analyses of models with non-traded goods by Tesar (1993) and Stockman and Tesar (1995).

4.3 Analysis

The low-elasticity version of the model with investment adjustment costs performs well with respect to a number of issues, but how realistic is that parameterization? There exists a large body of literature measuring import demand and export supply elasticities (e.g. Stern et al., 1976). This work suggests elasticities in the range of one to two. However, these measures are not conceptually identical to the substitution elasticity relevant to the model. Moreover, empirical studies have tended to be conducted on a highly disaggregated basis. The relevant empirical counterparts to the commodities represented in the model consist of *bundles* of goods. Some goods may be very close substitutes, other highly differentiated, some nontraded, some subject to trade distortions, etc. The relevant elasticity to consider is not a pure preference or technological parameter, but a composite that reflects a mixture of factors. The appropriate elasticity might be considerably lower than the measured substitutability of categorized, traded goods.

The issue of whether or not an elasticity of less than one is reasonable is addressed by some empirical estimates in Table 4. Taking the structure of the model as being an appropriate representation, the regression results in Table 4 represent measures of the relevant elasticity. Two measures of empirical counterparts to the ratio y/x ratio (along with the associated relative prices) are used: The first is simply the ratio of imports to exports, the second is the ratio of imports to output minus net exports. Table 4 also reports to estimation methods. One is an ordinary least-squares regression of the quantity ratio on the price ratio, in which the variables are logged and first-differenced. An AR(1) term is included to adjust for serially correlated error terms. The second approach is the estimation of a cointegrating regression of log levels of the price and output measures. The

cointegration approach is consistent with the usual calibration methodology of finding long-run parameter values and positing that they are relevant for short-run dynamics.

The elasticity estimates suggest that the low-elasticity calibration of the model is not unreasonable. Under each of the estimation methods and for each of the data measures used, elasticity estimates are generally found to be less than one. Those estimates which are found to be greater than one are only slightly so (and not significantly different from one). It should be noted that these estimation exercises do not represent a rigorous attempt to measure the appropriate elasticity, but are offered as cursory evidence to suggest that a low-elasticity calibration of the model is not outside the range of plausibility.

Given the range of these estimates, and the performance of the model under the low-elasticity specification, further research on the appropriate elasticity measure and its underlying determinants appears to be a promising avenue for future research.

5. Conclusions

This paper has demonstrated the importance of inter-country capital flows to the dynamics of a standard two country business cycle model, and the resulting sensitivity of the models predictions to the introduction of a small friction. The addition of investment adjustment costs to the model reverses the implied cyclical behavior of net exports and the terms of trade.

The paper also explored possible modifications to the model with the intention of finding additional propagation mechanisms to imply countercyclical net exports and

negative comovement between net exports and the terms of trade which would reinforce those features of the baseline case.

It turns out that for the model under consideration, asset market restrictions have little effect on the model's predictions. This finding can be related to Cole and Obstfeld (1991), in which it is shown that terms of trade fluctuations act to partially insure agents against consumption risk when asset markets are incomplete. The results reported in this paper demonstrate that the importance of the risk-pooling function for terms of trade changes carries over to models with a production sector, capital accumulation, and labor/leisure choice.

In all the versions of the model, the introduction of investment adjustment costs raises the terms of trade variability, lowers the cross-country consumption correlation, and raises the cross-country investment correlation -- movement in the direction of accounting for BKK's two puzzles.

The model simulations also show that a low-elasticity version successfully predicts countercyclical net exports and negative comovement between net exports and the terms of trade -- particularly when investment adjustment costs are included. Given the importance of this key parameter for the model's implications, it would seem to be worthwhile to consider the measurement and calibration of this elasticity more carefully.

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Table 1:
Properties of International Business Cycles [OECD Data]

<i>Country</i>	<i>Standard Deviation Relative to Y</i>				<i>Correlation With Y</i>				<i>Correlation With Foreign</i>			
	<i>C</i>	<i>I</i>	<i>NX</i>	<i>P</i>	<i>C</i>	<i>I</i>	<i>NX</i>	<i>P</i>	<i>Y</i>	<i>C</i>	<i>I</i>	<i>Corr(P,NX)</i>
Australia	0.66	4.29	0.75	2.67	0.48	0.76	-0.14	-0.92	0.53	0.09	0.52	-0.02
Austria	1.10	2.91	0.86	1.87	0.64	0.74	-0.40	0.13	0.61	0.31	0.59	-0.15
Canada	0.83	2.68	0.46	1.57	0.86	0.63	-0.09	0.25	0.63	0.48	0.37	-0.16
France	0.82	2.86	0.72	4.41	0.68	0.85	-0.34	0.07	0.60	0.49	0.64	-0.38
Italy	0.84	2.55	0.82	3.27	0.81	0.77	-0.58	0.18	0.64	0.52	0.58	-0.44
Japan	0.97	3.04	0.61	7.32	0.83	0.83	-0.35	-0.11	0.58	0.43	0.57	-0.46
Spain	1.01	3.89	1.06	4.94	0.82	0.87	-0.40	0.01	0.44	0.44	0.27	-0.43
U.K.	1.09	2.31	0.63	2.52	0.83	0.74	-0.37	0.10	0.56	0.58	0.39	-0.46
U.S.	0.80	2.81	0.26	2.79	0.88	0.95	-0.46	-0.27	0.34	0.01	0.25	-0.38
Average	0.90	3.04	0.68	3.48	0.76	0.79	-0.35	0.03	0.55	0.37	0.47	-0.24

Notes: Statistics are based on Hodrick-Prescott filtered data. Variables are Y, real output; C, real consumption; I, real fixed investment; NX, the ratio of net exports to output (both at current prices); P, the ratio of import to export price deflators. Except for the net exports ratio, the natural logarithm has been applied to all variables before filtering. Foreign variables are defined as OECD totals minus own-country values, with own-country values converted to 1990 dollars using purchasing power parities. All data are from the OECD's *Quarterly National Accounts*. The sample period is 1970:1 through 1996:4.

Table 1A: Cross-Country Investment Correlations [OECD Data]

	Australia	Austria	Canada	France	Italy	Japan	Spain	U.K.
Austria	0.28							
Canada	0.63	0.31						
France	0.38	0.47	0.46					
Italy	0.16	0.42	0.38	0.75				
Japan	0.28	0.36	0.29	0.76	0.71			
Spain	0.06	0.17	0.19	0.75	0.64	0.60		
U.K.	0.36	0.04	0.14	0.28	0.15	0.25	0.19	
U.S.	0.39	0.35	0.09	0.13	0.12	0.25	-0.16	0.42

Notes: See notes to Table 1.

Table 2:
Benchmark Parameter Values

	Description	Symbol	Value
Preferences	Discount factor	β	0.99
	Intertemporal substitution	σ	1.5
	Consumption share	θ	0.34
Technology	Capital's share	α	0.36
	Depreciation rate of capital	δ	0.025
Trade	Substitution elasticity	$1/\eta$	1.5
	Import share	a	0.15
Forcing processes	Coefficient matrix	A	$\begin{pmatrix} 0.906 & 0.088 \\ 0.088 & 0.906 \end{pmatrix}$
	Correlation matrix	V	$\begin{pmatrix} 1 & 0.258 \\ 0.258 & 1 \end{pmatrix}$
	Productivity innovation variance	σ_{ϵ}^2	.08325

Table 3:
International Business Cycles in Theoretical Economies

<i>Country</i>	<i>Standard Deviation Relative to Y</i>				<i>Correlation With Y</i>				<i>Correlation With Foreign</i>			<i>Corr(P,NX)</i>
	<i>C</i>	<i>I</i>	<i>NX</i>	<i>P</i>	<i>C</i>	<i>I</i>	<i>NX</i>	<i>P</i>	<i>Y</i>	<i>C</i>	<i>I</i>	
Data*	0.90	3.04	0.68	3.48	0.76	0.79	-0.35	0.03	0.55	0.37	0.47	-0.24
<u>Complete Markets</u>												
Baseline	0.44	3.40	0.21	0.33	0.88	0.94	-0.61	0.49	0.11	0.82	-0.50	-0.38
Inv. Adj. Costs	0.63	1.79	0.03	0.75	0.96	0.99	0.56	0.62	0.23	0.70	0.16	0.92
<u>Bonds Only</u>												
Baseline	0.44	3.40	0.21	0.32	0.89	0.93	-0.61	0.48	0.11	0.80	-0.49	-0.38
Inv. Adj. Costs	0.70	1.63	0.03	0.75	0.96	0.99	0.57	0.63	0.19	0.72	-0.05	0.92
<u>Low Elasticity</u>												
Baseline	0.47	3.34	0.26	0.51	0.92	0.94	-0.64	0.51	0.19	0.71	-0.44	-0.78
Inv. Adj. Costs	0.70	2.02	0.21	1.09	0.99	0.98	-0.56	0.56	0.37	0.55	0.02	-0.99

*Averages are based on statistics using OECD data as presented in Table 1.

Table 4:
Estimates of Substitution Elasticities

<i>Country</i>	<i>OLSQ Estimates*</i>		<i>Cointegrating Regressions**</i>	
	M/X	M/(Y-NX)	M/X	M/(Y-NX)
Australia	-0.87 (0.149)	-0.33 (0.123)	NA	0.66 (0.141)
Austria	-0.61 (0.184)	-0.02 (0.142)	1.01 (0.219)	1.38 (0.916)
Canada	-0.88 (0.186)	-0.13 (0.171)	0.41 (0.568)	0.50 (0.142)
France	-0.48 (0.118)	-0.03 (0.070)	0.56 (0.097)	0.33 (0.067)
Italy	-0.54 (0.168)	-0.04 (0.080)	1.16 (0.313)	NA
Japan	-0.45 (0.103)	-0.07 (0.067)	0.96 (0.093)	0.53 (0.106)
Spain	-0.35 (0.113)	-0.14 (0.069)	1.40 (0.310)	0.76 (0.114)
U.K	-0.39 (0.164)	0.077 (0.096)	NA	0.24 (0.098)
U.S.	-0.48 (0.193)	-0.18 (0.114)	0.63 (0.277)	0.24 (0.067)

Standard errors in parentheses.

*Regressions of of import ratios on relative prices (logged first-differences), using OLS with first-order autocorrelation adjustment.

**Normalized coefficient from cointegrating regressions of log-levels.

Figure 1:
Impulse-Responses to a Positive Productivity Shock in the Home Country (Baseline model)

Figure 2: Effects of Investment Adjustment Costs

Figure 3:
Net Foreign Asset Position of the Home Country