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1. Introduction

This paper applies principles of the New Neoclassical Synthesis (NNS) to questions of international trade and financial adjustment. The analytical framework is a 2-country, 2-good, 2-period model designed to explore the behavior of the balance of payments, the terms of trade, and aggregate fluctuations in terms of interest rate and exchange rate policies practiced by the world's most important central banks.[1]

In keeping with NNS principles, the analysis begins by specifying a flexible-price International Real Business Cycle (IRBC) model in which aggregate fluctuations are entirely real in nature and there is no role for monetary stabilization policy. The IRBC model serves as the core of an International New Neoclassical Synthesis (INNS) model which includes money prices and wages, a nominal exchange rate, nominal interest rates, and costly price adjustment.

Frictions associated with the use of money have two important consequences. First, monetary frictions *expose* the INNS economy to inefficient aggregate fluctuations relative to the IRBC core. Second, monetary frictions provide the *leverage* for interest rate policy to influence real aggregate variables. The New Neoclassical Synthesis provides strategic and tactical direction for interest rate policy, recommending the adoption of a flexible exchange rate to enable each country to target domestic inflation independently to make the INNS economy behave like its IRBC core.

In practice, monetary policy frictions associated with modeling, forecasting, and measurement inevitably produce inefficient outcomes relative to the IRBC core. The paper explores inefficiencies that occur because interest rate policy doesn't act flawlessly and those that occur because a country fixes its exchange rate, or because of credibility crises that manifest themselves as "inflation scares" in a flexible exchange rate regime or as "devaluation scares" in a fixed exchange rate regime.

[1] The model builds on Goodfriend (2002) which is an exposition of ideas in Goodfriend and King (1997).

The organization of the paper is as follows. Section 2 presents the structural equations of the 2-country, 2-good, 2-period model. Section 3 presents key equilibrium conditions that hold in the IRBC core and in the INNS economy. Section 4 characterizes the behavior of the IRBC core assuming that firms adjust their prices costlessly to maintain the flexible-price profit-maximizing markup. Section 5 introduces money prices, nominal interest rates, the nominal exchange rate, and costly price adjustment, and discusses the consequences for international business cycles and national interest rate policies. Section 6 characterizes optimal interest rate policies in the INNS economy under flexible and fixed exchange rates. Section 7 explores inefficient fluctuations due to credibility crises in the two exchange rate regimes. A brief summary concludes the paper.

2.The Two-Country, Two-Good, Two-Period Model

The world economy consists of two countries, A and B, each populated by representative households that live for two periods. Households supply work effort to firms in their respective countries, and firms produce consumption goods. Firms in country A produce a composite output called A goods. Country-B firms produce a composite output of B goods. A and B goods are traded in international markets. Households have access to a credit market where they can borrow or lend internationally to consume more or less than their current income allows.

Households maximize lifetime utility by choosing how much work effort to supply in each period, how much to consume each period, and how to divide each period's consumption between A and B goods. Utility in each period is assumed to be separable in A-good consumption, B-good consumption, and leisure, with the utility of x given by $u(\mathrm{x}) = \log(\mathrm{x})$ for each component, so that the marginal utility of x is $u'(\mathrm{x}) = 1/\mathrm{x}$. Future utility is discounted to the present by $1/(1+\rho)$, where ρ is a psychological rate of time discount which can differ across countries.

Let T_1 be the period-1 A-good price of B goods in world markets---the period-1 terms of trade. The optimal division of consumption for A households in period 1 between A and B goods is given by $u'(\mathrm{c}_1^{\mathrm{AA}})T_1 = u'(\mathrm{c}_1^{\mathrm{AB}})$, where $\mathrm{c}_1^{\mathrm{AA}}$ is A-household consumption of A goods in period 1, and $\mathrm{c}_1^{\mathrm{AB}}$ is A-household consumption of B goods in period 1.[2] Using log utility and allowing for a home-good bias in consumption yields

(1) $T_1\mathrm{c}_1^{\mathrm{AB}} / \mathrm{c}_1^{\mathrm{AA}} = \theta_1^{\mathrm{A}} < 1$

where $\theta_1^{\mathrm{A}} < 1$ reflects a period-1 country-A bias in favor of home-produced goods.[3]

The analogous condition for country B is

(2) $c_1^{\mathrm{BA}} / T_1 c_1^{\mathrm{BB}} = \theta_1^{\mathrm{B}} < 1$.

By defining B^{AB} as borrowing by country A from country B (in A-good units) and $\mathrm{y}_1^{\mathrm{A}}$ as A-household income in period 1 (also in A-good units), we can write

(3) $\mathrm{y}_1^{\mathrm{A}} + \mathrm{B}^{\mathrm{AB}} = \mathrm{c}_1^{\mathrm{AA}} + T_1\mathrm{c}_1^{\mathrm{AB}}$.

Since A-household borrowing must equal B-household lending we can write an analogous relationship (in B-good units) for country B

(4) $\mathrm{y}_1^{\mathrm{B}} - (\mathrm{B}^{\mathrm{AB}} / T_1) = \mathrm{c}_1^{\mathrm{BB}} + (\mathrm{c}_1^{\mathrm{BA}} / T_1)$.

When $\mathrm{B}^{\mathrm{AB}} > 0$, country A has a trade deficit and country B a trade surplus; when $\mathrm{B}^{\mathrm{AB}} = 0$, trade is balanced; and when $\mathrm{B}^{\mathrm{AB}} < 0$, country A has a trade surplus and country B a trade deficit.

Firms in country A produce consumption composite good A, $\mathrm{c}_1^{\mathrm{A}}$, in period 1 with a linear technology that multiplies period-1 labor input $\mathrm{n}_1^{\mathrm{A}}$ by a period-1 productivity coefficient a_1^{A} for country A as follows

(5) $\mathrm{c}_1^{\mathrm{A}} = a_1^{\mathrm{A}}\mathrm{n}_1^{\mathrm{A}}$

[2] This optimality condition reflects the fact that a household can get utility by consuming a unit of good B, or it can get utility instead by selling a unit of good B for A goods and obtaining utility from the A goods it purchases. The condition says that the division between A and B consumption should be undertaken so that each alternative yields the same utility at the margin.

[3] Obstfeld and Rogoff (2000), pp. 3-10, briefly reviews the theory and evidence of home good bias in consumption.

where n_1^A is the fraction of time that A households work in period 1. Firms in country B produce consumption composite good B with an analogous production technology

(6) $c_1^B = a_1^B n_1^B$

The world A-good market clearing condition is[4]

(7) $c_1^A = c_1^{AA} + c_1^{BA}$.

Firms are owned domestically by households in their respective countries.[5] There is no international diversification of the ownership of firms. Hence, period-1 household income in country A measured in A-good units exactly equals the period-1 production of A goods

(8) $y_1^A = a_1^A n_1^A$.

There is an analogous relationship measured in B-good units for country B

(9) $y_1^B = a_1^B n_1^B$.

The household's choice of labor supply is governed by two considerations. First, there is a constraint by which the fraction of time spent working and enjoying leisure in a given period must sum to unity. Second, households must choose the optimal fraction of time to work given the real wage in labor markets. If ω_1^A is the period-1 real wage measured in A-good units per hour in country A, then the optimal division of period-1 time between work and leisure for A households must satisfy $\omega_1^A u'(c_1^{AA}) = u'(l_1^A)$, where l_1^A is the fraction of time that A households spend enjoying leisure in period 1.[6] Using log utility and the period-1 time constraint to eliminate leisure yields the labor supply function for country A

(10) $n_1^{SA} = 1 - (c_1^{AA} / \omega_1^A)$

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[4] The world B-good market clearing condition is implied by the other equations as discussed in the text below.
[5] Obstfeld and Rogoff (2000) review the theory and evidence on home bias in equity portfolios.
[6] This optimality condition recognizes that a household can obtain utility directly by taking leisure, or it can obtain utility indirectly by working an extra hour and using the wage to acquire consumption. Optimality requires that a household choose work and leisure to get the same utility from the last hour of time devoted to each.

The analogous labor supply function for households in country B, in terms of the real wage measured in B-goods per hour, is

(11) $n_1^{SB} = 1 - (c_1^{BB} / \omega_1^{B})$.

We presume that there are a large number of firms in each country, and that each firm produces a different variety of consumption goods. Because their products are somewhat different, firms are monopolistically competitive. Each firm has enough pricing power in the market for its own output that it can sustain a price somewhat above the marginal cost of production. For instance, the period-1 markup in country A can be expressed as $\mu_1^{A} = \dfrac{1}{\omega_1^{A} / a_1^{A}}$ where the A-good product price is unity and the marginal cost of producing A goods is the A-good real wage per hour divided by labor productivity per hour. Using the definition of the markup above, the period-1, A-good real wage in country A is expressed as

(12) $\omega_1^{A} = a_1^{A} / \mu_1^{A}$.

The period-1 B-good real wage in country B is expressed likewise

(13) $\omega_1^{B} = a_1^{B} / \mu_1^{B}$

The labor market clearing conditions are

(14) $n_1^{SA} = n_1^{A}$

(15) $n_1^{SB} = n_1^{B}$

Equations (1) through (15) determine fifteen period-1 international prices and quantities *given* the endogenous variables B^{AB} , μ_1^{A} , and μ_1^{B} and exogenous variables a_1^{A} , a_1^{B} , θ_1^{A} and θ_1^{B} .

A second block of equations determines period-2 prices and quantities. The equations in the period-2 block correspond exactly to the equations above with a period-2 index, except for equations (3) and (4). Since international borrowing is paid back with interest, the period-2 equations relating income to spending must reflect period-1 international borrowing and lending as follows:

(16) $y_2^A - B^{AB}(1+r^A) = c_2^{AA} + T_2 c_2^{AB}$

(17) $y_2^B + (B^{AB}/T_1)(1+r^B) = c_2^{BB} + (c_2^{BA}/T_2)$

where r^A is the real A-good rate of interest in country A, and r^B is the real B-good rate of interest in country B. This second block of equations determines fifteen period-2 prices and quantities *given* the endogenous variables $B^{AB}, \mu_2^A, \mu_2^B, r^A, r^B$ and exogenous variables a_2^A, a_2^B, θ_2^A, and θ_2^B.

A third block of "interest rate equations" relates planned lifetime consumption in countries A and B and the respective real interest rates in the two countries. For instance, optimal lifetime consumption of A goods by households in country A must satisfy $u'(c_1^{AA}) = \frac{(1+r^A)u'(c_2^{AA})}{(1+\rho^A)}$,[7] which using log utility yields

(18) $c_2^{AA}/c_1^{AA} = \frac{1+r^A}{1+\rho^A}$.

Likewise, optimal lifetime consumption of B goods by households in country B must satisfy

(19) $c_2^{BB}/c_1^{BB} = \frac{1+r^B}{1+\rho^B}$

Finally, a "no real interest arbitrage condition" equates the real rates of return in the two countries in terms of the period-1 terms of trade, T_1, and the period-2 terms of trade, T_2, as

(20) $1+r^A = \frac{T_2}{T_1}(1+r^B)$.

[7] The optimality condition recognizes that there are two alternative routes by which a household can obtain utility from the consumption of good A: it can consume a unit of good A in period 1, or it can save that unit at interest and get utility from that unit with interest in period 2. The optimality condition says that the household should plan current and future A-good consumption so that the present value of the utility it gets from each route is equalized at the margin.

The no-real-interest-arbitrage condition reflects the fact that there are alternative routes by which a household can save for future consumption. For instance, one unit of A goods lent in period 1 at real interest r^{A} yields $1+r^{\mathrm{A}}$ units of A goods in period 2. Alternatively, a household can exchange one unit of A goods for $1/T_1$ units of B goods in period 1, lend the B goods at real interest r^{B} and then convert the proceeds back to A goods in period 2 to obtain $(1+r^{\mathrm{B}})\frac{T_2}{T_1}$ units of A goods in period 2. The no-arbitrage condition requires that the two alternatives yield the same rate of return.

Sequential substitution using equations (7), (3), (4), (8), (5), (6), and (9) on one hand, and substitution using (7), (3), (16), (17), (8), (5), (6), and (9) with period-2 subscripts on the other hand, yields B-goods-market-clearing conditions in the two periods: $\mathrm{c}_{\mathrm{i}}^{\mathrm{B}}=\mathrm{c}_{\mathrm{i}}^{\mathrm{BB}}+\mathrm{c}_{\mathrm{i}}^{\mathrm{AB}}$, i= 1, 2. Eliminating B^{AB} using (3) and (16), and eliminating B^{AB} with (4) and (17) indicates that households choose lifetime consumption to exhaust their lifetime income resources.

All together, the three equation blocks determine the 33 endogenous variables: B^{AB}, r^{A}, r^{B}, and the variables indexed to i = 1, 2 --- T_{i}, $\mathrm{c}_{\mathrm{i}}^{\mathrm{AA}}$, $\mathrm{c}_{\mathrm{i}}^{\mathrm{AB}}$, $\mathrm{c}_{\mathrm{i}}^{\mathrm{BB}}$, $\mathrm{c}_{\mathrm{i}}^{\mathrm{BA}}$, $\mathrm{y}_{\mathrm{i}}^{\mathrm{A}}$, $\mathrm{y}_{\mathrm{i}}^{\mathrm{B}}$, $\mathrm{c}_{\mathrm{i}}^{\mathrm{A}}$, $\mathrm{c}_{\mathrm{i}}^{\mathrm{B}}$, $\mathrm{n}_{\mathrm{i}}^{\mathrm{A}}$, $\mathrm{n}_{\mathrm{i}}^{\mathrm{B}}$, $\mathrm{n}_{\mathrm{i}}^{\mathrm{SA}}$, $\mathrm{n}_{\mathrm{i}}^{\mathrm{SB}}$, ω_i^{A}, ω_i^{B}. The 33 endogenous variables are determined in terms of exogenous variables describing productivity, home good bias, and impatience--- a_i^{A}, a_i^{B}, θ_i^{A}, $\theta_{\mathrm{i}}^{\mathrm{B}}$, ρ^{A}, ρ^{B}.

To close the system, one needs to specify four more equations to determine the period-1 and period-2 markups in countries A and B--- $\mu_{\mathrm{i}}^{\mathrm{A}}$ and $\mu_{\mathrm{i}}^{\mathrm{B}}$, i = 1, 2.

3. Equilibrium Conditions

The above system reduces to the following key equilibrium conditions. The "balance of payments condition" expresses country A's borrowing from country B (A's trade deficit with B) in A-good units)[8] as

(23) $$\mathrm{B}^{\mathrm{AB}} = \frac{a_1^{\mathrm{A}} a_2^{\mathrm{A}} [\theta_1^{\mathrm{A}} \theta_2^{\mathrm{B}} (1+\rho^{A}) - \theta_2^{\mathrm{A}} \theta_1^{\mathrm{B}} (1+\rho^{\mathrm{B}})]}{a_1^{\mathrm{A}} [\theta_1^{\mathrm{B}} (1+\mu_2^{\mathrm{A}})(1+\rho^{\mathrm{B}}) + \theta_1^{\mathrm{A}} \theta_2^{\mathrm{B}} (1+\rho^{\mathrm{A}})] + a_2^{\mathrm{A}} [\theta_2^{\mathrm{B}} (1+\mu_1^{\mathrm{A}})(1+\rho^{\mathrm{A}}) + \theta_2^{\mathrm{A}} \theta_1^{\mathrm{B}} (1+\rho^{\mathrm{B}})]}$$

where the numerator can be positive or negative.

An "interest rate condition" expresses country A's real interest rate as

(24) $$\frac{1+r^{\mathrm{A}}}{1+\rho^{\mathrm{A}}} = [\frac{a_2^{\mathrm{A}} - \mathrm{B}^{\mathrm{AB}}(1+r^{\mathrm{A}})}{1+\theta_2^{\mathrm{A}} + \mu_2^{\mathrm{A}}}][\frac{1+\theta_1^{\mathrm{A}} + \mu_1^{\mathrm{A}}}{a_1^{\mathrm{A}} + \mathrm{B}^{\mathrm{AB}}}]$$

where both bracket terms are positive.

The "period-1 terms of trade condition" expresses the period-1, A-good price of B goods as

(25) $$T_1 = [\frac{a_1^{\mathrm{A}} \theta_1^{\mathrm{A}} (1+\theta_1^{\mathrm{B}} + \mu_1^{\mathrm{B}})}{a_1^{\mathrm{B}} \theta_1^{\mathrm{B}} (1+\theta_1^{\mathrm{A}} + \mu_1^{\mathrm{A}})}] + [1 - \frac{1+\mu_1^{\mathrm{A}}}{\theta_1^{\mathrm{B}}} (\frac{1+\theta_1^{\mathrm{B}} + \mu_1^{\mathrm{B}}}{1+\theta_1^{\mathrm{A}} + \mu_1^{\mathrm{A}}})] \frac{\mathrm{B}^{\mathrm{AB}}}{a_1^{\mathrm{B}}}$$

where the second bracket term is negative.

The "period-2 terms of trade condition" expresses the period-2, A-good price of B goods as

(26) $$T_2 = [\frac{a_2^{\mathrm{A}} \theta_2^{\mathrm{A}} (1+\theta_2^{\mathrm{B}} + \mu_2^{\mathrm{B}})}{a_2^{\mathrm{B}} \theta_2^{\mathrm{B}} (1+\theta_2^{\mathrm{A}} + \mu_2^{\mathrm{A}})}] - [1 - \frac{1+\mu_2^{\mathrm{A}}}{\theta_2^{\mathrm{B}}} (\frac{1+\theta_2^{\mathrm{B}} + \mu_2^{\mathrm{B}}}{1+\theta_2^{\mathrm{A}} + \mu_2^{\mathrm{A}}})] \frac{\mathrm{B}^{\mathrm{AB}}(1+r^{\mathrm{A}})}{a_2^{\mathrm{B}}}$$

where the second bracket term is negative.

In addition, the following equilibrium conditions determine period 1 and period 2 employment in the two countries as

(27) $$\mathrm{n}_1^{\mathrm{A}} = \frac{1+\theta_1^{\mathrm{A}} - \frac{\mu_1^{\mathrm{A}}}{a_1^{\mathrm{A}}} \mathrm{B}^{\mathrm{AB}}}{1+\theta_1^{\mathrm{A}} + \mu_1^{\mathrm{A}}}$$

[8] This derivation ignores a term that is negligible as long as B^{AB} is a small fraction of country A's national output.

$$(28) \qquad n_2^A = \frac{1+\theta_2^A + \frac{\mu_2^A}{a_2^A} B^{AB}(1+r^A)}{1+\theta_2^A + \mu_2^A}$$

$$(29) \qquad n_1^B = \frac{1+\theta_1^B + \frac{\mu_1^B}{a_1^B T_1} B^{AB}}{1+\theta_1^B + \mu_1^B}$$

$$(30) \qquad n_2^B = \frac{1+\theta_2^B - \mu_2^B \frac{B^{AB}}{T_2}(1+r^A)}{1+\theta_2^B + \mu_2^B}$$

where all the expressions are positive.

4.The International Real Business Cycle Core

The first step in putting the model to use is to derive the equilibrium values of the endogenous variables under the assumption that firms adjust their product prices flexibly to sustain the profit-maximizing markups. We study the IRBC core to understand how our model of international trade and finance would behave in an "ideal" world without frictions associated with the use of money and monetary policy. We will use our understanding of the behavior of the IRBC core to guide interest rate policy to the welfare-maximizing optimum in the more "realistic" INNS economy below.

With log utility the flexible-price profit-maximizing markup is invariant to demand and cost shocks. The specification of the IRBC core is completed by assuming that firms adjust their prices flexibly each period to maintain the exogenous profit-maximizing markups

(31) $\mu_i^A = \mu_i^{A*}$, i = 1,2

(32) $\mu_i^B = \mu_i^{B*}$, i = 1,2

Given the exogenous profit-maximizing markups, the core IRBC model determines the remaining 33 endogenous variables in terms of exogenous variables describing productivity, home good bias, impatience, and the markups.

The equilibrium values of the endogenous variables in the IRBC model are determined recursively as follows. Equilibrium condition (23) determines B^{AB} in terms of the exogenous variables. Then, (24) and (25) determine r^{A} and T_1, respectively, in terms of B^{AB} and the exogenous variables. Next, (26) determines T_2 in terms of B^{AB}, r^{A}, and exogenous variables. Finally, equilibrium employment conditions (27) through (30) determine $\mathrm{n}_1^{\mathrm{A}}$, $\mathrm{n}_2^{\mathrm{A}}$, $\mathrm{n}_1^{\mathrm{B}}$, and $\mathrm{n}_2^{\mathrm{B}}$. The remaining endogenous variables are determined by the relationships given in Section 2.

The IRBC core exhibits a number of features that deserve mention. First, if the respective home good bias and impatience variables are identical across countries, then B^{AB} is zero. The direction of international borrowing and the trade balance depend on the home bias and impatience alone, and not on productivity or the markups. With identical home bias in consumption, the more impatient country will borrow from the other and run a trade deficit. With identical patience, the country whose home bias in consumption is expected to diminish at the faster rate will lend and run a trade surplus.

Second, if $\mathrm{B}^{\mathrm{AB}} = 0$ an increase in expected future productivity a_2^{A} causes the A-country real interest rate r^{A} to rise. Global employment is independent of productivity when $\mathrm{B}^{\mathrm{AB}} = 0$ according to employment conditions (27) through (30) because the income and substitution effects of the productivity shock on labor supply cancel in this case.[9] Country A does not import more B goods in period 2 because the increased future world supply of A goods raises T_2, worsening country A's future terms of trade, leaving country A's demand for B-good imports unchanged. Country B

[9] This can be shown using (10), (11), their period-2 counterparts, and the balanced trade condition to show that the consumption of the domestically produced good moves proportionately with productivity in this case.

responds to the future improvement in its terms of trade by importing more A goods. According to (20) the effect of a_2^{A} on T_2 / T_1 exactly matches that on $1+r^{\mathrm{A}}$, leaving $1+r^{\mathrm{B}}$ unchanged.

Third, an increase in B^{AB}, country-A's borrowing from country B, due to greater patience (lower ρ^{B}) in country B has the following effects. It lowers the real interest rate r^{A} in country A , encouraging A households to raise current consumption above current income by borrowing from country B to accommodate country B's desire to shift consumption to the future. According to (27) the increase in B^{AB} is associated with an increase in current leisure and a decline in current labor supply in country A, and therefore, a decline in the world supply of A goods. Hence, the increase in B^{AB} is associated with an improvement in country A's terms of trade in period 1, i.e., a decrease of T_1. Related employment effects can be traced through (28), (29), and (30). According to interest arbitrage condition (20) the decline in r^{A} and in T_1 / T_2 reduces r^{B} by more than r^{A}.

Fourth, consider what happens when θ_2^{A} moves closer to unity to reflect the expected diminished home bias in country A. The increase in the future demand for B goods relative to A goods increases T_2 according to the first term in (26).[10] According to (23), country A becomes a lender and country B a borrower, $\mathrm{B}^{\mathrm{AB}} < 0$. This is because country B wishes to borrow against brighter future prospects reflected in the improvement in its terms of trade, and country A wishes to save because of the deterioration in its future terms of trade. Given the home biases in consumption, negative B^{AB} partially offsets the effect on T_2, and according to (25) increases the period-1 A-good price of B goods, T_1. According to (20), the r^{B} real rate of interest in country B rises relative to the

[10] A model with traded and non-traded goods contains a second channel by which economic development improves the terms of trade. A developing economy that has higher productivity growth in its tradable-goods sector relative to its non-tradable-goods sector will experience a rise in the relative price of nontraded goods and an appreciation of its CPI-based real exchange rate. Japan is a case in point.

r^A real interest rate in country A, although the direction of the net change in world real interest rates is ambiguous according to (24).

Fifth, contrary to popular belief there is no structural correlation between the trade balance and the terms of trade. Both B^{AB} and T_1 are endogenous variables which react to exogenous variables that can cause them to co-vary positively, negatively, or not at all. For instance, greater impatience in country A (higher ρ^A) raises B^{AB} and lowers T_1, moving country A's trade balance into deficit and improving its terms of trade. If $B^{AB} = 0$, then the trade balance B^{AB} is invariant to productivity and markup shocks that cause an adjustment in the terms of trade T_1. On the other hand, an expected reduction in A-household home bias (higher θ_2^A) lowers B^{AB} and raises T_1, moving country A's trade balance into surplus and deteriorating its terms of trade.

5. The International New Neoclassical Synthesis Model

The International New Neoclassical Synthesis (INNS) model builds on the IRBC core by introducing money prices, the nominal exchange rate, nominal interest rates, and costly price adjustment. The idea is to introduce the costly pricing of goods in terms of money and then to show how such monetary frictions produce inefficient international fluctuations relative to the IBBC core, and provide the *leverage* for interest rate policies to influence international business cycles.

5.1 Money Prices, the Nominal Exchange Rate, and Firm Pricing Practices

Households in country A employ a medium of exchange called "A money" to facilitate transactions. Likewise, households in country B employ a medium of exchange called "B money." Firms price the products sold in the two countries in terms of the national monies as follows: $P^{AA} \equiv$ A-money price of A goods, $P^{BB} \equiv$ B-money price of B goods, $P^{AB} \equiv$ A-money price of B goods imported into country A, $P^{BA} \equiv$ B-money price of A goods imported into country B, and $e \equiv$ the A-money price of B money. In terms of money prices, the A-good price of B goods can be expressed as $T = \frac{P^{BB}}{P^{AA}} e$.

Assume that international goods arbitrage makes firms set prices so that the composite consumption goods cost the same in either country: $P^{AB} = P^{BB}e$ and $P^{BA} = P^{AA}/e$. It follows that households in each country face the same terms of trade: $\frac{P^{AB}}{P^{AA}} = \frac{P^{BB}e}{P^{AA}} = T$ and $\frac{P^{BB}}{P^{BA}} = \frac{P^{BB}}{P^{AA}/e} = T$.

Real wages and markups are expressed in terms of money wages and prices in the two countries as: $\omega^A = W^A / P^{AA}$, $\omega^B = W^B / P^{BB}$, $\mu^A = \frac{P^{AA}}{W^A / a^A}$, and $\mu^B = \frac{P^{BB}}{W^B / a^B}$.

It is costly in terms of management time and resources for a firm producing a differentiated product to collect and process information continuously in order to determine the money price that maximizes its profits at each point in time. Hence, a firm considers whether to change its product price only when demand or cost conditions are expected to move its actual markup significantly and persistently away from the flexible-price profit-maximizing markup. For instance, a firm would consider raising its product price P only if higher nominal wages W or lower productivity a were expected to compress its markup significantly and persistently.

The implications of costly price-setting for the rate of inflation may be summarized in the following "inflation condition" that pertains to country A (an analogous one pertains to country B):

(33) $\pi^A = INF[\mu_1^{A*} - \mu_1^A, \mu_2^{A*} - E\mu_2^A] + E\pi^A$

where $\pi^A \equiv$ the percentage increase in the A-money price of A goods, $E\pi^A \equiv$ the expected rate of inflation, and the INF function indicates the effect of markups on inflation. When current and expected future markups equal flexible-price profit-maximizing markups, then firms move current prices with expected inflation, i.e., $INF[0,0] = 0$. The compression of actual markups below profit-maximizing markups moves inflation above trend, and the elevation of actual markups above profit-maximizing markups moves inflation below trend, i.e., both derivatives of *INF* are positive.

Central bank A is said to have *credibility for zero inflation* of the A-money price of A-goods if $E\mu_2^{A} = \mu_2^{A*}$, $E\pi^{A} = 0$, and P_1^{AA} is nearly invariant to current shocks and monetary policy actions. When the central bank has credibility, firms choose not to adjust their product prices much because they are confident that the central bank will take whatever policy actions are necessary to produce labor market conditions that return actual markups to profit-maximizing markups in period 2.

5.2 Inefficient Fluctuations, Nominal Interest Rates, and the Effectiveness of Monetary Policy

Assume that central bank A has credibility for zero inflation. In this case, A-country firms accommodate temporary fluctuations in period-1 demand at current money prices by increasing or decreasing employment, which induces fluctuations in the period-1 markup, μ_1^{A}, as nominal wages W_1^{A} are bid up or down with tightness in the labor market.

These conditions convert the A-country markup into an *endogenous* variable. From (27) we see that A-country employment n_1^{A} is inversely related to μ_1^{A}, with indirect amplification or attenuation working through B^{AB}. The inverse relationship arises because the markup acts like an off-budget sales tax collected by monopolistically-competitive firms that is returned to A households as profit income. Hence, period 1 employment and output in country A move inversely with fluctuations in the μ_1^{A} markup. Temporary deviations of actual from flexible-price markups create aggregate fluctuations in the INNS economy that are *inefficient* relative to the IRBC core since such deviations would *not* occur in a flexible-price IRBC world.

The above-described conditions also give monetary policy leverage over real macroeconomic variables with the potential to counteract inefficient fluctuations. Circumstances that make μ_1^{A} endogenous provide the freedom for the r^{A} real interest rate in country A to be determined by interest rate policy. Let $\overline{R}^{A}$ as the A-money (nominal) interest rate policy instrument of central bank A. Central bank A's credibility for zero inflation means that $\overline{R}^{A} = \overline{r}^{A}$.

From (24), we see that interest rate policy actions of central bank A have the capacity to *counteract* effects on μ_1^A originating in shocks to exogenous variables at home or abroad. The key insight is that equilibrium conditions in Sections 2 and 3 hold whether or not monetary frictions are present in the model. Using (23) to eliminate B^{AB} in (24) and setting $E\mu_2^A = \mu_2^{A*}$ yields an equilibrium condition that includes r^A and only one endogenous variable, μ_1^A. As a matter of algebra, then, central bank A can manage its policy instrument $\overline{R}^{A}$ to stabilize μ_1^A at μ_1^{A*} in the IRBC core.

According to (24), the direct effect of a decrease in $\overline{R}^{A}$ is to compress μ_1^A, with an indirect effect working through B^{AB} according to (23). The leverage that $\overline{R}^{A}$ exercises over μ_1^A derives from the inverse effect that r^A has on c_1^{AA} according to (18). For instance, a cut in $\overline{r}^{A}$ induces A households to shift consumption from the future to the present, increasing the current demand for A output, which A firms accommodate by increasing employment, biding up the wage W_1^A, and compressing the markup μ_1^A.

6.The INNS Economy with Flexible and Fixed Exchange Rates

The capacity for national interest rate policies to overcome monetary frictions in the INNS economy depends critically on the nature of international monetary arrangements. In what follows we consider the behavior of the INNS economy with both flexible and fixed exchange rates, being careful to specify fully the monetary policy regime that each country pursues in support its choice of exchange rate regime. We shall see how a flexible exchange rate provides the leeway for independent interest rate policies to target domestic inflation so as to eliminate inefficient international fluctuations, while a fixed exchange rate exposes the INNS economy to fluctuations that are inefficient relative to the IRBC core.

6.1 Independent Inflation Targeting with a Flexible Exchange Rate

Suppose that both countries choose monetary regimes geared to targeting domestic inflation and allow the exchange rate to float on the foreign exchange market. Let each central bank have credibility for zero inflation in the sense defined above. Thus, for country A: $E\mu_2^{A} = \mu_2^{A*}$, $E\pi^{A} = 0$, and P_1^{AA} is nearly invariant to current shocks and policy actions. And for country B: $E\mu_2^{B} = \mu_2^{B*}$, $E\pi^{B} = 0$, and P_1^{BB} is nearly invariant to current shocks and policy actions.

With independent inflation targeting and a flexible exchange rate, the system of equations in Sections 2 and 3 helps to determine the original 33 endogenous variables, excluding r^{A} and r^{B} and including μ_1^{A} and μ_1^{B}, in terms of exogenous variables a_i^{A}, a_i^{B}, θ_i^{A}, θ_i^{B}, ρ^{A}, ρ^{B}, μ_2^{A*}, μ_2^{B*}. Policy instrument settings $\overline{R}^{A}$ and $\overline{R}^{B}$ determine r^{A} and r^{B}, respectively. The system is augmented by two versions of (33), one for each country, to determine the endogenous price levels, P_1^{AA} and P_1^{BB}, where $\pi^{i} = \frac{P_1^{i}}{P_0^{i}} - 1$ for i = A, B, given last period's price levels P_0^{AA} and P_0^{BB}, inflation expectations $E\pi^{A} = E\pi^{B} = 0$, and μ_1^{A*} and μ_1^{B*}. Finally, e_1 and e_2 are determined in conjunction with the respective period 1 and period 2 price levels in the two countries to yield the equilibrium terms of trade, T_1 and T_2 according to (25) and (26).

This flexible-exchange-rate-INNS economy has four important features. First, monetary frictions expose the international economy to inefficient business cycles in the sense that μ_1^{A} and μ_1^{B} fluctuate (independently of μ_1^{A*} and μ_1^{B*}) in response to various exogenous shocks. This is the case even though inflation expectations are well anchored and inflation is stabilized in both countries.

Second, the two central banks can choose $\overline{R}^{A}$ and $\overline{R}^{B}$ independently to stabilize their national markups at μ_1^{A*} and μ_1^{B*}, respectively. In so doing, the central banks secure their own credibility for zero inflation and stabilize their own economies against inefficient real fluctuations. Moreover, together they make the INNS economy behave like the IRBC core. The INNS economy still exhibits fluctuations, but they are "good" international real business cycles in the sense that such fluctuations would be generated by the international economy with perfectly flexible prices.

Third, as a practical matter it is difficult for a central bank to offset perfectly fluctuations in its actual relative to its profit-maximizing national markup. One problem is that domestic and international shocks are only imperfectly observable. Another is that interest rate policy actions work with a lag. Still another is that it is difficult to measure both the actual average economy-wide markup and the average flexible-price markup to target the latter with the former. However, INNS reasoning suggests that interest rate policy is not likely to go far wrong if domestic inflation stabilization is made a priority.

Fourth, the exchange rate must be flexible for the two central banks to target inflation independently. To see why, suppose that interest rate policies stabilize $\mu_1^{A} = \mu_1^{A*}$ and $\mu_1^{B} = \mu_1^{B*}$ exactly, so that the national price levels are stabilized at P_0^{AA} and P_0^{BB}, respectively. In this case, according to (25) and (26) the period 1 and period 2 nominal exchange rates must be determined flexibly to satisfy $e_1 = T_1 \frac{P_0^{AA}}{P_0^{BB}}$ and $e_2 = T_2 \frac{P_0^{AA}}{P_0^{BB}}$. In other words, the exchange rate must fluctuate to support fluctuations in the terms of trade consistent with efficient international real business cycles since the INNS economy must behave like its IRBC core to stabilize price levels exactly.

6.2 Dependent Interest Rate Policy with a Fixed Exchange Rate

If country B chooses to fix its exchange rate, its central bank must give up interest rate policy independence. To see why, write T_1 and T_2 in (20) in terms of money prices and exchange rates and rearrange (20) as follows

$$(34) \qquad \frac{1}{\mathrm{P}_1^{\mathrm{BB}}}(1+r^{\mathrm{B}})\mathrm{P}_2^{\mathrm{BB}}\frac{e_2}{e_1}=\frac{1}{\mathrm{P}_1^{\mathrm{AA}}}(1+r^{\mathrm{A}})\mathrm{P}_2^{\mathrm{AA}}$$

By definition $1+R^{\mathrm{B}}=\frac{\mathrm{P}_2^{\mathrm{BB}}}{\mathrm{P}_1^{\mathrm{BB}}}(1+r^{\mathrm{B}})$ and $1+R^{\mathrm{A}}=\frac{\mathrm{P}_2^{\mathrm{AA}}}{\mathrm{P}_1^{\mathrm{AA}}}(1+r^{\mathrm{A}})$, so we can write (34) in terms of the respective nominal interest rate policy instruments as

$$(35) \qquad (1+\overline{R}^{\mathrm{B}})\frac{e_2}{e_1}=1+\overline{R}^{\mathrm{A}}.$$

From (35) we see that central bank B must follow interest rate policy dictated by central bank A in order to fix its exchange rate at $\bar{e}$.

When exchange rate flexibility is not allowed to play a role in international adjustment, interest rate policies can no longer counteract inefficient fluctuations fully relative to the IRBC core. To see why, assume that country A pursues interest rate policy independently and credibly so that $\mathrm{P}_1^{\mathrm{AA}}=\mathrm{P}_2^{\mathrm{AA}}=\mathrm{P}_0^{\mathrm{AA}}$, $\mu_1^{\mathrm{A}}=\mu_1^{\mathrm{A}*}$, and $\mu_2^{\mathrm{A}}=\mu_2^{\mathrm{A}*}$.

The fixed exchange rate forces B firms to bear the burden of international adjustment in response to shocks to exogenous variables. If $\mathrm{P}_1^{\mathrm{BB}}$ prices were fully flexible, then B firms would keep $\mu_1^{\mathrm{B}}=\mu_1^{\mathrm{B}*}$ by changing $\mathrm{P}_1^{\mathrm{BB}}$ to make T_1 satisfy (25) once (23) is used to eliminate B^{AB}. However, sticky $\mathrm{P}_1^{\mathrm{BB}}$ prices make the terms of trade sticky, since $T_1=\mathrm{P}_1^{\mathrm{BB}}\frac{\bar{e}}{\mathrm{P}_0^{\mathrm{AA}}}$, which means that μ_1^{B} must fluctuate to satisfy (25). In other words, B firms will hire more or less labor as needed to accommodate fluctuations in B-good demand at sticky prices, and allow their markups,

$\mu_1^B = \frac{P_1^{BB}}{W_1^B / a_1^B}$, to fluctuate with B-money nominal wages W_1^B that move with conditions in the labor market. Country-B period-1 markup fluctuations, in turn, will be reflected in employment fluctuations according to (29).

By fixing its exchange rate, country B subjects its markup to fluctuations beyond the control of its central bank, fluctuations that can occur due to shocks originating anywhere in the global economy. Since such fluctuations generally are associated with deviations of actual from profit-maximizing markups, they are inefficient relative to the flexible-price IRBC core.

It is natural to ask whether an adjustment of the fixed exchange rate parity could influence the trade balance. For instance, could a revaluation of the exchange rate (an upward adjustment of $\bar{e}$) by country B reduce an A-country trade deficit measured in units of A-good output ($B^{AB} > 0$), perhaps to defuse protectionist pressure in country A? It is apparent from (23) that that the answer is no, since B^{AB} is invariant to an increase in $\bar{e}$ if central bank A continues to stabilize $\mu_i^A = \mu_i^{A*}$ for $i = 1, 2$. If P_1^{BB} prices are sticky, then the revaluation of the exchange rate raises the A good price of B goods and makes B goods more expensive relative to A goods, since $T_1 = P_1^{BB} \frac{\bar{e}}{P_0^{AA}}$. However, the increased "competitiveness" of A-goods relative to B goods impacts μ_1^B only, according to (25), with corresponding effects on country B employment and inflation. There is no effect on B^{AB} or on country A's trade balance measured in A-goods because income and substitution effects of the increase in T_1 cancel each other so that A-household consumption is unchanged relative to A-household income. Over time, B firms deflate their prices to $P_2^{BB} = T_2 \frac{P_0^{AA}}{\bar{\bar{e}}}$, where $\bar{e} < \bar{\bar{e}}$, to restore the T_2 that satisfies (26) when $\mu_2^B = \mu_2^{B*}$.

7. Credibility Crises in Flexible and Fixed Exchange Rate Regimes

In this section the INNS model is employed to investigate inefficient fluctuations relative to the IRBC core due to credibility crises associated with an "inflation scare" in the flexible exchange rate regime and a "devaluation scare" in the fixed exchange rate regime.

7.1 An Inflation Scare in a Flexible Exchange Rate Regime

Consider an "inflation scare" reminiscent of those endured by the Federal Reserve in the 1980s in which $E\pi^{A} > 0$ because firms in country A come to doubt central bank A's commitment to zero inflation.[11] Assume that central bank A intends to take the necessary interest rate actions to restore its credibility for zero inflation. Furthermore, suppose that the exchange rate is flexible and that country B employs independent interest rate policy to maintain its credibility for zero inflation so that $P_1^{BB} = P_2^{BB} = P_0^{BB}$, $\mu_1^{B} = \mu_1^{B*}$, and $\mu_2^{B} = \mu_2^{B*}$.

Central bank A must take the following steps to defeat the inflation scare challenge to its credibility. First, since $\overline{R}^{A} - E\pi^{A} = r^{A}$, central bank A must raise $\overline{R}^{A}$ to prevent the increase in inflation expectations from reducing real interest rate, r^{A}. Second, central bank A must raise $\overline{R}^{A}$ more than inflation expectations in order raise r^{A}, cut aggregate demand for A goods by (18), weaken labor markets, and elevate $\mu_1^{A} > \mu_1^{A*}$ by (24) and (23) in order to prevent firms from feeding inflation expectations through to actual inflation according to (33). In effect, central bank A must elevate actual markups in country A above flexible-price profit-maximizing markups in order to offset the effect of inflation expectations on actual inflation. Thus, according to (33) central bank A must create an inefficient recession relative to the IRBC core to restore its credibility for zero inflation.

[11] See Goodfriend (1993). The analysis in the text captures the essence of the inflation scare problem even if the inflation trend is initially well above zero, as was the case when the Fed was confronted with inflation scares in the 1980s.

Third, assuming that these interest rate actions succeed in holding the line on the price level at P_0^{AA} so that $P_1^{AA} = P_2^{AA} = P_0^{AA}$, from $e_1 = T_1 \frac{P_0^{AA}}{P_0^{BB}}$ and $e_2 = T_2 \frac{P_0^{AA}}{P_0^{BB}}$ we see that the flexible exchange rate must move with the respective terms of trade, T_1 and T_2. Fourth, according to (25) the elevation of μ_1^A lowers T_1, the A-good price of B goods, because it reduces the period-1 supply of A-goods on the world market. Fifth, if we suppose $B^{AB} > 0$ initially (that country A has a capital inflow and a trade deficit), then by (23) and (26) elevated μ_1^A reduces B^{AB} and causes T_2 to rise. A-country households save some gains owing to the temporarily favorable terms of trade to smooth consumption over their lifetime; and B households do the reverse.[12]

Sixth, it follows that e_1 falls and e_2 rises, that is, country A's current exchange rate appreciates and its future exchange rate depreciates when central bank A holds the line on inflation in response to an "inflation scare." These effects are reversed when central bank A's credibility for zero inflation is restored, $E\pi^A$ falls back to zero, and restrictive interest rate policy in country A is relaxed. Note that the effects of the "inflation scare" are transmitted internationally through the balance of payments and the terms of trade even though the scare is resisted successfully by central bank A. However, exchange rate flexibility allows country B to take interest rate policy actions to stabilize $\mu_1^B = \mu_1^{B*}$ and to insulate fully its employment and price level from the inflation scare in country A.

7.2 A Devaluation Scare in a Fixed Exchange Rate Regime

The fundamental problem with a fixed exchange rate is that the government must forgo completely the use of interest rate policy for domestic stabilization purposes. Yet, governments cannot be indifferent to adverse shocks to the domestic economy. A country's commitment to its

[12] If trade is balanced initially, then the substitution and wealth effects on consumption exactly cancel and trade remains balanced.

fixed exchange rate is called into question whenever the external (fixed exchange rate) objective conflicts with the internal (inflation/employment) objective. In what follows, we illustrate such a conflict in the INNS economy reminiscent of the East Asian financial crisis of 1997 that led to the devaluation of a number of East Asian currencies against the US dollar.

Assume that country A uses interest rate policy independently and credibly to stabilize its domestic price level so that $P_1^{AA} = P_2^{AA} = P_0^{AA}$, $\mu_1^{A} = \mu_1^{A*}$, and $\mu_2^{A} = \mu_2^{A*}$. Country B, the emerging market, developing economy chooses to fix its exchange rate and to import interest rate policy from country A because its monetary institutions lack the independence and credibility to pursue interest rate policy to target domestic inflation. Country B fixes its exchange rate at $e_1 = e_2 = \bar{e}$.

Starting from a position of balanced trade, $B^{AB} = 0$, suppose there is an expected future improvement in the demand for country B's exports to country A, i.e., an expected increase in θ_2^{A}. According to (26), B-export optimism raises T_2. And according to (23) it makes $B^{AB} < 0$ so that capital flows from country A to country B in period 1 as country B runs a trade deficit with country A. The trade imbalance offsets some of the initial increase in T_2 and puts upward pressure on T_1 because the world demand for B goods rises with the B-country trade deficit, given the home biases in consumption.

Because $T_1 = \frac{P_1^{BB}}{P_0^{AA}}\bar{e}$, T_1 does not adjust much to the B-export optimism since P_1^{BB} prices are sticky. Instead, B firms meet the increase in period-1, B-good demand by hiring more labor, raising W_1^{B} and compressing B-country markups μ_1^{B} relative to the profit-maximizing markup. B-export optimism creates an inflationary boom in country B, reflected in an increase in employment by (29). Assuming that B firms fully adjust their prices to restore the flexible-price profit-maximizing markup μ_2^{B*} in period 2, P_2^{BB} rises with the increased period-2 terms of trade so that

$T_2 = \frac{P_2^{BB}}{P_0^{AA}}\bar{e}$ satisfies (26) with $\mu_2^B = \mu_2^{B*}$ and an elevated θ_2^A.

The adjustment to B-export optimism exhibits i) a B-country capital inflow, ii) a B-country trade deficit, iii) high B-country employment, iv) B-country inflation, and v) a rising B-country terms of trade. These circumstances resemble those of the East Asian miracle in the years prior to the East Asian currency crisis.[13]

This situation is readily sustained by country B's government because B households benefit from the B-export optimism even as B's monetary authorities maintain the fixed exchange rate. One might conclude that compression of the markup relative to the flexible-price profit maximizing markup is beneficial because it temporarily lowers the distortionary markup tax. Yet this would ignore the fact that rational firms price so as to achieve the flexible-price profit maximizing markup on average over time, regardless of the exchange rate or monetary regime. It follows that a fixed-rate regime that allows booms such as this will also tend to produce recessions associated with elevated markups. Since tax smoothing generally improves welfare, a flexible-rate inflation-targeting regime that better stabilizes the markup is more efficient than a fixed-rate regime.[14]

In this case the boom *itself* exposes country B to a subsequent period of elevated markups and recession if the B-export optimism proves at some point to be excessive, even if ultimately it proves to be well-founded.[15] The problem is that *if* P^{BB} has already adjusted upward somewhat to the optimistic path for θ^A, and θ_1^A subsequently disappoints expectations or optimism about θ_2^A diminishes, then *downward* pressure on the terms of trade requires *deflation* of country B's price level, a decline of P^{BB}. According to (33), however, in the absence of a spontaneous expected

[13] See, for instance, Glick (1999), pp. 35-8. Similar circumstances preceded the Mexican devaluation of 1994.
[14] Goodfriend and King (2001) develop the case for price stability and markup constancy as optimal fiscal policy.
[15] After a period of rapid expansion, exports did slow markedly in East Asia prior to the devaluation crisis. See Glick (1999), p. 36.

deflation, firms respond initially to the downward adjustment in the demand for B goods by reducing employment rather than cutting prices. Firms deflate P^{BB} prices only in the presence of a significant elevation of the period-1 markup expected to persist in period 2 at unchanged prices. In other words, in order to sustain the fixed exchange rate country B must allow an inefficient recession relative to the IRBC core to run its course.

At this point country B's external (fixed exchange rate) objective comes into conflict with its domestic stabilization objective potentially making matters much worse. By devaluing B money against A money, country B could adjust its terms of trade downward without putting the country through the recession and markup elevation needed to deflate the B-money price level. In such circumstances, country B's government would be tempted to devalue rather than force a deflation, calling in question the credibility of its commitment to maintain the fixed exchange rate, and possibly initiating a "devaluation scare."

If the reassessment of B-export optimism triggers a devaluation scare, then international speculators have an incentive to bet against the currency. And if speculators expect B-money to be devalued in terms of A money ($\frac{E\overline{e_2}}{\overline{e_1}} < 0$), then B's central bank must raise $\overline{R}^{B}$ to continue to satisfy (35) in order to deter speculation. Higher $\overline{R}^{B}$ in conjunction with lower $E\pi^{B}$ pushes up the real interest rate r^{B}. According to (19), elevated r^{B} further reduces the demand for B-good output, deepens the inefficient recession relative to the IRBC core, and weakens further the credibility of the fixed-exchange-rate commitment.[16]

The leeway to defend the fixed exchange rate under such circumstances is extremely limited. A speculative attack raises the probability of a devaluation and forces central bank B to

[16] In addition, high interest rates have the capacity to create negative cash flow problems for banks, which must match the higher short-term interest rates to retain depositors even though their longer-term assets continue to earn lower interest.

raise $\overline{R}^{\mathrm{B}}$ even higher. A strong negative credibility feedback loop can force country B to devalue its exchange rate soon after news arrives that its export optimism has been excessive.

Under these circumstances, country B faces a dilemma: to defend its exchange rate with an even more inefficient recession relative to the IRBC core, or to devalue its exchange rate and relieve the domestic deflationary pressure. One might conclude that country B should be relatively quick to devalue its exchange rate when a conflict between domestic stabilization and exchange rate stability precipitates a speculative attack. However, being quick to devalue carries a cost---it invites more frequent devaluation scares and speculative attacks to which country B's central bank would have to respond by raising interest rates, with evermore inefficient recessions relative to the IRBC core in the future.

8. Conclusion

The 2-country, 2-good, 2-period model presented in the paper was designed for expository purposes to illustrate the principles of the New Neoclassical Synthesis in an international context. At the heart of the model were two national real business cycle models linked by trade and finance. The international real business cycle core served three purposes. First, IRBC core showed how the international economy would behave if firms adjusted prices flexibly to sustain their profit-maximizing markups. Second, the IRBC core served as a benchmark against which to judge inefficient international fluctuations that occur due to sticky prices in the INNS model. Third, the IRBC core of the INNS model provided guidance for national interest rate policies and for international monetary arrangements.

The main recommendation was that the countries should adopt a flexible exchange rate so that each could employ interest rate policy independently to target domestic inflation. Doing so stabilizes actual markups at flexible-price profit-maximizing markups, and makes the INNS model behave like its IRBC core so that the INNS model exhibits only "good" international real business cycles. As a practical matter, however, we noted that frictions in the implementation of monetary policy mean that inefficient fluctuations inevitably occur relative to the IRBC core. Nevertheless, INNS reasoning suggests that interest rate policy is not likely to go far wrong if domestic inflation stabilization is a priority, since credible inflation targeting should make any deviation of actual from profit-maximizing markups minor and temporary.

In contrast, we saw that a country that fixes its exchange rate and gives up interest rate policy independence subjects its markup to inefficient fluctuations due to shocks originating anywhere in the global economy. In particular, international pressure on the terms of trade produces domestic inflation or deflation accompanied by a compression or an elevation of the markup relative to the flexible-price profit-maximizing markup. Surprisingly, we saw that an adjustment of a fixed exchange rate parity that improves or deteriorates the terms of trade has no effect on the trade balance of a trading partner that pursues interest rate policy independently to stabilize its employment and inflation.

We explored how credibility crises create inefficient fluctuations relative to the IRBC core. In a flexible exchange rate regime, an "inflation scare" that challenges a central bank's credibility for zero inflation provokes restrictive interest rate policy actions that elevate the domestic markup, precipitate a recession at home, and appreciate the exchange rate. However, a trading partner that is willing to let its exchange rate depreciate can pursue interest rate policy independently to insulate fully its employment and price level from the inflation scare abroad.

Finally, we described how a period of "export optimism" (associated with an expected improvement in the terms of trade) that later proves excessive generates circumstances resembling the East Asian miracle and the subsequent currency crisis of 1997. A period of domestic inflation that improves the terms of trade subsequently produces an inefficient elevation of the markup, deflation, and recession when the export optimism is reversed. At that point, pressure to devalue the currency instead of deflating the price level precipitates a "devaluation scare" and forces the central bank to raise interest rates to deter a speculative attack, which further elevates the markup and worsens the recession. Thus, we saw how the INNS model with its IRBC core helps to understand the susceptibility of a fixed exchange regime to speculative attack.

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