North-South Trade and the Non-Neutrality of International Money

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Abstract:
This paper develops a Ricardian model with money to study North-South trade that is mediated by the currency of the North.   The model shows that an increase in the supply of Northern money results in inflation being "exported" to the South.   The increase in the supply of Northern money also has real effects: (1) it transfers real resources from the South to the North, lowers the wage rate in the South relative to that in the North, and worsens the terms of trade for the South; and (2) it leads to structural changes in both economies by encouraging the expansion of the tradable sector in the South and the expansion of the non-tradable sector in the North.

JEL classification: F11, F42, E41

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1. Introduction

When an Indian exporter sells to the US market, chances are that he will price his goods in US dollars and happily accept US dollars in payment. An US exporter, on the other hand, is unlikely to accept a payment in Rubee from an Indian buyer. Participants in international trade choose to use the US dollar and a small number of other currencies in their transactions for good reasons, including transaction cost savings (Krugman, 1980) and competition considerations (Goldberg & Tille, 2008). What's also interesting is that their choices of currencies as media of exchange have important implications for the way shocks, especially monetary shocks, are transmitted across countries. The purpose of this paper is to study some of these implications. Specifically, we investigate how a monetary shock originated from a country whose currency is used internationally is likely to affect this country and its trading partners.

We conduct our investigation by developing a monetary model of North-South trade in a Ricardian world. There is a large literature on North-South trade, addressing a variety of issues, for example, the gains of trade and its distribution (Chui, Levine, & Pearlman, 2001; Matsuyama, 2000), the effect of trade on wage and income inequality (Askenazy, 2005; Choi, 2007) and the role of technology transfer (Hoekman & Javorcik, 2006). However, to our knowledge, few researchers have carefully studied the implications of a prominent feature of North-South trade, namely that the trade is usually mediated by the currency of a Northern country.

Imagine a world consisting of a two countries, the South and the North. If the South uses the currency of the North in the trade between them, there is a demand by individuals in the South for holding the Northern currency. As with the demand for domestic money, Southern individuals' (nominal) demand for Northern money depends on, among other things, nominal income. When there is an increase in the supply of Northern money, the nominal income of the North goes up, which raises the demand for Southern goods. This increase in demand pushes up the prices of Southern goods, which in turn put upward pressure on nominal wage

rate and nominal income, thus inflation arrives in the South (with the additional inflow of Northern money). The rise in nominal income in the South also increases the demand for Northern money by Southern individuals. Since the increase in the holdings of Northern money is made possible only by an increase of Southern net exports to the North, there is a transfer of real resources from the South to the North.

The increase in demand for Northern money partly offsets the downward pressure on the exchange rate (i.e., the Southern money price of Northern money), such that the exchange rate falls by less than proportionally relative to the increase in the supply of Northern money. Correspondingly, the terms of trade worsens for the South, which means more goods have to be exported for the same amount of imports. In the new equilibrium therefore, the export sector in the South needs to be larger, and that in the North needs to be smaller. In other words, the increase in the money supply in the North leads to structural changes of production in both countries.

In the following section, we present a simple Ricardian model which formalises our conjecture described above about the likely consequences of an increase in the supply of Northern money. The model adds vigour to our intuitive analysis and allows us to see more clearly the interrelationship among the variables of interest. We offer some concluding remarks in section 3.

2. The model

Consider a Ricardian world with two countries: the South with a population of N_1, and the North with a population of N_2. There are three goods X, Y and Z. We assume that the South specialises in the production of good X, and the North in the production of good Y. Good Z is produced in both countries, and is not traded internationally.

Assume further that trade within each country is mediated by the country's domestic currency; whereas international trade is mediated by the currency of the North. As a result, an individual in the South has a demand for Southern money (used in internal trade) and a demand for Northern money (used in international trade). We can write the representative Southern individual's decision problem as:

$$\max_{x_1,y_1,z_1,m_1/P_{1xz},FX_1/p_{2y}} U_1 = U_1(x_1,y_1,z_1,\frac{m_1}{P_{1xz}},\frac{FX_1}{p_{2y}}) = x_1^{\alpha_1} y_1^{\alpha_2} z_1^{\alpha_3} (\frac{m_1}{P_{1xz}})^{\alpha_4} (\frac{FX_1}{p_{2y}})^{\alpha_5}$$

s.t. $p_{1x}x_1 + (p_{2y}e)y_1 + p_{1z}z_1 + m_1 + FX_1e = w_1 + \bar{m}_1 + \overline{FX}_1e$

$$\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5 = 1$$

where x_1, y_1, z_1 are quantities of goods X, Y, and Z demanded; P_{1xz} is the average price of good X and good Z (which are bought with Southern money); p_{2y} is the price of good Y; m_1/P_{1xz} is the demand for real balances in Southern money; FX_1/p_{2y} is the demand for real balances in foreign exchange (Northern money); $\bar{m}_1$ and $\overline{FX}_1e$ are initial money holdings in domestic and foreign currency, respectively; e is the exchange rate.

In the North, the representative individual consumer has a similar decision problem as that of the Southern individual except that the Northern individual has no demand for Southern money.

$$\max_{x_2,y_2,z_2,m_2/P_{2xyz}} U_2 = U_2(x_2,y_2,z_2,\frac{m_2}{P_{2xyz}}) = x_2^{\beta_1} y_2^{\beta_2} z_2^{\beta_3} (\frac{m_2}{P_{2xyz}})^{\beta_4}$$

s.t. $(p_{1x}/e)x_2 + p_{2y}y_2 + p_{2z}z_2 + m_2 = w_2 + \bar{m}_2$

$\beta_1 + \beta_2 + \beta_3 + \beta_4 = 1$

Solving the consumer decision problems, we obtain the demand functions for goods, domestic moneys and foreign exchange:

$$x_1 = \frac{\alpha_1(w_1 + \bar{m}_1 + \overline{FX}_1e)}{p_{1x}} ; \qquad x_2 = \frac{\beta_1(w_2 + \bar{m}_2)e}{p_{1x}} \tag{1}$$

$$y_1 = \frac{\alpha_2(w_1 + \bar{m}_1 + \overline{FX}_1e)}{p_{2y}e} ; \qquad y_2 = \frac{\beta_2(w_2 + \bar{m}_2)}{p_{2y}} \tag{2}$$

$$z_1 = \frac{\alpha_3(w_1 + \bar{m}_1 + \overline{FX}_1e)}{p_{1z}} ; \quad z_2 = \frac{\beta_3(w_2 + \bar{m}_2)}{p_{2z}} \tag{3}$$

$$m_1 = \alpha_4(w_1 + \bar{m}_1 + \overline{FX}_1e) ; \qquad m_2 = \beta_4(w_2 + \bar{m}_2) \tag{4}$$

$$FX_1 = \frac{\alpha_5(w_1 + \bar{m}_1 + \overline{FX}_1e)}{e} \tag{5}$$

On the supply side, we assume that all goods are produced with labor only. The production functions are:

South: $X_1 = a_{1x}L_{1x}$; $Z_1 = a_{1z}L_{1z}$

North: $Y_2 = a_{2y}L_{2y}$; $Z_2 = a_{2z}L_{2z}$

Under the assumption of perfect competition, the prices of goods are driven to the levels of production cost, thus we have

$$p_{1x} = \frac{w_1}{a_{1x}}; \quad p_{1z} = \frac{w_1}{a_{1z}} \tag{6}$$

$$p_{2y} = \frac{w_2}{a_{2y}}; \quad p_{2z} = \frac{w_2}{a_{2z}} \tag{7}$$

In equilibrium, all markets clear. Specifically the following market clearance conditions are met:

In the South:

    Labour market: $L_{1x} + L_{1z} = N_1$ (8)

    Market for good Z: $N_1 z_1 = Z_1$ (9)

In the North:

    Labor market: $L_{2y} + L_{2z} = N_2$ (10)

    Market for good Z: $N_2 z_2 = Z_2$ (11)

International:

    Market for good X: $N_1 x_1 + N_2 x_2 = X_1$ (12)

    Market for good Y: $N_1 y_1 + N_2 y_2 = Y_2$ (13)

    Market for Northern money: $N_1(FX_1 + p_{2y}y_1) = N_2(\frac{p_{1x}}{e})x_2 + N_1\overline{FX_1}$ (14)

Solving equations (1)-(14), we obtain the equilibrium values of all the endogenous variables, of which the following are of particular interest to us.

(1) Quantities demanded for foreign exchange holdings and for goods

$$FX_1^* = \frac{\alpha_5[\beta_1 N_2\overline{m}_2 + (\beta_1 + \beta_4 + \alpha_2\beta_1)N_1\overline{FX_1}]}{(\alpha_2\beta_4 + \alpha_5\beta_1 + \alpha_5\beta_4)N_1}$$

$$x_1^* = \frac{\alpha_1 a_{1x}[\beta_1 N_2\overline{m}_2 + (\beta_1 + \beta_4 + \alpha_2\beta_1)N_1\overline{FX_1}]}{(1-\alpha_4)\beta_1 N_2\overline{m}_2 + [(\alpha_1 + \alpha_3)(\beta_1 + \beta_4) + \alpha_2\beta_1]N_1\overline{FX_1}}$$

$$y_1^* = \frac{\alpha_2 a_{2y}(\beta_1 + \beta_4)N_2[\beta_1 N_2 \overline{m}_2 + (\beta_1 + \beta_4 + \alpha_2 \beta_1)N_1 \overline{FX}_1]}{[\alpha_2 \beta_1 + (\alpha_2 \beta_4 + \alpha_5 \beta_1 + \alpha_5 \beta_4)(\beta_2 + \beta_3)]N_1 N_2 \overline{m}_2 + \alpha_2(\beta_1 + \beta_4)N_1 N_1 \overline{FX}_1}$$

$$z_1^* = \frac{\alpha_3 a_{1z}[\beta_1 N_2 \overline{m}_2 + (\beta_1 + \beta_4 + \alpha_2 \beta_1)N_1 \overline{FX}_1]}{(1 - \alpha_4)\beta_1 N_2 \overline{m}_2 + [(\alpha_1 + \alpha_3)(\beta_1 + \beta_4) + \alpha_2 \beta_1]N_1 \overline{FX}_1}$$

$$x_2^* = \frac{\beta_1 a_{1x} N_1[\alpha_2 N_1 \overline{FX}_1 + (\alpha_2 + \alpha_5)N_2 \overline{m}_2]}{(1 - \alpha_4)\beta_1 N_2 N_2 \overline{m}_2 + [(\alpha_1 + \alpha_3)(\beta_1 + \beta_4) + \alpha_2 \beta_1]N_1 N_2 \overline{FX}_1}$$

$$y_2^* = \frac{\beta_2 a_{2y}(\beta_1 + \beta_4)[\alpha_2 N_1 \overline{FX}_1 + (\alpha_2 + \alpha_5)N_2 \overline{m}_2]}{\alpha_2(\beta_1 + \beta_4)N_1 \overline{FX}_1 + [(\alpha_2 \beta_4 + \alpha_5 \beta_1 + \alpha_5 \beta_4)(\beta_2 + \beta_3) + \alpha_2 \beta_1]N_2 \overline{m}_2}$$

$$z_2^* = \frac{\beta_3 a_{2z}(\beta_1 + \beta_4)[\alpha_2 N_1 \overline{FX}_1 + (\alpha_2 + \alpha_5)N_2 \overline{m}_2]}{\alpha_2(\beta_1 + \beta_4)N_1 \overline{FX}_1 + [(\alpha_2 \beta_4 + \alpha_5 \beta_1 + \alpha_5 \beta_4)(\beta_2 + \beta_3) + \alpha_2 \beta_1]N_2 \overline{m}_2}$$

We can see that the equilibrium quantities of goods are influenced by the supply of Northern money ($\overline{m}_2$), but not by the supply of Southern money ($\overline{m}_1$), that is, Southern money is neutral, but Northern money is not.   Also, we derive from above that:

$$\frac{\partial FX_1^*}{\partial \overline{m}_2} = \alpha_5 \frac{e^* \frac{\partial w_1^*}{\partial \overline{m}_2} - (w_1^* + \overline{m}_1)\frac{\partial e^*}{\partial \overline{m}_2}}{(e^*)^2} > 0$$

$$\frac{\partial x_1^*}{\partial \overline{m}_2} = \alpha_1 \frac{\overline{FX}_1 p_{1x}^* \frac{\partial e^*}{\partial \overline{m}_2} - (\overline{m}_1 + \overline{FX}_1 e^*)\frac{\partial p_{1x}^*}{\partial \overline{m}_2}}{(p_{1x}^*)^2} < 0,$$

$$\frac{\partial y_1^*}{\partial \overline{m}_2} = \alpha_2 \frac{p_{2y}^* e^* \frac{\partial w_1^*}{\partial \overline{m}_2} - (w_1^* + \overline{m}_1)(p_{2y}^* \frac{\partial e^*}{\partial \overline{m}_2}) - (w_1^* + \overline{m}_1 + \overline{FX}_1 e^*)(e^* \frac{\partial p_{2y}^*}{\partial \overline{m}_2})}{(p_{2y}^* e^*)^2} < 0,$$

$$\frac{\partial z_1^*}{\partial \overline{m}_2} = \alpha_3 \frac{\overline{FX}_1 p_{1z}^* \frac{\partial e^*}{\partial \overline{m}_2} - (\overline{m}_1 + \overline{FX}_1 e^*)\frac{\partial p_{1z}^*}{\partial \overline{m}_2}}{(p_{1z}^*)^2} < 0,$$

$$\frac{\partial x_2^*}{\partial \overline{m}_2} = \beta_1 \frac{p_{1x}^* e^* \frac{\partial w_2^*}{\partial \overline{m}_2} + p_{1x}^* e^* + (w_2^* + \overline{m}_2)(p_{1x}^* \frac{\partial e^*}{\partial \overline{m}_2} - e^* \frac{\partial p_{1x}^*}{\partial \overline{m}_2})}{(p_{1x}^*)^2} > 0$$

$$\frac{\partial y_2^*}{\partial \overline{m}_2} = \beta_2 \frac{p_{2y}^* - \overline{m}_2 \dfrac{\partial p_{2y}^*}{\partial \overline{m}_2}}{(p_{2y}^*)^2} > 0 ,$$

$$\frac{\partial z_2^*}{\partial \overline{m}_2} = \beta_3 \frac{p_{2z}^* - \overline{m}_2 \dfrac{\partial p_{2z}^*}{\partial \overline{m}_2}}{(p_{2z}^*)^2} > 0$$

The above comparative statics suggest that with an increase in Northern money, there is an increased demand in the South for holding Northern money. At the same time, the quantities of all goods consumed in the South fall, whereas the quantities of all goods consumed in the North increase. This means that associated with an increase in the supply of Northern money, there is a corresponding transfer of real resources from the South to the North. The negative impact of the monetary shock on the South is also reflected in other variables as we discuss below.

(2) Consumer prices, relative wage rate and the terms of trade

The equilibrium exchange rate, wages and prices are:

$$e^* = \frac{(\alpha_2\beta_4 + \alpha_5\beta_1 + \alpha_5\beta_4)N_1\overline{m}_1}{\alpha_4(\beta_1 + \beta_4)N_1\overline{FX}_1 + \alpha_4\beta_1 N_2\overline{m}_2}$$

$$w_1^* = \frac{1-\alpha_4}{\alpha_4}\overline{m}_1 - \overline{FX}_1 e^* = \frac{(1-\alpha_4)\beta_1 N_2\overline{m}_2\overline{m}_1 + [(\alpha_1 + \alpha_3)(\beta_1 + \beta_4) + \alpha_2\beta_1]N_1\overline{FX}_1\overline{m}_1}{\alpha_4(\beta_1 + \beta_4)N_1\overline{FX}_1 + \alpha_4\beta_1 N_2\overline{m}_2}$$

$$w_2^* = \frac{\beta_2 + \beta_3}{\beta_1 + \beta_4}\overline{m}_2 + \frac{\alpha_2 N_1\overline{m}_1}{\alpha_4(\beta_1 + \beta_4)N_2 e^*} = \frac{\alpha_2(\beta_1 + \beta_4)N_1\overline{FX}_1 + [(\alpha_2\beta_4 + \alpha_5\beta_1 + \alpha_5\beta_4)(\beta_2 + \beta_3) + \alpha_2\beta_1]N_2\overline{m}_2}{(\alpha_2\beta_4 + \alpha_5\beta_1 + \alpha_5\beta_4)(\beta_1 + \beta_4)N_2}$$

$$p_{1x}^* = \frac{w_1^*}{a_{1x}}, \qquad p_{1z}^* = \frac{w_1^*}{a_{1z}},$$

$$p_{2y}^* = \frac{w_2^*}{a_{2y}}, \qquad p_{2z}^* = \frac{w_2^*}{a_{2z}}$$

$$p_{2y}^* e^* = \frac{N_1\overline{m}_1}{a_{2y}(\beta_1 + \beta_4)N_2}\frac{\alpha_2(\beta_1 + \beta_4)N_1\overline{FX}_1 + [(\alpha_2\beta_4 + \alpha_5\beta_1 + \alpha_5\beta_4)(\beta_2 + \beta_3) + \alpha_2\beta_1]N_2\overline{m}_2}{\alpha_4(\beta_1 + \beta_4)N_1\overline{FX}_1 + \alpha_4\beta_1 N_2\overline{m}_2}$$

Clearly, an increase in the supply of Northern money lowers the purchasing power of Northern money therefore lowers the exchange rate, that is,

$$\frac{\partial e^*}{\partial \overline{m}_2} < 0 .$$

Moreover, we have

$$\frac{\partial p_{1x}^*}{\partial m_2} > 0, \quad \frac{d(p_{2y}^* e^*)}{d(\overline{m}_2)} > 0, \quad \frac{\partial p_{1z}^*}{\partial m_2} > 0.$$

These suggest that an increase in the supply of Northern money increases the monetary prices of all goods in the South, thus "exporting" inflation to the South.

Turning to wages and the terms of trade, we see that

$$\frac{\partial w_1^*}{\partial \overline{m}_2} > 0, \quad \frac{\partial w_2^*}{\partial \overline{m}_2} > 0$$

$$\frac{\partial (w_1^* / w_2^* e^*)}{\partial \overline{m}_2} < 0, \quad \frac{\partial (p_{1x}^* / p_{2y}^* e^*)}{\partial \overline{m}_2} < 0$$

That is, nominal wages in both the North and South rise as a result of an increase in the supply of Northern money.   However, the wage rate in the South falls relative to that in the North, and the terms of trade deteriorate for the South as well.

(3) Allocation of productive resources

If Northern money is non-neutral as we have shown above, it is to be expected that an increase in the supply of Northern money will have ramifications for the structures of the economies through its impact on the allocation of productive resources.   From our model, we can derive relative shares of labor resources devoted to the tradable and non-tradable sectors in both the South and the North.

$$\frac{L_{1x}^*}{L_{1z}^*} = \frac{\dfrac{N_1 x_1^* + N_2 x_2^*}{a_{1x}}}{\dfrac{N_1 z_1^*}{a_{1z}}} = \frac{\beta_1(\alpha_1 + \alpha_2 + \alpha_5)N_1 N_2 \overline{m}_2 + (\alpha_1\beta_1 + \alpha_1\beta_4 + \alpha_1\alpha_2\beta_1 + \alpha_2\beta_1)N_1 N_1 \overline{FX_1}]}{\alpha_3\beta_1 N_1 N_2 \overline{m}_2 + \alpha_3(\beta_1 + \beta_4 + \alpha_2\beta_1)N_1 N_1 \overline{FX_1}]}$$

$$\frac{L_{2y}^*}{L_{2z}^*} = \frac{\dfrac{N_1 y_1^* + N_2 y_2^*}{a_{2y}}}{\dfrac{N_2 z_2^*}{a_{2z}}} = \frac{(\alpha_2\beta_1 + \alpha_2\beta_4 + \alpha_2\alpha_2\beta_1 + \alpha_2\beta_2)N_1 \overline{FX_1} + (\alpha_2\beta_1 + \alpha_2\beta_2 + \alpha_5\beta_2)N_2 \overline{m}_2}{\beta_3[\alpha_2 N_1 \overline{FX_1} + (\alpha_2 + \alpha_5)N_2 \overline{m}_2]}$$

It is straightforward to show that

$$\frac{\partial (\frac{L_{1x}^*}{L_{1z}^*})}{\partial \overline{m}_2} > 0, \quad \frac{\partial (\frac{L_{2y}^*}{L_{2z}^*})}{\partial \overline{m}_2} < 0.$$

These imply that an increase in the supply of Northern money leads to an expansion of the tradable sector (and a contraction of the non-tradable sector) in the South and a contraction of the tradable sector (and an expansion of the non-tradable sector) in the North.

To summarize the above analysis, we have

Proposition 1: *In a Ricardian world where international trade between the North and the South is mediated by the currency of the North, an increase in the supply of Northern money leads to inflation being "exported" to the South. The increase in the supply of Northern money also has real effects: (1) it transfers real resources from the South to the North, lowers the wage rate in the South relative to that in the North, and worsens the terms of trade for the South; and (2) it leads to structural changes in both economies by encouraging the expansion of the tradable sector in the South and the expansion of the non-tradable sector in the North.*

3. Concluding remarks

In this paper we have presented a simple Ricardian model with money to study how a monetary shock in the North may have ramifications for itself and its Southern trading partner. By explicitly incorporating both the demand for local money and that for foreign exchange, our model generates several testable hypotheses in relation to the features of North-South trade and their corresponding consequences. [3] Our model also makes a contribution to the large literature on the transmission mechanism of monetary shocks (see, for instance, Meltzer, 1995) by looking at the issue from the perspective of international trade.

With some imagination, one might infer from our model that an expansionary monetary policy in the North may generate a boom in the export sector in the South, and a boom in the non-tradable sector in the North. When the boom turns into bust, the tradable sector in the South is forced to contract as is the non-tradable sector in the North. Of course, our model as it stands does not tell a compelling story about business cycles. However, it may be possible to extend our model, for instance, by incorporating international capital flows, to investigate various channels through which cycle-generating monetary shocks may be transmitted internationally.

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[3] To the extent that some North-North trade is mediated by the currency of one Northern country, the results of our model also apply.

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