

Exchange-Rate Variability and Foreign Factor Income

by

R. Glen Donaldson*

Maurice D. Levi

Barrie R. Nault

and

Thomas Ruf

November 11, 2011

Abstract

This paper investigates how the variability of a country's exchange rate is influenced by that country's 'net foreign factor income', which is comprised of foreign-currency-denominated flows into and out of countries from payments/receipts on bonds, loans and other debts, and dividends, plus workers' and ex-patriot remittances. We show theoretically that countries which are net receivers of foreign factor income should have less variable exchange rates than countries which are net payers, *ceteris paribus*. We test this prediction using 35 years of data from a wide cross section of countries and find that countries with greater net foreign cash inflows, relative to their size, do indeed have less variable exchange rates. This paper is the first to derive theoretically, and document empirically, the connection between foreign factor income and exchange rate variability and to show that this connection is strongly significant over-and-above other exchange rate variability factors that have been previously studied in the literature.

Key Words: Exchange Rate Variability; Foreign Factor Income

JEL Classifications: G15; F31

*Donaldson (corresponding author): Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver BC, Canada V6T 1Z2 (e-mail: glen.donaldson@sauder.ubc.ca). Levi: Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver BC, Canada V6T 1Z2 (e-mail: maurice.levi@sauder.ubc.ca). Nault: Haskayne School of Business, University of Calgary, 2500 University Drive Northwest, Calgary, Alberta, Canada T2N 1N4 (e-mail: nault@ucalgary.ca). Ruf: Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver BC, Canada V6T 1Z2 (e-mail: thomas.ruf@sauder.ubc.ca). The authors thank the Social Sciences and Humanities Research Council of Canada for generous financial support. All views expressed and any errors that remain are solely those of the authors.

Exchange-Rate Variability and Foreign Factor Income

1. Introduction

Today's exchange rate gyrations can unnerve even the most experienced central banker or financial manager. In the course of a few months or even weeks it is not unusual for currencies to gain or lose several percent of their value against the currencies of key trading partners, with potentially critical impacts on import and export trade, investment returns, corporate profits and economic performance. Not all currencies appear to be equally prone to such variability, however, and the degree of such variability appears to change over time.¹ Why is it that currencies differ as they do in terms of volatility, or lack of stability? Furthermore, why does the variability of individual currencies change over time? This paper addresses these important questions.

A variety of avenues for influencing exchange rate variability have previously been investigated in the literature. For example, differences in GDP growth and economic openness to international trade have been investigated as potential sources of cross-country and inter-temporal differences in exchange rate volatility (e.g., Bleaney (2006), Clark et al (2004), Hau (2002) and Hausmann, Panizza and Rigobon (2006)), as have differences in stocks of debt and foreign reserves (e.g., Devereux and Lane (2003) and Hviding, Nowak, and Ricci (2004)). Li and Muzere (2010) study the impact of investor beliefs and preferences on exchange rate volatility, while Anderson, Hammond and Ramezani (2010) study the joint dynamics of interest rates and various bilateral exchange rates. Other studies have investigated the impact of the information and market structure of foreign exchange trading on exchange rate dynamics (e.g., Evans (2002), Harvey and Huang (1991)) and have tried to capture the dynamics of exchange rate volatility (e.g., Brandt and Santa-Clara (2002) and Alizadeh, Brandt and Diebold (2002)). While the

¹ For example, the monthly volatility of the US Dollar vs. Korean Won exchange rate increased from less than 2% in 1990 to over 21% in 2009; within the calendar year 2009, the monthly volatility of the US Dollar vs. Euro exchange rate was approximately 7%, compared to over 20% for the US Dollar vs. New Zealand Dollar.

literature is making progress toward determining what drives differences in exchange rate variability across countries and over time, this important puzzle is far from solved.²

To the best of our knowledge, no-one has yet investigated the impact on exchange rate variability of ‘net foreign factor income’, which is comprised of foreign-currency-denominated flows into and out of countries from payments/receipts on bonds, loans and other debts, and dividends, plus workers’ and ex-patriot remittances (e.g., guest workers sending money to families back in their home country³). (In the national income and product accounts, Net Foreign Factor Income $\equiv$ GNP – GDP.) Given that labor-related and capital-related remittances tend to be denominated in the source currency (e.g., Mexican workers in the United States typically send US Dollars back home to Mexico, and developing country sovereign borrowers pay interest in US Dollars or Euros) there is either a stabilizing or destabilizing exchange rate force depending on the sign and size of these net factor income flows.⁴ The impact of such flows on exchange rate variability is therefore the focus of our investigation.

We begin our investigation by developing a simple model of exchange rate movements that distinguishes between currency demand/supply from goods and service exports/imports on the one hand, and currency demand/supply from positive/negative foreign factor income on the other hand.⁵ Our model is an extension of the structure that

² In addition to the literature on the *causes* of exchange rate variability (the topic of our research and the articles cited herein), there is also a large literature on the *consequences* of exchange rate variability. An investigation of such consequences is outside the scope of our paper.

³ The global dollar value of remittances has grown so large that it now exceeds the annual value of foreign direct investment. In extreme cases, such as Jamaica, Jordan, Lebanon, Moldova and Tajikistan, remittances contribute more than a quarter of GNP; in a few countries, such as Togo and Niger, remittance receipts are almost half as large as GDP (source: Global Economic Prospects 2006: Economic Implications of Remittances and Migration, World Bank.)

⁴ Evidence on the tendency for factor income flows to be in source countries’ currencies is provided by Hausmann and Panizza (2003) and Eichengreen (2003).

⁵ Here, the services we speak of when talking of ‘goods and services’ are performed services such as consulting, travel and so on, that should be price sensitive. These services appear in the services component of the balance of payments on current account along with the debt service payments and receipts and workers’ remittances, which together constitute the net foreign factor income of the country.

gives rise to the familiar Marshall-Lerner Condition for exchange rate stability.⁶ We show that inclusion of net foreign factor income, as being distinct from other current account sources of currency supply and demand, modifies the standard Marshall-Lerner Condition, making exchange rate stability more likely for countries that are net foreign factor income recipients from abroad and less likely for countries that are net payers of foreign factor income to abroad. We then argue that the more stable is a currency, in the sense of more easily satisfying our augmented Marshall-Lerner Condition, the less variable its exchange rate should be for given exogenous shocks.

To see the intuition for this negative relationship between exchange rate variability and net foreign factor income, consider an example in which Canadians receive more in payments from foreign sources (denominated in US Dollars) than foreigners receive in payments from Canadian sources, so that net foreign factor income is positive for Canada. Also assume that Canadians exchange the US Dollars they receive for Canadian Dollars. Now suppose the Canadian Dollar depreciates due to an exogenous shock; the same number of US Dollars thus translates into a larger number of Canadian Dollars. The demand for Canadian Dollars by Canadians who receive US Dollar payments, and transfer these US Dollars into Canadian Dollars, thus increases following the negative shock. This increased demand for Canadian Dollars pushes the value of the Canadian Dollar upward, which partially counteracts the negative shock that originally pushed the Canadian Dollar down, so that the net fluctuation of the Canadian Dollar is dampened thus stabilizing the Canadian Dollar and reducing exchange rate volatility.^{7,8} An opposite, destabilizing, effect that magnifies, rather than dampens, shocks would occur if Canada's net foreign factor income was negative rather than positive. Thus we see that in general there is a negative relationship between exchange rate variability and

⁶ Derivation of the well-known Marshall-Lerner Condition can be found in many standard textbooks in international finance and monetary economics, including Levi (2009).

⁷ We require only that some of the income be foreign currency denominated. Bonds, workers' remittances etc. are often euro- or dollar –denominated which is foreign denomination outside the US or Europe.

⁸ Other studies that suggest offsetting effects on exchange rate volatility include Bacchetta and van Wincoop (2000), who show how shocks such as monetary expansion can depreciate exchange rates that in turn increase foreign demand and demand for the home currency.

net foreign factor income; i.e., greater net foreign factor income is associated with greater exchange rate stability, and thus with lower exchange rate volatility, *ceteris paribus*.

In Section 2 of this paper we derive our augmented Marshall-Lerner Condition which yields the theoretical prediction, discussed above, of a negative relationship between net foreign factor income and exchange rate variability. Section 3 of our paper describes the panel data, from 80 countries over 35 years, which we employ to test the theory. Section 4 then reports the results from our various empirical tests. These tests reveal that, as predicted by the theory, exchange rates in the data are indeed less volatile (more stable) for countries that are net earners from abroad and more volatile (less stable) for countries that are net payers abroad. Our tests further reveal that our finding of a negative relationship between net foreign factor income and exchange rate variability is highly robust, across countries and over time, and is in addition to (i.e., remains highly significant even in the presence of) other sources of exchange rate volatility, including trade openness and GDP growth, that have been previously investigated in the literature. Section 5 concludes.

2. Exchange Rate Variability and Foreign Factor Income

Equation (1) specifies the excess demand for a country's currency arising from current account activities.

$$E = p_x Q_x(\pi \cdot p_x) + \frac{F}{\pi} - \frac{p_m}{\pi} Q_m\left(\frac{p_m}{\pi}\right) \quad (1)$$

Where: E = Excess demand for a country's currency measured in units of the country's own currency

p_x = Price of exports measured in the country's own currency

π = Exchange rate expressed in foreign currency units (e.g., US Dollars) per unit of the country's own currency; i.e. $\pi(\$ / i)$

$Q_x(\cdot)$ = Quantity exported as a function of price measured in foreign currency units (where foreign price is expressed as price in the country's own currency, p_x , converted to foreign currency units at the exchange rate π)

F = Net foreign income in foreign currency

p_m = Price of imports measured in foreign currency units

$Q_m(\cdot)$ = Quantity imported as a function of price measured in units of the country's own currency (where domestic price is expressed as foreign price, p_m , converted to domestic price at the inverse exchange rate $1/\pi$)

The first and last terms in equation (1), which capture the dependency of excess demand on the value of exports and imports, are standard in derivations of the Marshall-Lerner Condition.⁹ The middle term in equation (1) is our augmentation to account for net foreign factor income, F , where F is a given amount of foreign currency units converted into the country's own currency at the exchange rate π to represent a net demand for a country's own currency.

If we adopt the standard assumptions employed when deriving the classical Marshall-Lerner Condition (e.g., perfectly elastic supply of exports, so that p_x does not depend on Q_x , and also a perfectly elastic supply of imports),¹⁰ then the impact of a change in the exchange rate is:

$$\frac{dE}{d\pi} = p_x \frac{\partial Q_x}{\partial[\pi p_x]} \frac{d[\pi p_x]}{d\pi} + \frac{d[F/\pi]}{d\pi} - \frac{p_m}{\pi} \frac{\partial Q_m}{\partial[p_m/\pi]} \frac{d[p_m/\pi]}{d\pi} - Q_m \frac{d[p_m\pi]}{d\pi}$$

which after taking some derivatives and rearranging gives

$$\frac{dE}{d\pi/\pi} = \left\{ \frac{\pi p_x}{Q_x} \frac{\partial Q_x}{\partial[\pi p_x]} \right\} p_x Q_x + \left\{ \frac{p_m/\pi}{Q_m} \frac{\partial Q_m}{\partial[p_m/\pi]} \right\} \frac{p_m Q_m}{\pi} + \frac{p_m Q_m}{\pi} - \frac{F}{\pi} . \quad (2)$$

⁹ For example, see Levi (2009), pp. 184 – 186.

¹⁰ Note that it is possible to drop these assumptions at the cost of complexity; a small country assumption would take care of the perfectly elastic supply of imports while perfectly elastic supply of exports would follow from unused capacity.

Define the demand elasticities as:

$$|\eta_x| \equiv - \left\{ \frac{\pi p_x}{Q_x} \frac{\partial Q_x}{\partial [\pi p_x]} \right\} \quad \text{and} \quad |\eta_m| \equiv - \left\{ \frac{p_m / \pi}{Q_m} \frac{\partial Q_m}{\partial [p_m / \pi]} \right\}$$

so we can then write (2) as:

$$\frac{dE}{d\pi / \pi} = -|\eta_x| p_x Q_x - |\eta_m| \frac{p_m Q_m}{\pi} + \frac{p_m Q_m}{\pi} - \frac{F}{\pi}.$$

In equilibrium:

$$p_x Q_x + \frac{F}{\pi} = \frac{p_m Q_m}{\pi}, \quad (3)$$

that is, the demand for the country's currency from exports and net foreign factor income equals the supply of the country's currency from payments for imports, which therefore balances the current account. Inserting (3) in (2) yields:

$$\frac{dE}{d\pi / \pi} = -|\eta_x| p_x Q_x - |\eta_m| \left\{ p_x Q_x + \frac{F}{\pi} \right\} + \left\{ p_x Q_x + \frac{F}{\pi} \right\} - \frac{F}{\pi}$$

which simplifies to

$$\frac{dE}{d\pi / \pi} = -p_x Q_x \left\{ (|\eta_x| + |\eta_m| - 1) + \frac{F/\pi}{p_x Q_x} |\eta_m| \right\} \quad (4)$$

The left hand side of equation (4) is the response of excess demand for the country's currency to a percentage change in the exchange rate. This must be negative for

stability: i.e., stability requires that currency depreciation (appreciation) increases (decreases) excess demand for the currency.

The first term in the brackets on the right hand side of (4), i.e., $(|\eta_x| + |\eta_m|) - 1$, yields the traditional Marshall-Lerner Condition; i.e., if we ignore foreign factor income (so $F=0$), stability of the exchange rate requires that $(|\eta_x| + |\eta_m|) > 1$, which is the standard Marshall-Lerner Condition: the more elastic are imports and exports the more stable is the currency. This is because with greater import/export elasticity, quantities can absorb more of the shock so price – the exchange rate – absorbs less. For given shocks to the exchange market, the currency should therefore move less the more sensitive is trade to the exchange rate in a classical Marshall-Lerner world.¹¹

Now consider the final term in brackets on the right hand side of (4), i.e., $\frac{F/\pi}{p_x Q_x} |\eta_m|$, which contains net foreign factor income, F . For the purpose of discussing this term, we can apply the Correspondence Principle to argue that, since markets are generally stable,¹²

$$\left\{ (|\eta_x| + |\eta_m| - 1) + \frac{F/\pi}{p_x Q_x} |\eta_m| \right\} > 0. \quad (5)$$

The foreign factor income term, $\frac{F/\pi}{p_x Q_x} |\eta_m|$, represents the home currency value of net foreign factor income, F/π , relative to that same country's home-currency value of exports, $p_x Q_x$, all multiplied by the elasticity of demand for imports, $|\eta_m|$.

¹¹ Shocks to exchange rates could come from the capital account or from influences on the current account not captured by the price factors shown as arguments of the quantities imported and exported.

¹² For a recent application of the Correspondence Principle in comparative statics see Enchenique (2002).

The stability condition in equations (5) reveals that the larger is the importance of net foreign factor income, relative to the value of exports, the larger is the left hand side of (5) and thus, *ceteris paribus*, the more stable is the exchange rate as seen in equation (4). In other words, for a given shock to the foreign exchange market, the larger is the relative importance of net foreign factor income to a country the smaller is the resulting movement of that country's exchange rate.¹³ Simply stated, net foreign factor income and exchange rate volatility are negatively related to each other. We now proceed to test this relationship in the data.

3. Data Sources and Variable Construction

Exchange Rate Volatility: The first task in constructing our data set is to define the variable for “exchange rate volatility”. For consistency with previous studies, we use the same definition of “exchange rate volatility” as other authors who have examined the volatility effects of factors such as economic openness, trade and GDP growth (e.g., Hausmann, Panizza and Rigobon (2006); Clark, Tamirisa, Wei, Sadikov and Zeng (2004); Hau (2002); Devereux and Lane (2003)). Thus:

Exchange Rate Volatility_{it} for country *i* in year *t* is defined to be the standard deviation of the 12 month-over-month changes in the natural log of country *i*'s trade-weighted real effective exchange rate within year *t*.

To produce the *Exchange Rate Volatility_{it}* variable for each country *i* and date *t*, we collected, from the IMF's International Financial Statistics, data on trade-weighted real effective exchange rates for all available countries for the years 1975 (the first year of

¹³ The preceding discussion employs the standard assumption that markets are stable. If we allow for the possibility of instability we see from (5) that a country with a sufficiently negative net foreign factor income could have an unstable currency. In such a case, depreciation increases the quantity supplied of the country's currency: the translated amount of its currency supplied is increased by depreciation thereby adding pressure for further depreciation. Similarly, appreciation reduces the quantity of currency supplied, leading to further appreciation, etc.

data availability) to 2009. These data are reported on a monthly frequency.¹⁴ Various tests for unit roots reveal that the *Exchange Rate Volatility_{it}* variable is stationary.¹⁵

Net Foreign Factor Income: Our next variable of interest is net foreign factor income. We obtain this data from the World Bank's world development indicators (WDI). The World Bank reports data on this variable under the name “net income from abroad”, which includes net income from payments and receipts arising from prior investments and borrowing (e.g., dividends, coupon payments received from investments in bonds, payments made on outstanding debts, etc.) and remittance payments to and receipts from citizens overseas.¹⁶ In order to appropriately scale this variable, as is required by our equation (5), we divide “net income from abroad” for country i in year t by the value of country i 's exports in year t , in order to produce our variable of interest:

Net Foreign Factor Income_{it} is: ‘Net Income from Abroad (measured in current \$US)’ divided by ‘Exports of Goods and Services (measured in current \$US)’ for country i in year t .

Various unit root tests reveal that the *Net Foreign Factor Income_{it}* variable is also stationary.

Sample: The World Bank's data allow us to construct the *Net Foreign Factor Income* variable as far back as 1960 for some countries. Given that the IMF's exchange rate data do not begin until 1975, however, our data sample begins in 1975 and extends to the end of 2009. For country i to be included in our sample for year t , we require that data

¹⁴ Trade-weighted exchange rates, rather than an exchange rate against just one benchmark country such as the USA, are employed in our paper because this measure more accurately captures actual trade patterns and because using a broader measure minimizes inappropriate country-specific effects from a narrowly construed numeraire.

¹⁵ This is consistent with others' findings, for example Sweeney (2006).

¹⁶ The value of F should strictly be that component of net foreign cashflow received or paid in foreign currency units, to be perfectly consistent with the theory. However, the data reports total net foreign income, not just the part received in foreign currency. Fortunately, for the vast majority of countries, income received from foreign sources (stocks, bonds, remittances) are likely to be in foreign currency units; e.g., US Dollars, which gives us comfort that the data are not inconsistent with the theoretical setup.

be available to construct both the *Net Foreign Factor Income* and *Exchange Rate Volatility* variables described above, as well as all the control variables detailed below, for that country in that year. We also require that the *Exchange Rate Volatility* variable not be subject to obvious sources of potential data error and therefore omit from the sample countries whose reported exchange rates exhibit very large discontinuous jumps up or down in a given year without explanation.¹⁷ This leaves us with a sample that contains 80 countries with up to 35 annual observations for each country. Because of incomplete data for some countries in some years, the total number of observations is 2,148 country-years.

Table 1 Goes Here

Table 1 reports the set of countries included in our sample, along with the standard 3-letter indicator employed for that country.

Figure 1 Goes Here

Figure 1 provides a first look at the data by plotting the time-series average of *Exchange Rate Volatility*_{it} for each country *i* versus the time-series average of *Net Foreign Factor Income*_{it} for country *i* (recall that foreign factor income for each country is normalized by dividing by that country's exports). The 3-letter symbol for each country appears next to its point on the plot. The downward-sloping line in Figure 1 plots the relationship one obtains from a simple linear regression of the time-series average of *Exchange Rate Volatility*_{it} for each country *i* on the time-series average of *Net Foreign*

¹⁷ Occasionally we observe discontinuous large jumps in the real effective exchange rate for certain countries, particularly developing countries. Sometimes we are unable to determine whether a particular large jump is due to factors such as a hyperinflation or sudden currency reform or whether it is due to erroneous data. We therefore exclude from our sample at date *t* any country whose real effective exchange rate either dropped by more than 2/3, or more than tripled, from one month to the next at any time during that year. We exclude the country Lesotho from the sample because its average *Net Foreign Factor Income* is +300 percent of exports, which is an extremely extreme outlier (the next highest average *Net Foreign Factor Income* in the sample is +23% (Pakistan) and the lowest is -45% (Equatorial Guinea)).

*Factor Income*_{it} for country *i*.¹⁸ This line's negative slope is a preliminary indicator that the data support the negative relationship between net foreign factor income and exchange rate volatility established theoretically in a previous section of this paper.

When studying Figure 1, it should be remembered that net foreign factor income consists of dividends and debt service payments and receipts, plus workers' remittances, and that workers' remittances can sometimes offset the debt service flows. For example, while it is true that many poor countries receive significant remittances from their citizens living overseas (e.g., Ecuadorians living in the USA sending money back to family members still living in Ecuador), it is also the case that many such countries have significant foreign debt servicing obligations relative to their limited conventional exports, which together results in a very large negative *Net Foreign Factor Income*.¹⁹ Such is the case for Ecuador (ECU), Zambia (ZMB) and the Ivory Coast (CIV), all of whose dots appears on the far left of Figure 1. Conversely, Saudi Arabia (SAU) possesses a large positive net foreign factor income because of its substantial investment income from foreign investments which more than offsets outbound remittances from guest workers. Switzerland (CHE) also receives a substantial amount of net income from abroad but has the value of its *Net Foreign Factor Income* variable reduced by its high value of conventional exports (watches, medical devices and so on) since 'income from abroad' is divided by the 'value of exports' to produce the *Net Foreign Factor Income* variable, as explained above.

Control Variables: As noted in the introduction to this paper, although our paper is the first study we know of to investigate the relationship between exchange rate volatility and foreign factor income, we are not the first to investigate the sources of exchange rate volatility more generally. For example, Hausmann, Panizza and Rigobon (2006)

¹⁸ This regression line is essentially unchanged if we omit from the regression Figure 1's apparent outliers such as Zambia (ZMB), Pakistan (PAK) and Equatorial Guinea (GNQ).

¹⁹ Ideally we would report and investigate workers' remittances separately from debt service flows, and use only foreign currency denominated cashflows, but doing this on a consistent basis is not possible: the sum of the two sources of factor flows does not always add up to net income from abroad as available in national income and product accounts because of different bases of calculation, and cashflows are not available by currency.

investigate various economic factors that impact exchange rate volatility, including GDP growth rates, GDP levels and economic trade openness, and find that developing countries typically experience greater exchange rate volatility than developed countries. Hau (2002) shows that, in a cross section of up to 48 countries, economic openness is significantly negatively related to exchange rate volatility, even when controlling for income.²⁰

In our empirical investigations below we therefore include the key variables from this other literature. In our investigations:

Trade Openness_{it} is the sum of country *i*'s imports and exports in year *t*, divided by its GDP in year *t*,

Relative Size_{it} is the natural log of: country *i*'s GDP in year *t* divided by the GDP of the U.S. in year *t*,

Real GDP Growth Rate_{it} is the annual percentage rate of change in country *i*'s real GDP from year *t-1* to year *t*,

Relative Income Per Capita_{it} is the natural log of: country *i*'s per capita income in year *t*, measured in US dollars, divided by U.S. per capita income in year *t*.

We construct these variables for each year and each country in our sample, with data taken from the World Bank's World Development Indicators (WDI).

²⁰ In the context of trade, openness can be regarded as the width of the channel through which trade flows can be adjusted after a supply/demand imbalance arises in the foreign exchange market. A relatively closed economy can expect little stabilizing effect on the exchange rate from substitution in trade because trade is small relative to the size of the economy. In an open economy, on the other hand, changes in import/export patterns can potentially mitigate the exchange rate effects of currency imbalances.

4. Empirical Results

In this section we test the connection between net foreign factor income and exchange rate volatility. In order to do this we run panel regressions of *Exchange Rate Volatility*, our dependent variable, on a set of independent variables including our *Net Foreign Factor Income* variable plus the control variables discussed above (*Trade Openness*, *Relative Size*, *Real GDP Growth Rate* and *Relative Income Per Capita*).

Table 2 Goes Here

Table 2 reports our core results. All panel regressions are based on the 80 countries listed in Table 1 over the 35-year period 1975-2009 which, after cleaning the sample as detailed above, yields 2148 complete observations. To account for potential correlations across both time and country dimensions in our panel (thus addressing potential autocorrelation and heteroskedasticity), we follow the suggestion of Petersen (2009) and cluster residuals by country and by time to obtain robust standard errors, the t-statistics from which are reported in square brackets under the parameter estimates in Table 2.²¹ One, two and three stars signify 90%, 95% and 99% significance from a two-tailed t-test.

Consider Column 1 of Table 2, which reports the results from regressing exchange rate volatility on two explanatory variables employed in previous studies: *Relative Size* and *Trade Openness*. As expected, we see that larger countries with more open economies tend to have less volatile exchange rates, as evidenced by the negative coefficients on the *Relative Size* and *Trade Openness* variables. This makes sense since, *ceteris paribus*, the larger is an economy the more easily it can withstand shocks and, as explained above, the more open an economy is the more easily it is able to absorb shocks through trade adjustments (quantities) rather than through exchange rate adjustments (prices).

²¹ For a description of the methodology see: Cameron et al. (2011) and Thompson (2009). Results produced using other methods are reported and discussed below for robustness.

Next consider Column 2 of Table 2. Here we add two more variables that have been studied previously: *Real GDP Growth* and *Relative Income Per Capita*. Again we expect negative signs on these variables since it has been argued that prosperous, growing economies can withstand shocks more easily; indeed this is what the data reveal. Interestingly, inclusion of the *Real GDP Growth* and *Relative Income Per Capita* variables drives *Relative Size* and *Trade Openness* to insignificance when considered individually.

Now consider Column 3 of Table 2. Here we add to the four previously studied explanatory variables our new variable: *Net Foreign Factor Income*, which as discussed above is formally defined as 'Net Income from Abroad (measured in \$US)' divided by 'Exports of Goods and Services (measured in \$US)' for the country and year in question. Section 2's theoretical discussion of the augmented Marshall-Lerner Condition suggests that the coefficient on our *Net Foreign Factor Income* variable should be negative. This is because a country with income from abroad, received in foreign currency, sees the domestic-currency value of this foreign income rise as the domestic currency depreciates, and this increased demand for the domestic currency mitigates the original downward shock thereby stabilizing the currency. Conversely, the effects of a currency-appreciating shock are partly offset by the fall in the domestic-currency value of the foreign-currency-denominated income from abroad, which works to reduce demand for the domestic currency and thus again stabilize the currency. The negative sign on the *Net Foreign Factor Income* coefficient in Column 3 of Table 2 is therefore consistent with our theoretical prediction.

Also note from Column 3 of Table 2 that our new variable, *Net Foreign Factor Income*, does not simply capture effects that are already known and captured by the other explanatory variables. In particular, by comparing coefficient estimates in Columns 2 of Table 2 with those in Columns 3 of Table 2, we see that estimated values and significance levels for the *Real GDP Growth*, *Relative Income Per Capita*, *Relative Size* and *Trade Openness* variables are essentially unchanged by adding our new *Net Foreign Factor*

Income variable. This reveals that our *Net Foreign Factor Income* variable is capturing a new effect over-and-above previously studied volatility-influencing factors.

Our core finding that countries with higher net foreign factor income tend to have more stable exchange rates is robust to a number of perturbations. For example, Column 4 of Table 2 omits the *Real GDP Growth* and *Relative Income Per Capita* variables to leave only *Relative Size* and *Trade Openness* along with *Net Foreign Factor Income*, and we still find a persistently significant ability of *Net Foreign Factor Income* to stabilize exchange rates. Column 5 of Table 2 has only *Net Foreign Factor Income* in the regression and again the core result is maintained.

Table 3 Goes Here

Table 3 reports results from three variations of the basic regression setup. Columns 1 and 2 in Table 3, entitled “Lagged RHS”, use explanatory variables that are lagged by one year. This is to ensure that Table 2’s results are not being driven by possible simultaneity between shocks and the right-hand-sided variables or possible reverse-causality (with volatility impacting foreign factor income instead of the reverse). We see from Columns 1 and 2 that the explanatory variables retain their significance and signs, thereby confirming the validity of Table 2’s findings. Columns 3 and 4 of Table 3 differ from the base case in that we use the log transform of *Exchange Rate Volatility* and of *Trade Openness* in order to investigate whether our results are driven by skewed distributions. Again the results hold, which suggests that our previous results were not driven by distributional skews. Lastly, Columns 5 and 6 of Table 3 use a smaller, but more homogeneous, sample which contains only countries for which we have complete data for at least 25 years. This results in a sample of 57 countries, but the total number of observations does not shrink as much. Again, results carry through thus confirming that our results are not being driven by a few small countries with incomplete data. In all cases in Table 3, higher net foreign factor income is associated with lower exchange rate volatility.

Table 4 Goes Here

Table 4 contains robustness checks. In Column 1 of Table 4, all variables are winsorized at the outer 2.5 percent of both tails, and in Column 2 all observations for which at least one variable falls into the outer 2.5 percent of the distribution is omitted. From these two columns we see that our core result (negative sign on *Net Foreign Factor Income*) still holds, which reveals that our findings are not being driven by a few extreme outliers. Column 3 of Table 4 repeats our core regression, reported in Column 3 of Table 2, except instead of clustering residuals in both the time and country dimensions, as in Table 2, in Column 3 of Table 4 we use a dummy variable for each time period to capture time fixed-effects. Note that the results of Table 4 Column 3 are almost identical to those in Table 2 Column 3, thereby reinforcing the robustness of our findings with respect to treatment of time effects.

In Column 4 of Table 4 the export number used to calculate the *Net Foreign Factor Income* variable is adjusted as follows: where available, the exports reported by WDI are replaced by exports computed using data from the Comtrade database provided by the United Nations Statistics Division.²² This robustness check is motivated by the observation that on occasion the WDI export number is somewhat smaller than exports reported by Comtrade²³ and by the recognition that an artificially small export number could artificially inflate the *Net Foreign Factor Income* measure, thus biasing results. From Column 4 of Table 4 we see that our results barely change from those originally reported in Table 2, however, which gives us further confidence in our original findings. Lastly, in Column 5 of Table 4, the *Net Foreign Factor Income* variable is produced by dividing Income From Abroad by GDP rather than dividing by exports. Again, our *Net Foreign Factor Income* measure remains significantly negative as theory predicts.

²² Comtrade-based exports are computed using the aggregate of all trade flows from the country in question to all trading partners. In general, flows reported by the importer are considered to be more accurate than export data. Only when for a given importer-exporter-tuple, the importer does not report as part of the Comtrade database, the exporter-reported flows are used.

²³ In general, the number reported by WDI should be larger because it measures all exports including services, while the Comtrade number only accounts for manufacturing goods.

Table 5 Goes Here

Table 5 contains results obtained by splitting the sample into subsamples. Columns 1 and 2 of Table 5 report results for rich and poor countries separately, where a country is defined as being “poor” in year t if its per capita income is less than 20 percent of USA per capita income in year t . Again we see that *Exchange Rate Volatility* is negatively related to *Net Foreign Factor Income* regardless of whether the country in question is rich or poor. Columns 3 and 4 of Table 5 split the sample into early and late periods, with Column 3 reporting results for the time period 1975-1992 and Column 4 reporting results for 1993-2009. In both cases the expected result still obtains: greater net income from abroad is associated with less volatile exchange rates.

5. Conclusions

In this paper we have investigated the relationship between exchange rate variability and net foreign factor income, which consists of a country’s net income from payments and receipts arising from prior investments and borrowing (e.g., dividends, payments received from investments in foreign bonds, payments made on outstanding debts, etc.) and from remittance payments to, and receipts from, citizens overseas. We have derived an augmented Marshall-Lerner Condition which reveals that positive foreign factor income should stabilize a country’s exchange rate while negative foreign factor income should destabilize a country’s exchange rate. We have tested this theoretical prediction using panel data from a wide cross section of countries over a 35-year period and have found strong empirical support for this channel, which has not been previously investigated in the literature. Furthermore, our finding that countries with greater foreign factor income, relative to exports, tend to have less volatile exchange rates is remarkably robust to a number of perturbations and the addition of other variables, such as trade openness and real income, which have been investigated in previous studies.

REFERENCES

- Alizadeh, S.; Brandt, M.W. & Diebold, F.X. (2002), 'Range-based estimation of stochastic volatility models', *The Journal of Finance* **57**(3), 1047-1091.
- Anderson, B.; Hammond, P.J. & Ramezani, C.A. (2010), 'Affine models of the joint dynamics of exchange rates and interest rates', *Journal of Financial and Quantitative Analysis* **45**(5), 1341-1365.
- Bacchetta, P. & van Wincoop, E. (2000), 'Does exchange rate stability increase trade and welfare? ', *American Economic Review* **90**(5), 1093-1109.
- Bleaney, Michael 'Openness and real exchange rate volatility: in search of an explanation,' *Open Economies Review*, vol. 19, no. 2 (April 2008), pp. 135-46
- Brandt, M.W. & Santa-Clara, P. (2002), 'Simulated likelihood estimation of diffusions with an application to exchange rate dynamics in incomplete markets', *Journal of Financial Economics* **63**(1), 161-210.
- Cameron, A.C.; Gelbach, J.B. & Miller, D.L. (2011), 'Robust Inference with Multi-Way Clustering', *Journal of Business and Economic Statistics*, 29 (2), pp.238-249.
- Clark, P.; Tamisira, N.; Wei, S.J.; Sadikov, A. & Zeng, L. (2004), 'Exchange rate volatility and trade flows – some new evidence', *International Monetary Fund*, May.
- Devereux, M.B., Lane, P.R. (2003), 'Understanding bilateral exchange rate volatility', *Journal of International Economics* **60**(1), 109-132
- Echenique, F. (2002), 'Comparative Statics by Adaptive Dynamics and the Correspondence Principle', *Econometrica* **70**(2), 833-844.
- Evans, M.D.D. (2002), 'FX trading and exchange rate dynamics', *The Journal of Finance* **57**(6), 2405-2447.
- Harvey, C.R. & Huang, R.D. (1991), 'Volatility in foreign currency futures markets', *Review of Financial Studies* **4**(3), 543-570.
- Hau, H. (2002), 'Real Exchange Rate Volatility and Economic Openness: Theory and Evidence', *Journal of Money, Credit and Banking* **34**(3), 611-630.
- Hausmann, R.; Panizza, U. & Rigobon, R. (2006), 'The long-run volatility puzzle of the real exchange rate', *Journal of International Money and Finance* **25**(1), 93-124.
- Hviding, K., Nowak, M. and Ricci, L. A. (2004), 'Can Higher Reserves Help Reduce Exchange Rate Volatility?' No 04/189, IMF Working Papers, International Monetary Fund

Levi, M.D. (2009), *International Finance*, 5th Edition, Routledge, London.

Li, T. & Muzere, M.L. (2010), 'Heterogeneity and volatility puzzles in international finance', *Journal of Financial and Quantitative Analysis* **45**(6), 1485-1516.

Petersen, M.A. (2009), 'Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches', *Review of Financial Studies* **22**(1), 435-480.

Sweeney, R.J. (2006), 'Means reversion in G-10 nominal exchange rates', *Journal of Financial and Quantitative Analysis* **41**(3), 685-708.

Thompson, S.B. (2006), 'Simple Formulas for Standard Errors that Cluster by Both Firm and Time', Technical report, Harvard University.

Table 1
List of Countries Investigated
(Organized Alphabetically by 3-Letter Country Indicator)

Armenia (ARM)	Spain (ESP)	Malaysia (MYS)
Antigua and Barbuda (ATG)	Finland (FIN)	Nigeria (NGA)
Australia (AUS)	Fiji (FJI)	Netherlands (NLD)
Austria (AUT)	France (FRA)	Norway (NOR)
Burundi (BDI)	Gabon (GAB)	New Zealand (NZL)
Belgium (BEL)	United Kingdom (GBR)	Pakistan (PAK)
Bulgaria (BGR)	Georgia (GEO)	Philippines (PHL)
Bahrain (BHR)	Gambia, The (GMB)	Papua New Guinea (PNG)
Bahamas, The (BHS)	Equatorial Guinea (GNQ)	Portugal (PRT)
Belize (BLZ)	Greece (GRC)	Paraguay (PRY)
Central African Republic (CAF)	Grenada (GRD)	Russian Federation (RUS)
Canada (CAN)	Guyana (GUY)	Saudi Arabia (SAU)
Switzerland (CHE)	Croatia (HRV)	Singapore (SGP)
Chile (CHL)	Hungary (HUN)	Solomon Islands (SLB)
China (CHN)	Ireland (IRL)	Slovak Republic (SVK)
Cote d'Ivoire (CIV)	Iran, Islamic Rep. (IRN)	Sweden (SWE)
Cameroon (CMR)	Iceland (ISL)	Togo (TGO)
Colombia (COL)	Israel (ISR)	Trinidad and Tobago (TTO)
Costa Rica (CRI)	Italy (ITA)	Tunisia (TUN)
Cyprus (CYP)	Japan (JPN)	Uruguay (URY)
Czech Republic (CZE)	St. Lucia (LCA)	United States (USA)
Germany (DEU)	Luxembourg (LUX)	St. Vincent & Grenadines (VCT)
Dominica (DMA)	Morocco (MAR)	Venezuela, RB (VEN)
Denmark (DNK)	Moldova (MDA)	Samoa (WSM)
Dominican Republic (DOM)	Macedonia, FYR (MKD)	South Africa (ZAF)
Algeria (DZA)	Malta (MLT)	Zambia (ZMB)
Ecuador (ECU)	Malawi (MWI)	

Table 2
Parameter Estimates [and t-statistics] from Panel Regressions of
Exchange Rate Volatility on Net Foreign Factor Income and Control Variables
(35 years, 80 countries, 2148 complete observations)

	(1)	(2)	(3)	(4)	(5)
Intercept	0.0576 [6.04] ***	0.0553 [5.73] ***	0.0534 [5.85] ***	0.0557 [6.12] ***	0.0609 [12.32] ***
Net Foreign Factor Income			-0.1013 [-4.35] ***	-0.0977 [-3.40] ***	-0.1260 [-3.64] ***
Real GDP Growth Rate		-0.0028 [-3.39] ***	-0.0029 [-4.15] ***		
Relative Size	-0.0069 [-3.78] ***	0.0010 [0.48]	0.0025 [1.29]	-0.0054 [-3.25] ***	
Relative Income Per Capita		-0.0174 [-3.47] ***	-0.0174 [-3.69] ***		
Trade Openness	-0.0322 [-3.86] ***	-0.0053 [-0.66]	-0.0012 [-0.15]	-0.0284 [-3.70] ***	
adj. R-squared	0.040	0.104	0.124	0.058	0.032

Table 3
Results from Robustness Checks:
Parameter Estimates [and t-statistics] from Panel Regressions of
Exchange Rate Volatility on Net Foreign Factor Income and Control Variables

	Lagged RHS		log Volatility		Homogeneous	
Intercept	0.0606 [13.07] ***	0.0562 [7.05] ***	-3.1069 [-46.57] ***	-3.4563 [-26.06] ***	0.0537 [9.65] ***	0.0580 [6.25] ***
Net Foreign Factor Income	-0.1270 [-3.22] ***	-0.0986 [-3.63] ***	-1.2023 [-3.26] ***	-0.7849 [-3.41] ***	-0.1705 [-3.30] ***	-0.1276 [-3.90] ***
Real GDP Growth Rate		-0.0021 [-2.26] **		-0.0204 [-3.03] ***		-0.0034 [-5.33] ***
Trade Openness		-0.0115 [-1.43]		-0.2269 [-2.38] **		-0.0025 [-0.27]
Relative Size		0.0012 [0.59]		0.0008 [0.03]		0.0028 [1.24]
Relative Income Per Capita		-0.0155 [-3.39] ***		-0.1936 [-4.69] ***		-0.0152 [-3.60] ***
adj. R-squared	0.033	0.114	0.038	0.226	0.053	0.123
# Years	35	35	35	35	35	35
# Countries	80	80	80	80	57	57
# Complete Observations	2164	2164	2148	2148	1717	1717

Table 4
Results from Additional Robustness Checks:
Parameter Estimates [and t-statistics] from Panel Regressions of
Exchange Rate Volatility on Net Foreign Factor Income and Control Variables

	Outliers Winsorized	Outliers Omitted	Time Effects	Alternate Exports	GDP Normalized
Intercept	0.0541 [7.41] ***	0.0516 [8.69] ***	0.0817 [1.92] *	0.0534 [5.75] ***	0.0585 [6.49] ***
Net Foreign Factor Income	-0.0882 [-3.05] ***	-0.0647 [-2.32] **	-0.1014 [-4.19] ***	-0.0950 [-4.00] ***	-0.2228 [-3.26] ***
Real GDP Growth Rate	-0.0026 [-4.90] ***	-0.0015 [-2.77] ***	-0.0027 [-3.52] ***	-0.0029 [-3.93] ***	-0.0031 [-4.57] ***
Relative Size	0.0015 [0.88]	0.0008 [0.55]	0.0032 [1.63]	0.0022 [1.12]	0.0021 [1.02]
Relative Income Per Capita	-0.0140 [-4.18] ***	-0.0095 [-4.30] ***	-0.0190 [-5.31] ***	-0.0174 [-3.67] ***	-0.0175 [-3.65] ***
Trade Openness	-0.0073 [-0.94]	-0.0106 [-1.49]	0.0040 [0.54]	-0.0023 [-0.29]	-0.0091 [-1.19]
adj. R-squared	0.173	0.132	0.168	0.118	0.120
# Years	35	35	35	35	35
# Countries	80	75	80	80	80
# Complete Observations	2148	1641	2148	2148	2148

Table 5
Results from Sub-Sample Robustness Checks:
Parameter Estimates [and t-statistics] from Panel Regressions of
Exchange Rate Volatility_{it} on *Net Foreign Factor Income_{it}* and Control Variables

	Sub-Sample Split by Income		Sub-Sample Split by Time Period	
	(rich)	(poor)	(early)	(late)
Intercept	0.0529 [7.46] ***	0.0344 [1.16]	0.0619 [5.30] ***	0.0412 [4.04] ***
Net Foreign Factor Income	-0.0738 [-2.67] ***	-0.1152 [-3.65] ***	-0.1104 [-3.55] ***	-0.0835 [-2.32] **
Real GDP Growth Rate	-0.0022 [-1.90] *	-0.0032 [-3.83] ***	-0.0027 [-5.18] ***	-0.0029 [-2.39] **
Relative Size	-0.0027 [-0.92]	0.0049 [2.42] **	-0.0008 [-0.24]	0.0043 [2.22] **
Relative Income Per Capita	0.0004 [0.04]	-0.0244 [-3.25] ***	-0.0113 [-2.11] **	-0.0222 [-3.69] ***
Trade Openness	-0.0147 [-1.87] *	0.0139 [0.88]	-0.0137 [-0.68]	0.0072 [1.16]
adj. R-squared	0.038	0.095	0.104	0.152
# Years	35	35	18	17
# Countries	38	50	69	80
# Complete Observations	948	1200	962	1185

Figure 1

Plot of the time-series average of Exchange Rate Volatility_{it} for each country i versus the time-series average of Net Foreign Factor Income_{it} for country i.

Exchange Rate Volatility

