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Real exchange rate volatility, terms-of-trade shocks, and financial integration in primary-commodity exporting economies

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HIGHLIGHTS

- We utilize a panel of 53 primary-commodity exporting countries for 1980–2007.
- Let international financial integration be IFI, and let terms-of-trade be TOT.
- We focus on the interactive role of IFI in reducing real exchange rate volatility.
- Greater IFI reduces the impact of TOT shocks on real exchange rate volatility.
- This reduction is larger when we measure IFI by foreign direct investment.

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ABSTRACT

Using a panel of 53 primary-commodity exporting countries, we show that greater international financial integration reduces the impact of terms-of-trade shocks on real exchange rate volatility. This reduction is larger when we define financial integration as foreign direct investment.

1. Introduction

This study examines the effects of terms-of-trade shocks on real exchange volatility for primary-commodity exporting countries that have become more financially integrated with the rest of the world. In particular, we want to see whether greater financial integration exacerbates or mitigates the effects of terms-of-trade shocks on real exchange rate volatility. Our study contributes to the literature in three noteworthy aspects. First, we differ from previous studies which focus on the level effect of greater financial integration on real exchange rate volatility and overlook the interactive role of financial integration (see, for instance, Calderón and Kubota, 2009, and Hviding et al., 2004). Second, our sample includes small primary-commodity exporting countries in which one or two commodities dominate the exports.[1] As such, our examination focuses on the terms-of-trade shocks that are both dominant and exogenous. Third, we take note of the notion that the impact of greater financial integration on real exchange rate volatility may depend, among other factors, on the composition of foreign assets and liabilities. As such, we consider a long-term oriented (foreign direct investment) measure of financial integration and two short-term oriented (portfolio debt and portfolio equity investment) measures of financial integration for our analysis.

We utilize the data from 53 small primary-commodity exporting countries for the period 1980–2007. Our methodology focuses on the long-run relationship by taking five-year non-overlapping windows. We employ the Generalized Method of Moments (GMM) to estimate real exchange rate volatility based on a dynamic panel

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[1] The list of primary-commodity countries is taken from Cashin et al. (2004).

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data model with several fundamental volatility measures and structural determinants. Our findings reveal that the terms-of-trade effects on real exchange rate volatility are reduced as the economy becomes more financially integrated. Such evidence is in line with the recent theoretical predictions of open economy macroeconomics (Buch et al., 2005; Sutherland, 1996).

The format of this study is as follows: Section 2 presents a brief literature review and then describes the methodology and data. Section 3 discusses the empirical results. Section 4 concludes this study.

2. Literature review, methodology, and data

Hausmann et al. (2006) show that real exchange rates are three times more volatile in developing countries than in developed countries. One source, often cited in the literature, is the terms-of-trade which displays greater volatility due to the fact that primary commodities (whose prices are subject to wide fluctuations in world markets) constitute a significant component of the exports in developing countries (Cashin et al., 2004; De Gregorio and Wolf, 1994).

Recent empirical literature has also documented an increasing financial integration of developing countries with global financial markets. Reasons for this trend include easing restrictions on capital movements and the growing stock of foreign assets and liabilities that have been accumulated through capital flows (Kose et al., 2009). Greater financial integration may exacerbate or mitigate the impact of shocks to the economy. On the one hand, foreign capital flows (particularly, short-term) display significant pro-cyclical behavior, leading to the argument that greater financial integration may actually amplify the impact of shocks to the economy. On the other hand, greater financial integration may mitigate the impact of shocks by helping a country stabilize domestic consumption and investment spending through international risk-sharing and inter-temporal substitutions.

With this in mind, we ask whether greater financial integration with the rest of the world has exacerbated or mitigated the effects of terms-of-trade shocks on real exchange rate volatility in primary-commodity exporting countries.[2] In answering this question, we focus on the following real exchange rate volatility equation:

$$\text{Vol}\,(\text{REER}_{it}) = \Phi X_{it} + \Gamma Z_{it} + \gamma\left(\text{TOT}_{it}^{\text{shock}} * \text{IFI}_{it}\right) + \mu_i + \varphi_t + \varepsilon_{it} \quad (1)$$

where $\text{Vol}\,(\text{REER}_{it})$ is the real effective exchange rate volatility calculated as the annual standard deviation over five-year non-overlapping periods to filter out business cycle fluctuations (Aguiar and Gopinath, 2007); X_{it} is a vector of fundamental volatility measures including terms-of-trade shocks, real output growth shocks, government spending shocks, and monetary shocks[3]; Z_{it} is a vector of control variables including consumer price inflation, real output per capita gap, degree of trade openness, level of international financial integration, degree of financial development, and degree of flexibility in the exchange rate regime; $\text{TOT}_{it}^{\text{shock}}$ is the terms-of-trade shock and IFI_{it} is a measure of international financial integration; μ_i is the country-specific effect while φ_t is the period-specific effect; and ε_{it} is the error term.

Our sample includes the data from 53 small primary-commodity exporting countries for the period 1980–2007.[4] The Appendix lists the countries and provides more detailed information on the variables. In estimating Eq. (1), we utilize the Generalized Method of Moments (GMM) dynamic panel data model developed by Arellano and Bond (1991) in order to address the issue of joint endogeneity of explanatory variables with the error term and the potential biases caused by country-specific effects and omitted variables. Crucial to the purpose of this study is the sign of γ in Eq. (1). For instance, $\gamma < 0$ indicates that greater financial integration mitigates the effects of terms-of-trade shocks on real exchange rate volatility.

For a comprehensive examination, we utilize five different measures of international financial integration. The first definition includes the total stocks of gross foreign liabilities and foreign assets (calculated as the sum of foreign direct investment, portfolio debt investment, portfolio equity and other investment, and official reserves).[5] The estimates of Eq. (1) with this definition are reported in column 1 of Table 1. The second definition includes only foreign direct investment (as the long-term oriented financial integration measure). The estimates of Eq. (1) with this definition are reported in column 2. The third, fourth, and fifth definitions include, respectively, total portfolio debt plus equity investment, portfolio debt investment, and portfolio equity investment (as the short-term oriented financial integration measures).[6] The estimates of Eq. (1) with these definitions are reported, respectively, in columns 3, 4, and 5 of Table 1.

3. Main results

The estimates of Eq. (1) in columns 1–5 (with alternative measures of financial integration) pass a series of diagnostic tests including the Sargan test and the test for a second order serial correlation. Further, these estimates are robust to the use of 3-year (instead of 5-year) averages of the variables and to alterations in determinants and sample coverage.[7]

Consistent with other studies including Calderón and Kubota (2009) and Hau (2002), the parameter estimates on different measures of fundamental volatile and other determinants in columns 1–5 have theoretically correct signs. According to the estimates in column 1, the parameter estimates on the level of financial integration is positive, suggesting that higher stocks of foreign assets and liabilities increase real exchange rate volatility. The parameter estimates on the interactive term are negative, suggesting that financial integration significantly reduces the impact of terms-of-trade fluctuations on real exchange rate volatility. For instance, a 10% increase in the stocks of total foreign assets and liabilities will increase real exchange rate volatility by 1.08% but reduce the impact of the terms-of-trade shocks on real exchange rate volatility by 2.89%.

A closer look at the results in columns 2 and 3 indicate that financial integration defined as foreign direct investment has no effect on real exchange rate volatility but dampens the effect of terms-of-trade shocks on real exchange rate volatility more substantially than financial integration defined as total portfolio investment (i.e., the parameter estimate on the interactive term in column 2 is −1.135 while that in column 3 is −0.268). This finding is consistent with the view that financial integration oriented toward long-term capital flows could result in lower fluctuations

[2] Aizenman and Riera-Crichton (2008) show that greater stocks of foreign exchange reserves reduce the impact of terms-of-trade on annual real exchange rate changes for emerging market economies.

[3] The construction of these volatility measures is similar to that of real exchange rate volatility.

[4] The sample period ends with 2007 due to the availability of the international financial integration measures adopted from Lane and Milesi-Ferretti (2007).

[5] As discussed by Kose et al. (2009), the use of gross stocks is preferable to annual capital flows, as the latter tend to be more volatile and prone to measurement error. In addition, the use of gross stocks, compared to net stocks, provides a better measure of integration and efficient risk-sharing as it captures two-way interactions between economies with different risk portfolios.

[6] Unlike foreign direct investment, portfolio debt and equity investment display more instability and vulnerability to financial crises.

[7] Results are available from the author upon written request.

Table 1
2-step GMM estimation. Dependent variable: REER volatility.

	(1)	(2)	(3)	(4)	(5)
REER volatility lagged	−0.240(0.043)***	−0.204(0.045)***	−0.241(0.040)***	−0.226(0.043)***	−0.245(0.055)***
Fundamental volatility					
Terms-of-trade (TOT) shock	0.474(0.107)***	0.135(0.054)**	0.347(0.102)***	0.331(0.109)***	0.127(0.069)*
Real output growth shock	0.555(0.296)*	0.582(0.327)*	0.598(0.317)*	0.546(0.301)*	0.592(0.347)*
Government consumption shock	0.051(0.056)	0.097(0.048)**	0.056(0.048)	0.065(0.049)	0.084(0.056)
Private credit shock	0.170(0.035)***	0.175(0.038)***	0.167(0.037)***	0.167(0.037)***	0.172(0.048)***
Other controls					
Consumer prices inflation	0.148(0.091)*	0.149(0.098)	0.132(0.086)	0.124(0.090)	0.170(0.093)*
Trade openness	−0.148(0.038)***	−0.191(0.040)***	−0.146(0.037)***	−0.154(0.037)***	−0.161(0.038)***
Exchange rate regime flexibility	0.011(0.023)	0.022(0.030)	0.017(0.021)	0.020(0.019)	0.051(0.027)*
Level of private credit	0.104(0.040)***	0.155(0.037)***	0.108(0.039)***	0.133(0.041)***	0.083(0.051)*
GDP per capita gap	0.734(0.402)*	1.004(0.518)*	0.615(0.395)	0.782(0.441)*	−0.049(0.559)
Financial integration					
International financial integration (IFI)	0.108(0.037)***				
IFI ∗ TOT shocks	−0.289(0.085)***				
Foreign direct investment integration (FDII)		0.034(0.045)			
FDII ∗ TOT Shock		−1.135(0.364)***			
Total portfolio integration (TPI)			0.096(0.040)**		
TPI ∗ TOT shock			−0.268(0.099)***		
Total portfolio-debt integration (TPDI)				0.097(0.045)**	
TPDI ∗ TOT shock				−0.256(0.103)***	
Total portfolio-equity integration (TPEI)					0.232(0.206)
TPEI ∗ TOT shock					−1.534(0.956)
Countries/observations:	53/265	53/265	53/265	53/265	53/265
Specification tests (*p-values*)					
(a) Sargan test	0.231	0.234	0.233	0.232	0.145
(b) Serial correlation—2nd order	0.861	0.465	0.805	0.685	0.730

Notes: Standard errors are in parenthesis. Time dummies are included in all regressions.
* Mean significant at 10%.
** Mean significant at 5%.
*** Mean significant at 1%.

in non-tradable goods prices and thus better mitigate the impact of terms-of-trade shocks on real exchange rate volatility. To better understand, let us define real exchange rate as the relative price of non-tradable goods to the price of tradable goods. Since primary-commodity exporting countries are price-takers in foreign trade, the differential effects of alternative forms of financial integration on real exchange rate volatility should then come from their impact on the non-tradable goods prices. Ouyang and Rajan (2013) decompose real exchange rate volatility into two components of external prices (deviations from purchasing power parity) and relative prices of non-tradable and tradable goods (internal prices). They find that the latter component explains a larger portion of volatility in the real exchange rate, particularly for primary-commodity exporting countries.

With this in mind, our findings suggest that primary-commodity exporting countries should allow the type of financial integration that stabilizes the price of non-tradable goods. This makes financial integration through foreign direct investment a better candidate. Besides its effect on improving productivity through technology transfers and managerial expertise, foreign direct investment is seen to ease financing constraints, especially for low income countries (Harrison et al., 2004). Further, Blalock and Gertler (2005) find that foreign direct investment better mitigates the adverse effects of financial crises by helping firms maintain continuous access to credit through their parent companies. According to UNCTAD (2004), developing countries received about 55% of total foreign direct investment during 1990–2002. For this same period, about two thirds of foreign direct investment worldwide went into services such as telecommunications, banking, transportation, and electricity provision.

The estimation results in column 4 further indicate that financial integration defined as portfolio debt investment positively affects real exchange rate volatility but reduces the impact of terms-of-trade shocks on real exchange rate volatility; these results are very similar to those in column 3. However, the estimation results in column 5 indicate that financial integration defined as portfolio equity investment has no level effect and no interactive effect on real exchange rate volatility. This is in line with the notion that the impact of greater financial integration on real exchange rate volatility may depend, among other factors, on the composition of foreign assets and liabilities.

4. Conclusions

Utilizing the data from 53 primary-commodity exporting countries for the period 1980–2007, we show that greater financial integration mitigates the effects of terms-of-trade shocks on real exchange rate volatility. Our findings also indicate that long-term oriented measures of financial integration (such as foreign direct investment) are more effective than short-term oriented measures (such as total portfolio debt and equity investment) in reducing the effects of such shocks. This may be attributed to the effectiveness of foreign direct investment in stabilizing the price of non-tradable goods. Further research is needed to better understand the nature and dynamics of the relationship between international financial integration (especially, foreign direct investment) and real exchange rate volatility.

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Table A.1
List of countries included in the sample.

Algeria, Argentina, Bangladesh, Bolivia, Brazil, Burundi, Cameroon, Central African Republic, Colombia, Costa Rica, Côte d'Ivoire, Dominica, Dominican Republic, Ecuador, Ethiopia, Gabon, Ghana, Guatemala, Honduras, India, Indonesia, Kenya, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Morocco, Mozambique, Niger, Nigeria, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Saudi Arabia, Senegal, South Africa, Sri Lanka, St. Vincent and the Grenadines, Sudan, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, Uruguay, Zambia, Zimbabwe

Table A.2
List and definitions of variables.

Variable name	Definition and construction	Source
Real effective exchange rate (REER) volatility	Annual standard deviation of log REER. REER is a trade-weighted-average of nominal effective exchange rate divided by CPI price deflator	International Monetary Fund, IFS; and author's calculations
Terms-of-trade shock	Annual standard deviation of log net-barter-terms-of-trade	World Bank, WDI
GDP growth shock	Annual standard deviation of differenced log real GDP	World Bank, WDI
Government consumption shock	Annual standard deviation of log general government final consumption (% of GDP)	World Bank, WDI
Private credit shock	Annual standard deviation of log total domestic credit to private sector (% of GDP)	World Bank, WDI
Inflation rate	First difference of log CPI	World Bank, WDI
Trade openness	Log of exports plus imports (% of GDP)	World Bank, WDI
International financial integration (IFI)	Log total foreign assets plus total foreign liabilities (% of GDP)	Lane and Milesi-Ferretti (2007)
GDP per capita gap	Country GDP per capita minus US GDP per capita, both in PPP terms (constant 2005 international $) and in log	Author's calculation using World Bank, WDI
Exchange rate flexibility	A categorical measure of exchange rate regime flexibility; 1 = fix, 2 = peg, 3 = managed float, 4 = float	Reinhart and Rogoff (2004)
Total foreign direct investment	Log total foreign direct investment, assets plus liabilities (% of GDP)	Lane and Milesi-Ferretti (2007)
Total portfolio equity investment	Log total portfolio equity foreign assets plus liabilities (% of GDP)	Lane and Milesi-Ferretti (2007)
Total portfolio debt investment	Log total portfolio debt and other debt investment foreign assets and liabilities (% of GDP)	Lane and Milesi-Ferretti (2007)
Total portfolio investment	Log total portfolio equity investment plus total portfolio debt investment (% of GDP)	Author's calculation using Lane and Milesi-Ferretti (2007)

Appendix

See Tables A.1 and A.2.

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