

Current Issues

IN ECONOMICS AND FINANCE

www.newyorkfed.org/research/current_issues

Coping with Terms-of-Trade Shocks in Developing Countries

Christian Broda and Cédric Tille

Sharp swings in a developing country's terms of trade—the price of its exports relative to the price of its imports—can seriously disrupt output growth. An analysis of the effects of a decline in export prices in seventy-five developing economies suggests that countries with a flexible exchange rate will experience a much milder contraction in output than their counterparts with fixed exchange rate regimes.

Developing economies typically face large swings in the price of the goods they export. Such fluctuations are unwelcome because they can contribute to increased volatility in the growth of output (GDP). Indeed, several studies have concluded that changes in the terms of trade—the price of exports relative to the price of imports—can account for half of the output volatility in developing countries.¹

In this edition of *Current Issues*, we examine how the exchange rate regime affects the ability of developing countries to absorb fluctuations in their terms of trade. Economic theory offers a clear and widely accepted interpretation of the role played by the exchange rate regime. In a country with a flexible exchange rate, fluctuations in the terms of trade will be offset by movements in the exchange rate, eliminating much of the impact on economic activity. By contrast, a country with a fixed exchange rate will experience substantial swings in output.²

To test this interpretation, we observe the output effects of a 10 percent decline in export prices in seventy-five developing countries with differing exchange rate regimes. We find that two years after the price decline, real GDP is

almost unaffected in countries with a flexible exchange rate, while it drops by about 2 percent in countries with a fixed exchange rate. These results provide strong support for the theory that a flexible exchange rate can help to insulate an economy against fluctuations in export and import prices.

In a separate demonstration of the importance of the exchange rate regime, we narrow our focus to two countries with fixed rate regimes, Ecuador and Argentina, to show how forcefully changes in the terms of trade will drive economic activity when the buffer of a flexible exchange rate is absent. Ecuador benefited from higher export prices after adopting the dollar as its currency in 2000, while Argentina faced sharp falls in export prices during 1998 and 1999. Our calculations indicate that the contrary movements in the terms of trade experienced by these countries contributed heavily to divergent output performances.

Why Do the Terms of Trade Matter So Much?

To understand how export and import prices affect a country's terms of trade, consider a simple example in which a country exports wheat and imports oil. Increases in the price of oil represent a worsening of the terms of trade

because the country will pay more for the goods it imports. Conversely, increases in the price of wheat boost the country's export earnings and represent an improvement in its terms of trade.

The terms of trade have an especially marked impact on the economies of developing countries. One recent study (Baxter and Kouparitsas 2000) suggests that terms-of-trade fluctuations are twice as large in developing countries as in developed countries. The authors attribute this pattern to the heavy reliance of developing countries on commodity exports, whose prices are more volatile than those of manufactured goods. Moreover, because developing countries generally have a high degree of openness to foreign trade, these sharp swings in the terms of trade affect a large share of their economies.

Developing countries are also very exposed to terms-of-trade fluctuations because they have little, if any, leverage over their export prices (Broda 2003). World markets dictate the price of the goods they export. By contrast, developed countries and oil exporters can exert a substantial influence on export prices. Building on the fact that terms-of-trade shifts in developing countries are largely exogenous—that is, determined by forces outside the countries' control—Mendoza (1995) and Kose (2002) find that terms-of-trade movements can account for roughly half of the output volatility in these countries.³

Coping with Terms-of-Trade Volatility: The Role of the Exchange Rate

Economic theory suggests that the effectiveness with which countries cope with changes in their terms of trade—terms-of-trade shocks—depends primarily on the nature of their exchange rate regime. Under a fixed exchange rate system, the value of the domestic currency is pegged to the value of another currency or basket of currencies. Under a flexible exchange rate regime, by contrast, the value of the domestic currency is allowed to shift freely in response to supply and demand conditions in the foreign exchange market. Theory predicts that countries with flexible exchange rate regimes will be better able to adjust to terms-of-trade shocks.

To understand the logic behind the theory, consider the consequences of a fall in the price of a country's exports under both types of regimes. At the outset, the worsening of the terms of trade will reduce the income of the country's exporters, leading to a decline in activity and employment in the export industries.⁴ Since exporters are taking in less foreign currency—say, dollars—they will bring fewer dollars

to the foreign exchange market. As dollars become scarce, fewer market participants will want to sell dollars to buy the domestic currency—pesos in this example—and as a result, the peso will weaken.

If the authorities in the country follow a fixed exchange rate policy, they will be required to intervene in the foreign exchange market to keep the value of the two currencies in line. Thus, they will sustain the value of the peso by purchasing pesos for dollars. This move will in turn drain pesos out of the money market, reducing the amount of money and credit available for business investment and expansion. Because the authorities' actions are equivalent in their effects to a tightening of monetary policy, this response to the decline in export prices can lead to a costly contraction in output.

By contrast, if the authorities follow a flexible exchange rate policy, they will refrain from intervening in the foreign exchange market and will permit the currency to depreciate. This depreciation makes exports more competitive in world markets and thereby increases demand. Rising demand then stimulates activity in the export industries, cushioning the adverse impact of the terms-of-trade shock on output.⁵

In sum, theory predicts that a country with a fixed exchange rate regime will adjust to a terms-of-trade shock through a contraction in output, while a country with a flexible exchange rate will adjust through a currency depreciation that significantly offsets the shock's negative effects on output. To be sure, it does not necessarily follow that a flexible exchange rate is unambiguously the best choice for a developing country.⁶ Nevertheless, theory makes a compelling case that a flexible exchange rate can function as a kind of automatic stabilizer, absorbing by means of its own movements the fluctuations in the terms of trade.

The Empirical Evidence: Is the Theory Right?

We test the theoretical prediction that a flexible exchange rate is a superior tool for coping with terms-of-trade shocks by looking at the experience of developing countries with different exchange rate regimes (see Broda [2003]). Our sample consists of seventy-five developing countries in Africa, Latin America, Asia, and Eastern Europe, tracked from 1973 to 1998.

We classify the exchange rate regime of each country as either fixed or flexible, but we take into account changes through time. We do not use the regime classifications provided by the International Monetary Fund (IMF 1997), because they are based on the publicly stated commitment of the authorities in each country and may not represent the

countries' actual policies.⁷ Rather, we adopt the classifications used in Ghosh et al. (1997), which adjust the IMF classifications to reflect the observed behavior of the various countries. This source shows that developing countries have gradually moved toward more flexible exchange rate regimes since the early 1970s (Table 1).

Using this breakdown of countries by exchange rate regime, we assess the effects of a worsening in the terms of trade on each country's nominal exchange rate, real exchange rate,⁸ consumer prices, and real GDP. We consider a permanent 10 percent deterioration in the terms of trade⁹ and contrast the effects under a flexible exchange rate with those under a fixed exchange rate. A more detailed explanation of the methodology is provided in the box.

Chart 1 tracks the response of the four variables in countries with a flexible exchange rate (blue line) and countries with a fixed exchange rate (green line) following the worsening in the terms of trade at year 0. The responses are computed in terms of percentage changes from the initial situation. For example, a value of -1 indicates that the variable in question is 1 percent below the level that it would have reached had the terms of trade remained unchanged.

As expected, the worsening of the terms of trade leads to a substantial depreciation of the domestic currency—7 percent after one year—under a flexible exchange rate but has virtually no effect under a fixed exchange rate (Chart 1, top panel).¹⁰ Although the shock leads to a contraction in GDP under a flexible exchange rate (second panel from the top), the decrease is relatively modest—0.2 percent after two years—because the depreciation of the currency sustains the competitiveness of exporters. Under a fixed exchange rate, however, the effect on output is sharply different: here, we observe a substantial contraction in GDP that peaks at nearly 2 percent two years after the shock. These results bear out the prediction that a flexible exchange rate will soften the effects of terms-of-trade shocks relative to what the effects would have been under a fixed exchange rate.

Table 1
**Evolution of Exchange Rate Regimes
in Developing Countries**

	Number of Countries			
	1973	1980	1990	1998
Flexible	7	19	42	53
Fixed	63	53	31	22
Total	70	72	73	75

Source: Broda (2003).

The impact of the terms-of-trade shock on consumer prices also differs across exchange rate regimes (third panel from the top). Under a flexible exchange rate, the currency depreciation feeds into higher prices for imported goods and leads to an increase in consumer prices of 1.7 percent after one year. By contrast, the contraction in economic activity under a fixed exchange rate translates into lower wages and

Empirical Methodology

To test the effects of an export price decline under fixed and flexible exchange rate regimes, we use a vector autoregression (VAR) technique representing the dynamic paths of real GDP, the real exchange rate, consumer prices, and the terms of trade. The system can be represented as

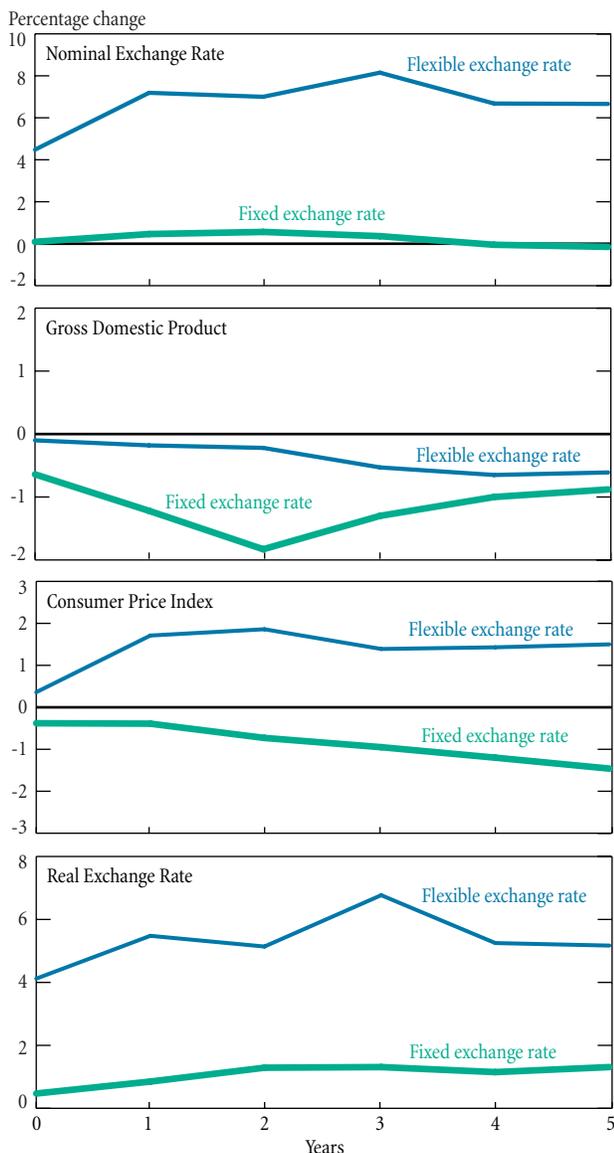
$$(1) \quad A*Y(t) = B*Y(t-1) + C*Y(t-2) + D*Y(t-3) + F*Y(t-4) + e(t),$$

where A to F are 4×4 matrices of coefficients and Y is a vector of the four endogenous variables. The system is estimated using the assumption of exogenous terms of trade. Our analysis gives the response of the variables to an exogenous decline in the terms of trade. We control for a series of factors (not included in the equation above) that can shape the response to terms-of-trade changes, such as the degree of openness, financial development, access to international capital markets, and fiscal policy. For a complete description of the empirical methodology, see Broda (2003).

The VAR methodology also allows us to assess the extent to which fluctuations in economic variables are driven by terms-of-trade movements. We do so by combining the volatility of the movements and the effect of the shocks on a given variable at a given horizon. This can be computed by using standard variance decomposition techniques on the VAR described above.

We offer one caveat concerning our method: our calculations assume that the choice of exchange rate regime is not systematically correlated with other characteristics of the economy. Two examples should illustrate the importance of this assumption. If countries that have relatively flexible labor markets adopt a flexible exchange rate, we may wrongly attribute the good performance stemming from their efficient labor markets to their flexible exchange rate. By contrast, if countries with relatively rigid labor markets adopt flexible regimes, we may underestimate the benefits of a flexible exchange rate. While both cases are possible, the current empirical literature on exchange rate regimes has not uncovered any systematic relationship between exchange rate regimes and structural characteristics of the economy.

Chart 1
Effects of a 10 Percent Worsening of the Terms of Trade



Source: Authors' calculations.

Note: In the top and bottom panels of the chart, a depreciation of the domestic currency is plotted as a rise.

prices, with the consumer price index falling 0.4 percent after one year. Although the higher prices under a flexible exchange rate cushion the impact of the depreciation on the real exchange rate, the offset is only partial and the country experiences a real depreciation of 5.5 percent after one year (bottom panel). The contraction in prices under a fixed exchange rate also leads to a real depreciation, although the magnitude—0.9 percent after one year—is much smaller.

Table 2
Share of the Variance in Real GDP and the Real Exchange Rate Driven by Terms-of-Trade Shocks

Exchange Rate Regime	Real GDP		Real Exchange Rate	
	Short-Run	Long-Run	Short-Run	Long-Run
Flexible	2.4	9.6	28.6	31.2
Fixed	21.3	30.0	4.5	12.9

Source: Broda (2003).

Note: Short-run denotes a horizon of two years, long-run a horizon of ten years.

In addition to showing that the response of the economy to terms-of-trade shocks depends on the exchange rate regime, our analysis provides evidence that these shocks are a substantial source of economic fluctuations in developing countries. Using our framework, we compute the share of actual volatility in a variable, such as GDP growth, that can be traced back to volatility in the terms of trade (see the box for details). We undertake this exercise for real GDP growth, the real exchange rate, and consumer prices, at both short (two-year) and long (ten-year) horizons.

Under a flexible exchange rate, terms-of-trade shocks play little role in driving GDP volatility but account for nearly a third of the real exchange rate volatility (Table 2, first row). By contrast, under a fixed exchange rate, these shocks are not an important source of real exchange rate volatility but explain between 20 and 30 percent of GDP volatility (second row). These results further underscore how the adjustment to shocks occurs through the exchange rate under a flexible exchange rate and through real activity under a fixed exchange rate.

How Output Effects Are Magnified in Fixed Regimes: The Case of Ecuador and Argentina

The recent experience of Ecuador and Argentina shows the crucial role of terms-of-trade shocks in driving economic activity once the exchange rate is prevented from cushioning the shocks' impact on GDP growth. Until December 2001, Argentina was under a currency board regime in which the value of its currency was rigorously pegged one-for-one to the U.S. dollar. Similarly, Ecuador has been using the U.S. dollar as its currency since early 2000.

Although both countries have operated under fixed exchange rate regimes, their growth performances in recent years have diverged dramatically. The Ecuadorian economy has experienced robust growth since it adopted the U.S. dollar, with GDP expanding by 3.7 percent each year on average

between 2000 and 2002 (Chart 2, top panel). By contrast, the Argentinean economy contracted in the three years before the collapse of the currency board, with GDP down 2.5 percent each year on average between 1999 and 2001 (Chart 2, bottom panel).¹¹

We might infer from these contrasting experiences that the exchange rate regime has no implication for growth, since one economy contracted and the other expanded under a fixed rate system. However, a closer look at the actual evolution of the terms of trade in Ecuador and Argentina, combined with our findings from the previous section, suggests that the fixed exchange rate played an important role in the growth performance of these countries.

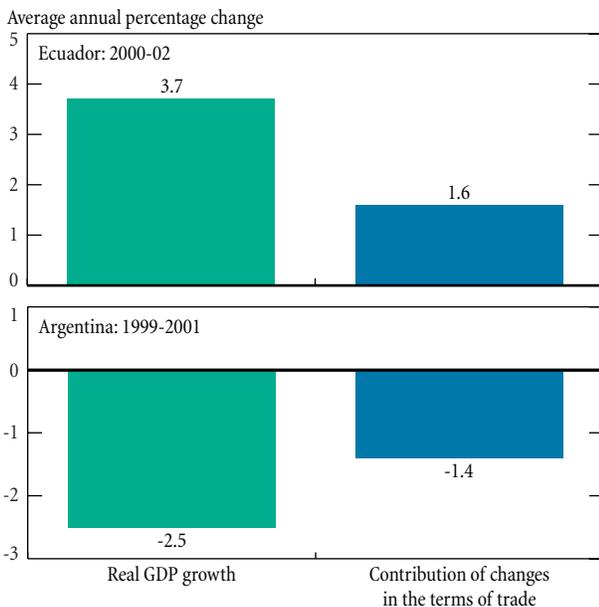
During the years in question, Ecuador and Argentina experienced diametrically different movements in their terms of trade (Table 3). In Ecuador, a surge in oil prices led to an 18.0 percent improvement in the terms of trade in 2000. Although oil prices subsequently dropped, the terms of trade did not decline as abruptly as oil prices because the prices of other exports, such as bananas, performed well.¹² By contrast, Argentina saw its terms of trade worsen by nearly 6 percent on average in 1998 and 1999. The deterioration reflected widespread weaknesses in the prices of several exports, such as edible oils, wheat, corn, and aluminum.¹³

Such movements in the terms of trade can affect a country's output growth over a period of several years, as Chart 2 suggests. The ongoing impact of terms-of-trade changes implies that a country's growth performance in a given year is driven by current and past changes. Thus, although the initial fall in Argentina's terms of trade was mostly offset in the latter part of the period under study (with a 10.2 percent rise in 2000), it still had a significant impact on growth.

To assess the extent to which terms-of-trade movements account for the growth performances of Ecuador and Argentina, we use our earlier statistical results (presented in Chart 1) for countries with fixed exchange rate regimes, together with the actual terms-of-trade changes experienced by Argentina and Ecuador. Specifically, we calculate what Ecuadorian GDP growth would have been if the only shocks affecting the economy had been the terms-of-trade movements starting in 2000.¹⁴ We undertake a similar exercise for Argentina for the 1999-2001 period.¹⁵ Comparing the GDP growth computed by our model with the actual GDP growth of these countries enables us to quantify the contribution of terms-of-trade shocks to the countries' growth performances.¹⁶

Using the dynamic responses to terms-of-trade shocks presented in Chart 1, our counterfactual exercise suggests that movements in the terms of trade had a marked influence on the growth performance of the two countries (Chart 2). We estimate that in Ecuador between 2000 and 2002, improvements in the terms of trade contributed an average of 1.6 percentage points annually to GDP growth, which averaged

Chart 2
Contribution of Changes in the Terms of Trade to Real GDP Growth



Sources: International Monetary Fund, *International Financial Statistics*; authors' calculations.

Table 3
Terms of Trade and Export Prices
Percentage Change

	Ecuador				
	Terms of Trade	Oil	Bananas		
1999	2.9	33.8	N.A.		
2000	18.0	57.1	-1.2		
2001	-6.5	-14.5	57.6		
2002	7.6	1.1	25.4		
	Argentina				
	Terms of Trade	Edible Oils	Wheat	Corn	Aluminum
1998	-5.5	16.5	-23.5	-9.6	-15.8
1999	-5.9	-34.1	-4.5	-8.6	1.5
2000	10.2	-22.1	2.2	-8.6	12.4
2001	-0.6	13.0	4.9	0.7	-6.4

Sources: Banco Central de Ecuador; Instituto Nacional de Estadística y Censos (Argentina); Chicago Board of Trade.

3.7 percent each year. By contrast, the worsening of the Argentinean terms of trade created a drag on growth averaging 1.4 percentage points each year between 1999 and 2001, a period during which GDP fell by 2.5 percent annually.

These estimates should be viewed with some caution since we are applying to only two countries a statistical relation drawn from a much larger sample. Nevertheless, our results provide persuasive evidence of the key role played by terms-of-trade movements in determining whether output rose or fell in Ecuador and Argentina in recent years. Moreover, our results suggest that a fixed rate regime, in contrast to a flexible rate regime, permits terms-of-trade movements to exert a strong influence on output growth in developing countries.

Conclusion

This article has explored how the exchange rate regime adopted by developing countries can affect their ability to adjust to terms-of-trade fluctuations. Our statistical analysis has shown that a terms-of-trade shock will have little impact on growth under a flexible exchange rate system because the exchange rate's own movements will absorb the effects of the shock. Under a fixed exchange rate, however, this buffer is absent and the adjustment will fall primarily on growth: consequently, a worsening of the terms of trade will lead to a contraction in output.

Our analysis has also shown that movements in the terms of trade represent a sizable source of volatility for developing countries. The contrasting experiences of Ecuador and Argentina are a case in point: in recent years, terms-of-trade shocks have been an important determinant of the direction and extent of output changes in these countries.

The effectiveness of the flexible exchange rate in responding to these shocks is only one of the many considerations that developing countries would weigh in choosing an exchange rate regime. Nevertheless, in light of the significant volatility risks that terms-of-trade movements pose for output growth in developing countries, the consideration appears to be an important one.

Notes

1. The studies include Mendoza (1995), Kose (2002), and Broda (2003).
2. Since Friedman's (1953) famous case for flexible exchange rate regimes, this argument has become one of the least disputed in favor of flexible rates.

3. Broda (2003) finds that the share explained by terms-of-trade movements is substantially smaller. His analysis is based on empirical estimates, while the calculations in Mendoza (1995) and Kose (2002) are based on calibrations of their models.

4. If wages in these industries were to adjust quickly, contracting in line with the drop in income, the terms-of-trade shock would have only a moderate impact on activity. In practice, however, wages exhibit substantial inertia. The failure of wages to react fast enough shifts the burden of adjustment onto the exchange rate.

5. The magnitude of the fall in output in each exchange rate regime will depend on the magnitude of the terms-of-trade change. However, for a given movement in the terms of trade, the fall in output should always be larger in a country with a fixed exchange rate regime than in a country with a flexible regime.

6. Many considerations enter into a country's choice of an exchange rate regime. A full assessment of the optimal exchange rate regime is beyond the scope of this article. Readers interested in the pros and cons of alternative exchange rate regimes might consult Calvo and Reinhart (2000), Calvo and Mishkin (2003), Ghosh et al. (1997), McKenzie (1999), and Tornell and Velasco (2000).

7. Several countries classified by the International Monetary Fund as fixed regimes experienced substantial depreciations of their exchange rate, making them more like flexible regimes in practice. For example, El Salvador (in 1983-84), Guatemala (in 1986-88), and Nicaragua (in 1985-87) were classified as fixed regimes (with currencies pegged to the dollar), but their currencies depreciated by 10 percent, 41 percent, and 106 percent, respectively. Conversely, several countries classified as flexible regimes—including India (in 1993-96) and Bolivia (in 1985-90)—acted more like fixed regimes when they limited the fluctuations of their exchange rate.

8. The nominal exchange rate is the price of one country's currency in terms of the currency of another country—for example, the quantity of pesos required to purchase one dollar. The real exchange rate—the nominal exchange rate adjusted for price differences—is the price of one country's consumption basket in terms of the consumption basket of another country. The real exchange rate, for example, might be understood as the quantity of Mexican consumption baskets that one must sell in Mexico to purchase one U.S. consumption basket in the United States. Specifically, the relation is $RER = NER * P(US) / P(Mex)$, where RER is the real exchange rate, NER the nominal exchange rate, $P(US)$ the dollar price of the U.S. consumption basket, and $P(Mex)$ the peso price of the Mexican consumption basket.

9. Because of the rich dynamics of the statistical model, the terms of trade worsen by slightly more than 10 percent initially, but then ease somewhat so that the total change is equivalent to a permanent 10 percent change.

10. Because the exchange rate is defined as units of domestic currency per unit of foreign currency, the depreciation appears as an increase in the chart.

11. We end our analysis of Argentina in 2001 because the sharp contraction in 2002 after the collapse of the currency board stemmed primarily from the failure of the banking sector and other factors unrelated to movements in the terms of trade. Such factors are outside the scope of this article.

12. Oil and bananas together accounted for 59 percent of Ecuadorian exports in 2001.

13. Together, these commodities accounted for 21 percent of Argentinean exports in 2000.

14. We ignore the pre-2000 shocks because the Ecuadorian economy was then operating under a flexible exchange rate, so the effects of terms-of-trade movements on output growth would have been limited. In any case, the terms-of-trade movements in 1999 were not large.

15. Because of the delayed impact of the terms of trade, we consider the 1998 shock even though our analysis of growth starts in 1999.

16. Note that our method, while illustrative, is imperfect in that we infer a statistical relation from a sample of countries and apply it to two particular cases. This limitation should be borne in mind when interpreting our results.

References

- Baxter, Marianne, and Michael Kouparitsas. 2000. "What Causes Fluctuations in the Terms of Trade?" NBER Working Paper no. 7462.
- Broda, Christian. 2003. "Terms of Trade and Exchange Rate Regimes in Developing Countries." *Journal of International Economics*, forthcoming. (See also Federal Reserve Bank of New York *Staff Reports*, no. 148.)
- Calvo, Guillermo, and Frederic S. Mishkin. 2003. "The Mirage of Exchange Rate Regimes for Emerging Market Countries." NBER Working Paper no. 9808.
- Calvo, Guillermo, and Carmen Reinhart. 2000. "Fixing for Your Life." NBER Working Paper no. 8006.
- Friedman, Milton. 1953. "The Case for Flexible Exchange Rates." In *Essays in Positive Economics*. Chicago: University of Chicago Press.
- Ghosh, Atish, Anne-Marie Gulde, Jonathan D. Ostry, and Holger C. Wolf. 1997. "Does the Nominal Exchange Rate Regime Matter?" NBER Working Paper no. 5874.
- International Monetary Fund (IMF). 1997. "Exchange Rate Arrangements and Economic Performance in Developing Countries." *World Economic Outlook*, October.
- Kose, M. Ayhan. 2002. "Explaining Business Cycles in Small Open Economies: How Much Do World Prices Matter?" *Journal of International Economics* 56, no. 2: 299-327.
- McKenzie, Michael. 1999. "The Impact of Exchange Rate Volatility on International Trade Flows." *Journal of Economic Surveys* 13, no. 1 (February): 71-106.
- Mendoza, Enrique G. 1995. "The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations." *International Economic Review* 36, no. 1 (February): 101-37.
- Tornell, Aaron, and Andres Velasco. 2000. "Fixed versus Flexible Exchange Rates: Which Provides More Fiscal Discipline?" *Journal of Monetary Economics* 45, no. 2 (April): 399-436.

About the Authors

Christian Broda is an economist and Cédric Tille a senior economist in the International Research Function of the Research and Market Analysis Group.

Current Issues in Economics and Finance is published by the Research and Market Analysis Group of the Federal Reserve Bank of New York. Dorothy Meadow Sobol is the editor.

Editorial Staff: Valerie LaPorte, Mike De Mott, Susan Szarkowitz, Robert Clark
Production: Carol Perlmutter, David Rosenberg, Jane Urry

Subscriptions to *Current Issues* are free. Write to the Public Information Department, Federal Reserve Bank of New York, 33 Liberty Street, New York, N.Y. 10045-0001, or call 212-720-6134. Back issues of this publication are available at <http://www.newyorkfed.org/research/current_issues>.

Learn about New Research Publications via Electronic Alert

By subscribing to our free Electronic Alert service, you receive e-mails describing the new publications recently posted on our website. You can then link directly to the publications. Visit <<http://www.newyorkfed.org/alertservices/>> to join.

The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.