The Structural Determinants of External Vulnerability

Norman V. Loayza and Claudio Raddatz

This article examines empirically how domestic structural characteristics related to openness and product- and factor-market flexibility influence the impact of terms of trade shocks on aggregate output. Applying semistructural vector autoregressions to a panel of 88 countries with annual observations for the period 1974–2000, the analysis isolates and standardizes the shocks, estimates their impact on GDP, and examines how this impact depends on the domestic conditions outlined above. The article finds that greater trade openness magnifies the output impact of terms of trade shocks, particularly negative ones, while financial openness reduces their impact. Flexibility of labor and firm-entry are beneficial, with labor flexibility dampening the impact of negative shocks and ease of firm-entry magnifying positive ones only. Domestic financial depth has a more nuanced role in stabilizing the economy. Analysis of interactions across structural determinants reveals complementarities among macroeconomic conditions (trade and financial openness and depth) and, separately, among microeconomic conditions (flexibility of labor markets and ease of firm-entry). Variables across these groups tend to behave as substitutes for each other. JEL codes: F36, F41, F43.

Macroeconomic volatility is not only a source of business cycle uncertainty but also a major cause of low economic growth. Ramey and Ramey (1995) were the first to document this finding for a cross-section of countries. Fatás (2002) and Hnatkovska and Loayza (2005) show that macroeconomic volatility is particularly harmful for developing countries, where volatility is higher and its impact more pronounced.

Among the causes of macroeconomic volatility, fluctuations in the terms of trade are important sources of external shocks. Across countries about 10

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THE WORLD BANK ECONOMIC REVIEW, VOL. 21, NO. 3, pp. 359–387 doi:10.1093/wber/lhm018
Advance Access Publication 4 October 2007

percent of the variation in GDP growth and about 25 percent of the variation in growth volatility can be explained by observed differences in the volatility of terms of trade changes (see Easterly and others 1993; Hnatkovska and Loayza 2005). Terms of trade shocks have also been documented to have a significant impact on GDP within countries (see Ahmed 2003; Raddatz 2007), although their preeminence over domestic shocks is subject to debate.[1]

Going beyond the average impact of external shocks, there is a rich literature suggesting that the impact of an external shock on the real side of the economy may be determined by domestic conditions interacting with the shock to produce macroeconomic stability or volatility. Traditional analysis of the domestic sources of vulnerability has stressed macroeconomic policy responses in monetary, foreign exchange, and fiscal areas. A recent example is Broda (2001), who compares the stabilizing properties of different exchange rate regimes in the face of terms of trade shocks. New developments in the study of vulnerability have concentrated on the role of structural characteristics related to the functioning of markets and institutions. Some studies stress the role of factor and product market rigidities in amplifying shocks at the macroeconomic level (see, for example, Kiyotaki and Moore 1997; Bernanke and Gertler 1989; Caballero and Hamour 1994, 1996, 1998; Caballero and Krishnamurty 2001). Others, such as Acemoglu and others (2003) and Rodrik (1999), point to the relevance of institutional development in the control of crises and management of shocks.[2]

Notwithstanding these contributions, the extent to which domestic structural characteristics can account for the relative instability of aggregate output remains an open question. This article contributes to this literature by examining how certain domestic structural characteristics influence the impact that external shocks may have on aggregate output. The broad issue is whether a country's vulnerability to shocks is not purely random but linked to structural characteristics that are at least partially policy driven: trade openness, financial depth, capital account openness, labor market flexibility, and ease of firm-entry. Not deep institutional variables, these are outcomes through which fundamentals operate. The purpose in using structural outcome variables is to separate and elucidate the mechanisms that drive external vulnerability.

For analysis two aspects of output vulnerability to external shocks can be distinguished: the frequency and strength of shocks affecting a country and the effect that a shock of a given size and frequency can have on the country's output. This article examines the second aspect, applying an econometric method that, using a panel sample of 88 countries and annual observations for 1974–2000, isolates

1. Mendoza (1995) and Kose and Riezman (2001), using calibrated small open economy models, find terms of trade shocks to account for almost half of economic fluctuations. Hoffmaister, Roldós, and Wickham (1998), Ahmed (2003), and Raddatz (2007), among others, using time-series analysis, find that external shocks explain a much smaller fraction of output volatility (around 20 percent).

2. Another strand of the literature takes one step back and focuses on explaining the business-cycle behavior of the terms of trade. For instance, Kraay and Ventura (forthcoming) link movements in the terms of trade to countries' endowments and resulting industrial structure.

and standardizes the shocks, estimates their impact on GDP, and examines how this impact depends on the domestic conditions outlined above.[3]

From an empirical perspective, the relevant question is whether the differential impact of a given external shock is related to country characteristics. Controlling for the size of the shocks is not easy. Most of the recent literature has relied on either indirect evidence from difference-in-difference estimation (see, for example, Braun and Larrain 2005; Caballero and others 2005; Raddatz 2006) or calibrated macroeconomic models developed to match certain moments of developing countries' economic performance (for a survey, see Arellano and Mendoza 2002).

This article takes a different approach and directly estimates the output impact of external shocks using semistructural vector autoregression analysis, as applied to panel data (cross-country, time-series) of aggregate variables. This method requires the identification assumption that the relevant external variable—the change in the terms of trade—does not respond to domestic output changes or the variables that account for the country's structural characteristics. In practice, this rather uncontroversial assumption amounts to a small open economy condition for the countries included in the analysis. Similar applications of this methodology can be found in Broda (2004), Ahmed (2003), Uribe and Yue (2003), and Raddatz (2007). Controlling for the size of the shock, the analysis accounts for its interaction with the set of country characteristics under analysis and estimates its conditional output impact.

Section I presents the econometric method in detail and the specification tests. Section II introduces the data, the variable definitions and sources, and the sample of countries and years under analysis. Section III presents the empirical results, including the discussion of symmetric and asymmetric effects, the potential interaction between structural characteristics, and a set of robustness checks.

I. Methodology

The impact of exogenous shocks on a country's economic performance and its relation to the country's structural characteristics are estimated using a panel vector autoregression. To minimize the need for identification assumptions (see below), the focus is exclusively on terms of trade shocks. Therefore, for a given country i the semistructural model corresponds to:

$$A_{i,0}x_{i,t} = \sum_{j=1}^{q} A_{i,j}x_{i,t-j} + \varepsilon_{it} \quad (1)$$

3. An analogy illustrates these ideas. How vulnerable people are to disease depends on the seriousness of the disease itself (first aspect) and how well prepared they are to bear a given disease (second aspect). Analyzing the second aspect requires examining how people facing the same disease (in type and strength) react, to shed light on why some people suffer so much from an attack of, say, the flu, while others remain unscathed.

where $x_{i,t} = (\Delta tt_{i,t}, \Delta y_{i,t})'$ is a vector that contains the first difference of the log of terms of trade index ($\Delta tt_{i,t}$) and the log of real GDP per capita ($\Delta y_{i,t}$), both as deviations from their country-specific means.[4] The matrices $A_{i,j}$ contain the structural coefficients for the different lags incorporated in the model (including the contemporaneous one). The structural errors $\varepsilon_{i,t}$ are independent and identically distributed, with zero mean and a diagonal variance–covariance matrix Σ.

The identification assumption applied is that terms of trade changes are strictly exogenous for a given country—$\Delta\ tt_{i,t}$ does not respond to $\Delta y_{i,t}$ at any lags. This assumption is equivalent to imposing the following triangular structure on all the A matrices:

$$A_{i,j} = \begin{bmatrix} {a^{i,j}}_{11} & 0 \\ {a^{i,j}}_{21} & {a^{i,j}}_{22} \end{bmatrix}. \tag{2}$$

For the developing and small developed countries in this study this assumption should be uncontroversial. In fact, for the sample of countries included in this study a standard Granger causality test cannot reject the hypothesis that output fluctuations do not Granger-cause terms of trade fluctuations.[5]

The relatively weak assumption required to identify the impact of terms of trade shock is the reason for focusing exclusively on these shocks. It is preferable to focus on a reduced set of shocks that can be clearly identified than on a broader set of shocks that would require strong and controversial identification assumptions. This means, however, that the results have to be interpreted with caution. Since the model does not account for all exogenous sources of fluctuations, it is semistructural. The terms of trade variable captures all strictly exogenous variables whose fluctuations are correlated with those of the terms of trade. Therefore, statements on the effects of different structural characteristics on the amplification or dampening of shocks apply directly to terms of trade shocks and indirectly to other exogenous contingencies that are correlated with these shocks, such as the world business cycle.

The baseline model corresponds to a panel vector autoregression in which part of the coefficients in the A matrices are assumed to be common across cross-sectional units. Of interest is testing how different structural characteristics of a country affect the impact of terms of trade shocks on output, as captured by the $a_{21}^{i,j}$ coefficients, so these coefficients are permitted to vary across countries according to the specific characteristics whose role is to be determined.

4. Of course, this is equivalent to including a country fixed effect in the vector autoregression.

5. When performed on a country by country basis, the test cannot reject the null hypothesis in 72 of the 88 cases. The results are not materially affected by excluding the 16 countries in which the hypothesis is rejected that terms of trade are not Granger-caused by output. The countries are Canada, Chile, Greece, India, Ireland, Jamaica, Kenya, Lesotho, Mali, Malaysia, Niger, Papua New Guinea, Senegal, Singapore, Togo, and Thailand.

In particular, it is assumed that

$$a_{21}^{i,j} = \beta_0^j + \beta_1^j \times \text{OPEN}_i + \beta_2^j \times \text{FDEV}_i + \beta_3^j \times \text{CAOPEN}_i + \beta_4^j \times \text{LABOR}_i + \beta_5^j \times \text{ENTRY}_i \quad (3)$$

where OPEN_i, FDEV_i, CAOPEN_i, LABOR_i, and ENTRY_i are measures of trade openness, financial development, capital account openness, labor flexibility, and ease of firm-entry for country i, respectively (described below). The analysis will also allow for the possibility that the influence of these characteristics on the transmission of terms of trade shocks may differ for increases and decreases in log terms of trade (with respect to the mean change). For the notation above, this corresponds to allowing the β^j coefficients to vary with the state of the terms of trade in the following way:

$$\beta = \begin{cases} \beta^+ & \text{if } \Delta tt_{i,t} > 0 \\ \beta^- & \text{otherwise} \end{cases}$$

where $\beta = (\beta^0, \ldots, \beta^j, \ldots, \beta^q)$, $\beta^j = (\beta_0^j, \ldots, \beta_5^j)$, and β^+ and β^- are similarly defined. The remaining of the coefficients that capture the dynamics of the terms of trade ($a_{11}^{i,j}$) and the lagged effect of output on itself ($a_{22}^{i,j}$) are restricted to be the same for all countries.

The use of panel vector autoregressions, with the corresponding restrictions on the parameters, is common in the recent literature estimating the impact of exogenous shocks on macroeconomic variables (Broda 2004; Ahmed 2003; Uribe and Yue 2003), because the limited length of the time-series dimension of the data (around 25 annual observations) makes it difficult to estimate country-specific dynamics. Using a panel vector autoregression approach increases the degrees of freedom of the estimation, and if the common parameter restrictions are correct, provides more efficient estimators. Of course, the obvious disadvantage is that the model is incorrectly specified if these restrictions are not valid.

A concern with this approach, as Pesaran and Smith (1995) note, is that assuming common coefficients may yield parameters that underestimate the short-run impact of exogenous variables (and overestimate the long-run impact) if the dynamics differ substantially across countries. However, as Pakes and Griliches (1984) demonstrate, if differences in slope coefficients are uncorrelated with the exogenous variables, the estimated parameters would be consistent estimators of the average coefficients. This is an important result for the analysis here as there is no obvious reason why the marginal effect of terms of trade in a country should be determined by the terms of trade itself. Nevertheless, in an additional exercise (and at the cost of reduced precision of the estimates) the vector autoregression is also estimated on a country by country basis, without imposing any restriction on the dynamics. The estimated country-specific effects of the shocks are then related to the structural

TABLE 1. Unit Root Test

Variable	Augmented Dickey–Fuller by country (cannot reject unit root, percent)	Augmented Dickey–Fuller by country (cannot reject unit root, percent)	Levin–Lin–Chu *p*-value
	(1)	(2)	(3)
Log GDP per capita	72	86	0.987
Log terms of trade index	60	83	0.994

Note: Column 1 reports the percentage of the 88 countries in the sample for which the Augmented Dickey–Fuller test cannot reject the null hypothesis of a unit root when the number of lags augmenting the test is country specific, as determined by performing the Hall (1990) procedure on a country by country basis. Column 2 reports the percentage for the case where for all countries the model is augmented using the median number of lags (two) across countries. Column 3 shows the *p*-value of the Levin–Lin–Chu (2002) test for panel unit roots for the case in which the panel is augmented by two lags.

Source: Authors' analysis based on data described in text.

characteristics under study. The results prove to be very similar to those obtained with the panel methodology.

As mentioned, the variables in the vector autoregression are the first differences of the log terms of trade and output per capita. The relevant series is modeled as difference–stationary for two reasons. First, standard tests suggest the presence of a unit root in the levels of both series. Columns 1 and 2 of table 1 show the results of the Augmented Dickey–Fuller tests performed on a country by country basis for country-specific and common lag structures.[6] In most cases the test cannot reject the null hypothesis of a unit root for both series (about 85 percent of the time for both series when the median number of lags is used for all countries). The panel-based unit-root test suggested by Levin, Lin, and Chu (2002), augmented by the median number of lags across countries (two), reaches a similar conclusion: the null hypothesis of a unit root cannot be rejected. The second reason for modeling the relevant series as difference–stationary is that previous empirical papers in this literature (for example, Ahmed 2003 and Broda 2004) have done so, giving this specification the advantage of being more directly comparable with previous results.[7]

The vector autoregression specification uses two annual lags in the benchmark specification. This lag structure was determined using standard lag selection tests (Akaike information criterion, Schwartz information criterion, and Hannan–Quinn criterion).

6. The number of lags for each country was determined using the methodology of Hall (1990). The common number of lags used in column 2 corresponds to the median across countries (two lags).

7. A Pedroni (1999) panel cointegration test, not reported, does not reject the null hypothesis of no cointegration between log terms of trade and output. The different statistics derived by Pedroni tend to give different results, but most of them cannot reject the null hypothesis of no cointegration. Because the power and size tradeoff of the different tests varies with the cross-sectional and time-series dimension of the panel (see Pedroni 2004), statistics with the largest size (that tend to overreject) and highest power at short time dimensions were emphasized. Those tests, corresponding to the panel and group *t*-statistics derived by Pedroni (1999), clearly do not reject the null hypothesis of no cointegration.

Under the identification assumptions described above, the parameters of the model are estimated using a two-step procedure: the reduced-form coefficients are first estimated equation by equation by ordinary least squares (OLS); then the impulse-response functions (IRFs) are computed for each of the structural shocks (using the reduced-form coefficients and the variance–covariance matrices of the reduced-form errors derived from these coefficients). The confidence bands for the IRFs are estimated by parametric bootstrapping, assuming normally distributed reduced-form errors.[8]

II. Data

The following are the main variables used in the analysis. *Real GDP per capita*, in constant 2000 U.S. dollars was obtained from the World Development Indicators Database (World Bank 2005) This series was used instead of GDP adjusted for purchasing power parity (PPP), despite reduced international comparability, because it has more recent coverage than the measures from the Penn World Tables (Heston, Summers, and Aten 2002) and longer coverage than the PPP series produced by the World Bank.[9] The *terms of trade index* is the ratio of export prices to import prices using the current and constant price values of exports and imports from the national accounts component of the Penn World Tables version 6.1 and updated using the terms of trade data from the World Development Indicators Database (World Bank 2005).[10] To reduce concerns about structural breaks, data are for the post Bretton-Woods period, 1974–2000.

The structural characteristics of countries are captured in the following variables. *Trade openness* is measured as the log of the ratio of total trade to GDP. *Financial development* is the log of the ratio of private credit provided by banks and other financial institutions to GDP, obtained from Beck,

8. The procedure can be briefly described as follows. The estimated variance–covariance matrix of the reduced form errors is used to simulate a random realization of the perturbations. The initial values of the different variables, the baseline coefficients, and the simulated perturbations are used to simulate a new set of observations for the variables in the vector autoregression. These simulated observations are used to estimate a new set of coefficients. This exercise is repeated 500 times. The IRF is computed for each set of coefficients obtained from the bootstrapping. A 90 percent confidence interval is built for the IRF by taking the 5th and 95th percentile of the empirical distribution of the IRF on a point by point basis.

9. In a robustness check presented below using PPP-adjusted GDP, the results remain basically the same.

10. This index is used instead of the more traditional net barter index because of its broader coverage. However, this index includes the service export sector (tourism and financial services), whose prices are not measured as precisely as those of merchandise trade and are much less likely to be exogenous to domestic conditions (the main identification assumption). This is unlikely to be a problem for the average country because of the typically small relevance of the export service sector, but to address any potential concern the index was replaced by the net barter terms of trade index in cases where the correlation between these two indexes (based on the post-1980 data in which both are available) was smaller than 0.5, taken as an indication of the importance of the export service sector (21 cases, or 25 percent of the sample).

Demirgüç-Kunt, and Levine (2000) or, if unavailable from that source, from the World Development Indicators Database. *Openness* in capital account transactions is captured by the Chinn–Ito index (Chinn and Ito 2002), with a higher value indicating a higher degree of openness.[11] The *index of labor market flexibility*, calculated from data in World Bank (2003), is a weighted average of three indicators (flexibility of hiring, conditions of employment, and flexibility of firing) as in Botero and others (2004). The original index was rescaled to range from 0 to 1, with higher values indicating more flexible labor markets. Finally, the *index of ease of firm entry*, calculated from data in World Bank (2003) and O'Driscoll, Feulner, and O'Grady (2003), is a weighted average of four indicators (registration procedures, cost to register, days to register, and burden of entry regulations) as in Chang, Kaltani, and Loayza (2005). This index also ranges from 0 to 1, with higher values indicating fewer restrictions.

The sample includes 88 countries representing different regions and income levels (see appendix). Sub-Saharan Africa has the largest share in the sample, at 30 countries, followed by Latin America at 20, East Asia and Pacific at 11, the Middle East and North Africa and Western Europe at 10 each, South Asia at 4, Eastern and Central Europe at 2, and North America at 1. There are 35 low-income countries, 35 middle-income countries, and 18 high-income countries. The sample includes all countries for which measures of the structural characteristics described above and at least 15 continuous observations of both terms of trade and output per capita were available during 1974–2000. The six large industrial countries (the United States, Japan, Germany, United Kingdom, France, and Italy) are excluded because of the possible endogeneity of their terms of trade, as are five developing countries whose terms of trade data exhibited long flat periods (Cape Verde, Grenada, Nepal, St. Lucia, St. Kitts, and Nevis).

Summary statistics for these variables for each country are in the appendix. Cross-sectional univariate summary statistics and bivariate correlations for these variables are presented in tables 2 and 3, respectively. Table 3 displays the well documented positive correlations between structural characteristics and output growth and negative correlations between measures of volatility and growth. It also shows that the structural characteristics are positively correlated with each other, although the magnitudes of the correlations are not particularly large, except between financial development and ease of firm-entry, which reaches 66 percent. These relatively low correlations suggest the possibility of sorting out the role of different structural characteristics in the transmission of shocks.

11. The Chinn–Ito index corresponds to the first principal components of the following four binary variables reported in the International Monetary Fund's *Annual Report on Exchange Arrangements and Exchange Restrictions* (various issues): existence of multiple exchange rates, restrictions on current account, capital account transactions, and the existence of requirements to surrender export proceedings.

TABLE 2. Descriptive Statistics of Country Averages, 1974–2000: Univariate (variables reported in appendix)

Variable	Mean	Standard deviation	Minimum	Maximum
Average output growth (percent)	1.17	1.94	−3.35	7.35
Average terms of trade growth (percent)	−0.75	1.55	−5.99	2.57
Standard deviation output growth	4.19	1.98	1.21	10.06
Standard deviation terms of trade growth	11.82	7.57	1.00	34.08
Trade openness	3.79	0.54	2.57	5.67
Financial depth	−1.43	0.91	−4.31	0.39
Financial openness	−0.16	1.15	−1.64	2.68
Labor market flexibility	0.47	0.14	0.21	0.80
Ease of firm entry	0.65	0.15	0.22	0.94

Note: Variables are measured over the period 1974–2000. Average output growth is growth of real GDP per capita. Average terms of trade growth is the average growth of the terms of trade index. Standard deviation output growth is the standard deviation of the growth rates of real GDP per capita. Trade openness = Log (Exports + Imports)/GDP. Financial depth = Log (Private credit) / GDP. Financial openness is the Chinn–Ito measure of capital account openness. Labor market flexibility is a 0 − 1index obtained from de jure labor regulation. Ease of firm-entry is a 0 − 1 index combining information on number of procedures, monetary cost, and time to open a new firm.

Source: Authors' analysis based on data described in text.

III. RESULTS

The basic results are derived from estimating the cumulative output effect of a one standard deviation shock to the terms of trade at different levels of a particular structural characteristic. As explained, this estimation is conducted in the context of a panel (cross-country, time-series) vector autoregression with (demeaned log) GDP changes as the dependent variable and (demeaned log) terms of trade changes as the exogenous variable. The output effect of terms of trade shocks are allowed to vary with five country structural characteristics: trade openness, financial depth, financial (or capital-account) openness, labor market flexibility, and ease of firm-entry. To get a sense of how much a given structural factor contributes to amplifying or dampening the external shock, the shock's cumulative output impacts are compared at relatively low (25th) and high (75th) percentiles of the world distribution of each structural characteristic.

The cumulative effect of a one standard deviation shock in the terms of trade on the level of GDP per capita for low and high levels of each country characteristic is displayed in figure 1 and table 4. To indicate the accuracy of the estimated impacts, figure 1 also presents their 90 percent confidence bands and table 4 the corresponding (empirical) standard errors.[12] To provide a

12. Critical values and corresponding confidence intervals are obtained from the empirical distribution derived through the parametric bootstrapping procedure already described.

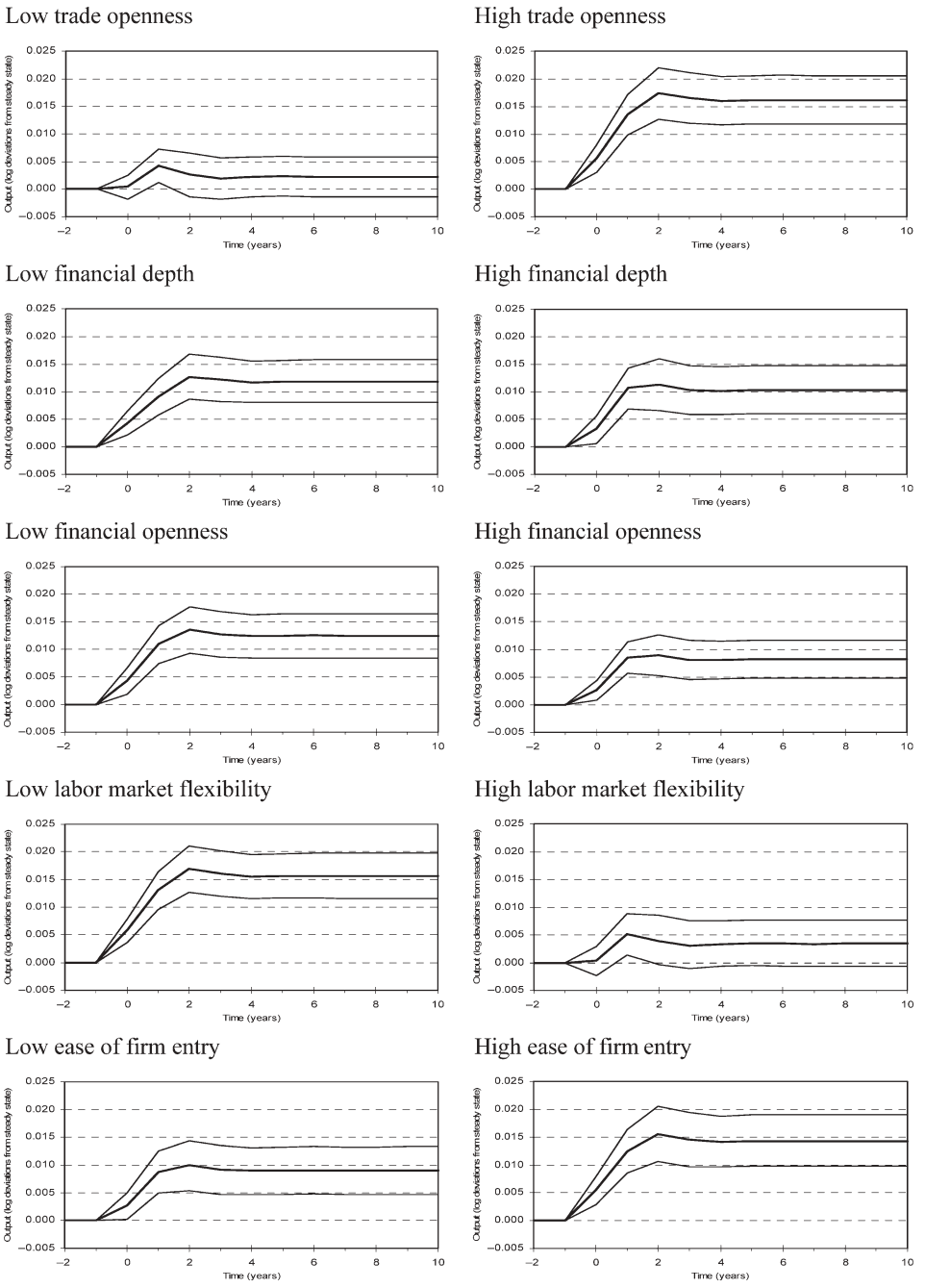
TABLE 3. Descriptive Statistics of Country Averages, 1974–2000: Bivariate Correlations (cross-sectional correlations between the different variables reported in appendix)

Variable	Output growth	Terms of trade growth	Standard deviation output growth	Standard deviation terms of trade growth	Trade openness	Financial depth	Financial openness	Labor market flexibility	Ease of firm-entry
Output growth	1.00								
Terms of trade growth	0.20	1.00							
Standard deviation output growth	−0.41	−0.13	1.00						
Standard deviation terms of trade growth	−0.57	−0.12	0.55	1.00					
Trade openness	0.25	−0.03	−0.13	−0.29	1.00				
Financial depth	0.52	0.30	−0.49	−0.65	0.32	1.00			
Financial openness	0.25	0.27	−0.33	−0.47	0.35	0.56	1.00		
Labor market flexibility	0.31	0.09	−0.32	−0.29	0.45	0.31	0.28	1.00	
Ease of firm entry	0.45	0.28	−0.46	−0.60	0.40	0.66	0.51	0.56	1.00

Note: Variables are measured over the period 1974–2000. Average output growth is growth of real GDP per capita. Average terms of trade growth is the average growth of the terms of trade index. Standard deviation output growth is the standard deviation of the growth rates of real GDP per capita. Trade openness = Log (Exports + Imports) / GDP. Financial depth = Log (Private credit) / GDP. Financial openness is the Chinn–Ito measure of capital account openness. Labor market flexibility is a 0 − 1index obtained from de jure labor regulation. Ease of firm-entry is a 0 − 1 index combining information on number of procedures, monetary cost, and time to open a new firm.

Source: Authors' analysis based on data described in text.

FIGURE 1. Cumulative Output Impact of Terms of Trade Shock: Symmetric Case



Note: See table 2 for definitions of variables. Bands are 90 percent confidence intervals.
Source: Author's analysis based on data described in text.

TABLE 4. Basic Results under Symmetric Analysis: Cumulative Output Impact of a One Standard Deviation Terms of Trade Shock for Low and High Values of Five Structural Characteristics (percent of GDP)

	Trade openness	Financial depth	Financial openness	Labor market flexibility	Ease of firm-entry
Low value (25th percentile)[a]	0.227 (0.222)	1.178 (0.234)	1.250 (0.244)	1.569 (0.240)	0.908 (0.262)
High value (75th percentile)[a]	1.609 (0.266)	1.032 (0.265)	0.819 (0.207)	0.338 (0.260)	1.430 (0.281)
Difference	1.382 (0.308)	−0.147 (0.312)	−0.430 (0.236)	−1.231 (0.297)	0.523 (0.373)
Test Ho:Diff. = 0 (one-tail)	**		**	**	*

*Significant at the 10 percent level; **significant at the 5 percent level.

Note: Numbers is parentheses are standard errors. Critical values are obtained from empirical distribution (which may have non-Gaussian properties). Trade openness = Log (Exports + Imports) / GDP. Financial depth = Log (Private credit) / GDP. Financial openness is the Chinn–Ito measure of capital account openness. Labor market flexibility is a 0−1index obtained from de jure labor regulation. Ease of firm entry is a 0 − 1 index combining information on number of procedures, monetary cost, and time to open a new firm.

[a]Percentiles of the world distribution of the respective structural characteristics.

Source: Authors' analysis based on data described in text.

benchmark for quantitative comparison, the median cumulative output impact of a one standard deviation terms of trade shock (the impact calculated at the median of all structural characteristics) was estimated. It was approximately 1 percent of GDP. As noted, the size of the shock is made the same for all countries in order to focus on the variation in responsiveness to a uniform shock.

The most noticeable result is that the cumulative output impact of terms of trade shocks rises with greater trade openness. This is likely to be a size effect in the sense that a higher volume of trade implies a larger share of economic activities that the terms of trade, as relative prices, can influence. This effect should not be confused with a purely mechanical effect, which applies to the relation between trade prices and nominal GDP (or the price of GDP in terms of importable goods). Since the analysis is based on real GDP, mechanical price effects should not be present.[13] The effect of openness is large and significant: the output impact of the shock is 1.4 percentage points higher at the third quartile of trade openness than at the first quartile. The vulnerability of open economies should not have a normative implication; it merely reflects the extent of real resource shifts in the presence of price signals and, from a

13. Unless output deflators are incorrectly or inconsistently measured, an issue considered in the discussion of robustness.

methodological perspective, highlights the need to control for openness in assessing the impact of other structural characteristics.

Conversely, greater financial depth seems to have no effect on the impact of terms of trade shocks. This is surprising, considering that financial depth is usually considered an antidote to external vulnerability. This important issue will be revisited, particularly in the analysis of asymmetric effects of positive and negative shocks and complementary interactions with other structural characteristics.

An increase in financial openness reduces the effect of terms of trade shock, significantly but by a moderate margin: the difference in the cumulative output impact between the 25th and 75th percentiles of financial openness is −0.43 percentage point. That access to international financial markets has a stabilizing effect while domestic financial depth does not is puzzling (a possible interaction between these two financial aspects is considered later).

Easing firm-entry significantly though moderately amplifies terms of trade shocks: the output impact of the shock is 0.52 percentage point higher at the 75th percentile than at the 25th percentile of ease of firm-entry. Entry of new firms is only one side of the firm-dynamics process; firm exit can also be a reaction to external shocks. Moreover, firm dynamics may have different characteristics under negative and positive shocks. The shock-amplifying effect of ease of firm-entry is reconsidered in the analysis of asymmetric effects.

Finally, of all structural characteristics considered here, improvement in labor market flexibility has the strongest effect on reducing the impact of terms of trade shocks on per capita GDP. The difference in the shock's cumulative output impact between the 25th and 75th percentiles of labor market flexibility is −1.23 percentage points, in absolute value almost as large as that of trade openness. The ability of firms to adjust their activities on the labor margin seems crucial for an economy's ability to accommodate the shock.

Robustness

This section examines the robustness of the basic results to changes in measurement of the terms of trade shock, in the sample of countries, the application of a longer lag structure in the estimated vector autoregressions, the inclusion of the exchange rate regime as a country characteristic, and implementation of an alternative method of estimating the effects of structural characteristics. The results on several robustness checks using the panel vector autoregression methodology are presented in the rows of table 5. The robustness check on the methodology is presented in table 6.

The first concern is whether the amplifying effect of trade openness reflects mostly a mechanical effect. Two robustness checks address this issue. The first replaces the simple terms of trade index with one that weighs export and import prices by the size of export and import volumes. When the basic exercise is

TABLE 5. Robustness: Cumulative Output Impact of a One standard Deviation Terms of Trade Shock for Low and High Values of Five Structural Characteristics (percent of GDP)

Robustness test[a]	Trade openness	Financial depth	Financial openness	Labor market flexibility	Ease of firm entry	Exchange rate regime
Benchmark[b]						
Low	0.227	1.178	1.250	1.569	0.908	
High	1.609	1.032	0.819	0.338	1.430	
Difference	1.382	−0.147	−0.430	−1.231	0.523	
Trade weighted terms of trade						
Low	0.526	1.018	0.890	0.996	0.264	
High	1.470	0.522	0.435	0.290	1.571	
Difference	1.995	−0.496	−0.455	−0.706	1.307	
Purchasing power parity GDP						
Low	0.281	0.948	0.983	1.167	1.000	
High	1.308	0.906	0.821	0.539	0.779	
Difference	1.027	−0.042	−0.162	−0.627	−0.221	
Developing countries only						
Low	0.235	1.314	1.370	1.714	1.015	
High	1.793	1.138	0.935	0.415	1.569	
Difference	1.558	−0.176	−0.435	−1.299	0.553	
Excluding 10 percent largest countries						
Low	−0.014	1.185	1.133	1.427	0.841	
High	1.606	0.873	0.769	0.325	1.290	
Difference	1.620	−0.312	−0.365	−1.102	0.448	
Excluding mainly manufacturing exporters						
Low	0.207	1.273	1.275	1.638	0.935	
High	1.701	1.052	0.912	0.359	1.522	
Difference	1.494	−0.220	−0.363	−1.279	0.587	
Three lags in common lag structure						
Low	0.128	0.982	1.101	1.482	0.589	
High	1.407	0.891	0.631	0.056	1.555	
Difference	1.279	−0.092	−0.470	−1.425	0.966	
Including exchange rate regime						
Flexible	0.467	1.228	1.411	1.706	1.153	1.296
Fixed	1.794	1.342	1.100	0.651	1.562	1.224
Difference	1.327	0.114	−0.311	−1.055	0.410	−0.072

Note: Trade openness = Log (Exports + Imports) / GDP. Financial depth = Log (Private credit) / GDP. Financial openness is the Chinn–Ito measure of capital account openness. Labor market flexibility is a 0−1 index obtained from de jure labor regulation. Ease of firm-entry is a 0−1 index combining information on number of procedures, monetary cost, and time to open a new firm.

[a]"Low" and "High" correspond to the 25th and 75th percentiles, respectively, of the world distribution of the respective structural characteristic.

[b]Includes all countries and sets the common lag structure to two lags.

Source: Authors' analysis based on data described in text.

repeated using this trade-weighted shock, the amplifying effect of trade openness becomes even larger. This indicates that trade openness, as a mechanism for shock expansion, operates not only through trade volumes but also through domestic

TABLE 6. Shock Impact and Structural Characteristics, (Dependent variable: cumulative GDP impact of a one-standard deviation terms of trade shock)

	Ordinary least squares[a]	Weighted least squares
Constant	−0.1547 (0.2086)	−0.2350 (0.2353)
Trade openness	0.1286 (0.0502)**	0.1187 (0.0513)**
Financial depth	0.0613 (0.0508)	0.0103 (0.0374)
Financial openness	−0.0558 (0.0301)*	−0.0379 (0.0259)
Labor market flexibility	−0.6658 (0.2164)**	−0.7498 (0.2190)**
Ease of firm-entry	0.2808 (0.2176)	0.4098 (0.2463)*
R-squared	0.16	—
Number of countries	85	88

*Significant at the 10 percent level; ** significant at the 5 percent level.

Note: Numbers in parentheses are robust standard errors. The regressions are estimated using a robust procedure that reduces the influence of outliers. Trade openness = Log (Exports + Imports) / GDP. Financial depth = Log (Private credit) GDP. Financial openness is the Chinn–Ito measure of capital account openness. Labor market flexibility is a 0−1 index obtained from de jure labor regulation. Ease of firm entry is a 0−1 index combining information on number of procedures, monetary cost, and time to open a new firm.

[a]Three outliers are excluded, based on the Hadi method.

Source: Authors' analysis based on data described in text.

economic activity more generally. The second robustness check addresses the potential shortcoming of GDP deflators in cleaning out (purely nominal) price effects from real GDP. This should be minimal if the GDP and terms of trade data come from the same source and GDP is adjusted for PPP. Then, at the cost of losing the most recent observations, the analysis is rerun using GDP data from the Penn World Tables. The shock-amplifying effect of trade openness remains large, although somewhat lower than in the benchmark case.

A second concern is that the results might derive only from the contrast between developing and developed countries. To consider this possibility, all high-income countries are excluded from the sample, the model is reestimated, and the impact statistics are recomputed. The results are qualitatively the same and quantitatively similar to those obtained using the full sample. This similarity indicates that the results can be compared with those of studies that focus only on developing countries.

The third concern relates to the exogeneity assumption of the terms of trade shock. Although the largest developed countries are excluded from the sample, the small-country assumption may be problematic for countries like Brazil, China, and India. Excluding the largest 10 percent of countries and repeating the exercise yields results with the same sign and quantitatively similar to those of the benchmark.[14] The exogeneity assumption may also be questionable for

14. The large countries are Australia, Brazil, Canada, China, India, Republic of Korea, Mexico, Netherlands, and Spain.

countries whose main exports are differentiated manufacturing goods with prices that are likely endogenous. To dispel this doubt, countries that are mainly manufacturing exporters are excluded (manufactured products constitute more than half of total exports).[15] Again the results are basically the same as those of the benchmark.[16]

A fourth concern pertains to the correct specification of the vector autoregression lag structure, which may be relevant in evaluating dynamic effects. To dispel doubts on whether preestimation diagnostics could have indicated a longer lag structure, the shock impacts from vector autoregressions are reestimated with three lags for all countries. Little if anything changes: the signs of the effects remain the same as the benchmark, and quantitative differences with the benchmark are mostly small and statistically insignificant, except for ease of firm-entry, whose shock-amplifying effect seems stronger.

The final robustness check concerns the exchange rate regime. This was not included in the set of structural determinants since it is generally associated with standard macroeconomic policy. However, since it has received so much attention in the stabilization literature and could in principle be related to the structural characteristics considered here, an additional exercise includes the exchange rate regime as an interaction variable. The Gosh, Gulde, and Wolf (2002) classification is used to separate country-year observations with a pegged regime from those with intermediate and floating regimes. The results are very similar to those of the benchmark. The effect of the exchange rate regime itself is quite small and statistically insignificant. This result is only tentative, however, as a complete analysis of the role of the exchange rate regime requires treatment of measurement issues that is outside the scope of this article.

As explained, an alternative to estimating the interactions model using panel data is to estimate the simple model country by country (vector autoregression of output growth on terms of trade growth with free coefficients) and then to run a cross-country regression of the resulting cumulative impacts on the five structural variables. This method allows for full country heterogeneity in (vector autoregression) parameter estimation, but at the cost of lower estimation efficiency and increased noise in the individual country impulse responses.

Table 6 presents the results using two methods that eliminate the undue influence of outlying observations. The first column shows the results of OLS estimation where three outliers are previously eliminated using the Hadi method.[17] The second column shows weighted least squares (WLS) estimation, with the weights

15. The mostly manufacturing exporting countries are Canada, China, Finland, Hong Kong, China, Hungary, Ireland, Israel, Republic of Korea, Singapore, Sweden, and Switzerland.

16. The results are also unaffected by the exclusion of the 13 countries for which the hypothesis is rejected that terms of trade fluctuations are not Granger-caused by output fluctuations.

17. The method was applied using a p-value of 0.3, which resulted in three observations being tagged as outliers.

inversely proportional to the corresponding squared residual.[18] The results are qualitatively similar to those obtained from panel vector autoregressions: the two most important country characteristics affecting the shocks' impact are trade openness (magnifying the impact) and labor market flexibility (reducing the impact). Both carry highly significant coefficients under OLS and WLS. Financial openness has negative coefficients under both methods and significantly so under OLS. Similarly, ease of firm-entry has positive coefficients under both methods and significantly so under WLS. As in the panel vector autoregression case, financial openness appears to stabilize the effect of shocks, whereas ease of firm-entry appears to enlarge them. Financial depth is not statistically significant under OLS or WLS, as was the case using the panel vector autoregression methodology.

Asymmetric Effects

The previous analysis can determine whether structural characteristics have a stabilizing (or destabilizing) effect for all shocks, whether positive or negative. In principle, however, this symmetric treatment could mask important differences in the effects of structural characteristics for positive and negative shocks. For instance, an ideal structural characteristic—one that in reality magnifies positive shocks and reduces negative ones—could be found to be ineffectual under a symmetric analysis. This section considers separately the output response to negative and positive terms of trade shocks.

The results of the asymmetric analysis are presented in table 7. The estimation of asymmetric shocks presents larger standard errors as it uses fewer observations and suffers from wide data variations associated with sign transitions. In reading the asymmetric results, for negative shocks a more negative value for the cumulative impact indicates a stronger effect, and for positive shocks a more positive value for the cumulative impact denotes a larger effect.

There is some evidence of asymmetric effects. The destabilizing effect of trade openness is strong and statistically significant only in the case of negative shocks. Financial depth has no significant effect on the impact of either positive or negative terms of trade shocks. Therefore, its lack of relevance as a shock stabilizer cannot be explained by asymmetric effects. Financial openness does not seem to have a statistically significant effect either, but for different reasons. An increase in financial openness reduces the (absolute) impact of both negative and positive shocks, and by similar magnitudes, found with symmetric effects (by around 0.4 percentage point). It is not surprising, then, that assuming symmetry in the case of financial openness produces more efficient estimates and, thus, significant effects.

An improvement in labor market flexibility dampens the effect of both negative and positive shocks in a statistically significant way. However, the stabilizing effect is substantially larger for negative shocks than for positive shocks, meaning that labor market flexibility is particularly important in the face of

18. That is, using the "rreg" command in STATA.

TABLE 7. Asymmetric Effects Cumulative Output Impact of One standard Deviation Terms of Trade Negative and Positive Shocks for Low and High Values of Five Structural Characteristics (percent of GDP)

	Trade openness		Financial depth		Financial openness		Labor market flexibility		Ease of firm entry	
	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive
Low	−0.262	0.427	−1.598	0.853	−1.791	0.724	−2.306	0.877	−1.461	0.210
	(0.437)	(0.422)	(0.418)	(0.400)	(0.452)	(0.436)	(0.439)	(0.422)	(0.460)	(0.442)
High	−2.494	0.661	−1.697	0.386	−1.429	0.317	−0.637	0.097	−2.020	1.249
	(0.474)	(0.453)	(0.484)	(0.475)	(0.375)	(0.369)	(0.468)	(0.452)	(0.481)	(0.476)
Difference	−2.231	0.234	−0.099	−0.466	0.362	−0.407	1.669	−0.781	−0.559	1.039
	(0.523)	(0.492)	(0.509)	(0.504)	(0.373)	(0.370)	(0.481)	(0.459)	(0.557)	(0.548)
Test Ho:Diff. = 0 (one-tail)	**						**	**		**

**Significant at the 5 percent level.

Note: Numbers in parentheses are standard errors of corresponding cumulative output impact. Critical values are obtained from empirical distribution (which may have non-Gaussian properties). Trade openness = Log (Exports + Imports) / GDP. Financial depth = Log (Private credit) / GDP. Financial openness is the Chinn–Ito measure of capital account openness. Labor market flexibility is a 0−1index obtained from de jure labor regulation. Ease of firm-entry is a 0−1 index combining information on number of procedures, monetary cost, and time to open a new firm.

Source: Authors' analysis based on data described in text.

adverse shocks. Finally, ease of firm-entry shows interesting evidence of an asymmetric effect: easing firm-entry significantly increases the consequences of positive shocks only. This provides an upbeat spin to the shock-magnifying effect found for ease of firm-entry in the benchmark case.

Interaction Effects

Up to now the output response to terms of trade shock has been allowed to vary linearly with the five structural characteristics. The relevance of each characteristic has been assessed while holding the rest constant. This section examines the output response to terms of trade shocks when the effect of each structural variable is allowed to depend on the rest. This is akin to allowing for multiplicative interactions in a regular regression context, and the focus is on interpreting the equivalent of interaction coefficients in that context. Allowing for multiplicative interactions is complex, so the analysis is restricted to the case of symmetric effects (of positive and negative shocks).

Following the presentation used previously, for a given pair of structural determinants the first is set at its 25th percentile, then the second is varied from its 25th to its 75th percentile and the difference in cumulative output impact is computed. Then the first structural determinant is set at its 75th percentile and the second is again varied from its 25th to its 75th percentile and the corresponding difference in the cumulative output impact is computed. Finally, the difference of the previously computed differences in cumulative output impacts is computed (always high minus low). This difference-in-difference value is the statistic of interest (as mentioned above, it carries analogous information to the coefficient on a regular multiplicative interaction). A negative sign for this difference-in-difference value reveals that the two structural determinants under consideration are complements in dampening the effects of terms of trade shocks: an increase in either one leads to a lower shock impact when the other one is at a high value. Conversely, a positive sign for the difference-in-difference value indicates that they are substitutes: an increase in either brings about a smaller output response to a shock when the other one is at a low value.

Table 8 summarizes the results of the interactions model, presenting only the difference-in-difference value for each pair of structural determinants, along with its standard error and its test of statistical significance. The following patterns emerge among the statistically significant results. Financial depth behaves as a complement to trade openness and financial openness. Likewise, labor market flexibility and ease of firm-entry are complements. In contrast to the basic case, the interactions model indicates a relevant though nuanced role for financial depth in affecting the impact of external shocks: deepening domestic financial markets can reduce the impact of external shocks when international trade and financial markets are open. This result is consistent with the literature that emphasizes the complementarity between reforms in domestic and international financial markets (see Caballero and Krishnamurthy 2001; Edwards 2001,

TABLE 8. Complementarities among Structural Characteristics: Differential Cumulative Output Impact of a One Standard Deviation Terms of Trade Shock for Low and High Values Between Pairs of Structural Characteristics (percent of GDP)

	Trade openness	Financial depth	Financial openness	Labor Market flexibility	Ease of firm-entry
Trade openness					
Difference-in-difference	—	−1.679 (0.383)	−0.489 (0.409)	−0.468 (0.388)	−0.074 (0.548)
Test Ho = Diff-diff = 0		**	—	—	—
Financial depth					
Difference-in-difference		—	−1.820 (0.474)	0.245 (0.455)	1.353 (0.558)
Test Ho = Diff-diff = 0			**	—	**
Financial openness					
Difference-in-difference			—	0.993 (0.452)	0.936 (0.436)
Test Ho = Diff-diff = 0				**	**
Labor market flexibility					
Difference-in-difference				—	−2.518 (0.644)
Test Ho = Diff-diff = 0					**
Ease of firm entry					
Difference-in-difference					—
Test Ho = Diff-diff = 0					

**Significant at the 5 percent level.

Note: Numbers in parentheses are standard deviations of corresponding output impact. Impacts are given in percentage points of GDP. They are the difference between a given pair of structural characteristics of the difference in the cumulative output impact of their corresponding low and high values. This is analogous to the effect of an interaction between a pair of variables. Critical values are obtained from empirical distribution (which may have non-Gaussian properties). Trade openness = Log (Exports + Imports) / GDP. Financial depth = Log (Private credit) / GDP. Financial openness is the Chinn–Ito measure of capital account openness. Labor market flexibility is a 0−1index obtained from de jure labor regulation. Ease of firm-entry is a 0−1 index combining information on number of procedures, monetary cost, and time to open a new firm.

Source: Authors' analysis based on data described in text.

among others).[19] In turn, labor flexibility is more effective in reducing the impact of the shock if ease of firm-entry is high, a result that highlights the importance of complementary reforms (see Eslava and others 2005).

Three other pairs of variables behave as substitutes. They are ease of firm-entry with both financial depth and financial openness, and labor market flexibility with financial openness. Thus, deepening financial markets and opening the capital account reduce the output effect of the shock, particularly when there are impediments to firm flexibility. Likewise, labor market flexibility has a larger role in reducing the impact of terms of trade shock when the capital account is closed. It is interesting to note that while ease of firm-entry and labor market flexibility are complements, they are substitutes for financial market depth and openness.

IV. Concluding Remarks

What underlies a country's vulnerability to external shocks? Why do some countries suffer so much from terms of trade shocks while others remain unscathed? This article examined how certain domestic characteristics influence the impact that terms of trade shocks can have on aggregate output. It has an empirical objective, but the analysis was motivated by the recent literature that emphasizes the role of product- and factor-market rigidities as the source of macroeconomic vulnerability.

The results indicate that the two most important country characteristics affecting the output impact of shocks are trade openness and labor market flexibility, with trade openness magnifying the impact and labor market flexibility reducing it. Financial openness also shows a significant but smaller stabilizing effect. Ease of firm-entry magnifies the shocks, but mainly the positive ones, as revealed by an examination of asymmetric effects. Financial depth does not seem to directly affect the impact of terms of trade shocks, but it affects how other structural characteristics amplify or dampen these shocks, as exposed by the analysis of interaction effects. These results are robust to checking for mechanical interpretations of the trade-related results, placing stricter restrictions to guarantee shock exogeneity, concentrating exclusively on developing countries, using a longer lag structure for the vector autoregressions, controlling in addition for the exchange rate regime and allowing full heterogeneity in the estimation of country impulse responses.

When the possibility of asymmetric effects (from negative and positive shocks) is considered, trade openness amplifies negative shocks, whereas ease of firm-entry

19. An alternative reading of the previous results may help to clarify the positive role of financial development. First, although trade openness always increases the impact of a shock, this is considerably smaller when the expansion in openness occurs in a country with well developed local financial markets. Similarly, the findings indicate that greater financial openness in an environment of underdeveloped local financial markets may result in an increase in the impact of external shocks. In contrast, when financial openness occurs in a country with well developed financial markets, the impact of the shocks is reduced.

magnifies only positive ones. Labor market flexibility dampens both shocks, but especially negative ones, and financial openness seems to reduce both shocks in a similar way. Analysis of the interactions among the structural determinants of the impacts of shocks reveals an interesting pattern. Macroeconomic outcomes (in trade and in financial openness and depth) tend to complement each other: an improvement in any of these dimensions leads to a larger reduction in the output impact of terms of trade shocks in a country that is advanced in the other related dimensions. The same happens for microeconomic conditions (in ease of firm-entry and in labor market flexibility), which also tend to be complements. However, macroeconomic and microeconomic conditions seem to behave as substitutes, compensating for each other's deficiencies.

The article opened by pointing out two aspects of output vulnerability to external shocks: the strength of the shock and the sensitivity to the shock. As the article looked only at sensitivity to the shock, it is only fair to ask whether this is indeed quantitatively relevant in assessing a country's degree of vulnerability. The empirical model can answer that question by decomposing the variance of total predicted volatility into the portion due to the countries' sensitivity to a homogeneous terms of trade shock and the fraction due to the variation of these shocks across countries. A conservative estimate of the importance of the portion due to the sensitivity to the shock is 30 percent. The estimate is conservative because it is based on homogeneous parameters across countries, as derived from the panel vector autoregression methodology.[20] A more liberal estimate—one based on country-specific vector autoregression parameter—would assign an importance more than twice as large. In any case, the relevance of domestic structural characteristics in dealing with external vulnerability cannot be ignored.

A final caveat is in order. The analysis focused on the role of structural characteristics on the amplification of terms of trade shocks only. This is a relevant exercise because of the importance typically attributed to these shocks and the advantages it offers for identification purposes. To the extent that the response to other types of external shocks is similar, the results convey information about the general influence that structural characteristics have on external vulnerability. However, the possibility that their role in the transmission of other external shocks may differ from the one documented here cannot be

20. This fraction is estimated as follows. For each country in the sample, the long-run output variance is computed in response to its own shock ($\alpha_i \sigma_i^2$), first, by estimating the response to a common shock and then by simulating the effect of its own shock. Actual values of the country's structural characteristics are used to estimate its long-run output variance in response to a common shock ($\alpha_i \sigma^2$), and the country's own data are applied to estimate the variance of its terms of trade shocks (σ_i^2). The log of the output variance [log ($\alpha_i \sigma_i^2$)] is then decomposed into the sum of the log of vulnerability [log (α_i)] and the log of terms of trade variance [log (σ_i^2)]. The cross-country variance of the log of output volatility then corresponds to the cross-country variance of the log of vulnerability, the log of terms of trade variance, and the covariance between them. The figure reported in the text corresponds to the contribution of the log of vulnerability to this variance when the covariance term is imputed in proportion to the standard deviation of each component (assuming constant correlation).

dismissed. In particular, financial development, which plays a secondary role in the results of this study, may have a more prominent job in dampening financial shocks. Since an appropriate analysis of this possibility would require more complex and controversial identification assumptions, it awaits future research.

APPENDIX

Country Sample and Summary Statistic

List of sample countries and summary statistics is given in table A-1.

TABLE A-1. List of Sample Countries and Summary Statistics

Country name	Average output growth (%) (1)	Average terms of trade growth (%) (2)	Standard deviation output growth (3)	Standard deviation terms of trade growth (4)	Trade openness (5)	Financial depth (6)	Financial openness (7)	Labor market flexibility (8)	Ease of firm-entry (9)
Algeria	0.46	−0.43	2.87	23.14	3.81	−1.12	−1.41	0.54	0.66
Angola	−2.26	−3.66	9.28	18.08	4.16	−4.31	−1.55	0.22	0.22
Argentina	0.27	−0.01	5.78	8.17	2.70	−1.78	−0.13	0.34	0.69
Australia	1.86	−0.66	1.92	5.06	3.28	−0.77	1.32	0.64	0.89
Austria	2.20	−0.31	1.56	1.34	3.97	−0.25	1.68	0.70	0.74
Bangladesh	1.62	−2.08	2.27	15.78	2.91	−1.60	−1.40	0.50	0.62
Belgium	1.95	−0.12	1.66	1.59	4.83	−0.96	1.56	0.52	0.80
Benim	0.55	−1.69	3.63	14.17	3.71	−2.37	−0.24	0.48	0.69
Bolivia	−0.11	−3.12	3.00	11.29	3.73	−1.40	0.68	0.34	0.52
Botswana	5.26	1.49	3.57	8.34	4.63	−2.06	−0.21	0.65	0.62
Brazil	1.21	−1.73	3.68	9.83	2.75	−1.30	−1.64	0.22	0.45
Burkina Faso	1.19	0.77	3.43	12.52	3.17	−2.01	−0.36	0.47	0.45
Burundi	−0.61	−2.78	5.11	33.79	3.28	−2.48	−1.09	0.38	0.25
Cameroon	0.61	0.00	7.03	22.39	3.45	−1.63	−0.47	0.56	0.59
Canada	1.76	0.18	2.28	3.05	3.90	−0.37	2.68	0.66	0.94
Central African Republic	−1.42	−1.27	4.61	16.26	3.22	−2.60	−0.66	0.38	0.25
Chad	−0.56	−2.94	9.06	13.46	3.26	−2.57	−0.76	0.34	0.41
Chile	3.18	−2.54	5.75	14.51	3.73	−0.85	−1.25	0.50	0.78
China	7.35	−0.93	3.44	5.74	3.16	−0.13	−1.24	0.53	0.61
Colombia	1.34	0.54	2.30	10.19	3.21	−1.33	−1.53	0.41	0.65
Congo, Rep.	0.37	−0.79	7.02	22.26	4.27	−2.28	−0.91	0.40	0.58
Costa Rica	1.29	0.14	3.73	9.45	4.12	−1.69	−0.56	0.37	0.64
Côte d'Ivoire	−1.14	−1.95	4.94	16.36	4.05	−1.16	−0.53	0.47	0.59
Denmark	1.65	0.40	1.93	2.43	3.97	−0.89	1.13	0.75	0.91

Dominican Republic	2.27	−2.49	3.31	11.72	4.02	−1.37	−1.46	0.51	0.60
Ecuador	0.40	−1.73	3.18	13.45	3.71	−1.53	0.04	0.45	0.51
Egypt, Arab Rep.	3.55	−2.80	2.86	11.33	3.57	−1.24	−1.05	0.41	0.59
El Salvador	0.01	0.07	4.83	17.84	3.90	−2.71	−0.64	0.31	0.59
Ethiopia	−0.09	0.29	7.67	19.72	3.02	−1.82	−1.14	0.49	0.69
Finland	2.13	−0.08	3.05	3.09	3.89	−0.55	1.54	0.45	0.85
Ghana	−0.60	−2.01	5.06	15.93	3.89	−3.26	−1.39	0.65	0.55
Greece	1.42	−1.11	2.46	4.60	3.47	−0.99	−0.54	0.33	0.63
Guatemala	0.48	−1.42	2.59	25.42	3.52	−1.90	0.63	0.35	0.56
Guinea	1.38	−3.96	1.42	8.91	3.71	−3.18	−1.07	0.40	0.56
Haiti	−1.59	−4.08	4.82	12.03	3.34	−2.2	0.44	0.40	0.32
Honduras	0.53	−0.59	3.25	13.45	4.07	−1.23	0.17	0.44	0.56
Hong Kong, China	4.56	0.38	4.50	1.75	5.22	0.39	2.68	0.73	0.94
Hungary	1.69	−0.88	3.91	3.18	4.36	−1.25	−0.68	0.46	0.76
India	3.12	1.64	2.92	10.60	2.57	−1.45	−1.03	0.49	0.56
Indonesia	3.87	1.46	4.46	10.94	3.72	−1.20	2.05	0.43	0.45
Iran, Islamic Rep.	−0.64	−1.18	7.73	24.31	3.31	−1.25	−0.90	0.48	0.63
Ireland	4.35	−0.46	3.15	2.55	4.57	−0.56	0.58	0.51	0.88
Israel	1.86	0.89	1.96	4.16	4.09	−0.65	−0.39	0.62	0.83
Jamaica	−0.21	−1.60	4.19	8.67	4.17	−1.33	−0.36	0.66	0.76
Jordan	1.73	0.68	7.52	7.06	4.31	−0.49	−0.18	0.40	0.69
Kenya	0.23	−0.44	2.33	10.48	3.80	−1.24	−0.74	0.66	0.60
Korea, Rep.	5.82	−0.73	3.79	5.29	4.03	−0.30	−0.63	0.49	0.70
Lesotho	2.85	−0.98	6.64	15.82	4.79	−2.01	−0.54	0.55	0.59
Madagascar	−1.57	0.86	3.67	11.23	3.32	−1.86	−0.92	0.39	0.65
Malawi	0.56	−2.13	5.34	10.94	3.97	−2.25	−1.03	0.48	0.63
Malaysia	3.92	−0.14	4.08	6.99	4.71	−0.29	1.63	0.75	0.77
Mali	0.65	0.01	5.93	8.07	3.64	−2.03	−0.24	0.46	0.62

(Continued)

TABLE A-1. Continued

Country name	Average output growth (%) (1)	Average terms of trade growth (%) (2)	Standard deviation output growth (3)	Standard deviation terms of trade growth (4)	Trade openness (5)	Financial depth (6)	Financial openness (7)	Labor market flexibility (8)	Ease of firm-entry (9)
Mauritania	0.10	0.46	3.36	9.42	4.29	−1.16	−1.08	0.41	0.55
Mexico	1.50	−0.38	3.74	9.90	3.28	−1.67	0.92	0.23	0.66
Morocco	1.57	1.12	4.98	9.09	3.74	−1.25	−1.26	0.49	0.82
Mozambique	0.88	−3.59	7.90	10.57	3.45	−2.19	−1.32	0.26	0.40
Namibia	−0.47	−1.94	2.72	11.23	4.58	−0.97	−1.18	0.57	0.64
Netherlands	1.83	−0.14	1.50	1.00	4.52	0.08	2.53	0.46	0.80
New Zealand	0.68	0.37	2.39	5.05	3.79	−0.64	1.70	0.68	0.93
Nicaragua	−2.91	−2.46	7.85	18.30	4.01	−1.28	0.11	0.39	0.62
Niger	−1.71	0.10	6.05	17.16	3.47	−2.13	−0.53	0.41	0.57
Nigeria	−0.96	−0.03	5.59	27.87	4.11	−2.11	−1.19	0.57	0.62
Norway	3.04	−0.48	1.76	7.94	3.95	−0.22	0.54	0.59	0.82
Pakistan	2.47	−1.26	1.93	9.80	3.39	−1.48	−1.09	0.42	0.65
Panama	1.12	−0.74	4.92	10.46	3.67	−0.59	2.68	0.21	0.78
Papua New Guinea	0.07	−1.47	5.43	12.24	4.36	−1.67	−0.23	0.74	0.67
Paraguay	1.32	1.94	4.12	17.48	3.36	−1.73	−0.70	0.27	0.50
Peru	−0.42	−1.56	6.10	12.96	3.23	−1.97	0.12	0.27	0.59
Philippines	0.72	0.04	3.76	11.79	3.86	−1.13	−0.57	0.40	0.63
Portugal	2.47	0.02	3.23	4.65	3.87	−0.32	0.09	0.21	0.65
Rwanda	0.32	1.98	10.06	30.39	3.08	−2.67	−1.00	0.40	0.55

Senegal	0.19	−0.85	4.34	6.69	3.90	−1.29	−0.24	0.46	0.62
Sierra Leone	−3.35	2.57	7.15	34.08	3.52	−3.12	−0.85	0.33	0.46
Singapore	5.32	−1.24	2.56	2.08	5.67	−0.17	2.00	0.80	0.92
South Africa	−0.38	−0.79	2.30	5.61	3.75	−0.69	−1.12	0.64	0.77
Spain	1.98	0.52	1.76	5.11	3.36	−0.24	0.36	0.30	0.68
Sri Lanka	3.48	1.15	1.21	14.27	4.02	−1.73	−0.52	0.58	0.74
Sweden	1.62	−0.47	2.00	2.82	3.94	0.01	1.58	0.58	0.84
Switzerland	0.80	1.25	2.38	3.86	3.99	0.31	2.68	0.64	0.79
Syrian Arab Republic	1.57	−3.00	6.00	13.70	3.80	−2.68	−1.64	0.55	0.65
Thailand	4.66	−1.99	4.37	5.57	3.99	−0.51	−0.04	0.39	0.75
Togo	−0.49	−2.48	7.08	23.49	4.05	−1.51	−0.87	0.43	0.44
Tunisia	2.44	−1.18	2.65	4.71	4.14	−0.53	−0.92	0.43	0.78
Turkey	1.93	−0.45	4.11	6.89	3.11	−1.86	−0.95	0.45	0.77
Uganda	2.05	−0.91	3.44	20.64	3.11	−3.69	−0.47	0.58	0.6
Uruguay	1.59	−0.26	4.89	6.40	3.35	−1.29	0.87	0.61	0.68
Venezuela	−0.94	2.30	4.53	22.09	3.71	−1.07	0.64	0.25	0.55
Zambia	−2.23	−5.99	3.98	26.15	4.08	−2.78	−0.71	0.54	0.71

Note: Variables are measured over the period 1974–2000. Average output growth is growth of real GDP per capita. Average terms of trade growth is the average growth of the terms of trade index. Standard deviation output growth is the standard deviation of the growth rates of real GDP per capita. Trade openness = Log (Exports + Imports) / GDP. Financial depth = Log (Private credit) / GDP. Financial Openness is the Chinn–Ito measure of capital account openness. Labor market flexibility is a 0 − 1index obtained from de jure labor regulation. Ease of firm-entry is a 0−1 index combining information on number of procedures, monetary cost, and time to open a new firm.

Source: Authors' analysis based on data described in text

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