2020

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Abstract

This paper investigates nonlinear relationships between terms of trade volatility (*totvol*) and economic growth in 14 Latin American economies from 1997 to 2014. In the 2000s, Latin American countries experienced accelerated economic growth often attributed to commodity price booms. We split the sample into two regimes based on *totvol* thresholds determined by bootstrap techniques. Fixed-effects, instrumental variable and dynamic panel regressions address endogeneity in trade-growth, subject to traditional economic channels such as domestic investment, population growth, exchange rate, government size, and institutions. We find statistically significant thresholds and stronger trade-growth links during the 2000s commodity boom and in larger economies.

Keywords: Economic Development; Latin America; Panel Data; Threshold Techniques; Trade-Growth Nexus.

JEL Classification: O47; O54; C23; C24; B27.

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1. Introduction

The relationship between trade and economic growth has been subject of extensive investigation in the development literature. In the 1970s, the discussion was centered on strategies concerning either import-substituting industrialization or export expansion, especially of manufactured goods (Emery, 1967; Voivodas, 1973; Williamson, 1978). Neoclassical economists later reached a consensus on the theory of export-led growth as "new conventional wisdom" (Tyler, 1981). From the 1980s to 1990s, the overall evidence supports exports leading to higher levels of output growth, as documented by an extensive literature that includes Krueger (1980); Feder (1983, 1986); Kavoussi (1984); Balassa (1985); Ram (1985, 1987); Singer and Gray (1988); Mbaku (1989); Fosu (1990, 1996); Otani and Villaneuva (1990); Alam (1991); Dodaro (1991); Salvatore and Hatcher (1991); De Gregorio (1992); Sheehey (1992); Sprout and Weaver (1993); Coppin (1994); Amirkhalkhali and Dar (1995); Yaghmaian and Ghorashi (1995); and McNab and Moore (1998).

Helpman and Krugman (1985) argue that export growth accelerates economic development by means of economies of scale, specialization in production and diffusion of technical knowledge. Similarly, Bhagwati (1988) shows that exports promote economic growth which promotes skill formation and technological progress, creating a comparative advantage for a country. In the 2000s, research started considering trade openness measured as the sum of exports and imports over GDP as key driver of economic growth. Rodrik et al. (2004) note that, together with institutions and geography, international trade is a crucial determinant of economic development and is part of one of the three main lines of thought in the large literature on the wealth of nations. Hausmann et al. (2007) argue that "what you export matters" and build an index of the income level of a country's exports that predicts subsequent economic growth.

The literature has not yet addressed, however, the question whether there is any evidence of threshold effects of the terms-of-trade volatility on the relationship between trade openness and economic growth. This is important because Rodrik (1998, p. 1014) proposes that terms-of-trade volatility "not only would be the theoretically appropriate measure of external risk but would be the only relevant measure of such risk". This proposition has been recently examined for the behavior of government expenditures to GDP ratios in Latin American economies by Vianna and Mollick (2018a). Along the same lines, Caporale and Girardi (2016) find evidence for Latin America that the trade channel appears to be the most important source of business cycle co-movements, whilst capital flows are found to have a limited role, especially in the very short run. Latin America has been subject to extreme commodity price fluctuations in the recent years, including the post-2003 years normally referred to as "commodity boom period" by Radetzki (2006) and Humphreys (2019), which makes the research question linking terms-of-trade volatility to economic growth once again worth exploring.

We attempt in this paper to fill the gap in the literature between economic growth and terms of trade for 14 Latin American countries at annual frequency from 1997 to 2014. We employ the threshold estimation technique by Law et al. (2013), who run regressions of economic growth on financial development and controls using a bootstrap threshold test from Hansen (2000) and find that the impact of finance on growth is positive and significant only after a certain threshold level of institutional development has been attained. Our approach uses economic growth as function of standard economic factors and can be contrasted to works on business cycles with very different results on the role of commodity prices in economic growth, such as Zeev et al. (2017) on a sample of Latin American countries in support of the hypothesis that terms-of-trade shocks are an important source of cyclical fluctuations. See also Fernández et

al. (2018) and Schmitt-Grohé and Uribe (2018) for studies of emerging markets with business cycle perspectives.

The 2000s commodity boom is different from previous booms because it combines a strong macroeconomic expansion in the period with the widespread use of commodities in emerging markets. Baffes and Haniotis (2010, p. 3) describe it as "the longest-lasting and the broadest in the numbers of commodities involved. It was the only one that simultaneously involved all three main commodity groups — energy, metals, and agriculture (…) It was not associated with high inflation, unlike the boom of the 1970s (…) it unfolded simultaneously with the development of two other booms — in real estate and in equity markets — whose end led most developed countries to their most severe post-WWII recession."

We examine the trade-growth nexus using more recent time spans, country size effects, while controlling for the international financial crisis of 2008-2009. Since the literature on the export-led growth hypothesis shows evidence of a bidirectional causal relationship between its variables of interest, we also control for a potential reverse causation from economic growth to international trade.[1] Our main findings are that the regime with above-threshold volatility displays stronger coefficients (5.98 or 4.34 for trade flows over GDP and exports over GDP, respectively, both significant at the 1% level) than the regime with below-threshold volatility (both measures with coefficients equal to 3.50 but not statistically significant). Results also support a higher positive impact of international trade on economic growth during the commodity boom when controlling for the financial crisis and size effects of large versus small economies of the region.

[1] For example, Dreger and Herzer (2013) adopt panel cointegration techniques for a sample of 45 developing countries and find that exports have a positive short-run effect on non-export GDP and vice versa.

The implications of this paper vary from the global economy perspective to the level of concentration of exports at the country level. First, Latin America is one of the most commodity-dependent regions within the emerging market world. According to Harrup (2016), the region's exposure to commodities is unique in the world, even greater than middle-income African countries. Rosnick and Weisbrot (2014) explain that the rebound in Latin American economic growth in the 2000s is often attributed to the commodity boom. Indeed, right before the global financial crisis, the global economy rose more than 4% each year in the period 2003-2007, the highest economic growth year-by-year sequence since the early 1970s (International Monetary Fund, 2016). On the path to economic recovery, the 2010s have experienced intense trade agreement negotiations in several countries, not only in the Asia-Pacific region (Euromonitor Research, 2018) but also in the U.S. and Europe (Jackson, 2018).[2] When we focus exclusively on the commodity boom period and add a crisis dummy (negative and statistically significant) to our estimations, the results support an even larger impact of international trade on growth with a coefficient of 12.20, compared to 7.32 for the full sample from 1997 to 2014.

Second, controlling for standard growth determinants we show that the impact of international trade (measured by either volume of trade/GDP or exports/GDP) for regimes of above-threshold terms-of-trade volatility imply stronger economic growth. In this paper, terms-of-trade volatility corresponds to deviations from the mean of the index calculated as the price of exports divided by the price of imports. Economic growth is higher – for the panel of countries –

[2] Jackson (2018, summary) explains that "during the Obama Administration, the United States negotiated two mega-regional free trade agreements that its participants argued were comprehensive and high-standard: the Trans-Pacific Partnership (TPP) among the United States and 11 other countries, and the U.S.-European Transatlantic Trade and Investment Partnership (T-TIP). The 12 TPP countries signed the agreement in February 2016, but the agreement required ratification by each country before it could enter into force. Upon taking office, President Trump withdrew the United States from the TPP and halted further negotiations on the T-TIP, but may reengage in the TPP under different terms. The remaining 11 partners to the TPP concluded, without U.S. participation, a revised TPP, now identified as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP)."

when this measure is larger than a terms-of-trade volatility threshold; and lower otherwise. We argue that this result is due to the high share of natural resources in Latin American exports. In fact, recent research sheds light on some of these effects. Lectard and Rougier (2018), for example, find that defying comparative advantage helps diversify the export baskets of middle-income and resource-based economies while concentrating those of lower-income economies. Bahar and Santos (2018) introduce a theoretical framework showing how wage pressures caused by a resource windfall results in higher export concentration. When estimating export concentration indices on the share of natural resources in exports, Bahar and Santos (2018) find positive effects for non-OECD countries, more likely to be subject to Dutch Disease than OECD countries in which no effects are found. Articles on emerging markets using external trade include Dufrenot et al. (2010), who apply quantile regressions for a panel of 75 developing countries and show that the heterogeneous effect of international trade on growth is higher in countries with low growth rates. Lin and Ye (2018) quantify the effects of the international credit channel of U.S. monetary policy transmission to developing countries using trade data. Vianna and Mollick (2018b) perform system GMM dynamic panel regressions for 192 countries and find that international trade and institutions are the most important determinants of Latin American economic development.

The rest of paper proceeds as follows. Section 2 explains the empirical methodologies. Section 3 describes the data. Section 4 provides the empirical results. Section 5 performs robustness tests and the last section summarizes the conclusions of this study.

2. Methodology

The main empirical model is based on Law et al. (2013), whose methodology relies on Hansen's (2000) endogenously-determined threshold estimation of the finance-growth hypothesis. In this paper we examine the trade-led growth hypothesis and allow for the real effective exchange rate (reer), government size (G/Y), and institutions – averaging the 3 WGI measures as selected in Law et al. (2013) – to the model. Given the trade-led growth hypothesis and the sample of countries in this study, the threshold is based on *totvol* (terms-of-trade volatility) instead of institutions.[3]

The analysis starts with a simple fixed effects panel data regression model:

$$GROWTH_{it} = \alpha_i + \beta_1 ln\,(TRADE)_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1),$$

where $GROWTH_{it}$ is the average growth rate in country *i at time t*, α_i is the unobserved heterogeneity (fixed effect) of each country, $TRADE_{it}$ is alternates between the trade flows measure (exports plus imports over GDP) and the exports measure (exports/GDP), X is a vector of controls (population growth rate, investment/GDP ratio, real effective exchange rate, government size and institutions), and ε_{it} is a noise term. Except for growth, population growth and institutions, variables are transformed into natural logarithms.

The threshold regression model can be expressed as follows:

[3] Using institutions as a threshold, the bootstrap threshold test fails to reject H_0 (no threshold), i.e., it is not a good threshold for the trade-led growth model. A table with these results is available upon request.

$$GROWTH_{it} = [\mu_i + \mu_1 \ln(TRADE)_{it} + \mu_2 X_{it}]\, I(totvol_{it} \leq \lambda) + [\gamma_i + \gamma_1 \ln(TRADE)_{it} + \gamma_2 X_{it}]\, I(totvol_{it} > \lambda) + \varepsilon_{it} \quad (2),$$

where *totvol* is the threshold variable used to split the sample into regimes or groups and λ is the unknown threshold parameter. I (.) is the indicator function that takes the value of 1 if the argument is valid; zero otherwise. This type of modeling strategy allows the role of international trade to differ depending on whether terms-of-trade volatility is below or above some unknown level of λ. In this equation, *totvol* acts as sample-splitting (or threshold) variables. The impact of international trade on growth will be μ_1 and γ_1 for countries with a low or high regime, respectively. Under the hypotheses $\mu_1 = \gamma_1$ and $\mu_2 = \gamma_2$ the model becomes linear and reduces to (1). A useful theoretical framework is Rodrik (1998), who examines two proxies of exposure to external risk: the first is terms of trade risk and the second is an index of the product concentration of exports. Since Rodrik (1998) interacts the measure of trade openness with the standard deviation of the first differences in terms of trade for his first measure, our empirical model (2) implements this non-linearity when *totvol* is the threshold linking trade to growth.

We next handle endogeneity from growth to trade in the context of threshold estimation using an instrumental variable (IV), in which the variable of interest, international trade, is instrumented by Kilian's (2009) real economic activity index based on dry-cargo single voyage ocean shipping freight rates. Controlling for endogeneity is especially important given that recent studies, such as Fujii (2019), show that the cross-country variation of trade openness derives more from the variability in GDP than trade itself. In the context of finance and growth, Law and Singh (2014) apply the threshold method by Kremer et al. (2013) for threshold estimation under

dynamic panels. In addition to 2SLS using a measure of global trade as instrument, we employ dynamic panel regressions with threshold effect and endogeneity based on Seo and Shin (2016), who propose a general GMM approach based on the first-difference (FD) transformation, allowing simultaneously for nonlinear asymmetric dynamics and unobserved individual heterogeneity. Following the methodology by Seo and Shin (2016), we estimate the FD-GMM adopting the following model that includes lagged dependent variable (economic growth) together with threshold estimation:[4]

$$GROWTH_{it} = [\phi_1 GROWTH_{it-1} + \phi_{11} \ln(TRADE)_{it} + \phi_{21} X_{it}]\, I(totvol_{it} \leq \gamma) +$$

$$[\phi_2 GROWTH_{it-1} + \phi_{12} \ln(TRADE)_{it} + \phi_{22} X_{it}]\, I(totvol_{it} > \gamma) + \alpha_i + \upsilon_{it} \quad (3),$$

where *totvol* is the threshold variable used to split the sample into regimes or groups and γ is the unknown threshold parameter. I (.) is the indicator function that takes the value of 1 if the argument is valid; and zero otherwise. Seo and Shin (2016) explain that, although Kremer et al. (2013) have considered a hybrid dynamic version by combining the forward orthogonal deviations transformation by Arellano and Bover (1995) and the IV estimation of the cross-section model by Caner and Hansen (2004), the crucial assumption in these studies is that either regressors or the transition variable or both are exogenous. Models ranging from (2) to (3) allow

[4] Seo and Shin's (2016) sample was for a large N, 565 firms (reduced to 560 due to exclusion of extremes) and a smaller T, from 1973 to 1987, i.e., 15 years. In our sample, we have n=14 and T=18, i.e., T is about the same magnitude although n=14 is smaller. However, we have decided to keep the methodology since one of the anonymous referees recommended that we adopted a dynamic panel threshold model.

for non-linearities and do not require additional identifying assumptions, which might be necessary in alternative models.[5]

3. The Data

All data used in this paper are at annual frequency. The sample period is from 1997 to 2014. We select 1997 as the starting year due to data availability. Since Hansen's (2000) threshold model estimation requires balanced panels, the dataset covers the 14 countries listed in the notes of Table 1. Most of the measures are obtained from the World Bank's World Development Indicators (WDI) database, except for the institutions measure coming from the Worldwide Governance Indicators (WGI) database.

Table 1 reports the descriptive statistics of the dataset. Economic growth is calculated as the yearly percentage change in the country's GDP growth rate. The average economic growth rate is 3.825% in the 1997-2014 period with a maximum of 18.3% from Venezuela in 2004 and a minimum of -10.9% from Argentina in 2002. The average population growth rate is around 1.4% with a maximum of 2.39% from Costa Rica in 1997 (closely followed by Paraguay at 2.25% in the same year) and a minimum of -0.06% from Uruguay in 2003. The average investment-to-output ratio is 20.18% with a maximum of 43.3% from Panama in 2014 and a minimum of 11.7% from Bolivia in 2004. The real effective exchange rate (*reer*) is calculated by WDI as an index that is equal to 100 in the year 2010. An increase in *reer* corresponds to an appreciation of

[5] The structural vector autoregression (SVAR) approach in Schmitt-Grohé and Uribe (2018) reports, for example, for 38 poor and emerging market economies from 1980 to 2011 that on average terms of trade shocks explain only 10% of movements in aggregate activity. Extensions of the SVAR with an alternative identification strategy by Zeev et al. (2017) for "commodity based terms of trade" (computed as the real price index of the country commodity export bundle and the U.S. corporate bond Baa spread) lead to news-augmented CTOT shocks explaining almost half of output fluctuations in emerging economies. Starting with a quarterly dataset from 1980 to 2014, Fernández et al. (2018) report that more than a third of the variance of real output is associated to commodity price shocks.

the local currency. The average *reer* in the 1997-2014 period is 99.2 with a maximum of 202.8 from Venezuela in 2014 and a minimum of 56.6 from Brazil in 2003. Government size is measured as the government expenditures over GDP and has a sample average of 12.98% with a maximum of 22.7% from Colombia in 1999 and a minimum of 6.2% from the Dominican Republic in 2004. Following Law et al. (2013), institutions are calculated as an equally-weighted average of the measures *Control of Corruption*, *Rule of Law* and *Government Effectiveness*. These measures are scaled from -2.5 to +2.5 and have an average of -0.23 points in this Latin American sample. The maximum value is +1.4 from Chile in 2012 and the minimum is -1.5 from Venezuela in 2014.[6]

International trade, the key explanatory variable in this paper, has two measures that undergo separate regressions: trade flows (exports plus imports) over GDP and the exports-to-GDP ratio. Trade flows average around 61.61% of GDP with a maximum of 165.3% from Panama in 1997 and a minimum of 16.4% of GDP from Brazil in 1998. The average exports-to-GDP ratio is 30.73% with a maximum of 76.99% from Panama in 1997 and a minimum of 6.98% from Brazil in 1997. Brazil, the largest country in Latin America measured by GDP, is an example of a relatively closed economy.

The threshold variable in this study is terms-of-trade volatility, *totvol*, calculated as the deviation from the mean of the index value (price of exports divided by imports). The average *totvol* is 0.017 (median is 0.0133), with a maximum of 0.37 from Venezuela in 2000 and a minimum of -0.345 also from Venezuela in 1998.

Table 2 displays the matrix of correlation coefficients of the variables in the empirical model. The bivariate relationships between the dependent variable (growth) and the explanatory

[6] The Worldwide Governance Indicators (WGI) aggregate indicators and underlying source data are available at http://info.worldbank.org/governance/wgi/

variables are consistent with previous literature: ln (Trade) and ln (Exp) have positive correlation coefficients (0.2709 and 0.2583, respectively); *pop* shows a positive and very small coefficient of 0.0318; ln(I/Y) and *inst* have positive correlation coefficients of 0.2974 and 0.0483, respectively; ln(reer) and ln(G/Y) are negatively correlated with growth (-0.0980 and -0.1882, respectively). The only high correlation coefficient is the one between the two international trade measures. However, this very high coefficient of 0.9773 does not bring a multicollinearity bias to the model since *ln(Trade)* and *ln(Exp)* are used in separate regressions of economic growth as dependent variable. There are also medium correlation coefficients between population growth rate and institutions (-0.4865) and between government size and international trade: -0.4684 from *ln(G/Y)* versus *ln(Trade)* and -0.4727 from *ln(G/Y)* against *ln(Exp)*.

4. Empirical Results

This section begins by reporting the fixed effects panel data regression results using (1) and comparing them with results from separate regimes (subsamples) that are split by an exogenously-determined threshold. Subsequently, we provide results from the bootstrap threshold test using the Hansen (2000) methodology and report fixed effects panel data regressions using the endogenously-determined threshold as described in (2). We next answer additional questions related to the robustness of results when splitting data into subsamples with different selections of countries and time spans.

4.1 Exogenously-Determined Threshold

Table 3 reports fixed effects panel data regression results for (1). In the first three columns, international trade is measured by trade flows over GDP. The first column brings regression results for the linear model, i.e., fixed-effects regressions without the threshold. The second and third columns report fixed-effects regressions of regimes split by an exogenously-determined threshold. We define this threshold as the median of terms-of-trade volatility (*totvol*) and obtain two regimes (subsamples) of the same size: 126 observations each. Column 2 shows results for regime 1 (above threshold) while column 3 displays the results for regime 2 (below threshold). The last three columns adopt exports over GDP as the measure for international trade and the criteria for each of them are the same as in the first three columns.

The linear regression results demonstrate that both measures of international trade are highly significant at the 1% level and have a positive relationship with economic growth: we find the coefficients of 7.32 for trade flows over GDP and 5.06 for exports over GDP. There are statistically significant coefficients for some of the control variables: investment shows a very strong and positive association with economic growth significant at the 1% level in both linear regression specifications; government size has a negative coefficient significant at the 1% level in both linear models; and institutions are positively related to economic growth with 5% and 10% significance levels in the linear models using, respectively, trade flows and exports as the international trade measure. Population growth and the real effective exchange rate do not show statistical significance at any level. The R-squared for the linear models are 24.5% and 23.4%, respectively.

The threshold model regressions provide evidence of a stronger trade-growth link when terms-of-trade volatility is higher (regime 1). The coefficient of trade flows over GDP is 7.364 in

regime 1 (statistically significant at 1%) while it has the value of 6.068 in regime 2 (statistically significant at 5%). The exports measure has coefficients of 4.859 in regime 1 and 4.125 in regime 2, both significant at the 5% level. From the control variables, there are interesting results as well: investment has a stronger coefficient when terms-of-trade volatility is lower, government size has a stronger negative association with economic growth when terms-of-trade volatility is higher, and institutions are only statistically significant in regime 2 when the economy is subject to less terms-of-trade volatility.

4.2 Endogenously-Determined Threshold

Table 4 brings the threshold estimation results using the terms-of-trade volatility measure (*totvol*) in (2). Following Hansen (2000), the statistical significance of the threshold estimate is evaluated by a p-value that results from a bootstrap method with 1000 replications and 15% trimming percentage. In contrast to Law et al. (2013), who first run a single-threshold test and then test whether the high-threshold group could be split further into sub-regimes, we are not able to test the second split since the resulting panel is, as expected, an unbalanced panel.[7] For robustness, however, we check for both single- and double-threshold models, which would split the sample into two or three regimes, respectively.

Model 1 (single-threshold) displays bootstrap p-values of 0.003 in both empirical model specifications (with trade flows/GDP or exports/GDP). This indicates that the null hypothesis of no threshold effect can be rejected. The sample can therefore be split into two regimes. The point estimate of the threshold value of *totvol* is -0.0486 with a corresponding 95% confidence interval

[7] Law et al. (2013) are able to perform this second split test – in which the threshold did not turn out significant in any case – since their dataset is a cross-section: one observation per country. Therefore, in their case, excluding observations does not result in an unbalanced panel.

[-0.0497, -0.0481] for both specifications. This implies that observations with *totvol* values of less than -0.0486 are classified into the low-*totvol* group (i.e., low terms-of-trade volatility) while those with greater values are classified into the high-*totvol* group (high terms-of-trade volatility). Model 2 (double-threshold), however, shows insignificant bootstrap p-values for a double-threshold model, suggesting that only the single threshold is suitable for the dataset. Once we have estimated the terms-of-trade volatility threshold, the next step is to examine how *totvol* affects economic growth.

Table 5 presents fixed effects panel data regression results for (2) splitting the sample into two regimes accordingly to the endogenously-determined terms-of-trade volatility (*totvol*) threshold. The first two columns show the results from the model specification that adopt trade flows/GDP as the international trade measure, while the last two columns employ exports/GDP as the measure of trade. The main difference between the results from Table 5 (endogenously-determined *totvol*) and the ones from Table 3 (exogenously-determined *totvol*) is the finding that the impact of international trade on economic growth is positive and highly significant (at the 1% level) only after a certain threshold level of *totvol* has been attained. Until then, the effect of trade on growth is nonexistent since standard errors associated with international trade are large in columns (2) and (4) for regime 2 when *totvol* is lower than the threshold. This result is robust to both measures of international trade.

The results for the control variables in Table 5 are somewhat similar to the previous regression tables: investment again has a larger coefficient when terms-of-trade volatility is lower, although the statistical significance is stronger in the high-totvol group (regime 1); the government size coefficient is only a little more negative and has higher statistical significance (at the 1% level) when volatility is higher (regime 1) but is insignificant in the low-volatility

regime; and institutions remain only statistically significant in regime 2 (less volatile terms of trade), but with larger coefficients than in previous regressions. Once more, population growth and real effective exchange rate do not show any statistical significance.

Interestingly, the R-squared from the regime 1 regressions in Table 5 (21.6% and 20.9%, columns 1 and 3) are a little lower than the equivalent ones in Table 3 (24.5% and 22.6%), while the R-squared from the regime 2 regressions in Table 5 (35.8% and 37.4%, columns 2 and 4) are much higher than the respective ones in Table 3 (26.9% and 25.9%). The higher R-square value indicates that *investment* and *institutions* represent over a third of the variance in Latin American economic growth when the economy is operating below a certain level of volatility determined by the *totvol* threshold. These results are in line with Vianna and Mollick (2018b), who provide evidence that international trade and – especially – institutions represent key forces for Latin American economic development.[8]

4.3 Additional Questions

The finding of a significant link between international trade and economic growth only after a certain level of *totvol* is attained raises new questions: could this evidence be related to the 2000s commodity boom period? Could we obtain similar evidence (of a non-significant and a highly significant regime) from splitting the sample into pre-commodity and commodity boom periods? In addition, what do we find when the sample is split into large and small country sizes? Do larger countries have a stronger trade-growth nexus? And are these results robust to a

[8] Vianna and Mollick's (2018b) find that a 0.1-point increase in their aggregate institutions index, built from the World Governance Indicators (WGI) database, has an effect of 3.9% increase in Latin American per capita output versus a 2.6% impact on the world's economic development.

potential endogeneity in the trade-growth relationship? We address these questions in subsequent analysis.

Table 6 compares linear fixed effects panel data regression results of (1) for the full sample (1997-2014) and the more recent period. For additional robustness, we test the 2003-2010 period which the literature has defined more clearly as the "commodity boom period".[9] The results for the full sample regressions with either of the international trade measures (trade flows or exports) show that the trade coefficient is highly significant and equal to 7.32 or 5.06 (trade flows/GDP and exports/GDP, respectively), while in the 2003-2014 period the coefficient is equal to 8.88 or 7.73, or equal to 9.03 or 7.92 when a crisis dummy variable representing the global financial crisis years of 2008-2009 is inserted into the model. The crisis coefficient is equal to around -1.3 in both model specifications in the 2003-2014 period. The robustness test using the commodity boom period (2003-2010) shows that if the crisis dummy variable is omitted, the coefficient of the trade-growth nexus is not much significant (8.266 with significance at the 10% level and 5.042 with no statistical significance, in each specification, respectively). However, with the inclusion of crisis, the coefficient is highly significant and has a large positive coefficient: 12.2 for the trade flows/GDP measure and 7.83 for the exports/GDP measure, with statistical significance at the 1% and 5% levels, respectively.

Results from the control variables are the following. The coefficient of population growth rate is not significant in any regression, while investment shows evidence of statistical significance at the 1% level for the full sample (1997-2014) and the commodity boom period (2003-2010). Government size and institutions have, respectively, negative and positive

[9] We adopt the period of 2003-2010 to represent the commodity boom period. This choice comes from evidence from Bai-Perron tests (available upon request) and applied studies such as Radetzki (2006) and Humphreys (2019), who attribute the start of the commodity price boom to around 2003.

coefficients that are statistically significant in most specifications. The real effective exchange rate does not show much evidence of any statistical significance, except for one out of the ten regressions where it is only significant at the 10% level.

Table 7 reports linear fixed effects panel data regression results of (1) after we split the sample into two subsamples: small and large countries. The split threshold is the average GDP of each country in the 2007-2014 period. The 7 small countries sorted by GDP, in US$ billion, from smallest to highest, are Paraguay (8.2), Bolivia (8.5), Panama (12.3), Costa Rica (13.2), Uruguay (14.9), Dominican Republic (16.6) and Ecuador (26.9). The 7 large countries sorted by GDP, in US$ billion, from highest to smallest, are Brazil (781.0), Mexico (257.2), Argentina (143.3), Venezuela (119.4), Colombia (110.3), Chile (76.3) and Peru (56.0).

For extra robustness, we test the large countries group by excluding Argentina and Brazil. Since these two countries are much more closed economies than the region's average, they could be downward biasing the results, especially the coefficient of international trade. The results for the small countries regressions with either of the international trade measures (trade flows or exports) show that the trade coefficient is statistically significant at the 5% level and smaller than those in the large countries.

When excluding Argentina and Brazil, the international trade coefficients grow in value and statistical significance: the trade flows coefficient jumps from 8.25 to 10.72 and from 5% to 1% significance level while the exports coefficient rises from 4.72 to 6.46 and from 10% to 5% significance level. These findings support the idea that countries with higher exposure to trade benefit more in terms of economic growth. Results from the control variables are the following. Investment displays weak signs of significance for the group of small countries, at the 11% and

10% levels (in the first and fourth columns, respectively), but it does not appear statistically significant for the large countries group. Government size displays a negative relationship with growth and is highly significant at the 1% level for the group of large countries, while the significance for small countries is at the 10% level. In large countries, the negative coefficient on G/Y is much stronger, suggesting that governments should not grow proportionally to its population or exports such that their economies achieve higher economic growth rates.

Table 8 reports instrumental variable regressions using the two-stage least squares (2SLS) method. In these regressions, the variable of interest, international trade, is instrumented by Kilian's (2009) real economic activity index based on dry-cargo single voyage ocean shipping freight rates. This technique is performed to control for the potential endogeneity arising from reverse causation from economic growth to international trade. For all specifications, the first-stage specification tests show that: (a) the Durbin-Wu-Hausman endogeneity test null hypothesis that international trade can be treated as exogenous (in that case, there would be no need of an instrumental variable) is rejected at the 5% level of significance or better; (b) the Kleibergen-Paap test null hypothesis that the model is underidentified is rejected at the 1% level for all specifications; and (c) the Cragg-Donald test null hypothesis that the model is weakly identified is rejected at the 10% level or better: the F-stat is higher than the corresponding critical value of 16.38. We employ the crisis variable (*crisis*) equal to one in the 2008-2009 years of financial crisis, otherwise zero. We also adopt a commodity boom binary variable (*boom*) that is equal to one for the period from 2003 to 2010, defined as the 2000s commodity boom period in this paper. In addition, we build one more binary variable, *large*, to control for the possibly different growth rates in the largest Latin American economies.

The results show that international trade, measured by trade flows/GDP or exports/GDP, has a positive and significant impact on economic growth. These are at the 1% level in four regressions and at the 5% level in two regressions. The coefficients range between 4.57 in column (4) and 6.79 in column (3), consistent with the ones in previous tables. While *crisis* has a negative coefficient, *boom* and *large* have positive and statistically significant coefficients (1% or 5% significance levels for *boom* and 10% level for *large*). The statistically significant results from the control variables are: the highly significant (at the 1% level) negative coefficients for population growth, ranging between -2.521 and -3.067, the positive coefficients for the investment-to-output ratio, varying from 4.716 to 6.552, and the positive coefficients for institutions, fluctuating between 0.908 and 1.297. In contrast, government size loses statistical significance in Table 8 under IV estimations. The real effective exchange rate is found to be significant in 2 out of 6 regressions with negative coefficients: real currency appreciation leads to lower economic growth in columns (1) and (4), in line with what is expected for less competitiveness of small open economies.

5. Robustness Tests

Following recommendations from anonymous referees, we perform two additional sets of fixed effect panel data regressions and one set of dynamic panel regressions with threshold effect and endogeneity. In Table 9, we run a robustness check for the exogenously determined threshold regression adopting thresholds at the 75^{th} and 25^{th} percentiles of terms-of-trade volatility (*totvol*). While the international trade coefficients are nonsignificant for columns 1, 4, 5 and 8, specifically, high regime at the 75^{th} percentile threshold (totvol = +0.051196) and low regime at the 25^{th} percentile threshold (totvol = – 0.040241), the coefficients are highly

significant at the 1% level for columns 2, 3, 6 and 7, namely, low regime at the 75% percentile of totvol and the high regime at the 25th percentile of totvol, varying from 3.79 to 5.89. Interestingly, investment/GDP ratio is statistically significant in every regression, showing however higher coefficients for columns 1, 4, 5, 8, varying from 7.47 to 11.03. These results suggest that economic growth in Latin America does not benefit from international trade in times of extreme negative or extreme positive terms-of-trade volatility, when domestic investment takes over and plays an important role in the region's development. Government size shows negative and statistically significant coefficients, except for the high regime at the 75% threshold, varying from -6.57 to -9.25. Similar to results from Table 3, institutions are only statistically significant in the low regime, when the economy is subject to lower terms-of-trade volatility.

Table 10 performs another robustness test by adding an interactive term between international trade and terms-of-trade volatility. The results show that totvol interacts with international trade to positively impact economic growth in Latin America, consistent with our main finding that regimes with above-threshold terms-of-trade volatility show higher international trade effects on economic growth. Results for the control variables show that investment has a positive coefficient while government size negatively affects Latin American economic growth, in line with our previous findings.

In Table 11, we employ dynamic panel regressions with threshold effect and endogeneity based on Seo and Shin (2016). The dynamic panel results show that international trade is, in fact, the most significant variable under this methodology and for various model specifications. For robustness, the regression specifications employ different combinations of regressors. In columns (1) and (2), we set the trim rate to zero. International trade is significant at the 1% level, while

real effective exchange rate has a negative coefficient significant at the 10% level in column (2). The stronger the home currency compared to the basket, the lower the real GDP growth rate. Institutions under these specifications in columns (1) and (2) show no statistical significance. The coefficient for crisis is negative in both regressions but only significant at the 5% level in column (2). In columns (3) and (4), we set the trim rate to 10% and continue to find significant positive coefficients at the 5% level for international trade, while government size has a negative coefficient in column (3) also significant at the 5% level. In column (4), the investment/GDP coefficient is positive and significant at the 1% level, while institutions show a positive coefficient which is statistically significant at the 5% level. The lagged economic growth variable which represents the initial condition of growth has negative coefficients and is highly significant at the 1% level in three out of the four specifications. Finally, these specifications are stable under the kink model.[10] In fact, results for the kink slope are mixed although its coefficients are significant in three out of four regressions. The idea behind estimating the threshold in the dynamic model is to minimize the objective function of the generalized method of moments. As far as *totvol*, the results from the Seo and Shin (2016) model are consistent with highly significant threshold effects on economic growth: the higher *totvol* the higher economic growth, allowing for a mix of control variables: REER, G/Y, I/Y, institutions, and crisis.

6. Concluding Remarks

This article adopts threshold estimation models to terms-of-trade volatility within the trade and economic growth framework. There is evidence of a positive nonlinear relationship

[10] Hansen (2017) defines a regression kink model (or continuous threshold model) as a threshold regression constrained to be everywhere continuous with a kink at an unknown threshold.

between international trade and economic growth in Latin America in the last two decades. Our approach is grounded on economic growth in the long run explained by a set of fundamentals including terms of trade and openness measures. Given that the vector of controls is mostly pertained to the domestic economy (population growth, investment rate, government size, and institutions) the empirical specification is fairly stable leaving trade considerations (trade flows/GDP or exports/GDP) to assume the driving force of growth. As explained in the methodology section, our estimates do not require any identification assumptions, which contrast to a group of business cycles studies whose results quantifying the relevance of commodity prices to real fluctuations appear sensitive to the method of identification of shocks.

We provide evidence of a nonlinear trade-growth channel in Latin America that appears related to the increased economic volatility from the 2000s commodity boom. Fixed effects panel data regressions using an endogenously determined threshold method indicate that terms-of-trade volatility, the threshold variable, mediates the impact of international trade on economic growth. We find that the regime with above-threshold volatility displays a stronger coefficient for the trade-growth links. For robustness, we examine trade-growth using different time spans, country sizes and controlling for the 2008-2009 financial crisis. We then address endogeneity in two ways. First, we employ IV regressions to control for potential endogeneity in the relationship between international trade and economic growth. Second, we extend the threshold panel data model when lagged dependent variable (real GDP growth) is present. Both threshold models (without and with lagged dependent variable) suggest that as totvol goes higher than the threshold, the amount of trade flows with respect to GDP goes up. This appears robust, although the set of controls is not the same across models since the lagged dependent variable introduces dynamics, through the persistence coefficient, and it is not necessary to allow as many controls

as in the original threshold model. Further research includes a more elaborate assessment on the stability of non-linear models under the presence of lagged dependent variables for small open economies.

While there is evidence of a statistically significant negative impact of the financial crisis on economic growth, the trade-growth nexus is stronger during the 2000s commodity boom and in larger economies. Since regimes with larger terms-of-trade volatility are associated with higher economic growth, we might expect growing export concentration in Latin America. Our findings call for more research to better understand the dynamics of export industry subject to concentration or diversification trends in periods of terms-of-trade volatility. Future research could investigate the response of trade in developing countries to factors not commonly explored in economic growth models dealt in this paper. If global factors such as U.S. monetary policy and oil prices exert an impact on economic activity, extensions exploring these channels subject to high and low regimes represent an interesting research avenue for quantifying these effects on small open economies.

Table 1
Descriptive Statistics. 14 Countries, 1997-2014, 252 Observations.

	Unit of Measurement	Mean	Median	Std dev.	Minimum	Maximum
Economic growth	%	3.825	4.169	3.838	-10.894	18.287
Population growth	%	1.396	1.422	0.433	-0.064	2.391
Investment	% of GDP	20.183	19.854	4.373	11.687	43.343
Real effective exchange rate	Index (2010=100)	99.180	98.871	18.580	56.560	202.844
Government size	% of GDP	12.980	12.352	2.993	6.207	22.734
Institutions	Scaled from -2.5 to 2.5	-0.230	-0.322	0.657	-1.501	1.403
International trade						
Trade flows	% of GDP	61.611	56.012	29.348	16.439	165.344
Exports	% of GDP	30.729	27.897	14.565	6.984	76.988
Volatility						
Terms-of-trade volatility	Deviation from index (2000=100) mean	0.017	0.0133	0.090	-0.345	0.370

Countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Mexico, Panama, Paraguay, Peru, Uruguay, Venezuela.

Table 2

Correlation Coefficients.

	growth	ln(Trade)	ln(Exp)	pop	ln(I/Y)	ln(reer)	ln(G/Y)	inst	totvol
growth	1								
ln(Trade)	0.2709	1							
ln(Exp)	0.2583	0.9773	1						
pop	0.0318	0.3722	0.3534	1					
ln(I/Y)	0.2974	0.2569	0.1758	0.1778	1				
ln(reer)	-0.0980	-0.0229	-0.0688	0.0756	0.2364	1			
ln(G/Y)	-0.1882	-0.4684	-0.4727	-0.1	-0.0759	-0.0824	1		
Inst	0.0483	0.0183	-0.0078	-0.4865	0.1375	-0.1318	0.1336	1	
totvol	0.2432	0.0183	0.0937	0.0022	-0.0617	-0.0497	-0.1207	-0.0460	1

Notes: growth = economic growth rate; ln(Trade) = log of trade flows; ln(Exp) = log of exports; pop = population growth; ln(I/Y) = log of investment; ln(reer) = log of real effective exchange rate; ln (G/Y) = log of government size; inst = institutions; totvol = terms-of-trade volatility.

Table 3
Fixed Effect Panel Data Regression Results Using the Median of Terms-of-Trade Volatility (Totvol) as Threshold.

Dependent variable: economic growth.

	International trade = Trade flows/GDP			International trade = Exports/GDP		
	Linear model	Threshold model (totvol median = 0.0133126)		Linear model	Threshold model (totvol median = 0.0133126)	
	FE without threshold	Regime 1: totvol > median	Regime 2: totvol <= median	FE without threshold	Regime 1: totvol > median	Regime 2: totvol <= median
International trade	7.322***	7.364***	6.068**	5.059***	4.859**	4.125**
	(1.705)	(2.418)	(2.411)	(1.315)	(1.903)	(1.865)
Population growth	-1.189	0.115	-0.848	-1.157	0.289	-0.979
	(1.149)	(1.775)	(1.547)	(1.171)	(1.822)	(1.562)
Investment	4.853***	5.203**	6.339***	6.087***	6.508***	7.063***
	(1.575)	(2.370)	(2.205)	(1.538)	(2.318)	(2.172)
Government size	-7.027***	-7.052**	-5.709*	-7.060***	-7.206**	-6.070*
	(2.249)	(3.348)	(3.179)	(2.277)	(3.401)	(3.186)
R.E. exchange rate	0.000422	-0.567	2.817	0.240	-0.860	3.045
	(1.841)	(2.883)	(2.580)	(1.935)	(2.968)	(2.729)
Institutions	4.066**	0.670	5.938**	3.692*	0.446	5.704**
	(1.934)	(3.264)	(2.433)	(1.939)	(3.306)	(2.441)
Constant	-19.63	-20.20	-36.05*	-11.82	-9.366	-27.36
	(14.65)	(21.77)	(21.19)	(14.15)	(21.02)	(19.98)
Observations	252	126	126	252	126	126
R-squared	24.5%	24.5%	26.9%	23.4%	22.6%	25.9%
Countries	14	14	14	14	14	14

Notes: Robust standard errors (White corrected for heteroscedasticity) reported in parentheses. Scripts *, ** and *** correspond to significance at the 10%, 5% and 1% levels, respectively.

Table 4
Endogenously-Determined Threshold Estimates of Terms-of-Trade Volatility (Totvol).

	Model 1 Single-Threshold	Model 2 Double-Threshold
	TRADE = Trade Flows/GDP	
Fstat test for no threshold	18.75	-0.44
Bootstrap p-value	0.003	1.000
Threshold estimate(s)	-0.0486	-0.0519; -0.0037
95% Confidence interval(s)	(-0.0497, -0.0481)	(-0.0520, -0.0507); (-0.0048, -0.0031)
	TRADE = Exports/GDP	
Fstat test for no threshold	18.52	0.24
Bootstrap p-value	0.003	0.999
Threshold estimate	-0.0486	-0.0525; -0.0037
95% Confidence interval	(-0.0497, -0.0481)	(-0.0540, -0.0520); (-0.0048, -0.0031)

Notes: H_0: no threshold effect.

Table 5
Fixed Effect Panel Data Regression Results Using the Endogenously-Determined Terms-of-Trade Volatility (Totvol) Threshold Estimates.

Dependent variable: economic growth.

	International trade = Trade flows/GDP		International trade = Exports/GDP	
	Regime 1: totvol > -0.0486	Regime 2: totvol < -0.0486	Regime 1: totvol > -0.0486	Regime 2: totvol < -0.0486
International trade	5.977***	3.500	4.342***	3.499
	(1.837)	(3.795)	(1.439)	(2.709)
Population growth	-1.282	1.800	-1.149	2.102
	(1.297)	(1.920)	(1.319)	(1.905)
Investment	4.069**	6.900*	4.891***	7.455**
	(1.725)	(3.553)	(1.691)	(3.391)
Government size	-7.705***	-4.191	-7.697***	-4.157
	(2.410)	(4.794)	(2.431)	(4.719)
R.E. exchange rate	0.165	2.036	0.718	2.859
	(2.037)	(3.366)	(2.159)	(3.335)
Institutions	2.136	6.688*	1.667	7.440**
	(2.165)	(3.465)	(2.156)	(3.507)
Constant	-10.93	-32.33	-6.600	-35.58
	(15.58)	(30.88)	(15.23)	(27.20)
Observations	202	50	202	50
R-squared	21.6%	35.8%	20.9%	37.4%
Countries	14	13	14	13

Notes: Robust standard errors (White corrected for heteroscedasticity) reported in parentheses. Scripts *, ** and *** correspond to significance at the 10%, 5% and 1% levels, respectively. In columns 2 and 4 (regressions from regime 2), the number of countries is 13 because all observations for Mexico have *totvol* above the threshold.

Table 6
Fixed Effect Panel Data Regression Results Using Different Time Spans. Dependent variable: economic growth.

	International trade = Trade Flows/GDP					International trade = Exports/GDP				
	1997-2014 (Full sample)	2003-2014		2003-2010 (Commodity boom)		1997-2014 (Full sample)	2003-2014		2003-2010 (Commodity boom)	
International trade	7.322***	8.881***	9.028***	8.266*	12.20***	5.059***	7.731***	7.915***	5.042	7.833**
	(1.705)	(3.006)	(2.968)	(4.854)	(4.543)	(1.315)	(2.574)	(2.541)	(4.035)	(3.792)
Crisis			-1.275**		-3.355***			-1.294**		-3.226***
			(0.577)		(0.781)			(0.576)		(0.789)
Population growth	-1.189	0.128	0.677	1.265	0.811	-1.157	0.0301	0.589	0.988	0.446
	(1.149)	(2.513)	(2.493)	(3.935)	(3.609)	(1.171)	(2.508)	(2.487)	(3.956)	(3.659)
Investment	4.853***	1.898	2.803	4.624	9.745***	6.087***	3.022	3.954**	6.302**	11.92***
	(1.575)	(1.978)	(1.995)	(3.204)	(3.170)	(1.538)	(1.893)	(1.913)	(2.949)	(3.053)
Government size	-7.03***	-6.064**	-6.094**	-8.541*	-5.407	-7.06***	-5.326*	-5.312*	-9.603*	-6.701
	(2.249)	(2.940)	(2.902)	(4.910)	(4.560)	(2.277)	(3.042)	(3.001)	(5.063)	(4.733)
R.E. exchange rate	0.0004	0.864	0.759	4.331	7.842*	0.240	2.407	2.358	3.667	7.050
	(1.841)	(2.590)	(2.557)	(4.552)	(4.252)	(1.935)	(2.816)	(2.778)	(4.738)	(4.457)
Institutions	4.066**	10.48***	9.427***	8.861*	6.629	3.692*	8.980***	7.883***	8.905*	6.769
	(1.934)	(3.002)	(3.001)	(4.539)	(4.194)	(1.939)	(3.008)	(3.008)	(4.572)	(4.258)
Constant	-19.63	-23.28	-26.70	-40.09	-93.78**	-11.82	-25.86	-29.77	-22.51	-69.89*
	(14.65)	(22.36)	(22.12)	(39.44)	(38.26)	(14.15)	(22.81)	(22.57)	(37.98)	(36.97)
Observations	252	168	168	112	112	252	168	168	112	112
R-squared	24.5%	22.4%	24.9%	20.6%	34.0%	23.4%	22.5%	25.1%	19.4%	31.9%
Countries	14	14	14	14	14	14	14	14	14	14

Notes: Robust standard errors (White corrected for heteroscedasticity) reported in parentheses. Scripts *, ** and *** correspond to significance at the 10%, 5% and 1% levels, respectively. *Crisis* is a binary variable equal to one in the crisis period between December 2007 and June 2009; zero otherwise.

Table 7
Fixed Effect Panel Data Regression Results Using Samples Split by Country Size.
Dependent variable: economic growth.

	International trade = Trade Flows/GDP			International trade = Exports/GDP		
	7 Small Countries	7 Large Countries	7 Large excl. Argentina & Brazil	7 Small Countries	7 Large Countries	7 Large excl. Argentina & Brazil
International trade	6.761**	8.246**	10.72***	4.679**	4.715*	6.456**
	(1.955)	(2.296)	(3.294)	(1.315)	(2.063)	(1.600)
Population growth	-1.162	1.441	1.708	-1.115	0.906	1.118
	(1.366)	(1.870)	(1.723)	(1.431)	(2.215)	(1.883)
Investment	4.052	5.517	1.404	4.855*	7.987	4.351
	(2.195)	(5.082)	(3.609)	(2.320)	(4.785)	(3.836)
Government size	-5.648*	-16.48***	-18.24***	-6.017*	-16.14***	-17.01***
	(2.384)	(3.493)	(1.908)	(2.648)	(2.700)	(1.909)
R.E. exchange rate	7.036	-0.371	-1.963	7.147	-1.169	-1.958
	(3.858)	(2.305)	(2.744)	(4.049)	(3.027)	(2.788)
Institutions	2.399	1.888	1.499	3.117	0.240	-0.944
	(2.307)	(1.225)	(1.237)	(2.620)	(1.529)	(1.906)
Constant	-52.61**	-0.867	10.60	-42.10**	11.30	19.93
	(16.19)	(15.64)	(18.56)	(15.11)	(15.15)	(17.17)
Observations	126	126	90	126	126	90
R-squared	29.6%	29.5%	32.4%	27.6%	28.5%	30.5%
Countries	7	7	5	7	7	5

Notes: Robust standard errors (White corrected for heteroscedasticity) reported in parentheses. Scripts *, ** and *** correspond to significance at the 10%, 5% and 1% levels, respectively. The 7 small countries are Bolivia, Costa Rica, Dominican Republic, Ecuador, Panama, Paraguay, and Uruguay. The large countries are Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela.

Table 8

Two-Stage Least Squares (2SLS) Regression Results. Dependent variable: economic growth.

	International trade = Trade Flows/GDP			International trade = Exports/GDP		
International trade	5.085***	5.183***	6.788**	4.569***	4.648***	5.453**
	(1.879)	(1.821)	(2.670)	(1.694)	(1.645)	(2.142)
Crisis	-1.185*	-2.521***	-2.372***	-1.248**	-2.455***	-2.361***
	(0.625)	(0.749)	(0.756)	(0.621)	(0.736)	(0.744)
Boom		2.046***	1.656**		1.847***	1.595**
		(0.605)	(0.689)		(0.616)	(0.679)
Large			2.291*			1.281*
			(1.289)			(0.728)
Population growth	-2.942***	-2.742***	-3.067***	-2.705***	-2.521***	-2.664***
	(1.038)	(1.027)	(1.198)	(0.975)	(0.971)	(1.062)
Investment	5.401***	5.737***	4.716***	6.234***	6.552***	6.122***
	(1.484)	(1.449)	(1.784)	(1.412)	(1.384)	(1.513)
Government size	-1.654	-2.296	-2.169	-1.462	-2.039	-1.923
	(1.927)	(1.843)	(1.828)	(1.859)	(1.775)	(1.752)
R.E. exchange rate	-3.359**	-1.674	-2.343	-3.019**	-1.491	-1.834
	(1.535)	(1.588)	(1.664)	(1.489)	(1.529)	(1.535)
Institutions	1.167**	1.051**	1.297**	1.015**	0.908**	1.021**
	(0.494)	(0.489)	(0.605)	(0.450)	(0.450)	(0.513)
Constant	-17.48	-29.17**	-29.77**	-16.04	-26.57**	-26.46**
	(13.65)	(13.29)	(13.51)	(12.96)	(12.56)	(12.57)
Observations	252	252	252	252	252	252
R-squared	8.2%	12.2%	7.7%	9.6%	12.8%	9.4%
Durbin-Wu-Hausman endogeneity test (p-value)	0.031	0.010	0.009	0.035	0.009	0.008
Kleibergen-Paap under identification test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
Cragg-Donald weak identification test (F-stat)	38.62	39.74	29.70	42.38	44.66	33.56
Countries	14	14	14	14	14	14

Notes: Robust standard errors (White corrected for heteroscedasticity) reported in parentheses. Scripts *, ** and *** correspond to significance at the 10%, 5% and 1% levels, respectively. Instrumented variable: international trade. Instrumental variable: Kilian's (2009) real economic activity index based on dry-cargo single voyage ocean shipping freight rates. *Crisis* = 1 in the crisis years from 2007 to 2009; otherwise zero. *Boom* = 1 in the commodity boom years from 2003 to 2010; otherwise zero. *Large* = 1 for the following large Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela; otherwise zero.

Table 9
Robustness Test: Fixed Effect Panel Data Regressions using the 75th and 25th percentiles of Terms-of-Trade Volatility (Totvol) as Thresholds.

Dependent variable: economic growth.

	International trade = Trade flows/GDP				International trade = Exports/GDP			
	Threshold = +0.051196		Threshold = -0.040241		Threshold = +0.051196		Threshold = -0.040241	
	High regime	Low regime	High regime	Low regime	High regime	Low regime	High regime	Low regime
International trade	5.863	5.662***	5.888***	5.248	3.711	3.793***	4.390***	3.765
	(5.347)	(1.843)	(1.936)	(3.311)	(3.988)	(1.422)	(1.513)	(2.398)
Population growth	-2.664	-0.904	-0.879	1.265	-2.894	-0.998	-0.661	1.203
	(5.944)	(1.204)	(1.361)	(1.794)	(6.029)	(1.216)	(1.385)	(1.781)
Investment	9.341*	5.337***	4.169**	7.468**	11.03**	6.125***	4.913***	8.322**
	(4.797)	(1.767)	(1.801)	(3.280)	(4.377)	(1.730)	(1.771)	(3.159)
Government size	-6.679	-6.567***	-7.514***	-8.608*	-5.667	-6.975***	-7.370***	-9.245**
	(6.454)	(2.496)	(2.497)	(4.297)	(6.390)	(2.498)	(2.521)	(4.239)
R.E. exchange rate	-5.820	2.223	0.377	2.703	-6.491	2.371	0.980	2.810
	(5.526)	(2.045)	(2.140)	(3.099)	(5.488)	(2.146)	(2.266)	(3.156)
Institutions	-2.769	4.824**	1.526	5.376*	-3.305	4.665**	1.170	5.272*
	(5.309)	(2.090)	(2.349)	(2.998)	(5.277)	(2.103)	(2.342)	(2.976)
Constant	0.140	-26.73*	-13.02	-31.60	6.605	-18.32	-9.651	-24.33
	(44.15)	(15.99)	(16.49)	(28.33)	(43.30)	(15.07)	(16.09)	(25.04)
Observations	64	188	190	62	64	188	190	62
R-squared	34.4%	23.3%	19.4%	40.4%	34.0%	22.2%	19.0%	40.4%
Number of countries	14	14	14	14	14	14	14	14

Notes: Robust standard errors (White corrected for heteroscedasticity) reported in parentheses. Scripts *, ** and *** correspond to significance at the 10%, 5% and 1% levels, respectively.

Table 10

Robustness Test: Fixed Effect Panel Data Regressions with Interaction Term TRADE x TOTVOL. Dependent variable: economic growth.

	International trade = Trade flows/GDP	International trade = Exports/GDP
International trade	6.194***	3.872***
	(1.709)	(1.354)
International trade × totvol	2.078***	2.383***
	(0.649)	(0.804)
Population growth	-0.949	-1.052
	(1.130)	(1.152)
Investment	5.885***	6.950***
	(1.578)	(1.540)
Government size	-5.928***	-6.189***
	(2.232)	(2.259)
R.E. exchange rate	-0.0869	-0.213
	(1.806)	(1.909)
Institutions	3.143	2.746
	(1.919)	(1.933)
Constant	-21.26	-11.11
	(14.37)	(13.92)
Observations	252	252
R-squared	27.7%	26.2%
Number of countries	14	14

Notes: Robust standard errors (White corrected for heteroscedasticity) reported in parentheses. Scripts *, ** and *** correspond to significance at the 10%, 5% and 1% levels, respectively.

Table 11
Dynamic panels with threshold effect and endogeneity (Seo & Shin, 2016).
Dependent variable: economic growth. International trade = Trade flows/GDP

International trade	38.55***	25.99***	18.79**	50.13**
	(4.779)	(5.241)	(8.154)	(22.02)
R.E. exchange rate		-14.06*		
		(7.831)		
Government size			-25.08**	25.00
			(12.61)	(36.57)
Investment				35.44***
				(12.74)
Institutions	10.37	-4.572		58.18**
	(12.89)	(9.212)		(25.06)
Crisis	-1.356	-2.362**		
	(0.854)	(1.114)		
$GROWTH_{it-1}$	-0.240***	-0.0632	-0.309***	-0.709***
	(0.0883)	(0.103)	(0.103)	(0.126)
Kink slope	-70.98*	145.3	73.04***	-74.39**
	(38.47)	(115.7)	(26.43)	(33.38)
Threshold (totvol)	0.154***	0.255***	0.163***	0.110**
	(0.0317)	(0.0796)	(0.0208)	(0.0478)
Trim rate	0%	0%	10%	10%
Number of moment conditions	336	352	320	352
Periods	18	18	18	18
Countries	14	14	14	14

Notes: Scripts *, ** and *** correspond to significance at the 10%, 5% and 1% levels, respectively. Instrumented variable: international trade. Instrumental variable: *totvol*. *Crisis* = 1 in the crisis years from 2007 to 2009; otherwise zero.

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