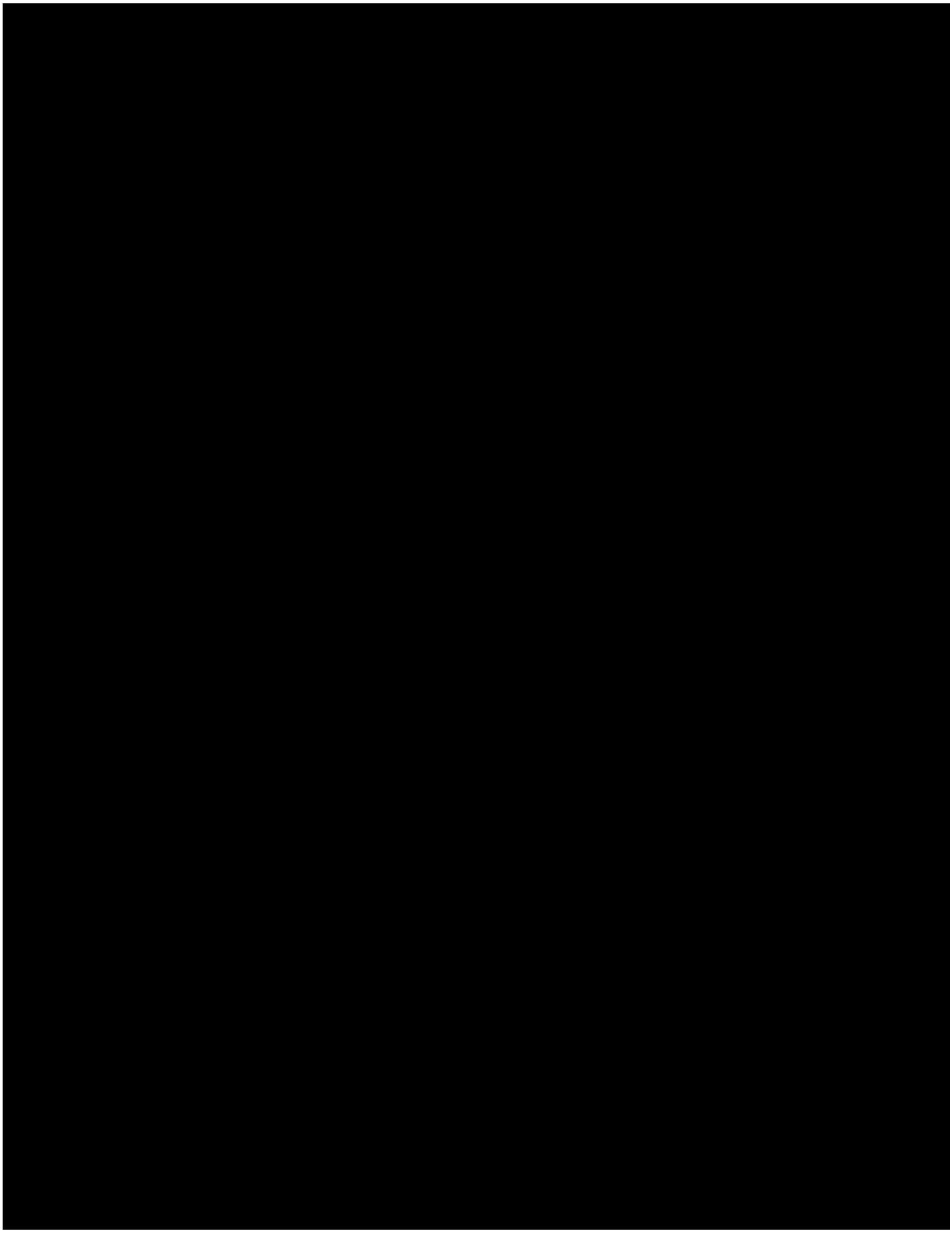

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Does A Regional Trade Agreement Lessen or Worsen Growth Volatility? An Empirical Investigation

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Authorized for distribution by Doris Ross

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Abstract

This paper assesses how regional trade agreements (RTAs) impact growth volatility on a worldwide sample of 170 countries with data spanning the period 1978-2012. Notwithstanding concerns that trade openness through RTAs can heighten exposure to shocks, in particular when it leads to increased product specialization, RTAs through enhanced policy credibility, improved policy coordination, and reduced risk of conflicts can ease growth volatility. Empirical estimations suggest the benefits outweigh the costs as RTAs are consistently associated with lower growth volatility, after controlling for trade openness and other determinants of growth volatility. Furthermore, regression results also suggest that countries that are more prone to shocks are more likely to join a RTA, in particular with countries with relatively less volatile growth, additionally enhancing the stabilization effect.

JEL Classification Numbers: F13, F15, F43

Keywords: Regional trade agreement, trade openness, growth volatility

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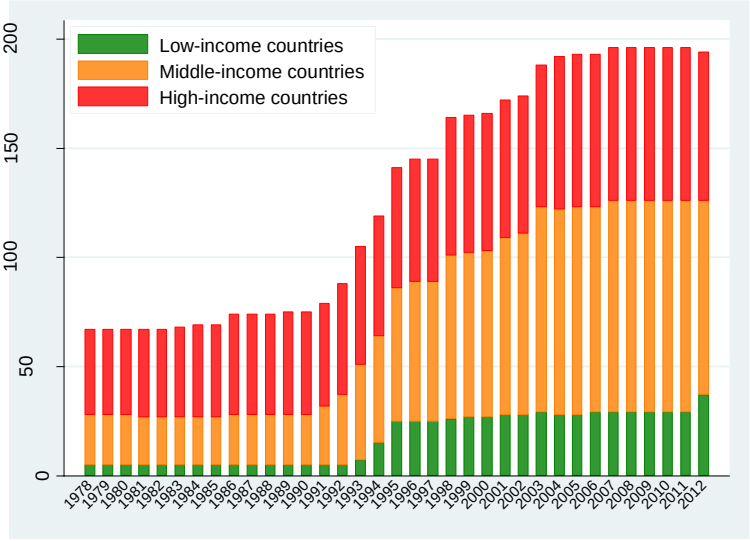
I. INTRODUCTION

The literature on the impact of trade openness on growth is old and rich though the findings are inconclusive. While some scholars argue that trade openness supports economic growth (for a review, see Winters, 2004; and Wacziarg and Welch, 2008), others are more skeptical of the benefits of trade openness on growth (Rodriguez and Rodrik, 2001). Although more recent, another strand that has attracted attention within the literature is the link between trade openness and growth volatility. The empirical results on whether trade openness has favorable or adverse effects on growth volatility also remain ambiguous (see for instance Rodrik, 1997; Easterly, Islam, and Stiglitz, 2000; Kose, Prasad and Terrones, 2005; Raddatz, 2007; and Giovanni and Levchenko, 2009).

The studies on the impact of regional trade agreements (RTAs) on growth were part of this literature. In the early days, however, the interest in RTAs was weak for a specific reason: RTAs were perceived as a threat to the multilateral trade system and considered a second-best choice to broader liberalization. Although RTAs create trade, they also divert it, by excluding countries from trade agreements, thereby leading to welfare losses. Subsequent developments in trade policies led to a shift in the literature. With multilateral trade negotiations having stalled, RTAs have been increasingly viewed as substitutes for them, implying that RTAs are not as bad as originally thought, probably because they are easier to implement politically speaking. The number of countries belonging to at least one RTA soared from a little above 50 countries in the late 1970s to close to 200 countries by 2012, propelled by middle-income countries, though low-income countries lagged behind the trend (Figure 1).

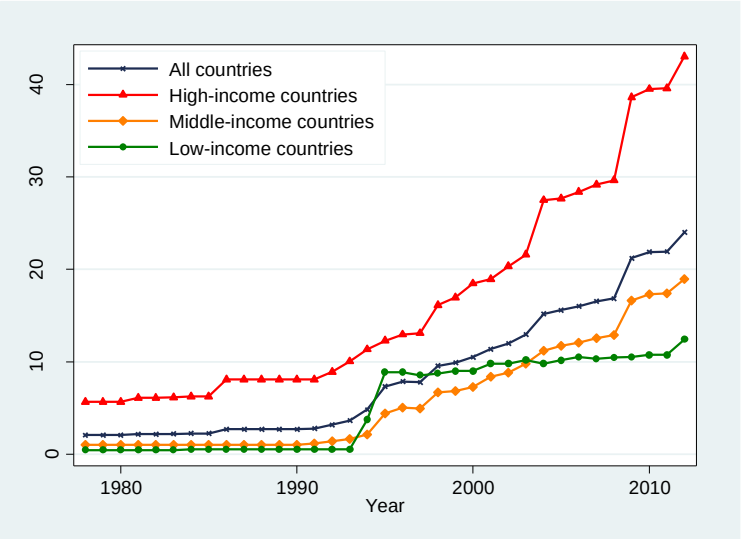
Figure 1. Number of Countries Member of at Least one RTA, 1978-2012



Sources: De Sousa (2012) and authors' calculations.

The average number of regional trade partners per country has also increased dramatically, from a mere two countries in 1978 to 24 countries in 2012 (Figure 2). The sharp increase in the number of regional partners in high-income countries was largely driven by the enlargement of the European Union. The rising trend could also be explained by membership in multiple, and often overlapping RTAs, in particular for middle-income countries. Once again, low-income countries stand out with their relatively low level in RTA memberships.

Figure 2. Average Number of Regional Trading Partners per Country, 1978-2012



Sources: De Sousa (2012) and authors' calculations.

The fact that many policymakers devote much effort to negotiating regional trade agreements, or try to deepen existing ones further, suggests that there may be some benefits to it beyond the traditional trade gains. While initially seen as a threat to broad trade liberalization, RTAs are now considered a step towards trade liberalization, as demonstrated by the rise of mega-RTAs agreements in recent years.[2] The literature has adapted to these changes by looking at the costs and benefits of RTAs and their impact on economic growth (e.g. de Melo, Montenegro and Panagariya, 1992; Vamvakidis, 1998 and 1999). However, much less attention has been paid to how RTAs and growth volatility are intertwined. At the same time, a challenge for policy makers is the tension between the alleged benefits of trade integration for growth, but also concerns about growth volatility that could result from larger trade openness. While the arguments as to why trade openness can make countries less vulnerable may also apply in general to RTAs, the latter have specific features which are likely to dampen growth volatility, notably through enhanced policy credibility, better coordination, and reduced risk of conflicts. Against this backdrop, the question arises: does a RTA lessen or worsen growth volatility?

[2] "Mega-RTAs" involve trade agreements between countries or regions with sizeable share of world trade.

In addition to tackling this question, this paper also addresses the question of finding an economic explanation for the rising proliferation of RTAs. Should RTAs affect growth volatility, a relevant question is whether countries take into account growth vulnerability in their decision to join a RTA. Existing papers (e.g. Whalley, 1998; Baier and Bergstrand, 2004) have investigated a range of economic and political factors to explain RTAs, but overlooked growth volatility, a gap this paper tries to fill.

While this paper does not delve into the specificity and characteristics of each regional trade agreement, it contributes to the literature in two aspects:

- Using a large sample (170 countries) with data during the period 1978-2012, the paper shows that RTAs lead to lower growth volatility, after controlling for trade openness and other factors explaining growth shocks. The results are robust to several indicators of RTAs and different econometric methodologies (fixed effects and System GMM estimator).
- A panel logit model reveals that countries vulnerable to growth shocks would tend to join a RTA in subsequent periods, possibly as a strategy to ease growth volatility. Moreover, the probability of joining a RTA declines with the relative strength of growth volatility of future regional trade partners compared to other countries.

The rest of the paper is organized as follows. Section II surveys the theoretical arguments on how RTAs may affect growth volatility as well as the state of the empirical literature on trade openness and growth volatility. Section III describes the empirical strategy and the results. It first starts with the description of the sample, the variables used, and the econometric methodology adopted, before presenting the results on the impact of RTAs on growth volatility. Then, it explores the factors driving the decision to join a RTA while highlighting the role of growth volatility. Section V concludes with policy implications.

II. THEORY AND EMPIRICAL BACKGROUND

There have been a number of studies on the benefits of regional trade agreements for growth (e.g. de Melo, Montenegro and Panagariya, 1992; Vamvakidis, 1998 and 1999). The impact of volatility on growth has been less studied, although it is equally important, as volatility can be harmful to growth. This omission is surprising, as there is a large literature on trade openness and growth volatility (see for instance Rodrik, 1997; Kose, Prasad and Terrones (2005) and Raddatz, 2007) from which implications can be drawn for RTAs. However, unlike broad trade liberalization, RTAs have special features which, looked at in turn, could reduce growth volatility, through signaling commitment to predictable macroeconomic policies, better coordination as well as reduced risk of conflicts for member countries.

There are several reasons to believe that RTAs can help reduce growth volatility. RTAs involve greater openness to trade towards a certain number of countries, and as such, enhance

the possibility of risk sharing through product diversification, free circulation of goods and labor, cross-border lending, and a larger market. With a RTA, domestic firms gain access to a larger market, and thus may face demand for new products that, if they can be supplied at a competitive price, would enlarge their production base. Diversification of production and of the export base would reduce a country's vulnerability to idiosyncratic sectoral shocks (Acemoglu and Zilibotti, 1997), while free circulation of goods and production factors (capital and labor) would similarly serve as a cushion against such fluctuations.

Cavallo and Frankel (2004) find that trade openness makes countries less vulnerable, both to severe sudden stops and currency crashes, as the positive effects (increased resilience and ability to adjust to crises) outweigh the negative ones (e.g., greater exposure to shocks). Similarly, Guidotti, Sturzenegger, and Villar (2004) emphasize that trade openness contributes to a faster output recovery following a sudden stop, and that the adjustment of the current account occurs through higher export growth and less import contraction (see also Easterly, Islam, and Stiglitz, 2000).

In addition, better policy coordination in a RTA fosters the implementation of sound macroeconomic policies, leading to a more stable growth path. According to Haddad, Lim, and Saborowski (2010), the disciplining nature of international competition and the prevalence of formal international contracts could potentially limit the risk of domestic policy mistakes, and therefore reduce growth volatility. Fernandez and Portes (1998) highlight the potential of RTAs in addressing the time inconsistency problems. The authors argue that in the arena of international trade, the problem of time inconsistency occurs if the government faces the temptation to undertake unexpected trade policy actions when other first-best instruments are not available. This could lead to a suboptimal equilibrium in which the government cannot make a credible promise not to intervene. In contrast, by acting as a commitment device and making the cost of deviation from agreed policies large,[3] a RTA makes it easier to discourage policy actions that exacerbate economic uncertainties.

Another important benefit from a RTA is the positive signaling effect. It offers private investors some assurances on the predictability of trade policies and potentially domestic policies, which is particularly critical for foreign direct investment. This would likely result in larger and stable private investment, leading to higher and more stable growth.

Finally, by reducing the likelihood of conflicts, RTAs can reduce growth volatility. Martin, Mayer, and Thoenig (2012) underscore that RTAs can support peaceful relations by offering a political forum that facilitates settlement of disputes and by increasing the opportunity costs of future and potentially trade- disrupting wars. Besides reducing the risk of conflicts among members, regional integration can also strengthen the hand against third-country

[3] The other members of the RTA may trigger sanction mechanisms, push the deviating country to take corrective actions or force its exit from the agreement.

security threats (Schiff and Winters, 1998). Some RTAs may involve explicit provisions on security cooperation, thus providing a strong institutional framework for conflict prevention, management, and resolution (see also Whalley, 1998). Given that conflicts can destabilize growth, RTAs may thus reduce growth volatility through promoting peace as well.

There are also opposing forces identified in the literature, whereby openness or RTAs can increase growth volatility. Theory predicts that with trade openness, countries specialize in products where they have a comparative advantage. RTAs could, therefore, lead to less product diversification, a narrower export base, and, hence, create higher vulnerability to shocks in an open economy. The neo-classic view (Heckscher-Ohlin theory) suggests that countries would specialize in the product whose production is intensive in the factor the country is relatively well endowed with. More recent international trade theories also weigh in on the debate, underscoring the importance of economies of scale and transportation costs. Access to larger markets, due to trade openness, creates opportunities for countries to specialize by taking advantage of scale economies in production which drive down production costs (see Grubel and Lloyd, 1975). In an authoritative study, Krugman (1991a) develops the New Economic Geography which gives a prominent role to transport cost in explaining trade patterns between two countries. In order to realize scale economies while minimizing transport costs, manufacturing firms tend to locate in the region with larger demand. But the advantage of being close to markets might decline if transportation costs fall. Whether or not trade openness leads to economic diversification or specialization remains an open question.[4] It is, however, likely that if trade openness leads to export concentration, it would raise output volatility (see di Giovanni and Levchenko, 2009). Moreover, a narrow export base encourages pro-cyclical fiscal policy with adverse effects on output fluctuations (van der Ploeg and Poelhekke, 2009)[5].

While an imperfect correlation between domestic and regional shock might lower growth volatility thanks to the possibility of diversifying risks, business cycle synchronization among RTA members can amplify country-level volatility. Buch, Döpke and Strotmann (2009) develop a model whereby trade openness can potentially increase output volatility as trade-oriented firms react more to exogenous shocks, as they are more exposed to foreign shocks than domestic firms. However, a low correlation between domestic and foreign shocks might have a dampening impact on volatility, implying that the net impact of trade openness on volatility is theoretically ambiguous.

The conflicting views in the theoretical literature are also found in the ambiguity of the empirical results. Using a sample of 74 developed and developing countries with data

[4] The empirical literature remains also inconclusive on that matter (see Krenz and Rübel, 2010, for a look at European Union countries).

[5] When commodity prices are high, commodity-exporter countries often increase public spending and when prices reverse and revenues dry up, they have to cut spending.

spanning from 1960-97, Easterly, Islam, and Stiglitz (2000) find that terms of trade volatility and openness to trade are associated with higher growth volatility, but that effect is smaller in richer countries. Moreover, although more open countries tend to experience volatile growth, the authors find that they are less prone to deep recessions, suggesting that trade openness might strengthen resilience to shocks. This result is also corroborated by Raddatz (2007), who finds that in low-income countries that are open, the initial impact of commodity price shocks is larger (see also Becker and Mauro, 2006), but their persistence is shorter, suggesting that more open economies are better prepared to deal with the impact of these shocks than more closed ones.

These findings suggest that even though trade openness might expose a country to more exogenous shocks, the long-term impact on growth associated with higher growth volatility is mild. In line with that, Kose, Prasad, and Terrones (2005) show in their growth regressions that the interaction term between growth volatility and trade integration (and financial integration to a lesser extent) is positive, implying that trade integration helps countries handle volatility, thereby mitigating the harmful effect of volatility on growth. Similarly, Cavallo (2007) finds that exposure to trade increases output volatility through the terms-of-trade channel, but this is more than offset by the stabilizing effect of trade openness, notably by reducing country's vulnerability to some forms of external crises, such as sudden stops and currency crashes.

Haddad, Lim, and Saborowski (2010) go beyond trade openness and look at product diversification. The authors investigate the impact of trade openness on growth volatility and argue that the sign of this relationship hinges on the composition of the export basket. The results for a sample of 77 developing and developed economies, with data covering 1976-2005, indicate that a country's vulnerability to external shocks is reduced when its export base is well diversified across products and markets. More recently, two studies have specifically looked at regional trade integration. By examining growth volatility of countries before and after entering a RTA, Edwards (2010) argues that in many cases, a RTA reduces growth volatility.[6] However, a RTA does not spare a country from volatility spillovers from trading partner economies (Edwards and Ginn, 2011). Finally, Cadot, Olarreaga, and Tschopp (2009) illustrate how RTAs reduce agricultural trade-policy volatility,[7] as RTAs act as a commitment mechanism constraining member states from introducing new barriers, thereby making policies more predictable and less distortionary.

[6] Guillaumont (2013) also finds for the CFA franc countries that deeper regional integration can potentially enhance growth as it helps reduce export volatility, and hence growth volatility.

[7] Agricultural trade-policy volatility is measured by the absolute value of the first difference in the wedge between domestic and world prices, averaged across products, and purged of the influence of world-price volatility.

Besides macro studies, sectoral studies using firm-level data also attempt to disentangle the link between trade openness and growth volatility. Buch, Döpke, and Strotmann (2009) use German firm-level data to study the impact of trade openness on the volatility of real sales during 1971-1998 and show that trade openness tends to lower volatility. In contrast, di Giovanni and Levchenko (2009) use data from 61 countries, for 28 manufacturing sectors during 1970-1999. The authors find a positive and significant relationship between trade openness and aggregate volatility as trade leads to increased specialization, and sectors with higher trade tend to be also more volatile. Despite conflicting results, Buch, Döpke, and Strotmann (2009) and di Giovanni and Levchenko (2009) concur on one aspect: the growth volatility from trade openness is more or less dampened by the reduced comovement between trade-oriented sectors and the rest of the economy.

This paper belongs to the group of macro-studies, but unlike previous papers it focuses on assessing the specific impact of RTAs on growth volatility, rather than that of overall trade openness, using a larger dataset and robust econometric methods. It also improves on existing studies by investigating if countries more prone to shocks are likely to participate in a RTA as a strategy to mitigate growth volatility.

III. EMPIRICAL STRATEGY AND RESULTS

A. Regional Trade Agreement and Growth Volatility

The data and model

In this section, the framework to test empirically the relationship between regional trade agreements and growth volatility is laid out. The question being assessed is whether countries belonging to a RTA exhibit lower or higher growth volatility. A worldwide sample of 170 developed and developing countries with data over the period 1978-2012 is considered. The period of study is divided into five-year sub-periods, with up to 7 data points per country.

To estimate the impact of RTAs on growth volatility, we adopted a linear model whereby the instability of real GDP growth rate is explained by the variable of interest measuring membership of a RTA or the depth of regional integration, and a set of control variables capturing the level of development, trade openness, domestic and external shocks, and financial instability. Specifically, the variables of the model, their measurement and reasons for their consideration, are as follows:

The dependent variable is *growth volatility*. To measure it, the long term component of the logarithm of real GDP is assumed to follow an AR (1) process with a trend as shown in equation (1):

$$\ln(y_{i,t}) = \alpha_i + \beta_i \ln(y_{i,t-1}) + \gamma_i t + \varepsilon_{i,t} \qquad (1)$$

where $y_{i,t}$ is the real GDP for country *i* at time *t*, and $\varepsilon_{i,t}$ is the error term

Fitting equation (1) for each country separately with annual data over the period 1978-2012 allows estimating the error term $\widehat{\varepsilon_{i,t}}$, which represents the cyclical component of the logarithm of real GDP:

$$\widehat{\varepsilon_{i,t}} = \ln(y_{i,t}) - \widehat{\ln(y_{i,t})} \qquad (2)$$

where $\widehat{\ln(y_{i,t})}$ is the fitted value of $\ln(y_{i,t})$ derived from equation 1, and represents the component of the logarithm of real GDP which is more sensitive to long-term than to short-term fluctuations.

For each sub-period of 5 years, growth volatility $Vgrowth$ is calculated as the standard error of the cyclical component $\widehat{\varepsilon_{i,t}}$, as shown below:

$$Vgrowth = \sqrt{\sum_{j=1}^{5} \frac{(\widehat{\varepsilon_{i,t}} - \overline{\widehat{\varepsilon_{i,t}}})^2}{4}} \qquad (3)$$

where $\overline{\widehat{\varepsilon_{i,t}}}$ is the average of $\widehat{\varepsilon_{i,t}}$ over the sub-period

This is a more flexible approach in measuring growth volatility than the most commonly used indicator in the empirical literature that consists in taking the standard deviation of the real GDP growth rate. The later relies on strong assumptions on the functional form of the long-term component. Indeed, by assuming that $\alpha_i = \gamma_i = 0$ and $\beta_i = 1$ for all *i*, and deriving from equation (1) the error term, equation (3) is, therefore, equivalent to the standard deviation of real GDP growth rate. In contrast, our approach allows the parameters of equation (1) to be country-specific and controls for the presence of a trend in the series.[8] Nevertheless, we also used the standard deviation of the real GDP growth rate in the robustness check.

The variable of interest is *Regional Trade Agreement.* We discussed extensively in the previous section how a RTA can affect positively or negatively a country's growth volatility. The theoretical predictions are not clear, although it is likely that the benefits would outweigh the cost. As a result, we expect the empirical investigation to reveal a net favorable impact of a RTA on reduced growth volatility. The main issue to tackle first is how to measure regional trade agreement. A simple approach is to use a dummy variable taking one

[8] There are a number of other filters in the literature which can be used to decompose a series into its cyclical and long-run component. A couple of examples include the HP filter (Hodrick and Prescott, 1997), the Baxter and King (BK) filter (Baxter and King, 1995) and the modified BK filter by Christiano and Fitzgerald (2003).

when a country is a member of at least one RTA and zero otherwise. However, the downside of this indicator is that it does not capture the depth of regional trade integration. A country can belong to a RTA but trade little with its regional partners. Therefore we use three additional indicators measuring trade intensity between a country and its regional trade partners: (i) the ratio of exports to RTA members to total exports; (ii) the ratio of imports from RTA members to total imports; and (iii) the sum of exports to and imports from RTA members divided by the sum of total exports and imports, a measure of relative trade openness towards RTA members (henceforth regional trade openness). These indicators also indirectly capture different forms of RTAs ranging from a simple free trade agreement to an economic and monetary union.

The control variables include:

- *Level of economic development*. One would expect a negative correlation between the level of development, measured by GDP per capita, and growth volatility, as poorer countries are more prone to external shocks and are likely to suffer from macroeconomic instability resulting from a less conducive environment for sound macroeconomic policies. Koren and Tenreyro (2007) point out that during early stages of development, high sectoral concentration tends to accumulate in high-risk sectors magnifying shocks to the economy during these stages. As a result, poor countries tend to experience more frequent and more severe aggregate shocks.

- *Trade openness*. As discussed above, trade openness may dampen output volatility as it offers opportunity for diversification and international risk sharing, but it can also raise output volatility by exposing countries to external shocks and by enhancing specialization of production. Controlling for overall trade openness would allow isolating the effect of RTA (trade openness towards regional partners) on growth volatility. Trade openness is measured by the sum of exports and imports as a share of GDP.

- *Terms of trade shocks*. Positive shocks would increase domestic demand, which will translate into higher economic growth as domestic supply reacts to higher domestic demand. In contrast, negative shocks would lead to domestic demand contraction and ultimately lower economic growth. The channel of transmission can also arise through domestic production cost with a more direct impact on the supply side. This close link between terms of trade changes and fluctuations in output explains why terms of trade changes can significantly impact output volatility. This is particularly the case in countries where trade is concentrated on a narrow range of products. For instance, Easterly and Kraay (2000) find that a significant portion of growth volatility in small states stems from terms of trade shocks, as they are less diversified, and trade accounts for a larger share of GDP. Terms of trade shocks are measured by the change in the ratio of export prices to import prices.

- *Inflation volatility*. It is expected to be positively correlated with growth volatility, given that price instability volatility disrupts investment decisions and creates economic uncertainties. While we introduce terms of trade shocks in the model to capture external shocks, inflation volatility is meant to account for domestic shocks mainly originating from policy choices such as discretionary fiscal and monetary policies, or weather shocks.[9] Inflation volatility is measured by the volatility in the consumer price index.

- *Financial instability*. The instability of the financial system can translate into output volatility through the credit channel. Because investment is closely linked to credit availability, financial instability is likely to exacerbate fluctuations in the investment rate, thereby destabilizing growth (Guillaumont Jeanneney and Kpodar, 2011). Two alternative indicators are used to measure financial instability: the volatility of the private credit ratio to GDP and the volatility of the private credit growth.

The baseline specification is as follows:

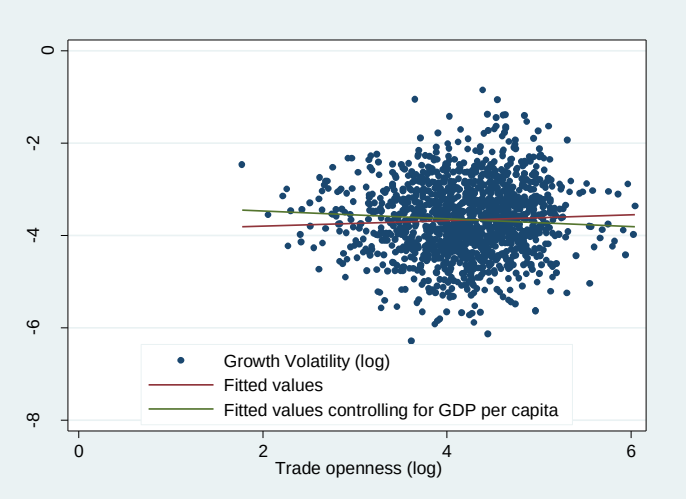
$$Vgrowth_{it} = \alpha + \beta \mathrm{RTA}_{\mathrm{it}} + \mathrm{A}X_{it} + \mathrm{u_i} + \varepsilon_{it} \qquad (4)$$

where $Vgrowth$ is the volatility of real GDP growth, RTA is the indicator of regional trade agreement, X is the set of control variables described above; u is country-specific effect, and ε the error term (see Appendix Table 3 for the sources and description of data).
Before proceeding with the regressions, an analysis of the descriptive statistics is undertaken. To begin with, Figure 3 plots growth volatility against trade openness and reveals that the correlation between the two variables is weak and at best slightly negative after controlling growth volatility for income level. This is not surprising given the mixed results in the literature in that regard.

In contrast, when comparing growth volatility between countries belonging to a RTA and those which do not, it emerges that countries in a RTA tend to experience smaller growth volatility than the others in all income groups but for the lowest (Figure 4).

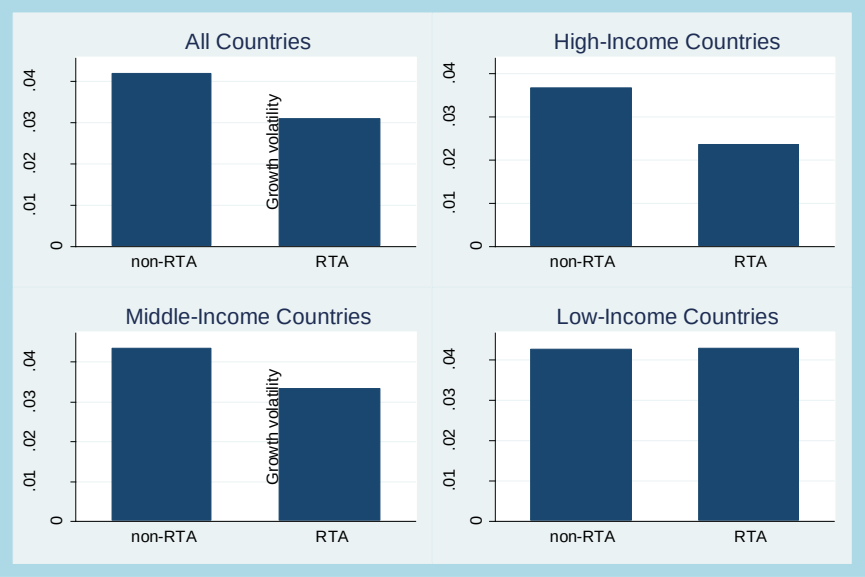
[9] Although inflation volatility can also be driven by external factors, this effect will be captured by the terms of trade as both are included as explanatory variables in the regression.

Figure 3. Growth Volatility and Trade Openness



Sources: World Bank and authors' calculations.

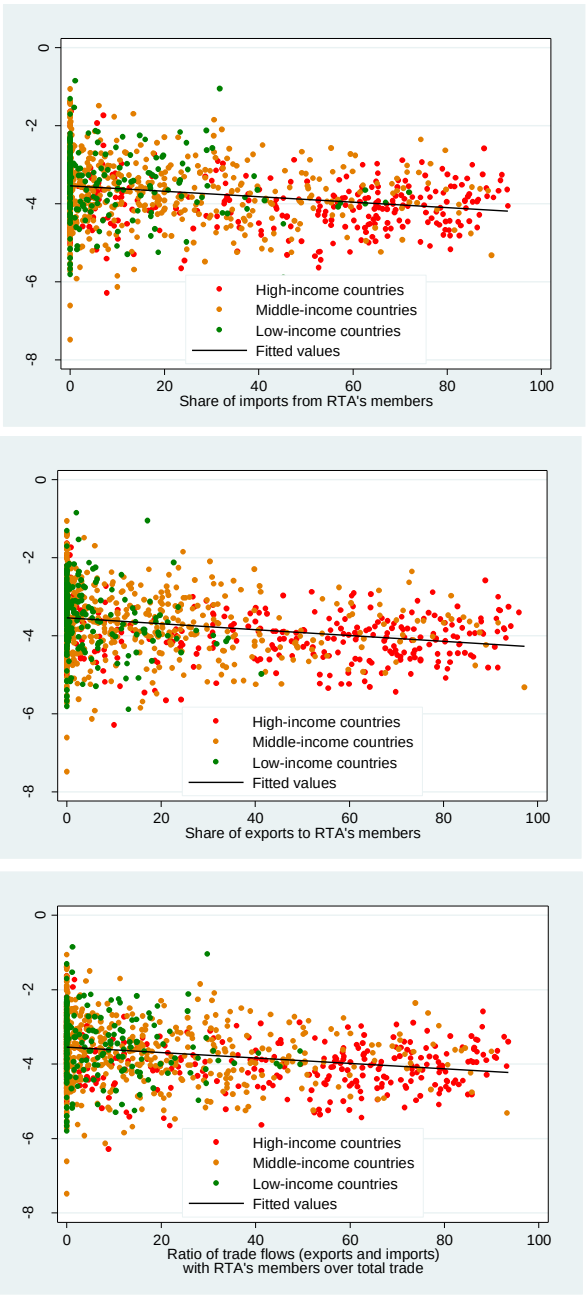
Figure 4. Growth Volatility and Membership of Regional Trade Agreement



Sources: IMF, De Sousa (2012) and authors' calculations.

Figure 5 takes this analysis a step further by looking at whether growth instability is related to how well a country is integrated into a RTA. The data show that countries that trade the most with their regional trade partners appear to also enjoy smoother growth. High-income countries are concentrated in the right tail of the distribution as they have more stable growth and a higher share of trade with their regional partners, while the opposite holds for low-income countries at the other end of the distribution. Notwithstanding these findings, the descriptive analysis does not control for the other variables that may affect growth volatility, a shortcoming addressed in the next section.

Figure 5. Growth Volatility and Trade Intensity with Regional Trade Partners



Sources: IMF, Barbieri and Keshk (2012) and authors' calculations.

The Results

Fixed effect estimations

The fixed-effect estimator controls for country-specific effects, capturing any determinant of growth volatility that varies across countries but not over time (for instance, the colonial

history of the country which may shape institutions). Table 1 (columns 2 to 4) presents the results of the regressions using the dummy variable of RTA membership to measure regional integration. In all regressions, the coefficient for the dummy variable is negative and significant at the 1 percent level, suggesting that countries in a RTA do benefit from more stable growth even after other determinants of growth volatility are controlled. The magnitude of the coefficient suggests that a country in a RTA would experience on average about 25 percent less volatility than a similar country that is not a RTA member.

However, the shortcoming of the RTA dummy variable is that it does not capture a country's trade intensity with regional trade partners. Indeed, there is evidence, for instance, that many developing countries trade little with their regional partners, in particular when the RTA members have similar economic structures and a narrow export base dominated by primary commodities. In these cases, it is likely that the stabilization effect of a RTA would not materialize.[10] This underlines the need to use a measure of the depth of regional integration, in addition to the dummy variable of RTA membership.

Columns 5 to 7 of Table 1 report the results with the share of imports from regional trade partners in total imports of a country as a measure of regional integration. As expected, the coefficient is negative and significant across specifications. We obtain qualitatively and quantitatively similar results when using the share of exports to regional partners and the indicator of regional trade openness (Table 2). Using the coefficient obtained in Table 2, we could say, for instance, that should Burkina Faso trade with its regional trade partners--the West African Economic and Monetary Union countries--as much as Italy does with European Union countries, its regional trade openness would be 70 percent instead of 5 percent, and, consequently, its growth volatility would be reduced by 26 percent.[11]

[10] Also, the RTA dummy variable does not allow much variation across countries or for a given country over time. As such, the estimated effect captures an average effect which may hide significant changes over time.

[11] (70-5)*(-0.004)*100

Table 1. Impact of RTA Membership and Import Share of Regional Trade Partners on Growth Volatility: Fixed-Effect Estimator

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP per capita (log)	0.013	0.079	0.082	0.105	0.065	0.078	0.107
	[0.054]	[0.058]	[0.060]	[0.059]*	[0.067]	[0.067]	[0.067]
RTA Membership		-0.236	-0.256	-0.230			
		[0.079]***	[0.078]***	[0.078]***			
Share of Imports from Regional Trade Partners					-0.004	-0.005	-0.005
					[0.002]**	[0.002]**	[0.002]**
Trade openness (log)	-0.128	-0.035	0.030	-0.072	-0.059	-0.034	-0.112
	[0.125]	[0.128]	[0.135]	[0.129]	[0.144]	[0.145]	[0.145]
Volatility of Terms of Trade (log)	0.052	0.042	0.032	0.031	0.033	0.019	0.019
	[0.030]*	[0.030]	[0.029]	[0.030]	[0.033]	[0.033]	[0.033]
Volatility of Inflation (log)	0.237	0.232	0.183	0.201	0.232	0.181	0.198
	[0.034]***	[0.034]***	[0.037]***	[0.036]***	[0.038]***	[0.041]***	[0.040]***
Volatility of Private Credit Ratio (log)			0.159			0.178	
			[0.043]***			[0.046]***	
Volatility of Private Credit Growth (log)				0.163			0.176
				[0.047]***			[0.053]***
Constant	-2.341	-3.122	-3.211	-2.956	-3.010	-2.998	-2.882
	[0.548]***	[0.604]***	[0.627]***	[0.614]***	[0.651]***	[0.657]***	[0.655]***
Observations	737	737	698	726	640	612	632
Number of countries	170	170	169	170	147	146	147
R-squared	0.10	0.12	0.14	0.14	0.10	0.13	0.12

Notes: Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

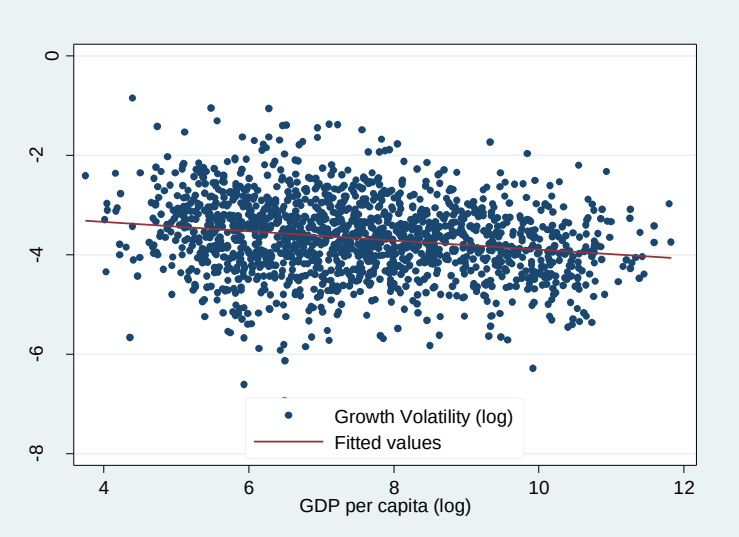
Table 2. Impact of Export Share of Regional Trade Partners and their Total Trade Share on Growth Volatility: Fixed-Effect Estimator

	(1)	(2)	(3)	(5)	(6)	(7)
GDP per capita (log)	0.060	0.074	0.100	0.064	0.076	0.104
	[0.067]	[0.068]	[0.068]	[0.067]	[0.068]	[0.067]
Share of Exports to Regional Trade Partners	-0.004	-0.004	-0.004			
	[0.002]*	[0.002]**	[0.002]**			
Regional Trade Openness				-0.004	-0.004	-0.004
				[0.002]**	[0.002]**	[0.002]**
Trade openness (log)	-0.074	-0.048	-0.126	-0.063	-0.038	-0.116
	[0.143]	[0.144]	[0.145]	[0.144]	[0.145]	[0.145]
Volatility of Terms of Trade (log)	0.038	0.025	0.025	0.035	0.022	0.022
	[0.033]	[0.033]	[0.033]	[0.033]	[0.033]	[0.033]
Volatility of Inflation (log)	0.233	0.182	0.200	0.233	0.181	0.199
	[0.038]***	[0.041]***	[0.040]***	[0.038]***	[0.041]***	[0.040]***
Volatility of Private Credit Ratio (log)		0.176			0.177	
		[0.046]***			[0.046]***	
Volatility of Private Credit Growth (log)			0.172			0.174
			[0.053]***			[0.053]***
Constant	-2.909	-2.905	-2.777	-2.980	-2.965	-2.843
	[0.645]***	[0.653]***	[0.652]***	[0.651]***	[0.658]***	[0.656]***
Observations	640	612	632	640	612	632
Number of countries	147	146	147	147	146	147
R-squared	0.10	0.13	0.12	0.10	0.13	0.12

Notes: Regional trade openness is measured by the share of total imports from and exports to regional trade partners in the sum of total imports and exports of the country. Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

With regard to the control variables, interesting results emerge. As expected, terms of trade volatility is positively associated with growth volatility, although the coefficient is only significant in a few specifications.[12] In contrast, the positive link between inflation and growth volatility is stronger and significant at the 1 percent level in all specifications, which could suggest that growth volatility might be more domestically than externally driven. Financial instability, measured by the volatility of either the private credit ratio or the private credit growth rate, is negatively associated with growth volatility. The coefficient for trade openness is not significant, reflecting the ambiguity surrounding the impact of trade openness on growth volatility. Another possible explanation is that one of the channels through which trade openness influences growth volatility, namely terms of trade shock, is already controlled for. Surprisingly, the coefficient for the level of economic development has a sign that is counterintuitive, although not statistically significant. In fact, a scatter plot of GDP per capita and growth volatility shows a negative slope (Figure 6).Therefore, it is likely that the factors making growth more volatile in developing economies are captured by other explanatory variables in the model.

Figure 6. Growth Volatility and GDP per Capita



Sources: IMF and authors' calculations.

[12] For low-income countries, Raddatz (2007) finds that external shocks such as terms of trade shocks can be a source of volatility, but to a lesser extent than internal factors.

System GMM estimations

The results from the fixed effect estimator are informative. However, they may suffer from endogeneity bias due to feedback effects from the right-hand side variables, measurement errors, or omitted variable bias. To address the endogeneity issue, the System GMM estimator (dynamic panel Generalized Method-of-Moment) developed by Blundell and Bond (1998) is utilized, which has the advantage of relying on internal instruments (the lagged variables). Blundell and Bond (1998) show that the System GMM estimator, which simultaneously uses both the *difference* panel data and the data from the original *levels* specification, produces dramatic increases in both consistency and efficiency relative to the first-differenced GMM developed by Arellano and Bond (1991). To test the validity of the lagged variables as instruments, the standard Hansen test of over-identifying restrictions is deployed, where the null hypothesis is that the instrumental variables are not correlated with the residual, and the serial correlation test, where the null hypothesis is that the errors exhibit no second-order serial correlation.

The results from the one-step System GMM estimator with robust standard errors are presented in Tables 3 and 4. The finding that regional trade integration lowers growth volatility is confirmed in almost all specifications with the four indicators of RTA. The results on the control variables are also qualitatively comparable to that of the fixed effect estimations. In addition, a higher inflation level is found to be detrimental to a stable growth path. Both the Hansen and serial correlation test do not reject the null hypothesis of the validity of the instruments.

As a robustness check, a set of regressions with the same explanatory variables as above was run, but with growth volatility, the dependent variable, measured by the standard deviation of real GDP growth rate. The results documented in Table 5 confirm that country members of a RTA, which trade more with their regional trade partners tend to experience more stable growth, irrespective of the indicator of regional integration used.[13]

[13] We also include a step dummy to take into account the 2008 global financial crisis, and this did not change the results in a significant way.

Table 3. Impact of RTA Membership and Import Share of Regional Trade Partners on Growth Volatility: System GMM Estimator

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GDP per capita (log)	0.059	0.062	0.045	0.085	0.088	0.075	0.043	0.080	0.100
	[0.048]	[0.046]	[0.049]	[0.045]*	[0.043]**	[0.057]	[0.054]	[0.052]	[0.056]*
RTA Membership		-0.406	-0.374	-0.433	-0.391				
		[0.093]***	[0.096]***	[0.090]***	[0.095]***				
Share of Imports from Regional Trade Partners						-0.005	-0.005	-0.005	-0.005
						[0.002]*	[0.003]*	[0.002]**	[0.002]**
Trade openness (log)	0.041	0.285	0.030	0.220	0.133	0.085	-0.029	0.053	0.057
	[0.177]	[0.155]*	[0.171]	[0.149]	[0.156]	[0.186]	[0.150]	[0.175]	[0.173]
Volatility of Terms of Trade (log)	0.085	0.090	0.142	0.113	0.129	0.054	0.085	0.047	0.077
	[0.051]*	[0.047]*	[0.040]***	[0.045]**	[0.043]***	[0.053]	[0.043]**	[0.050]	[0.049]
Volatility of Inflation (log)	0.210	0.217		0.138	0.127	0.200		0.145	0.114
	[0.057]***	[0.054]***		[0.053]***	[0.057]**	[0.071]***		[0.064]**	[0.062]*
Inflation (log)			0.300				0.342		
			[0.132]**				[0.159]**		
Volatility of Private Credit Ratio (log)				0.271				0.302	
				[0.077]***				[0.086]***	
Volatility of Private Credit Growth (log)					0.205				0.274
					[0.075]***				[0.078]***
Constant	-3.407	-4.125	-3.580	-3.516	-3.443	-3.738	-3.662	-3.094	-3.450
	[0.641]***	[0.626]***	[0.622]***	[0.577]***	[0.613]***	[0.826]***	[0.697]***	[0.748]***	[0.760]***
Observations	737	737	759	698	726	640	660	612	632
Number of countries	170	170	173	169	170	147	150	146	147
Hansen test prob.	0.17	0.46	0.46	0.68	0.49	0.67	0.60	0.91	0.79
AR2 test prob.	0.39	0.58	0.50	0.91	0.87	0.43	0.51	0.77	0.77

Notes: Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.
AR (2): Arellano and Bond test of second order autocorrelation

Table 4. Impact of Export Share of Regional Trade Partners and their Total Trade Share on Growth Volatility: System GMM Estimator

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita (log)	0.089	0.072	0.089	0.112	0.075	0.050	0.084	0.101
	[0.057]	[0.054]	[0.051]*	[0.055]**	[0.056]	[0.054]	[0.052]	[0.055]*
Share of Exports to Regional Trade Partners	-0.005	-0.006	-0.005	-0.005				
	[0.002]**	[0.002]***	[0.002]**	[0.002]**				
Regional Trade Openness					-0.005	-0.005	-0.005	-0.004
					[0.002]*	[0.002]**	[0.002]**	[0.002]*
Trade openness (log)	0.137	-0.030	0.106	0.080	0.086	-0.046	0.054	0.043
	[0.174]	[0.142]	[0.170]	[0.168]	[0.182]	[0.146]	[0.173]	[0.171]
Volatility of Terms of Trade (log)	0.049	0.083	0.027	0.073	0.059	0.090	0.046	0.080
	[0.053]	[0.042]**	[0.050]	[0.050]	[0.053]	[0.043]**	[0.051]	[0.050]
Volatility of Inflation (log)	0.207		0.188	0.120	0.200		0.158	0.111
	[0.071]***		[0.059]***	[0.063]*	[0.072]***		[0.063]**	[0.062]*
Inflation (log)		0.328				0.326		
		[0.159]**				[0.158]**		
Volatility of Private Credit Ratio (log)			0.260				0.288	
			[0.081]***				[0.083]***	
Volatility of Private Credit Growth (log)				0.262				0.285
				[0.079]***				[0.078]***
Rule of Law (log)								
Constant	-4.042	-3.860	-3.414	-3.650	-3.730	-3.625	-3.126	-3.384
	[0.734]***	[0.608]***	[0.691]***	[0.700]***	[0.784]***	[0.652]***	[0.725]***	[0.731]***
Observations	640	660	612	632	640	660	612	632
Number of countries	147	150	146	147	147	150	146	147
Hansen test prob.	0.68	0.65	0.89	0.77	0.66	0.64	0.93	0.81
AR2 test prob.	0.46	0.55	0.78	0.81	0.44	0.52	0.78	0.80

Notes: Regional trade openness is measured by the share of total imports from and exports to regional trade partners in the sum of total imports and exports of the country; Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%; AR(2): Arellano and Bond test of second order autocorrelation

Table 5. Robustness Analysis with Growth Volatility Measured by the Standard Deviation of Growth Rate: System GMM Estimator
Dependent Variable: Standard Deviation of Real GDP Growth Rate

	(1)	(2)	(3)	(4)	(5)	(6)
GDP per capita (log)	0.070	0.056	0.102	0.119	0.105	0.087
	[0.043]	[0.043]	[0.049]**	[0.050]**	[0.050]**	[0.049]*
RTA Membership	-0.458	-0.386				-0.215
	[0.094]***	[0.087]***				[0.098]**
Share of Imports from Regional Trade Partners			-0.007			
			[0.002]***			
Share of Exports to Regional Trade Partners				-0.008		
				[0.002]***		
Regional Trade Openness					-0.007	-0.004
					[0.002]***	[0.002]*
Trade openness (log)	0.208	0.289	0.167	0.221	0.162	0.211
	[0.154]	[0.158]*	[0.181]	[0.176]	[0.176]	[0.173]
Volatility of Terms of Trade (log)	0.125					
	[0.045]***					
Volatility of Inflation (log)	0.136					
	[0.054]**					
Volatility of Private Credit Ratio (log)	0.263					
	[0.079]***					
Standard Deviation of Terms of Trade Change		0.159	0.127	0.135	0.135	0.143
		[0.043]***	[0.048]***	[0.046]***	[0.048]***	[0.048]***
Standard Deviation of Inflation Rate		0.215	0.212	0.218	0.206	0.197
		[0.056]***	[0.064]***	[0.065]***	[0.065]***	[0.060]***
Standard Deviation of Private Credit Ratio		0.463	0.441	0.136	0.379	0.483
		[0.408]	[0.410]	[0.413]	[0.409]	[0.373]
Constant	1.345	0.694	0.626	0.357	0.629	0.642
	[0.602]**	[0.617]	[0.762]	[0.684]	[0.714]	[0.723]
Observations	700	695	611	611	611	611
Number of countries	170	173	150	150	150	150
Hansen test prob.	0.64	0.73	0.87	0.88	0.87	0.96
AR2 test prob.	0.71	0.35	0.27	0.28	0.29	0.34

Notes: Regional trade openness is measured by the share of total imports from and exports to regional trade partners in the sum of total imports and exports of the country; Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%; AR(2): Arellano and Bond test of second order autocorrelation.

B. Are RTAs a Response to Growth Volatility?

Background

Having established that RTAs reduce growth volatility, it is worth investigating whether countries that are more prone to shocks are likely to join a RTA as a strategy to shield growth from volatility? There are reasons to believe so. First, countries vulnerable to shocks will gain from joining a RTA as possibilities of product and market diversification are likely to contribute to lower growth volatility. Second, RTAs can act as an insurance mechanism for its member countries against future shocks. This is particularly relevant in RTAs involving a large and a small country, or countries with similar levels of development but asymmetric shocks. Finally, the likelihood of sudden protectionist measures or unanticipated changes in trade policy by trading partners—which may induce growth volatility in the home country—is diminished in a RTA, making the latter an appealing opportunity for vulnerable countries to weather trade shocks.[14]

The existing theoretical literature on the determinants of trade agreements offers some guidance in finding why a country may want to sign a RTA, but the role of growth volatility has been overlooked. In their seminal paper, Baier and Bergstrand (2004) investigate key economic factors influencing the likelihood of pairs of countries forming an FTA in a given year using a probit model. First, the authors expand earlier work of Krugman (1991b, c) and Frankel, Stein, and Wei (1995, 1996, 1998) by developing a Computable General Equilibrium (CGE) model allowing for heterogeneity in countries' economic size, their absolute and relative factor endowments, as well as, non-zero intra and inter-continental transport. The model leads to testable hypotheses according to which the net welfare gain of two countries entering a trade agreement depends on the trade creation versus trade diversion associated with three main economic factors: geography, economic size, and factor endowments. Second, using a sample of 54 developed and developing economies and a probit model, they find that:

- The lower the geographic distance between two countries, the higher the probability that they form a RTA, due to higher potential trade creation resulting from lower transport costs and removal of trade barriers, and thus less price distortions;
- The more remote a pair of continental trading partners is from the rest of the world (ROW), the likelier a RTA will be formed due to less trade diversion;
- The larger and more similar in economic size are two trading partners, the higher the probability of a RTA as potential trade creation is larger; and trade diversion is less, the smaller the economic size of the ROW.

[14] However, since most RTAs allow the imposition of contingent protection and make exemptions for national security purposes, strategic sectors, or infant industries, the insurance role of a RTA may be limited (Fernandez and Portes, 1998).

(continued…)

- Two partner countries' with greater differences of capital–labor ratios would gain from a RTA, as they specialize more in the industries in which they have comparative advantages,[15] and trade diversion is lower, the smaller the difference between the relative factor endowments of the pair and that of the ROW.

One limitation of Baier and Bergstrand (2004)'s study is that the authors do not take into account other economic factors such as growth volatility, as well as strategic and political factors which may well influence a country's decision to join a RTA. Whalley (1998) offers an overview of political and strategic factors that are at play when countries seek to enter a RTA; arguing that RTAs around the world are different because countries have different objectives when negotiating them. These include:

- *Strengthening domestic policy reform*. Reforms are less likely to be reversed when imposed by a supranational body. For instance, removal of trade barriers would find less resistance from domestic producers when the move is part of the harmonization of common external tariffs in the context of a RTA.
- *Increasing multilateral bargaining power*. Countries may use RTAs to influence subsequent multilateral negotiation as negotiating as group provides more leverage than individually.
- *Strategic alliance*. RTAs can help underpin security arrangements as in the case of the European integration in the 1950s (Whalley, 1998). The idea that trade can prevent conflicts by increasing their opportunity cost has also been documented by Martin, Mayer, and Thoenig (2012).

This paper builds on the empirical framework developed by Baier and Bergstrand (2004). Given the difficulty to capture political factors in an econometric model, this paper does not try to address the limitation of Baier and Bergstrand (2004)'s model with regard to political and strategic determinants of a RTA,[16] but instead expands their analysis to incorporate growth volatility, an equally important economic aspect to which little attention has been devoted so far.

The model and results

The sample and the data are the same as described in the previous section. Drawing on Baier and Bergstrand (2004), the following model is estimated:

$$\mathrm{RTA_{it}} = \partial + \sum_{j=2}^{3} \delta_j Vgrowth_{it-j} + BZ_{i,t} + \mathrm{u_i} + \varepsilon_{it} \qquad (5)$$

[15] However, Baier and Bergstrand (2004) noted that the welfare gains of trade partners might eventually decline due to considerable trade diversion when transport costs between trade partners and the ROW are low.

[16] While Whalley (1998) offers insightful perspective on strategic and political motivations behind RTAs, they are difficult to test empirically.

where:

- RTA is a dummy variable for regional trade agreement
- $Vgrowth$ is the lagged volatility of real GDP growth. A country's decision to join a RTA is often taken several years before the country formally joins the RTA, but this decision is not observable as the variable RTA captures the starting date of the agreement. Since most agreements had phased-in barrier reduction time tables, it is reasonable to assume that the relevant measure of growth volatility in this model is its lagged values. The second and third lags are selected to maximize the Akaike Information Criterion (AIC).
- We follow Baier and Bergstrand (2004) by including in Z a set of explanatory variables that are critical factors driving the formation of a RTA.[17] This includes:
  1. RDGP, the sum of the logs of real GDPs of countries in the RTA and DRGDP is the absolute value of the difference between the log of real GDP of country *i* and the average of the other countries in the RTA. The hypothesis is that the probability of a RTA is higher when the economies of future trading partners are larger and similar, increasing prospects for trade creation.
  2. DKL, the absolute value of the difference between the logs of the capital–labor ratios of countries *i* and the average of the other countries in the RTA, and DROWKL is the difference between the capital–labor ratio of the RTA member countries and that of the ROW. The probability of a RTA should be higher when the difference between member countries' relative factor endowments (DKL) is higher. In contrast, the probability of a RTA should decline if DROWKL is high, due to potential trade diversion and thus a smaller net gain from the RTA.[18]
- The term u is country-specific effect, and ε is the error term.

The model is estimated with a logit fixed effect estimator given that the dependent variable is a dummy. Although not a fully satisfactory approach, we use the lag value of the explanatory variables RDGP, DRGDP, DKL and DROWKL to address potential endogeneity issues.[19] The results illustrated in Table 6 suggest that past growth volatility is indeed a good predictor of the probability to join a RTA (columns 1 to 5). The third lag of growth volatility has a

[17] Nevertheless, the model employed differs from Baier and Bergstrand's in three aspects. First, while the authors use cross-country data and look at a snapshot of free trade agreements (FTAs) in 1996, this paper uses panel data which combine the cross-country dimension with the time dimension, allowing to capture the exact year the trade agreement enters into effect. Second, the model used controls for country-specific effects, thus freeing the model from including time-invariant factors such as distance to trading partners and the ROW. Third, Baier and Bergstrand (2004) assume that the decision to form an FTA is a binary choice by a pair of countries' governments, whereas the model used here is flexible in that the decision to enter a RTA can be bilateral or multilateral.

[18] For more details on the construction of these variables, see Baier and Bergstrand (2004).

[19] Given that we do not expect these variables to react in anticipation of a RTA, we can safely assume that the lagged variables are uncorrelated with the contemporaneous error term.

positive and significant coefficient, and this result holds even when growth volatility is measured by the standard deviation of real GDP growth rate (columns 6 and 7).

One interesting result that supports the idea that growth volatility may drive the decision to enter into a RTA is the negative sign of the average growth volatility in a RTA relative to that of the ROW. This variable is introduced in the model because even if a country views a RTA as a device to reduce its vulnerability, it would tend to join a RTA with trade partners that are relatively more stable given potential shock transmissions. The results imply that the probability of joining a RTA is higher, the lower the volatility of regional trade partners compared to countries outside the RTA (columns 5 and 7). With regard to the other explanatory variables, the coefficients are highly significant and have the expected sign as in Baier and Bergstrand (2004). The predictive power of the model is quite good, with 67 percent of the values of the dependent variable correctly predicted (column 5).

Finally, the predicted probability of a RTA is derived in Equation 5, which is then used to replace the dummy variable for RTA in Equation 4. The results presented in Table 7 show that the variable RTA retains its negative sign and remains statistically significant, thus confirming the hypothesis that RTA reduces country's vulnerability to shocks.[20]

[20] Since the variable RTA is an estimate, its standard error in Table 7 may be biased. We used a bootstrapping method to approximate the standard error, and the results suggest that the significance of the variable RTA is not affected.

Table 6. Explaining the Probability of a RTA: the Role of Growth Volatility: Panel Logit Estimator

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Growth Volatility (Lag 2)	-0.248	-0.280	-0.311	-0.285	-0.266		
	[0.230]	[0.223]	[0.293]	[0.300]	[0.307]		
Growth Volatility (Lag 3)	0.485	0.416	1.008	1.078	1.072		
	[0.232]**	[0.220]*	[0.321]***	[0.339]***	[0.341]***		
Standard Deviation of Real GDP Growth Rate (Lag 2)						-0.317	-0.330
						[0.301]	[0.309]
Standard Deviation of Real GDP Growth Rate (Lag 3)						0.847	0.853
						[0.317]***	[0.321]***
Ratio of Average Growth Volatility in RTA to that of the ROW					-2.293		-2.402
					[1.089]**		[1.060]**
RGDP (Lag 1)	0.264		1.226	1.500	1.844	1.482	1.845
	[0.046]***		[0.213]***	[0.259]***	[0.332]***	[0.256]***	[0.329]***
DRGDP (Lag 1)		-0.289					
		[0.043]***					
DKL (Lag 1)			3.692	5.709	6.678	5.663	6.681
			[0.715]***	[1.090]***	[1.257]***	[1.079]***	[1.250]***
DROWKL (Lag 1)				-1.206	-1.492	-1.208	-1.505
				[0.382]***	[0.470]***	[0.378]***	[0.463]***
Observations	511	511	466	466	466	473	473
Number of countries	80	80	72	72	72	73	73
Pseudo R2	0.53	0.51	0.64	0.66	0.67	0.66	0.67

Note: Standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.
RDGP: Sum of the logs of real GDPs of countries in the RTA; DRGDP: Absolute value of the difference between the log of real GDP of the country and the average of the other countries in the RTA; DKL: Absolute value of the difference between the logs of the capital–labor ratios of the country and the average of the other countries in the RTA; DROWKL: Difference between the average capital–labor ratio of the RTA member countries and that of the ROW

Table 7. Predicted Probability of a RTA and Growth Volatility: System GMM Estimator

	(1)	(2)
	Our measure of Growth Volatility	Standard Deviation of Real GDP Growth Rate
GDP per capita (log)	0.114	0.111
	[0.051]**	[0.050]**
Predicted Probability of a RTA	-0.240	-0.310
	[0.100]**	[0.099]***
Trade openness (log)	0.021	-0.021
	[0.181]	[0.181]
Volatility of Terms of Trade (log)	0.172	0.172
	[0.053]***	[0.053]***
Volatility of Inflation (log)	0.106	0.099
	[0.060]*	[0.061]
Volatility of Private Credit Ratio (log)	0.290	0.299
	[0.091]***	[0.094]***
Constant	-3.161	1.722
	[0.641]***	[0.658]***
Observations	622	622
Number of countries	151	151
Hansen test prob.	0.71	0.60
AR2 test prob.	0.71	0.86

Note: Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.
AR (2): Arellano and Bond test of second order autocorrelation.

IV. CONCLUSION

This paper assesses the relationship between RTAs and growth volatility and finds that RTAs are consistently associated with lower growth volatility. This finding is both supported by descriptive statistics as well as econometric estimations using data for a sample of 170 countries with data covering the period 1978-2012. The model is estimated with the fixed-effect estimator to control for country-specific effects and System GMM estimator to address endogeneity issues. The results are robust across estimators, different measures of growth volatility, and different measures of RTAs (a dummy variable of RTA membership, the ratio of exports to RTA members to total exports, the ratio of imports from RTA members to total imports, and the sum of exports to and imports from RTA members divided by the sum of total exports and imports).

Building on Baier and Bergstrand (2004), this paper estimates a panel logit model to explain the probability of a RTA with lagged values of growth volatility. The results suggest that countries which experienced large growth shocks in the past are likely to participate in a RTA, but the probability for a country to form a RTA with other countries depends

negatively on the growth volatility of regional trade partners compared to that of countries outside the RTA.

The policy implications of these findings are straightforward. Among other strategies, countries that are vulnerable to growth shocks, particularly low-income countries, would benefit from joining a RTA or deepen trade with existing regional partners to cope with growth shocks. This is particularly relevant for low-income countries which tend to experience higher growth volatility. Surprisingly, they have made little progress in regional integration in contrast to middle and high-income countries. RTAs can offer mechanisms to strengthen policy credibility and coordination, as well as reduce the likelihood of conflicts, factors that reduce risks of growth volatility. Furthermore, as richer countries tend to have more stable growth, low-income countries would benefit from RTAs involving advanced economies to minimize the transmission of shocks and increase their resilience to shocks through trading with larger markets.

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Appendix Table 1. Summary Statistics

Variables	Observations	Mean	Std. Dev.	Min	Max
Growth Volatility (log)	737	-3.8	0.7	-6.1	-1.0
GDP per Capita (log)	737	7.7	1.6	4.7	11.6
RTA Membership	737	0.7	0.4	0	1
Share of Imports from Regional Trade Partners	640	22.8	27.8	0.0	92.9
Share of Exports to Regional Trade Partners	640	21.6	28.0	0.0	97.2
Regional Trade Openness	640	22.2	27.5	0.0	93.5
Trade openness (log)	737	4.3	0.6	2.6	6.0
Volatility of Terms of Trade (log)	737	-3.2	1.2	-10.5	-0.8
Inflation (log)	737	0.1	0.3	0.0	4.0
Volatility of Inflation (log)	737	-3.5	1.5	-33.1	0.7
Volatility of Private Credit Ratio (log)	698	-2.6	0.8	-5.1	-0.1
Volatility of Private Credit Growth (log)	726	-2.2	0.7	-5.0	-0.2
RGDP	729	19.6	12.2	0.0	31.2
DRGDP	729	8.2	9.4	0.0	29.4
DKL	688	4.2	3.1	0.1	11.6
DROWKL	688	3.2	3.0	0.0	10.2
Ratio of Average Growth Volatility in RTA to that of the ROW	729	0.8	0.5	0.0	1.4

Notes: RTA Membership: dummy variable equal to 1 when a country has signed at least one regional trade agrrements, and zero otherwise; RDGP: Sum of the logs of real GDPs of countries in the RTA; DRGDP: Absolute value of the difference between the log of real GDP of the country and the average of the other countries in the RTA; DKL: Absolute value of the difference between the logs of the capital–labor ratios of the country and the average of the other countries in the RTA; DROWKL: Difference between the average capital–labor ratio of the RTA member countries and that of the ROW.

Appendix Table 2. Correlation Matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Growth Volatility (log)	(1)	1																
GDP per Capita (log)	(2)	-0.10	1															
RTA Membership	(3)	-0.09	0.31	1														
Share of Imports from Regional Trade Partners	(4)	-0.15	0.58	0.48	1													
Share of Exports to Regional Trade Partners	(5)	-0.18	0.63	0.45	0.92	1												
Regional Trade Openness	(6)	-0.16	0.61	0.47	0.98	0.97	1											
Trade openness (log)	(7)	0.04	0.34	0.20	0.33	0.32	0.33	1										
Volatility of Terms of Trade (log)	(8)	0.16	-0.30	-0.08	-0.39	-0.38	-0.40	-0.27	1									
Inflation (log)	(9)	0.16	-0.18	-0.17	-0.19	-0.19	-0.19	-0.23	0.16	1								
Volatility of Inflation (log)	(10)	0.21	-0.37	-0.15	-0.23	-0.25	-0.25	-0.17	0.17	0.41	1							
Volatility of Private Credit Ratio	(11)	0.33	-0.27	0.00	-0.25	-0.31	-0.29	-0.04	0.26	0.30	0.49	1						
Volatility of Private Credit Growth	(12)	0.29	-0.34	-0.06	-0.21	-0.24	-0.23	-0.09	0.18	0.29	0.33	0.61	1					
RGDP	(13)	-0.12	0.39	0.92	0.61	0.59	0.61	0.23	-0.11	-0.14	-0.16	-0.05	-0.07	1				
DRGDP	(14)	0.07	-0.28	-0.91	-0.56	-0.51	-0.55	-0.27	0.09	0.15	0.13	-0.01	0.02	-0.98	1			
DKL	(15)	0.09	-0.15	-0.82	-0.64	-0.59	-0.63	-0.14	0.08	0.11	0.08	0.03	0.02	-0.91	0.91	1		
DROWKL	(16)	0.10	-0.14	-0.76	-0.62	-0.60	-0.62	-0.10	0.07	0.14	0.09	0.05	0.03	-0.85	0.85	0.94	1	
Ratio of Average Growth Volatility in RTA to that of the ROW	(17)	-0.13	0.34	0.96	0.52	0.49	0.51	0.19	-0.12	-0.10	-0.15	-0.04	-0.09	0.92	-0.90	-0.81	-0.74	1

Notes: RTA Membership: dummy variable equal to 1 when a country has signed at least one regional trade agrrements, and zero otherwise; RDGP: Sum of the logs of real GDPs of countries in the RTA; DRGDP: Absolute value of the difference between the log of real GDP of the country and the average of the other countries in the RTA; DKL: Absolute value of the difference between the logs of the capital–labor ratios of the country and the average of the other countries in the RTA; DROWKL: Difference between the average capital–labor ratio of the RTA member countries and that of the ROW.

Appendix Table 3. Variable Definitions and Sources

Variables	Definition	Sources
GDP per Capita	The ratio of nominal GDP divided by the size of the population.	International Monetary Fund
Inflation	Change in consumer price index (CPI).	
Growth Volatility	Main measure: The standard error of the residual of the log of real Gross Domestic Product (GDP) regressed on its lags value and a time trend (assuming an AR(1) process with a trend), calculated over a five-year period. Alternative measure: The standard error of annual real GDP growth rate over a five-year period	International Monetary Fund and author's calculations
Volatility of Terms of Trade	The standard error of the residual of the log of terms of trade index regressed on its lags value and a time trend, calculated over a five-year period. The terms of trade index is calculated as the percentage ratio of the export unit value indexes to the import unit value indexes, measured relative to the base year 2000.	
Volatility of Inflation	The standard error of the residual of the log of CPI regressed on its lags value and a time trend, calculated over a five-year period.	
Share of Imports from Regional Trade Partners	Imports from RTA members divided by country's total imports	Author's calculations based on bilateral trade flow data from Barbieri and Keshk (2012)
Share of Exports to Regional Trade Partners	Exports to RTA members divided by country's total exports	
Regional Trade Openness	Sum of exports to and imports from RTA members divided by the sum of country's total exports and imports	
RTA Membership	Dummy variable equal to 1 when a country has signed at least one regional trade agreement (RTA), and zero otherwise	De Sousa (2012)
Trade openness	Sum of exports and imports of goods and services measured as a share of GDP.	World Bank (Word Development Indicators)
Volatility of Private Credit Ratio	The standard error of the residual of the log of private credit ratio regressed on its lags value and a time trend, calculated over a five-year period. The private credit ratio is calculated as credit by deposit money banks to the private sector divided by GDP.	2013 Financial Development and Structure Dataset (Beck, Demirgüç-Kunt and Levine, 2000) and author's calculations
Volatility of Private Credit Growth (log)	The standard error of the residual of the log of private credit regressed on its lags value and a time trend, calculated over a five-year period. Private credit is the amount of loans in USD by deposit money banks to the private sector.	
RGDP	Sum of the logs of real GDPs of countries in the RTA	Author's calculations based on real GDP data from the International Monetary Fund
DRGDP	Absolute value of the difference between the log of real GDP of the country and the average of the other countries in the RTA	
DKL	Absolute value of the difference between the logs of the capital–labor ratios of the country and the average of the other countries in the RTA	Author's calculations based on capital stock and population data from the Penn World Table 8
DROWKL	Difference between the average capital–labor ratio of the RTA member countries and that of the ROW.	
Ratio of Average Growth Volatility in RTA to that of the ROW	Average growth volatility of the country's regional partners in an RTA divided by the average growth volatility of non-RTA members	Author's calculations