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Trade and Economic Growth

Evidence on the Role of Complementarities for CAFTA-DR Countries

César Calderóna
Virginia Poggio

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Abstract

This paper examines the effects of trade on growth among Central America-Dominican Republic Free Trade Agreement countries. To accomplish this task, the authors collected a panel data set of 136 countries over 1960–2010, and estimated cross-country growth regressions using an econometric methodology that accounts for unobserved effects and the likely endogeneity of the growth determinants. Following recent empirical efforts, they tested whether the impact of trade openness on growth may be more effective after surpassing a "minimum threshold" in specific areas closely related to economic development. The analysis finds not only that there is a robust causal link from trade to growth, but also that the growth benefits from trade are larger in countries with higher levels of education and innovation, deeper financial markets, a stronger institutional framework, more developed infrastructure networks, a high level of integration with world capital markets, and less stringent economic regulations. On average, rising trade has benefited growth in Central America-Dominican Republic Free Trade Agreement countries. However, the lack of progress in structural reforms has not allowed these countries to maximize the potential benefits from trade.

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Trade and Economic Growth: Evidence on the role of complementarities for CAFTA-DR countries*

César Calderón[a], **Virginia Poggio**[a]

[a] *The World Bank, 1818 H Street NW, Washington DC 20433, USA*

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1. Introduction

One of the salient features of the world economy has been the important surge in trade and financial globalization in the last two decades. Multiple free trade agreements and regional integration agreements are being celebrated —with more than 400 regional trade agreements in force by December 2008 according to WTO/GATT. In addition, world trade grew at least twice as fast as world output over the last two decades, thus deepening economic integration. In August 2004, the U.S. signed the CAFTA-DR free trade agreement with five Central American countries (Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua) and the Dominican Republic. According to the Office of the U.S. Trade Representative, U.S. exports to CAFTA-DR countries totaled US$ 26.3 billion in 2008, and the total trade between U.S. and CAFTA-DR in 2008 was US$ 45.6 billion. The Office also points out that CAFTA-DR countries represent the third largest U.S. export market in the LAC region, after Mexico and Brazil.[1]

Theoretically, it has long been argued in the literature that trade stimulates long-term growth and that it can do so through multiple channels. International trade would allow countries to specialize in areas where they possess comparative advantage, expand potential markets and allow firms to exploit economies of scale, enable the diffusion of technological innovation and frontier managerial practices, and reduce incentives for firms to conduct rent-seeking activities through higher market competition. Empirically, earlier works find evidence in support of the growth-enhancing effects of trade. However, Rodriguez and Rodrik (2000) suggested that most of the evidence was not robust due to issues related to the measurement of trade openness and trade policy as well as econometric problems (i.e. endogeneity of trade measures and co-linearity of trade and institutions). Also, Rodrik (2005) argued that policies towards trade openness may not render the same results for all countries since there is no unique mapping from economic principles to economic packages. Most of these criticisms have been tackled in recent empirical efforts by developing new identification strategies (Frankel and Romer, 1999), new trade indicators (Wacziarg, 2001), examining the trade-growth correlation around episodes of policy changes (Wacziarg and Welch, 2008), and addressing the issue of mapping from principles to policies by assessing the role of complementarities between trade and other structural reforms in stimulating growth (Calderon, Loayza, and Schmidt-Hebbel, 2006; Chang, Kaltani and Loayza, 2009; Calderon and Fuentes, 2009).

The goal of this paper is to assess the growth effects of trade among CAFTA-DR countries and, more specifically, to evaluate the structural areas that might become a constraint to reaping the growth benefits from growth. In this context, the paper argues that policy complementarities are a cornerstone to start up growth. Pro-growth policies should mutually reinforce —e.g. trade openness will have positive and substantial effects on growth in countries with higher levels of human capital. At the same time, policy complementarities may also impose severe restrictions in the design of optimal growth strategy —especially, among countries with less favorable initial conditions.

[1] See webpage: http://www.ustr.gov/trade-agreements/free-trade-agreements/cafta-dr-dominican-republic-central-america-fta

To accomplish this task we gather annual information for a sample of 136 countries over the period 1960-2009 and construct a panel data base of 5-year non-overlapping observations. We run our cross-country regressions using econometric techniques suitable for dynamic panel data models that account not only for the presence of unobserved components but also for the likely endogeneity or reverse causality of the growth determinants. Our results find that trade has indeed promoted growth, and our result is robust to the specification and technique used. However, the growth benefits of rising trade openness are conditional on the level of progress in structural areas such as education, innovation, infrastructure, institutions, the regulatory framework, financial development and international financial integration. Indeed, we find that the lack of progress in these areas can restrict the potential benefits of trade.

We discuss the implications of our regression analysis for CAFTA-DR nexus, putting emphasis on the impact of trade openness on growth per capita and identifying the structural areas that may represent a constraint to growth. To do so we calculate the impact of trade on growth among CAFTA-DR countries over the last 15 years and the potential growth gains of raising trade openness to the levels of a benchmark country/region (in our case, the East Asian Tigers, EAP7). In both cases, we find that there is room for trade to stimulate growth but special attention should be placed on reforms in structural areas that are complementary to the trade reform policies implemented by CAFTA-DR countries, mainly in the areas of education, institutional quality, and infrastructure.

This paper is divided in 5 sections. Section 2 presents a brief review of the literature on trade and growth with some emphasis on the channels of transmission, the problems in the empirical literature and the complementarities between trade and other structural factors in driving growth. Section 3 describes the data used in the paper and outlines the econometric methodology to estimate our cross-country growth regressions. Section 4 presents the empirical evidence on trade and growth and tests whether the impact of the former on the latter is enhanced by advances in structural areas such as education, domestic financial market development, institutional quality, infrastructure, financial integration, innovation and the regulatory framework. We also discuss the economic implications of our statistical analysis on CAFTA-DR countries. Finally, Section 5 concludes.

2. Literature Review

The classical paradigm of international trade argues that trade will promote growth by increasing the relative price of the good that is intensive in the relatively abundant factor (see, e.g. Deardorff, 1973, 1974). It has been found that the standard theory predicts an effect of trade openness on the long-run level rather than on the long-run growth of GDP (Lucas, 1988; Young, 1991). The new trade literature, on the other hand, argues that long-term growth gains from trade can be channeled through more intense research and development activity (see Romer, 1990; Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991). In this context, trade promotes long-term growth by raising the availability of resources for R&D and, thus, increasing the availability of specialized inputs and the size of the market, among other things.

More broadly speaking, the theoretical literature is ambiguous about the impact of trade on long-run growth. A strand of the literature suggests that the growth effects are positive when trade specializes in increasing-returns-to-scale activities (Young, 1991; Grossman and Helpman, 1991; Eicher, 1999). Others suggest that the effect is either negligible or negative whenever there are market or institutional imperfections (Rodrik and Rodriguez, 2001), under-utilization of human or capital resources, focus on extractive activities (Sachs and Warner, 1995, 1999) or there is specialization away from technologically-intensive, increasing returns to scale sectors (Matsuyama, 1992).

It has been argued in the literature that trade may affect economic growth through different channels. First, trade openness may increase a country's market size and, thus, may provide innovators with new business opportunities and allow domestic firms to take advantage of scale economies. Alesina, Spolaore and Wacziarg (2005) find evidence supporting this hypothesis —especially, for smaller countries. Second, trade can enhance technological diffusion and transmit know-how and managerial practices thanks to stronger interactions with foreign firms and markets (Keller, 2004; Sachs and Warner, 1995). In a seminal paper, Coe and Helpman (1995) find that foreign R&D has a beneficial effect on domestic productivity and that these growth benefits are particularly stronger in countries that are more integrated to international goods' markets. Analogous studies support the hypothesis of productivity gains due to trade-facilitated technology spillovers among developed countries (Xu and Wang, 1999; Keller, 2000; Funk, 2001) as well as among developing countries (Coe et al. 1997).[2] Consistent with this evidence, Lewer and van den Berg (2003) find that the strength of trade as an engine of growth depends on the composition of trade. More specifically, they find that countries that import mostly capital goods and export consumer goods tend to grow faster than those that export capital goods. Third, trade may enhance product market competition, thus reducing anti-competitive practices of domestic firms and leading to higher specialization due to exploitation of comparative advantages of domestic firms. Trefler (2004) finds evidence supporting this hypothesis for Canada. In addition, Aghion, Fedderke, Howitt, Kularatne and Viegi (2008) find that trade liberalization stimulated productivity growth in South Africa through product market competition and pricing power of domestic producers.

The literature on the consequences of trade liberalization strategies can also be classified in two strands. The first one focuses on the long-run productivity benefits of free trade policies (e.g. Tybout et al., 1991; Levinsohn, 1993; Harrison, 1994; Tybout and Westbrook, 1995; Krishna and Mitra, 1998; Head and Ries, 1999a,b; Pavcnik, 2002) while the second strand examines the impact of freer trade on short-run worker displacement and earnings (e.g. Gaston and Trefler, 1994, 1995; Revenga, 1997; Levinsohn, 1999; Beaulieu, 2000; Krishna et al. 2001).

The empirical literature on trade and growth typically argued that growth was positively correlated with higher trade volumes, even after accounting for a variety of growth determinants. Edwards (1992), Dollar (1992), Ben-David (1993), Sachs and Warner (1995), Ades and Glaeser (1999), and Alesina, Spolaore and Wacziarg (2000) are examples of this sort. However, Rodriguez and Rodrik

[2] Relatedly, several empirical papers suggest that the investment rate is an important channel that links trade and growth (Levine and Renelt, 1992; Baldwin and Seghezza, 1996; Wacziarg, 2001).

(2000) argued that most of these findings were less robust than claimed due to: (a) difficulties in measuring openness and especially trade policy, (b) the statistical sensitivity of the specifications and other econometric difficulties —among them, collinearity of protectionist policies with other bad policies, and likely endogeneity of trade openness. These authors argued that the literature focused on the growth effects of trade volumes rather than trade policy, and that the former is plagued by severe endogeneity problems (i.e. a booming country may trade more in international markets). In addition, they suggested that the indicators of trade openness typically used in the empirical literature were as controversial as those proxies for trade barriers. Finally, they stated that the empirical methodologies used to examine the linkages between trade policy and growth were not robust to accounting for endogeneity and controlling for other structural factors —more, specifically, institutions.

To address the issue of endogeneity, Frankel and Romer (1999) use a gravity model to instrument for trade openness. According to this model, trade flows between countries would depend on the geographical and cultural characteristics of trading partners —say, distance, remoteness, common border, landlocked and/or island countries, common language, among others— as well as their size (population and surface area). Using gravitational variables, they attempted to establish a causal link between trade and growth and found that the impact of the former on the latter was positive and statistically significant.

The need for a paper that studies contingent relationships between trade policy and growth was addressed by Wacziarg and Welch (2008). More specifically, these authors examined the evolution of growth, investment and openness around episodes of trade liberalization. They found that growth rates in countries that liberalized their trade regimes were 1.5 percentage points higher than before liberalization, and that investment rates rose 1.5-2.0 percentage points after liberalization. Finally, the trade to GDP ratio rose by 5 percentage points due to the liberalization. In sum, their results suggest that trade and growth have a positive co-movement and one of the channels of transmission is likely to be investment.

A strand of the empirical literature has suggested that trade openness appears to be beneficial to economic growth on average. However, its effect may vary considerably across countries and may depend upon a variety of conditions associated to structural policies and institutions. Edwards (1993) surveys the conditions needed for successful trade reforms and finds that growth benefits from trade may depend upon a "*minimum critical threshold*" associated to the level of development (Helleiner, 1986) or the structure of trade (Kohli and Singh, 1989). A recent paper by Chang, Kaltani and Loayza (2009) finds that although trade stimulates growth, this effect can be enhanced by complementary reforms undertaken in the economy. The authors specifically find that interactions among trade and structural factors such as human capital, financial depth, infrastructure and economic regulations are statistically and economically significant, and robust to changes in specification, econometric method, and openness measure.[3] Finally, Bolaky and Freund (2004) use cross-country regressions to find that

[3] The empirical growth literature offers some related examples of non-linear specifications considering interaction effects. Borensztein et al. (1996) and Alfaro et al. (2006) find that growth benefits from FDI are attained when the host country has sufficiently high levels of human capital and financial development, respectively.

trade openness is effective in promoting an expansion of income in countries that are not excessively regulated. They argued that resource allocation towards the most productive sectors and companies is more difficult in highly-regulated countries.

3. Data and Methodology

3.1 The Data

We have initially collected a panel dataset of 136 countries organized in 5-year non-overlapping observations over the period 1970-2010, with each country having at most 8 observations. The list of countries in our sample is presented in Table A.1.[4] Given that the availability of data is different across variables, we have an ***effective*** sample of 99 countries with at least 4 consecutive observations for all variables involved in our analysis. This sub-section describes the construction and sources of the data used in our empirical analysis. The focus of this paper is to examine the growth effects of trade openness and the role of complementarities between the latter and other structural factors in promoting growth.

Our dependent variable is the average annual growth rate in real GDP per capita within the 5-year period, which is computed as the simple average of log differences in real GDP per capita over the 5-year period. Real GDP per capita is expressed in 2005 international dollars (adjusted by PPP) from Heston, Summers and Aten (2009).

Our set of control variables includes the (log) level of real GDP per capita at the beginning of the 5-year period to test for the existence of *transitional convergence*. A negative coefficient estimate for this variable would imply that poorer countries may grow faster than richer countries —i.e. consistent with the neoclassical model. The rest of variables that conform our set of long-run growth determinants follows Loayza, Fajnzylber and Calderon (2005): human capital, financial depth, institutional quality, lack of price stability, infrastructure, financial openness and our variable of interest, trade openness.

[4] Note that we have collected information for some variables since 1960. However, the information on holdings of foreign assets and liabilities restrict our effective regression sample to start since 1970.

Human capital is approximated by the initial gross rate of secondary schooling (in logs) and the data is obtained from Barro and Lee (2001).[5] *Financial development* is measured by the ratio of domestic credit to the private sector to GDP and the data is collected from Beck, Demirgüç-Kunt and Levine (2000), Beck and Demirgüç-Kunt (2009), and updated using data from the IMF's International Financial Statistics and the World Bank's WDI. For the sake of robustness, we use other proxies of financial development: domestic credit provided by domestic money banks, and liquid liabilities of the financial sector. Both variables are expressed as a percentage of GDP and in logs. *Institutional quality*, on the other hand, comprises different dimensions such as absence of corruption, rule of law, enforcement of contracts, quality of the bureaucracy, democratic accountability, among others. We use the ICRG index of political risk as our indicators of institutional quality. The data is published in the International Risk Country Guide (ICRG) by the Political Risk Services (PRS) Group. The *lack of price stability* is approximated by the average CPI inflation rate. This variable typically reflects the quality of monetary and fiscal policies and is directly related to other indicators of poor macroeconomic management. The data on the inflation rate is gathered from the IMF's International Financial Statistics.

Infrastructure is a multi-dimensional concept; however, most empirical studies have focused on a single-sector approach partly due to: (i) the difficulty of capturing the multiple dimensions of infrastructure in a simple way, and (ii) the high correlation often found among indicators of different types of infrastructure assets (Calderón and Servén, 2004).[6] To overcome this problem, while accounting for the multi-dimensionality of infrastructure, we use principal component analysis to build synthetic indices summarizing information on the quantity of different types of infrastructure assets as well as the quality of services in different infrastructure sectors.[7] These synthetic indices combine information on three core infrastructure sectors -- telecommunications, power, and roads -- and help address the problem of high co-linearity among their individual indicators.[8] We denote IK the synthetic quantity

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[5] This "flow" measure captures more closely current policies on schooling and human capital investment than "stock" measures related with educational attainment of the adult population or life expectancy (Loayza et al. 2005).

[6] Calderón and Servén (2004) find that the sample correlation between standard measures of telephone density and power generation capacity (measured respectively by a country's total number of telephone lines, and its total power generation capacity, in both cases relative to the number of workers) exceeds 0.90, which makes it hard to disentangle in a regression framework the separate roles of the two types of assets.

[7] Alesina and Perotti (1996) used principal component analysis to create a measure of political instability, while Sánchez-Robles (1998) employed it to build an aggregate index of infrastructure stocks.

[8] We should point out that the sector-specific indicators of infrastructure quantity and quality employed below, while standard in the literature, are subject to caveats regarding their homogeneity and international comparability. For example, the quality and condition of a 'paved road' can vary substantially across countries – even within the same country. More homogeneous measures of infrastructure performance would be clearly

indices that result from this procedure. The indices can be expressed as linear combinations of the underlying sector-specific indicators, and hence their use in a regression context is equivalent to imposing linear restrictions on the coefficients of the individual infrastructure indicators. We define the synthetic infrastructure quantity index IK_1 as the first principal component of three variables: total telephone lines (fixed and mobile) per 1000 people (Z_1/L), electric power installed capacity expressed in MW per 1000 people (Z_2/L), and the length of the road network in km. per 1000 people (Z_3/L). Each of these variables is expressed in logs and standardized by subtracting its mean and dividing it by its standard deviation. All three infrastructure stocks enter the first principal component with roughly similar weights:

$$IK_1 = 0.603 * \ln\left(\frac{Z_1}{L}\right) + 0.613 * \ln\left(\frac{Z_2}{L}\right) + 0.510 * \ln\left(\frac{Z_3}{A}\right)$$

The index accounts for almost 80 percent of the overall variance of the three underlying indicators. As a robustness check, we compute an alternative index of infrastructure quantity, IK_2, which uses main telephone lines instead of the combined main lines and mobile phones employed in the first index. [9]

Financial openness is approximated by the data on holdings of foreign assets and liabilities from Lane and Milesi-Ferretti (2001, 2007). Specifically, we use summary measures of financial openness:

$$FO_{it} = \frac{FA_{it} + FL_{it}}{GDP_{it}} \text{ and } FO(L)_{it} = \frac{FL_{it}}{GDP_{it}}$$

where *FA* and *FL* refer to the stocks of foreign assets and liabilities —expressed as a ratio to GDP. Note that *FA* and *FL* include stocks of assets and liabilities in foreign direct investment, portfolio equity, financial derivatives and debt (portfolio debt, bank and trade-related lending).[10] On the other hand, given that international trade in debt instruments may be driven by special factors, we also consider the

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preferable, but unfortunately they do not exist, at least with any significant coverage across countries and time periods.

[9] The correlation between the two synthetic quantity indices is over 0.996. This is unsurprising given the similarly high correlation between the two indicators of telephone density underlying the respective synthetic indicators.

[10] In this paper we also evaluate the role of the structure of external capital in driving the long-term growth performance of countries. Hence, we will break down our outcome measure of financial openness into equity- and loan-related foreign liabilities. While the former includes the foreign liability position in foreign direct investment and portfolio equity, the latter includes only the debt liability position. The same calculation is performed for the ratio of foreign assets and liabilities to GDP.

decomposition of financial openness into equity-related and debt-related financial measures (Lane and Milesi-Ferretti, 2003):

$$Eq-FO_{it} = \frac{FDIA_{it} + FDIL_{it} + PEQA_{it} + PEQL_{it}}{GDP_{it}}$$

$$Db-FO_{it} = \frac{PDBA_{it} + PDBL_{it} + OIA_{it} + OIL_{it} + RA_{it}}{GDP_{it}}$$

where *FDIA* and *FDIL* are stocks of foreign direct investment assets and liabilities, *PEQA* and *PEQL* are the stocks of portfolio equity assets and liabilities, *PDBA* and *PDBL* are holdings of portfolio debt assets and liabilities, *OIA* and *OIL* are stocks of other investment assets and liabilities, and *RA* represents reserve assets. In short, *Eq-FO* and *Db-FO* are indicators of the level of equity- and debt-related cross holdings. Analogously to the definition of overall financial openness, we also define these ratios for only liability holdings, *Eq-FO(L)* and *Db-FO(L)*, and asset holdings, *Eq-FO(A)* and *Db-FO(A)*.

Our variable of interest, *trade openness*, affects growth through various channels. It allows production specialization through the exploitation of comparative advantages, enabling technological diffusion and expanding potential markets for the country's goods, among other things. Trade openness is measured as the ratio of real exports and imports to real GDP (all these magnitudes are expressed in local currency at constant prices) and the data is collected from the World Bank's World Development Indicators. We also use an alternative measure of openness that adjusts the volume of trade over GDP for the size (area and population) of the country and for whether the country is landlocked or an oil exporter.[11] Loayza, Fajnzylber and Calderon (2005) argue that this structure-adjusted volume of trade maybe preferable than the unadjusted ratio given that the econometric analysis is based on cross-country comparisons. Unadjusted measures of trade volume may unfairly attribute to trade policy what is merely the result of structural country characteristics —e.g. small countries are more dependent on foreign trade than larger countries, oil exporters may have large trade volumes and also impose high import tariffs, and landlocked countries tend to trade less than other countries due to higher transport and trading costs.

Finally, we will describe two sources of data for which we lack extensive time series but we have a good cross-country coverage: research and development, and economic regulations. We argue that

[11] A similar adjustment is presented in Pritchett (1996).

positive complementarities between trade and innovation can be exploiting in triggering higher and sustained growth. Our proxies for innovation are R&D spending as percentage of GDP, R&D scientists (per one million people), and R&D technicians (per one million people). We summarize all these three measures in an aggregate R&D index. In addition, we used the share of high-tech exports to manufacturing exports as a proxy for innovation.

3.2 Econometric Methodology

We have an effective pooled data set of cross-country and time-series observations for 99 countries over the period 1970-2010, and we use an estimation method that is appropriate for dynamic panel data models. The methodology used not only controls for unobserved time- and country-specific effects but also accounts for likely endogeneity or reverse causality among the explanatory variables. In short, we use the generalized method of moments (GMM) for dynamic panel data models developed by Arellano and Bond (1995), Arellano and Bover (1995) and Blundell and Bond (1998). For more details on the econometric methodology, see Appendix I.

We regress the growth in real output per capita on a standard set of growth determinants that includes our variable of interest, trade openness. Our basic set of control variables comprises information on the level of human capital, domestic financial depth, institutional quality, lack of price stability, financial openness and infrastructure stocks. In addition to our baseline regression, we explore the role of complementarities between trade and structural factors in driving growth. In short, our dynamic regression equation can be specified as follows:

$$\begin{aligned} y_{it} - y_{it-1} &= \alpha y_{it-1} + \phi' K_{it} + \gamma' Z_{it} + \mu_t + \eta_i + \varepsilon_{it} \\ &= \alpha y_{it-1} + \beta' X_{it} + \mu_t + \eta_i + \varepsilon_{it} \end{aligned} \qquad (1)$$

where *y* denotes the real GDP per worker (in logs), *K* is a set of standard growth or inequality determinants, and *Z* is our variable of interest: trade openness. The terms μ_t and η_i respectively denote an unobserved common factor affecting all countries, and a country effect capturing unobserved country characteristics. The second equality follows from defining $X_{it} = (K'_{it}, Z'_{it})'$ and $\beta = (\phi', \gamma')'$.

Our assessment of the effects of trade openness on economic growth in our panel data set poses some econometric challenges: (i) the presence of unobserved effects, and (ii) the potential endogeneity of explanatory variables. We control for unobserved time effects by including period-specific dummies in our regressions while unobserved country effects are accounted for by differencing and instrumentation. The problem of joint endogeneity is addressed again by instrumentation in this methodology. More specifically, this econometric technique relaxes the assumption of *strong exogeneity* of the explanatory variables by allowing them to be correlated with current and previous realizations of the error term, ε. Since there are no obviously exogenous instruments available, the methodology primarily relies on *internal instruments* —that is, suitable lags of the explanatory variables (Arellano and Bond, 1991).

Additionally, we will use some external instruments to control for the likely endogeneity of our variable of interest, trade openness. We are concerned that moment conditions may not hold with the use of internal instruments and that our results may be driven by invalid instruments. It has been argued that future shocks to growth may promote the expansion of international trade. In this context, we may be required to find instruments that can be considered exogenous and yet be correlated with trade openness. We follow Loayza, Fajnzylber and Calderon (2005) and Chang, Kaltani and Loayza (2009) and consider measures of size and geography as instruments of trade openness —i.e. (actual and lagged values of) population, surface area of the country, and dummies for oil exporting countries and landlocked countries.

The consistency of the GMM-IV estimator relies on the validity of the moment conditions specified in the Appendix I —equations (I.2) through (I.6). Their validity can be examined through two specification tests (Arellano and Bond, 1991; Arellano and Bover, 1995): First, the *Sargan test of over-identifying restrictions* examines the overall validity of the instruments by evaluating the sample analog of the moment conditions used in the estimation process. If we fail to reject the null hypothesis, we can argue that the moment conditions hold —thus providing statistical support to the model. Second, we conduct higher-order serial correlation tests of the error term ε_{it}. The *system GMM-IV* estimator, GMM-IV(S), tests whether the differenced error term (i.e. the residual of the regression in first differences) shows second-order serial correlation. We expect that the differenced error term shows first-order serial correlation even if the error term of the regression in levels is uncorrelated —unless the latter follows a random walk. In this case, the presence of second-order serial correlation indicates that the original error term is serially correlated and follows a moving average process of at least order one. This would render invalid the proposed instruments.[12] Failure to reject the null would tend to support the model.

4. Empirical Assessment

4.1 Basic Correlations and Baseline Regression

Panel Correlations

Table 1 presents the simple panel correlations between trade openness and growth for our sample of 136 countries with 5-year non-overlapping observations spanning the period 1960-2010. The panel correlation between these two variables is positive, significant and equal to 0.08. This correlation is significantly higher in countries with high levels of income per capita, human capital, infrastructure and financial openness.

Figure 1 depicts the degree of association between trade openness and growth in the 2000s. We note that this correlation is higher than that of the full sample (0.21 vs. 0.08). Note that the second panel of the period identifies the CAFTA-DR countries in our scatter plot. Most of these countries are close to or below the medians of both trade openness and growth, and they have a flatter relationship than that of the rest of the sample.

Figure 2, on the other hand, plots trade vis-à-vis growth and distinguishes the observations in higher percentiles of the distribution of the control factor (say, human capital, financial development, institutions, financial openness, infrastructure, and regulations) to that of lower percentiles (i.e. those below the 67th percentile of the sample distribution for the period 2001-10). Our cross-sectional figures confirm the results for the pooled panel correlations: the trade-growth nexus is stronger in countries with more educated people, stronger institutions, an improved infrastructure network and more flexible regulations. Note that these are unconditional correlations and the conditional ones will be conducted below in our regression analysis.

[12] If so, we would have to use higher-order lags of the variables as instruments.

Baseline Regression

Table 2 reports the coefficient estimates for our baseline regressions using different estimation techniques. We should note that the coefficient estimate of our variable of interest, trade openness, is positive and significant (at least at the 10 percent level) regardless of the technique used. In column [1] we run a pooled OLS regression while column [2] controls for time dummies and column [3] controls only for country dummies. We apply the Arellano-Bover (1991) GMM-IV difference estimator in column [4], thus controlling for unobserved components and endogeneity by differencing and instrumenting the differences of the explanatory variables using their lagged levels. However, the GMM-IV difference estimator may face the problem of weak instruments if the explanatory levels are highly persistent. Hence, columns [5] and [6] estimate our baseline regression using the GMM-IV system estimator (Arellano and Bover, 1995; Blundell and Bond, 1998). While the estimation in [5] uses internal instruments, the estimation in [6] uses external instruments to account for the likely endogeneity of trade openness. As we pointed out in Section 3, those external instruments are the (actual and lagged levels of) population (in logs), the surface area of the country (in logs), and dummies for landlocked and oil exporting countries. Given that it jointly addresses the issue of likely endogeneity and unobserved factors, our preferred estimation is the one reported in column [6]. We will discuss these results for our baseline regressions.

We find a negative and significant coefficient for the initial (log level of) GDP per capita, thus providing evidence of conditional convergence. Growth is enhanced by a faster accumulation of human capital (as proxied by rising gross rates of secondary schooling), deeper domestic financial markets (as measured by higher ratios of domestic credit to the private sector to GDP), and better institutions (as approximated by higher levels of the ICRG political risk index). Lack of price stability, measured by higher rates of consumer price inflation, hinders growth. A faster accumulation of infrastructure stocks (as proxied by deeper telecommunication penetration, larger electricity installed capacity and a longer road network) promotes long-term growth. Financial openness, on the other hand, seems to have an adverse effect on growth rate.

Our variable of interest, trade openness, has a positive and significant coefficient. This result implies that long-run growth is enhanced by a more outward orientation in goods' markets. Our coefficient estimates suggests that doubling trade openness would raise the growth rate by 43 basis points per year –that is, more than 4 percentage points over a decade. Finally, we should also note that the coefficient estimate of trade openness may vary according to the extent of the outward orientation of the country and/or over time.

Trade and growth: does the extent of international trade integration matter?

Table 3 investigates whether the effect of trade openness on economic growth will depend on the extent of international trade integration. Regression [1] includes the trade openness (*TO*) and a censored variable that takes the values of our trade openness indicator if it is higher than the 66th percentile of the sample distribution and 0 otherwise. We find that the *TO* coefficient is negative and statistically not different from zero whereas the TO coefficient for countries with high trade integration is positive and significant. Regressions [2] through [5] differentiate trade openness in our regression analysis for countries with low trade integration (up to the 33rd percentile of the sample distribution), medium trade integration (between 33rd and 67th percentiles) and high trade integration (higher than the 67th percentile). The difference between these regressions lies on the set of instruments used to account for endogeneity. Regression [2] uses the same set of instruments as our baseline regression. Regressions [3] and [4] use an adjusted measure of trade openness in our regression –thus following Chang, Kaltani and Loayza (2009). Regression [3] uses an adjusted measure calculated as the residual from the regression of trade openness on size and geography measures such as (the log of) population, (log of) surface area, and dummies of landlocked and oil exporting countries. Regression [4] uses the adjusted measure that adds global effects to the previously described regression (*i.e.* time dummies). Finally, regression [5] uses only internal instruments in the spirit of Arellano and Bond (1991) and Arellano and Bover (1995).

Our preferred estimated regression, [2], shows that the coefficient estimate of trade openness is positive regardless of the extent of outward orientation of the country; however, it is statistically significant only for countries with high trade integration. Note that when using only internal instruments (regression [4]), we find that all estimated coefficients are positive and significant, and that the impact of trade openness on growth is higher the deeper is the level of trade integration of the country.

Does the impact of trade on growth change over time?

Table 4 shows the coefficient of our variable of interest, trade openness, interacted with dummy decades for the 1980s, 1990s and 2000s. Regressions [1] through [3] include only trade openness (*TO*) and *TO* interacted with a dummy variable that takes the value of 1 for the period 2000-9 and 0 otherwise. These regressions differ from the set of instruments used to account for the endogeneity of trade openness (i.e. external instruments as in our baseline, and adjusted measures of trade openness in the spirit of Chang et al, 2009). Regressions [4] through [6] include TO as well as its interaction dummies for the periods 1980-9, 1990-9, and 2000-9. In general, we find that the coefficient estimate for the 1980s is negative and significant in most cases, whereas the TO coefficient for the 2000s is positive and significant.

4.2 Trade and Growth: The Role of Complementarities

The evidence presented in Tables 3 and 4 shows that the coefficient estimate of trade openness may not be either constant across countries or over time. In this respect we proceed to estimate the following regression equation

$$y_{it} - y_{it-1} = \alpha y_{it-1} + \phi' K_{it} + \gamma_{it}' Z_{it} + \mu_t + \eta_i + \varepsilon_{it} \tag{2}$$

Note that the parameter associated to trade openness (*TO*), γ_{it}, is now allowed to vary across countries and time. In this paper, we will model this parameter as follows:

$$\gamma_{it} = \gamma_0 + \gamma_1 F_{it}$$

where the coefficient of trade openness depends directly on TO as well as its interaction with structural factors. In this paper we consider the complementarities between trade openness and the following factors: human capital, financial development, institutions, infrastructure, financial openness, research and development and certain aspects of the regulatory framework.

Complementarities between Trade and Structural Factors

Table 5 presents regression estimates that test for the significance of complementarities between trade openness and human capital (regression [2]), trade openness and financial development (regressions [3] to [5]), trade openness and institutional quality (regression [6]). We should note that the impact of trade openness on growth will now depend on the level of the specific structural factor in each country at a determined period of time.

Regression [1] of Table 5 includes the interaction between trade openness and the level of income per capita in our baseline regression. While the TO coefficient (γ_0) is negative and significant, its interaction with income per capita is positive and significant (γ_1). This finding suggests that a more outward-oriented strategy in goods' markets would have adverse effects on poorer countries and positive effects on countries with higher income levels. Economically speaking, our regressions suggest that a one standard deviation increase in trade openness —i.e. an increase in the ratio of approximately 75 percent— would lead to a decline in the growth rate of 30 basis points per year for countries with lower levels of income per capita (approximately US$ 2500 at 2005 PPP prices — Mongolia in 2005) while it would raise growth of output per capita in countries with higher levels of income per capita (US$ 22000 —Republic of Korea in 2005) by almost 1 percentage point (more precisely, 97 basis points).

The first panel of Figure 3 reports the growth effects of rising trade openness for different levels of income per capita —that is, selected percentiles of the distribution (10th, 25th, 33rd, the median, 67th, 75th, and 90th percentiles), regions (CAFTA, LAC excluding CAFTA countries, OECD) and countries (CAFTA-DR countries and the United States). Our evidence shows that countries with higher income per capita reap the largest growth benefits from rising trade openness. We also find that all CAFTA-DR countries (with the exception of Costa Rica) have income per capita levels below sample median for 2005 and, hence, they have a growth effect that is lower than the median response —that is, an increase that is smaller than 40 basis points per year in the growth rate. The growth increase in Costa Rica is approximately 55 basis points per annum (higher than the median) and the smallest response among CAFTA-DR countries is registered in Nicaragua. Here, the increase in trade openness leads to an annual decline in output per capita growth of 38 basis points.

Regression [2] of Table 5, on the other hand, includes the interaction between trade openness and human capital (more specifically, the gross rate of secondary schooling). We find similar results to those found for the income per capita: the coefficient of TO is negative and significant while the interaction with secondary schooling is positive and statistically significant. Again, we could argue that the growth benefits from trade are larger in countries with higher human capital levels. Controlling for the gross rates of secondary enrollment across countries for 2005 in our sample, we find that rising trade openness in countries with low rates of enrollment in secondary schooling (43 percent —e.g. Bangladesh and Ghana located in the 25th percentile of the sample distribution for 2005) would have negligible effects on growth —almost 5 basis points per annum, and this small hike is not statistically significant. On the other hand, a one standard deviation increase in trade openness would raise the growth rate by almost 1.3 percentage points per annum in countries with higher rates of secondary schooling enrollment (96 percent —e.g. Slovak Republic and Slovenia in the 75th percentile).

Regressions [3] through [5] report the interaction between trade openness and measures of financial development, that is, domestic credit to the private sector, domestic credit provided by domestic money banks, and liquid liabilities, respectively. All these variables are expressed as a percentage of GDP and in logs, and they are interacted with trade openness. Regardless of the indicators of financial development used in our analysis, we find that the coefficient of TO is negative and not statistically significant in most cases but the interaction with financial development is robustly positive. Again, we find that countries with deeper domestic financial markets may reap the largest growth benefits from trade. Economically, we find that countries with low financial development (say, with domestic credit to the private sector of 20% of GDP —e.g. the average for the 2006-8 period in Paraguay and Botswana at the 25th percentile of the distribution for that period) would raise their growth per capita by 35 basis points if trade openness were to increase by a one standard deviation. The growth effect of an analogous increase in trade openness more than doubles (a 72 basis point hike in growth per capita) for countries with high financial development (e.g. Greece and Israel with an average domestic credit of 90% of GDP in 2006-8 —i.e. the 75th percentile of the distribution for that period).

Finally, regression [6] interacts trade openness and the level of institutional quality. As we said before, our indicator of institutional quality is the average of the ICRG index of political risk (in logs). Analogous to the other regressions reported in Table 5, we find that the coefficient of TO is negative (and, in this case, statistically significant) whereas the interaction between TO and institutions is positive and significant. This result implies that the growth effects of rising trade openness would be larger in countries with stronger institutions —which is consistent with previous work that show evidence on the role of complementarities between trade and institutional quality; that is, trade reforms may lead to higher growth per capita in countries with stronger institutional quality (Calderon and Fuentes, 2006, 2009; Chang, Kaltani and Loayza, 2009). More specifically, our evidence shows that the rate of growth per capita would increase only by 30 basis points per annum in countries with weak institutions (say, Bolivia and Honduras at the 25th percentile of the sample distribution for the 2006-9 period), whereas the annual per capita growth benefit for a country with strong institutions (Poland and Slovak Republic at the 75th percentile) is approximately 72 basis points per annum.

Complementarities between trade and infrastructure

An adequate and efficient supply of infrastructure services has long been perceived as a key ingredient for development (The World Bank, 1994). A strand of the literature shows that infrastructure quantity and quality help promote long-term growth (Sanchez-Robles, 1998; Calderon and Serven, 2004, 2010). Access to infrastructure, on the other hand, plays a significant role in helping reduce income inequality (Estache, Foster and Wodon, 2002; Calderon and Chong, 2004; Calderon and Serven, 2004; Galiani et al. 2005). Recent work has also found that efficient provision of infrastructure is crucial for the success of trade liberalization strategies aimed at optimal resource allocation and growth of exports (Lederman, Maloney and Servén, 2005).

Table 6 includes the interactions between trade openness (*TO*) and a battery of infrastructure indicators (either at the aggregate level or by sector). We have constructed two aggregate indices of infrastructure, IK_1 and IK_2, that summarize information on telecommunications, electricity and roads. The definition of these indices was provided in Section 3. Regressions [1] and [2] in Table 6 include the interaction between trade openness and the aggregate indices of infrastructure, IK_1 and IK_2, respectively. In both cases, we find that the coefficient of TO is negative and significant whereas that of the interaction between TO and infrastructure is positive and significant. Thus, our evidence suggests that a better infrastructure network would enhance the impact of trade on growth. Using the estimates of regression [1] we find that a one standard deviation increase in trade openness would lead to an increase in the growth rate per capita of 16 basis points in countries with a poor infrastructure network (i.e. India and Pakistan's average index of infrastructure is at the 25^{th} percentile of the distribution for the 2006-8 period) while growth per capita would be higher by 1.4 percentage points for countries with better infrastructure networks (Taiwan, Singapore with levels of infrastructure provision in the 75^{th} percentile of the distribution).

Regressions [3] through [5] include the index of aggregate infrastructure IK_1 and the interaction between trade openness and sectoral measures of infrastructure —say, number of main lines and mobile phones per 1000 people, electricity installed capacity (in MW per 1000 people), and the length of the road network (in km. per 1000 people). On the other hand, regressions [7] to [10] include both the sector indicators of infrastructure and its interaction between trade openness and each of the sectoral indicators. Regression [7] includes the measure of telephone penetration (main lines and mobiles per 1000 people) and its interaction with trade openness, whereas regressions [8] and [9] use electricity installed capacity and road length instead of total phones, respectively. These results imply that an adequate supply of telecommunications, electricity and an improved road network may help raise the growth benefits from trade.

Complementarities between trade and financial openness

Table 7 explores the complementarities between trade and financial openness in driving growth. It has been argued that vertical FDI may allow MNEs to fragment production optimally and benefit from cost advantages related to targeting labor-intensive production states in labor-abundant countries (Hanson, Mataloni and Slaughter, 2001). This would lead to rising two-way trade (i.e. higher imports of inputs and subsequent export of upgraded products). Also, trade and financial openness are typically determined by the same set of forcing variables in a gravity model; more specifically, information flows and frictions (Portes and Rey, 2005). In this context, the access to financial flows would lead to more resources that could be devoted to further specialization in traded sectors (Kalemli-Ozcan, Sorensen and Yosha, 2001).

Before we assess the interactions between trade and financial openness, we will briefly discuss the results of our baseline regression and those of regression [1] where we decompose the extent of financial openness into equity- and debt-related openness. In the baseline regression we found that the coefficient of financial openness, as proxied by the ratio of foreign assets and liabilities to GDP, is negative and statistically significant. This suggests that financial openness may be harmful for growth and one of the leading explanations behind this result would be its deleterious effects on aggregate volatility (Kose, Prasad, and Terrones, 2003). However, when we decompose the holdings of foreign assets and liabilities of the country into equity-related and debt-related, further insights arise. We find that the coefficient of equity-related financial openness (that is, FDI and portfolio equity assets and liabilities) is positive and significant whereas that of debt-related financial openness (i.e. portfolio debt and other investment assets and liabilities as well as reserve assets) is negative and significant. This result suggests that growth benefits from financial openness would arise in countries with lower debt to equity ratios.

Regression [2] introduces the ratio of foreign assets and liabilities to GDP (*FO*) and its interaction with trade openness (*TO*) in our regression equation. On the other hand, regressions [3] and [4] include foreign liabilities as a percentage of GDP (*FL*) and foreign assets (*FA*) instead of the sum of foreign assets and liabilities (*FO*), respectively. Regardless of the measure of financial openness, we find that the coefficient of *TO* is negative and significant (same as that of financial openness) whereas the interaction between *TO* and the indicators of financial openness is positive and significant. We will focus our discussion on the estimates in regression [2]. Again, we compare the growth effects of trade openness on growth for countries with low and high financial integration. Countries with low financial integration are those in the 25th percentile of the sample distribution for the 2006-9 period (Peru and Costa Rica, with foreign assets and liabilities of 115 percent of GDP) while countries with high financial integration are located in the 75th percentile of that distribution (e.g. Taiwan, with foreign assets liabilities of 300 percent of GDP).

Regressions [5] to [7] include measures of financial openness decomposed into equity- and debt-related only in its interaction with trade openness whereas regressions [8] to [10] include this decomposition autonomously and also interacted with *TO*. Focusing on the results presented in the last three columns of Table 7 we find that the coefficient of trade openness is negative and, interestingly, the interaction between TO and equity-related financial openness is positive and significant whereas that of TO and debt-related financial openness is negative and significant. This result holds when we use the definitions for financial assets and liabilities (*FO*) as well as financial liabilities (*FL*). These results suggest that the structure of external assets and liabilities may have a role in catalyzing the effect of trade on growth. In short, it implies that growth benefits from trade openness may be larger in countries that accumulate more equity rather than debt assets and liabilities.

Complementarities between trade openness and research and development (R&D)

Table 8 further investigates the complementarities between trade and human capital by examining the interaction between trade openness and innovation. As proxy of innovation we use measures such as R&D spending (as percentage of GDP), R&D scientists (per 1 million people), R&D technicians (per 1 million people), and high technology exports (as percentage of manufacturing exports). We also explore the interaction between trade and an index of R&D that summarizes information on R&D spending, R&D technicians and R&D scientists.

Regression [1] of Table 8 includes the interaction between trade openness and our index of innovation. As we stated above, this index is the first principal component of spending and number of scientists and technicians in R&D. Higher values of this index indicates more resources devoted to R&D. In general we find that the coefficient of TO and its interaction are positive and significant, thus implying that trade openness enhances growth and that this effect is higher in countries with higher levels of innovation –as proxied by more resources devoted to R&D.

Regressions [2] through [4] replace the interaction between TO and our index of innovation with the interaction between TO and each of the categories that comprise our index: R&D spending (regression [2]), R&D scientists (regression [3]), and R&D technicians (regression [4]). In all these regressions, the coefficient of TO is positive and significant; however, the interaction between trade openness and R&D is positive and significant only for R&D spending and the number of R&D scientists. What are the economic implications of our estimates? Using the estimates of regression [3] we can assess the growth benefits of higher trade in countries with low R&D spending (like Colombia and Thailand with 1.2% of GDP at the 25^{th} percentile of the sample distribution in 2000-9), and countries with high R&D spending (such as Ireland and New Zealand with 3.2 percent of GDP at the 75^{th} percentile). A one standard deviation increase in trade openness would lead to higher growth per capita by 90 basis points per annum in countries with low R&D spending whereas it leads to higher growth per capita by 101 basis points per annum in countries with high R&D spending.

Finally, regression [6] of Table 8 includes an interaction between TO and the share of high-tech exports in manufacturing exports. Although the TO coefficient is positive and significant, we find that the interaction is negative and not different from zero.

Complementarities between trade openness and regulations

Table 9 presents evidence on the complementarities between trade openness and economic regulations –*i.e.* firm entry regulations and labor market regulations. Previous research shows that trade openness is unable to promote growth in heavily-regulated economies. Bolaky and Freund (2004) argue that excessive regulation may prevent the mobilization of resources towards the most productive sectors and to the most efficient firms within each sector. This implies that trade may likely occur in goods where there is no comparative advantage.

As we stated in Section 3, we constructed an index of firm entry regulations by compiling information on the number of procedures required to start a business, the number of days that it takes to start that business and its cost. Our index of labor regulations, on the other hand, compiles information on indices of the difficulty of hiring, the difficulty of firing and the rigidity of hours. These indices were constructed either using simple averages or principal components. Finally, we used all six indicators to construct an index of economic regulations –again, simple averages and principal components were used for aggregation. For the sake of brevity, we will discuss the results using simple averages –regressions [1] through [3]. However, we should point out that the results are qualitatively similar regardless of the aggregation technique used.

In regressions [1] through [3] we find that the coefficient of TO is positive and significantly different from zero whereas that of the interaction between TO and regulations is negative and statistically significant. This confirms existing evidence that more stringent regulations in the economy may hinder economies to reap the growth benefits of rising trade openness. We use the estimates of regression [1] to assess the growth benefits of rising trade openness in countries with more flexible regulations (*e.g.* Colombia, located in the 25th percentile of the sample distribution) vis-à-vis countries that are heavily regulated (*e.g.* France, located in the 75th percentile of the sample distribution). We find that a one standard deviation increase in trade openness would lead to growth per capita that is higher by almost 50 basis points per annum in countries with low regulations, whereas growth per capita increases only by approximately 30 basis points per annum in countries with heavy regulations.

4.3 Economic Implications of Our Estimates: Discussion for CAFTA-DR

This sub-section discusses the economic implication of the regression analysis in the sub-section 4.2 for the CAFTA-DR countries. We will conduct this analysis along three dimensions: (a) plot the growth response to a one standard deviation increase in trade openness conditional to the country's level of determined structural factors, (b) show the growth response to an increase in trade openness in 2006-10 vis-à-vis 1991-95, and (c) display the potential growth benefits of trade openness if CAFTA-DR countries reached the extent of trade openness in a benchmark region (EAP7).

Growth implications of rising trade in CAFTA-DR

Figure 3 depicts the growth response to a one standard deviation increase in trade openness (*i.e.* a sample increase in the trade ratio of approximately 75 percent during the period 2006-9) conditional on the level of income per capita (Figure 3.1), human capital (Figure 3.2), financial development (Figure 3.3), and institutions (Figure 3.4). We calculate the response for all CAFTA-DR countries (Costa Rica, Dominican Republic, Guatemala, El Salvador, Honduras, and Nicaragua), selected regions and/or countries (CAFTA, LAC excluding CAFTA, OECD, USA) and selected percentiles of the sample distribution in 2006-9. The bars represent the growth response (in percentage points) and the dotted lines are the 95% level confidence interval. Growth benefits from trade vary greatly across CAFTA-DR countries. For instance, the growth benefits of CAFTA-DR countries conditional on the level of secondary schooling are below the median of our sample distribution (i.e. below 1.1 percentage points per year), with Costa Rica close to the median while Honduras is below the 25th percentile of the distribution and the model predicting a contraction in growth per capita of 19 basis points (see Figure 3.2). On the other hand, we find that the growth benefits of rising trade conditional on the depth of domestic financial markets among CAFTA-DR countries cannot surpass those of the 67th percentile of the sample distribution (66 basis points per year). Indeed, the growth effects of trade of Costa Rica, Honduras and El Salvador fluctuate between 53 and 57 basis points per year. On the other hand, the lowest benefits from trade are registered by Dominican Republic (42 basis points), which is closer to that of countries in the 33rd percentile of the sample distribution (see Figure 3.3). Finally, growth effects of trade openness conditional on the level of institutional quality are also below that of the 67th percentile of the sample distribution for CAFTA-DR countries.

Figure 4 also assumes an analogous increase in trade openness and plots the growth response conditional to the level of infrastructure. We compute the response conditional on an aggregate index of infrastructure stock IK_1 (Figure 4.1), and also conditional on the stocks of telecommunications (Figure 4.2), electricity (Figure 4.3), and roads (Figure 4.4). For the sake of brevity, we will focus our discussion on the growth effects conditional on the aggregate index of infrastructure. We examine the growth response to higher trade conditional on the IK_1 levels and find that the growth effects of rising trade are below that of the country with the median level of infrastructure. Costa Rica and the Dominican Republic enjoy the largest benefits from trade (with increases in growth per capita of 95 and 84 basis points) thanks to their relatively better infrastructure network among CAFTA-DR countries. Nicaragua is the country with the lowest gains from growth (below 50 basis points) among CAFTA-DR countries.

Figure 5 shows the response of growth to a one standard deviation increase in trade conditional on the level of financial openness. We will focus our discussion on Figure 5.1 that uses the holdings of foreign assets and liabilities as percentage of GDP as our proxy of financial openness. Note that our results are qualitatively similar, either using foreign liabilities (Figure 5.2) or equity-related financial openness measures (see Figure 5.3). In Figure 5.1, Honduras displays the largest growth response (below the median and slightly higher than that of LAC excluding CAFTA). On the other hand, Guatemala is the worst performer (below the 10th percentile of the distribution of financial openness), thus reflecting its low integration to international capital markets.

Finally, Figure 6 displays the growth response to trade openness conditional on spending in research and development (Figure 6.1) and regulatory indices for firm entry (Figure 6.2) and labor markets (Figure 6.3). Interestingly, we find that the growth response to rising trade is positive regardless of the values of the structural factors, although not significant in some cases —more specifically for labor market regulations. Given that the intensity of R&D spending is below the median of R&D expenditures in our world sample, the same goes for the growth response to trade openness. However, we should point out that the differences between the growth responses of Costa Rica (close the median in R&D) and El Salvador (just below the 10^{th} percentile in R&D spending) is not significant (91 vis-à-vis 88 basis points, respectively). Note that the same holds for economic regulations. We find that CAFTA-DR countries have regulations that are, on average, more restrictive than those of the representative country in our sample. The differences in the gains of growth from trade openness do not seem too large when comparing the countries with the most stringent regulations and that with the most flexible regulations among CAFTA-DR countries (see Figures 6.2 and 6.3).

Growth effects to changes in trade openness over time

If we assume that α_0 is the coefficient estimate of trade openness *TO* and α_1 is that of the interaction between *TO* and a determined structural factor *SF*, then the response of growth to a change in trade openness in period 1 with respect to period 0 is:

$$dg = \left(\alpha_0 + \alpha_1 \cdot SF_0\right) \cdot \left(TO_1 - TO_0\right)$$

where the subscript 1 refers to the averages for these variables in the period 2006-10 and the subscript 0 refers to the period 1991-95. Hence we evaluate the growth effects of changes in trade openness over the last 15 years. Note that we evaluate the growth response for the following structural factors: human capital, financial development, institutional quality, the infrastructure stock, and the extent of financial openness. Table 10 reports these results for two scenarios: the first scenario assumes that SF_0 is the level of the structural factor in the country or region during the 1991-5 period. The second scenario assumes that SF_0 is the level in 2006-10 (*i.e.* period 1). This figure adds to the changes in growth per capita due to trade openness those that were experienced by the country in the structural factor. Note that the 2 bottom rows in Table 10 report the source of the regression coefficients used to perform these calculations.

Table 10 measures the contribution of trade to growth over the last 15 years —as measured in basis points per annum. Panel I of Table 10 report those figures conditional on the initial values of the structural factor (say, 1991-5 in our analysis) and compares them to the model without interactions (*i.e.* baseline model). Note that if the growth benefits are higher than those reported in the baseline model, then the complementarities at work enhance rather than hinder the impact of trade openness on growth.

We find that on average, the baseline model predicts that growth per capita in CAFTA has increased on average by 19 points per annum. However, there is a large degree of variation across countries. On one hand, the model predicts growth benefits of expanding trade of 41 basis points for Nicaragua and a contraction in the growth rate of 3 basis points in Dominican Republic. Note that when trade openness is interacted with human capital, the benefits of trade growth are, on average, reduced in CAFTA due to the lower levels of human capital in this sub-region (where our model predicts a decline in growth per capita of 18 basis points). Note that our model with TO interacted with human capital predicts a poorer growth performance in the event of rising trade openness. In general, the growth performance of CAFTA is not better than the one predicted by the baseline, except for when including the interaction between trade openness and financial openness (i.e. growth improves by 23 basis points per year and it is mostly explained by the considerable growth gains in Nicaragua). In most cases, note that the initial level of structural factors represent a severe hindrance for trade to stimulate growth in Honduras and the Dominican Republic, while structural factors facilitate the effects of growth in the rest of the CAFTA-DR countries. On the other hand, infrastructure seems to play less of a complementary role for all CAFTA-DR countries with the exception of Costa Rica.

The panel II of Table 11, in contrast, calculates the growth effects of changes in trade openness conditional on the level of the structural factors in 2006-10. Interestingly, we find that the improvement in all structural factors (human capital, financial depth, institutions, infrastructure, and financial openness) lead to higher growth benefits than those in the baseline model. While the baseline regression predicts an annual average increase in growth per capita of 19 basis points for CAFTA, the model predicts increases of 30 and 34 basis points for CAFTA in the models that interact trade openness with human capital and infrastructure, respectively. This result implies that these two sectors may have represented bottlenecks to reap the growth benefits from trade.

Potential growth effects to reaching a benchmark in trade openness

Following the notation specified above, we calculate the potential growth benefits from raising trade openness if a specific country *C* were to reach the level of outward orientation of a benchmark region/country B —where these variables are evaluated with the averages of the period 2006-10:

$$dg = \left(\alpha_0 + \alpha_1 \cdot SF_1^C\right) \cdot \left(TO_1^B - TO_1^C\right)$$

In our exercise, country C is represented by CAFTA-DR countries as well as the LAC region while the benchmark B is the average of the East Asian Tigers (EAP7).[13] Hence, we calculate the potential growth benefits of CAFTA-DR countries in reaching the average levels of trade openness among EAP7 countries. Table 11 presents these calculations under two scenarios: the first one uses the value of the structural factor, *SF*, in country *C* whereas the second scenario measures the additional growth benefits that country *C* may have reaped if it had the level of the structural factor in the benchmark country *B*.

Table 11 shows that if the extent of trade openness among CAFTA-DR countries is raised to that of EAP7 countries (*i.e.* an increase from an average of 97 to 147 percent of GDP in 2006-9), our baseline model predicts an average annual increase in the growth per capita of CAFTA-DR of 26 basis points. Note that when interacted with human capital, research and development, and infrastructure, the growth benefits from trade predicted in our model are even higher (say, 40, 64, and 46 basis points, respectively). In general, the distance of CAFTA-DR countries to the benchmark would directly determine the extent of the potential growth gains.

Panel II of Table 11 present the growth benefits of closing the gap in trade openness of CAFTA-DR countries with respect to EAP7 countries but conditional on CAFTA-DR countries having the level of structural factors of the average EAP7 country. As expected, the growth benefits are higher than those reported in Panel I —which reflects the fact that CAFTA-DR countries lagged relative to EAP7 countries in terms of human capital, financial depth, institutions, among other structural areas. We find that growth rates would be higher by almost 80 basis points per annum if trade openness were to rise in the model provided that CAFTA-DR possessed the human capital or the infrastructure network of EAP7 countries.

5. Concluding Remarks

The goal of this study is to evaluate the growth effects of trade openness among CAFTA-DR countries and, more specifically, to examine whether these growth effects are stimulated or hindered by advances in structural policies and institutions. Following recent empirical literature, we evaluated the role of complementarities between trade openness and the following factors: human capital, financial

[13] The East Asian tigers (EAP7) are Hong Kong, Indonesia, Republic of Korea, Malaysia, Singapore, Taiwan, and Thailand.

development, institutional quality, infrastructure, financial openness, innovation, and economic regulations.

Using our effective regression sample of 99 countries with 5-year non-overlapping observations over the period 1960-2010, we find the following results:

First, there is a robust causal link between trade and growth. Regardless of the set of instruments used in our regression analysis, we find that trade openness stimulates growth. In fact, our estimates are not only statistically but also economically significant: a one standard deviation increase in the ratio of trade to GDP (that is, an increase of roughly 75 percent in the ratio) would lead to an increase in the rate of growth per capita of 35 basis points per year (and an accumulated increase of 5.5 percentage points over 15 years).

Second, we find strong evidence that the impact of trade openness on growth depends upon country-specific conditions on structural areas such as education, financial development, institutional quality, infrastructure, financial openness, innovation and regulations. In general, we find that growth benefits from trade openness would be larger in countries that surpass a certain threshold in the structural areas mentioned above.

Third, trade stimulates growth in countries with higher levels of human capital, deeper domestic financial markets, stronger institutions, more developed infrastructure networks, highly-integrated to world financial markets, higher intensity in R&D investment, and less stringent regulations.

Fourth, although our baseline model (without interactions) predicts growth benefits from trade for CAFTA-DR countries, we find that not accounting for complementarities between trade openness and structural factors may overstate these results. In fact, we find that human capital, infrastructure development and institutional quality may play an important role in enhancing the growth benefits from trade (see Table 10).

Finally, there is ample room among CAFTA-DR for reaping the growth benefits from trade. However, a larger role should be played by further reforms in areas such as education, infrastructure, international financial integration, and the development of domestic financial markets (see Table 11).

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Appendix I

Econometric Methodology[14]

The estimation of equation (1) faces the potential problem of endogenous regressors. This affects, in principal, both the standard determinants of growth (variables in matrix *X* such as education, financial depth, inflation and so on) and the trade openness variable (as well as its interactions with other structural factors as captured) in (matrix) *Z* given that we can argue that these variables may be jointly determined. Indeed, the may be subject to reverse causality from growth per capita.[15] Furthermore, the lagged dependent variable y_{it} is also endogenous due to the presence of the country-specific effects.

We need suitable instruments to deal with endogeneity issues. There are no obviously exogenous variables at hand to construct them and we may rely primarily on *internal instruments* within the framework described by Arellano and Bond (1991). These instruments are provided by suitable lags of the variables. However, note that the presence of unobserved country characteristics likely means that $E[X_{is}\eta_i] \neq 0$, and hence lagged levels of the regressors are not valid instruments for (1). Therefore, we first eliminate the country-specific effect by taking first-differences of equation (1):

$$y_{it} - y_{it-1} = (1+\alpha)\left(y_{it-1} - y_{it-2}\right) + \beta'\left(X_{it} - X_{it-1}\right) + \left(\varepsilon_{it} - \varepsilon_{it-1}\right) \qquad \text{(I.1)}$$

Assuming that (i) the time-varying disturbance ε is not serially correlated, and (ii) the explanatory variables *X* are weakly exogenous (*i.e.* they are uncorrelated with future realizations of the time-varying error term), lagged values of the endogenous and exogenous variables provide valid instruments.[16] In other words, we assume that:

$$E\left[y_{i,t-s} \cdot \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \quad for\ s \geq 2; t = 3, \ldots, T \qquad \text{(I.2)}$$

$$E\left[X_{i,t-s} \cdot \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \quad for\ s \geq 2; t = 3, \ldots, T \qquad \text{(I.3)}$$

These conditions define the *GMM-difference* estimator. In spite of its simplicity, it has some potential shortcomings. When explanatory variables are persistent over time, their lagged levels are

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[14] The present Appendix draws heavily from Calderón and Servén (2004a).
[15] For example, infrastructure accumulation could be driven by productivity growth.
[16] Note that this still allows current and future values of the explanatory variables to be affected by the error term.

weak instruments for the regression equation in differences (Alonso-Borrego and Arellano, 1996; Blundell and Bond, 1998). This raises the asymptotic variance of the estimator and creates a small-sample bias.[17]

To avoid these problems, below we use a *system* estimator that combines the regression in differences and in levels (Arellano and Bover 1995, Blundell and Bond 1998). The instruments for the regression in differences are the same as above. The instruments for the regression in levels are the lagged *differences* of the corresponding variables. These are appropriate instruments under the additional assumption of no correlation between the *differences* of these variables and the country-specific effect. Formally, we assume

$$\begin{aligned} &E[y_{i,t+p} \cdot \eta_i] = E[y_{i,t+q} \cdot \eta_i] \quad and \\ &E[X_{i,t+p} \cdot \eta_i] = E[X_{i,t+q} \cdot \eta_i] \quad for\ all\ p\ and\ q \end{aligned} \tag{I.4}$$

This leads to additional moment conditions for the regression in levels:[18]

$$E[\left(y_{i,t-1} - y_{i,t-2}\right) \cdot \left(\eta_i + \varepsilon_{i,t}\right)] = 0 \tag{I.5}$$

$$E[\left(X_{i,t-1} - X_{i,t-2}\right) \cdot \left(\eta_i + \varepsilon_{i,t}\right)] = 0 \tag{I.6}$$

Using the moment conditions in equations (3), (4), (6), and (7), we employ a Generalized Method of Moments (GMM) procedure to generate consistent estimates of the parameters of interest and their asymptotic variance-covariance (Arellano and Bond, 1991; Arellano and Bover, 1995). These are given by the following formulas:

$$\hat{\theta} = (\overline{X}' W \hat{\Omega}^{-1} W' \overline{X})^{-1} \overline{X}' W \hat{\Omega}^{-1} W' \overline{y} \tag{I.7}$$

$$AVAR(\hat{\theta}) = (\overline{X}' W \hat{\Omega}^{-1} W' \overline{X})^{-1} \tag{I.8}$$

where θ is the vector of parameters of interest (α, β), $\overline{y}$ is the dependent variable stacked first in differences and then in levels, $\overline{X}$ is the explanatory-variable matrix including the lagged dependent

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[17] An additional problem with the simple *difference* estimator relates to measurement error: differencing may exacerbate the bias due to errors in variables by decreasing the signal-to-noise ratio (see Griliches and Hausman, 1986).

[18] Given that lagged levels are used as instruments in the differences specification, only the most recent difference is used as instrument in the levels specification. Using other lagged differences would result in redundant moment conditions (see Arellano and Bover, 1995).

variable (y_{t-1}, X) stacked first in differences and then in levels, W is the matrix of instruments derived from the moment conditions, and $\hat{\Omega}$ is a consistent estimate of the variance-covariance matrix of the moment conditions. [19]

Consistency of the GMM estimators depends on the validity of the above moment conditions. This can be checked through two specification tests suggested by Arellano and Bond (1991) and Arellano and Bover (1995). The first is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. Failure to reject the null hypothesis that the conditions hold gives support to the model. Furthermore, validity of the *additional* moment conditions required by the system estimator relative to the difference estimator can likewise be verified through difference Sargan tests. The second test examines the null hypothesis that the error term $\varepsilon_{i,t}$ is serially uncorrelated. As with the Sargan test, failure to reject the null lends support to the model. In the *system* specification we test whether the differenced error term (that is, the residual of the regression in differences) shows second-order serial correlatation. First-order serial correlation of the differenced error term is expected even if the original error term (in levels) is uncorrelated, unless the latter follows a random walk. Second-order serial correlation of the differenced residual indicates that the original error term is serially correlated and follows a moving average process at least of order one. This would render the proposed instruments invalid (and would call for higher-order lags to be used as instruments).

So far we have limited our discussion to internal instruments. But as a double check that our results concerning trade openness are not driven by invalid instruments, we also experiment below with a set of external instruments provided by size and demographic features. This is motivated by the results of Frankel and Romer (1999), Loayza, Fajnzylber and Calderon (2005) and Chang, Kaltani and Loayza (2009), who show that much of the observed variation in infrastructure stocks is explained by population, surface area of the country, and dummies for oil exporting and landlocked countries. Thus, in our core regression analysis, we drop all lags of the trade openness indicator from the set of instruments and replace them with current and lagged values of these variables.

[19] In practice, Arellano and Bond (1991) suggest the following two-step procedure to obtain consistent and efficient GMM estimates. First, assume that the residuals, $\varepsilon_{i,t}$, are independent and homoskedastic both across countries and over time. This assumption corresponds to a specific weighting matrix that is used to produce first-step coefficient estimates. Then, construct a consistent estimate of the variance-covariance matrix of the moment conditions with the residuals obtained in the first step, and use this matrix to re-estimate the parameters of interest (i.e. second-step estimates). Asymptotically, the second-step estimates are superior to the first-step ones in so far as efficiency is concerned.

Table 1

Trade and Growth: Correlation Analysis

Panel correlation for a sample of 135 countries

Sample period: 1960-2010 (5-year non-overlapping observations)

Structural factors	Overall Sample	Levels of structural factors: Low	Middle	High
Income per capita	0.0792	0.0997	0.0645	0.1315
	2.53	1.80	1.21	2.42
Human capital	0.0792	0.0656	-0.0053	0.1266
	2.53	1.20	-0.10	2.38
Financial development	0.0792	0.1049	0.0089	0.0314
	2.53	1.85	0.16	0.58
Institutional quality	0.0792	-0.0109	0.1233	0.0822
	2.53	-0.18	2.20	1.51
Infrastructure	0.0792	0.0469	0.0127	0.1356
	2.53	0.85	0.23	2.53
Financial openness	0.0792	-0.0077	0.245	0.2699
	2.53	-0.13	4.03	4.21
R&D Spending	0.0792	0.1608	0.2251	-0.1098
	2.53	2.59	3.56	-1.73
Regulation	0.0792	0.0503	0.1337	0.03
	2.53	0.88	2.48	0.58

Table 1 reports the correlation between trade openness and growth for the full sample conditional on low, medium, and high levels of the mentioned structural factors. Note that the figures below the correlation coefficient represent t-statistics

Table 2

Trade and Growth: Baseline regression under different estimation techniques

Dependent Variable: Growth in real GDP per capita (annual average, %)

Variables	Pooled OLS [1]	OLS *Time dummies* [2]	Within Group [3]	GMM-IV Difference [4]	GMM-IV System [5]	GMM-IV System [6]
Variable of interest						
Trade openness	0.5756 *	0.4860 *	1.7448 **	5.8530 **	0.3614 **	0.6245 **
(Exports and imports as % of GDP, log)	(0.319)	(0.322)	(0.757)	(1.053)	(0.134)	(0.143)
Control variables						
Transitional convergence	-1.7788 **	-1.9137 **	-6.4594 **	-7.4420 **	-2.1768 **	-2.1263 **
(Initial GDP per capita, log)	(0.394)	(0.437)	(0.852)	(0.760)	(0.343)	(0.218)
Human capital	0.7783 **	0.9918 **	-1.3719 **	1.0505 *	1.8700 **	1.5336 **
(Gross secondary enrollment rate, log)	(0.350)	(0.327)	(0.575)	(0.597)	(0.285)	(0.207)
Financial depth	0.2492	0.1963	0.4415	0.6054 **	0.2939 *	0.6229 **
(Credit to private sector, % GDP, log)	(0.299)	(0.305)	(0.378)	(0.281)	(0.158)	(0.148)
Institutional quality	0.6914	0.9657	0.4272	0.6872	1.0118 **	1.5695 **
(ICRG Political risk index, log)	(0.725)	(0.713)	(0.854)	(0.732)	(0.345)	(0.418)
Lack of price stability	-2.5916 **	-2.4343 **	-2.9280 **	-3.4301 **	-3.6547 **	-3.7073 **
(CPI inflation rate, log)	(0.610)	(0.642)	(0.526)	(0.823)	(0.134)	(0.184)
Infrastructure stock	0.6284 **	0.5882 **	1.2285 **	-0.2651	0.4335 **	0.2987 **
(Principal component) 1/	(0.169)	(0.187)	(0.244)	(0.293)	(0.139)	(0.146)
Financial openness	-0.6767 **	-0.4241	-0.2343	-1.2307 **	-0.3706 **	-0.5876 **
(Foreign assets and liabilities, % GDP, log)	(0.281)	(0.303)	(0.279)	(0.380)	(0.123)	(0.129)
Time dummies						
Dummy: 1976-80 period	..	0.0138	..	..	-0.1739	-0.2339
Dummy: 1981-85 period	..	-2.4998 **	..	-1.4681 **	-2.6141 **	-2.5612 **
Dummy: 1986-00 period	..	-1.2370 **	..	0.7218 **	-1.4532 **	-1.3186 **
Dummy: 1991-95 period	..	-1.6349 **	..	-0.5876 *	-1.8917 **	-1.6285 **
Dummy: 1996-00 period	..	-1.7096 **	..	-0.5278	-1.9168 **	-1.5804 **
Dummy: 2001-05 period	..	-1.5078 **	..	0.3271	-1.9714 **	-1.5529 **
Dummy: 2006-09 period	..	-0.6260	..	1.0000 **	-1.0186 **	-0.5994 *
Countries / Observations	99 / 646	99 / 646	99 / 547	99 / 547	99 / 646	99 / 646
Country Effects	*No*	*No*	*Diff*	*Diff*	*Diff*	*Diff*
Time Effects	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*
Instruments 2/	*No*	*No*	*No*	*Internal*	*Internal*	*External*
Specification tests (*p-value*)						
- Sargan test (*Overidentifying restrictions*)	..	..	..	(0.072)	(0.310)	(0.256)
- Second-order serial correlation	(0.082)	(0.044)	(0.273)	(0.181)	(0.182)	(0.211)

*Numbers in parenthesis are robust standard errors. Regression includes constant. ** (*) indicates that the coefficient estimate is significant at the 5 (10) percent*

1/ The aggregate stock of infrastructure is computed as the first principal component of: (a) main telephone lines and mobiles, (b) electric power installed capac

(in MW), and (c) length of the road network (in Km.). All these physical indicators of infrastructure are expressed in their corresponding units per 1000 people.

2/ The set of "internal instruments" correspond to lagged levels and differences of the corresponding explanatory variables in our regression analysis. In contras

"external instruments" include variables that instrument for trade openness such as lagged population, surface area of the country, dummy for landlocked coun

and oil exporting countries.

Table 3

Trade and Growth: Does the extent of trade openness matters?

Dependent Variable: Growth in real GDP per capita (annual average, %)

Estimation method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) 1/

Variables	Baseline Regression	Ancillary Regressions [1]	[2]	[3]	[4]	[5]
Variable of interest						
Trade openness (*TO*)	0.6245 **	-0.0177	..	..	..	..
(Exports and imports as % of GDP, log)	(0.143)	(0.283)				
Trade openness - LOW	..	..	0.5234	1.0010 **	-1.0332 **	1.3245 **
(TO lower than 33th %-ile, 0 otherwise)			(0.385)	(0.407)	(0.377)	(0.647)
Trade openness - MEDIUM	..	..	0.2588	0.7802 **	4.4229 **	2.4355 *
(TO if 33rd %-ile < TO < 66th %-ile)			(0.327)	(0.330)	(1.515)	(1.461)
Trade openness - HIGH	..	0.2115 **	0.5356 *	0.8788 **	5.7540 **	4.1330 **
(TO greater than 66th %-ile, 0 otherwise)		(0.090)	(0.278)	(0.293)	(0.429)	(0.538)
Countries / Observations	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646
Instruments 2/	*External*	*External*	*External*	*External 2*	*External 3*	*Internal*
Specification tests (*p-value*)						
- Sargan test (*Overidentifying restrictions*)	(0.256)	(0.280)	(0.203)	(0.165)	(0.277)	(0.269)
- Second-order serial correlation	(0.211)	(0.251)	(0.280)	(0.295)	(0.342)	(0.195)

*Numbers in parenthesis correspond to robust standard errors. ** (*) indicates that the coefficient estimate is significant at the 5 (10) percent level.*

1/ The full regression includes as control variables: the initial GDP per capita (log), gross secondary enrollment rate (log), domestic credit to the private sector as % of GDP (log), ICRG political risk index (log), CPI inflation rate, the aggregate index of infrastructure stock (in logs, see definition in footnote 1 of Table 1), foreign assets and liabilities as % of GDP (log). The regression also includes constant and time (5-year period) dummies.

2/ The set of "internal instruments" correspond to lagged levels and differences of the corresponding explanatory variables in our regression analysis. In contrast, "external instruments" include variables that instrument for trade openness such as lagged population, surface area of the country, dummy for landlocked countries, and oil exporting countries. External 2 includes in the regression the measure of trade openness that adjusts for population, area, and geographical measures, and we use lagged levels and differences of this adjusted measure as instruments. Finally, External 3 includes to our adjusted measure the possibility of global shocks by accounting for time effects.

Table 4

Trade and Growth: Does the effect of trade changes over time?

Dependent Variable: Growth in real GDP per capita (annual average, %)

Estimation method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) 1/

Variables	Baseline Regression	Ancillary Regressions [1]	[2]	[3]	[4]	[5]	[6]
Variable of interest							
Trade openness (*TO*)	0.6245 **	-0.3054	-1.2033 **	-0.2938	1.3346 **	1.4228 **	0.0055
(Exports and imports as % of GDP, log)	(0.143)	(0.259)	(0.249)	(0.202)	(0.398)	(0.424)	(0.369)
TO * D(1980s)	..	..	..	..	-2.3629 **	-3.5915 **	-1.0916 **
					(0.509)	(0.559)	(0.347)
TO * D(1990s)	..	..	..	..	-2.3024 **	-1.9858 **	0.0305
					(0.316)	(0.547)	(0.326)
TO * D(2000s)	..	4.4630 **	6.2430 **	2.4479 **	2.3700 **	1.3297 *	2.0329 **
		(0.712)	(0.652)	(0.318)	(0.728)	(0.770)	(0.501)
Countries / Observations	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646
Instruments 2/	*External*	*External*	*External 2*	*External 3*	*External*	*External 2*	*External 3*
Specification tests (*p-value*)							
- Sargan test (*Overidentifying restrictions*)	(0.256)	(0.343)	(0.161)	(0.174)	(0.367)	(0.300)	(0.248)
- Second-order serial correlation	(0.211)	(0.214)	(0.193)	(0.151)	(0.226)	(0.186)	(0.181)

*Numbers in parenthesis correspond to robust standard errors. ** (*) indicates that the coefficient estimate is significant at the 5 (10) percent level.*

1/ The full regression includes as control variables: the initial GDP per capita (log), gross secondary enrollment rate (log), domestic credit to the private sector as % of GDP (log), ICRG political risk index (log), CPI inflation rate, the aggregate index of infrastructure stock (in logs, see definition in footnote 1 of Table 1), foreign assets and liabilities as % of GDP (log). The regression also includes constant and time (5-year period) dummies. Finally, D(1980s) is a dummy variable that takes the value of 1 for the period 1980-89 and 0 otherwise, D(1990s) is a dummy variable that takes the value of 1 for the period 1990-99 and 0 otherwise, and D(2000s) takes the value of 1 for the 2000-9 period (and 0, otherwise).

2/ The set of "internal instruments" correspond to lagged levels and differences of the corresponding explanatory variables in our regression analysis. In contrast, "external instruments" include variables that instrument for trade openness such as lagged population, surface area of the country, dummy for landlocked countries,and oil exporting countries. We should note that "External 2" includes in the regression the measure of trade openness that adjusts for population, area, and geographical measures, and we use lagged levels and differences of this adjusted measure as instruments. Finally, "External 3" includes to our adjusted measure the possibility of global shocks by accounting for time effects.

Table 5

Trade and Growth: Interaction with Structural Factors and Policies

Dependent Variable: Growth in real GDP per capita (annual average, %)

Estimation method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) 1/

Variables	Baseline Regression	Ancillary Regressions [1]	[2]	[3]	[4]	[5]	[6]
Variable of interest							
Trade openness (*TO*)	0.6245 **	-8.2487 **	-9.8907 **	-0.6676	-1.2141	-2.5225 **	-10.0006 **
(Exports and imports as % of GDP, log)	(0.143)	(1.627)	(1.105)	(0.474)	(0.873)	(1.251)	(2.054)
TO * *ypc*	..	0.9916 **	..	..	..	..	..
		(0.183)					
TO * *human*	..	..	2.6520 **	..	..	..	..
			(0.282)				
TO * *findev1*	..	..	..	0.4230 **	..	..	..
				(0.129)			
TO * *findev2*	..	..	..	..	0.4382 **	..	..
					(0.216)		
TO * *findev3*	..	..	..	..	..	0.8046 **	..
						(0.312)	
TO * *instq*	..	..	..	..	..	..	2.5798 **
							(0.492)
Control variables							
Transitional convergence (*ypc*)	-2.1263 **	-7.7486 **	-3.8154	-2.7008 **	-2.2621 **	-1.8939 **	-3.3400 **
(Initial GDP per capita, log)	(0.218)	(0.864)	(0.213)	(0.239)	(0.261)	(0.301)	(0.186)
Human capital (*human*)	1.5336 **	1.5093 **	-9.0224	1.6259 **	2.1980 **	1.9878 **	1.5617 **
(Gross secondary enrollment rate, log)	(0.207)	(0.205)	(1.116)	(0.212)	(0.198)	(0.232)	(0.181)
Financial depth (*findev1*)	0.6229 **	0.7660 **	0.7449	-1.2707 **	..	..	0.6589 **
(Domestic credit to private sector, % GDP, log)	(0.148)	(0.128)	(0.120)	(0.549)			(0.127)
Financial depth (*findev2*)	..	..	..	..	-2.0794 **	..	..
(Banking Credit private sector, % GDP, log)					(0.823)		
Financial depth (*findev3*)	..	..	..	..		-3.0230 **	..
(Liquid liabilities --M3-- % GDP, log)						(1.260)	
Institutional quality (*instq*)	1.5695 **	1.3471 **	1.4749	0.2013 **	0.1840	1.8149	-8.7044 **
(ICRG Political risk index, log)	(0.418)	(0.303)	(0.274)	(0.334)	(0.356)	(0.424)	(1.942)
Countries / Observations	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646
Specification tests (*p-value*)							
- Sargan test (*Overidentifying restrictions*)	(0.256)	(0.243)	(0.196)	(0.226)	(0.280)	(0.299)	(0.190)
- Second-order serial correlation	(0.211)	(0.213)	(0.181)	(0.201)	(0.193)	(0.261)	(0.214)

*Numbers in parenthesis correspond to robust standard errors. ** (*) indicates that the coefficient estimate is significant at the 5 (10) percent level.*

1/ The full regression includes as control variables: the initial GDP per capita (log), gross secondary enrollment rate (log), domestic credit to the private sector as % of GDP (log), ICRG political risk index (log), CPI inflation rate, the aggregate index of infrastructure stock (in logs, see definition in footnote 1 of Table 1), foreign assets and liabilities as % of GDP (log). The regression also includes constant and time (5-year period) dummies. We control for endogeneity using lagged levels and differences for all the variables other than trade openness. The latter variable, in turn, is instrumented using lagged population, surface area of the country and dummies for landlocked and oil exporting countries.

Table 6

Trade and Growth: The role of physical infrastructure

Dependent Variable: Growth in real GDP per capita (annual average, %)

Estimation method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) 1/

Variables	Baseline Regression	Ancillary Regressions [1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Variable of interest											
Trade openness (*TO*)	0.6245 **	-1.7379 **	-1.1129 **	0.0076	1.2848 **	-0.5840 **	-1.1934 **	-1.6612 **	1.9481 **	-2.3922 **	-2.4914 **
(Exports and imports as % of GDP, log)	(0.143)	(0.225)	(0.186)	(0.236)	(0.140)	(0.123)	(0.267)	(0.389)	(0.216)	(0.271)	(0.454)
TO * *IK1*	..	0.7038 **	..	..	..	..	..	..	..	..	..
		(0.066)									
TO * *IK2*	..	..	0.4733 **	..	..	..	..	..	..	..	..
			(0.049)								
TO * *TC1*	..	..	..	0.1188 **	..	..	..	0.5174 **	..	..	..
				(0.048)				(0.072)			
TO * *EGC*	..	..	..	..	0.4285 **	..	..	..	1.2333 **	..	..
					(0.038)				(0.132)		
TO * *RD*	..	..	..	..	..	0.0246 **	..	..	..	1.8601 **	..
						(0.012)				(0.149)	
TO * *TC2*	..	..	..	..	..	..	0.3869 **	..	..	..	0.7101 **
							(0.048)				(0.096)
Control variables											
Index of aggregate infrastructure *IK1*	0.2987 **	-1.6361 **	..	0.3848 **	0.0341	-1.2645 **	..	..	..	..	..
(First principal component: tc, egc, rd)	(0.146)	(0.228)		(0.158)	(0.138)	(0.117)					
Index of aggregate infrastructure *IK2*	..	..	-0.2592 *	..	..	..	0.3200 *	..	..	..	..
(First principal component: tc, egc, rd)			(0.166)				(0.167)				
Telecommunications 1 (*TC1*)	..	..	..	..	..	..	..	-1.5394 **	..	..	..
(Main lines and mobiles per 1000 people, log)								(0.285)			
Electric Power (*EGC*)	..	..	..	..	..	..	..	..	-4.5521 **	..	..
(Installed capacity, in MW per 1000 people, log)									(0.508)		
Roads (*RD*)	..	..	..	..	..	..	..	..	..	-7.3920 **	..
(Length of total network, in Km per 1000 people, log)										(0.608)	
Telecommunications 2 (*TC2*)	..	..	..	..	..	..	..	..	..	..	-2.0130 **
(Main telephone line per 1000 people, log)											(0.374)
Countries / Observations	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646
Specification tests (*p-value*)											
- Sargan test (*Overidentifying restrictions*)	(0.256)	(0.222)	(0.377)	(0.221)	(0.252)	(0.246)	(0.186)	(0.206)	(0.283)	(0.214)	(0.192)
- Second-order serial correlation	(0.211)	(0.177)	(0.162)	(0.173)	(0.184)	(0.180)	(0.188)	(0.195)	(0.163)	(0.172)	(0.142)

*Numbers in parenthesis correspond to robust standard errors. ** (*) indicates that the coefficient estimate is significant at the 5 (10) percent level.*

1/ The full regression includes as control variables: the initial GDP per capita (log), gross secondary enrollment rate (log), domestic credit to the private sector as % of GDP (log), ICRG political risk index (log), CPI inflation rate, the aggregate index of infrastructure stocks (in logs, see definition in footnote 1 of Table 1), foreign assets and liabilities as % of GDP (log). The regression also includes constant and time (5-year period) dummies. We control for endogeneity using lagged levels and differences for all the variables other than trade openness. The latter variable, in turn, is instrumented using lagged population, surface area of the country and dummies for landlocked and oil exporting countries.

Table 7

Trade and Growth: Interactions between trade and financial openness

Dependent Variable: Growth in real GDP per capita (annual average, %)

Estimation method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) 1/

Variables	Baseline Regression	Ancillary Regressions [1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Variable of interest											
Trade openness (*TO*)	0.6245 **	0.9605 **	-2.2329 **	-1.2498 **	-0.8781 **	0.3481 **	-0.0384	-0.0490	-1.5740 **	-4.3373 **	2.4291 **
(Exports and imports as % of GDP, log)	(0.143)	(0.123)	(0.374)	(0.405)	(0.376)	(0.128)	(0.158)	(0.213)	(0.388)	(0.476)	(0.248)
TO * *FO*	..	..	0.6277 **	..	..	..	..	..	..	..	..
			(0.086)								
TO * *FL*	..	..	..	0.4867 **	..	..	..	..	..	..	..
				(0.098)							
TO * *FA*	..	..	..	..	0.3230 **	..	..	..	..	..	..
					(0.108)						
TO * *FO-Eq*	..	..	..	..	..	0.0703 **	..	..	0.6811 **	..	..
						(0.014)			(0.100)		
TO * *FO-Db*	..	..	..	..	..	0.1966 **	..	..	-0.6230 **	..	..
						(0.078)			(0.160)		
TO * *FL-Eq*	..	..	..	..	..	..	0.0988 **	..	..	1.2039 **	..
							(0.032)			(0.112)	
TO * *FL-Db*	..	..	..	..	..	..	-0.2330 **	..	..	-1.7729 **	..
							(0.056)			(0.206)	
TO * *FA-Eq*	..	..	..	..	..	..	..	-0.1857 **	..	..	-0.8552 **
								(0.019)			(0.055)
TO * *FA-Db*	..	..	..	..	..	..	..	0.5031 **	..	..	1.7377 **
								(0.080)			(0.110)
Control variables: Financial Openness											
Foreign assets and liabilities	-0.5876 **	..	-3.3657 **	..	..	-1.7900 **	..	..	..	..	..
(as % GDP, log) [FO]	(0.129)		(0.423)			(0.423)					
Foreign liabilities	..	..	..	-2.8541 **	..	..	0.0012	..	..	..	..
(as % GDP, log) [FL]				(0.458)			(0.371)				
Foreign assets	..	..	..		-1.4523 **	..		-1.3299 **	..	..	..
(as % GDP, log) [FA]					(0.496)			(0.404)			
Equity-related foreign assets and	..	0.1521 **	..	..	..	..	..	..	-2.7371 **	..	..
liabilities *(as % GDP, log) [FO-Eq]*		(0.051)							(0.378)		
Debt-related foreign assets and	..	-1.3168 **	..	..	..	..	..	..	1.9208 **	..	..
liabilities *(as % GDP, log) [FO-Db]*		(0.130)							(0.649)		
Equity-related foreign liabilities	..	..	..	..	..	..	..	..	..	-4.6919 **	..
(as % GDP, log) [FL-Eq]										(0.453)	
Debt-related foreign liabilities	..	..	..	..	..	..	..	..	..	6.5510 **	..
(as % GDP, log) [FL-Db]										(0.858)	
Equity-related foreign assets	..	..	..	..	..	..	..	..	..		2.7084 **
(as % GDP, log) [FA-Eq]											(0.217)
Debt-related foreign assets	..	..	..	..	..	..	..	..	..		-6.3968 **
(as % GDP, log) [FA-Db]											(0.446)
Countries	99 / 646	97 / 621	99 / 646	99 / 646	99 / 646	97 / 621	97 / 621	97 / 621	97 / 621	97 / 621	97 / 621
Specification tests (*p-value*)											
- Sargan test (*Overidentifying restrictions*)	(0.256)	(0.226)	(0.276)	(0.227)	(0.178)	(0.246)	(0.239)	(0.185)	(0.326)	(0.223)	(0.268)
- First-order serial correlation	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
- Second-order serial correlation	(0.211)	(0.202)	(0.213)	(0.277)	(0.170)	(0.191)	(0.217)	(0.260)	(0.271)	(0.265)	(0.276)

*Numbers in parenthesis correspond to robust standard errors. ** (*) indicates that the coefficient estimate is significant at the 5 (10) percent level.*

1/ The full regression includes as control variables: the initial GDP per capita (log), gross secondary enrollment rate (log), domestic credit to the private sector as % of GDP (log), ICRG political risk index (log), CPI inflation rate, the aggregate index of infrastructure stocks (in logs, see definition in footnote 1 of Table 1), foreign assets and liabilities as % of GDP (log). The regression also includes constant and time (5-year period) dummies. We control for endogeneity using lagged levels and differences for all the variables other than trade openness. The latter variable, in turn, is instrumented using lagged population, surface area of the country and dummies for landlocked and oil exporting countries.

Table 8

Trade and Growth: Complementarities between trade openness and R&D

Dependent Variable: Growth in real GDP per capita (annual average, %)

Estimation method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) 1/

Variables	Baseline Regression	Ancillary Regressions [1]	[2]	[3]	[4]	[5]
Variable of interest						
Trade openness (*TO*)	0.6245 **	2.4385 **	1.5130 **	3.5576 **	1.5577 **	0.7394 **
(Exports and imports as % of GDP, log)	(0.143)	(0.874)	(0.216)	(0.055)	(0.748)	(0.161)
TO * *R&D Index*	..	0.0002 *	..	..	..	..
(R&D Aggregate Index) 2/		(0.000)				
TO * *R&D Spending*	..	..	0.1989 **	..	..	..
(R&D Spending as % of GDP)			(0.041)			
TO * *R&D Scientists*	..	..	..	0.0004 **	..	..
(Scientists in R&D per 1 million people)				(0.000)		
TO * *R&D Technicians*	..	..	..	..	0.0001	..
(Technicians in R&D per 1 million people)					(0.000)	
TO * *High-Tech Exports*	..	..	..	..	..	-0.0062
(High-tech exports, % manufacturing exports)						0.013
Countries	99 / 646	67 / 446	82 / 545	78 / 519	72 / 472	98 / 641
Specification tests (*p-value*)						
- Sargan test (*Overidentifying restrictions*)	(0.256)	(0.693)	(0.311)	(0.318)	(0.638)	(0.164)
- Second-order serial correlation	(0.211)	(0.394)	(0.219)	(0.263)	(0.641)	(0.188)

*Numbers in parenthesis correspond to robust standard errors. ** (*) indicates that the coefficient estimate is significant at the 5 (10) percent level.*

1/ The full regression includes as control variables: the initial GDP per capita (log), gross secondary enrollment rate (log), domestic credit to the private sector as % of GDP (log), ICRG political risk index (log), CPI inflation rate, the aggregate index of infrastructure stock (in logs, see definition in footnote 1 of Table 1), foreign assets and liabilities as % of GDP (log). The regression also includes constant and time (5-year period) dummies. We control for endogeneity using lagged levels and differences for all the variables other than trade openness. The latter variable, in turn, is instrumented using lagged population, surface area of the country and dummies for landlocked and oil exporting countries.

2/ The aggregate index of R&D is calculated as the first principal component of the following variables: R&D spending as % of GDP, scientists in R&D per 1 million people, and technicians in R&D per 1 million people.

Table 9

Trade and Growth: The Role of Regulations

Dependent Variable: Growth in real GDP per capita (annual average, %)

Estimation method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) 1/ 2/

		Ancillary Regressions					
	Baseline	Aggregation method: Simple Averages			Aggregation method: Principal components		
Variables	Regression	[1]	[2]	[3]	[4]	[5]	[6]
Variable of interest							
Trade openness (*TO*)	0.6245 **	0.7914 **	1.0219 **	0.6772 **	0.6950 **	0.7087 **	0.8693 **
(Exports and imports as % of GDP, log)	(0.143)	(0.144)	(0.171)	(0.192)	(0.135)	(0.184)	(0.230)
TO * *Index of regulations*	..	-0.5878 **			-0.3190 **		
		(0.224)			(0.055)		
TO * *Index of Firm entry regulations*			-1.6636 **			-0.4504 **	
			(0.276)			(0.178)	
TO * *Index of labor regulations*				-0.6731 **			-0.3388 **
				(0.135)			(0.096)
Countries	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646	99 / 646
Specification tests (*p-value*)							
- Sargan test (*Overidentifying restrictions*)	(0.256)	(0.250)	(0.194)	(0.321)	(0.201)	(0.282)	(0.211)
- First-order serial correlation	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
- Second-order serial correlation	(0.211)	(0.181)	(0.158)	(0.311)	(0.194)	(0.251)	(0.192)

*Numbers in parenthesis correspond to robust standard errors. ** (*) indicates that the coefficient estimate is significant at the 5 (10) percent level.*

1/ The full regression includes as control variables: the initial GDP per capita (log), gross secondary enrollment rate (log), domestic credit to the private sector as % of GDP (log), ICRG political risk index (log), CPI inflation rate, the aggregate index of infrastructure stock (in logs, see definition in footnote 1 of Table 1), foreign assets and liabilities as % of GDP (log). The regression also includes constant and time (5-year period) dummies. We control for endogeneity using lagged levels and differences for all the variables other than trade openness. The latter variable, in turn, is instrumented using lagged population, surface area of the country and dummies for landlocked and oil exporting countries.

2/ Our indices of regulations comprise information on the following dimensions: (a) firm entry regulations: number of procedures to start a business, time to start (in days), and its cost (as % of income per capita), and (b) labor market regulations: difficulty of hiring, rigidity of hours and difficulty of firing. All these indices are constructed such that higher values indicate more obstacles to entry and industry and more rigidities in the labor market. Our index of regulations comprises information of all these 6 indicators and it is aggregated either using simple averages or the principal components analysis (i.e. we take the first principal components). Analogously, we compute the aggregate index of regulation for firm entry regulations and labor market regulations by either taking simple averages or the first principal component of the 3 indicators in each category.

Table 10
Growth effects due to changes in trade openness, 2006-10 vs. 1991-95
(In basis points per annum)

		Trade openness interacted with:				
	Baseline Model	Human Capital	Financial Development	Institutional Quality	Infrastructure Stock	Financial Openness
I. Conditional on the structural factors of the country in 1991-95						
Costa Rica	22	3	14	37	21	20
Dominican Republic	-3	0	-3	-2	1	-2
Guatemala	12	-31	9	2	-22	8
Honduras	4	-4	5	1	-6	6
Nicaragua	41	-5	49	15	-75	113
El Salvador	39	-76	43	14	-41	23
Latin America (LAC)	17	8	19	15	1	19
CAFTA	19	-18	19	12	-17	23
LAC (excl. CAFTA)	14	14	17	13	6	15
II. Conditional on the structural factors of the country in 2006-10						
Costa Rica	22	59	32	36	57	26
Dominican Republic	-3	-7	-3	-4	-7	-3
Guatemala	12	11	15	13	17	7
Honduras	4	-2	6	3	6	6
Nicaragua	41	82	56	51	46	55
El Salvador	39	74	58	53	72	52
Latin America (LAC)	17	39	21	20	38	22
CAFTA	19	30	27	24	34	24
LAC (excl. CAFTA)	14	36	17	16	34	18
Table	Table 1	Table 4	Table 4	Table 4	Table 5	Table 6
Regression	[6]	[2]	[3]	[6]	[1]	[2]

Table 11

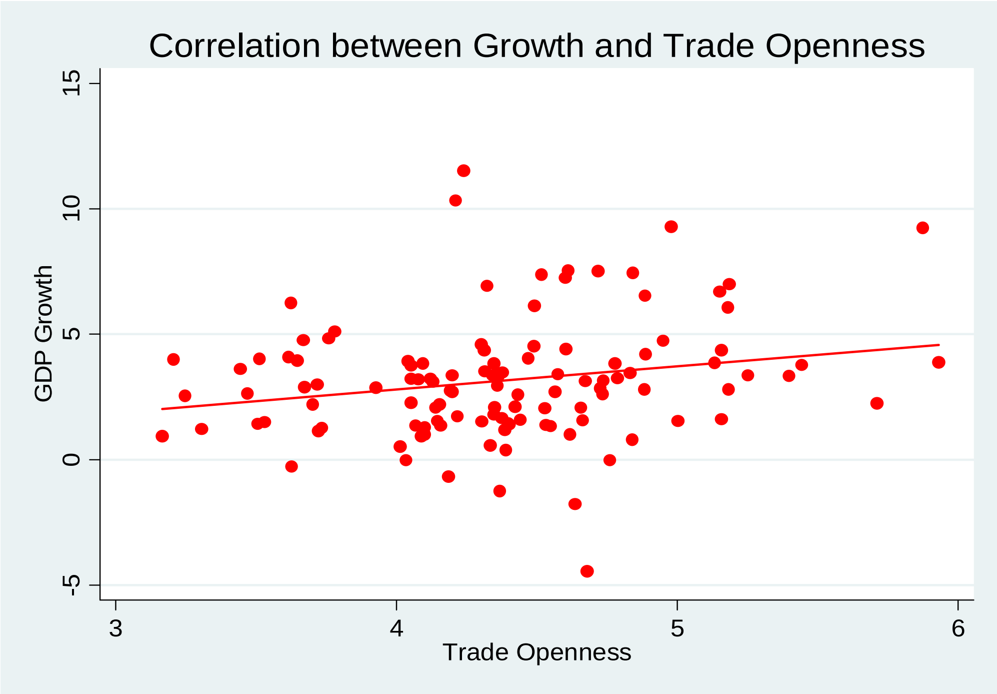
Potential growth effects of attaining the level of trade integration of the East Asian Tigers

(In basis points per annum)

	Baseline Model	Trade openness interacted with: Human Capital	Financial Development	Institutional Quality	Infrastructure Stock	Financial Openness	Research & Development	Economic Regulations
I. Conditional on the structural factors of the country in 2006-10								
Costa Rica	17	48	26	29	46	21	44	16
Dominican Republic	34	78	39	45	80	36	..	35
Guatemala	48	42	60	52	66	26	117	47
Honduras	7	-3	10	5	9	9	16	6
Nicaragua	32	64	44	40	36	43	79	32
El Salvador	17	33	25	23	31	23	42	17
Latin America (LAC)	45	105	58	54	104	60	113	43
CAFTA	26	40	36	32	46	33	64	25
LAC (excl. CAFTA)	55	143	68	65	136	74	138	52
II. Conditional on the structural factors of the benchmark in 2006-10								
Costa Rica	17	53	34	30	53	39	48	19
Dominican Republic	34	104	67	58	104	76	94	37
Guatemala	48	146	94	81	146	106	131	52
Honduras	7	20	13	11	20	14	18	7
Nicaragua	32	98	63	55	98	71	88	35
El Salvador	17	53	34	29	53	38	47	19
Latin America (LAC)	45	137	88	76	137	100	123	49
CAFTA	26	79	51	44	79	58	71	28
LAC (excl. CAFTA)	55	166	107	93	166	121	150	59
Table	Table 1	Table 4	Table 4	Table 4	Table 5	Table 6	Table 7	Table 8
Regression	[6]	[2]	[3]	[6]	[1]	[2]	[2]	[1]

Figure 1
Trade and Growth

1.1 Trade openness vs. Growth: Scatterplot



1.2 Trade openness vs. Growth: Where are the CAFTA-DR countries?

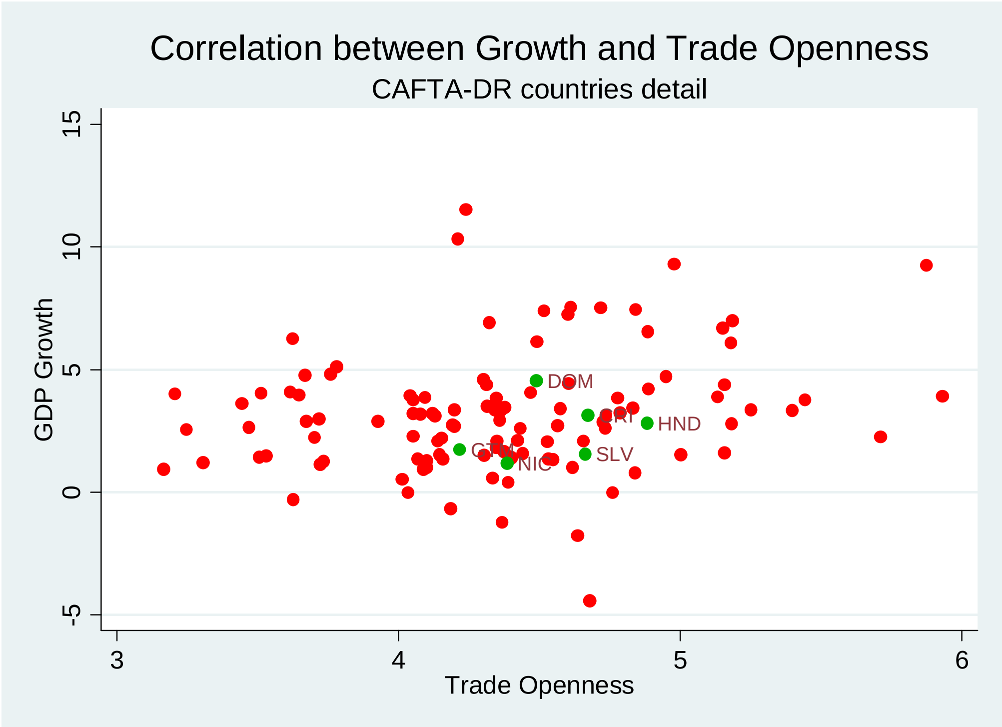
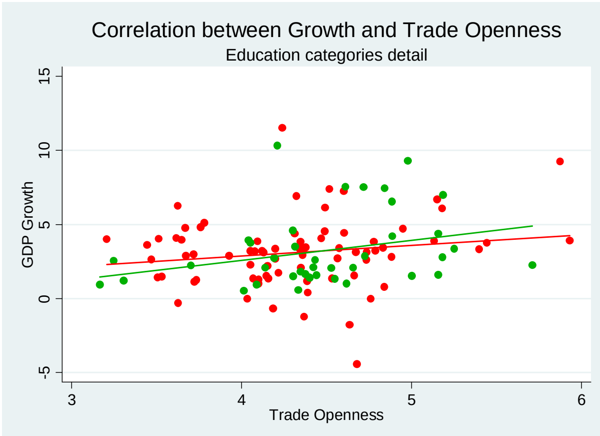
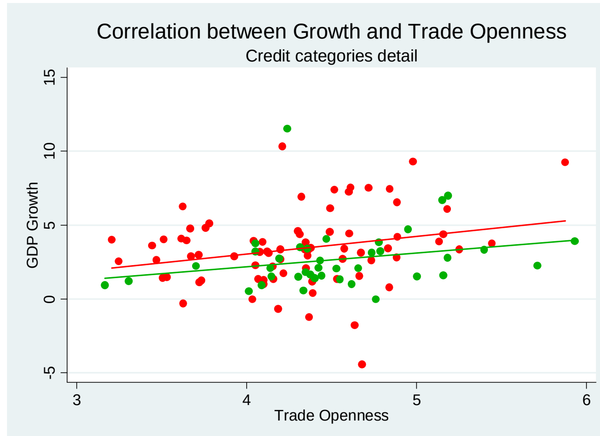


Figure 2
Trade openness vs. Growth: Do reformers exploit a higher correlation?

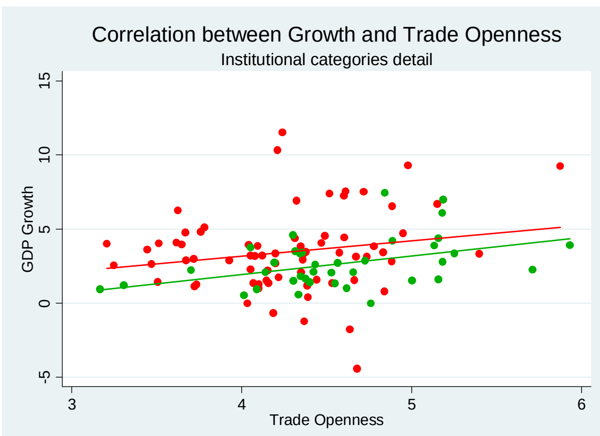
2.1 Correlation according to levels of human capital



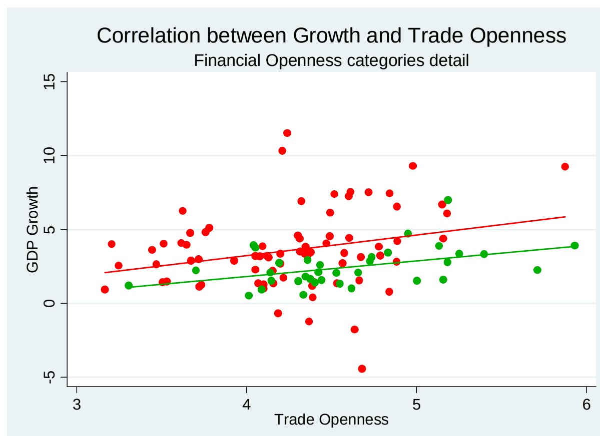
2.2 Correlation according to levels of financial development



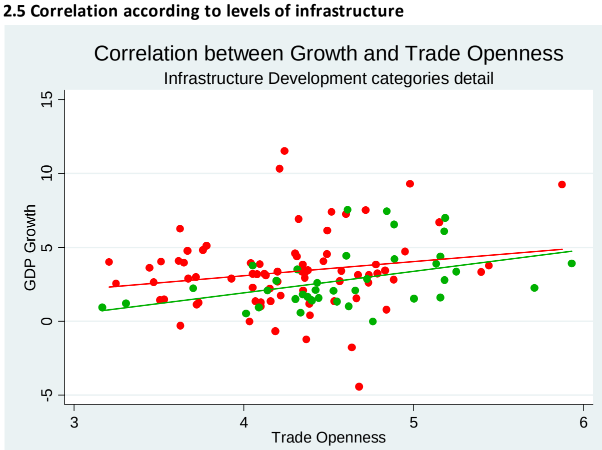
2.3 Correlation according to levels of institutions



2.4 Correlation according to levels of financial openness



2.5 Correlation according to levels of infrastructure



2.6 Correlation according to levels of economic regulation

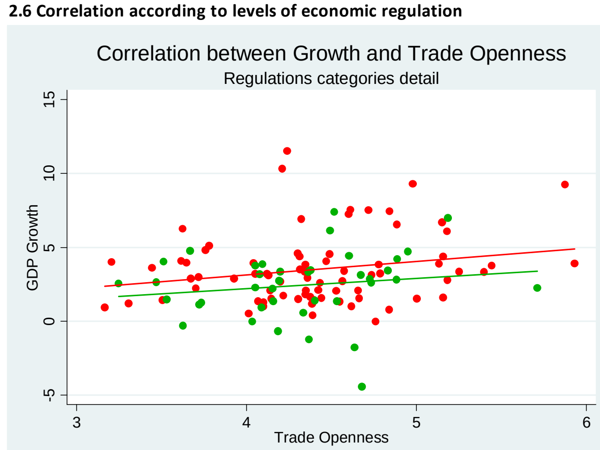
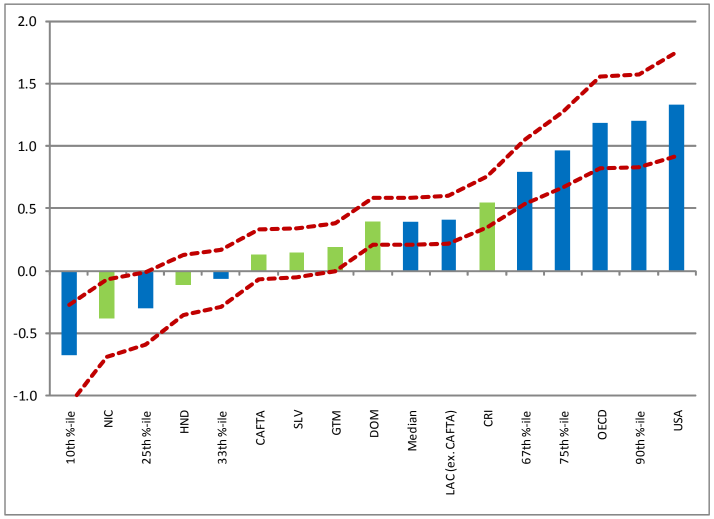


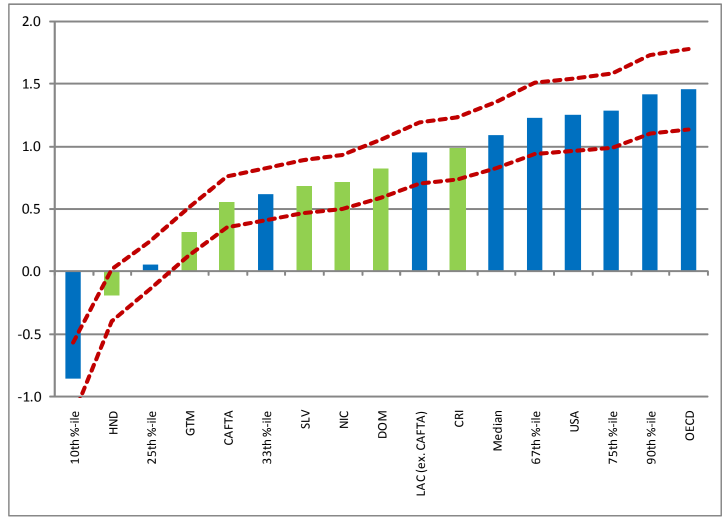
Figure 3
Growth response to a one standard deviation increase in trade openness

3.1 Conditional on the level of income per capita



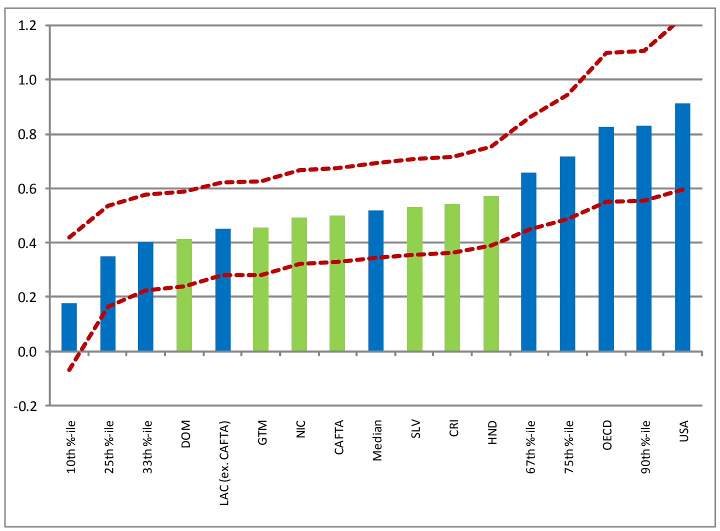
Note: The computed responses were obtained using the estimated coefficients from column [1] of Table 4. Higher percentiles imply higher levels of income per capita.

3.2 Conditional on the level of secondary schooling



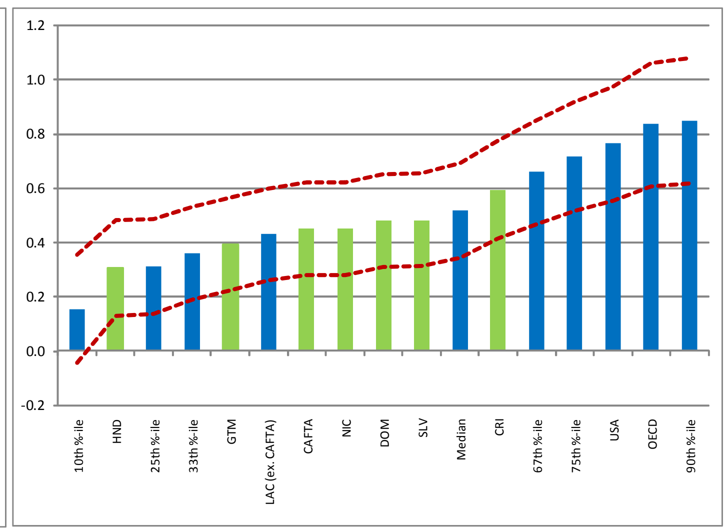
Note: The computed responses were obtained using the estimated coefficients from column [2] of Table 4. Higher percentiles imply higher (gross) enrollment rates for secondary schooling.

3.3 Conditional on the level of domestic financial development



Note: The computed responses were obtained using the estimated coefficients from column [3] of Table 4. Higher percentiles imply higher ratios of domestic credit to the private sector relative to GDP.

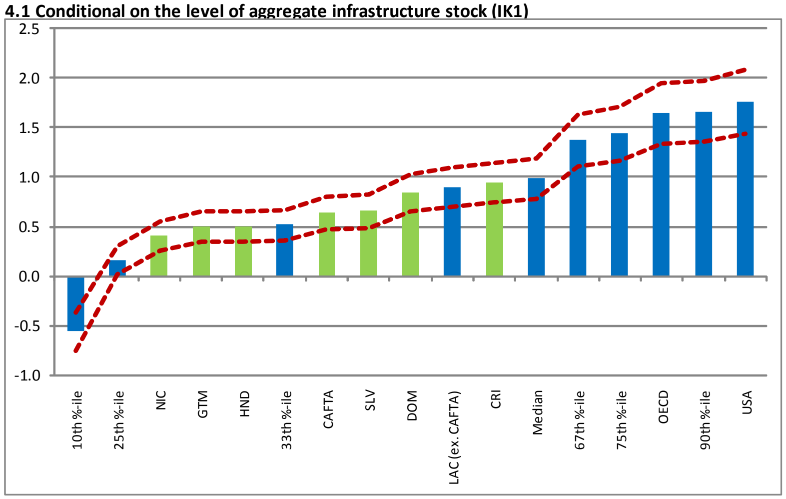
3.4 Conditional on the level of institutional quality



Note: The computed responses were obtained using the estimated coefficients from column [6] of Table 4. Higher percentiles imply higher values of the ICRG index of political risk (as reported by the PRS Group).

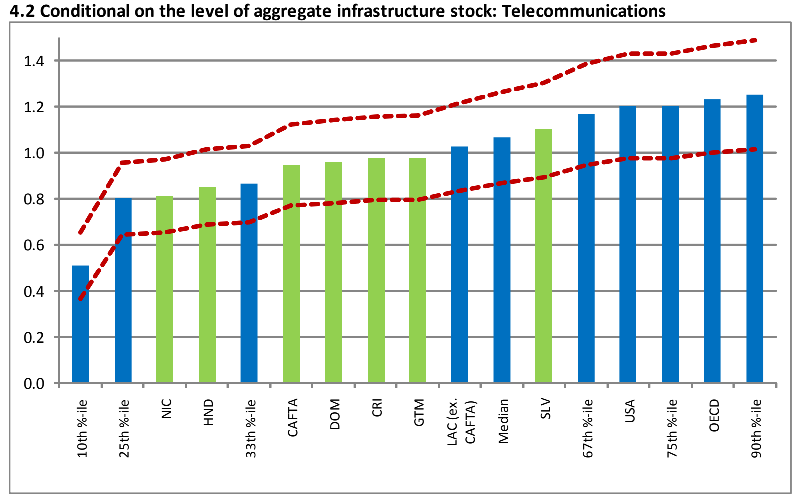
Figure 4
Growth response to a one standard deviation increase in trade openness

4.1 Conditional on the level of aggregate infrastructure stock (IK1)



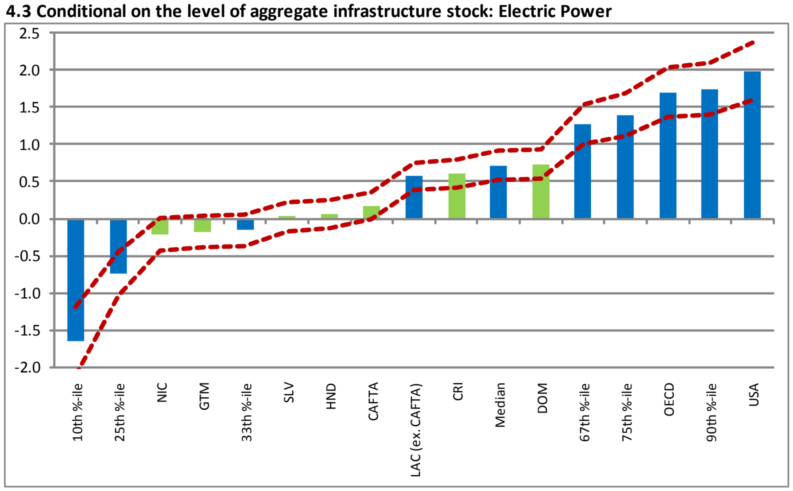
Note: The computed responses were obtained using the estimated coefficients from column [2] of Table 5. The IK1 index is the first principal component of main lines and mobiles, electricity installed capacity (MW) and road length (Km). Higher percentiles imply higher values of the synthetic infrastructure index IK1 (i.e. more provision of infrastructure).

4.2 Conditional on the level of aggregate infrastructure stock: Telecommunications



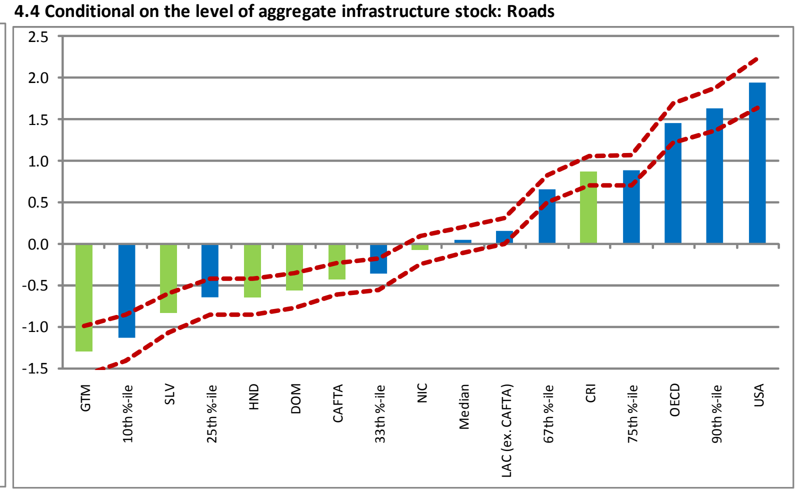
Note: The computed responses were obtained using the estimated coefficients from column [7] of Table 5. Our indicator of tele-communications is the number of main lines and mobile phones per 1 million people (in logs). Higher percentiles imply a higher penetration of main lines and mobile phones among the population of the country.

4.3 Conditional on the level of aggregate infrastructure stock: Electric Power



Note: The computed responses were obtained using the estimated coefficients from column [8] of Table 5. Our indicator of electric power is the electricity installed capacity (in MW) per 1 million people. Higher percentiles imply higher electricity installed capacity per person.

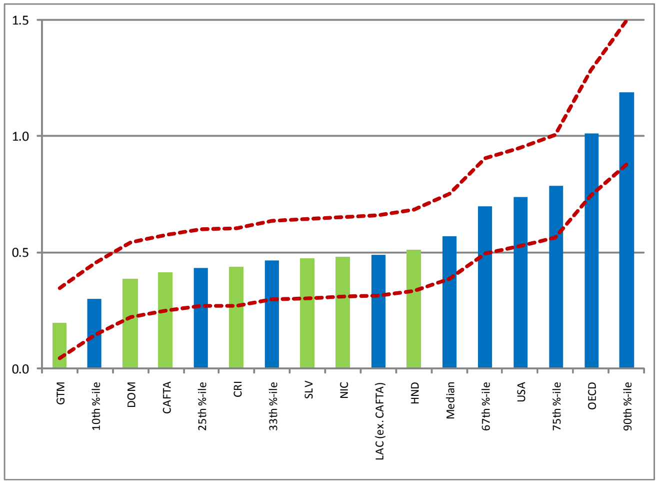
4.4 Conditional on the level of aggregate infrastructure stock: Roads



Note: The computed responses were obtained using the estimated coefficients from column [9] of Table 5. Our indicator of roads is the length of the total road network (in km.) per 1000 people. Higher percentiles imply a larger road network per person.

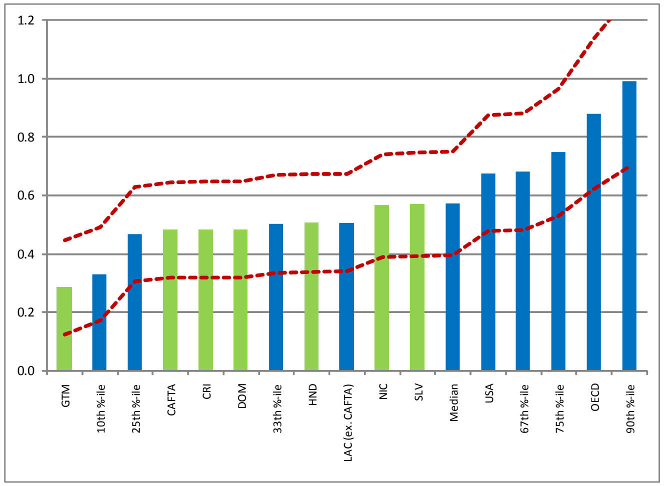
Figure 5
Growth response to a one standard deviation increase in trade openness

5.1 Conditional on the level of financial openness - Foreign assets and liabilities



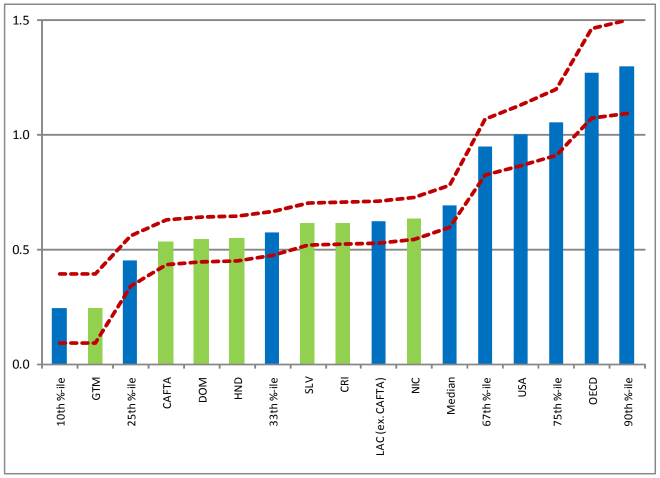
Note: The computed responses were obtained using the estimated coefficients from column [2] of Table 6. Financial openness is calculated by the ratio of foreign asset and liability holdings as % of GDP (in logs). Higher percentiles imply higher ratios of foreign assets and liabilities to GDP (i.e. deeper international financial integration).

5.2 Conditional on the level of financial openness - Foreign liabilities



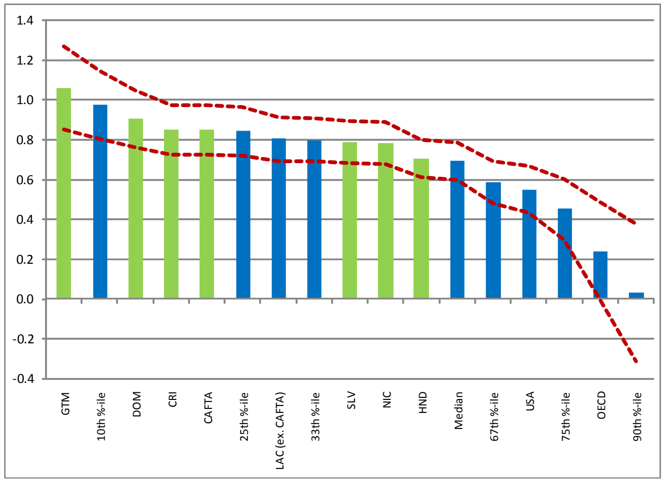
Note: The computed responses were obtained using the estimated coefficients from column [3] of Table 6. Financial openness is calculated by the ratio of foreign asset and liability holdings as % of GDP (in logs). Higher percentiles imply higher ratios of foreign liabilities to GDP.

5.3 Conditional on the level of equity-related financial openness - Foreign assets and liabilities



Note: The computed responses were obtained using the estimated coefficients from column [8] of Table 6. Equity-related financial openness is calculated by the holdings of FDI and Portfolio Equity assets and liabilities as % of GDP (in logs). Higher percentiles indicate higher equity-related financial openness ratios.

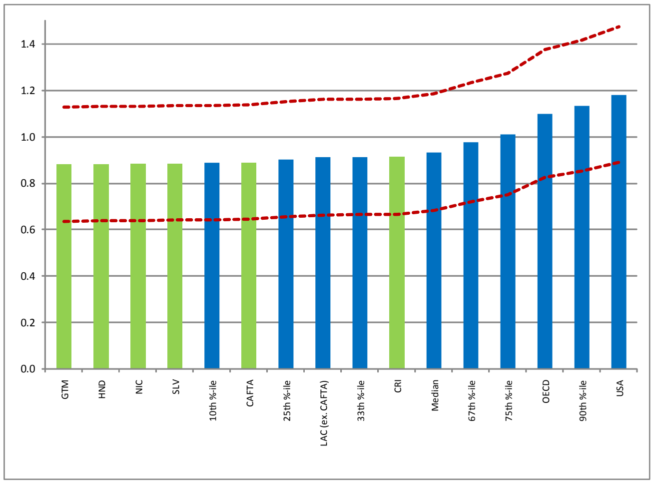
5.4 Conditional on the level of debt-related financial openness - Foreign assets and liabilities



Note: The computed responses were obtained using the estimated coefficients from column [8] of Table 6. Debt-related financial openness is calculated by the holdings of Portfolio Debt and Other Investment assets and liabilities as % of GDP (in logs). Higher percentiles indicate higher debt-related financial openness ratios.

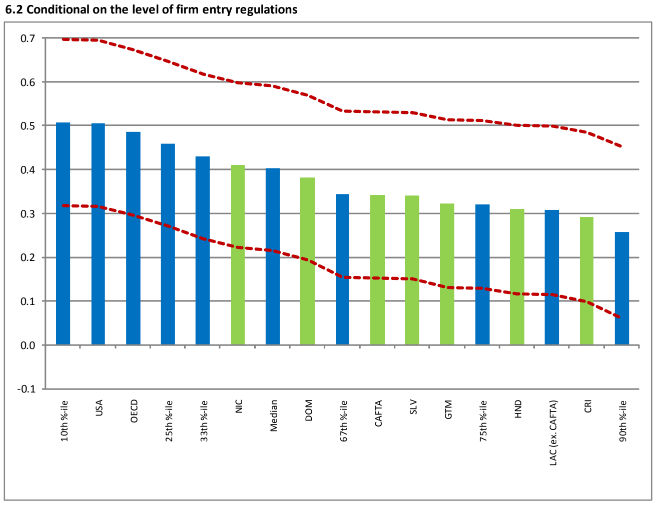
Figure 6
Growth response to a one standard deviation increase in trade openness

6.1 Conditional on the level of R&D Spending



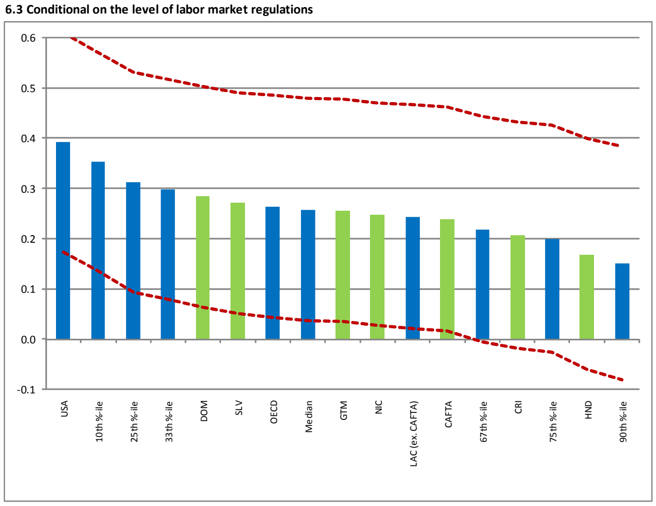
Note: The computed responses were obtained using the estimated coefficients from column [2] of Table 7. R&D spending is the average ratio of R&D expenditure as % of GDP for the 2000-9 period. Higher percentiles imply higher R&D spending to GDP ratios.

6.2 Conditional on the level of firm entry regulations



Note: The computed responses were obtained using the estimated coefficients from column [2] of Table 8. Firm entry regulations are calculated as the simple average of the following measures: number of procedures, time and cost. Higher percentiles imply stricted regulations on firm entry (barriers to entry).

6.3 Conditional on the level of labor market regulations



Note: The computed responses were obtained using the estimated coefficients from column [3] of Table 8. Labor market regulations are calculated as the simple average of the following measures: difficulty of hiring, rigidity of hours and difficulty of firing. Higher percentiles indicate more strict regulations on labor markets.