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# The Nature of Trade and Growth Linkages

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## Abstract

This paper shows new empirical regularities indicating that the structure of trade connections affects the trade-growth nexus. System generalized method of moments estimations indicate that key structural features associated with the composition of traded products and partners matter for growth. The results show that increases in the degree of intra-industry trade, greater insertion into the middle of global value chains, and increases in the shares of differentiated goods, skilled labor-intensive goods, and high-tech-intensive goods in traded baskets are all associated with higher income growth. An increase in the share of trade with countries at the core of the global trade network is also associated with greater growth effects. However, many of these effects are non-linear and depend on the degree of trade openness and labor force education. The results suggest that technological diffusion and learning spillovers play some role in the growth effects associated with the nature of trade connections.



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# The Nature of Trade and Growth Linkages

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## 1. Introduction

A large literature has actively discussed the role of trade in fostering economic development. The seminal article of Frankel and Romer (1999) showed using data for 1985 that trade, instrumented with countries' geographic characteristics, has a quantitatively large and robust positive effect on income. Irwin and Tervio (2002) also find similar results for a sample covering the period between 1913 and 1990. However, many have questioned these findings. Rodríguez and Rodrik (2001) argue that the geography-based instrument used in these studies is likely to be correlated with other geographic variables that affect income through non-trade channels. They provide evidence that, when any of three summary indicators of geography is introduced as a control, the result that trade has a positive effect on income disappears. Acemoglu et al. (2001) contend that these geographic instruments are closely correlated with countries' experiences during colonial times, which in turn help explain the international differences in governance and institutions. Moreover, Rodrik et al. (2004) show empirically that when different institutional arrangements across countries are taken into account, there is a lack of statistical significance on the coefficient of trade on income. More recently however, Noguer and Siscart (2005) argue that geographical controls must enter the trade-income equation directly in order to avoid estimation biases. They find that countries that trade more reach higher levels of income and the results are robust to a wide array of geographical and institutional controls. While the debate has not yet settled, most recent empirical papers tend to find a causal effect from trade to income levels and growth.[1]

Trade theory tends to support this the positive trade-income nexus, though specific theoretical studies differ in their predictions about the underlying channels through which trade affects income. For instance, larger economies can export greater quantities of each good (the intensive margin), a wider set of goods (the extensive margin), or higher-quality goods.[2] It is possible that larger economies simply export more of each good, at lower prices on average on world markets. Hence, efficiency gains associated with specialization or economies of scale for instance may be attained as countries increase their degree of trade openness. It is also possible that larger economies export more varieties to more countries or that they export higher-quality goods at higher prices. Hummels and Klenow

[1] For papers on trade and income, see for example Alcalá and Ciccione (2004), Felbermayr (2005), and Dufrénotet al. (2010). For papers on trade and growth, see for example Dollar (1992), Edward (1992), Wacziarg (2001), Easterly and Levine (2001), Dollar and Kraay (2003), Lee et al. (2004). Singh (2010) provides a recent review of this literature.

[2] For example, Armington's (1969) models emphasize the intensive margin, monopolistic competition models (e.g. Krugman, 1981) focus on the extensive margin, and vertical differentiation models (e.g. Grossman and Helpman, 1991a) explore the quality margin.

(2005) argue that, in this case, forces such as technology diffusion and learning spillovers must play a role in explaining income differences across countries.[3] For example, exporters might gain access to new technology and knowledge from the feedback provided by their global buyers, including on how to innovate and improve production processes and managerial practices so as to better satisfy demand niches, consistently attain high quality, and more ably adapt to changing market conditions.[4] Empirically, there are estimates of positive and quantitatively large spillover effects from import-weighted foreign R&D on national industries, particularly in developing countries.[5] A few studies have also provided some evidence on the diversification of export baskets (Acemoglu and Zilibotti, 1997; Al-Marhubi, 2000; Funke and Ruhwedel, 2002) or the relevance of the quality dimension (Schott, 2004). More broadly however, the issue remains largely under-explored. Perhaps, the mixed evidence on the trade-income nexus reflects differences in the nature of trade relations across countries.

In this paper, we aim at shedding some light on these issues by focusing on whether the structural features of trade connections affect the trade-growth nexus.[6] That is, the main contribution of this paper lies in providing new cross-country empirical evidence on how the growth effect of openness depends not only on the size of cross-border trade but also on a variety of characteristics of trade relations. Following several recent studies, we analyze the issue empirically with a two-step system-GMM approach that addresses endogeneity and controls for unobserved country-specific factors in order to estimate the growth effect of openness as well as those of other relevant variables.[7] Our sample covers 118 countries during 1960-2010. Overall, two set of results emerge from our analysis. First, our estimations consistently show that some structural features associated with the

[3] A few theoretical papers emphasize these channels through which trade affects growth. See for example Arrow (1962), Krugman (1979), Helpman and Krugman (1985), Grossman and Helpman (1991b), Romer (1990, 1993), Rivera-Batiz and Romer (1991), Matsuyama (1992), Vernon (1996), Barro and Sala-í-Martin (1995), Eaton and Kortum (1999), Keller (2002a), Agosin (2007), Alvarez et al. (2013), and Chaney (2013).
[4] See for example Lucas (1988), Young (1991), Keesing and Lall (1992), Blundell et al. (1995), Piore and Ruiz Durán (1998), Clerides et al. (1998), Gereffi (1999), and Castellani (2002).
[5] See for example Coe and Helpman (1995), Coe et al. (1997), Lumenga-Neso et al. (2001), Keller (2002b), and Keller (2004) for a literature review.
[6] There has been a heated debate on whether certain types of goods are more conducive to spillover effects than others. On the one hand, Hidalgo et al. (2007), Hidalgo and Hausmann (2009), and Hausmann and Hidalgo (2011) for example place the emphasis on what countries produce in order to trade. They develop an index of complexity to rank countries' export baskets and find a statistically significant positive association between this complexity index and growth. On the other hand, others such as Lederman and Maloney (2012) place the emphasis not so much on what is produced but on how it is produced. The underlying notion is that the same production process in two different firm-country setups may entail very different degrees of technology diffusion and learning spillovers. This point of view questions the tendency to unduly attribute special growth-enhancing virtues to certain type of goods (say, high-tech manufactures) over others (say, mineral commodities or services). See also Sachs and Warner (1995), Sinnott et al. (2010) and references herein.
[7] Dollar and Kraay (2004), Loayza and Fajnzylber (2005), and Chang et al. (2009), for example, use this methodology to estimate trade-growth regressions.

composition of *products* traded matter for growth. Second, the results indicate that the composition of trade *partners* is also important. Furthermore, our findings are suggestive that technological diffusion and learning spillovers that can arise from integration into the global markets play some role in these growth effects associated with the features of trade connections.

To capture the potential growth effects associated with the composition of traded products, we explore several different measures. We first examine the share of trade in homogeneous goods (i.e. those traded on an organized exchange or with well-defined reference prices, as defined by Rauch 1999). There is empirical evidence showing that trading in differentiated products, as compared to homogeneous goods, is characterized by: a greater importance of distance, language, and search barriers; the home market effect; lower price elasticities and higher markups; smaller transactions but more long-lasting trading relationships.[8] Trading relationships involving homogeneous goods may be characterized by a higher degree of substitutability (consumers may not care about the specific source of these goods) and thus appear to be more fragile as price effects would tend to dominate relationship-specific factors. All these facts indicate that trading relations characterized by a greater share of differentiated goods may be associated with greater growth effects, especially those associated with technological diffusion and learning spillovers. Our findings indicate that this is indeed the case. Our results show that a greater share of homogeneous goods in their trade baskets is associated with lower income growth. Moreover, the effects are larger the greater the level of a country's human capital and the lower the level of trade openness.

We then study whether the factor-intensity (such as the degree of technology, skilled and unskilled human capital) embedded in the goods traded is associated with differentiated growth effects. Goods that require a larger share of skilled labor or high technology in their production processes may provide greater potential for upgrading and improvements. Moreover, their production may involve positive human capital externalities. Increasing the production of certain goods (such as goods intensive in high technology and skilled labor) may provide greater incentives for accumulating high-level human capital and thus be associated with greater growth effects. Exporting these goods may provide even greater incentives. For emerging economies, selling goods to consumers with higher incomes than domestic consumers—and thus potentially higher valuation of quality—may require quality upgrading, marketing, and other types of knowledge that skilled workers provide. Indeed, the empirical evidence indicates that exporting firms tend to hire more skilled labor and pay higher wages

[8] See for example Feenstra et al. (2001), Erkel-Rousse and Mirza (2002), Broda and Weinstein (2006), Feenstra and Hanson (2004), and Besedeš and Prusa (2006).

than firms that sell only to domestic consumers (Brambilla, Lederman, and Porto 2012). Our findings show that the factor intensity embedded in traded goods plays a role the nature of the trade and growth linkages. In particular, a greater share of goods that used intensively skilled labor is typically associated with the largest growth effects. Nonetheless, there are significant changes in the relative ranking of the different types of goods at different levels of trade openness, suggesting that not all goods bring the same benefits to all economies.

We also investigate whether the degree of intra-industry trade (IIT) plays any role in the trade-growth nexus. For example, the economies of scale associated with product differentiation arising with a greater degree of IIT are thought to lead to more rapid productivity gains and hence faster growth. Moreover, if a greater share of trade is within broadly defined industries, the adoption, adaptation, and mastery of foreign technologies available through imported goods is relatively easier as they are directly applicable to a countries' export basket. A high level of IIT within broadly defined industries indicates that the adoption, adaptation, and mastery of foreign technologies available through imported goods may be easier to the extent that they are directly applicable to a countries' export basket. High IIT thus increases the probability that knowledge and technology gained from imports can be applied to exports. Alvarez et al. (2013) adopt a similar concept. They argue that improvements in technology can arise from interactions among firms that are brought together by the prospects of gains from trade and that get new ideas by adapting better technologies used in the production of other goods. In fact, other researchers highlight that the extent of IIT may be a direct proxy for technological diffusion and knowledge spillovers.[9] The economies of scale associated with larger markets and the product differentiation that is possible with a higher level of IIT are thought to lead to more rapid productivity gains and hence faster growth. Our estimations show that, for a given level of trade openness and human capital, an increase in the degree of IIT is associated with higher income growth and this effect is in addition to the direct effects of trade openness and education on growth.

A complementary way of exploring the scope for international trade–related growth effects, especially effects associated with technology diffusion and learning spillovers, is to focus on global value chains (GVCs). The development of GVCs, which is characterized by the dispersion of production stages and processes across countries, is an important aspect of the changing patterns of economic globalization—what Baldwin (2006, 2012a, 2012b) calls globalization's second unbundling.

[9] See for example Helpman and Krugman (1989), Bernstein and Nadiri (1989), and Badinger and Egger (2008).

The technological revolution, especially in information technology, communications, and inventory management, facilitated development of these production chains. Moreover, large wage differentials across countries and declining trade costs made the geographical fragmentation of production profitable.[10] A large body of literature documents the importance of foreign direct investment (FDI) flows in forging these global production chains.[11] The fragmentation of the production process means that individual countries no longer need to develop the full range of capabilities required to create a product or provide a service.[12] They can contribute particular components of the final good, becoming specialized in "tasks" that contribute to the overall production process. As GVCs have gained in prominence, "trade in tasks," where value is added along the production chain, has led to a significant increase in the value of global trade of intermediary goods (WTO and IDE-JETRO 2011). Indeed, as Grossman and Rossi-Hansberg (2008) note "It's not wine for cloth anymore." Individual products are no longer produced entirely in a single country; production chains are now spread out across many countries. Our results indicate that insertion into GVCs, especially its middle segments, is associated with the positive effects in the trade-growth nexus. Moreover, this effect is larger the greater the level of trade openness and it is particularly strong for countries with low levels of labor force education.

Our second set of results focuses on the composition of trade partners. Trading with fast-growing and/or more advanced economies may be associated with positive growth effects partly as a result of aggregate demand effects for the goods in which the country has a comparative advantage. Arora and Vamvakidis (2005), for example, provide empirical evidence that trading partners' growth and relative income levels have strong positive effects on domestic growth. Greater integration with more advanced economies can also open and enhance communication channels and or lead to the specialization in sectors or tasks that facilitate greater technology diffusion and learning spillovers. Intense competition from larger trading partners may reduce the profitability of investments in knowledge in relatively smaller economies if knowledge spillovers are national in reach. Increased competition with a more technologically advanced trading partner can slow innovation and growth in a country that begins with some disadvantage in research productivity if spillover effects are geographically concentrated (Grossman and Helpman, 1991a). Export baskets concentrated in few

[10] Several theoretical papers analyze the underpinnings of the fragmentation of productions. See, for example, Ethier (1982), Sanyal and Jones (1982), Jones and Kierzkowski (1990), Lüthje (2003), Yi (2003), Burda and Dluhosch (2002), and Baldwin and Robert-Nicoud (2014).

[11] See, for example, Hanson et al. (2005), Harrison and McMillan (2011), and Becker and Muendler (2010).

[12] Baldwin (2012a) argues that since 1985, managerial and technical know-how have become more mobile as offshore stages of production need to seamlessly merge into onshore ones. Hence, countries have been able to industrialize by joining GVCs rather than by building entire supply chains at home.

destinations may lead to increased volatility due to fluctuations in trading partners' economy, import-export patterns, or relative prices; hence, they may be associated with worse growth outcomes (Loayza and Raddatz, 2007; Haddad et al., 2013; Di Giovanni and Levchenko, 2012). It may also lead to more economic and political dependency (Dolan and Tomlin, 1980; Packenham, 1992). Our findings suggest that this relation seems to be more complex than pointed out in the literature.

We analyze whether greater trade ties with countries in the center of the global trade network (as opposed to more peripheral countries) is associated with improved growth prospects. Independent of their level of sophistication, these core countries, for being more strongly connected to a wider range of countries, may be more exposed to the technology and knowledge frontier. The quality and intensity of the feedback effects between buyers and sellers engaged in global trade may be greater if one of the countries involved is at the center of the global trade network, thus enhancing the potential for technology diffusion and learning spillovers. Indeed, we find that for sufficiently integrated countries, an increase in trade links with countries at the center of the global trade network is associated with greater growth effects, even after we control for the overall volume of trade flows and for the country's trade share with its main trading partner. Furthermore, our results are consistent with a differential impact on growth for different levels of openness. In fact, they indicate some form of complementarity between trade openness and the share of trade with the most central countries in the trade network. They also suggest that countries need to have educated enough labor forces to be able to benefit the most from trading with these core countries. The results suggest that growth effects of openness are not simply related to having strong trade ties with a larger or more developed country, but rather having strong ties with countries exposed to the frontier of ideas and technologies is important. Finally, we find that the extent that countries participate more in GVCs with inner-periphery (rather than core) countries is part of the growth differential observed.

The remainder of the paper is organized as follows. Section 2 describes the methodology adopted and the data. Section 3 presents the estimation results and Section 4 concludes.

## 2. Empirical Analysis

This paper analyzes whether the nature of trade connections affects the trade-growth nexus. More specifically, it focuses on some features of trade relations associated with the composition of traded goods as well as the composition of trading partners.

### 2.1 Regression Specifications

As a starting point and in order to compare our results with the existing literature, we estimate a benchmark regression specification, in which a country's growth rate is a linear function of its trade openness and human capital, after controlling for conditional convergence effects. This specification also includes a set of control variables considering not only their potential effect on growth rates, but also whether they can affect the relation between trade openness and growth. In particular, the control variables include proxies for infrastructure development and relative price stability. Country- and time-specific fixed effects are also included in this basic specification. This benchmark regression specification is given by Equation 1:

$$y_{c,t} - y_{c,t-1} = \beta_0 y_{c,t-1} + \beta_1 CV_{c,t} + \beta_2 TO_{c,t} + \beta_3 HK_{c,t} + \beta_4 TC_{c,t} + \mu_t + \eta_c + \varepsilon_{c,t}, \quad (1)$$

where $y_{c,t}$ is GDP per capita for country *c* at time *t*, $TO_{c,t}$ is trade openness, $HK_{c,t}$ is human capital, $TC_{c,t}$ represents proxies for the features of trade connections (in terms of both partners and products), $CV_{c,t}$ are the control variables, $\mu_t$ are (unobserved) time-specific effects, $\eta_c$ are (unobserved) country-specific effects, and $\varepsilon_{c,t}$ is the error term.

We extend this benchmark specification to capture a potential non-linearity in the effects of trade openness on growth that depends on the nature of countries' trade connections. We do this by adding interaction terms between trade openness and, in turn, the different proxies for the nature of trade relations. Equation 2a shows this extended regression specification:

$$\begin{aligned} y_{c,t} - y_{c,t-1} = {} & \beta_0 y_{c,t-1} + \beta_1 CV_{c,t} + \beta_2 TO_{c,t} + \beta_3 HK_{c,t} + \beta_4 TC_{c,t} + \beta_5 TO_{c,t}TC_{c,t} \\ & + \mu_t + \eta_c + \varepsilon_{c,t}, \end{aligned} \quad (2a)$$

where $TO_{c,t}TC_{c,t}$ represents the interaction between trade openness and the nature of trade connections (in terms of both partners and products) at country *c* time *t*. In addition, we also considered an extended version of this specification by allowing for a quadratic interactive term, as in Equation 2b:

$$\begin{aligned} y_{c,t} - y_{c,t-1} = {} & \beta_0 y_{c,t-1} + \beta_1 CV_{c,t} + \beta_2 TO_{c,t} + \beta_3 HK_{c,t} + \beta_4 TC_{c,t} + \beta_5 TO_{c,t}TC_{c,t} \\ & + \beta_6 \left(TO_{c,t}TC_{c,t}\right)^2 + \mu_t + \eta_c + \varepsilon_{c,t}. \end{aligned} \quad (2b)$$

Potential nonlinearities between the proxy for human capital and the features of trade connections is also considered. The idea is that the effects of human capital on growth could vary with the nature of trade relations. For example, to the extent that certain features of trade connections are associated with greater technology diffusion and learning spillover, their effects on growth depend on the development of human capital. This alternative specification is given by Equation 3a:

$$y_{c,t} - y_{c,t-1} = \beta_0 y_{c,t-1} + \beta_1 CV_{c,t} + \beta_2 TO_{c,t} + \beta_3 TC_{c,t} + \beta_4 HK_{c,t} + \beta_5 HK_{c,t}TC_{c,t} + \mu_t + \eta_c + \varepsilon_{c,t}, \quad (3a)$$

where $HK_{c,t}TC_{c,t}$ represents the interaction between the level of human capital and the nature of trade connections (in terms of both partners and products) at country *c* time *t*.

Similarly, we also explore the possibility of non-linearity in this interacted term. This extended version is given by Equation 3b:

$$y_{c,t} - y_{c,t-1} = \beta_0 y_{c,t-1} + \beta_1 CV_{c,t} + \beta_2 TO_{c,t} + \beta_3 TC_{c,t} + \beta_4 HK_{c,t} + \beta_5 HK_{c,t}TC_{c,t} + \beta_6 (HK_{c,t}TC_{c,t})^2 + \mu_t + \eta_c + \varepsilon_{c,t}. \quad (3b)$$

The regressions specifications are used to estimate the total growth effects of changes in the structural features of trade relations. While they do not identify the mechanisms through which trade structure may affect growth, they may provide suggestive evidence on the extent to which technology diffusion and learning spillovers matter.

## 2.2 Estimation Methodology

The trade-growth regression specifications presented above pose several challenges for estimation. A number of empirical papers in the growth literature adopt the system generalized method of moments (S-GMM) procedure developed in Arellano and Bover (1995) and Blundell and Bond (2001) to overcome the endogeneity issue.[13] The S-GMM procedure estimates a system of equations that combines the regression specification in levels, as described above, and the same specification in

[13] Dollar and Kraay (2004), Loayza and Fajnzylber (2005), and Chang et al. (2009), for example, use this methodology to estimate trade-growth regressions. Beck and Levine (2004), Beck et al. (2000), and Rajan and Subramanian (2008) use it in the finance-growth literature.

differences.[14] This method deals with both the unobserved country-specific effects in this dynamic setup and the potential biases arising from the endogeneity of explanatory variables. Differencing the regressions controls for the unobserved country-specific effects, but it creates the additional problem that the error term of the differentiated equation is correlated with the lagged dependent variable. Taking advantage of the panel structure of the dataset, the S-GMM procedure uses so-called internal instruments to address this issue as well as the potential endogeneity of the explanatory variables. More specifically, for the equation in levels, the instruments are given by the lagged differences of the explanatory variables, whereas for the equation in differences, the instruments are lagged observations of both the explanatory and the dependent variables.

It is worth pointing out that the set of instruments grows with the number of explanatory variables and time periods. As the time dimension of the sample size is limited, only a restricted set of moment conditions is used in order to avoid over-fitting bias.[15] In particular, we use as internal instruments only the first appropriate lag of each time-varying explanatory variable. For the variables measured as period averages, the instruments correspond to their average in period $t-2$; for the variables measured as initial values within a given period, the instruments correspond to their observation at the start of period $t-1$. As a consequence, in the estimations of equations 2 and 3, the proxies for the nature of trade connections are interacted one at a time in order to simplify the interpretation of the results and to avoid overextending the number of required instruments (and hence the number of estimated parameters).[16] Even with this restricted set of instruments, there are specifications in which the actual number of instruments is close to or even larger than the number of countries in the sample. In these cases, a restricted sample of control variables is used to reduce the number of explanatory variables, as suggested by Roodman (2013).

The S-GMM procedure relies on four key assumptions: (a) the error terms are not serially correlated, (b) shocks to growth are not predictable based on past values of the explanatory variables, (c) the explanatory variables are uncorrelated with future realizations of the error term, and (d) the correlation between the explanatory variables and the country-specific effects is constant over time. Notwithstanding these assumptions, the method allows current and future values of the explanatory

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[14] We use the S-GMM instead of the difference GMM estimator, which relies solely on the difference equation, because our explanatory variables are persistent over time and this persistence could render our instruments weak. In addition, Bond et al. (2001) show that for relatively small sample periods, S-GMM performs better than the difference GMM.
[15] See for example Roodman (2009).
[16] We do not use instruments for the interacted terms as we already have instruments for each individual term within an interaction. A similar approach has been followed by Chang et al. (2009).

variables to be affected by growth shocks—it is exactly this type of endogeneity that the method is designed to handle. In addition, the consistency of the S-GMM estimates of the parameters of interest and their asymptotic variance-covariance matrix depend on whether lagged values of the explanatory variables are valid instruments in the growth regression.

Three specification tests are used to evaluate these potential issues: (a) the "full Hansen" test of overidentifying restrictions on the full set of instruments (which tests the validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process), (b) the "incremental Hansen" test of overidentifying restriction on the additional instruments that are introduced in the levels equations (which tests the stationarity assumption on which these instruments are based), and (c) a second-order serial correlation test (which tests whether the error term is serially correlated).[17] The results of the Hansen and serial correlation tests indicate that the null hypothesis of correct model specification cannot be rejected, lending support to the estimation results shown in this paper.

### 2.3 Data

To assess whether the structural features of trade connections in terms of partner and product composition affect the trade-income nexus with an S-GMM framework, we analyze an unbalanced panel dataset covering 117 countries—13 from North and Central America and the Caribbean, 11 from South America, 30 from Europe, 32 from Africa, 11 from the Middle East and Central Asia, 5 from Southeast Asia, 12 from East Asia, and 3 from the Pacific.[18] As robustness, we also considered a smaller (and arguably more standard in the literature) sample of 82 countries.[19] Within each panel, the dataset includes at most 10 observations consisting of non-overlapping five-year averages spanning the 1960–2010 period.

As pointed out above, the dependent variable in our empirical analysis is the average rate of growth in real per capita GDP within a five-year period. One of the key variables of interest is the degree of trade openness, which is defined as imports plus exports as a share of GDP, and is also measured as the average over any given five-year period. A number of other explanatory variables are

[17] In the S-GMM system specification, the test is whether the residual of the equation in differences is second-order serially correlated, which would indicate that the original error term is serially correlated and follows a moving average process of at least order one. In this case, it would reject the validity of the proposed set of instruments and would call for higher order lags to be used as instruments.
[18] See Appendix Table 1 for the list of countries in the analysis.
[19] See for example Loayza and Rancière (2006) and Chang et al. (2009).

also included in the regressions. As is standard in the literature, we control for the initial condition in an economy by including its GDP per capita at the beginning of each period as a regressor. We also include labor force education, proxied by the rate of secondary and tertiary school enrollment of the active population at the beginning of the period, to account for human capital investment. As additional controls in the regressions, we have the number of main telephone lines per capita as a proxy for the development of the public infrastructure in each country and a country's terms of trade to proxy for relative price stability and exchange rate fluctuations. Both variables are measured as averages over five-year periods.

All other variables of interest related to the features of trade connections belong to two categories: the nature of the products traded and the composition of trading partners.[20] All these variables are as averages within any given five-year period. With respect to the first set of variables, we use the share of homogenous goods traded in an organized exchange or with well-defined reference prices, as developed in Rauch (1999). As in most of the literature, we focus on Rauch's liberal classification, which maximized the number of homogenous goods when ambiguities existed. The classification of traded goods into homogeneous and differentiated goods is conducted at the 4-digit SITC level.

To characterize the factor intensity embedded in traded goods, we use the classification of Hinloopen and Marrewijk (2001), which is based on an UNCTAD/WTO classification, and Krause (1987). Goods are divided into the following five categories according to the relative use of the factors of production: (a) primary products, (b) natural-resource intensive products, (c) unskilled-labor intensive products, (d) technology-intensive products, and (e) human-capital intensive products. This classification is conducted at the 4-digit SITC level. All our reported results are relative to the omitted category, the natural-resource intensive products.

Another variable of interest is the degree of IIT. We follow the methodology of Grubel and Lloyd (1975), in which the degree of IIT of country *i* is given by $GL_{ij} = 1 - \frac{\sum|X_{ik}-M_{ik}|}{\sum(X_{ik}+M_{ik})}$, where $X_{ik}$ are the exports of country *i* of product *k* and $M_{ik}$are the imports of country *i* of product *k*.[21] The index ranges from degree of IIT ranges from 0 (pure inter-industry trade) to 1 (pure intra-industry trade). To construct our country-level variable, we aggregate the measure across all industries for any

[20] See Appendix Table 2 for more details on the definition of these variables as well as the data sources used. See also Appendix Table 3 for the descriptive statistics of the variables used in the estimations.

[21] We do not correct the IIT index by the level of trade imbalances between countries as such an adjustment would mechanically capture the degree of inter-industry trade (Fontagné and Freudenberg, 1997).

given country, weighted by the share of trade in each industry. We use the classification of goods *k* at the 2-digit SITC level in order to obtain a broad classification of goods, thus allowing us assess the effects of IIT as related to trade of related but different goods rather than those of products with some degree of horizontal differentiation. For example, "optical glass and elements of optical glass" and "glass mirrors, unframed, framed" belong to the same 2-digit SITC category (industry code 66, "non-metallic mineral manufactures"), but are not in the same 4-digit SITC category (the former is classified as industry code 6642 and the latter as 6648). The broader classification may capture and is arguably more indicative of possible technology diffusion and learning spillovers than the stricter classification at the 4-digit level, which can be associated with the love for variety as in Krugman (1979).

Our measure of countries' insertion into GVCs is proxied by the degree of upstreamness embedded in traded goods. Antrás et al. (2012) calculate a measure for the United States by exploring input-output matrices for 426 industries in the 2002.[22] The constructed indicator ranges from 1 (final use goods, such as cars and footwear) to 4.65 (goods associated with the processing of raw materials, such as petrochemical manufactures and copper and iron ore mining). We use this classification of US industries as a benchmark and apply it to the basket of other countries' exported goods. In particular, we calculate the share of exports classified within a given range of this upstreamness indicator: goods used at the beginning of GVCs (e.g. exports of primary products), goods used in the middle of GVCs (e.g. exports of intermediate goods), and goods used at the end of GVCs (e.g. exports of final goods).[23] We consider two alternative definitions for these three ranges of goods. First, we split evenly the 426 industries into five groups. The first group corresponds to goods used at the beginning of GVCs, the three following groups correspond to goods used in the middle segments of GVCs, and the last group corresponds to goods at the end of GVCs. Second, as robustness, we evenly split industries in three groups, each one corresponding to one of these segments of GVCs.

The second set of variables analyzed is related to the composition of countries' trading partners, exploring the position of these partners in the global trade network. Even though Few countries occupy central places in the global trade network, there is no widely accepted definition of

[22] The classification by Antrás et al. (2012) is based on the HS 2002 classification at the 10-digit level. We convert this classification to the 4-digit level SITC Revision 2, which is the classification available for the trade database of Feenstra et al. (2005).

[23] We also tried a number of alternative classifications involving 4, 5, or even 10 groups of industries based on the characteristics of the industries and the number of goods within each category. The results are qualitatively similar to the ones presented in the paper.

how many and which countries can be considered core central countries. Using network analysis, we rank the most central countries in the global network using the random walk betweenness centrality measure.[24] This measure takes into account each country's share of world trade, their number of trading partners, and the position of their partners in the global trade network.[25] This ranking changes over time to reflect changes in the global trade network.[26] Based on this ranking, we construct four different proxies to characterize countries' composition of trading partners: (a) the share of trade with the largest single trading partner among the top-3 most central countries in the global trade network; (b) the total share of trade with the top-3 countries in the network; (c) the share of trade with countries above the 95$^{th}$ percentile of the ranking of countries in the global trade network (the so-called core countries); and (d) and the share of trade with countries in 70-94$^{th}$ percentile of the ranking of countries in the network (the so-called inner-periphery countries). To put the results in perspective, we also constructed two analogous proxies to characterize the composition of countries' main trading partners: (a) the share of trade with its main trading partner; and (b) the share of trade with its top-3 trading partners. All these measures are time-varying variables—they are constructed as yearly averages for every five-year window in the sample.

## 3. Estimation Results

Let's start with the estimation of the benchmark regression specification (1) with different methodologies. The results are reported in Table 1. Column 1 shows our preferred estimation technique, the S-GMM with the two-step estimation procedure. The estimation results are comparable to those reported in the existing empirical literature relying on the cross-country variation of within-country changes—the estimated coefficients have the expected signs and magnitudes. Trade openness is positive and statistically significant, indicating a positive impact on average on economic growth. Initial GDP per capita has a negative and statistically significant coefficient, which is typically interpreted as evidence in favor of conditional convergence. That is, more developed countries on average grow less than less developed ones. The coefficient associated with human capital investments is not statistically significant in this specification, though it is positive and significant in other specifications throughout the paper. The estimated coefficient on public infrastructure is also positive

[24] See Appendix A for a detailed description of the methodology used.

[25] The random walk betweenness centrality is a widely used measure in network analysis and has been applied to the global trade and financial networks. See for example Newman (2005), Fisher and Vega-Redondo (2006), and Reyes et al. (2009).

[26] See, for example, de la Torre et al. (2015) for an analysis of the dynamics of the global trade network over the past 40 years.

and statistically significant. Terms of trade has a negative and statistically significant coefficient, which captures the adverse effects of relative price and exchange rate volatility on growth outcomes. Although not reported, the time dummies are negative, denoting an average decline in per capita growth rates over time. The three specification tests presented at the bottom of the table, namely the two Hansen tests and the serial correlation test, support our estimation results. They indicate that the null hypothesis of a correct specification of the estimated model cannot be rejected. This is also the case for most the estimations presented in the rest of this paper. We return to them only when different results are obtained.

Arellano and Bond (1991) and Blundell and Bond (1998) argue that the two-step procedure produces asymptotically efficient estimates of the S-GMM under the conditions of a large enough sample (in the cross-sectional dimension) and appropriate instruments. Moreover, the resulting standard error estimates are consistent in the presence of heteroskedasticity and autocorrelation within panels. However, when these conditions are not fully met, the two-step procedure may produce biased estimates—it may lead to underestimation of standard errors.

For robustness, we present five alternative estimations of this benchmark model: one-step S-GMM estimates; the Windmeijer-corrected two-step estimates, the collapsed two-step estimates; pooled OLS estimates; and fixed effects panel estimates. The one-step procedure estimates a variance–covariance matrix consistent with a homoskedastic error term in the levels regression. The results, shown in column 2 of Table 1, are comparable to those of the two-step procedure. The Windmeijer-corrected two-step procedure applies a finite-sample correction to the two-step covariance matrix derived by Windmeijer (2005). Although this procedure aims at dealing with the downward bias in the estimates of the standard errors of the two-step procedure, it may produce abnormally large standard errors under certain conditions, as recognized in Windmeijer (2005). Indeed, as reported in column 3 of Table 1, the Windmeijer standard errors are considerably larger than those in column 1. Nonetheless, the coefficients on all regressors, except terms of trade, remain statistically significant. The collapsed two-step estimates restrict the instrument matrix, so that it contains one instrument for each lag depth instead of one instrument for each period and lag depth as in the conventional S-GMM instrument matrix. At the cost of the reduced efficiency, this procedure uses fewer instruments thus accommodating cases when a large number of explanatory variables and the presence of several time-series periods lead to many instruments. In this benchmark case, the number of instruments is reduced significantly and both Hansen tests reject the null of under-identification, indicating that the instruments used are not jointly valid, and hence this is not an appropriate specification for this benchmark model. The consistency of the two-step S-GMM estimates can be assessed by comparing its estimates with those of the pooled OLS and Within-Group estimators. Bond (2002) argues that these two estimators are biased in opposite directions of the S-GMM one. Hence, the S-GMM estimates should lie in between those two other estimates (Nickel, 1981). The pooled OLS and Within-Group estimators, reported in columns 5 and 6 of Table 1, show that our two step S-GMM estimates typically lie indeed in between them. Overall, the results obtained with these alternative methods give support to our preferred two-step S-GMM estimation procedure and yield qualitatively similar results. For the remainder of this paper, we will report only the results based on the two-step S-GMM estimation procedure.

The benchmark specification explored thus far allows only linear effects of trade on growth and the estimates reflects its average effect. In the next tables, we will shed light on whether some features of trade relations play a role in the trade-growth nexus, thus altering this average effect. We divide our results in three sets: those related to the nature of products traded (in Section 3.1), those related to insertion in the GVCs (in Section 3.2), and those related to the composition of trading partners (in Section 3.3).

### 3.1 The Nature of Products Traded

To capture the potential growth effects associated with the nature of traded products, we explore several different measures. We first analyze whether the share of trade in homogeneous goods (i.e. those traded on an organized exchange or with well-defined reference prices) is associated with greater income growth. Column 1 of Table 2 reports the estimates associated with Equation 1. The coefficient on the share of homogenous goods is negative and not only statistically significant, but also economically meaningful. An increase of 10 percentage points in the share of homogenous goods is associated with a decline in growth of about 0.5 percentage points. The estimates on all the other variables from Equation 1 remain unchanged vis-à-vis the previous estimates—the degree of trade openness and the development of public infrastructure are positive and statistically significant, whereas initial GDP per capita and terms of trade are negative and statistically significant.

Columns 2 and 3 of Table 2 show the regression estimates associated with Equations 2a and 2b, respectively. The coefficient associated with the interaction term is positive, though when the quadratic term is included in the regression, neither of them is statistically significant. The coefficient on the share of homogeneous goods remains negative, though that on trade openness is not significant. In order to infer the total impact of a change in the share of homogeneous goods on growth, we need to consider the coefficients on both the interaction terms and on the variable itself (taking as given all the other explanatory variables). In Panel A of Figure 1, we show how this total growth effect changes as the degree of trade openness varies. More specifically, this figure presents the total effect on economic growth of a 10 percentage point increase in the share of homogeneous goods from its sample mean based on the estimates in column 3. An increase in the share of traded homogenous goods has a negative impact on growth, ranging from -0.6 percentage point for closed economies to -0.2 for economies with exports plus imports as a ratio of GDP greater than 150 percent. This positive slope suggests that for relatively closed countries changes in this characteristic of the traded goods, that is, its degree of substitutability in global markets, is associated with stronger growth effects than for more open economies.

Analogously, columns 4 and 5 correspond to the estimates of Equations 3a and 3b. The results show that the interaction between the share of traded homogenous goods and the extent of the labor force education is negative and statistically significant. Moreover, the relation is non-linear, as indicated by the results in column 5. Panel B of Figure 1, which is based on column 5, reports how the total impact of a change in the share of homogeneous goods on growth varies with the degree of secondary and tertiary schooling. The figure shows that an increase of 10 percentage points in the share of homogenous goods in the trade basket leads to negative growth effects for all levels of education of the active labor force. Furthermore, these effects become even more negative with greater levels of labor force education, indicating greater growth benefits from increasing the share of heterogeneous goods in trade baskets. The non-linearity of these effects on the level of human capital development suggests an important role for technology diffusion and learning spillovers. That is, as trade baskets contain more heterogeneous goods, there is greater scope for the development of trading relationships with strong feedback loops between buyers and sellers for which there is stronger potential for learning.

We also analyze the role of the factor-intensity embedded in the goods traded (such as the degree of technology, skilled and unskilled human capital embedded in traded goods) on economic growth. The estimations in Table 3 indicate that the factor intensity embedded in traded goods affects the nature of trade-growth linkages. Column 1 reports the estimates of Equation 1. The coefficient on trade openness is positive and statistically significant, as are all the coefficients associated with the variables capturing the relative factor intensity of the traded basket. These results indicate additional growth effects relative to the omitted baseline category of the share of traded goods intensive in natural resources, although the magnitude of the growth effects varies. A larger share of skilled labor–

intensive goods is typically associated with the largest growth effects, followed by that of unskilled labor- and high-technology-intensive goods, which have coefficients of similar magnitude. A Wald test, reported at the bottom of the table, indicates that larger growth effects associated with greater share of goods intensive in skilled labor than in unskilled labor.

There are, however, significant changes in the relative ranking of goods at different levels of trade openness and labor force education. The last four columns in Table 3 show the regression results of the interactions between each of the different variables related to factor intensity in the export basket and trade openness (columns 2 and 3) or the proxy for investments in human capital (columns 4 and 5). For ease of exposure, we focus on the total growth effects of a change in these different shares. Figure 2 shows the total growth effects for different categories of products of a 10 percentage–point increase in the shares of traded goods (from their sample means, accompanied by a decline of the same magnitude in the share of traded goods in natural resources).[27] It shows how these effects vary with the level of trade openness (panel c) and human capital development (panel d) (these effects are in addition to the direct effects of trade openness and education on growth). An increase in the share of traded goods that are intensive in skilled labor yields the largest effects on economic growth for almost all levels of labor force education and trade openness (especially so for relatively closed economies). The second-largest growth effect is associated with an increase in the share of high-tech-intensive goods, especially as trade integration increases. In fact, for economies with trade openness of 70 percent or higher, the effects are even larger than the effects associated with skilled labor–intensive goods. These changes in the relative ranking of different types of goods at different levels of trade openness and human capital development suggest that externalities may play some role in the trade- growth dynamics and that not all goods are expected to bring the same benefits to all economies.

We also analyze whether the degree of IIT affects the trade-growth nexus. A high level of IIT within broadly defined industries indicates that the adoption, adaptation, and mastery of foreign technologies embedded in imported goods may be more relevant, at least to the extent that they are directly applicable to a countries' export basket. High IIT would thus increase the probability that knowledge and technology gained from imports can be applied to exports. In fact, many studies have used the degree of IIT as a direct proxy for technological diffusion and knowledge spillovers. The results in column 1 of Table 4 show that, for a given level of trade openness and human capital development, an increase in the degree of IIT has a positive and statistically significant impact on

[27] Appendix Figure 1 reports the confidence intervals around the estimated curves shown in Figure 2.

growth. The effect is sizeable: a 10 percentage-point increase in IIT from its sample mean is associated with an increase of about 0.6 percentage points in growth. Notice that this effect is in addition to the direct effects of trade openness and education on growth.

Although an increase in IIT always has positive and large effects on growth in income per capita, the magnitude of this effect is nonlinear. The results are shown in columns 2 and 3 of Table 2 for the estimations with the interacted coefficients with trade openness and IIT and in columns 4 and 5 for the estimations with the interacted coefficients with human capital development and IIT. Figure 3 shows the total growth effects of a 10 percentage-point increase in IIT from its sample mean as a function of trade openness (Panel A) and labor force education (Panel B). In countries in which exports plus imports represent 50 percent or more of GDP, the growth effect is about 0.6 percentage points. For countries with secondary or tertiary enrollment rates of more than 20 percent, the growth effects can be as large as 0.7 percentage points.

### 3.2 Insertion into the Global Value Chains

The international division of labor (or tasks) in the production process can also lead to productivity increases that generate important welfare gains that can ultimately drive economic growth. Hence, examining the scope for international trade–related growth effects associated with GVCs is relevant. Involvement in GVCs can also yield indirect benefits by providing mechanisms for technology and knowledge spillovers. For instance, these gains can arise through learning-by-doing effects, direct technology transfers, and increased efficiency and productivity as a result of participation in these chains of production.

We consider insertion into three segments of GVCs: beginning (e.g. exports of primary products), middle (e.g. exports of intermediate goods), and end (e.g. exports of final goods). The estimations reported in Table 5 omit the latter category; hence, the results should be interpreted as relative to insertion at the last stages of GVCs. The results reported in Columns 1 and 6 of Table 5 show that an increase in the share of traded goods that typically belong to the middle of GVCs (accompanied by a decline of the same magnitude in the share of traded goods typically associated with the last stages of GVCs) is associated with positive and significant effects on growth. In contrast, increasing the share of goods in the initial stages of GVCs (accompanied by a similar decline in the share of traded goods related to the last stages of GVCs) is associated with negative and statistically significant effects on growth.

However, the magnitude of this effect is non-linear. For example, the total growth effect of an increase of 10 percentage points in the share of traded goods in the middle segments of GVCs is positive when trade openness is superior to 40 percent of GDP (Figure 3, Panel A). Gains in per capita income growth can be as large as 0.9 percentage points when a country is highly integrated into global markets. In contrast, for levels of trade openness below 100 percent, the point estimates indicate that increasing the share of the most upstream traded goods is generally accompanied by negative growth outcomes. Nonlinear effects between participation at the different stages of GVCs and the degree of labor force education are also observed. For countries with secondary or tertiary enrollment of more than 25 percent of the active population, increasing the share of traded goods in the middle of GVCs, from its sample mean, is associated with positive effects on per capita income growth (Figure 3, Panel B). This increase reaches about 0.5 percentage points for countries with highly educated labor forces. In contrast, the effects of increasing the share of traded goods that fall in the initial stages of GVCs is associated with a negative growth impact, whatever the level of labor force education.

Overall, participation in GVCs does not automatically translate into additional gains from trade beyond the gains associated with increased export volumes. Our results indicate that insertion into the middle of GVCs may be key as it is associated on average with the largest increases in growth. Moreover, the growth effect appears to be larger the greater the level of trade openness; it is particularly strong for countries with high levels of labor force education. The underlying notion is that the more the economic activities of a country are connected to global production chains—particularly the middle range of such chains—and the more capable the country's labor force is, the more productivity-enhancing learning and innovation effects can take place. That is, it could improve the ability of firms to generate, import, and apply new technologies and even upgrade within and across GVCs, thus reaping the lauded benefits from GVC participation.

### 3.3 The Composition of Trading Partners

In this section, we explore the role of the composition of trading partners when countries integrate into global markets and the extent to which the identity of partners matter. More specifically, we examine whether greater trade ties with countries in the center of the global trade network (as opposed to more peripheral countries) is associated with improved growth prospects. Whether trading partners are at the center of the global trade network or on its periphery may affect the growth prospects associated with trade connections. Independent of their level of economic development or technological sophistication, the central countries in the global trade network, which are more closely connected to a wider range of countries, are more exposed to the technology and knowledge frontiers. To the extent that firms get new production-related ideas and technology by learning from firms with which they do business (or compete), the establishment of strong ties with countries more exposed to the frontiers of ideas and technologies may lead to stronger growth effects. The quality and intensity of the feedback effects between buyers and sellers engaged in global trade, for example, may be greater if one of the countries involved is at the center of the network. Trade with central countries may also be associated with a selection effect of putting domestic producers in contact with the most efficient (subject to trade costs) foreign producers. All these factors enhance the likelihood of technology diffusion and learning spillovers. For a given country, then, the potential for exposure to a wider set of ideas and technologies increases with the strength of its trade ties with more central countries. Hence, a key question is to what extent are stronger trade ties with countries in the center of the global trade network associated with higher growth?

Table 6 reports the estimations associated with the share of trade with the most central country in columns 1 to 5, and with the top-3 countries in the global trade network in columns 6 to 10. To contrast the effects of trading with these central countries with simply more concentrated trading relations, the regressions also include an analogous proxy to capture countries' share of trade with their main partners. The coefficient on the share of trade with the most central country in the global trade network is positive and statistically significant; the coefficient on the share of trade with a country's main trading partners is negative and statistically significant (column 1). The differential effect is economically large—about 0.7 percentage points. An increase of 10 percentage points in the share of trade with the most central country is associated with an increase in growth of about 0.1 percentage point, whereas a similar increase in the share of trade with the top trading partner is associated with a decline in growth of about 0.6 percentage points. The differential impact on growth rates remains about the same at about 0.8 percentage points if the top-3 countries are considered (column 5).

Figure 5 shows the total growth effect associated with an increase of 10 percentage points (from their sample mean) in the share of trade with the most central countries in the global trade network and with the main trading partners. The figure shows how these effects vary with the degree of trade openness (Panels A and B) and the level of human capital development (Panels C and D). For low enough levels of trade openness, increasing trade ties with a country's main trading partners is accompanied by a positive effect on per capita income growth, though the effect becomes negative at about 35 percent of trade openness. In contrast, the total growth effect associated with an increase in the share of trade with the most central countries in the global trade network increases with the degree of trade openness—it is associated with positive growth effects for any level of trade openness in the case of the trade for the top-3 most central countries, but only for levels of trade openness above 35 percent when considering the top central trading partner. The growth effects are also non-linear in the degree of human capital development. The total growth effect of an increase of 10 percentage points in the share of trade with the most central countries is typically positive, though declining with labor force education. In contrast, the effect on growth associated with trading with the top trading partners is negative, but increasing with labor force education.

Exploring further the role trade with these central countries, we analyze in Table 7 the share of trade with core countries (countries in the 95$^{th}$ percentile or above) with the share of trade with countries in the inner-periphery (countries in the 70-94$^{th}$ percentile) of the global trade network. The results in column 1 reinforce the previous findings—both coefficients are positive and statistically significant. For example, the average effect of an increase of 10 percentage points in the share of trade with core countries (from its sample mean) is associated with an increase in growth of about 0.8 percentage points for the average country, whereas the effect reaches almost 1.2 percentage points for a similar increase in the share of trade with countries in the inner-periphery.

The effect associated with the share of trade with countries in the inner periphery is larger than that of the share of trade with core countries, as indicated by a Wald test reported at the bottom of the column 1 of Table 7. We test in Table 8 whether this arguably counter-intuitive result can be explained by differential growth rates of inner-periphery countries (column 1). If inner-periphery countries typically grow faster than core countries, trading with former is more likely to be accompanied by larger growth effects—associated, for instance, with direct aggregate demand effects. Indeed, the (weighted) growth rates of core and inner-periphery countries have a positive impact on growth of per capita GDP. When this growth differential is controlled for, the effects associated with the share of trade with core countries become larger than the effects associated with the share of trade with inner-periphery countries—and the growth differential is statistically significant.

We also test in Table 8 whether the positive differential effect on growth rates associated with trade inner-periphery countries versus core countries can be explained by greater integration into GVC of the former (column 2). As argued above, the degree and manner in which countries participate in GVCs affects the dynamics of trade and growth. To the extent that countries participate more in GVCs with inner-periphery (rather than core) countries, part of the growth differential reflects this insertion in GVCs. The results indicate that this can also be the case. Consistent with the results in the previous section, participation in GVCs is positively associated with growth prospects. When this participation is controlled for, the growth effects associated to the share of trade with inner-periphery countries is smaller than those associated with the share of trade with core countries—and the positive growth differential is statistically significant. The findings in the previous section also indicate that insertion into the middle segments of a GVC is associated with the largest improvement in the trade-growth nexus. The estimations in columns 3 and 4 of Table 8 show that there is some heterogeneity in these results depending on the composition of partners in the production chain. The growth effects associated with participation in GVCs with inner-periphery countries are largest in the middle and initial stages. In contrast, for participation in GVCs with core countries, the growth effects associated with participation in the final stages of the chain are greatest.

There is also a strong nonlinearity in the total growth effects associated with increases in trade shares with these central countries on trade openness and the human capital development, as shown by the estimations Table 7 and Figure 6. These growth effects are not only positive but increasing with trade openness, albeit at different degrees. At relatively low levels of trade openness (below 80 percent), an increase in trade shares with inner-periphery countries is associated with slightly larger (though not statistically significant) growth effects than an increase in the share of trade with core countries. The opposite is observed for higher levels of trade openness. Similar nonlinear effects with the degree of labor force education are observed. The total growth effects associated with an increase of 10 percentage points in the share of trade with inner-periphery countries, shown in Panel B of Figure 6, are typically positive, at around 1 percentage point, and relatively stable. Interestingly, the growth effects associated with a similar increase in the share of trade with core countries increase with labor force education and can surpass 2 percentage points for levels of secondary and tertiary enrollment above 85 percent.

In sum, the estimation results indicate that for sufficiently integrated countries, an increase in trade links with countries at the center of the global trade network is accompanied by strong growth in income per capita, even after controlling for the overall volume of trade flows and a country's trade share with its main trading partners. Furthermore, the results are indicative of a differential impact on growth for different levels of openness. They suggest some form of complementarity between trade openness and the share of trade with the central countries in the global trade network. They also indicate that countries need to have educated labor forces to be able to benefit most from trading with core countries, suggesting that human capital development is key for the absorption of foreign technology and knowledge. These results are consistent with the idea that the growth effects associated with trade openness are not related simply to the development of strong trade ties with a single country but rather to the establishment of such ties with countries that are more exposed to the frontiers of ideas and technologies.

Importantly, the results in this section may interact with and complement the results of the previous section, which characterized the interactions between growth and the nature of traded goods. The results on participation in GVCs and the composition of trading partners provide only a glimpse of these potential interactions, because the S-GMM procedure is limited to a relatively restricted set of explanatory variables in the estimated regressions if overfitting bias is to be avoided. This methodology constrains a more thorough analysis of these interactions, which is therefore left for future research.

## 4. Conclusions

Using a system-GMM approach, we provide empirical evidence that some features of trade relations—in particular, the composition of traded products and partners—are associated with differentiated growth outcomes. While the literature provides inconclusive evidence on the superiority of one type of good over another and hence on the selection of products or industries for special treatment, the evidence in this papers consistently shows that the structure and quality of trade baskets merits special attention. More specifically, we show that an increase in the share of differentiated goods or in the share of skilled labor-intensive goods or high-tech-intensive goods, a greater degree of IIT are all associated with greater growth effects. Our results also suggest that the extent and manner in which countries participate in GVCs also affect the trade and growth linkages—being part of GVCs, especially in its middle segments, is associated with higher per capita income growth rates. Regarding the composition of trading partners, we show that an increase in the share of trade with countries at the core of the global trade network (as opposed to more peripheral ones) is associated with improved economic growth. That is, the more central to the global trade network a trading partner is, the greater the impact on income growth is, even after controlling for the growth differential observed across countries in the periphery versus those in the core of the network and their degree of participation in GVCs. Overall, these results assessing the relation between the nature of trade relations and economic growth hold in addition to those associated with the overall volume of trade flows. In fact, these effects are, in most cases, reinforced when interacted with the overall level of trade openness and the level of human capital.

All the different features of trade relations considered in this paper are suggestive that trade affects income growth through technological diffusion and learning spillovers that can arise from integration into global markets. For instance, a high level of IIT within broadly defined industries indicates that the adoption, adaptation, and mastery of foreign technologies available through imported goods may be easier to the extent that they are directly applicable to a countries' export basket. High IIT thus arguably increases the probability that knowledge and technology gained from imports can be applied to exports. The channel of technology diffusion and knowledge spillovers may also be important in regards to the composition of trading partners. Independent of their level of economic development or technological sophistication, the more central countries in the global trade network are more closely connected to a wider range of countries, hence, are arguably more exposed to the technology and knowledge frontiers. To the extent that firms get new production-related ideas and technology by learning from firms with which they do business (or compete), the establishment of strong ties with countries more exposed to the frontiers of ideas and technologies may lead to stronger growth effects.

While some of our findings are supported by well-known theoretical frameworks, others, especially those related to participation in GVCs and the partners' position in the global trade network, are new and would greatly benefit from insights from a theoretical framework, especially if one would like to draw policy implications from the analysis presented in this paper. That is, identifying the optimal conditions under which trade generates growth would allow countries to better design their policies and shape incentives to avoid many of the downsides associated with greater integration into world markets.

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## Appendix A. Random Walk Betweenness Centrality

Network centrality measures capture the importance of a node within a network. In the context of this paper, nodes are countries, edges, which connect countries in the network, reflect the value of bilateral trade flows, and paths are sequences of nodes and edges connecting countries. The simplest centrality measure in a network is the degree of the node, i.e. the number of other countries to which one is connected to. This measure is not useful in our context as almost all the countries are connected to one another in global trade. Such an un-weighted measure of centrality would yield little dispersion in centrality values across countries. In contrast, a measure based on a weighted average of those trade connections would lead to a ranking in which the largest traders appear as most central.

Betweenness centrality measures captures the extent to which a node lies on paths between two other nodes. Nodes with high betweenness-centrality measure have a substantial influence in the network as they "control" the flow passing through them. Betweenness centrality is typically measured as the ratio of shortest paths between nodes pairs that pass through the node of interest. Mathematically, betweenness centrality for country *i* is defined as:

$$x_i = \sum_{jk} \frac{n_{jk}^i}{g_{jk}},$$

where $n_{jk}^i$ is equal to 1 if country *i* lies on the path from country *j* to *k*, and zero otherwise; $g_{jk}$ is the total number of alternative paths from *j* to *k* . In the case of the global trade network, as many countries are directly connected, the shortest path would almost always be the direct connection between *j* and *k,* with no stop by *i*. Once more, all the countries in this case would have a similar value of betweenness centrality, with little dispersion across countries.

There is a different measure of betweenness that takes into account all possible paths and their weight—the random-walk betweenneess centrality developed by Newman (2005) and Fisher and Vega-Redondo (2006). In this variant, which we adopt in this paper, all the paths from country *j* to county *k* are taken into account—not only the shortest one. However, paths have different probabilities—typically, shorter paths and paths with a high intensity of trade have a greater contribution to the betweenness score of country *i*. Formally,

$$x_i^{RWBC} = \sum_{jk} r_{jk}^i,$$

where $r_{jk}^i$ is a combination of the number of times that the random walk from *j* to *k* passes through *i* and the weight of each path, averaged over many repetitions of the random walk.

Appendix Figure 2 shows the application of this classification to the global trade network; it reports the value of the centrality measure for the largest developed and developing countries. As discussed above, we consider two alternative definitions of countries in the center of the global trade network: (a) countries (top 1 or top-3) with the largest centrality measure; (b) core (those at the $95^{th}$ percentile or higher of the ranking) and inner-periphery countries (those in the $70\text{-}94^{th}$ percentiles). In 1960, the core countries comprised the Canada, Germany, Japan, USA, and the United Kingdom. In 2010, the core included the China, France, Germany, Italy, Japan, Netherlands, the Republic of Korea, the United States, and the United Kingdom.

**Table 1. Benchmark Regressions**

| | Two-Step S-GMM | One-Step S-GMM | Two-Step S-GMM: Windmeijer Correction | Two-Step S-GMM: Collapse | Pooled OLS | Fixed Effects |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Trade Openness | 1.571*** | 1.904*** | 1.571** | 1.045 | 0.423*** | 1.664*** |
| | (0.234) | (0.439) | (0.683) | (1.034) | (0.162) | (0.505) |
| Initial GDP per Capita | -2.318*** | -2.397*** | -2.318*** | -2.125*** | -1.482*** | -5.831*** |
| | (0.174) | (0.312) | (0.470) | (0.680) | (0.233) | (0.520) |
| Labor Force Education | -0.035 | -0.072 | -0.035 | -1.128 | 0.421** | -0.985* |
| | (0.204) | (0.448) | (0.634) | (1.001) | (0.195) | (0.521) |
| Terms of Trade | -0.941*** | -1.259*** | -0.941 | -0.604 | -0.602** | -0.548 |
| | (0.164) | (0.342) | (0.576) | (0.508) | (0.237) | (0.332) |
| Public Infrastructure | 2.036*** | 2.043*** | 2.036*** | 2.533*** | 1.002*** | 1.172*** |
| | (0.151) | (0.267) | (0.400) | (0.584) | (0.163) | (0.268) |
| Time Dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of Observations | 846 | 846 | 846 | 846 | 846 | 846 |
| No. of Countries | 117 | 117 | 117 | 117 | 117 | 117 |
| No. of Instruments | 88 | 88 | 88 | 18 | . | . |
| No. of lags in Diff. Eq. | 1 | 1 | 1 | 1 | . | . |
| *Specification Tests (p-values):* | | | | | | |
| Full Hansen Test | 0.19 | . | 0.19 | 0.00 | . | . |
| Incremental Hansen Test | 0.44 | 0.00 | 0.44 | 0.00 | . | . |
| 2nd. Order Serial Correlation Test | 0.11 | 0.186 | 0.11 | 0.11 | . | . |

This table reports the estimation results of the benchmark specification of GDP per capita growth on trade openness, initial GDP per capita, labor force education, terms of trade, and public infrastructure. Time dummies are included in all regressions. Robust standard errors are shown in parentheses. *, **, and *** denote statistical significance at 10, 5, and 1 percent, respectively.

**Table 2. Trade in Homogeneous Goods in Trade**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Share of Trade in Homogeneous Goods | -8.294*** | -19.082*** | -15.066** | -0.692 | 0.350 |
| | (0.870) | (5.179) | (6.621) | (3.130) | (3.265) |
| Trade Openness * S. T. in Homogeneous Goods | | 2.757** | 0.163 | | |
| | | (1.329) | (2.746) | | |
| (Trade Openness * S. T. in Homogeneous Goods)$^2$ | | | 0.479 | | |
| | | | (0.407) | | |
| Lab. For. Ed. * S. T. in Homogeneous Goods | | | | -2.266*** | -3.589*** |
| | | | | (0.833) | (1.261) |
| (Lab. For. Ed. * S. T. in Homogeneous Goods)$^2$ | | | | | 0.374 |
| | | | | | (0.240) |
| Trade Openness | 0.967*** | -0.208 | 0.141 | 0.900*** | 0.930*** |
| | (0.144) | (0.551) | (0.654) | (0.146) | (0.156) |
| Initial GDP per Capita | -2.247*** | -2.146*** | -2.199*** | -2.446*** | -2.520*** |
| | (0.123) | (0.135) | (0.140) | (0.150) | (0.155) |
| Labor Force Education | -0.233 | -0.221 | -0.233 | 0.888** | 1.149** |
| | (0.175) | (0.175) | (0.176) | (0.424) | (0.460) |
| Terms of Trade | -1.052*** | -0.979*** | -0.999*** | -1.003*** | -1.021*** |
| | (0.130) | (0.138) | (0.143) | (0.130) | (0.132) |
| Public Infrastructure | 2.055*** | 1.999*** | 2.031*** | 2.135*** | 2.147*** |
| | (0.115) | (0.119) | (0.120) | (0.132) | (0.134) |
| Time Dummies | Yes | Yes | Yes | Yes | Yes |
| No. of Observations | 806 | 806 | 806 | 806 | 806 |
| No. of Countries | 117 | 117 | 117 | 117 | 117 |
| *Specification Tests (p-values):* | | | | | |
| Full Hansen Test | 0.16 | 0.18 | 0.17 | 0.03 | 0.14 |
| Incremental Hansen Test | 0.79 | 0.84 | 0.86 | 0.71 | 0.71 |
| 2nd. Order Serial Correlation Test | 0.14 | 0.13 | 0.12 | 0.22 | 0.15 |

This table reports the regressions of GDP per capita growth on the share of homogeneous goods traded, trade openness, initial GDP per capita, labor force education, terms of trade, and public infrastructure. One lag is included in the difference equation and the total number of instruments in each regression is 104. Time dummies are included in all regressions. Robust standard errors are shown in parentheses. *, **, and *** denote statistical significance at 10, 5, and 1 percent, respectively.

**Table 3. The Factor-Intensity of Trade Baskets**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Share of Trade in: | | | | | |
| Primary Products | 5.572*** | 11.752** | 50.236*** | 8.774*** | 17.264*** |
| | (0.784) | (5.561) | (10.282) | (2.444) | (3.489) |
| Unskilled Labor-intensive Goods | 12.756*** | 9.562 | 28.704** | 11.425*** | 9.911* |
| | (0.807) | (6.545) | (11.883) | (3.979) | (5.439) |
| High-tech-intensive Goods | 11.726*** | 42.943*** | 7.454 | 39.410*** | 25.979*** |
| | (0.626) | (8.678) | (12.870) | (4.118) | (6.623) |
| Skilled Labor-intensive Goods | 26.141*** | 39.236*** | 73.768*** | -2.923 | -15.291* |
| | (1.076) | (7.634) | (15.077) | (5.908) | (8.829) |
| Trade Openness * S. T. Primary Products | | -1.725 | -17.112*** | | |
| | | (1.469) | (3.223) | | |
| Trade Openness * S. T. Unskilled Labor G. | | 0.205 | -4.307 | | |
| | | (1.663) | (3.270) | | |
| Trade Openness * S. T. High-Tech G. | | -7.213*** | 7.335* | | |
| | | (2.098) | (3.790) | | |
| Trade Openness * S. T. Skilled Labor G. | | -4.470** | -10.789* | | |
| | | (1.953) | (5.955) | | |
| (Trade Openness * S. T. Primary Products)$^2$ | | | 1.915*** | | |
| | | | (0.394) | | |
| (Trade Openness * S. T. Unskilled Labor G.)$^2$ | | | -0.315 | | |
| | | | (0.466) | | |
| (Trade Openness * S. T. High-Tech G.)$^2$ | | | -3.063*** | | |
| | | | (0.425) | | |
| (Trade Openness * S. T. Skilled Labor G.)$^2$ | | | -2.684 | | |
| | | | (1.846) | | |
| Lab. For. Ed. * S. T. Primary Products | | | | -1.332 | -9.518*** |
| | | | | (1.134) | (1.866) |
| Lab. For. Ed. * S. T. Unskilled Labor G. | | | | 0.159 | 0.249 |
| | | | | (1.440) | (2.290) |
| Lab. For. Ed. * S. T. High-Tech G. | | | | -7.567*** | 0.093 |
| | | | | (1.387) | (2.851) |
| Lab. For. Ed. * S. T. Skilled Labor G. | | | | 8.000*** | 20.152*** |
| | | | | (1.835) | (4.714) |
| (Lab. For. Ed. * S. T. Primary Products)$^2$ | | | | | 2.283*** |
| | | | | | (0.475) |
| (Lab. For. Ed. * S. T. Unskilled Labor G.)$^2$ | | | | | -0.121 |
| | | | | | (0.857) |
| (Lab. For. Ed. * S. T. High-Tech G.)$^2$ | | | | | -2.029*** |
| | | | | | (0.503) |
| (Lab. For. Ed. * S. T. Skilled Labor G.)$^2$ | | | | | -7.684*** |
| | | | | | (1.853) |
| Trade Openness | 0.515*** | 3.379*** | 7.074*** | 0.882*** | 0.753*** |
| | (0.133) | (1.232) | (1.854) | (0.148) | (0.164) |
| Initial GDP per Capita | -0.422*** | -0.421*** | -0.345*** | -0.180* | -0.375** |
| | (0.081) | (0.078) | (0.110) | (0.099) | (0.146) |
| Labor Force Education | 0.898*** | 0.857*** | 0.808*** | 1.164 | 0.957 |
| | (0.048) | (0.055) | (0.075) | (0.881) | (0.958) |
| Time Dummies | Yes | Yes | Yes | Yes | Yes |
| No. of Observations | 806 | 806 | 806 | 806 | 806 |
| No. of Countries | 117 | 117 | 117 | 117 | 117 |
| *Specification Tests (p-values):* | | | | | |
| Full Hansen Test | 0.36 | 0.43 | 0.34 | 0.30 | 0.24 |
| Incremental Hansen Test | 0.72 | 0.88 | 0.85 | 0.53 | 0.55 |
| 2nd. Order Serial Correlation Test | 0.30 | 0.25 | 0.20 | 0.26 | 0.28 |
| *Wald Tests (p-value):* | | | | | |
| H0: Skilled Labor = Unskilled Labor | 0.00 | . | . | . | . |

This table reports the regressions of GDP per capita growth on the share of goods traded with different factor intensities, trade openness, initial GDP per capita, and labor force education. One lag is included in the difference equation and the total number of instruments in each regression is 120. Time dummies are included in all regressions. Robust standard errors are shown in parentheses. *, **, and *** denote statistical significance at 10, 5, and 1 percent, respectively.

## Table 4. The Degree of Intra-Industry Trade

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Intra-Industry Trade (IIT) | 7.841*** | 9.718*** | -1.548 | 14.347*** | -0.951 |
| | (0.707) | (2.650) | (4.871) | (3.051) | (3.686) |
| Trade Openness * IIT | | -0.467 | 4.390** | | |
| | | (0.637) | (1.771) | | |
| $(\text{Trade Openness * IIT})^2$ | | | -0.939*** | | |
| | | | (0.279) | | |
| Lab. For. Ed. * IIT | | | | -1.731** | 5.954*** |
| | | | | (0.815) | (1.660) |
| $(\text{Lab. For. Ed. * IIT})^2$ | | | | | -1.577*** |
| | | | | | (0.355) |
| Trade Openness | 1.390*** | 1.540*** | 1.023*** | 1.543*** | 1.463*** |
| | (0.129) | (0.245) | (0.355) | (0.141) | (0.153) |
| Initial GDP per Capita | -2.620*** | -2.595*** | -2.221*** | -2.389*** | -1.968*** |
| | (0.139) | (0.142) | (0.189) | (0.173) | (0.205) |
| Labor Force Education | 0.077 | 0.094 | 0.130 | 0.300* | -0.422** |
| | (0.128) | (0.130) | (0.126) | (0.165) | (0.195) |
| Terms of Trade | -0.937*** | -0.900*** | -1.015*** | -0.994*** | -1.026*** |
| | (0.154) | (0.163) | (0.167) | (0.147) | (0.159) |
| Public Infrastructure | 1.701*** | 1.665*** | 1.451*** | 1.562*** | 1.216*** |
| | (0.097) | (0.110) | (0.139) | (0.114) | (0.159) |
| Time Dummies | Yes | Yes | Yes | Yes | Yes |
| No. of Observations | 806 | 806 | 806 | 806 | 806 |
| No. of Countries | 117 | 117 | 117 | 117 | 117 |
| *Specification Tests (p-values):* | | | | | |
| Full Hansen Test | 0.28 | 0.27 | 0.26 | 0.28 | 0.20 |
| Incremental Hansen Test | 0.52 | 0.53 | 0.44 | 0.49 | 0.31 |
| 2nd. Order Serial Correlation Test | 0.23 | 0.23 | 0.23 | 0.24 | 0.26 |

This table reports the regressions of GDP per capita growth on the degree of intra-industry trade, trade openness, initial GDP per capita, labor force education, terms of trade, and public infrastructure. One lag is included in the difference equation and the total number of instruments in each regression is 104. Time dummies are included in all regressions. Robust standard errors are shown in parentheses. *, **, and *** denote statistical significance at 10, 5, and 1 percent, respectively.

## Table 5. Participation in GVCs

| | Definition 1 of GVC Participation | | | | | Definition 2 of GVC Participation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Participation in GVCs in: | | | | | | | | | | |
| Middle Segments | 1.301** | -53.441*** | -62.312*** | 1.656 | 4.839 | 4.325*** | -17.074** | -28.259*** | 28.243*** | 39.385*** |
| | (0.585) | (7.360) | (9.320) | (3.234) | (4.077) | (0.769) | (7.902) | (9.974) | (3.406) | (5.244) |
| Initial Segments | -5.440*** | -41.944*** | -37.813*** | -0.144 | -7.401** | -2.723*** | -19.467*** | -10.942 | 21.889*** | 8.262*** |
| | (0.514) | (5.851) | (6.104) | (2.783) | (3.061) | (0.657) | (7.165) | (6.864) | (2.850) | (2.792) |
| Trade Openness * Part. Middle Seg. | | 13.597*** | 22.292*** | | | | 5.270*** | 18.112*** | | |
| | | (1.778) | (3.376) | | | | (1.936) | (3.986) | | |
| Trade Openness * Part. Initial Seg. | | 9.043*** | 8.310*** | | | | 4.068** | 2.007 | | |
| | | (1.447) | (2.030) | | | | (1.726) | (2.172) | | |
| (Trade Openness * Part. Middle Seg.)$^2$ | | | -1.964*** | | | | | -2.956*** | | |
| | | | (0.395) | | | | | (0.561) | | |
| (Trade Openness * Part. Initial Seg.)$^2$ | | | 0.004 | | | | | 0.109 | | |
| | | | (0.417) | | | | | (0.440) | | |
| Lab. For. Ed. * Part. Middle Seg. | | | | 0.407 | -6.205*** | | | | -7.313*** | -18.631*** |
| | | | | (1.063) | (1.599) | | | | (1.271) | (2.410) |
| Lab. For. Ed. * Part. Initial Seg. | | | | -1.592* | 3.016** | | | | -7.581*** | 2.962** |
| | | | | (0.849) | (1.288) | | | | (0.975) | (1.194) |
| (Lab. For. Ed. * Part. Middle Seg.)$^2$ | | | | | 1.974*** | | | | | 2.369*** |
| | | | | | (0.342) | | | | | (0.363) |
| (Lab. For. Ed. * Part. Initial Seg.)$^2$ | | | | | -1.298*** | | | | | -3.244*** |
| | | | | | (0.361) | | | | | (0.388) |
| Trade Openness | 1.133*** | -6.226*** | -6.559*** | 1.076*** | 1.015*** | 1.033*** | -2.439** | -3.036** | 0.990*** | 1.315*** |
| | (0.237) | (1.784) | (1.922) | (0.239) | (0.278) | (0.111) | (1.231) | (1.395) | (0.130) | (0.160) |
| Initial GDP per Capita | 0.152 | 0.201 | 0.003 | 0.017 | -0.272 | -0.086 | -0.107 | -0.357*** | -0.475*** | -0.838*** |
| | (0.127) | (0.129) | (0.128) | (0.165) | (0.192) | (0.083) | (0.094) | (0.079) | (0.111) | (0.113) |
| Labor Force Education | 1.133*** | 0.984*** | 1.229*** | 3.352*** | 3.973*** | 1.121*** | 1.132*** | 1.353*** | 6.856*** | 8.264*** |
| | (0.158) | (0.168) | (0.194) | (1.034) | (1.092) | (0.120) | (0.128) | (0.116) | (0.878) | (1.028) |
| Time Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of Observations | 806 | 806 | 806 | 806 | 806 | 806 | 806 | 806 | 806 | 806 |
| No. of Countries | 117 | 117 | 117 | 117 | 117 | 117 | 117 | 117 | 117 | 117 |
| *Specification Tests (p-values):* | | | | | | | | | | |
| Full Hansen Test | 0.167 | 0.220 | 0.308 | 0.119 | 0.111 | 0.167 | 0.154 | 0.184 | 0.128 | 0.281 |
| Incremental Hansen Test | 0.54 | 0.41 | 0.57 | 0.48 | 0.45 | 0.32 | 0.26 | 0.47 | 0.24 | 0.57 |
| 2nd. Order Serial Correlation Test | 0.209 | 0.223 | 0.266 | 0.211 | 0.192 | 0.194 | 0.204 | 0.257 | 0.207 | 0.177 |

This table reports the regressions of GDP per capita growth on participation in the different segments of GVCs, trade openness, initial GDP per capita, and labor force education. Participation in the different segments of GVCs is measured by the share of exported goods used at the beginning of GVCs (e.g. exports of primary products), in the middle of GVCs (e.g. exports of intermediate goods), and at the end of GVCs (e.g. exports of final goods). We report the results based on two definitions of these shares. In definition 1, we split evenly the 426 industries into five groups. The first group corresponds to goods used at the beginning of GVCs, the three following groups correspond to goods used in the middle segments of GVCs, and the last group corresponds to goods at the end of GVCs. In definition 2, we evenly split industries in three groups, each one corresponding to one of these segments of GVCs. We omit from the regressions the category capturing goods at the final segments final of GVCs. Two lags are included in the difference equation and the total number of instruments in each regression is 109. Time dummies are included in all regressions. Robust standard errors are shown in parentheses. *, **, and *** denote statistical significance at 10, 5, and 1 percent, respectively.

**Table 6. Trading with Countries at the Center of the Global Trade Network**

| | Top-1 Country | | | | | Top-3 Countries | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Share of Trade with: | | | | | | | | | | |
| Main Trading Partners | -8.352*** | 86.100*** | 76.604*** | 4.934** | 4.347 | -6.946*** | 74.755*** | 67.090*** | 7.046** | 5.812 |
| | (0.765) | (9.577) | (12.762) | (2.146) | (3.096) | (0.738) | (9.513) | (9.674) | (3.565) | (4.101) |
| Most Central Countries in the Global Trade Network | 1.842** | -66.132*** | -66.132*** | -1.021 | -12.480*** | 4.371*** | -18.119*** | -24.152*** | -4.041** | -14.812*** |
| | (0.778) | (7.878) | (9.093) | (1.966) | (2.323) | (0.568) | (6.010) | (7.891) | (1.940) | (3.956) |
| Trade Openness * S. T. Main Trad. Partners | | -23.722*** | -23.096*** | | | | -20.792*** | -21.703*** | | |
| | | (2.358) | (4.075) | | | | (2.411) | (3.124) | | |
| Trade Openness * S. T. Most Central Countries | | 17.053*** | 20.954*** | | | | 5.662*** | 15.369*** | | |
| | | (1.911) | (2.650) | | | | (1.513) | (2.250) | | |
| (Trade Openness * S. T. Main Trad. Partners)$^2$ | | | 1.046 | | | | | 1.089* | | |
| | | | (0.705) | | | | | (0.659) | | |
| (Trade Openness * S. T. Most Central Countries)$^2$ | | | -2.165*** | | | | | -3.545*** | | |
| | | | (0.598) | | | | | (0.444) | | |
| Lab. For. Ed. * S. T. Main Trad. Partners | | | | -5.559*** | -15.184*** | | | | -5.170*** | -11.662*** |
| | | | | (0.749) | (1.876) | | | | (1.155) | (2.068) |
| Lab. For. Ed. * S. T. Most Central Countries | | | | 1.819*** | 14.952*** | | | | 3.393*** | 14.026*** |
| | | | | (0.616) | (1.347) | | | | (0.624) | (2.457) |
| (Lab. For. Ed. * S. T. Main Trad. Partners)$^2$ | | | | | 6.341*** | | | | | 2.609*** |
| | | | | | (0.896) | | | | | (0.500) |
| (Lab. For. Ed. * S. T. Most Central Countries)$^2$ | | | | | -6.824*** | | | | | -3.693*** |
| | | | | | (0.746) | | | | | (0.651) |
| Trade Openness | 1.737*** | 3.767*** | 3.359*** | 1.925*** | 2.170*** | 1.656*** | 7.652*** | 6.471*** | 1.627*** | 1.648*** |
| | (0.124) | (0.259) | (0.424) | (0.142) | (0.157) | (0.126) | (0.810) | (0.937) | (0.138) | (0.128) |
| Initial GDP per Capita | -0.038 | -0.049 | -0.183** | -0.373*** | -0.489*** | -0.276*** | -0.235*** | -0.345*** | -0.612*** | -0.694*** |
| | (0.083) | (0.078) | (0.092) | (0.092) | (0.102) | (0.080) | (0.074) | (0.082) | (0.105) | (0.147) |
| Labor Force Education | 1.213*** | 1.180*** | 1.345*** | 2.583*** | 2.202*** | 1.418*** | 1.156*** | 1.250*** | 3.045*** | 2.416*** |
| | (0.117) | (0.113) | (0.139) | (0.232) | (0.276) | (0.126) | (0.120) | (0.133) | (0.488) | (0.575) |
| Time Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of Observations | 809 | 809 | 809 | 809 | 809 | 809 | 809 | 809 | 809 | 809 |
| No. of Countries | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 114 | 114 |
| *Specification Tests (p-values):* | | | | | | | | | | |
| Full Hansen Test | 0.30 | 0.24 | 0.26 | 0.26 | 0.31 | 0.25 | 0.24 | 0.22 | 0.24 | 0.22 |
| Incremental Hansen Test | 0.69 | 0.95 | 0.92 | 0.85 | 0.78 | 0.88 | 0.70 | 0.54 | 0.83 | 0.76 |
| 2nd. Order Serial Correlation Test | 0.28 | 0.41 | 0.36 | 0.30 | 0.36 | 0.25 | 0.32 | 0.21 | 0.31 | 0.25 |

This table reports the regressions of GDP per capita growth on the share of trade with main trading partners and with the most central countries in the global trade network, trade openness, initial GDP per capita, and labor force education. See the data section in the main text for details on how countries are classified as central in the global trade network. Two lags are included in the difference equation and the total number of instruments in each regression is 109. Time dummies are included in all regressions. Robust standard errors are shown in parentheses. *, **, and *** denote statistical significance at 10, 5, and 1 percent, respectively.

**Table 7. Trading with Countries at the Core of the Global Trade Network**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Share of trade with: | | | | | |
| Core Countries | 13.819*** | 0.929 | -0.324 | -28.377*** | 3.556 |
| | (1.199) | (12.031) | (15.914) | (4.636) | (6.490) |
| Inner-periphery Countries | 15.678*** | 11.667 | -68.633*** | -20.807*** | -20.657*** |
| | (1.263) | (12.557) | (19.066) | (4.369) | (5.794) |
| Trade Openness * S. T. Core Countries | | 3.302 | -11.490*** | | |
| | | (2.871) | (3.980) | | |
| Trade Openness * S. T. Inner-periphery Countries | | 0.946 | 29.943*** | | |
| | | (3.036) | (5.378) | | |
| (Trade Openness * S. T. Core Countries)$^2$ | | | 4.197*** | | |
| | | | (0.641) | | |
| (Trade Openness * S. T. Inner-periphery Countries)$^2$ | | | -3.986*** | | |
| | | | (0.464) | | |
| Lab. For. Ed. * S. T. Core Countries | | | | 14.451*** | -4.192 |
| | | | | (1.317) | (2.770) |
| Lab. For. Ed. * S. T. Inner-periphery Countries | | | | 12.386*** | 19.482*** |
| | | | | (1.408) | (2.004) |
| (Lab. For. Ed. * S. T. Core Countries)$^2$ | | | | | 2.804*** |
| | | | | | (0.450) |
| (Lab. For. Ed. * S. T. Inner-periphery Countries)$^2$ | | | | | -4.441*** |
| | | | | | (0.472) |
| Trade Openness | 2.088*** | 0.412 | -4.764 | 1.862*** | 2.226*** |
| | (0.149) | (2.093) | (2.908) | (0.174) | (0.197) |
| Initial GDP per Capita | -0.873*** | -0.909*** | -0.667*** | -1.199*** | -1.546*** |
| | (0.070) | (0.094) | (0.098) | (0.090) | (0.155) |
| Labor Force Education | 1.887*** | 1.950*** | 1.627*** | -7.591*** | -1.509 |
| | (0.124) | (0.145) | (0.160) | (0.955) | (1.250) |
| Time Dummies | Yes | Yes | Yes | Yes | Yes |
| No. of Observations | 809 | 809 | 809 | 809 | 809 |
| No. of Countries | 114 | 114 | 114 | 114 | 114 |
| *Specification Tests (p-values):* | | | | | |
| Full Hansen Test | 0.16 | 0.14 | 0.13 | 0.19 | 0.23 |
| Incremental Hansen Test | 0.59 | 0.60 | 0.48 | 0.68 | 0.53 |
| 2nd. Order Serial Correlation Test | 0.20 | 0.21 | 0.16 | 0.18 | 0.15 |
| *Wald Tests (p-value):* | | | | | |
| H0: Core = Inner Periphery | 0.00 | . | . | . | . |

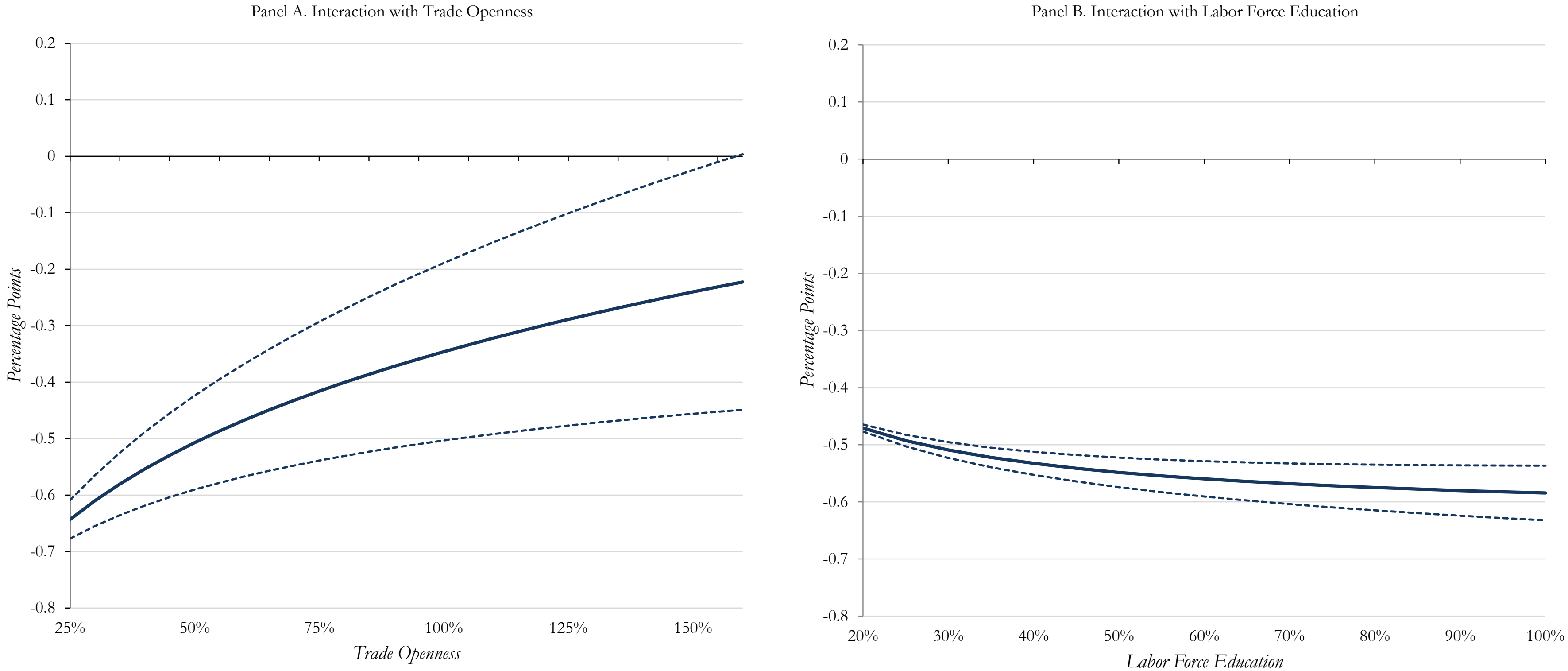
This table reports the regressions of GDP per capita growth on the share of trade with core and inner periphery countries in the global trade network, trade openness, initial GDP per capita, and labor force education. Core countries are defined as those ranked in the 95th percentile or higher in terms of centrality in the global trade network; inner-periphery countries are those ranked within the 70th and 94th percentiles; all other countries are considered periphery countries. The share of trade with periphery countries is excluded from the regressions. Two lags are included in the difference equation and the total number of instruments in the regressions in column 1 is 109 and in columns 2-5 is 120. Time dummies are included in all regressions. Robust standard errors are shown in parentheses. *, **, and *** denote statistical significance at 10, 5, and 1 percent, respectively.

**Table 8. Trading with Core vs. Peripheral Countries**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Initial GDP per Capita | -0.634*** | -0.961*** | -0.839*** | -0.893*** |
| | -0.073 | (0.093) | (0.070) | (0.082) |
| Labor Force Education | 1.687*** | 1.729*** | 1.623*** | 1.617*** |
| | (0.102) | (0.125) | (0.110) | (0.126) |
| Trade Openness | 1.804*** | 1.257*** | 1.522*** | 1.501*** |
| | (0.155) | (0.165) | (0.148) | (0.137) |
| Share of Trade with: | | | | |
| Core Countries | 8.887*** | 8.836*** | 10.269*** | 9.209*** |
| | (1.526) | (1.434) | (1.987) | (2.181) |
| Inner-periphery Countries | 6.816*** | 5.625*** | 10.252*** | 8.691*** |
| | (1.565) | (1.583) | (1.833) | (2.218) |
| Growth of Core Countries | 0.273*** | | | |
| *(trade-weighted average)* | (0.035) | | | |
| Growth of Inner-periphery Countries | 0.881*** | | | |
| *(trade-weighted average)* | (0.028) | | | |
| Participation in GVCs | | 8.595*** | 6.637*** | 6.330*** |
| *(as a share of total trade)* | | (0.830) | (0.948) | (0.880) |
| Participation in GVCs: | | | | |
| Share of Intermediate Goods Traded with Core Countries | | | -1.166*** | |
| *(as a share of GVC participation with core countries)* | | | (0.236) | |
| Share of Intermediate Goods Traded with Inner-Periphery Countries | | | 1.937*** | |
| *(as a share of GVC participation with inner-periphery countries)* | | | (0.354) | |
| Share of Final Goods Traded with Core Countries | | | | 1.775*** |
| *(as a share of GVC participation with core countries)* | | | | (0.306) |
| Share of Final Goods Traded with Inner-Periphery Countries | | | | -0.470** |
| *(as a share of GVC participation with inner-periphery countries)* | | | | (0.229) |
| Time Dummies | Yes | Yes | Yes | Yes |
| No. of Observations | 809 | 744 | 744 | 744 |
| No. of Countries | 114 | 113 | 113 | 113 |
| *Specification Tests (p-values):* | | | | |
| Full Hansen Test | 0.40 | 0.19 | 0.80 | 0.82 |
| Incremental Hansen Test | 0.94 | 0.91 | 0.88 | 0.89 |
| 2nd. Order Serial Correlation Test | 0.77 | 0.27 | 0.25 | 0.31 |

This table reports the regressions of GDP per capita growth on the share of trade with core and inner periphery countries in the global trade network, trade openness, initial GDP per capita, and labor force education. Core countries are defined as those ranked in the 95th percentile or higher in terms of centrality in the global trade network; inner periphery countries are those ranked within the 70th and 94th percentiles; all other countries are considered periphery countries. The share of trade with periphery countries is excluded from the regressions. Two lags are included in the difference equation. Time dummies are included in all regressions. Robust standard errors are shown in parentheses. *, **, and *** denote statistical significance at 10, 5, and 1 percent, respectively.

**Figure 1. Total Growth Effects of Increasing the Share of Homogenous Goods in Trade by 10 p.p.**

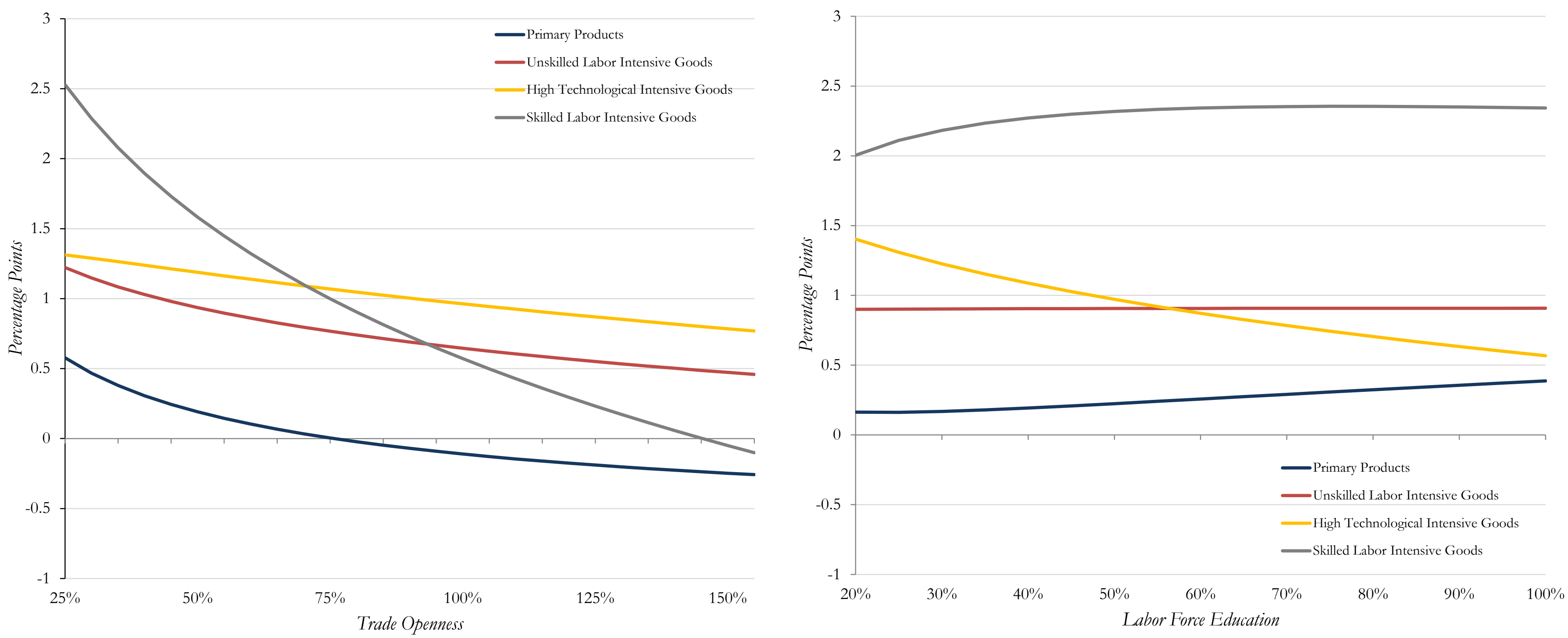



This figure shows the total growth effects associated with an increase in the share of homogeneous goods traded by 10 percentage points from the sample mean. The estimates are based on the regressions in columns 3 (Panel A) and 5 (Panel B) of Table 2. The total growth effects shown in Panel A are given by growth=($\beta_{sh.Homog}$+$\beta_{interacted}$*TO+2*$\beta_{interacted2}$*$TO^2$*sh.homog)*$\Delta_{sh.homog}$. $\beta_{sh.Homog}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of homogenous goods in trade, the interaction between the share of homogenous goods in trade with trade openness, and the interaction between the share of homogenous goods in trade with trade openness squared. $\Delta_{sh.homog}$ is a constant equal to 10 percentage points of the sample mean of share of trade and trade openness takes different possible values starting at 25 % (the lowest value of TO in our sample) to 160% (the highest value of TO in our sample). Analogously, the total growth effects shown in Panel B are given by Growth=($\beta_{sh.Homog}$+$\beta_{interacted}$*LaborForceEduc. +2*$\beta_{interacted2}$*LaborForceEduc.$^2$*sh.homog) *$\Delta_{sh.homog}$. $\beta_{sh.Homog}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of homogenous goods in trade, the interaction between the share of homogenous goods in trade with labor force education, and the interaction between the share of homogenous goods in trade with labor force education squared. $\Delta_{sh.homog}$ is a constant equal to 10 percentage points of the sample mean of share of trade and labor force education takes different possible values between 20% (the lowest value of Labor Force Education in our sample) and 100 percent. Dotted lines are confidence bands.

**Figure 2. Total Growth Effects of Increasing the Shares of Traded Goods of Different Factor Intensities by 10 p.p.**

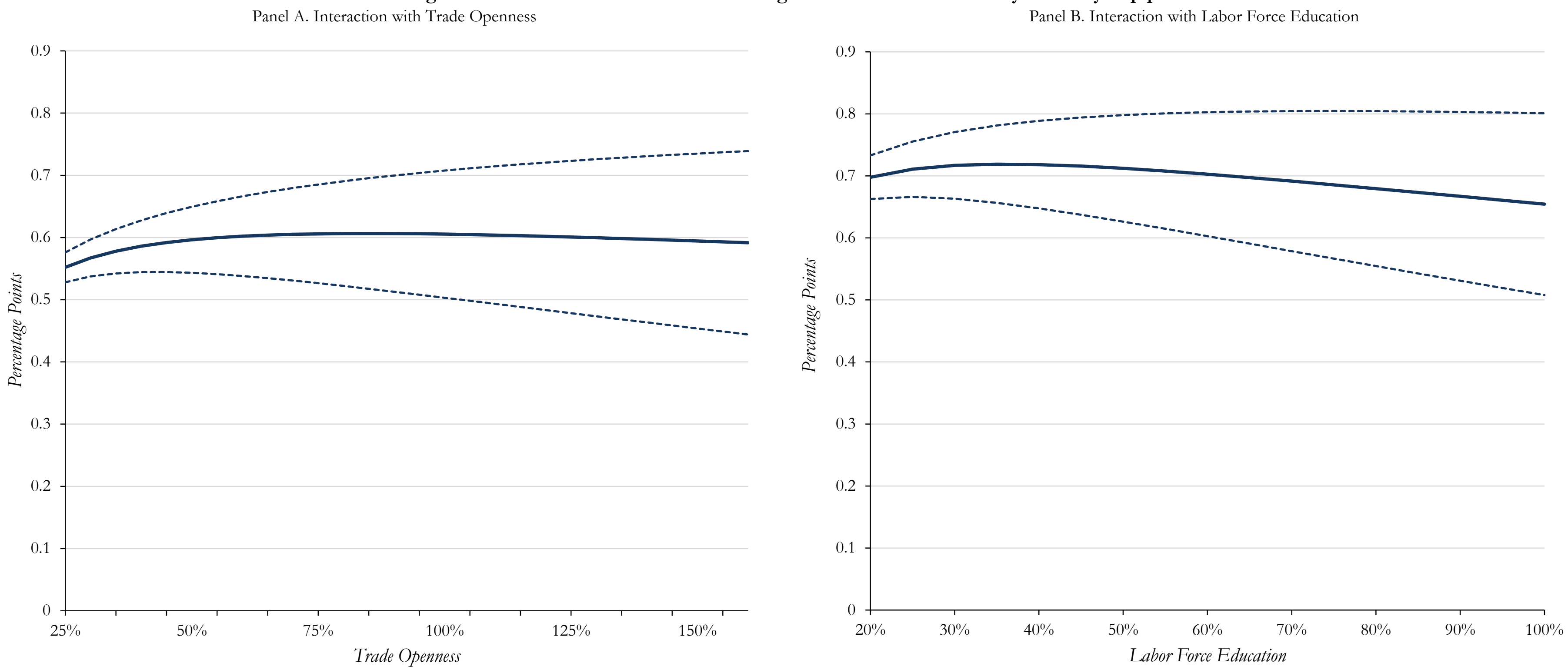
Panel A. Interaction with Trade Openness

Panel B. Interaction with Labor Force Education




This figure shows the total growth effects associated with an increase in the share of traded goods with different factor intensities by 10 percentage points from the sample mean. The estimates are based on the regressions in columns 3 (Panel A) and 5 (Panel B) of Table 3. The total growth effects shown in Panel A are given by Growth=$(\beta_{FI}+\beta_{interacted}*TO+2*\beta_{interacted2}*TO^2*FI)*\Delta_{FI}$. $\beta_{FI}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade in the different categories of factor intensity , the interaction between the share of trade in the different categories of factor intensity with trade openness, and the interaction between the share of trade in the different categories of factor intensity with trade openness squared. $\Delta_{FI}$ is a constant equal to 10 percentage points of the sample mean of share of trade in the different categories of factor intensity and trade openness takes different possible values starting at 25 % (the lowest value of TO in our sample) to 160% (the highest value of TO in our sample). Analogously, the total growth effects shown in Panel B are given by Growth=$(\beta_{FI}+\beta_{interacted}*LaborForceEduc.+2*\beta_{interacted2}*LaborForceEduc.^2*FI)*\Delta_{FI}$. $\beta_{FI}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade in the different categories of factor intensity, the interaction between the share of trade in the different categories of factor intensity with labor force education, and the interaction between the share of trade in the different categories of factor intensity with labor force education squared. $\Delta_{FI}$ is a constant equal to 10 percentage points of the sample mean of share of trade in the different categories of factor intensity and labor force education takes different possible values between 20% (the lowest value of Labor Force Education in our sample) and 100 percent. Confidence intervals are presented in Appendix Figure 1.

**Figure 3. Total Growth Effects of Increasing the Share of Intra-Industry Trade by 10 p.p.**

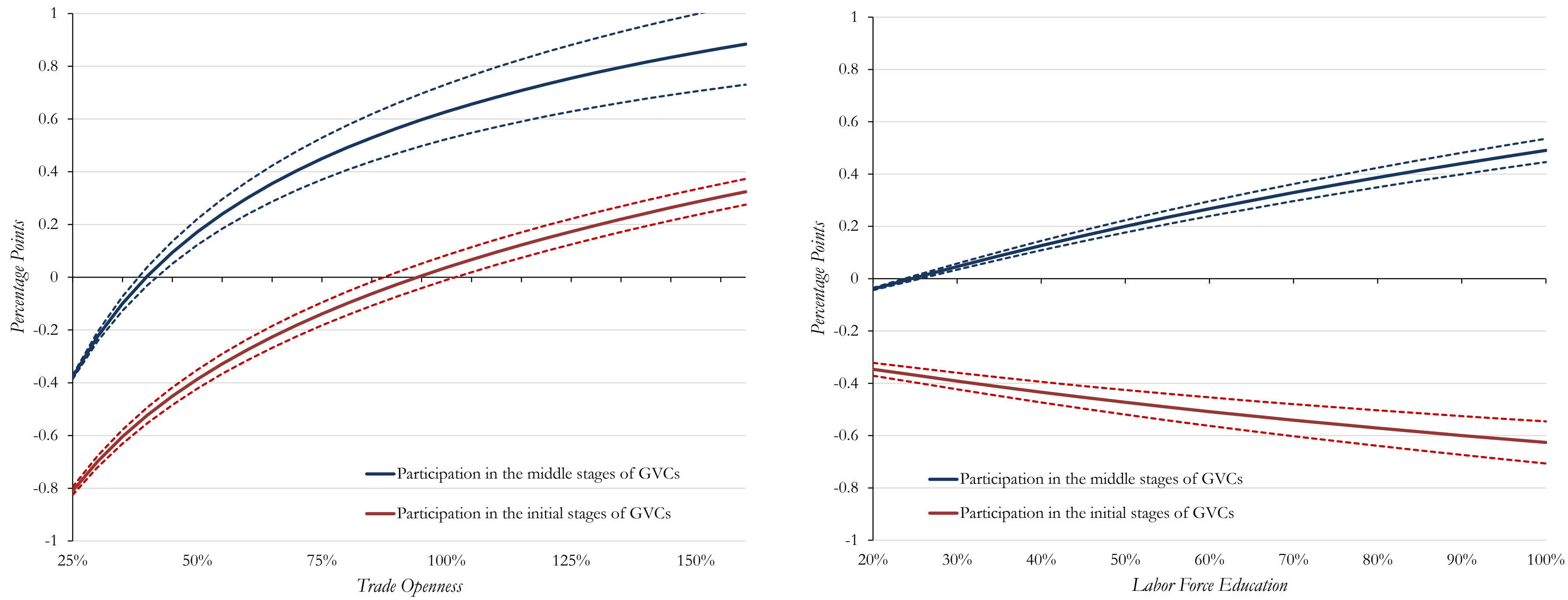



This figure shows the total growth effects associated with an increase in the degree of intra-industry trade by 10 percentage points from the sample mean. The estimates are based on the regressions in columns 3 (Panel A) and 5 (Panel B) of Table 4. The total growth effects shown in Panel A are given by Growth=($\beta_{IIT}$+$\beta_{interacted}$*TO+2*$\beta_{interacted2}$*TO$^2$*IIT)*$\Delta_{IIT}$. $\beta_{IIT}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of intra-industry trade, the interaction between the share of intra-industry trade with trade openness, and the interaction between the share of intra-industry trade with trade openness squared. $\Delta_{IIT}$ is a constant equal to 10 percentage points of the sample mean of the share of intra-industry trade and trade openness takes different possible values starting at 25 % (the lowest value of TO in our sample) to 160% (the highest value of TO in our sample). Analogously, the total growth effects shown in Panel B are given by Growth=($\beta_{IIT}$+$\beta_{interacted}$*LaborForceEduc.+2*$\beta_{interacted2}$*LaborForceEduc.$^2$*IIT)*$\Delta_{IIT}$. $\beta_{IIT}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of intra-industry trade, the interaction between the share of intra-industry trade with labor force education, and the interaction between the share of intra-industry trade with labor force education squared. $\Delta_{IIT}$ is a constant equal to 10 percentage points of the sample mean of share of intra-industry trade and labor force education takes different possible values between 20% (the lowest value of Labor Force Education in our sample) and 100 percent. Dotted lines are confidence bands.

**Figure 4. Total Growth Effects of Increasing the Share of Traded Goods in Different Categories of Upstreamness by 10 p.p.**

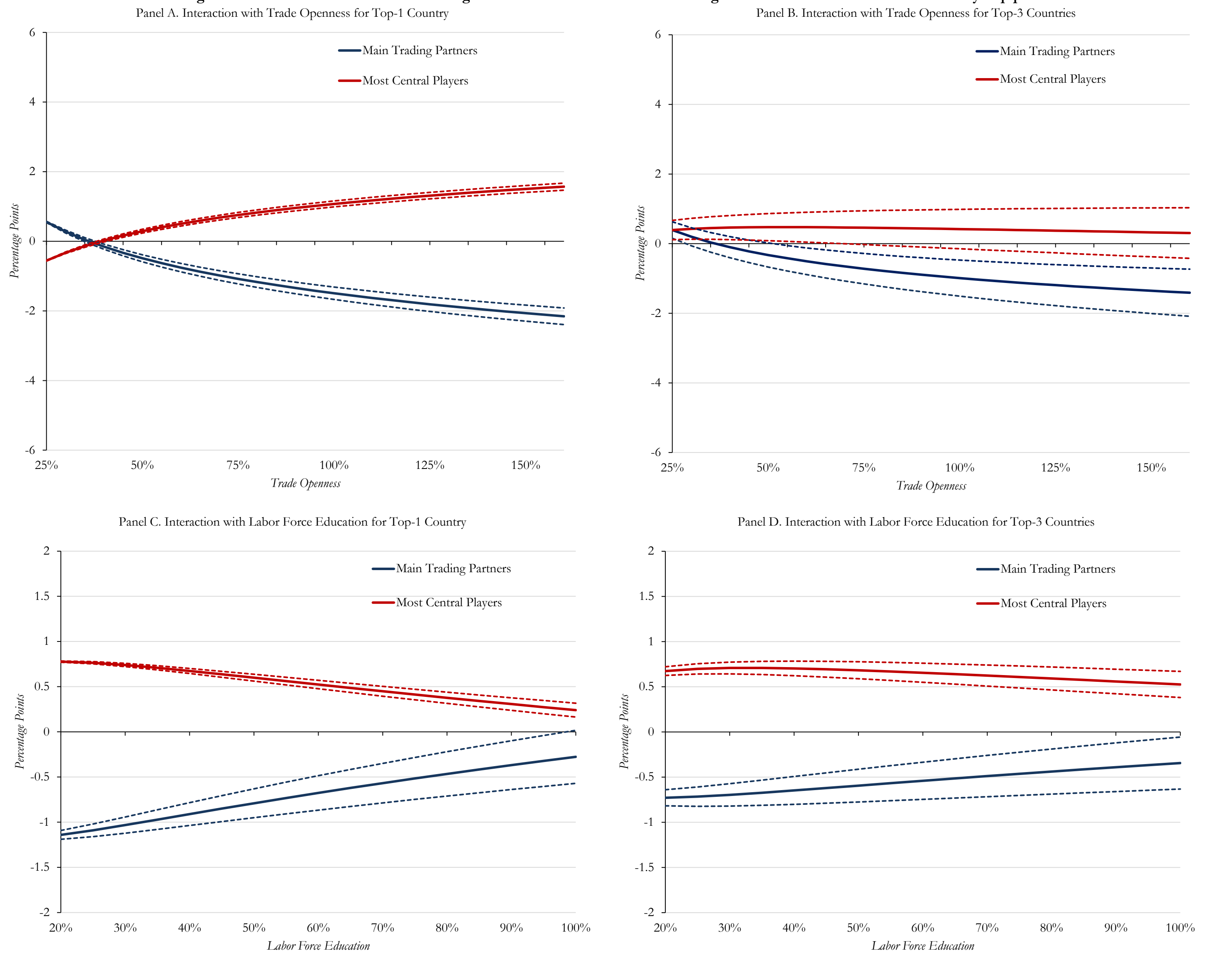
Panel A. Interaction with Trade Openness

Panel B. Interaction with Labor Force Education




This figure shows the total growth effects associated with an increase in the share of goods that belong to different stages of GVCs (or different categories of upstreamness) by 10 percentage points from their sample mean. The estimates are based on the regressions in columns 3 (Panel A) and 5 (Panel B) of Table 5. The total growth effects shown in Panel A are given by Growth=$(\beta Upstr+\beta_{interacted}*TO+2*\beta_{interacted2}*TO^2*Upstr)*\Delta_{upstr}$. $\beta_{upstr}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade in different categories of upstreamness, the interaction between the share of trade in different categories of upstreamness with trade openness, and the interaction between the share of trade in different categories of upstreamness with trade openness squared. $\Delta_{upstr}$ is a constant equal to 10 percentage points of the sample mean of share of trade in different categories of upstreamness and trade openness takes different possible values starting at 25 % (the lowest value of TO in our sample) to 160% (the highest value of TO in our sample). Analogously, the total growth effects shown in Panel B are given by Growth=$(\beta_{upstr}+\beta_{interacted}*LaborForceEduc.+2*\beta_{interacted2}*LaborForceEduc.^2*Upstr)*\Delta_{upstr}$. $\beta_{upstr}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade in different categories of upstreamness, the interaction between the share of trade in different categories of upstreamness with labor force education, and the interaction between the share of trade in different categories of upstreamness with labor force education squared. $\Delta_{upstr}$ is a constant equal to 10 percentage points of the sample mean of share of trade in different categories of upstreamness and labor force education takes different possible values between 20% (the lowest value of Labor Force Education in our sample) and 100 percent. Dotted lines are confidence bands.

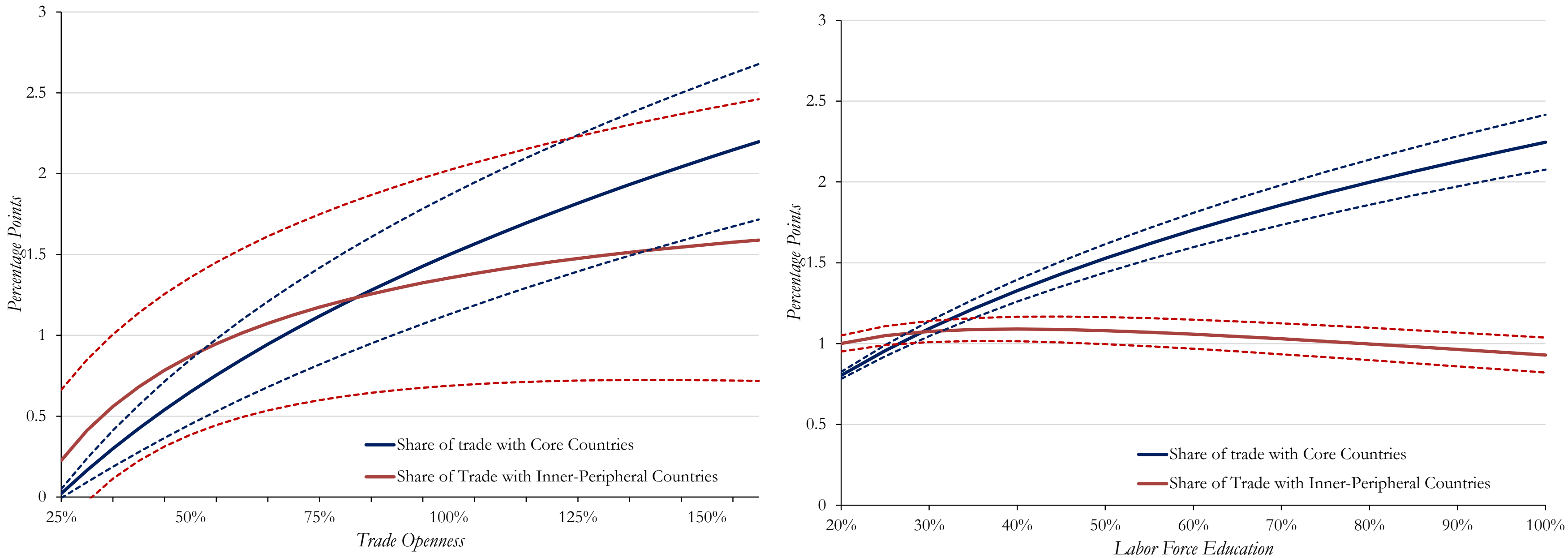
**Figure 5. Total Growth Effects of Increasing the Share of Trade with Main Trading Partners and Most Central Countries by 10 p.p.**




This figure shows the total growth effects associated with an increase in the share of trade with main trading partners (MP) and the most central countries (MCC) in the global trade network by 10 percentage points from their sample mean. The estimates are based on the regressions in columns 3 (Panel A), 8 (Panel B), 5 (Panel C), and 10 (Panel D) of Table 7. The total growth effects shown in Panels A and B are given by Growth=(($\beta_{MP}$ or $\beta_{MCC}$)+$\beta_{interacted}$*TO+2*$\beta_{interacted2}$*$TO^2$*(MP or MCC))*($\Delta_{MP}$ or $\Delta_{MCC}$). $\beta_{MP}$ or $\beta_{MCC}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade with MP or MCC, the interaction between the share of trade with MP or MCC and trade openness, and the interaction between the share of trade with MP or MCC and trade openness squared. $\Delta_{MP}$ and $\Delta_{MCC}$ are constants equal to 10 percentage points of the sample mean of the share of trade with MP and MCC, respectively, and trade openness takes different possible values starting at 25 % (the lowest value of TO in our sample) to 160% (the highest value of TO in our sample). Analogously, The total growth effects shown in Panels C and D are given by Growth=(($\beta_{MP}$ or $\beta_{MCC}$) +$\beta_{interacted}$*Labor Force Educ. +2*$\beta_{interacted2}$*Labor Force Educ.$^2$*(MP or MCC))*($\Delta_{MP}$ or $\Delta_{MCC}$). $\beta_{MP}$ or $\beta_{MCC}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade with MP or MCC, the interaction between the share of trade with MP or MCC and labor force education, and the interaction between the share of trade with MP or MCC and labor force education squared. $\Delta_{MP}$ and $\Delta_{MCC}$ are constants equal to 10 percentage points of the sample mean of share of trade with MP and MCC, respectively, and labor force education takes different possible values between 20% (the lowest value of Labor Force Education in our sample) and 100 percent. Dotted lines are confidence bands.

**Figure 6. Total Growth Effects of Increasing the Share of Trade with Core or Inner Periphery Countries by 10 p.p.**

*Panel A. Interaction with Trade Openness* *Panel B. Interaction with Labor Force Education*




This figure shows the total growth effects associated with an increase in the share of trade with core and inner periphery countries by 10 percentage points from the sample mean. The estimates are based on the regressions in columns 3 (Panel A) and 5 (Panel B) of Table 8. The total growth effects shown in Panel A are given by Growth=(($\beta_C$ or $\beta_{IP}$)+$\beta_{interacted}$*TO+2*$\beta_{interacted2}$*TO$^2$*(C or IP))*($\Delta_C$ or $\Delta_{IP}$). $\beta_C$ or $\beta_{IP}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade with C or IP, the interaction between the share of trade with C or IP and trade openness, and the interaction between the share of trade with C or IP and trade openness squared. $\Delta_C$ and $\Delta_{IP}$ are constants equal to 10 percentage points of the sample mean of the share of trade with C and IP, respectively, and trade openness takes different possible values starting at 25 % (the lowest value of TO in our sample) to 160% (the highest value of TO in our sample). Analogously, the total growth effects shown in Panel B are given by Growth=(($\beta_C$ or $\beta_{IP}$) +$\beta_{interacted}$*LaborForceEduc. +2*$\beta_{interacted2}$*LaborForceEduc.$^2$ *(C or IP)) *($\Delta_C$ or $\Delta_{IP}$). $\beta_C$ or $\beta_{IP}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade with C or IP, the interaction between the share of trade with C or IP and labor force education, and the interaction between the share of trade with C or IP and labor force education squared. $\Delta_C$ and $\Delta_{IP}$ are constants equal to 10 percentage points of the sample mean of share of trade with C and IP, respectively, and labor force education takes different possible values between 20% (the lowest value of Labor Force Education in our sample) and 100 percent. Dotted lines are confidence bands.

**Appendix Table 1: Sample of Countries**

| | |
|---|---|
| Albania | Latvia |
| Algeria | Lesotho |
| Argentina | Lithuania |
| Armenia | Malawi |
| Australia | Malaysia |
| Austria | Mali |
| Bahrain | Mauritius |
| Bangladesh | Mexico |
| Belgium | Mongolia |
| Benin | Morocco |
| Bolivia | Mozambique |
| Botswana | Namibia |
| Brazil | Nepal |
| Bulgaria | Netherlands |
| Burundi | New Zealand |
| Cambodia | Nicaragua |
| Cameroon | Niger |
| Canada | Norway |
| Central African Republic | Pakistan |
| Chile | Panama |
| China | Papua New Guinea |
| Colombia | Paraguay |
| Congo, Rep. | Peru |
| Costa Rica | Philippines |
| Côte d'Ivoire | Poland |
| Croatia | Portugal |
| Cyprus | Russian Federation |
| Czech Republic | Rwanda |
| Denmark | Saudi Arabia |
| Dominican Republic | Senegal |
| Ecuador | Sierra Leone |
| Egypt, Arab Rep. | Singapore |
| El Salvador | Slovak Republic |
| Estonia | Slovenia |
| Finland | South Africa |
| France | Spain |
| Gabon | Sri Lanka |
| Gambia | Sudan |
| Germany | Sweden |
| Ghana | Switzerland |
| Greece | Syrian Arab Republic |
| Guatemala | Tanzania, United Republic of |
| Guyana | Thailand |
| Haiti | Togo |
| Honduras | Trinidad and Tobago |
| Hungary | Tunisia |
| India | Turkey |
| Indonesia | Uganda |
| Iran, Islamic Rep. | Ukraine |
| Ireland | United Arab Emirates |
| Israel | United Kingdom |
| Italy | United States |
| Jamaica | Uruguay |
| Japan | Venezuela, RB |
| Jordan | Vietnam |
| Kazakhstan | Yemen, Rep. |
| Kenya | Zambia |
| Korea, Rep. | Zimbabwe |
| Lao PDR | |

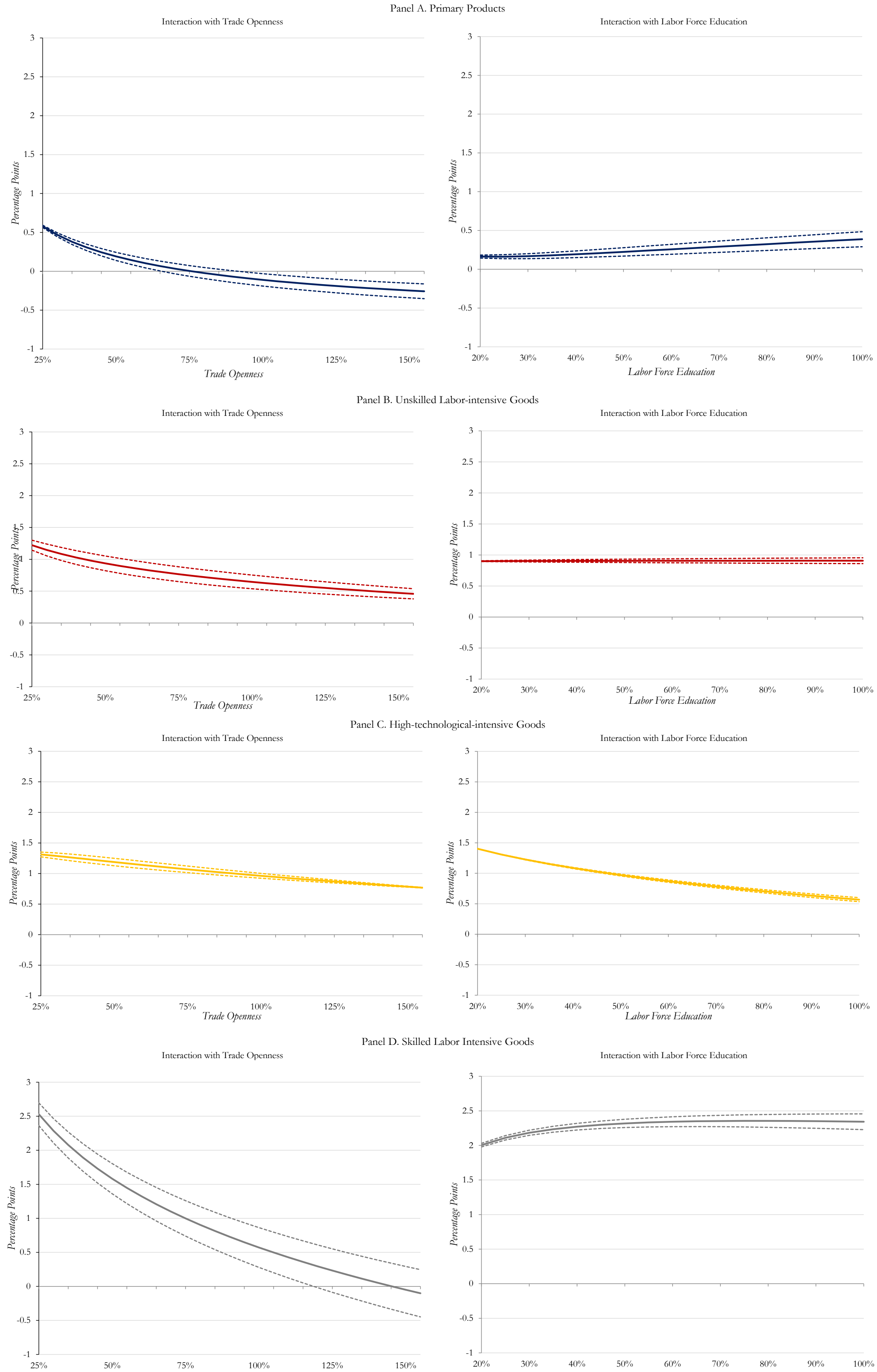
**Appendix Table 2. Data Description and Sources**

| Variable | Description | Source |
|---|---|---|
| Growth in GDP per Capita | Growth rate of GDP per capita based on real GDP per capita PPP measured in 2005 constant dollars | Penn World Table 7.1 |
| Initial GDP per Capita (in logs) | GDP per capita PPP measured in 2005 constant dollars in the first year of each five-year period | Penn World Table 7.1 |
| Labor Force Education (in logs) | Percentage of population older than 15 years that attained secondary or tertiary schooling | Updated database from Barro-Lee (2010) |
| Public Infrastructure (in logs) | Average number of telephone lines per capita | World Development Indicators |
| Terms of Trade (in logs) | Ratio of export unit value indexes to import unit value indexes, measured relative to base year (2000) | World Development Indicators |
| Trade Openness | Sum of exports and imports, scaled by GDP | Penn World Table 7.1 |
| Classification of Homogeneous Goods in Trade | Calculated according Rauch (1999) liberal classification. | Calculations based on 4-digit SITC Revision 2 data of Feenstra et al. (2005), updated with Comtrade data |
| Classification of Traded Goods Based on Factor Intensity | Calculated using the definition of Hinloopen and van Marrewijk (2001). Traded goods are classified into five categories: primary products, natural resource–intensive manufactures, unskilled labor–intensive goods, skilled labor–intensive goods, and high-technology-intensive goods. Shares of traded goods in each category are calculated based on both exports and imports. | Calculations based on 3-digit SITC Revision 2 data of Feenstra et al. (2005), updated with Comtrade data |
| Intra-Industry Trade | Calculated according to the Grubel-Lloyd (1975) methodology; the degree of IIT ranges from 0 (pure inter-industry trade) to 1 (pure intra-industry trade) | Calculations based on 2-digit SITC Revision 2 data of Feenstra et al. (2005), updated with Comtrade data |
| Degree of Upstreamness in Exports (Definition 1) | Calculated using to the benchmark upstreamness measure in Antras et al. (2012) for the United States. This measure is applied to the basket of exported goods of every country in the sample. Industries are evenly split into five groups. The first group corresponds to goods used at the beginning of GVCs (e.g. exports of primary products), the three following groups correspond to goods used in the middle segments of GVCs (e.g. exports of intermediate goods), and the last group corresponds to goods at the end of GVCs (e.g. exports of final goods) | Calculations based on 4-digit SITC Revision 2 data of Feenstra et al. (2005), updated with Comtrade data |
| Degree of Upstreamness in Exports (Definition 2) | Calculated using to the benchmark upstreamness measure in Antras et al. (2012) for the United States. This measure is applied to the basket of exported goods of every country in the sample. Industries are evenly split into three groups. The first group corresponds to goods used at the beginning of GVCs (e.g. exports of primary products), the second group corresponds to goods used in the middle segments of GVCs (e.g. exports of intermediate goods), and the third group corresponds to goods at the end of GVCs (e.g. exports of final goods) | Calculations based on 4-digit SITC Revision 2 data of Feenstra et al. (2005), updated with Comtrade data |
| Share of Trade with the Top-3 Main Trading Partners | Share of a country's exports and imports with its top-3 trading partners. These top-3 partners are defined as the three partners with the largest value of bilateral total trade in a given year. | Calculations based on DOTS |
| Share of Trade with the Top-3 Most Central Countries in the Global Trade Network | Share of a country's exports and imports with the top-3 most central countries in the global trade network. The top-3 most central countries in the global trade network are those with the greatest value of the random walk betweenness centrality measure developed by Newman (2005) and Fisher and Vega-Redondo (2006). This classification is conducted separately for every year in the sample period. | Calculations based on DOTS |
| Share of Trade with Core and Inner-Periphery Countries | Share of a country's exports and imports with countries in the core and in the inner-periphery of the global trade network. Core countries are those ranked above the 95$^{th}$ percentile of the cross-country rankings given by the random walk betweenness centrality measure developed by Newman (2005) and Fisher and Vega-Redondo (2006). Inner-periphery countries are ranked in the 70-94$^{th}$ percentiles of the rakings. This classification is conducted separately for every year in the sample period. | Calculations based on DOTS |

## Appendix Table 3: Descriptive Statistics

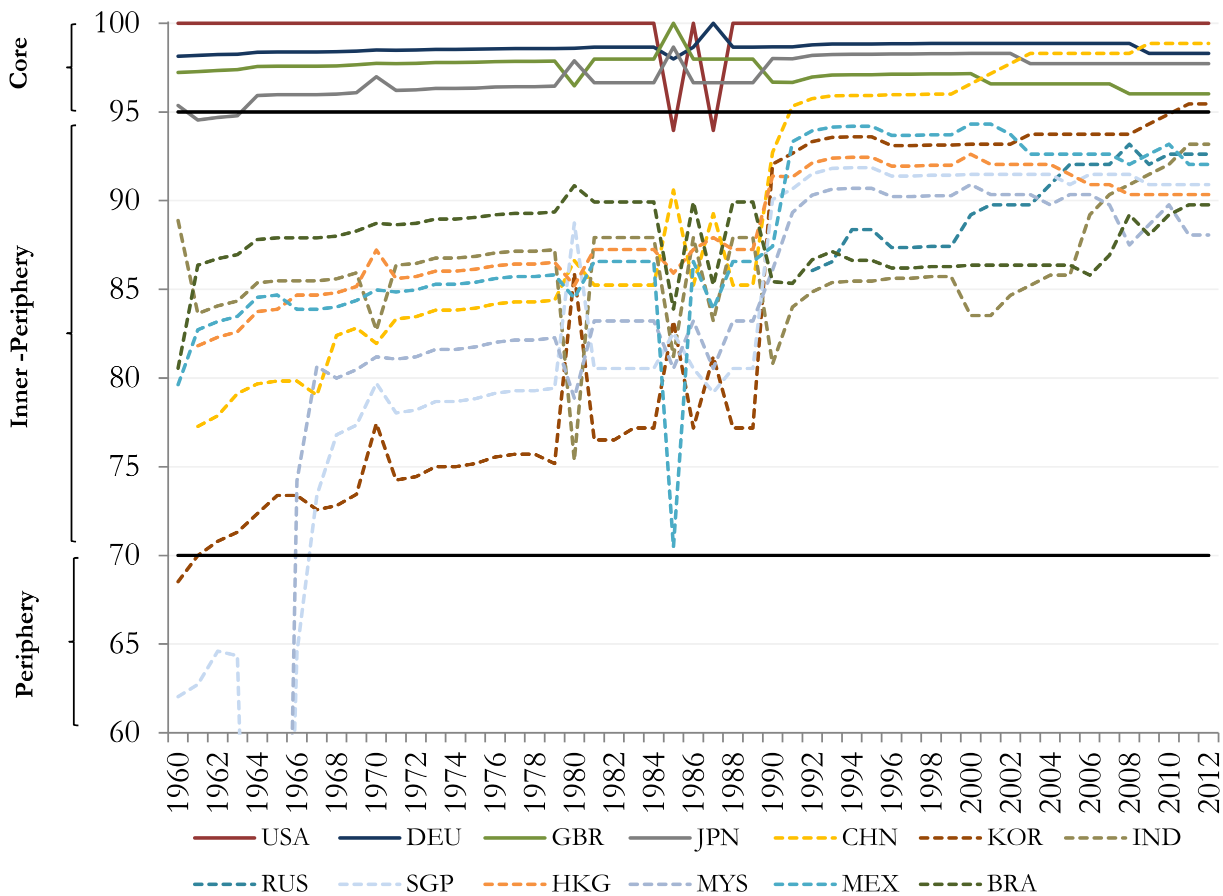
| **Variables:** | **Mean** | **Standard Dev.** |
|---|---|---|
| GDP per Capita Growth | 1.8% | 2.9% |
| Initial GDP per Capita | 4430.41 | 3.58 |
| Trade Openness | 54.0% | 1.9% |
| Secondary and Tertiary Education | 28.0% | 2.5% |
| Terms of Trade | 102.5 | 143.8 |
| Main Telephones Lines per Capita | 4% | 668% |
| | | |
| Share of Homogeneous Goods in Trade | 54.2% | 10.5% |
| | | |
| *Factor Intensity* | | |
| Sh. of Tr. In Primary Products | 39.4% | 12.9% |
| Sh. of Tr. in Nat. Res. Int. Goods | 6.3% | 7.2% |
| Sh. of Tr. in Unskilled Labor Int. Goods | 11.0% | 8.8% |
| Sh. of Tr. in High-Tech Int. Goods | 24.8% | 8.8% |
| Sh. of Tr. in Skilled Int. Goods | 16.3% | 5.1% |
| | | |
| Intra-Industry Trade | 30.1% | 18.3% |
| | | |
| *Upstreamness* | | |
| Sh. of Exp. in Final Seg. of GVCs - Def. 1 | 20.8% | 11.4% |
| Sh. of Exp. in Middle Seg. of GVCs - Def. 1 | 45.0% | 11.5% |
| Sh. of Exp. in Initial Seg. of GVCs - Def. 1 | 31.4% | 15.0% |
| Sh. of Exp. in Final Seg. of GVCs - Def. 2 | 11.4% | 8.7% |
| Sh. of Exp. in Middle Seg. of GVCs - Def. 2 | 51.7% | 11.3% |
| Sh. of Exp. in Initial Seg. of GVCs - Def. 2 | 34.5% | 14.0% |
| | | |
| Share of Intra-Regional Trade | 36.4% | 21.8% |
| | | |
| Share of Trade with Main Trading Partner | 25.9% | 10.5% |
| Share of Trade with Most Central Country | 20.2% | 11.8% |
| Share of Trade with Top-3 Main Trading Partners | 47.0% | 8.8% |
| Share of Trade with Top-3 Most Central Countries | 31.3% | 12.0% |
| | | |
| Share of Trade with Core Countries | 54.2% | 9.5% |
| Share of Trade with Inner-periphery Countries | 34.7% | 10.6% |
| Share of Trade with Periphery Countries | 9.6% | 6.4% |

**Appendix Figure 1. Confidence Intervals for Figure 2**




This figure shows the total growth effects associated with an increase in the share of traded goods with different factor intensities by 10 percentage points from the sample mean. The estimates are based on the regressions in columns 3 (Panel A) and 5 (Panel B) of Table 3. The total growth effects shown in Panel A are given by Growth=$(\beta_{FI}+\beta_{interacted}*TO+2*\beta_{interacted2}*TO^2*FI)*\Delta_{FI}$. $\beta_{FI}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade in the different categories of factor intensity , the interaction between the share of trade in the different categories of factor intensity with trade openness, and the interaction between the share of trade in the different categories of factor intensity with trade openness squared. $\Delta_{FI}$ is a constant equal to 10 percentage points of the sample mean of share of trade in the different categories of factor intensity and trade openness takes different possible values starting at 25 % (the lowest value of TO in our sample) to 160% (the highest value of TO in our sample). Analogously, the total growth effects shown in Panel B are given by Growth=$(\beta_{FI}+\beta_{interacted}*LaborForceEduc.+2*\beta_{interacted2}*LaborForceEduc.^2*FI)*\Delta_{FI}$. $\beta_{FI}$, $\beta_{interacted}$, and $\beta_{interacted2}$ are respectively the estimated regression coefficients on the share of trade in the different categories of factor intensity, the interaction between the share of trade in the different categories of factor intensity with labor force education, and the interaction between the share of trade in the different categories of factor intensity with labor force education squared. $\Delta_{FI}$ is a constant equal to 10 percentage points of the sample mean of share of trade in the different categories of factor intensity and labor force education takes different possible values between 20% (the lowest value of Labor Force Education in our sample) and 100 percent. Dotted lines are confidence bands.

**Appendix Figure 2. Centrality in the Global Trade Network**




This figure shows the evolution of the random-walk betweenness centrality measure on the global trade network. The following thresholds are used to classify countries into the core, inner periphery, and periphery: 95th percentile or higher, 70-94th percentiles, and below 70th percentile, respectively.