6-6-2018

# Essays on Trade and Growth

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**DOI:** 10.25148/etd.FIDC006827

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# ESSAYS ON TRADE AND GROWTH

A dissertation submitted in partial fulfillment of the

requirements for the degree of

DOCTOR OF PHILOSOPHY

in

ECONOMICS

by

Yulin Hou

2018

To: Dean John F.Stack, Jr
Steven J. Green School of International and Public Affairs

This dissertation, written by Yulin Hou, and entitled Essays on Trade and Growth, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Date of Defense: June 6, 2018

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Florida International University, 2018

DEDICATION

To my parents.

# ACKNOWLEDGMENTS

I am especially grateful to my major advisors, Cem Karayalcin and Hakan Yilmazkuday, who introduced me to the area of international trade and development economics, gave me much enlightenment, guidance, and encouragement over the past five years. I am also appreciative of Mihaela Pintea for her thoughtful discussions and advice, as well as her support and encouragement. I thank Tie Su for his encouragement during my studies in the United States. I acknowledge the financial support from the Florida International University Graduate School Dissertation Year Fellowship from Spring 2018 to Summer 2018. Finally, I thank my parents and my husband Qing Zhang, for their love and support.

ABSTRACT OF THE DISSERTATION

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This dissertation is composed of three essays on international trade and economic growth. The first essay investigates whether the content of what economies export matters for human capital accumulation. I construct a small open economy model and find that expansion of primary exports can harm human capital accumulation if the economy is initially allocating significant resources to primary goods production. Then I test this prediction empirically using Latin American data over the period from 1965 to 2010 and find robust evidence in support of the hypothesis that a shift towards primary exports reduces human capital accumulation.

In the second essay, I investigate the effects of gravity variables (distance, common border, colony relationship, free trade agreement, or language) on preference and trade costs. This essay models the imports of the U.S. at the individual good level and uses the three-stage least square regression approach by focusing on the trade elasticities. Using actual data on trade costs, this essay decomposes the overall effects of gravity variables on trade into those through gravity channels: duties/tariffs, transportation costs, and dyadic-preference. The results imply that gravity variables mainly capture the effect of preference rather than trade costs.

In the final essay, I examine the effects of increased demand from China on economic growth of the Latin American and the Caribbean (LAC) countries. This essay

views the increased Chinese demand in the early 2000s as a quasi-natural experiment and considers it as a treatment to which a part of the LAC region was subjected. I adopt a difference-in-difference framework and find that China's demand did deliver significantly higher growth rates to LAC exporters over the last decade and a half.

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CHAPTER 1

# EXPORTS OF PRIMARY GOODS AND HUMAN CAPITAL ACCUMULATION

## 1.1 Introduction

In the last half-century, many developing countries have experienced export-led growth. Export expansion has increased the skill premium in some developing countries. For instance, with the integration into the global economy, the return to skill and the percentage of the population with higher levels of education grew markedly in China and India. In some countries, however, enrollment rates remain still low at higher levels of education. For example, on average, only 11 percent of the population aged 15 and above in Latin America have enrolled in tertiary education in 2010[1]. How does one account for the higher level of human capital accumulation in some countries and persistent stagnation in others during the export-led growth period? Does the content of what economies export matter for human capital accumulation?

This paper explores the trade-human capital nexus by focusing on exports of primary goods. We argue that expansion of primary exports can harm human capital accumulation if the economy is initially allocating significant resources to primary goods production. Briefly, the effect of international trade on educational acquisition depends on a country's initial production specialization pattern. When an economy has a strong comparative advantage in primary goods production, export expansion reinforces its traditional specialization patterns in the production of unskilled intensive goods. The associated fall in the demand for skilled labor reduces the incentives to invest in human capital, slowing down skill upgrading in the primary sector and

[1] Barro–Lee Educational Attainment Dataset

transition to the modern sector. Therefore, export expansion in primary goods can slow down the progress of human capital accumulation.

To understand the role of export structure in generating differences in human capital accumulation, we develop a small open economy model of agriculture and manufacture sectors that lasts for two periods. The analysis demonstrates that an exogenous increase in the relative world price of the agricultural good can reduce the levels of human capital accumulation if the share of manufacturing employment is initially less than a critical level. In other words, if the initial agricultural employment and output are higher than a critical value, export expansion of agricultural goods may act as a positive demand shock for unskilled labor. Naturally, this trend increases the relative return to unskilled labor and then decreases the share of skilled workers in the labor force. Hence, in the long run, the levels of human capital accumulation will fall. This framework highlights an economy's initial production composition and exogenous trade shocks that result in the different levels of education acquisition.

Latin America and the Caribbean (LAC) region provides a perfect setting to study the effect of primary exports on human capital accumulation. Unlike most industrial countries and some developing countries, an important characteristic of LAC is the large share of primary goods in their exports. Over the period from 1965 to 2010, the average share of primary exports in total merchandise exports across LAC countries is around 59 percent[2]. In particular, in the 2000s, some LAC countries experienced an impressive trade boom in primary exports. For instance, according to the Latin American Economic Outlook (2016), in the period 2001-2010, mining and fossil fuels exports from Latin America grew at an impressive 16 percentage annually, followed by agricultural products at 12 percentage. In this paper, we document that the effects of export expansion in primary goods on human capital accumulation are shown to

[2]Source: World Development Indicators

be negative and significant across countries in LAC over the period 1965-2010. The results are shown to be robust to the consideration of many control variables and alternative measures of educational attainment. Furthermore, to address the potential endogeneity of export structure, we use resource discoveries and international primary goods exports price index as instruments for primary exports to provide further evidence of causality. The TSLS results are consistent with our panel finds. Overall, the findings suggest that the specific characteristics of export structure in LAC can explain the persistent stagnation of its human capital accumulation in the period from 1965 to 2010. Finally, we find evidence that a shift towards primary exports exacerbated the education inequality in LAC over the same period.

This paper is related to a large literature addressing the trade-human capital nexus in a variety of contexts. First, this paper provides evidence in support of models of trade with endogenous skill acquisition (e.g., see Findlay and Kierzkowski, 1983; Foster and Rosenzweig, 1996; Wood and Ridao-Cano,1999; Galor and Mountford, 2008). In their framework, international trade increases the return to the abundant factor in an economy. For example, Galor and Mountfor (2008) argue that international trade has played an asymmetrical role in the human capital accumulation between industrial economies and non-industrial economies. They suggest that in industrial economies, international trade has enhanced the specialization in the skilled intensive goods production which naturally rose the demand for skilled workers and contributed to the invest in education. However, in non-industrial economies, the expansion of international trade has generated less demand for skilled workers and people has less incentives to invest in human capital.

Second, this paper complements the studies which explain the evolution in educational attainment across countries. Easterly (2007) and Galor, Moav, and Vollrath (2009) argue that the distribution inequality of landownership is a key factor for human capital accumulation. Gallego (2010) shows that the degree of democratization has played a positive role in the development of primary education, and political decentralization has a significant impact in higher levels of education. Hendricks (2010) suggests that the majority of the variation in educational attainment across countries is due to within-industry variation rather than industry composition. Restuccia and Vandenbroucke (2013, 2014) find that wage and life expectancy have played an essential role in explaining the trends in hours of work and educational attainment of the U.S. over the period from 1870 to 1970.

Finally, this paper also contributes to the growing literature examining the effect of openness on educational attainment. In the context of India, Shastry (2012), Jensen (2012) and Oster and Steinberg (2013) all find that the arrival of information technology service jobs has a positive influence on the educational attainment of India. Similarly, Heath and Mobarak (2012) show evidence that new job opportunities in garment factory in Bangladesh improve girls' educational attainment. Atkin (2016) shows that export expansion in less-skilled manufacturing in Mexico increased the school drop-out rate at grade nine during the period from 1986 to 2000. In general, these studies focus exclusively on specific sectors in a relatively small number of locations. One recent paper by Blanchard and Olney (2017) focus on the role of types of sectoral growth in influencing educational attainment. They use the panel data from 102 countries and argue that the change in the composition of a country's exports is the key demand-side driver of education. We differ most importantly from Blanchard and Olney (2017) in that we focus on exports of primary good in LAC countries and highlight the initial production specialization pattern. Moreover, we use the alternative instrument identification, namely, resource discoveries and international primary good export price index, to proxy the export expansion in primary goods. Finally, we provide the evidence on the effect of primary exports on the education inequality in LAC over the period 1965-2010 and offer a potential explanation.

The rest of the paper is organized as follows. The next section introduces a small open economy model. Section 3 presents data and the corresponding descriptive statistics. Section 4 provides the empirical analysis. Section 5 pursues a variety of extensions. Section 6 concludes.

## 1.2 The model

To provide guidance for the empirical work, we develop a small open economy model in this section. We consider a small open economy that lasts for two periods with a constant number of identical individuals. Competitive firms in the economy produce two final goods: an agricultural good and a manufactured good, both of which are tradable. We now turn to a detailed analysis of firm and individual behaviors.

### 1.2.1 Firms

Firms produce the two final goods by employing labor as the only input. In the agriculture sector firms use unskilled workers. We posit the following production function for agricultural good:

$$Q_i^a = A_i^a L_i^u \tag{1.1}$$

where $i \in (1, 2)$ denotes the time period, $A_i^a$ is the level of productivity in the agriculture sector and $L_i^u$ is amount of unskilled workers employed in the production of the agricultural good in period i. The production function for manufactured good is:

$$Q^m = A^m L^s \tag{1.2}$$

where $A^m$ is the level of productivity in the manufacturing sector, and $L^s$ is the amount of skilled workers employed in the production of the manufactured good. In the first period, there is no manufacturing production, no trade and no international lending or borrowing.

We assume that $A_1^a = A_2^a = A^a$. Under perfect competition, profit maximization of the representative firm in the agriculture sector pays $w^a = A^a$ (the price of the agricultural good is taken as the numeraire). The representative firm in the manufacturing sector pays $w^m = pA^m$, where $p$ is the relative price of the manufactured good in terms of the agricultural good in the world market. We also impose the condition that $pA^m \geq 2A^a$.

### 1.2.2 Individuals

Individuals live for two periods. In first period of their lives, they can start working in the agricultural sector as unskilled workers($L_1^u$), or they can invest in human capital and become skilled workers ($L_1^e$). In second period of their lives, skilled workers ($L_2^s$) supply the acquired efficiency units of labor in manufacturing and earn the corresponding wage. Unskilled workers ($L_2^u$) continue work in the agriculture sector. Note that the total population is $N = L_1^u + L_1^e = L_2^u + L_2^s$, where $L_1^e = L_2^s$.

All individuals have a log-linear utility function over the two goods in the two periods: agricultural goods in both periods ($c_1^a, c_2^a$) and manufactured goods in the second period ($c_2^m$). Their preferences are given by

$$U^j(c_1^{aj}, c_2^{aj}, c_2^{mj}) = logc_1^{aj} + \beta[\phi logc_2^{aj} + (1-\phi)logc_2^{mj}] \quad (1.3)$$

where $j \in (s, u)$, $\beta$ is the time preference and $\phi$ is a utility weight over the two goods in the second period. $\beta$ and $\phi$ are all between zero and one. $c_1^a$ and $c_2^a$ denote individual consumption of agricultural goods in two periods, respectively. $c_2^m$ denotes individual consumption of manufactured goods in the second period.

Each type of workers receive a wage equal to their marginal product of labor.

$$W^u = w^a + \frac{w^a}{1+r} = c_1^u + \frac{c_2^u}{1+r} \tag{1.4}$$

$$W^s = \frac{w^m}{1+r} = c_1^s + \frac{c_2^s}{1+r} \tag{1.5}$$

where $W^j$ denotes lifetime income for each type of workers, and $c_i^j$ denotes individual consumption for each type of worker in period i. $(j \in (u, s))$. Let $u$, $s$ represent unskilled workers and skilled workers, respectively. Note that $c_2^u = c_2^{au} + pc_2^{mu}$, $c_2^s = c_2^{as} + pc_2^{ms}$.

Individuals maximize their utility (1.3) subject to their budget constraints (1.4) and (1.5). Using the first order conditions and budget constraints for the individual, and the profit maximization conditions for the firms in two sectors, we can derive analytically individual consumption levels for both unskilled and skilled workers as a function of their wages.

$$c_1^{aj} = \frac{W^j}{1+\beta} \tag{1.6}$$

$$c_2^{aj} = \frac{\phi\beta(1+r)W^j}{1+\beta} \tag{1.7}$$

$$c_2^{mj} = \frac{\beta(1-\phi)(1+r)W^j}{p(1+\beta)} \tag{1.8}$$

### 1.2.3 Market clearing

Given that there is no trade in the first period, total consumption on the agricultural goods must equal total agriculture production.

$$(N - L^s)c_1^{au} + L^s c_1^{as} - Q_1^a = 0 \tag{1.9}$$

In the second period, agricultural goods and manufactured goods can be produced domestically, imported from the rest of the world, or exported. Imposing balanced trade we get the following condition

$$Q_2^a - c_2^a = (c_2^m - Q^m)p \tag{1.10}$$

where

$$c_2^a = (N - L^s)c_2^{au} + L^s c_2^{as} \tag{1.11}$$

and

$$c_2^m = (N - L^s)c_2^{mu} + L^s c_2^{ms} \tag{1.12}$$

Finally, given identical initial conditions and free schooling arbitrage requires that unskilled workers receive the same lifetime utility as skilled workers.

$$U^u - U^s = (1-\beta)log\frac{(2+r)w^a}{w^m} = 0 \tag{1.13}$$

which given $w^a$ and $w^m$, we can solve for the equilibrium r,

$$r = \frac{pA^m}{A^a} - 2 \tag{1.14}$$

### 1.2.4 Equilibrium

A competitive equilibrium is a set of prices $\{p, w^a, w^m\}$ and allocations $\{c_i^{aj}, c^{mj}, L^s\}_{i\in(1,2),j\in(s,u)}$ such that:

1. Given prices, $\{L^s\}$ solves the problem of the representative firm, given by equations (1.1) and (1.2).
2. Given prices, $\{c_i^{aj}, c^{mj}\}_{i\in(1,2),j\in(s,u)}$ solve the household's problem in (1.3).
3. Markets clear so that equations (1.9) to (1.13) hold.

Now let's consider the effect of a negative shock to $p$, i.e. an increase in the world relative price of the agricultural good. It is straightforward to show that

$$\frac{dL^s}{dp} = \frac{A^m N(\frac{\beta}{1+\beta} - \frac{L^s}{N})}{(pA^m - A^a)} \tag{1.15}$$

which indicates that an increase in the relative price of agricultural goods (a fall in $p$) reduces human capital accumulation (i.e., $L^s$) if and only if the share of manufacturing employment in total employment, $\frac{L^s}{N}$, is less than a critical level (given by $\beta/(1+\beta)$). In other words, a rise in the relative price of agricultural goods will reduce human capital accumulation if the country is initially allocating significant resources (as measured here by the share of unskilled labor in the labor force) to primary goods production. We also note that an increase in $p$ reduces the lifetime incomes, $W^j$, of both skilled and unskilled workers by the same amount $(-A^m/(1+r))$. The reason for the reduction is that a rise in $p$ increases the interest rate $r$, reducing the discounted second-period wages.

## 1.3 Data and stylized facts

In this section we document the evolution of exports of primary goods and educational attainment in our LAC dataset. We assembled data for 33 countries in LAC over the period from 1965 to 2010. Table 1.1 provides a detailed description of our sample.

### 1.3.1 Exports of primary goods

We define primary exports to consist of agricultural raw materials, food, ore, and metals exports. Data on the share of primary exports in total merchandise exports for each country-year observation are obtained from World Development Indicators. Some features regarding primary exports in LAC are notable in Table 1.1. First, the average share of primary exports in total merchandise exports is around 59 percent in LAC over the period 1965–2010, indicating that primary goods play an essential role in LAC's exports. Second, the standard deviation of this variable shows that there is considerable variation in primary exports among LAC countries.

Since the mid-1960s, there was an average of 3.3 primary goods booms per country in South America and 1.4 per country in Central America and the Caribbean, compared to 1.6 per country globally. For instance, in the last fifty years, Chile and Peru experienced mineral booms; Argentina, Brazil, and Paraguay experienced cereal booms; Colombia and Costa Rica experienced a coffee boom[3]. In particular, in the last two decades, primary goods boom accelerated due to rising Chinese demand. Many LAC countries increased primary exports markedly after 2001.[4] For Brazil, the share of food exports in merchandise exports rose from 24.9 % in 1991 to 34.2 % in 2009; for Chile, the share of ore and metals in merchandise exports increased from 54.6 % in 1990 to 64.6 % in 2010. This trend, however, was not universal among LAC countries. A handful of countries in LAC did not participate fully in the expansion of primary exports in the last fifteen years. For example, in Mexico, the share of agriculture raw material exports in merchandise exports declined from 17 % in 1965 to 0.4 % in 2010 and the share of food exports declined from 44 % in 1965 to 6 % in 2010.

### 1.3.2 Educational attainment

We obtain seven different measures of educational attainment from the Barro-Lee Educational Attainment Dataset for every five years from 1965 to 2010.[5] We observe that there is much more variation across countries in secondary school enrollment,

[3]See, Latin American Economic Outlook 2015: Education, Skills, and Innovation for Development

[4]Joining the World Trade Organization in 2001 gave Chinese manufacturers greater access to imported primary commodities.

[5]The measures of educational attainment used are as follows: the percentage of secondary schooling attained in population aged 15 and above; the percentage of complete secondary schooling attained in population aged 15 and above; the percentage of tertiary schooling attained in population aged 15 and above; the percentage of complete tertiary schooling attained in population aged 15 and above; the average years of schooling attained; the average years of secondary schooling attained; the average years of tertiary schooling attained.

motivating our focus on this measure (though we will also show results using other measures).

In the past fifty years, educational attainment in LAC has improved significantly. Compared with the previous generation, young people today are better educated in LAC. There is now almost universal access to primary schooling. The average years of schooling have increased markedly. Specifically, in the early 1970s, LAC received an average of seven years of schooling. By 2012, LAC had increased its average years of schooling to 13 years. Enrollment in primary schools is now close to the OECD average in most LAC countries. It is important to emphasize that primary education is the necessary building block to acquire skills, higher levels of education play an important role in the development process of countries by providing specialized skills. Therefore, in the current research, we focus on the higher level of education, namely, secondary education and tertiary education.

In LAC countries, enrollment rates and graduation rates are generally low at higher levels of education. On average, only 26 % of the population aged 15 and above has completed secondary education and 6 % has completed tertiary education in 2010. Therefore, although LAC countries has experienced substantial changes in their educational attainment, the higher levels of education has suffered stagnation in the past fifty years. Accordingly, the persistent stagnation in higher level of education has induced the wider gap between skill supply and demand in the LAC. For example, according to the Latin American Economic Outlook (2015), on average in LAC, 36 percent of companies struggle to find appropriately skilled workers. In particular, 67 percent of companies in Peru has experienced the searching difficulties. In contrast, there is only 15 percent of companies in OECD countries have trouble to hire the specialized skilled labor. Figure 1.1 plots secondary enrollment and secondary completion rates in different periods in LAC. Compare the secondary enrollment in 2010 to 1965, we find that all countries lie above the 45-degree line, suggesting that all countries in LAC experienced a noticeable increase in secondary school enrollment. However, when we focus on the recent period, namely, 2000-2010, some countries lie below the 45-degree line. It means that after 2000, the secondary enrollment has dropped in some countries of LAC. Furthermore, in terms of secondary completion rate, we observe the similar trend. In the 2000s, the secondary completion rate has dropped for some countries in LAC.

For completeness, Figure 1.2 plots tertiary enrollment and tertiary completion rate in different periods and suggests that both rates in tertiary education have decreased in the year after 2000 for some countries in LAC. For instance, the percentage of tertiary schooling in Chile rose from 3 % in 1965 to 20 % in 2000, then dropped to 15 % in 2010. Similarly, Peru had increased its tertiary enrollment from 3.44 % in 1965 to 26.52 % in 2000, then fell to 16.62 % in 2010. Consistent with the proposed theory, these countries are also the ones that experienced rising primary exports in the 2000s.

### 1.3.3 Other variables

We use the following additional data in our empirical analysis. Data on GDP per capital, urbanization rate, population, the death rate, the share of international migrant stock in population, the share of FDI net inflow in GDP are from World Bank's World Development Indicator's Database. The human capital index is obtained from PWT9.0. The gini coefficients of education inequality are borrowed from Ziesemer (2016). More details about the data source can be found in Table 1.1.

## 1.4 Empirical Analysis

We now examine the consequences of an increase in primary exports on human capital accumulation. To do this we use two different empirical approaches to test the model's predictions. The first one uses panel estimates to study the association between primary exports and human capital accumulation. The second one employs the instrumental variable specification, using resource discoveries and international primary goods exports price index as instruments for primary exports to carefully identify a causal relationship. In each case, the estimated relationship of primary exports with human capital accumulation has the expected negative sign, is statistically significant and economically large.

### 1.4.1 Baseline Specification

We use the following basic specification

$$Ed_{i,t} = \beta_1 Ex_{i,t-1} + \beta_2 X_{i,t-1} + \epsilon_{i,t} \tag{1.16}$$

where $Ed_{i,t}$ is a measure of educational attainment in country $i$ in period $t$, $Ex_{i,t-1}$ is the share of primary exports in total merchandise exports in country $i$ in period $t-1$, $X_{i,t-1}$ is a vector of control variables including urbanization rate, GDP per capita in different lags, and $\epsilon_{i,t}$ is an error term, capturing all other omitted factors, with $E(\epsilon_{i,t}) = 0$ for all countries in period $t$. The main object of interest is $\beta_1$ which denotes the sensitivity of educational attainment with respect to changes in primary exports.

There are several concerns with this identification: reverse causality, omitted variables, and endogeneity issues. First, one concern is about the potential reverse causality from educational attainment to primary exports. To address this concern, we regress educational attainment, $Ed_{i,t}$, on lagged primary exports, $Ex_{i,t-1}$. The lagged formulation first absorbs the component of the error term correlated with $Ex_{i,t-1}$. Second, it also captures the existence of lags between the economic conditions and their effects on an individual's education decision.

Another challenge is that there could be omitted factors which affect both primary exports and educational attainment, even when the broader set of controls are included. The observed relationship between educational attainment and primary exports is not necessarily a causal one. It may reflect the influence of institutional, geographical, cultural characteristics on the joint process of human capital accumulation and expansion in primary exports. To overcome this challenge and allow for the time-invariant characteristics across countries, we include country fixed effects and control initial conditions. Specifically, the initial conditions include the level of educational attainment in 1965, the share of primary exports in total merchandise exports in 1965 and log of GDP per capita in 1965.

A third issue is the possibility of endogeneity. Given that the export structure is a choice variable and endogenous, we need an instrument for primary exports which provides us with exogenous variation in the share of primary exports in total merchandise exports. Accordingly, besides the benchmark analysis, we also consider an IV estimation. The IV strategy permits us to attempt to establish the causal effect of primary exports on educational attainment.

### 1.4.2 Basic results

Table 1.2 provides the basic results using OLS. Each regression in the table uses the percentage of secondary schooling attained in the population aged 15 and above as the dependent variable. The standard errors are clustered at the country level. In all regressions, the estimated effects of primary exports on secondary enrollment are negative and statistically significant, independent of including the control variables.

Column 1 shows the bivariate relationship between primary exports and secondary school enrollment without any other controls. As is evident, there is a strong negative association, indicating that countries that experienced export expansion in primary goods have the lower levels of secondary school enrollment. The remaining columns in Table 1.2 include several controls. Specifically, column 2 contains only the urbanization rate as a control variable. The percentage of urban population is included to capture the higher demand for skilled workers in urban sectors. After adding the urbanization rate, there is still a negative association between the primary exports and secondary school enrollment, though the coefficient is slightly smaller now. Again, the effect of primary exports on secondary enrollment remains statistically significant.

In column 3 we consider initial conditions in 1965 to capture the country-specific trends that may correlate with the initial conditions of education, export composition, and economic development. Specifically, we include the share of primary exports in total merchandise exports in 1965, the secondary enrollment in 1965 and the level of log GDP per capita in 1965. As is evident, the negative relationship between primary exports and secondary school enrollment is robust to including initial conditions and the magnitude of the effect is slightly larger.

Column 4 incorporate a series of the lagged log of GDP per capita. GDP per capita is expected to affect the education expenditures across countries positively. As is evident, the inclusion of these controls does not alter the negative association of primary exports with secondary enrollment. The effects of primary exports on secondary enrollment is negative, where the coefficient estimate takes a value of about -0.23. This estimate suggests that when the share of primary exports increases by one percent, on average, the secondary enrollment falls by 0.23 percent across LAC countries between 1965 to 2010. Moreover, the effects of lagged log GDP capita on secondary enrollment are statistically insignificant.

To address the evolving effect over the panel, we add time fixed effects in column 5. Interestingly, primary exports continue to be negative and statistically significant, but the urbanization rate becomes to be negative and statistically significant. Lastly, to address the possibility that the regressions in column 1 through 5 are still picking up unobserved factors driving both primary exports and secondary enrollment, we incorporate country fixed effects in column 6. The relationship between primary exports and secondary school enrollment is also negative and significant. Again, the effect of urbanization on secondary enrollment is negative and significant. There is no significant effect of lagged log GDP per capita on secondary enrollment.

Overall, we conclude that, contrary to conventional wisdom about the human capital will increase with the arrival of new exporting opportunities, there is no evidence that export expansion in primary goods is related to skill premium in LAC region over the period 1965 to 2010. On the contrary, in our specification, we find that, regardless of controls, the relationship of primary exports and secondary enrollment is negative and statistically significant in the panel estimates.

### 1.4.3 Robustness

We next continue with the panel estimates, incorporating several robustness checks. As the first robustness check, we consider different measures of educational attainment. The results are given in Table 1.3. Column 1 simply replicates the result from column 4 in Table 1.2 for comparison purposes. We redefine the dependent variable to be the percent of complete secondary schooling attained in population aged 15 and above (column 2), the percent of tertiary schooling attained in population aged 15 and above (column 3), the percent of complete tertiary schooling attained in population aged 15 and above (column 4), the average years of schooling attained (column 5), the average years of secondary schooling attained (column 6), and the average years of tertiary schooling attained (column 7)[6]. All regressions consider lagged urbanization rate, a series of lagged GDP per capita, and initial conditions in 1965. As is evident, the effect of primary exports on educational attainment are still negative, statistically significant, and economically meaningful in all columns. This finding provides suggestive evidence that export expansion in primary goods not only discourages young people from enrolling secondary/tertiary schooling but also increases the dropout rate of those in secondary/tertiary schooling. Furthermore, we also find that the most substantial effects for primary exports are during the secondary schooling period, which suggests that young people are most sensitive to economic conditions at the time of secondary schooling. In sum, there is substantial evidence for the negative effects of primary exports on educational attainment across countries in LAC in the last fifty years, even after considering different measures of educational attainment.

As the second robustness check, we consider the possible reverse causality from educational attainment to export expansion in primary goods. The results are given in Table 1.4. Column 1 regresses primary exports at time $t$ on the percentage of secondary schooling completed in time $t-1$ and finds there is no significant relationship. This result suggests that there is no evidence that change in secondary schooling leads to subsequent changes in primary exports. In column 2 and 3, we use different measurements of educational attainment and still find the evidence supporting our argument. Column 4 looks at the contemporaneous effect of primary exports in time $t$ on the percentage of secondary schooling completed in time $t$. As can be seen, we find no significant relationship here. Similarly, we use different contemporaneous measures of educational attainment in columns 4 and 5 and find that there is still no significant relationship. Therefore, these findings provide the further support our

[6]One concern of using enrollment ratios is that they measure the access to education rather than the cumulated education outcome. Hence, we resort to the stock variable, such as average years of schooling.

argument that a shift towards primary exports leads to lower level of human capital accumulation and not the other way around.

We consider the heterogeneous effects of different types of primary goods on educational attainment in the third robustness check. The results are given in Table 1.5. Accordingly, we split primary exports into agricultural raw material exports, ore and metals exports, and food exports. We expect stronger effects for agricultural raw material exports, as their global supply is relatively inelastic and their production process is unskilled-intensive compared with ore, metal, and food exports. In columns 1 and 2, we consider the effect of agriculture raw material exports on secondary enrollment. Columns 3 and 4 examine ore and metal exports. Columns 5 and 6 focus on food exports. As is evident, each type of the primary exports has a negative and significant effect on the secondary enrollment. As we expected, the absolute value of the estimated coefficient is largest for agriculture raw materials exports. Furthermore, we consider time fixed effects and country fixed effects in column 2, 4, and 6. Again the results are similar in sign and significance for the primary exports on the secondary enrollment. Note that the magnitude of the effect of ore and metal export on secondary enrollment becomes slightly more significant.

The final robustness check in the panel specifications addresses the concern that the one-year lag structure could be too short to capture the individual's incentive to invest in human capital. Table 1.6 reports the results by using a different lag structure. Column 1 replicates the result from column 4 in Table 1.2 for comparison purposes. Column 2 lags the primary exports share by two years rather than one year. The results are remain of the expected sign, statistically significant, and quantitatively similar to the baseline results. Columns 3-6 use three years, four years, and five years lag structure, respectively. The results are unaltered. Finally, column 6 uses the five-year lags but instead focuses on the average years of schooling. Again, the coefficients on primary exports remain similar in negativesign and statistically significance. Overall, there is still strong evidence that primary exports have the negative effect on the educational attainments.

### 1.4.4 Investigating causality

This section introduces the instrumental variables analysis to further enhance confidence in the identification of the effect of primary exports on educational attainment. To identify the effect of primary exports on educational attainment, we require a source of exogenous variation in the size of primary exports that does not influence educational attainment directly. Following Sachs and Warner (2001), Bruckner (2012), and Douglas Gollin et al.(2015), we use resource discoveries and international primary goods exports price index as instruments.

The first instrument we use is a dummy variable of resource discoveries. For each country, we use the USGS (2013) to create a post-discovery indicator whose value is one if the country's main natural resource over the period 1965-2010 had already been discovered at period t-1. For example, if the country had discovered their resource in 1965, the resource discoveries dummy are coded with a one for each year over the period 1965-2010. Similarly, if the country had discovered the resource in 1990, this dummy will switch from zero (1965-1989) to one (1990-2010) for each year.

The second instrument we consider is the export price index of the primary goods. Changes in primary goods price in the world market reflect fluctuations in demand for primary goods, which in turn generate changes in the evolution of primary exports. Therefore, we construct the country-specific international primary goods exports price index as:

$$Prindex_{i,t} = \Pi_{g \in G} Price_{g,t}^{\theta_{i,g}} \tag{1.17}$$

where $Price_{g,t}$ is the international price of commodity g in year t, and $\theta_{i,g}$ is the average value of exports of commodity g in the total merchandise exports of country i. The data on the average value of exports of commodity g in the total merchandise exports are from the World Development Indicators. We match these weight with the specific international primary goods price provided by UNCTAD (2013). The primary goods are done for the broad commodity categories, namely, agricultural materials, ores, metals, and food. Compared to resource discoveries, the advantage of using the international primary goods export price index as an instrument is that they provide both positive and negative shocks to primary exports.

These instruments appear to satisfy the exclusion restriction. Certainly, resource discovery is an exogenous variable that is not affected by changes in the economic conditions. Also, variation in the international primary goods price is plausibly exogenous for most primary goods in LAC countries as these countries are price takers in the world primary good market.

Therefore, given the logic behind our instruments, we run the following regressions as the first stage of TSLS:

$$EX_{i,t-1} = \alpha_1 I_{i,t-1} + \alpha_2 U_{i,t-1} + \alpha_3 GDP_{i,t-2} + \alpha_4 GDP_{i,t-3} + \alpha_5 GDP_{i,t-4} + \epsilon_{it} \quad (1.18)$$

where $I_{i,t-1}$ is the lagged instrumental variable. The coefficient $\alpha$, in front of the instrument is expected to have a positive sign. Table 1.7 and Table 1.8 show the details of the first-stage regressions results by using different instruments. Regarding the results, both resource discoveries and international primary good export price affect the primary exports positively, independent of the set of educational attainment measures used, although the magnitude of the positive effect changes across educational attainment measures. Moreover, both instruments are relevant according to the F-test and the R-squared takes values up to 0.74, which are indicators of strong instruments.

Tables 1.9 reports the second-stage results of the two-stage least squares estimation where the resource discovery is used as the instrument for primary exports. As in the benchmark case, the coefficients before primary exports remain negative, suggesting that a shift towards to primary exports reduce the level of human capital accumulation. Moreover, the point estimates are now larger in absolute value than in the OLS estimates and remain statistically significant.

Table 1.10 shows results of IV regression by using the international primary goods export price index as the instrument for primary exports. The effect of primary exports remains negative and statistically significant. Comparing the IV results in Table 1.9 with the baseline panel results in Table 1.3, the estimated effect of primary exports on human capital accumulation is larger in IV (0.48 versus 0.23). Moreover, the R-squared in IV is larger than the OLS estimates. These findings indicate that some country time-invariant characteristic are not as large as suspected in the OLS panel results. In other words, the endogeneity problems in OLS estimates are not so severe. Again, we do not find other factors, such as urbanization rate, lagged GDP, and initial conditions, play an economically significant role. In sum, the effects of export expansion in primary exports are negative and significant in all IV results, independent of the instrument used and educational attainment measures used. These results provide further support that there is a causal adverse effect of the export expansion in primary goods on human capital accumulation across LAC countries during 1965-2010.

## 1.5 Extension

### 1.5.1 Schooling vs Human capital

The analysis that we have achieved so far has been based on the schooling data. However, schooling data do not capture the return to schooling which is crucial in human capital accumulation. Therefore, in this subsection, we replace the schooling data with human capital index to provide further support. The human capital index data are obtained from the Penn World Table 9.0. This index is constructed based on the assumed rate of return to education and the average years of schooling[7].

Table 1.11 examines the relationship between the human capital index and export expansion of primary goods. Here, we again see the statistically significant negative coefficients on the primary exports using any estimation methodologies. As is evident, in column 1, the coefficient estimate, -0.004, suggesting that a country with a one standard deviation above the mean primary export share tends to have 0.4 % lower in human capital index over the period 1965-2010. The quantitative magnitude of this effect is somewhat smaller than the magnitude associated with the schooling measure. In column 2, we consider the lagged GDP and the initial conditions as control variables, there are also negative and statistically coefficients on the primary exports variable. In column 3 and column 4, we use IV method in order to deal with the potential endogeneity concerns. The results are more robust. Column 3 uses the

[7]The human capital index is calculated from the following equation,

$$\phi(y) = \begin{cases} 0.134 \cdot y & \text{if } y \leq 4 \\ 0.134 \cdot 4 + 0.101(y-4) & \text{if } 4 < y \leq 8 \\ 0.134 \cdot 4 + 0.101 \cdot 4 + 0.068(y-8) & \text{if } y > 8 \end{cases}$$

where $y$ is the average years of schooling from either dataset. The methodology is explained in detail at: http://www.rug.nl/ggdc/productivity/pwt/. Regarding the assumed rate of return to education, see Psacharopooulos, 1994.

resource discoveries indicator as the instrument for primary exports and column 4 uses the international primary good export price index as an instrument. Again, the coefficient of primary exports is negative and statistically significant. Overall, we can safely claim that a shift towards primary exports reduces human capital accumulation in LAC over the period 1965-2010, independent of using schooling data or human capital index.

### 1.5.2 Sensitivity analysis

We report some sensitivity checks in Table 1.12 by adding additional controls. All the regressions use the international primary goods export price index as an instrument variable for the primary exports and each column considers the initial conditions. In column 1, we add the log of the population as a control variable and find that there is a significant negative effect of population on the secondary enrollment. The coefficient on the primary export remains negative and statistically significant. Column 2 adds the death rate (per 1000 people) to capture a series of shocks such as disease, famine which could affect both primary exports and educational attainment. As expected, there is a negative and significant coefficient in front of the death rate. Again, we see the statistically significant negative coefficient on the primary exports.

Column 3 adds the international migrant stock share of the population as a control variable. The inflow of migrants might dilute the effect of primary exports on educational attainment if, for example, export expansion in primary goods attracts low-skill immigrants. As is evident, the effect of primary exports on the secondary enrollment becomes smaller when we consider the migrant share. The population and the death rate remain negatively correlated with the secondary enrollment, but the effect of death rate is insignificant.

To capture the channels other than exports that affect educational attainment, we also consider the FDI net inflows share of GDP in column 4 and find that the FDI net inflow has a positive but insignificant effect on the secondary enrollment. In column 5, we switch the dependent variable from flow variable (secondary enrollment) to the stock variable (average years of schooling). Column 6 uses the human capital index as the dependent variable. As is evident, the primary exports still have negative effects on educational attainment.

In summary, through columns 1-6, the estimated coefficients on the primary exports are consistently negative and statistically significant. The corresponding effects of death rate, migrant stock, foreign direct invest net inflows on educational attainment are mixed. Therefore, independent of the educational attainment measures used and additional controls added, we have confirmed that the primary exports play a negative role in the human capital accumulation over the period 1965-2010 for Latin American countries.

### 1.5.3 Gender

The previous analysis groups males and females together. The Barro-Lee data also reports educational attainment by gender. In this subsection, we explore heterogeneity across genders by rerunning the main specification. We replace the measure of educational attainment in equation (1.16) with either the measure of educational attainment of males or the measure of educational attainment of females. The results are given in Table 1.13.

The enrollment of secondary schooling and tertiary schooling of both males and females respond to export expansion in primary goods in broadly the same way. Specifically, regarding secondary school enrollment, the estimated coefficient on the primary exports is -0.24 for males and -0.23 for females, both are statistically significant. However, regarding secondary completion rate and tertiary completion rare, we find that the males respond more than females. In other words, males drop-out rates in secondary school and tertiary school is greater than female drop-out rates as export expansion in primary goods. This finding is consistent with existing studies such as by Atkin (2016) who finds that males respond more to employment shocks than the female.

The reasonable explanation of the gender difference is as follows. Some export job opportunities are gender-specific. For example, some new export job opportunities are particularly suited to males, hence, males will have a more significant response effect than females and vice versa. As we know, in general, the primary good sector places more emphasis on "brawn". Compared to women, men are endowed with brawn and have an absolute advantage in brawn. Although there are the growing brawn-saving technologies which could compensate for the female disadvantage in physical tasks, women may still retain a comparative disadvantage in goods production (e.g., see Goldin, 2006; Rendall, 2010). Export expansion in primary goods has created new job opportunities for males who have a natural comparative advantage, therefore, primary exports affect males more than females in their education decision.

### 1.5.4 Education Inequality

In this section, we turn to investigate the effect of primary exports on education inequality. Since education is a partially tradable asset, the aggregate production of education depends not only on the level of the human capital accumulation but also on its distribution. Most recent studies on education inequality have focused on the relationship between education inequality and economic growth (e.g., see Thomas, Wang and Fan, 2000; Casterllo-Climent and Madrid, 2004).

How does the expansion of primary exports affect education inequality in the LAC region over the period 1965-2010? The mechanism we postulate is as follows. As the sectors producing primary commodities exported by LAC countries are relatively intensive in their use of unskilled labor, the rise observed in the prices of these commodities raises the relative return to unskilled labor, leading to a decline in human capital acquisition for this labor type, and thereby raises educational inequality.

We use the panel estimates specification to examine the effect of primary exports on education inequality. The education inequality data measured by education gini are borrowed from Ziesemer (2016) who provides five-year data of gini coefficient of education for 146 countries for the years 1950-2010 [8]. This education gini is constructed based on the educational attainment rather than enrollment or education financing[9]. It ranges from zero, which represents perfect equality, to one, which represents perfect inequality[10]. Before we turn to the regression, we present some preliminary description of the evolution in education inequality of our sample.

Figure 1.3 plots education gini in 2010 against education gini in 1965 for each country in LAC. We find that all countries lie below the 45-degree line, suggesting

[8]http://www.merit.unu.edu/docs/ginipublicexcel.xls

[9]Education Gini measures the ratio to the mean of half of the average schooling deviations between all possible pair of people. The education gini formula is constructed from the following equation,

$$E = (\frac{1}{\mu})\sum_{i=2}^{n}\sum_{j=1}^{i-1} s_i|y_i - y_j|s_j$$

where $E$ is the education gini based on educational attainment distribution, $\mu$ is the average years of schooling for the concerned population, $s_i$ and $s_j$ stand for the shares of population with certain levels of schooling, $y_i$ and $y_j$ are the years of schooling at different educational attainment levels, $n$ is the number of levels of attainment and equals to seven. Note that the seven categories include no schooling, and total and completed primary, secondary and tertiary education

[10]Data in education gini are constructed at 5-year intervals from 1950 to 2010. We use a linear interpolation method to estimate missing observations (e.g., see Hsieh and Klenow, 2010).

that the education inequality measured by education gini has been declined for all the countries in LAC in the last fifty years. More importantly, there is considerable variation in the decrease in education gini on the same initial level. Specifically, from 1965 to 2010, education gini declined rapidly in some countries, such as Bolivia and Honduras, but slowly in other cases such as Argentina, Chile, and Uruguay. For instance, Bolivia decreased its education gini from 0.58 in 1965 to 0.18 in 2010; Honduras dropped its education gini from 0.59 in 1965 to 0.22 in 2010. Argentina's education gini coefficient fell slowly, from 0.21 in 1965 to 0.17 in 2010. Furthermore, some countries in LAC experienced increased education inequality in recent years (Figure 1.4). For example, Barbados increased its education gini from 0.048 in 2005 to 0.053 in 2010; Belize increased its education gini from 0.192 in 2005 to 0.194 in 2010.

The estimation results are given in Table 1.14, where the effect of primary exports on education inequality are positive and statistically significant, independent of including the control variables. As is evident, column 1 shows the bivariate relationship between education gini and primary exports without any other controls. The estimated coefficient suggests that primary exports increase education gini by about 0.001 across LAC countries over the period from 1965 to 2010. Column 2-4 consider further control variables. After including these controls, there is still a positive association between the education gini and primary exports, though the coefficient is slightly larger. Specifically, column 2 adds the urbanization rate; column 3 adds the initial conditions in 1965, namely, the education gini in 1965, the share of primary export in total merchandise exports in 1965, and log GDP per capita in 1965. Column 4 demonstrates that this relationship is robust to including a series of lagged log GDP per capita controls. Moreover, we see a statistically negative relationship between education inequality and urbanization. Column 5 and 6 use resource discoveries and international primary good export price index as instruments for primary exports. The coefficients on the primary exports are also significant and positive, but urbanization is insignificant. Overall, there is strong evidence that a shift towards primary exports exacerbated the education inequality in LAC over the period 1965-2010.

## 1.6 Conclusion

In this paper, we argued that the expansion of primary goods exports may harm human capital accumulation. The mechanism we have emphasized that leads to this result is as follows. In general, export expansion enhances the initial patterns of comparative advantage and exacerbates the existing differences in levels of human capital accumulation. In particular, if the economy is initially allocating significant resources to primary goods production, the export expansion will increase the production of unskilled labor-intensive goods and decrease the demand for skilled labor, reducing the incentives to invest in human capital.

The central hypothesis of this research that a shift towards primary exports reduces the levels of human capital accumulation is supported by empirical evidence based on Latin American data over the period 1965–2010. The results are robust to the inclusion of a variety of controls and usage of different human capital accumulation indicators. Furthermore, using resource discoveries and international primary goods export price index as instruments, we find supporting evidence that the effect of primary exports is causal for reductions in the level of human capital accumulation. Finally, we also provide evidence that export expansion in primary goods exacerbates the education inequality in LAC over the period 1965-2010.

The findings in this paper suggest that the specific characteristics of export structure in LAC over the period 1965–2010 can explain the persistent stagnation in its level of human capital accumulation. Human capital accumulation is widely recognized as a critical driver to support inclusive development and favorable labor market outcomes, especially in developing countries. Therefore, given the importance of human capital accumulation for long-run growth, our results suggest a potential role for policy intervention.

## Tables and Figures

Table 1.1: Descriptive Statistics

| | Obs | Mean | Std.Dev | Mini | Maxi |
|---|---|---|---|---|---|
| primary exports | 1339 | 58.60 | 28.40 | 0.05 | 99.90 |
| urbanization | 1749 | 52.84 | 19.77 | 8.53 | 95.15 |
| log GDP per capita | 1701 | 8.13 | 0.83 | 6.10 | 10.11 |
| % of secondary schooling | 250 | 29.99 | 16.84 | 4.09 | 86.56 |
| % of complete secondary | 250 | 13.95 | 8.98 | 1.55 | 50.54 |
| % of tertiary schooling | 250 | 6.68 | 5.37 | 0.00 | 31.08 |
| % of complete tertiary | 250 | 3.86 | 3.72 | 0.00 | 24.37 |
| years of schooling | 250 | 6.26 | 2.16 | 0.95 | 11.29 |
| years of secondary schooling | 250 | 1.71 | 0.91 | 0.19 | 4.10 |
| years of tertiary schooling | 250 | 0.21 | 0.18 | 0.00 | 1.11 |
| recovery indicator | 2314 | 0.25 | 0.43 | 0.00 | 1.00 |
| price index | 2306 | 0.38 | 0.77 | 0.00 | 13.45 |
| human capital index | 1255 | 2.06 | 0.47 | 1.14 | 3.41 |
| gini coefficient of education | 275 | 0.32 | 0.15 | 0.05 | 0.88 |
| log of Population | 1,776 | 13.90 | 2.55 | 8.55 | 19.10 |
| Death rate (per 1,000 people) | 1,546 | 7.60 | 2.60 | 2.60 | 20.55 |
| Migrant stock (% of population) | 198 | 10.43 | 15.64 | 0.13 | 79.09 |
| FDI net inflow (% of GDP) | 1,144 | 3.89 | 15.14 | -55.24 | 466.56 |

*LAC countries* – Argentina, Barbados, Bolivia, Brazil, Chile, Columbia, Costa Rica, Ecuador, EL Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, Venezuela . Source: World Bank

*Primary exports* – Primary good exports consist of agricultural raw materials, ores, metals and food exports. We use the share of primary good exports in total merchandise exports (%) for the LAC countries in 1965-2010. It comprises SITC section 0 (food and live animals), 1(berages and tobacco), 2(crude materials except fuels), 4(animal and vegetable oils and fats), 22(oil seeds, oil nuts, and oil kernels), 27(crude fertilizer, minerals nes), 28(metalliferous ores and scrap). Source: World Development Indicator

*Urbanization rate* Source: World Development Indicator

*Log GDP per capita.* Source: World Development Indicator

*Percentage of Secondary Schooling Attained in Pop* Source: Barro Lee Dataset

*Percentage of Complete Secondary Schooling Attained in Pop.* Source: Barro Lee Dataset

*Percentage of Tertiary Schooling Attained in Pop.* Source: Barro Lee Dataset

*Percentage of Complete Tertiary Schooling Attained in Pop.* Source: Barro Lee Dataset

*Average Years of Schooling Attained.* Source: Barro Lee Dataset

*Average Years of Secondary Schooling Attained.* Source: Barro Lee Dataset

*Average Years of Tertiary Schooling Attained.* Source: Barro Lee Dataset

*Human capital index.* Source: Penn World Tables 9.0, series hc

*Log of population.* Source: World Development Indicator

*Death rate (per 1,000 people).* Source: World Development Indicator

*Migrant stocks (% of population)* Source: World Development Indicator

*FDI net inflow (% of GDP)* Source: World Development Indicator

*Gini coefficient of education.* Source: http://www.merit.unu.edu/docs/ginipublicexcel.xls

Table 1.2: Panel analysis, main stylized fact

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Primary exports | -0.18*** | -0.17*** | -0.25*** | -0.23*** | -0.11*** | -0.11** |
| (%, in year t-1) | (0.04) | (0.04) | (0.04) | (0.04) | (0.03) | (0.03) |
| Urbanization rate | | 0.07 | 0.29*** | 0.23** | -0.19** | -0.54** |
| (%, in year t-1 ) | | (0.06) | (0.07) | (0.07) | (0.06) | (0.17) |
| Log of GDP (in year t-2) | | | | 3.03 | 0.23 | 4.15 |
| | | | | (15.00) | (11.21) | (9.83) |
| Log of GDP(in year t-3) | | | | 4.78 | -0.56 | -3.75 |
| | | | | (15.59) | (11.63) | (9.70) |
| Log of GDP (in year t-4) | | | | -3.25 | 1.39 | 1.06 |
| | | | | (2.20) | (1.81) | (1.52) |
| Initial Conditions in 1965 | | No | Yes | Yes | Yes | Yes |
| Time fixed effect | | No | No | No | Yes | Yes |
| Country fixed effect | | No | No | No | No | Yes |
| R-squared | 0.08 | 0.09 | 0.54 | 0.55 | 0.81 | 0.89 |
| Observation | 212 | 212 | 165 | 164 | 164 | 164 |

Notes: The sample consist of LAC countries from 1965-2010. The dependent variable is the percentage of secondary schooling attained in popolation aged 15 and above. Columns (2)–(6) control for initial conditions, i.e. the percentage of secondary schooling, the share of primary goods exports in total merchandise exports(%) and Log of GDP per capita in 1965. Columns (3)–(6) include lagged GDP per capital. Column (4)–(6) include time fixed effect. Column (6) also include country fixed effect. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ See Appendix for data sources and construction of variables.

Table 1.3: Panel analysis, different measures of educational attainment

| | (1)<br>% of<br>Seco | (2)<br>% of<br>Seco Complete | (3)<br>% of<br>Tert | (4)<br>% of<br>Tert Complete | (5)<br>Years of<br>Schooling | (6)<br>Years of<br>Seco | (7)<br>Years of<br>Tert |
|---|---|---|---|---|---|---|---|
| Primary exports | -0.23*** | -0.12*** | -0.06** | -0.05*** | -0.03*** | -0.01*** | -0.00*** |
| (% , in year t-1) | (0.04) | (0.03) | (0.02) | (0.01) | (0.01) | (0.00) | (0.00) |
| Urbanization rate | 0.23** | 0.20*** | 0.10** | 0.01 | 0.05*** | 0.01* | 0.00 |
| (%, in year t-1) | (0.07) | (0.05) | (0.03) | (0.03) | (0.01) | (0.01) | (0.00) |
| Log of GDP (in year t-2) | 3.03 | 11.93 | 0.54 | 2.58 | -0.52 | 0.10 | 0.06 |
| | (15.00) | (10.26) | (7.24) | (5.56) | (2.01) | (1.02) | (0.25) |
| Log of GDP (in year t-3) | 4.78 | -6.51 | 4.31 | 1.22 | 1.51 | 0.67 | 0.11 |
| | (15.59) | (10.66) | (7.49) | (5.74) | (2.09) | (1.06) | (0.26) |
| Log of GDP (in year t-4) | -3.25 | -2.40 | -1.74 | -0.94 | -0.75* | -0.25 | -0.05 |
| | (2.20) | (1.50) | (1.05) | (0.81) | (0.30) | (0.15) | (0.04) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.55 | 0.53 | 0.47 | 0.40 | 0.67 | 0.53 | 0.43 |
| Observation | 164 | 164 | 164 | 164 | 164 | 164 | 164 |

Notes: The sample consist of LAC countries from 1965-2010. The dependent variables are different measurement of educational attainment. Columns (1)–(7) control for initial conditions, i.e. the educational attainment, the share of primary goods exports in total merchandise exports(%) and Log of GDP per capita in 1965. Column (1) simple replicates the result from column (3) in table 2 for comparison purpose. Column (2) uses the percentage of complete secondary schooling attained in population aged 15 and above. Column (3) we uses the percentage of tertiary schooling attained. Column (4) uses the percentage of complete tertiary schooling attained. Column (5) uses the average years of schooling attained. Column (6) uses the average years of secondary schooling attained. Column (7) use the average years of tertiary schooling attained. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 1.4: Panel analysis, robustness

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Secondary Complete | -0.29 | | | | | |
| (in year t-1) | (0.37) | | | | | |
| Tertiary Complete | | 0.83 | | | | |
| (in year t-1) | | (0.50) | | | | |
| Years of Schooling | | | 0.70 | | | |
| (in year t-1) | | | (2.50) | | | |
| Primary goods exports | | | | -0.01 | 0.02 | -0.00 |
| (in year t) | | | | (0.02) | (0.02) | (0.00) |
| Urbanization rate | -1.53*** | -1.54*** | -1.50*** | -0.15 | 0.11 | 0.02 |
| (in year t-1) | (0.41) | (0.40) | (0.41) | (0.11) | (0.08) | (0.02) |
| Log of GDP | -2.29 | -12.08 | -7.06 | 15.08* | 2.73 | -0.20 |
| (in t-2) | (25.37) | (24.78) | (24.89) | (6.47) | (4.70) | (0.90) |
| Log of GDP | 14.72 | 15.45 | 19.14 | -13.08* | -2.00 | -0.22 |
| (in t-3) | (40.28) | (39.61) | (39.99) | (6.36) | (4.62) | (0.89) |
| Log of GDP | -23.95 | -16.48 | -24.73 | 0.45 | 0.16 | 0.18 |
| (in t-4) | (29.88) | (30.04) | (29.93) | (0.96) | (0.70) | (0.13) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes |
| Time fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Country fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.86 | 0.86 | 0.86 | 0.89 | 0.74 | 0.96 |
| Observation | 151 | 151 | 151 | 166 | 166 | 166 |

Notes: The sample consist of LAC countries from 1965-2010. The dependent variable in column (1)–(3) is the share of primary exports in total merchandise exports at time t. The dependent variables in column (4)–(6) are different measurements of educational attainment. Dependent variable in column (4) is the percentage of complete secondary schooling attained, in column (5) is the percentage of complete tertiary schooling attained, in column (6) is the average years of schooling attained. Columns (1)–(6) all include time fixed effect, country fixed effect and control for initial conditions in 1965. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.See Appendix for data sources and construction of variables.

Table 1.5: Panel analysis, heterogeneous effects of different primary goods

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Agriculture raw material exports | -0.40*** | -0.32** | | | | |
| (% in year t-1) | (0.10) | (0.11) | | | | |
| Food export | | | -0.07* | -0.08** | | |
| (%, in year t-1) | | | (0.03) | (0.03) | | |
| Ore and metals exports | | | | | -0.02 | -0.19* |
| (%, in year t-1) | | | | | (0.05) | (0.08) |
| Urbanization rate | 0.01 | 0.60*** | -0.00 | -0.72*** | -0.00 | 0.69*** |
| (%, in year t-1) | (0.04) | (0.11) | (0.04) | (0.12) | (0.04) | (0.10) |
| Log of GDP (in year t-2) | -2.60 | 20.54 | 0.23 | -2.05 | -4.52 | 13.81 |
| | (16.00) | (12.31) | (16.73) | (9.80) | (16.90) | (12.40) |
| Log of GDP (in year t-3) | 22.82 | -4.25 | 21.24 | 3.07 | 26.46 | -0.69 |
| | (16.64) | (12.60) | (17.45) | (9.81) | (17.51) | (12.62) |
| Log of GDP (in year t-4) | -3.56 | 0.31 | -3.70 | 1.50 | -3.82 | 1.64 |
| | (2.62) | (2.06) | (2.71) | (1.67) | (2.74) | (2.05) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes |
| Time fixed effect | No | Yes | No | Yes | No | Yes |
| Country fixed effect | No | Yes | No | Yes | No | Yes |
| R-squared | 0.46 | 0.74 | 0.42 | 0.75 | 0.41 | 0.74 |
| Observation | 198 | 198 | 197 | 197 | 197 | 197 |

Notes: The sample consist of LAC countries from 1965-2010. The dependent variable is the percentage of secondary schooling attained in population aged 15 and above. Columns (1)–(6) control for initial conditions, i.e. the percentage of secondary schooling and Log of GDP per capita in 1965. Columns (2), (4) and (6) include time fixed effect and country fixed effect. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ See Appendix for data sources and construction of variables.

Table 1.6: Panel analysis, different lags structure

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Primary exports | -0.23*** | | | | | |
| (%, in year t-1) | (0.04) | | | | | |
| Primary exports | | -0.26*** | | | | |
| (%, in year t-2) | | (0.04) | | | | |
| Primary exports | | | -0.28*** | | | |
| (%, in year t-3) | | | (0.04) | | | |
| Primary exports | | | | -0.27*** | | |
| (%, in year t-4) | | | | (0.04) | | |
| Primary exports | | | | | -0.28*** | -0.04*** |
| (%, in year t-5) | | | | | (0.04) | (0.01) |
| Urbanization rate | 0.23** | 0.20** | 0.16* | 0.14 | 0.16* | 0.05*** |
| (%, in year t-1) | (0.07) | (0.07) | (0.07) | (0.08) | (0.08) | (0.01) |
| Log of GDP (in year t-2) | 3.03 | 4.35 | 10.94 | 6.33 | 7.51 | -0.55 |
| | (15.00) | (14.66) | (15.07) | (16.64) | (16.03) | (2.14) |
| Log of GDP (in year t-3) | 4.78 | 3.56 | -2.84 | -0.45 | 0.40 | 3.08 |
| | (15.59) | (15.23) | (15.58) | (29.51) | (28.85) | (3.85) |
| Log of GDP (in year t-4) | -3.25 | -3.34 | -3.46 | -1.86 | -4.84 | -2.56 |
| | (2.20) | (2.14) | (2.13) | (19.32) | (19.26) | (2.57) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.55 | 0.58 | 0.59 | 0.57 | 0.58 | 0.69 |
| Observation | 164 | 162 | 160 | 150 | 150 | 150 |

Notes: The sample consist of LAC countries from 1965-2010. The dependent variable Columns (1)–(5) is the percentage of secondary schooling attained in population aged 15 and above. The dependent variable in column 6 is the average years of schooling. Columns (1)–(6) control for initial conditions, i.e. the percentage of secondary schooling and Log of GDP per capita in 1965. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ See Appendix for data sources and construction of variables.

Table 1.7: First Stage Results of 2SLS Estimation Using The First Instrument

| Dependent variable: Primary exports | | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Post-discovery indicator | 34.60*** | 27.94*** | 37.86*** | 41.08*** | 37.47*** | 33.83*** | 39.09*** |
| (in year t-1) | (2.07) | (2.20) | (1.95) | (1.87) | (1.97) | (2.15) | (1.89) |
| Urbanization rate | -1.03*** | -1.02*** | -1.14*** | -1.22*** | -0.96*** | -1.04*** | -1.20*** |
| (%, in year t-1) | (0.07) | (0.07) | (0.07) | (0.06) | (0.06) | (0.07) | (0.06) |
| Log of GDP (in year t-2) | 15.18 | 18.39 | 22.35 | 25.25* | 11.66 | 16.93 | 23.34 |
| | (13.25) | (13.04) | (12.69) | (12.21) | (12.86) | (13.51) | (12.34) |
| Log of GDP (in year t-3) | -28.65* | -30.37* | -29.34* | -30.24* | -27.55* | -30.20* | -28.52* |
| | (14.27) | (14.04) | (13.67) | (13.15) | (13.83) | (14.55) | (13.29) |
| Log of GDP (in year t-4) | 0.52 | 1.29 | 2.99 | 3.74 | -1.20 | 0.83 | 3.38 |
| | (3.72) | (3.66) | (3.56) | (3.43) | (3.61) | (3.79) | (3.46) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-test on instrument | 278.69 | 161.21 | 377.42 | 480.09 | 361.15 | 247.43 | 427.02 |
| | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0000] |
| R-squared | 0.66 | 0.67 | 0.68 | 0.71 | 0.68 | 0.64 | 0.70 |
| Oberservation | 827 | 827 | 827 | 827 | 827 | 827 | 827 |

Notes: All columns control for log initial GDP per capita and the initial share of primary commodity exports. Column (1) controls for the initial percentage of secondary; Column (2) controls for the initial percentage of secondary complete; Column (3) controls for the initial percentage of Tertiary; Column (4) controls for the initial percentage of Tertiary complete; Column (5) controls for the initial average years of schooling; Column (6) controls for the initial average years of secondary schooling; Column (7) controls for the initial average years of tertiary schooling. All regressions include a constant. F-test on instrument shows the Sanderson-Windmeijer F-stat based on the null hypothesis of the coefficient of instrument being equal to zero. The corresponding p-values are given in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1.8: First Stage Results of 2SLS Estimation Using The Second Instrument

| Dependent variable: Primary exports | | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| International primary goods price index | 21.68*** | 18.74*** | 23.76*** | 24.91*** | 22.83*** | 22.03*** | 24.15*** |
| (base period=2000,in year t-1) | (1.21) | (1.40) | (1.01) | (0.97) | (1.06) | (1.25) | (0.98) |
| Urbanization rate | -0.98*** | -0.97*** | -1.20*** | -1.26*** | -0.99*** | -0.99*** | -1.25*** |
| (%, in year t-1) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.07) | (0.06) |
| Log of GDP (in year t-2) | 14.64 | 16.94 | 17.07 | 19.87 | 8.90 | 15.75 | 18.08 |
| | (13.01) | (12.93) | (11.84) | (11.46) | (12.33) | (13.13) | (11.53) |
| Log of GDP (in year t-3) | -30.10* | -31.23* | -24.65 | -26.03* | -25.36 | -31.11* | -24.14 |
| | (14.00) | (13.92) | (12.75) | (12.33) | (13.25) | (14.14) | (12.42) |
| Log of GDP (in year t-4) | 1.32 | 1.73 | 3.05 | 3.76 | -0.55 | 1.56 | 3.42 |
| | (3.65) | (3.63) | (3.32) | (3.22) | (3.46) | (3.68) | (3.24) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-test on instrument | 319.72 | 178.38 | 557.71 | 659.09 | 466.97 | 311.04 | 610.10 |
| | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0000] | [0.0000] |
| R-squared | 0.67 | 0.67 | 0.73 | 0.74 | 0.70 | 0.66 | 0.74 |
| Observation | 827 | 827 | 827 | 827 | 827 | 827 | 827 |

Notes: All columns control for log initial GDP per capita and the initial share of primary commodity exports. Column (1) controls for the initial percentage of secondary; Column (2) controls for the initial percentage of secondary complete; Column (3) controls for the initial percentage of Tertiary; Column (4) controls for the initial percentage of Tertiary complete; Column (5) controls for the initial average years of schooling; Column (6) controls for the initial average years of secondary schooling; Column (7) controls for the initial average years of tertiary schooling. All regressions include a constant. Robust standard errors in parentheses. F-test on instrument shows the Sanderson-Windmeijer F-stat based on the null hypothesis of the coefficient of instrument being equal to zero. The corresponding p-values are given in brackets.* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1.9: 2SLS Estimation Results Using The First Instrument

| | % of Seco | % of Seco Complete | % of Tert | % of Tert Complete | Years of Schooling | Years of Seco | Years of Tert |
|---|---|---|---|---|---|---|---|
| Primary exports | -0.59*** | -0.47*** | -0.15*** | -0.08*** | -0.08*** | -0.04*** | -0.00*** |
| (%, in year t-1) | (0.11) | (0.11) | (0.03) | (0.02) | (0.01) | (0.01) | (0.00) |
| Urbanization rate | 0.10 | 0.01 | 0.07 | -0.00 | 0.05*** | 0.00 | 0.00 |
| (%, in year t-1) | (0.11) | (0.11) | (0.04) | (0.03) | (0.01) | (0.01) | (0.00) |
| Log of GDP (in year t-2) | 1.67 | 12.23 | 1.98 | 3.18 | -1.11 | 0.16 | 0.11 |
| | (20.32) | (16.55) | (7.41) | (5.27) | (2.65) | (1.51) | (0.25) |
| Log of GDP (in year t-3) | -1.41 | -12.50 | 1.40 | 0.14 | 0.96 | 0.01 | 0.03 |
| | (21.69) | (17.27) | (7.33) | (5.25) | (2.74) | (1.58) | (0.25) |
| Log of GDP (in year t-4) | -2.54* | -1.53 | -1.28 | -0.76 | -0.73*** | -0.18* | -0.04 |
| | (1.15) | (1.31) | (0.67) | (0.41) | (0.18) | (0.09) | (0.02) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.29 | 0.05 | 0.38 | 0.38 | 0.50 | 0.12 | 0.38 |
| Observation | 164 | 164 | 164 | 164 | 164 | 164 | 164 |

Notes: We use an instrument for the share of primary exports in merchandise exports (%) in year t-1: a post-discovery indicator whose value is one in year t-1 if the country's main commodity was already "discovered". All columns controls for initial conditions, i.e. the educational attainment, log of GDP per capita and the share of primary commodity exports in 1965. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ See Appendix for data sources and construction of variables.

Table 1.10: 2SLS Estimation Results Using The Second Instrument

| | % of Seco | % of SecoComplete | % of Tert | % of Tert Complete | Years of Schooling | Years of Seco | Years of Tert |
|---|---|---|---|---|---|---|---|
| Primary exports | -0.48*** | -0.38*** | -0.08** | -0.06** | -0.06*** | -0.03*** | -0.00** |
| (%, in year t-1) | (0.09) | (0.10) | (0.03) | (0.02) | (0.01) | (0.01) | (0.00) |
| Urbanization rate | 0.14 | 0.05 | 0.10* | 0.01 | 0.05*** | 0.01 | 0.00 |
| (%, in year t-1) | (0.11) | (0.10) | (0.04) | (0.03) | (0.01) | (0.01) | (0.00) |
| Log of GDP (in year t-2) | 2.09 | 12.16 | 0.90 | 2.67 | -0.88 | 0.14 | 0.07 |
| | (18.17) | (14.60) | (6.63) | (5.09) | (2.35) | (1.25) | (0.23) |
| Log of GDP (in year t-3) | 0.49 | -11.04 | 3.58 | 1.07 | 1.17 | 0.27 | 0.09 |
| | (19.32) | (15.18) | (6.60) | (5.09) | (2.42) | (1.30) | (0.23) |
| Log of GDP (in year t-4) | -2.76** | -1.75 | -1.63* | -0.91* | -0.74*** | -0.21** | -0.05* |
| | (0.93) | (1.06) | (0.68) | (0.42) | (0.15) | (0.07) | (0.02) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.43 | 0.26 | 0.47 | 0.40 | 0.61 | 0.38 | 0.43 |
| Observation | 164 | 164 | 164 | 164 | 164 | 164 | 164 |

Notes: We use an instrument for the share of primary exports in merchandise exports (%) in year t-1: the world price index of the country's main commodity(base period=2000) in year t-1. All columns controls for initial conditions, i.e. the educational attainment, log of GDP per capita and the share of primary commodity exports in 1965. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ See Appendix for data sources and construction of variables.

Table 1.11: Panel analysis, human capital index

| Dependent variable: Human Capital Index | | | | |
|---|---|---|---|---|
| | OLS | OLS | IV1 | IV2 |
| | (1) | (2) | (3) | (4) |
| Primary exports | -0.004*** | -0.005*** | -0.018*** | -0.015*** |
| (%, in year t-1) | (0.000) | (0.000) | (0.001) | (0.001) |
| Urbanization rate | 0.007*** | 0.009*** | 0.003** | 0.005*** |
| (%, in year t-1 ) | (0.001) | (0.001) | (0.001) | (0.001) |
| log of GDP (in year t-2) | | 0.307 | 0.575* | 0.521* |
| | | (0.219) | (0.295) | (0.269) |
| log of GDP (in year t-3) | | -0.014 | -0.515 | -0.413 |
| | | (0.236) | (0.320) | (0.292) |
| log of GDP (in year t-4) | | -0.067 | -0.060 | -0.061 |
| | | (0.061) | (0.082) | (0.075) |
| Initial Conditions in 1965 | No | Yes | Yes | Yes |
| R-squared | 0.163 | 0.626 | 0.317 | 0.430 |
| Observation | 1076 | 827 | 827 | 827 |

Notes: The sample consist of LAC countries from 1965-2010. The dependent variable is human capital index. Columns (2)–(4) control for initial conditions, i.e. the human capital index, the share of primary goods exports in total merchandise exports(%) and Log of GDP per capita in 1965. Columns (2)–(4) include lagged GDP per capital. Column (3) uses an instrument for the share of primary exports in merchandise exports (%) in year t-1: a post-discovery indicator whose value is one in year t-1 if the country's main commodity was already "discovered". Column (4) use an instrument for the share of primary exports in merchandise exports (%) in year t-1: the world price index of the country's main commodity(base period=2000) in year t-1. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ See Appendix for data sources and construction of variables.

Table 1.12: Sensitivity analysis, using the second instrument

| | % Secondary | % Secondary | % Secondary | % Secondary | Avg years of schooling | Human capital |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Primary exports | -0.37*** | -0.35*** | -0.27** | -0.27** | -0.03** | -0.01*** |
| | (0.07) | (0.06) | (0.09) | (0.08) | (0.01) | (0.00) |
| Urbanization rate in year t-1 | 0.61*** | 0.43*** | 0.41* | 0.38* | 0.06*** | 0.01 |
| | (0.11) | (0.12) | (0.18) | (0.19) | (0.02) | (0.00) |
| log of GDP in t-2 | 10.59 | 4.14 | 17.93 | 13.44 | 1.36 | 0.37 |
| | (14.70) | (14.27) | (17.79) | (19.25) | (2.24) | (0.44) |
| log of GDP in t-3 | -20.22 | -12.64 | -46.28 | -40.19 | -0.67 | -0.77 |
| | (25.27) | (26.08) | (28.59) | (30.98) | (3.29) | (0.74) |
| log of GDP in t-4 | 13.01 | 8.52 | 32.72 | 31.27 | -0.73 | 0.25 |
| | (15.98) | (16.78) | (20.87) | (21.46) | (2.28) | (0.57) |
| log of Population in year t-1 | -6.00*** | -4.43*** | -6.28*** | -5.83** | -0.54*** | -0.11* |
| | (1.16) | (1.20) | (1.81) | (1.83) | (0.16) | (0.05) |
| Death rate in year t-1 | | -0.99*** | -0.95 | -0.70 | -0.09 | -0.09*** |
| | | (0.26) | (0.86) | (0.84) | (0.07) | (0.02) |
| Migrant in year t-1 | | | -1.18** | -1.09** | -0.10* | 0.02 |
| | | | (0.39) | (0.40) | (0.04) | (0.01) |
| FDI in year t-1 | | | | 0.49 | 0.08* | 0.00 |
| | | | | (0.36) | (0.04) | (0.01) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.60 | 0.63 | 0.57 | 0.58 | 0.75 | 0.72 |
| Observation | 152 | 152 | 85 | 85 | 85 | 85 |

Notes: All regressions use an instrument for the share of primary exports in merchandise exports (%) in year t-1: the world price index of the country's main commodity (base period=2000) in year t-1. The dependent variable in column 1-4 is the secondary school enrollment. Column 1 control for log of population in the lagged year. Column 2 includes the death rate. Column 3 controls for migrant stocks (% population). Column 4 add the foreign directly investment net inflows (% of GDP). Column 5 use the average years of schooling as the dependent variable. Column 6 uses the human capital index as the dependent variable. All columns controls for initial conditions, i.e. the measure of educational attainment, log of GDP per capita and the share of primary commodity exports in 1965. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ See Appendix for data sources and construction of variables.

Table 1.13: Impact of primary exports on educational attainment by gender (OLS)

| | % Secondary | | % Secondary Compl | | % Tertiary | | % Tertiary Compl | |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female | Male | Female |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Primary exports | -0.24*** | -0.23*** | -0.14*** | -0.09** | -0.05** | -0.05* | -0.04** | -0.03 |
| (% of merchandise exports, in year t-1) | (0.05) | (0.04) | (0.03) | (0.03) | (0.02) | (0.02) | (0.01) | (0.02) |
| Urbanization rate | 0.21* | 0.24** | 0.19** | 0.23*** | 0.09* | 0.17*** | 0.02 | 0.06* |
| (% in t-1) | (0.10) | (0.09) | (0.06) | (0.06) | (0.04) | (0.04) | (0.03) | (0.02) |
| log of GDP (in year t-2) | 5.35 | 2.42 | 14.73 | 10.11 | -0.70 | -0.69 | 0.03 | 0.78 |
| | (16.33) | (15.21) | (11.98) | (11.17) | (6.76) | (6.90) | (5.63) | (4.91) |
| log of GDP (in year t-3) | 3.49 | 4.83 | -9.27 | -4.38 | 5.75 | 4.19 | 3.35 | 1.65 |
| | (17.27) | (16.11) | (12.57) | (11.77) | (6.85) | (6.89) | (5.72) | (4.91) |
| log of GDP (in year t-4) | -3.17** | -3.37*** | -2.33** | -2.38*** | -1.59* | -2.05** | -0.99** | -1.24* |
| | (0.95) | (0.97) | (0.73) | (0.68) | (0.61) | (0.77) | (0.37) | (0.49) |
| Initial Conditions in 1965 | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.55 | 0.53 | 0.46 | 0.39 | 0.56 | 0.52 | 0.45 | 0.35 |
| Observation | 164 | 164 | 164 | 164 | 164 | 164 | 164 | 164 |

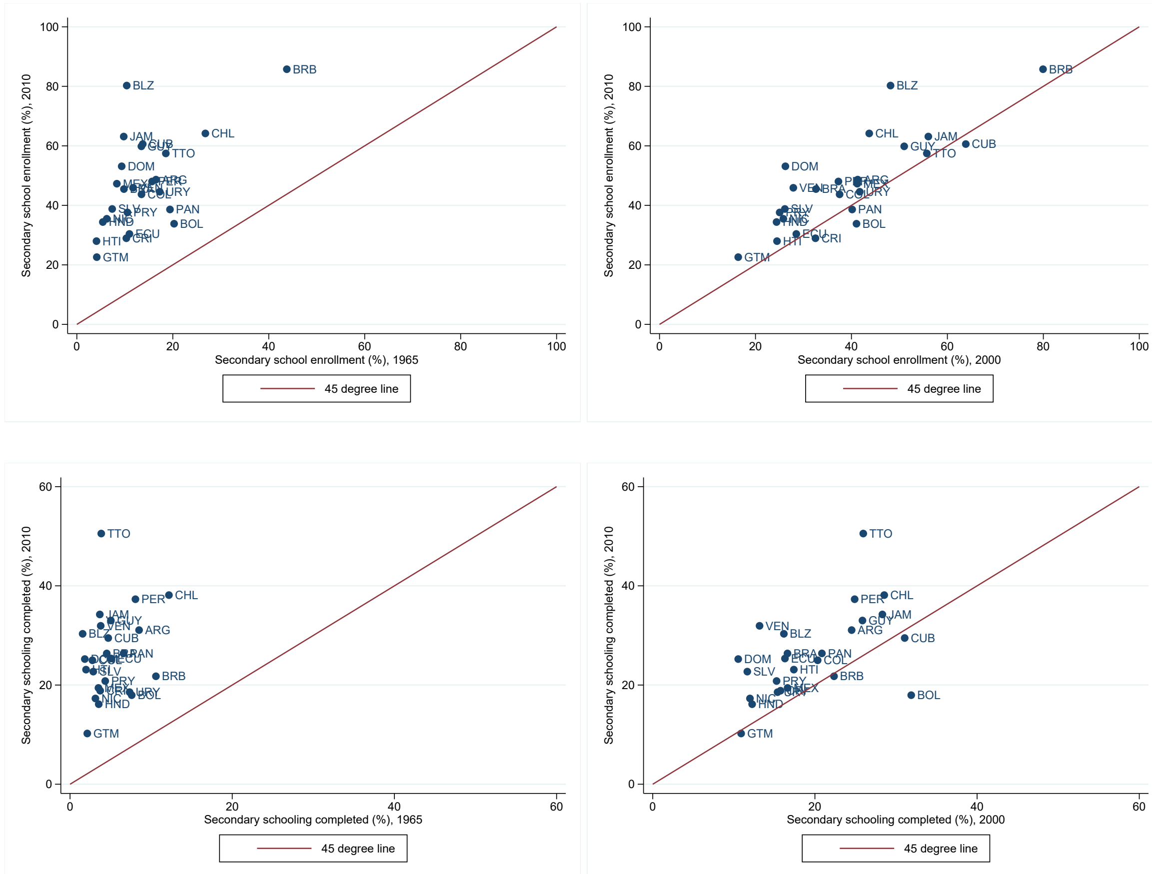
Notes: Dependent variable in column 1-2 is the gender-specific percentage of secondary schooling. Dependent variable in column 3-4 is the gender-specific percentage of completed secondary schooling. Dependent variable in column 5-6 is the gender-specific percentage of tertiary schooling. Dependent variable in column 7-8 is the gender-specific percentage of completed tertiary schooling. All columns controls for initial conditions, i.e. the educational attainment, log of GDP per capita and the share of primary commodity exports in 1965. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ See Appendix for data sources and construction of variables.

Table 1.14: Gini coefficient of education

| | OLS<br>(1) | OLS<br>(2) | OLS<br>(3) | OLS<br>(4) | IV1<br>(5) | IV2<br>(6) |
|---|---|---|---|---|---|---|
| Primary exports | 0.001*** | 0.001*** | 0.002*** | 0.001*** | 0.004*** | 0.004*** |
| (%, in year t-1) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Urbanization rate | | -0.001*** | -0.002*** | -0.001*** | -0.000 | -0.000 |
| (%, in year t-1 ) | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Log of GDP (in year t-2) | | | | -0.075 | -0.120 | -0.119 |
| | | | | (0.077) | (0.085) | (0.085) |
| Log of GDP (in year t-3) | | | | -0.001 | 0.090 | 0.089 |
| | | | | (0.083) | (0.093) | (0.092) |
| Log of GDP (in year t-4) | | | | -0.016 | -0.017 | -0.017 |
| | | | | (0.021) | (0.023) | (0.023) |
| Initial Conditions in 1965 | No | No | Yes | Yes | Yes | Yes |
| R-squared | 0.073 | 0.107 | 0.424 | 0.462 | 0.333 | 0.337 |
| Observation | 1024 | 1024 | 764 | 760 | 760 | 760 |

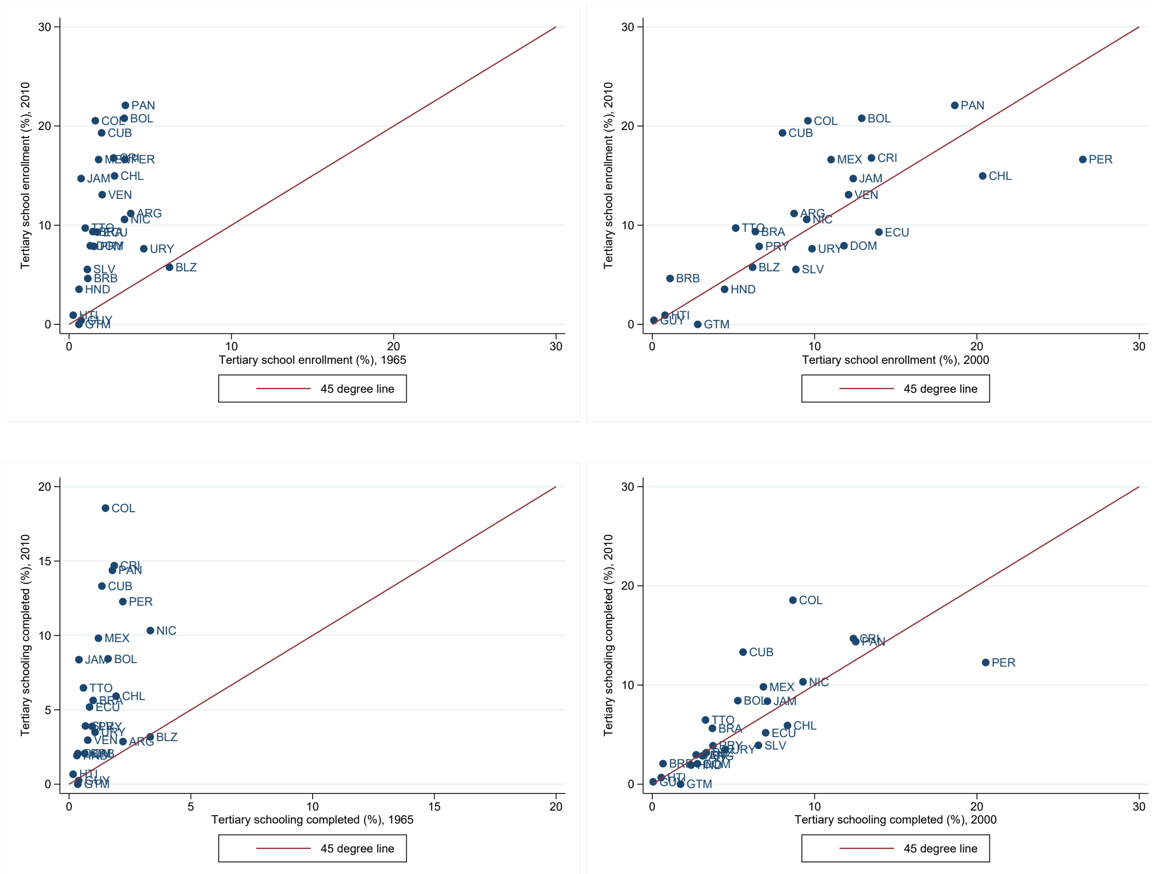
Notes: The sample consist of LAC countries from 1965-2010. The dependent variable is the gini coefficient of education. Columns (2)–(7) control for initial conditions, i.e. the education gini in 1965, the share of primary goods exports in total merchandise exports(%) in 1965 and Log of GDP per capita in 1965. Columns (3)–(6) include lagged GDP per capital. Column (5) uses an instrument for the share of primary exports in merchandise exports (%) in year t-1: a post-discovery indicator whose value is one in year t-1 if the country's main commodity was already "discovered". Column (6) use an instrument for the share of primary exports in merchandise exports (%) in year t-1: the world price index of the country's main commodity(base period=2000) in year t-1. All regressions include a constant. Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ See Appendix for data sources and construction of variables.

Figure 1.1: Secondary School Enrollment and Completion Rate, Different Periods




Notes: The top two graphs plots secondary school enrollment rate against lag period's enrollment rate. The left one compare enrollment in 2010 and 1965. The right one focuses on the recent period, comparing enrollment in 2010 and 2000; The below two graphs plots secondary schooling completion rate against lag period's completion rate. The left one compare completion rate in 2010 and 1965. The right one focuses on the recent period, comparing completion rate in 2010 and 2000. Schooling data is from Barro and Lee (2010).

Figure 1.2: Tertiary School Enrollment and Completion Rate, Different Periods




Notes: The top two graphs plots tertiary school enrollment rate against lag period's enrollment rate. The left one compare enrollment in 2010 and 1965. The right one focuses on the recent period, comparing enrollment in 2010 and 2000; The below two graphs plots tertiary schooling completion rate against lag period's completion rate. The left one compare completion rate in 2010 and 1965. The right one focuses on the recent period, comparing completion rate in 2010 and 2000. Schooling data is from Barro and Lee (2010).

Figure 1.3: Gini Education, 1965 vs 2010

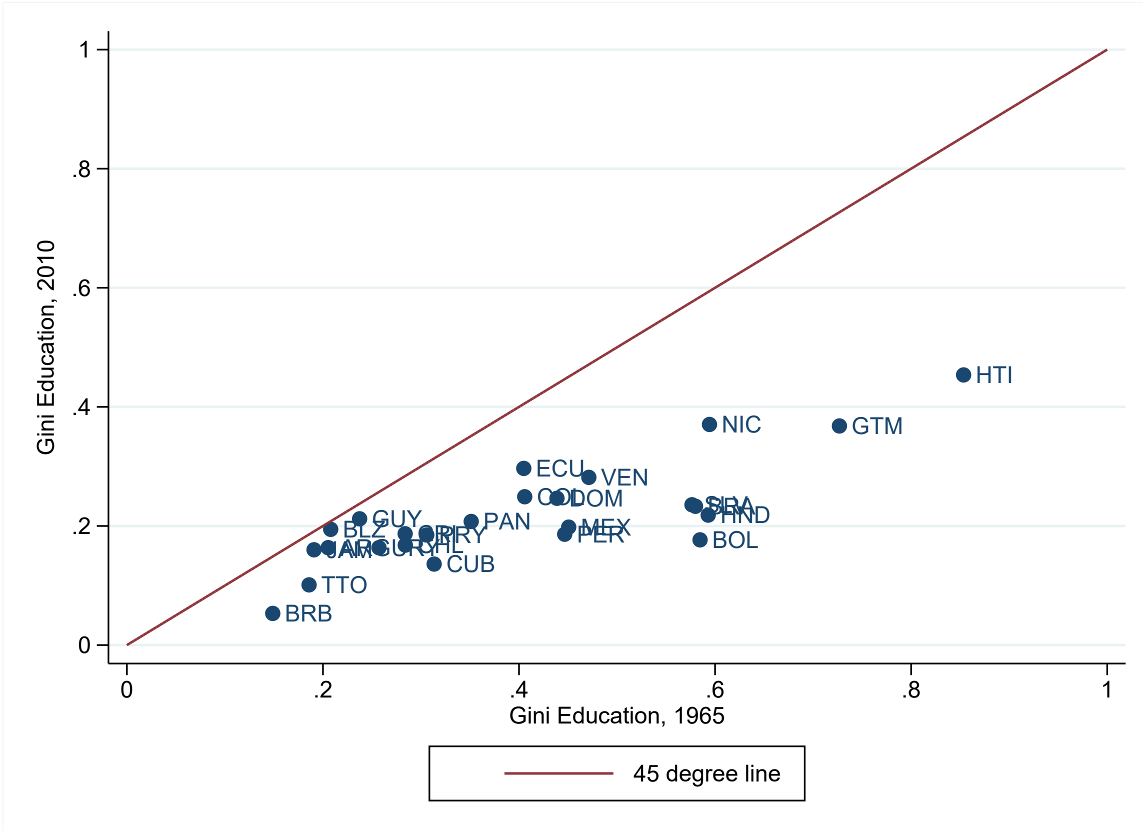
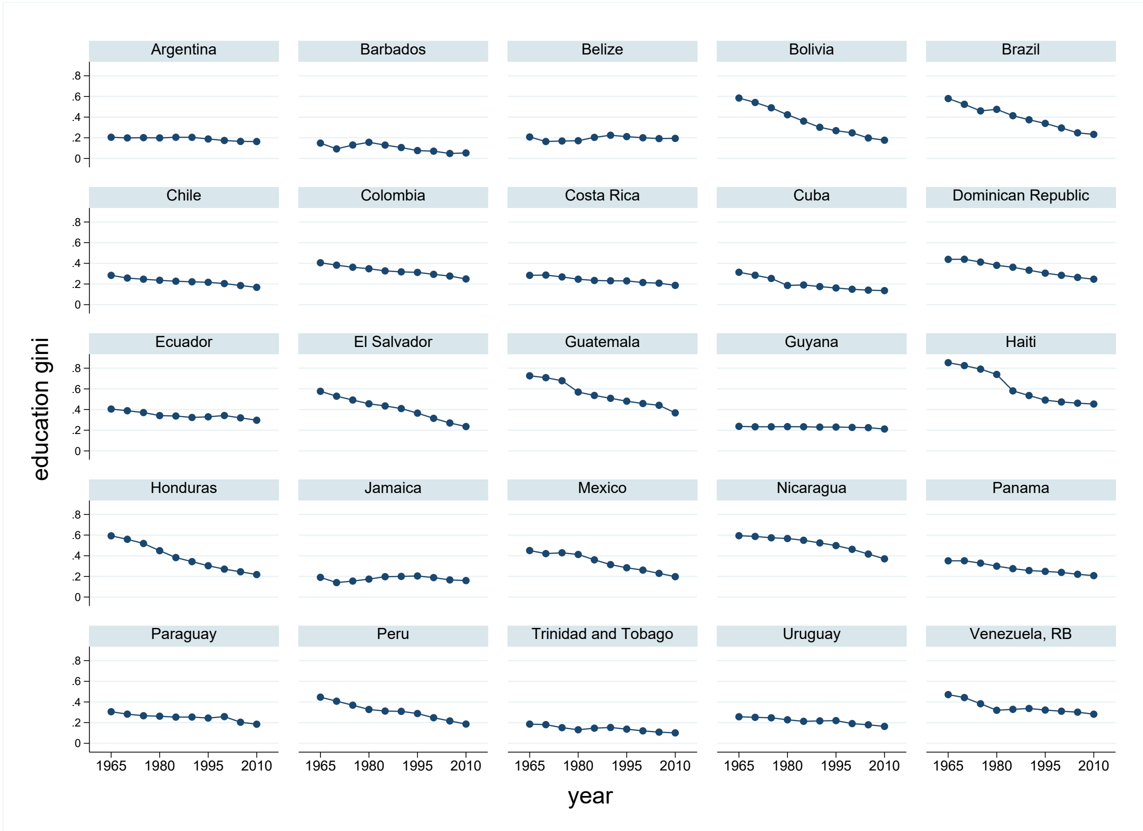


Figure 1.4: Gini Education by Country, 1965-2010




Source: Ziesemer (2016)

CHAPTER 2

# GRAVITY VARIABLES IN TRADE: TRADE COSTS VERSUS PREFERENCES

## 2.1 Introduction

The gravity variables such as distance, language, border, colonial relationship, and free trade agreements are popularly used as proxies for both direct and indirect trade costs; while the former refer to measurable costs such as transportation costs and duties/tariffs, the latter correspond to abstract costs such as information costs or search costs. In the existing literature, the estimated gravity model can be expressed in a log-linear format where log trade enters as the dependent variable, while source and destination effects together with gravity variables representing trade costs enter as independent variables.[1]

Within this context, gravity variables have been shown to be the main focus of estimations, since they are directly linked to any policy investigation due to their representation of trade costs (e.g., see Anderson and van Wincoop, 2004; Head and Mayer, 2014). Although economic models in the existing studies imply that gravity variables capture such trade costs, mostly corresponding to the difference between source and destination prices, it is understood in the background that these gravity variables may also be capturing preferences in the destination country. For example, Anderson (2011) emphasizes the difficulty of distinguishing between the effects of gravity variables on preferences and trade costs. We believe that this difficulty in the literature is mostly due to the lack of actual trade costs data. In this paper, a unique dataset on trade costs of U.S. imports makes this analysis possible. First, we

[1] e.g., see Head and Mayer (2014) present an excellent survey based on other recent studies.

introduce a simple trade model to provide the guidance for our empirical analysis. Second, we consider two types of preferences. The first type of preferences is random preferences, which is mostly the case in the literature. Based on these random preferences, the model implies that gravity variables only capture the effects of measured trade costs in a typical gravity regression. A decomposition analysis further shows that about one third of the effects on international trade (of gravity variables) are due to the channel of duties/tariffs, while the rest is due to the channel of transportation costs. The second type of preferences is dyadic preferences. Based on dyadic preferences, the model implies that gravity variables not only capture the effects of measured trade costs but also those of preferences in a typical gravity regression. A decomposition analysis further shows that almost all the effects of dyadic/gravity variables on U.S. imports are due to preferences, while the effects through duties/tariffs and transportation costs are very small.

We also investigate the overall effects of gravity variables on trade through three gravity channels: duties/tariffs, transportation costs, and dyadic-preferences. In the case of both random and dyadic preferences, the results show that distance is the dominant gravity variable for the channels of duties/tariffs and transportation costs. However, for the channel of dyadic preferences that captures virtually all the effects of gravity variables on U.S. imports, the results change as having a common border contributes about 45.12 percent, followed by distance about 32.22 percent, colony about 13.98 percent, free trade agreement (FTA) about 6.91 percent, and language about 1.76 percent.

We finally investigate the contribution of each gravity variable through alternative gravity channels. In the case of random variables, the effects of distance, common border, colonial relationship, and common language are shown to be mostly through transportation costs, whereas the effects of FTAs are through duties/tariffs. However, in the case of dyadic preferences though, all gravity variables are shown to be effective through the channel of dyadic-preferences rather than duties/tariffs or transportation costs.

This study is related to a large literature, addressing the effects of graivty variables in trade costs (e.g., see Anderson and Van Wincoop, 2004; Head and Mayer, 2014). Within this picture, distance has been one of the key variables, since it is used as a proxy for many components of trade costs. (e.g., see Hummels, 1999; Limao and Venables, 2001; Kortum, 2002; Head and Mayter, 2013). Much of the recent studies have focused on the solution to the distance puzzle[2] (e.g., see Disdier and Head, 2008; Berthelon and Freund, 2008). For example, Disdier and Head (2008) point out that the estimated impact of distance on trade has remained persistently large since the middle of the century. Compared to the existing literature, this paper shows that the distance puzzle can be solved when the channel of preference is introduced.

Consider the border effect, McCallum (1995) finds that border has a significant impact on trade between any U.S states and Canadian province. In subsequent literature, many researchers repeat the exercise with other countries or other regions such as by Helliwell (1997,1998), Anderson and Smith (1999), Wall (2000), Feenstra (2002), Evans (2003), Chen (2004), Millimet and Osang (2005) and so on. They all find that there is a statistically and economically significant border effect for the trade costs. Other studies also have a similar discussion based on having a common language, historical colonial relationships, the same currency, and regional free trade agreement. Specifically, having a common language can facilitate communication between trade partners by reducing language barrier for international trade (e.g., see Rauch, 1999; Melitz, 2013). Rauch (1999) uses common language and colonial ties

[2]Although the improvements in transportation and communication technology, the estimates of the distance elasticity have continually non-decreasing or even increasing over time.

as proxies for trade costs and find that the information costs are higher for differentiated goods. Regarding the effect of historical ties on trade costs, Casella and Rauch (1997) emphasize the importance of group ties in international trade. Head, Mayer, and Rise (2010) find that due to the deterioration of trade networks, higher trade costs has induced the erosion in colonial trade. Regarding the currency barriers, Rose and van Wincoop (2001) find that the estimated tariff equivalent associated with different currencies is 14 percent. The later studies also find the significant impact of currency union on trade costs (e.g., see, Estevadeordal, Frantz, and Taylor, 2003; Lopez-Cordova and Meissner, 2003; Rose, 2004)

In the trade agreement perspective, Mirodot and Shepherd (2012) show that there is around 6.5 percent decreasing trade costs of trade partners have service regional trade agreements. Novy (2013) indicates that the presence of a free trade agreement across a set of developed countries could reduce trade costs by almost 7 to 12 percent. Considering the impact of trade facilitation commitments in trade agreement on trade costs, Duval, Neufeld, and Utoktham (2016) show that the inclusion of trade facilitation measures in regional trade agreements (RTA) has a statistically significant but small discriminatory impact on trade costs between RTA members. They find that each additional trade facilitation provision in a regional trade agreement can cut trade costs of two trade partners by one percent.

This study complements the literature by investigating the contribution of each gravity channel through each gravity variable. We achieve several decompositions and show that when dyadic preferences are introduced, the preference channel dominates all other channels by big margins. This is important from a policy perspective, because policy tools such as duties/tariffs or investment on transportation technologies are implied as simple not enough to have any impact on trade; it is rather the globalization itself that should be promoted in order to shift the preferences of destination countries toward partner country products. Therefore, the consideration of the effects of graivty variables on preferences is essential to understand the contribution of gravity effects on trade.

The rest of the paper is organized as follows. Section 2 introduces a trade model and presents its implications. Section 3 introduces the data. Section 4 depicts the estimation results by connecting the estimates to several discussions in the literature. Section 5 achieves several variance decomposition analyses. Section 6 concludes.

## 2.2 The Model

In this section, we introduce a simple model. Specifically, we model the imports of the U.S. at the good level considering the optimization problems of individuals in the U.S. and the firms in the source countries.

### 2.2.1 Individuals

The individual in the U.S. maximizes utility of a composite index of goods at time $t$ given by:

$$C_t \equiv \prod_j \left(C_t^j\right)^{\gamma_t^j}$$

where $C_t^j$ represents the composite index of varieties of good $j$ at time $t$ given by:

$$C_t^j \equiv \left(\sum_i \left(\theta_{t,i}^j\right)^{\frac{1}{\eta_t}} \left(C_{t,i}^j\right)^{\frac{\eta_t - 1}{\eta_t}}\right)^{\frac{\eta_t}{\eta_t - 1}}$$

where $C_{t,i}^j$ is the variety $i$ of good $j$ imported from source country $i$; $\eta_t > 1$ is the elasticity of substitution across varieties; $\gamma_t^j$ and $\theta_{t,i}^j$ are taste parameters.

The optimal allocation of any given expenditure within each variety of goods yields the following demand functions:

$$C_{t,i}^{j} = \theta_{t,i}^{j} \left( \frac{P_{t,i}^{j}}{P_{t}^{j}} \right)^{-\eta_t} C_{t}^{j} \tag{2.1}$$

and

$$P_{t}^{j} C_{t}^{j} = \gamma_{t}^{j} P_t C_t \tag{2.2}$$

where

$$P_{t}^{j} \equiv \left( \sum_{i} \theta_{t,i}^{j} \left( P_{t,i}^{j} \right)^{1-\eta_t} \right)^{\frac{1}{1-\eta_t}} \tag{2.3}$$

is the price index of good $j$ (which is composed of the prices of different varieties), and

$$P_t \equiv \prod_{j} \left( \frac{P_{t}^{j}}{\gamma_{t}^{j}} \right)^{\gamma_{t}^{j}} \tag{2.4}$$

is the cost of living index (which is composed of the prices of different goods) at time $t$. Last four equations imply that the total value of imports of at time $t$ in terms of good $j$ can be written as follows:

$$P_{t}^{j} C_{t}^{j} = \sum_{i} P_{t,i}^{j} C_{t,i}^{j} \tag{2.5}$$

and that the total expenditure at time $t$ for all goods can be written as follows:

$$P_t C_t = \sum_{j} P_{t}^{j} C_{t}^{j}$$

### 2.2.2 Firms

The unique firm in source country $i$ specialized in the production of good $j$ maximizes its profits out of producing variety $i$ of good $j$ to be exported to the U.S. according to the following profit maximization problem using its pricing to market strategy:

$$\max_{P_{t,i}^{j}} Y_{t,i}^{j} \left[ P_{t,i}^{j} - Z_{t,i}^{j} \right]$$

subject to

$$Y_{t,i}^{j} = C_{t,i}^{j}$$

where $Y_{t,i}^{j}$ is the level of output, and $Z_{t,i}^{j}$ is the marginal cost of production that is given by:

$$Z_{t,i}^{j} = \frac{W_{t,i}\tau_{t,i}^{j}}{A_{t}^{j}}$$

where $W_{t,i}$ represents the time and source-country specific input costs, $A_t^j$ is the productivity that is time and good specific, and $\tau_{t,i}^{j}$ represents trade costs between the source country $i$ and the U.S. for good $j$ at time $t$ that is further given by:

$$\tau_{t,i}^{j} = \tau_{t,i}^{j,D}\tau_{t,i}^{j,T} \tag{2.6}$$

where $\tau_{t,i}^{j,D}$ represent trade costs of duties/tariffs, and $\tau_{t,i}^{j,T}$ represents transportation costs.

The first order condition for the profit maximization problem implies that:

$$P_{t,i}^{j} = \left(\frac{\eta_t}{\eta_t - 1}\right) Z_{t,i}^{j} \tag{2.7}$$

where $\frac{\eta_t}{\eta_t-1}$ represents (gross) markups. The source prices (excluding trade costs) $P_{t,i}^{j*}$ are implied as follows:

$$P_{t,i}^{j*} = \frac{P_{t,i}^{j}}{\tau_{t,i}^{j}} = \left(\frac{\eta_t}{\eta_t - 1}\right)\frac{W_{t,i}}{A_t^j} \tag{2.8}$$

### 2.2.3 The Case of Random Taste Parameters

According to Equation 2.1, the values of U.S. imports are implied as follows:

$$M_{t,i}^{j} = P_{t,i}^{j}C_{t,i}^{j} = P_{t,i}^{j}\theta_{t,i}^{j}\left(\frac{P_{t,i}^{j}}{P_t^j}\right)^{-\eta_t} C_t^j \tag{2.9}$$

which can be estimated in its log format according to:

$$\underbrace{\log M_{t,i}^{j}}_{\text{Trade Data}} = (1-\eta_t) \underbrace{\left(\log P_{t,i}^{j}\right)}_{\text{Destination-Price Data}} + \underbrace{\log\left(C_t^j\left(P_t^j\right)^{\eta_t}\right)}_{\text{Time and Good Fixed Effects}} + \underbrace{\log\theta_{t,i}^{j}}_{\text{Taste Parameters as Residuals}} \tag{2.10}$$

where (log) taste parameters $\log \theta_{t,i}^{j}$ are assumed to be i.i.d. random variables, and thus they are considered as the residuals. Considering the definition of destination prices $P_{t,i}^{j} = P_{t,i}^{j*} \tau_{t,i}^{j,D} \tau_{t,i}^{j,T}$ due to Equations 2.6 and 2.8, this expression can be rewritten as follows:

$$\underbrace{\log M_{t,i}^{j}}_{\text{Trade Data}} = (1-\eta_t) \underbrace{\left(\log P_{t,i}^{j*} + \log \tau_{t,i}^{j,D} + \log \tau_{t,i}^{j,T}\right)}_{\text{Destination Prices}} + \underbrace{\log \left( C_t^{j} \left(P_t^{j}\right)^{\eta_t} \right)}_{\text{Time and Good Fixed Effects}} + \underbrace{\log \theta_{t,i}^{j}}_{\text{Residuals}} \tag{2.11}$$

where source prices $P_{t,i}^{j*}$, together with trade costs of $\tau_{t,i}^{j,D}$ and $\tau_{t,i}^{j,T}$, are simultaneously determined in equilibrium. Accordingly, following Zellner and Theil (1962), we employ the estimation methodology of Three-Stage Least Squares (3SLS) that simultaneously estimates Equation 2.11 (under the restriction that $\log P_{t,i}^{j*}$, $\log \tau_{t,i}^{j,D}$ and $\log \tau_{t,i}^{j,T}$ have the same coefficient of $1-\eta_t$ representing *trade elasticity*) together with the following three expressions representing source prices $P_{t,i}^{j*}$, trade costs due to duties/tariffs $\tau_{t,i}^{j,D}$, and transportation costs $\tau_{t,i}^{j,T}$, respectively:

$$\log P_{t,i}^{j*} = \underbrace{\log \left( \frac{\eta_t}{\eta_t - 1} \right)}_{\text{Time Fixed Effects}} + \underbrace{\log W_{t,i}}_{\text{Time and Source-Country Fixed Effects}} - \underbrace{\log A_t^{j}}_{\text{Time and Good Fixed Effects}} + \underbrace{v_{t,i}^{j,P}}_{\text{Residuals}}$$

and

$$\log \tau_{t,i}^{j,D} = \delta_t^{j,D} + G_{t,i}^{D} + v_{t,i}^{j,D} \tag{2.12}$$

and

$$\log \tau_{t,i}^{j,T} = \delta_t^{j,T} + G_{t,i}^{T} + v_{t,i}^{j,T} \tag{2.13}$$

where $\delta_t^{j,A}$ (for $A \in \{D, T\}$) represents time and good fixed effects, $v_{t,i}^{j,D}$ and $v_{t,i}^{j,T}$ represent the random components (as residuals), and $G_{t,i}^{A}$ (for $A \in \{D, T\}$) represents the effects of basic gravity variables according to the following specification:

$$G_{t,i}^{A} = d_{t,i} + bo_{t,i} + la_{t,i} + co_{t,i} + fta_{t,i} \tag{2.14}$$

where $d_{t,i}$ is the effect of (log) distance between the source country $i$ and the U.S., $bo_{t,i}$ is the effect of sharing a land border (i.e., adjacency), $la_{t,i}$ is the effect of sharing a language, $co_{t,i}$ is the effect of any colonial relationship, and $fta_{t,i}$ is the effect of country $i$ and the U.S. having a free trade agreement. It is important to emphasize that the gravity variables that we consider have time-varying effects[3].

In order to see the effects of gravity variables on trade in a better way, once the estimation is achieved, we can rewrite the fitted value of Equation 2.11 as follows:

$$\log \widehat{M}_{t,i}^{j} = \widehat{G}_{t,i} + (1-\eta_t)\left(\log \widehat{P}_{t,i}^{j*} + \widehat{\delta}_t^{j,D} + \widehat{\delta}_t^{j,T}\right) + \log\left(\widehat{C_t^j \left(P_t^j\right)^{\eta_t}}\right) + \widehat{\delta}_t^{j,U}$$

where $\widehat{G}_{t,i}$ represents the combined fitted effects of gravity variables according to:

$$\widehat{G}_{t,i} = (1-\eta_t)\left(\widehat{G}_{t,i}^{D} + \widehat{G}_{t,i}^{T}\right) \tag{2.15}$$

which can easily be decomposed into effects due to duties/tariffs and transportation costs, as we will achieve below.

### 2.2.4 The Case of Dyadic Taste Parameters

If taste parameters are functions of gravity variables rather than i.i.d. random variables, the taste parameters can be written as follows:

$$\log \theta_{t,i}^{j} = \delta_t^{j,U} + G_{t,i}^{U} + v_{t,i}^{j,U} \tag{2.16}$$

where $\delta_t^{j,U}$ represents time and good fixed effects, $G_{t,i}^{U}$ represents the effects of very same gravity variables (as described in Equation 2.14) on taste parameters, and $v_{t,i}^{j,U}$ represents the i.i.d. random component of taste parameters. When this expression is

[3]e.g., see Bergstrand (2015) suggests that ignoring the changes in gravity variables over time may lead into biased estimates.

substituted into Equation 2.11, we can obtain:

$$\log M_{t,i}^{j} = (1-\eta_t)\underbrace{\left(\log P_{t,i}^{j*} + \log \widehat{\tau}_{t,i}^{j,D} + \log \widehat{\tau}_{t,i}^{j,T}\right)}_{\text{Destination Prices}} + \underbrace{\log\left(C_t^j\left(P_t^j\right)^{\eta_t}\right) + \delta_t^{j,U}}_{\text{Time and Good Fixed Effects}} \tag{2.17}$$

$$+ \underbrace{G_{t,i}^{U}}_{\text{Taste Parameters as Gravity Variables}} + \underbrace{v_{t,i}^{j,U}}_{\text{Residuals}}$$

which can be estimated with the same methodology introduced above. Compared to Equation 2.11 that considers gravity variables affecting trade through duties/tariffs $\tau_{t,i}^{j,D}$'s and transportation costs $\tau_{t,i}^{j,T}$'s, Equation 2.17 is a more general framework where gravity variables can affect trade also through taste parameters $\theta_{t,i}^{j}$'s. Therefore, it is very useful to investigate the channels through which gravity variables affect trade.

In order to see the effects of gravity variables on trade in a better way, we can rewrite the fitted value of this expression as follows:

$$\log \widehat{M}_{t,i}^{j} = \widehat{G}_{t,i} + (1-\eta_t)\left(\log \widehat{P}_{t,i}^{j*} + \widehat{\delta}_t^{j,D} + \widehat{\delta}_t^{j,T}\right) + \log\left(\widehat{C_t^j\left(P_t^j\right)^{\eta_t}}\right) + \widehat{\delta}_t^{j,U}$$

where $\widehat{G}_{t,i}$ again represents the combined fitted effects of gravity variables, this time according to:

$$\widehat{G}_{t,i} = (1-\eta_t)\left(\widehat{G}_{t,i}^{D} + \widehat{G}_{t,i}^{T}\right) + G_{t,i}^{U} \tag{2.18}$$

which can also be decomposed into effects due to duties/tariffs, transportation costs, and taste parameters, as we show in details, below.

## 2.3 Data

We obtain the U.S. imports data are from the U.S. International Trade Commission.[4] These data cover 224 countries at the SITC 4-digit good level over the period from

[4] *https://dataweb.usitc.gov/*

1996 to 2013. The data set includes: (1) customs value (defined as the total price actually paid or payable for merchandise, excluding U.S. import duties, freight, insurance, and other charges), (2) unit of quantity, (3) calculated duties in values (i.e., the estimated duties are calculated based on the applicable rates of duty as shown in the Harmonized Tariff Schedule), (4) import Charges (i.e., the aggregate cost of all freight, insurance, and other charges incurred, excluding U.S. import duties).

Total trade costs are decomposed into duty costs and transportation costs; ad valorem duties/tariffs are calculated by dividing the calculated duties by the customs value, while ad valorem transportation costs are calculated by dividing the general import charges by the customs value. Import prices (measured at the source) are calculated by dividing the customs value by the quantity traded. After ignoring missing observations, we are left with 425,812 observations, consisting of 822 goods and 177 countries between 1996 and 2013.

We combine the trade data set with the dyadic data borrowed from Glick and Rose (2016) that include the gravity variables introduced above between the U.S. and its trade partners. In particular, data on distance, common border, colonial relationship and common language are obtained from the CIA's World Factbook; data on regional/free trade agreements (FTAs) are obtained from the World Trade Organization. It is important to emphasize that the data on FTAs change across years as well. For example, the dummy variable of FTA takes a value of one after the U.S. starts having an FTA with Australia in 2005, while the same dummy takes a value of zero before 2005.

## 2.4 Estimation Results

This section depicts the estimation results of 3SLS regressions by individually focusing on the effects of trade elasticity as well as those of each gravity variable, for the case of both random and dyadic preferences. We depict the estimation results in figures to show their pattern over time and connect the results to the relevant discussions in the existing literature.

### 2.4.1 Welfare Gains: Trade Elasticity

Trade elasticity is the key parameter for connecting the movements in prices to quantities and thus consumer welfare. The existing literature such as by Arkolakis, Costinot, and Rodviguez (2012) have shown the importance of this parameter in the determination of welfare gains from trade, where there is a negative relationship between trade elasticity and welfare gains. We follow Arkolakis et al. (2012) to confirm that our model also implies the same expression for welfare gains from trade, this time at the good level. The welfare gains from trade in this paper corresponds to the following expression at the good $j$ level:

$$\log WGT_t^j = -\frac{1}{\eta_t - 1} \log \left( X_{t,H}^j \right)$$

where $X_{t,H}^j \left(= P_{t,H}^j C_{t,H}^j / \sum_i P_{t,i}^j C_{t,i}^j \right)$ is the current expenditure share of good $j$ that is produced at home (in the U.S.). It is implied that there is an inverse relationship between trade elasticity $(\eta_t - 1)$ welfare gains from trade $WGT_t^j$.

Under the light of this theoretical discussion, year-specific estimation results for the coefficient in front of destination prices, $1-\eta_t$, of which absolute value corresponds to the trade elasticity of $\eta_t - 1$, are given in Figure 2.1, where we distinguish between random and dyadic preferences. As is evident, the estimates of the trade elasticity range between 1.38 and 2.23; they are all significant at the 0.1% level. These numbers are close to the lower bound of the estimates in similar recent studies such as by Simonovska and Waugh (2014) who have estimated trade elasticities between 2.79 and 4.46 using alternative data sets. Therefore, for given home expenditure shares of

$X^j_{t,H}$'s, welfare gains from trade estimated in this paper are relatively higher compared to the existing literature.

When random preferences are compared to dyadic preferences for any given home expenditure shares of of $X^j_{t,H}$'s, welfare gains from trade are estimated to be relatively higher in the case of dyadic preferences, which is essential for policy makers. It is also evident in Figure 2.1 that the estimates of the trade elasticity have been increasing over time, suggesting that welfare gains from trade are getting smaller over time, for both random and dyadic preferences.

### 2.4.2 Distance Puzzle

In gravity studies, distance elasticity has been another key parameter, since distance is used as a proxy for many components of trade costs. The recent studies have focused on the solution to the distance puzzle. Under the light of this discussion, our estimates for the coefficient of log distance are available for the regressions based on log duties/tariffs (as shown in Equation 2.12) and log transportation costs (as shown in Equation 2.13) for the case of random variables, while they are available for also the regressions based on preferences (as shown in Equation 2.16) for the case of dyadic preferences. The coefficient estimates over the years are given in Figure 2.2. It is important to emphasize that due to the way that we achieve our estimations, the estimates based on trade-costs regressions should be compared to the absolute value of the distance-elasticity measures in the literature, since they have another (and negative) coefficient of trade elasticity $(1 - \eta_t)$ in front of them in Equations 2.11 and 2.17.

As is evident, for both cases of random and dyadic preferences, the effects of distance on transportation costs and duties/tariffs are consistent with the expectations based on their positive sign (since trade costs are expected to increase with distance) and magnitude; e.g., the average distance elasticity of observed trade costs, which is about 0.005, corresponds to an *ad-valorem* distance effects on trade of about 7 percent for a distance of about a thousand miles which is consistent with our expectations based on the actual data on duties/tariffs and transportation costs. Therefore, our results based on the distance elasticity provide a simple and an alternative solution to the magnitude dimension of the distance puzzle. Moreover, the effects of distance on transportation costs and duties/tariffs have also decreased over time, suggesting another simple and alternative solution to the time dimension of the distance puzzle.

The contribution of this paper is more clear when we consider the estimates for the distance elasticity of dyadic preferences in Figure 2.2. As is evident, after controlling for distance effects due to duties/tariffs and transportation costs (and thus solving the distance puzzle), the effects of distance on trade due to preferences is positive during the 1990s, which is against most of the studies in the literature using distance as a proxy for such observed trade costs. Nevertheless, this result is consistent with some other studies in the literature such as by Yilmazkuday (2016b) who also focus on the effects of distance through the preference of consumers toward exotic products coming from distant countries. The distance elasticity estimates become mostly insignificant over time since 2005, partly due to free trade agreements such as NAFTA showing its effects (gradually starting from 1994) when the U.S. might have started importing more products from nearby NAFTA countries. In particular, as trade between the U.S., Canada and Mexico has increased over time, the U.S. might have demanded more products coming from these countries due to having more information about them; we will discuss more about this below while focusing on the effects of a common border. Nevertheless, it is important to emphasize that such effects are relative to the average effects captured by the other gravity variable of having a free trade agreement, which covers other free trade agreements of the U.S. as well.

Overall, the results based on distance effects have implications from a broader perspective. Specifically, while the effects of distance on measured trade costs can be considered as supply shifters due to the marginal costs of delivering the product to the destination country (including both production costs and trade costs), the effects of distance on dyadic preferences can be considered as demand shifters. Since the literature has mostly focused on the effects of distance as a supply shifter due to focusing mostly on duties/tariffs and transportation costs (which corresponds to a movement along the demand curve), such studies have apparently missed a big part of the picture that is about distance effects contributing as demand shifters (which is newly introduced in this paper).

### 2.4.3 Effects of Having a Common Border

We investigate whether the U.S. has been involved in higher amounts of trade with Canada and Mexico. In other words, for the U.S., the effects of having a common border can also be considered as investigating the pure effects of NAFTA over time. The coefficient estimates of having a common border are given in Figure 2.3. Independent of the preference type, as is evident, the effects of having a common border on transportation costs are significant and negative starting from early 2000s, suggesting that transportation costs have become cheaper over the years, potentially due to the introduction of NAFTA back in 1994 after which transportation networks might have improved (as consistent with studies such as by Woudsma, 1999, or Hesse and Rodrigue, 2004). In terms of the magnitude, since we have log transportation costs on the estimated Equation of 2.13, the average coefficient of about $-0.05$ corresponds to the U.S. having about 5% lower transportation costs with NAFTA countries compared to other trade partners, after controlling for all other factors.

The effects of having a border on duties/tariffs are also shown in Figure 2.3, where there is evidence for decreasing common-border effects on duties/tariffs with NAFTA countries until 2004 (after which the effects become insignificant). This is exactly what one would expect due to the details of NAFTA that eliminate duties/tariffs starting in 1994 and continuing for ten years (with a few tariffs continuing to 15 years) as discussed by many studies (e.g., Romalis, 2007, or Hakobyan and McLaren, 2016). Regarding the magnitude of the effects, NAFTA has reduced duties/tariffs from about 3% to nothing during our sample period.

The effects through dyadic preferences dominate one more time in terms of its magnitude (compared to the effects on observed trade costs) in Figure 2.3. As is evident, the U.S. has increased their already existing preference toward NAFTA products over time, even after controlling for all other factors (captured by other gravity variables). In particular, back in 1996, the U.S. used to have a preference toward NAFTA products by about 2, which has increased to about 2.5 over the years. Regarding the intuition of these numbers, they suggest that the U.S. has imported about double the amount of products coming from NAFTA countries compared to other trade partners, after controlling for all other factors. This result, which can be called *adjacency bias* or *common-border bias*, acts just like the *home-bias* in trade as discussed in several studies such as by Obstfeld and Rogoff (2001) as a puzzle and is shown to be solved by considering the existence of trade costs. Compared to these studies, this paper shows that such trade costs mostly show up through dyadic preferences (rather than transportation costs or duties/tariffs) when one considers the broader definition of trade costs by Anderson and van Wincoop (2004) as we introduced above.

### 2.4.4 Effects of Having a Colonial Relationship

We examine the effects of having a colonial relationship on the trade patterns of the U.S. The estimated results are given in Figure 2.4, the effects of having a colonial relationship on transportation costs and duties/tariffs are pretty stable over time, although there is some evidence for increasing trade costs. It is implied that trade costs between the U.S. and the countries that it has historical ties with have increased relative to the trade costs between the U.S. and other trade partners. However, the big part of the picture appear itself when the effects of having a colonial relationship are investigated on dyadic preferences. In particular, such effects were captured by a coefficient of about 1.98 in 1996, and this coefficient is reduced to 1.24 in 2012, suggesting that, after controlling for other factors, the U.S. prefers importing that many times more from countries that it has historical colonial relationships with, but these effects have been reduced significantly in recent years. In other words, after controlling for all other factors, historical ties have lost some of their importance for U.S. imports.

### 2.4.5 Effects of Free Trade Agreements

We examine the effects of free trade agreements on the trade patterns of the U.S.[5]. The results are given in Figure 2.5. In particular, since the U.S. started having FTAs in early 2000s with either distant countries (e.g., Singapore or Australia) or FTA partner countries that initially have high duties/tariffs, the effects of having an FTA on both transportation costs and duties/tariffs have started increasing in early 2000s.

[5]Although we have covered the effects of NAFTA above, the U.S. has regional/free trade agreements (FTAs) with totally 20 different countries. From a policy perspective, it is essential to understand the pure effects of these FTAs in order to shape the future global trade policy of the U.S..

Our results in Figure 2.5 also show that the effects of FTAs on transportation costs and duties/tariffs are almost entirely the mirror image of the results on common-border (NAFTA) effects (in Figure 2.3) along the horizontal axis. Therefore, while transportation costs and duties/tariffs have decreased over time between the U.S., Canada and Mexico in relative terms, the same measured trade costs have increased over time between the U.S. and other trade partners with FTAs, again in relative terms. It is implied that NAFTA has dominated all other FTAs due to its reducing impact on both transportation costs and duties/tariffs by a large margin.

When we consider the dyadic preferences of the U.S. toward products coming from FTA partner countries, it is evident in Figure 2.5 that such preferences have been reduced dramatically during our sample period. The result suggests that NAFTA has dominated all other FTAs not only due to its reducing impact on measured trade costs but also due to the shifts that it has created in the U.S. imports demand through preferences.

### 2.4.6 Effects of Having a Common Language

We examine the effects of having a common language on trade patterns of the U.S. In the existing literature, having a common language can facilitate communication between trade partners by reducing language barriers for trade. Our corresponding results are given in Figure 2.6, where the effects of language are pretty stable over time. While having a common language coincides with slightly positive (and sometimes insignificant) effects on transportation costs, it coincides with negative and significant effects on duties/tariffs. Therefore, having a common language reduces trade costs mostly through duties/tariffs rather than transportation costs, where negotiation of tariff rates might have been affected historically or recently through FTAs. In terms of the magnitude, though, the higher effects of having a common language show up again when we consider them on dyadic preferences of the U.S.. In particular, after controlling for all other factors, the U.S. has preferred importing relatively fewer products from the countries that it shares a language with, and these effects are pretty stable over time as also shown in Figure 2.6.

## 2.5 Decomposition Analysis

In this section, we employ variance decomposition analyses to answer the following questions: among the three gravity channels, namely duties/tariffs (DC), transportation-costs (TC), and dyadic-preferences (PC), which gravity channel contributes more to the overall effects of gravity variables on trade? What is the contribution of each gravity variable to a given gravity channel? What is the contribution of each gravity channel for a given gravity variable?

### 2.5.1 Random Preferences

In the case of random preferences, we start with investigating the contribution of each gravity channel to the overall effects of gravity variables on trade. We achieve this through a variance decomposition analysis by taking the covariance of both sides in Equation 2.15 (i.e., the fitted values of estimated gravity effects) with respect to the left hand side variable of $\widehat{G}_{t,i}$ as follows:

$$cov\left(\widehat{G}_{t,i}, \widehat{G}_{t,i}\right) = cov\left((1-\eta_t)\,\widehat{G}^{D}_{t,i}, \widehat{G}_{t,i}\right) + cov\left((1-\eta_t)\,\widehat{G}^{T}_{t,i}, \widehat{G}_{t,i}\right) \tag{2.19}$$

which can be rewritten in percentage terms as follows by using $cov\left(\widehat{G}_{t,i}, \widehat{G}_{t,i}\right) = var\left(\widehat{G}_{t,i}\right)$:

$$\frac{cov\left((1-\eta_t)\,\widehat{G}^{D}_{t,i}, \widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)} + \frac{cov\left((1-\eta_t)\,\widehat{G}^{T}_{t,i}, \widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)} = 100\% \tag{2.20}$$

where the first part of the left hand side in equation (2.20) represents the contribution of gravity effects through Duties/Tariffs; the second part of the left hand side captures the contribution of gravity effects through transportation costs. $cov(\cdot)$ and $var(\cdot)$ are the operators of covariance and variance, respectively. All variables are pooled across source countries $i$ and time $t$. The corresponding results are given in Table 2.1, where duties/tariffs contribute about 30.55 percent, whereas transportation costs contribute about 69.45 percent to the overall effects of gravity variables on trade. Therefore, when we ignore dyadic preferences, gravity variables are mostly effective through transportation costs rather than duties/tariffs.

We continue with investigating the contribution of each gravity variable to these gravity channels (in the absence of dyadic preferences). Such results, which are also given in Table 2.1, are obtained by using the same variance decomposition analysis, this time by considering the fitted values of all gravity variables within each gravity channel. As is evident, distance is the dominant gravity variable for both duties/tariffs and transportation costs; the contribution of other variables are pretty insignificant, except for the (expected) contribution of FTAs to duties/tariffs that is about 7.19 percent.

In the case of random variables, we also investigate the contribution of each given gravity variable through alternative gravity channels; the corresponding results are given in Table 2.2. As is evident, the effects of distance, common border, colonial relationship, and common language are mostly through transportation costs, whereas only the effects of FTAs are through duties/tariffs.

### 2.5.2 Dyadic Preferences

In the case of dyadic preferences, regarding the investigation of the contribution of each gravity channel to the overall effects of gravity variables on trade, we achieve a variance decomposition analysis by using the very same methodology as above in order to obtain:

$$\frac{cov\left(\left(1-\eta_t\right)\widehat{G}^{D}_{t,i},\widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)}+\frac{cov\left(\left(1-\eta_t\right)\widehat{G}^{T}_{t,i},\widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)}+\frac{cov\left(G^{U}_{t,i},\widehat{G}_{t,i}\right)}{var\left(\widehat{G}_{t,i}\right)}=100\% \quad (2.21)$$

where the first part the left hand side in equation(2.21) captures the contribution of gravity effects through Duties/Tariffs; the second part represents the contribution of gravity effects through transportation costs; and the third part shows the contribution of gravity effects through dyadic-preference. The corresponding results are given in Table 1.1. The decomposition results show that duties/tariffs contribute about 0.48 percent, transportation costs contribute 2.44 percent, whereas the dyadic-preference contribute 97.08 percent to the overall effects of gravity variables on trade. Therefore, we claim that almost all gravity effects on trade are through the channel of dyadic-preferences that are newly introduced in this paper, rather than the standard channels of duties/tariffs or transportation costs.

When we investigate the contribution of each gravity variable to each of these gravity channels, we observe that distance is again the dominant gravity variable due to its contribution to duties/tariffs and transportation costs. Nevertheless, the tables turn for the contribution of each gravity variable on the additional channel of dyadic-preferences, where having a common border contributes most with about 45.12 percent, followed by distance with about 32.23 percent, colony about 13.98 percent, FTA about 6.91 percent, and language about 1.76 percent. Therefore, the channel of dyadic-preferences is the dominant gravity channel on trade with (a common) border contributing most to it.

When we investigate the contribution of each given gravity variable through alternative gravity channels, the corresponding results are given in Table 2.2. As is evident, all gravity variables are effective through the channel of *dyadic-preferences* rather than duties/tariffs or transportation costs.

## 2.6 Conclusion

Gravity variables such as distance, adjacency, colony, free trade agreements or language have been extensively used in empirical studies to capture the effects of trade costs. By using actual data on transportation costs and duties/tariffs obtained from U.S. imports, this paper has decomposed the overall effects of such gravity variables on trade into those through three gravity channels: duties/tariffs (DC), transportation-costs (TC), and dyadic-preferences (PC). When PC is ignored as is typical in existing studies in the literature, we show that nearly all gravity effects are due to distance, 29 percent through DC and 71 percent through TC. However, when PC is introduced, 45 percent gravity effects are due to common border, 32 percent are due to distance, 14 percent are due to colony, 7 percent are due to free trade agreement, and 2 percent are due to language.

The results are further connected to several existing discussions in the literature, such as the distance puzzle or welfare gains from trade. In particular, we show that the distance puzzle can easily be solved by decomposing the effects of distance into those due to transportation costs, duties/tariffs and dyadic preferences. Moreover, welfare gains from trade are estimated to be relatively higher in the case of dyadic preferences, which is ignored in the existing literature.

In summary, these findings suggest that the gravity variables in trade are shown to be effective through the channel of preferences rather than the channel of trade costs. From the policy perspective, policy tools such as duties/tariffs or investment on transportation technologies are simply implied as not having enough impact on trade as advocated in studies such as by Harley (1988) or Irwin and ORourke (2011); it is rather the globalization itself that should be promoted in order to shift the preferences of destination countries toward partner country products.

Table 2.1: Contribution of Each Gravity Channel to Overall Gravity Effects

| | Random Preference | | | Dyadic Preference | | | |
|---|---|---|---|---|---|---|---|
| | Duties/ Tariffs (DC) | Transportation costs (TC) | Total | Duties/ /Tariffs DC) | Transportation costs (TC) | Dyadic preference (PC) | Total |
| % Contribution of Gravity Channels | 30.55% | 69.45% | 100.00% | 0.48% | 2.44% | 97.08% | 100.00% |
| %Contribution of Individual variables to each Gravity Channel | | | | | | | |
| Distance | 92.16% | 98.61% | 97.00% | 92.15% | 97.74% | 34.43% | 32.23% |
| Border | 0.30% | 1.96% | 1.54% | 0.29% | 2.82% | 42.57% | 45.12% |
| Colony | 0.01% | 0.08% | 0.04% | -0.04% | 0.06% | 14.28% | 13.98% |
| FTA | 7.19% | 0.31% | 2.07% | 7.22% | 0.18% | 6.90% | 6.91% |
| Language | 0.34% | -0.96% | -0.65% | 0.38% | -0.80% | 1.91% | 1.76% |
| Total | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

Notes: This table shows the contribution of each gravity channel to the overall gravity effects. The effects due to each gravity channel is further decomposed into the effects due to individual variables.

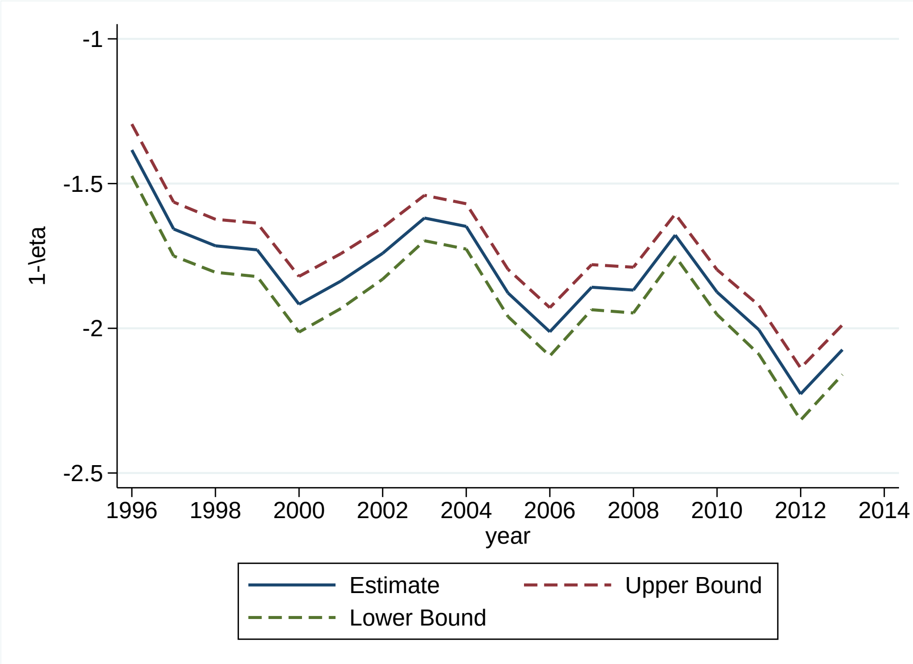
Table 2.2: Contribution of Individual variables to Overall Gravity Effects

| | Random Preference | | | Dyadic Preference | | | |
|---|---|---|---|---|---|---|---|
| | Duties/ Tariffs (DC) | Transportation costs (TC) | Total | Duties/ /Tariffs DC) | Transportation costs (TC) | Dyadic preference (PC) | Total |
| Distance | 29.43% | 70.57% | 100.00% | 0.40% | 3.40% | 96.20% | 100.00% |
| Border | 13.54% | 84.46% | 100.00% | -0.41% | 2.71% | 97.70% | 100.00% |
| Colony | -7.30% | 107.30% | 100.00% | -0.31% | 1.28% | 99.03% | 100.00% |
| FTA | 75.00% | 25.00% | 100.00% | 2.55% | 2.63% | 94.82% | 100.00% |
| Language | 39.22% | 60.78% | 100.00% | -1.80% | 2.15% | 99.65% | 100.00% |

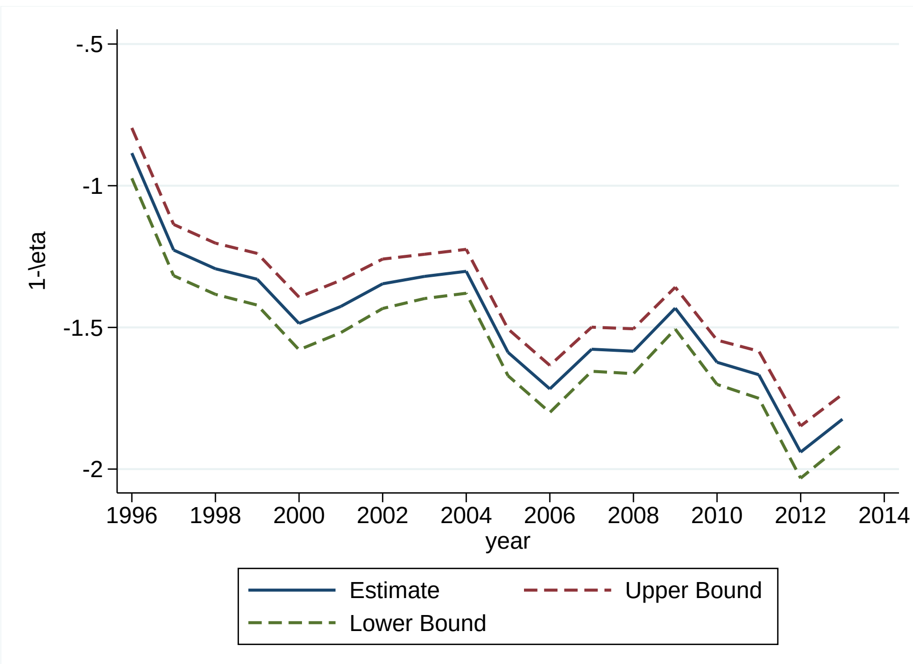
Notes: This table shows the contribution of each gravity variable to the overall gravity effects.

Figure 2.1: Estimation of Trade Elasticity between 1996-2013

(a) Random Preference



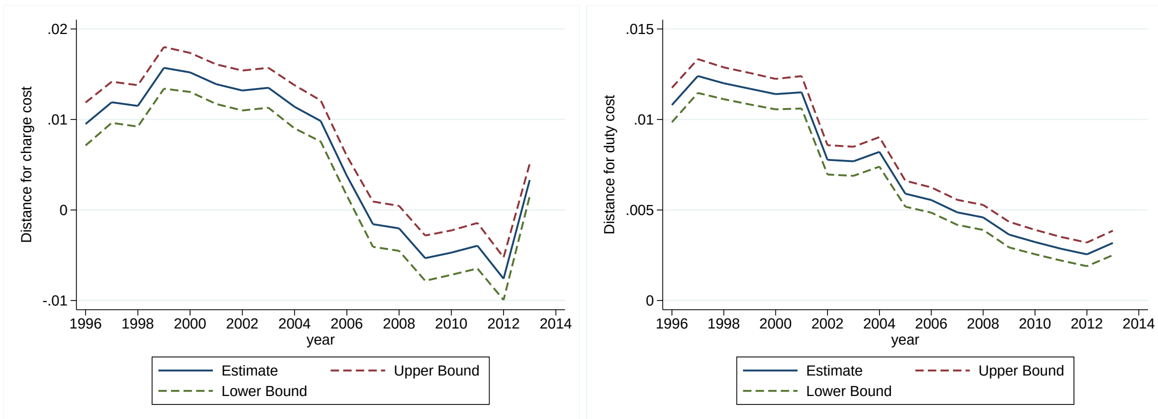

(b) Dyadic Preference



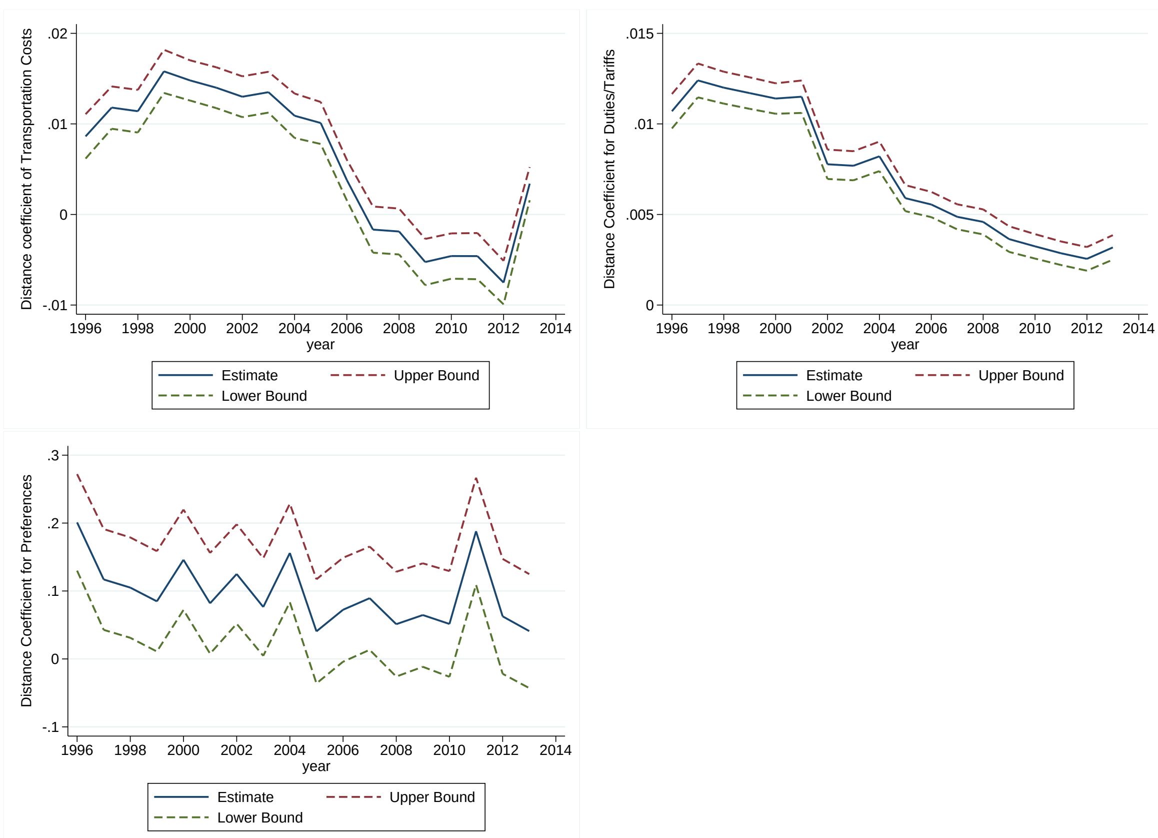

Notes: Upper and lower bounds represents the 99% confidence interval

Figure 2.2: Estimation of Distance Elasticity between 1996-2013

(a) Random Preference



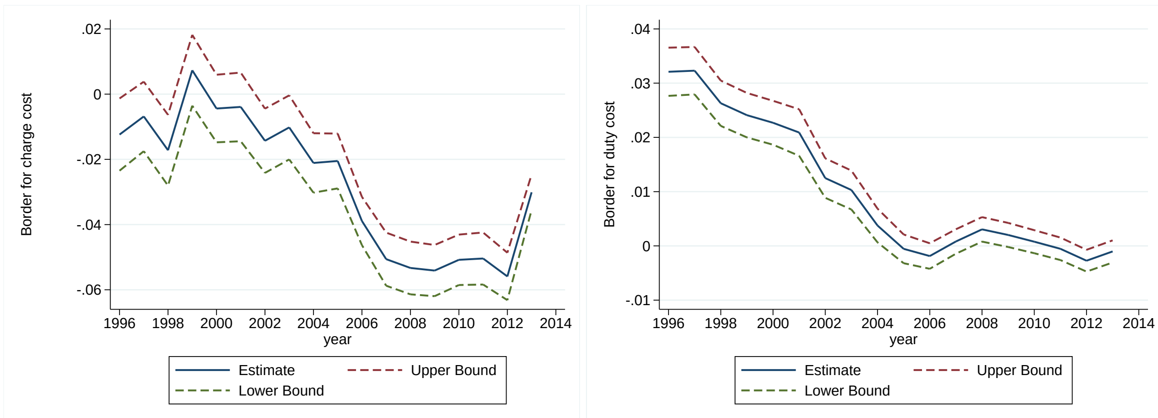

(b) Dyadic Preference




Notes: Upper and lower bounds represents the 90% confidence interval

Figure 2.3: Common-Border Coefficient Elasticity between 1996-2013

(a) Random Preference




(b) Dyadic Preference


Notes: Upper and lower bounds represents the 90% confidence interval

Figure 2.4: Colonial-Relationship Coefficient Elasticity between 1996-2013

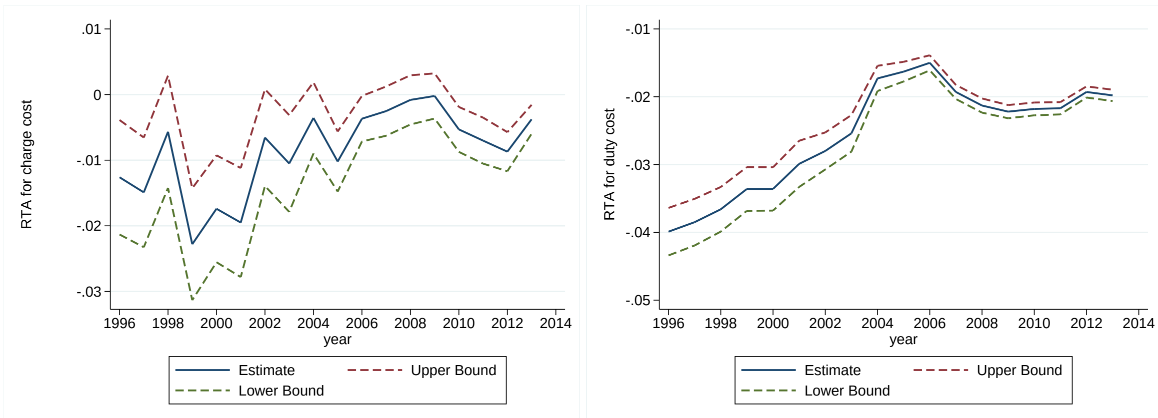
(a) Random Preference


(b) Dyadic Preference

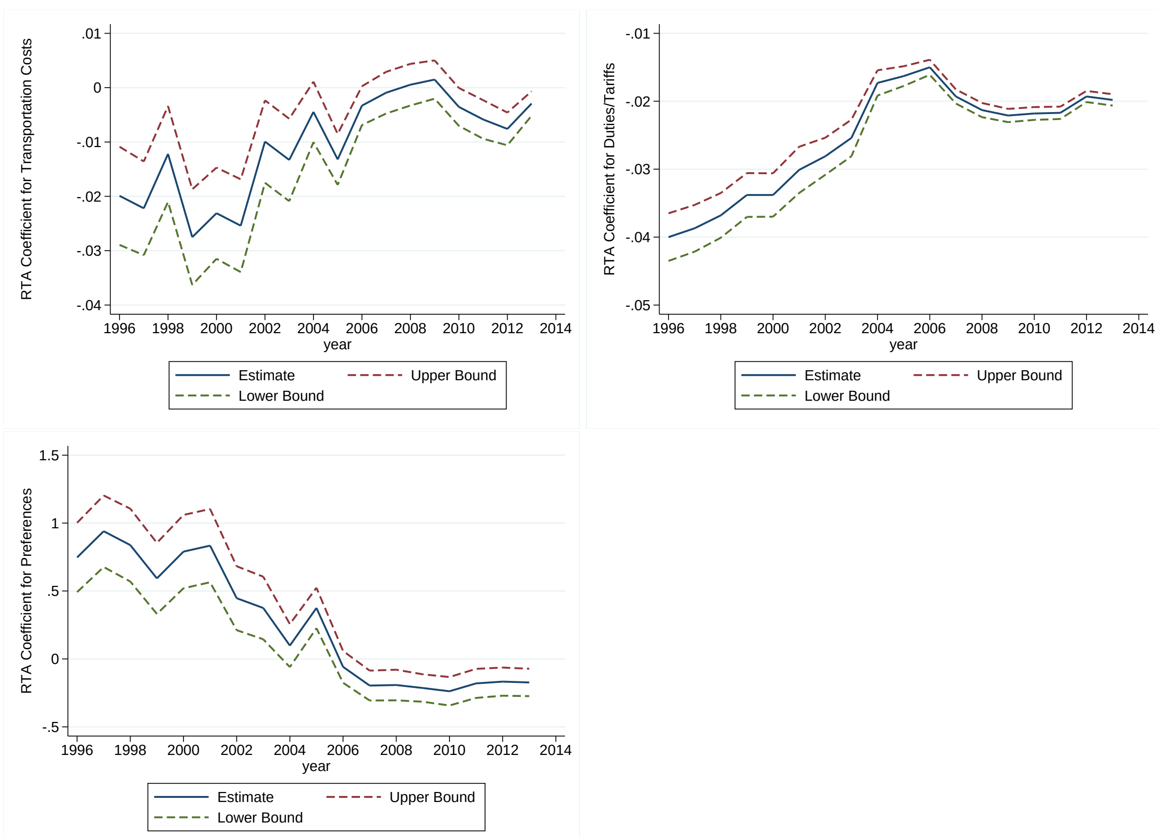

Notes: Upper and lower bounds represents the 90% confidence interval

Figure 2.5: Regional/Free-Trade-Agreement Coefficient Elasticity between 1996-2013

(a) Random Preference



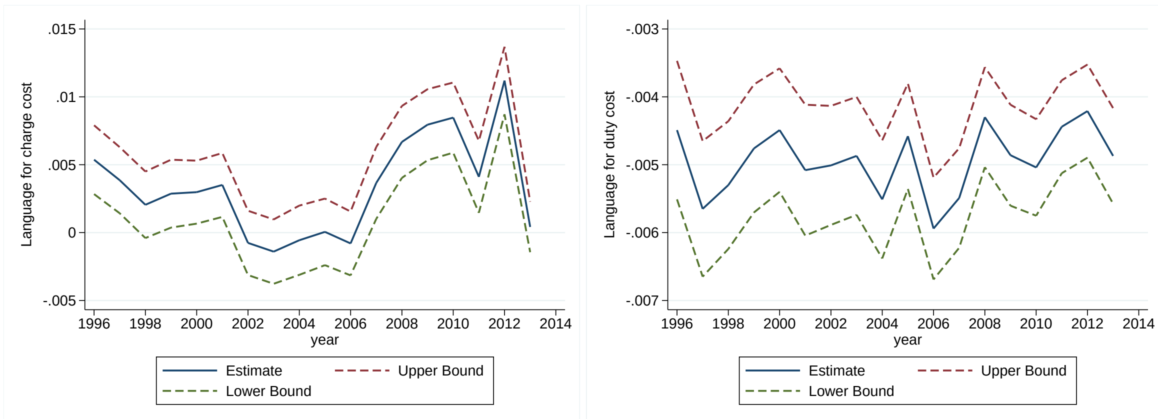

(b) Dyadic Preference



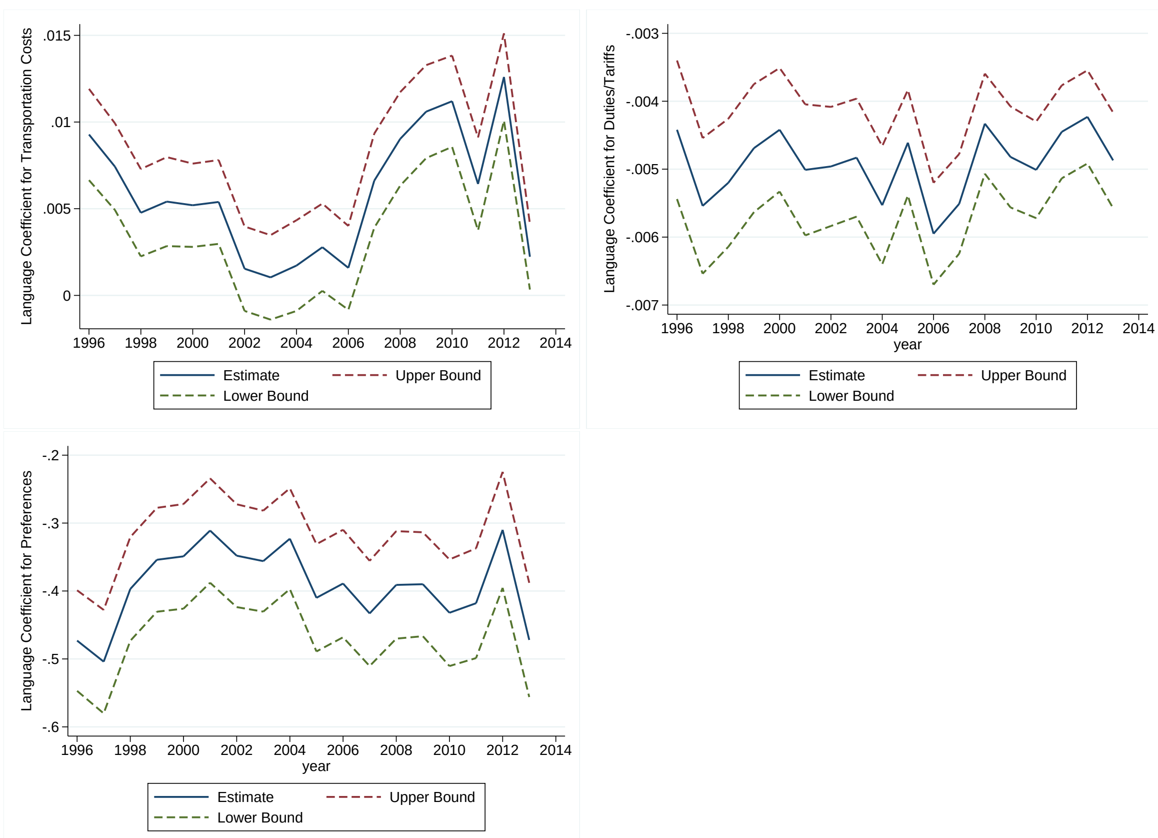

Notes: Upper and lower bounds represents the 90% confidence interval

Figure 2.6: Common-language Coefficient Elasticity between 1996-2013

(a) Random Preference




(b) Dyadic Preference




Notes: Upper and lower bounds represents the 90% confidence interval

CHAPTER 3

# LATIN AMERICAN GROWTH AND EXPORTS TO CHINA

## 3.1 Introduction

How did increased demand from China affect the economic growth of the Latin American and Caribbean (LAC) countries? The answer to this question is essential for our understanding of the economic performance in LAC both in the current period and in the near future. To see the significant role played by Chinese demand, consider the following facts. Before 2001, trade between China and the LAC was limited. However, the situation changed markedly after 2001 due to China's spectacular economic growth. China and the LAC countries experienced an impressive trade boom between 2001 and 2014, with trade between them increasing 23-fold.[1] The region's exports to China have been particularly robust. However, it is worth noting that this trend has weakened since 2012 due to the slackening of Chinese demand. Similarly, since 2012, the high rates of economic growth observed in the LAC since the 2000s have decreased significantly. Regional gross domestic product (GDP) expanded a mere 1 percent in 2014, far from the 5 percent average rates of the previous decade. It is interesting that LAC growth patterns have followed those of Chinese demand for LAC products, though with significant differences among countries.

Many policymakers and commentators agree that China has been and will continue to be a game changer for the LAC region. The existing literature suggests that China's growth has represented both a positive global supply shock for manufacturing, as well as a large positive global demand shock for primary goods. In particular, as put by Artuc, Lederman and Rojas (2015): "China has been playing two main roles in global trade: one as a larger exporter of manufactured goods, and another

[1] See World Integrated Trade Solution (WITS)

as an important importer of mining and agricultural goods". These developments concern policymakers in the LAC as they perceive the region to be over-reliant on exports of commodities which might result in de-industrialization and losses in manufacturing.[2] In addition, China's upgraded industrial structure has also presented challenges to the competitiveness of the manufacture exporters on the region. In fact, there is evidence that the manufacturing sector in LAC, especially that of Mexico's labor-intensive manufacturing, was crowded out by China's rising exports to Mexico's trading partners in the past decades.

China's entry into the World Trade Organization (WTO) in 2001 gave Chinese industries greater access to intermediate inputs, capital goods, and foreign technologies. This structural transition resulted in a sharp increase in China's imports of primary commodities and led to a net trade deficit in a number of these. At the same time, LAC countries were well placed to respond to the external demand shock based on their new internal economic environment. Starting in the late 1980s, most of the countries of LAC gradually reduced inflation levels, brought fiscal deficits under control, eliminated financial repression, and privatized their state enterprises. By the end of the 1990s, LAC economies were far more open than they had been two decades earlier. Most countries in LAC have achieved major progress in macroeconomic stabilization and structural reform, leading to a period of sustained growth.

The growing trade between LAC and China mainly took the form of inter-industry trade, primary commodities in exchange for manufactures. Exports from LAC to China have been concentrated in a small number of commodities, such as oil, iron ore, copper and soybean. Not every country in the LAC region, however, was able to participate fully in this expanded trade in the last fifteen years, as the substantial variation in the natural resources of LAC countries allow some to meet the higher

[2]See, for instance, Latin American Economic Outlook (2016)

Chinese demand for commodities more easily and rapidly than others. For instance, in 2001, Brazil's exports to China were about 3 percent of Brazil's total exports, while in 2015 this number rose to 19 percent, an increase of 16 percent. In contrast, from 2001 to 2015, China increased its importance in Mexico's exports by only about 1 percent point.[3]

The aim of this paper is to provide a quantitative answer to the question of the effects of increased Chinese demand on the economic performance of the LAC by using a difference-in-difference framework. This study views the increased Chinese demand in the early 2000s as a quasi-natural experiment and considers it as a "treatment" to which a part of the LAC region was subjected. Using a treatment-and-control partition of countries based on the significance of their engagement in trade with China, I test whether some countries in LAC experienced a higher economic growth rate due to increased Chinese demand in the last fifteen years. I use both a discrete treatment measure and a continuous treatment measure with a difference-in-difference design. I also consider the IV estimation to address the possible self-selection concerns. The results show that there is a significant correlation between higher economic growth and engagement in expanded trade with China. The results obtained are robust to the consideration of many control variables and alternative estimation methodologies. The main result in this paper is best visualized in Figure 3.1. In that figure, I trace the trends of GDP per capita over the last 30 years for the treatment and the control groups. As is evident, before 2001, the two group's GDP per capita patterns tracked each other very closely. However, with the rising demand from China, the treatment group saw a significant increase in its level of GDP per capita relative to that of the control group. By 2014, there is a 25 percent gap in detrended GDP per capita outcomes.

[3]For these numbers, see World Integrated Trade Solution (WITS)

The existing literature mostly focuses on the import competition consequences of the growth of the Chinese manufacturing. Much previous research has studied the effects of imports on the labor market. For instance, Autor, Dorn, and Hanson (2013) examine the effect of rising Chinese import competition on the U.S. local labor market over the period from 1990 to 2007. They find that in this period Chinese import competition accounts for 20 percent of the decline in U.S. manufacturing employment. Similarly, using data on Norway over the period from 1996 to 2007, Balsvik, Jensen, and Salvanes (2015) suggest that Chinese import competition has a negative effect on low-skilled workers, and 10 percent of the decrease in manufacturing employment was due to import exposure to China. Moreover, studies such as by Bloom, Draca, and Reenen (2016) have found that Chinese trade in manufactured goods has induced the positive effects on innovation, technical change, and productivity growth in European countries from 2000 to 2007. All of the above studies take the supply side perspective. In contrast, there is a small number of papers that focus on the effects of higher Chinese demand on the countries that exports to China. Hsien and Ossa (2016) examine the impact of Chinas productivity growth on aggregate welfare through international trade. They find that the spillover effects are small for all countries in their sample without distinguishing between the supply and demand effects of China's growth. Costa, Garred, and Pessoa (2016) find that higher Chinese commodity demand has induced faster wage growth in some location of Brazil over the period from 2000 to 2010 by using the census data. Compared to the literature, this paper studies the relationship between Chinese demand and GDP growth in LAC countries taking a different route. The results show that China's demand did deliver significantly higher growth rates to LAC exporters over the last decade and a half.

The paper proceeds as follows. Section 2 describes the estimation methodology and the data in detail. Section 3 discusses the results of discrete treatment. Section

4 presents the results of continuous treatment and discusses the self-selection issues. The last section concludes the paper.

## 3.2 Estimation Methodology and Data

### 3.2.1 Estimation design

This section presents the estimation methodology and the data. Here, the question I pose is that of the causal effects of the higher Chinese import demand for LAC commodities on growth rates of the LAC. To answer this question, I consider the post-2001 rise in demand for primary goods from China as a treatment. I try to identify the causal effects of the increased demand from China by employing three methods. The first method considers the demand shock from China as a discrete treatment (zero-one) and uses a difference in difference estimator. The second method takes the demand shock as a continuous treatment and uses the changes in the share of exports to China as a proxy in regressions in differences. It is well known that difference estimators can avoid the problems associated with omitted variables as long as the omitted variables are time-invariant. To the extent that the regressors in this study are time-invariant country characteristics, such as human capital or the quality of institutions, both remain little changed over the medium run. Finally, I employ an instrumental variable approach to address the potential self-selection bias.

Using this empirical design together with the data to be described below, the baseline specification is as follows:

$$\Delta Growth_i = \alpha\Delta(\mathrm{TS}_i) + \beta\Delta\mathbf{X}_i + \mu_i \tag{3.1}$$

where the subscript i indexes countries. The dependent variable is the change of growth rate in country-specific log GDP per capita. Rates of growth over long periods are calculated in continuous fashion, using difference in log levels of GDP per capita divided by years elapsed. The variable TS is used to capture the trade shock from China. The vector X consists of control variables, for instance, the initial institution quality, the initial levels of schooling, the initial GDP per capita. Putting these controls into difference form implies that $\Delta X$ should contain the change in institutions, the change in schooling and the lagged level of growth. Finally, $\mu_i$ is an error term that captures other determinants of change in growth.

### 3.2.2 Data

For my analysis, I assemble data for 35 countries in LAC from 1987 to 2014. The countries that do not have sufficient data over the entire period, for instance, Aruba and Haiti are excluded, leaving 33 countries. I use the following data for empirical analysis.

*Growth rate.* The dependent variable is the rate of growth of GDP per capita in constant 2010 US dollars, from the World Bank's World Development Indicators based on annual data from 1985 to 2014.

*Export share to China.* The country-specific export share (ratio of a country's exports to China to its total exports) data are obtained from World Integrated Trade Solution (WITS). I use two periods as benchmarks: a pre-treatment period (between 1987-2000) and a post-treatment period (between 2001-2014). The export shares to China before and after the treatment are given in figure 2.

*Basic controls.* In the benchmark empirical analysis, I use the standard control variables in the growth regressions. The country-specific institutional quality is measured by legal and property rights scores from the Economic Freedom in the World 2015 database (variable area 2). The measure of human capital is proxied by the percentage of primary schooling attained in the population aged 15 and above obtained from Barro-Lee Educational Attainment Dataset. The financial openness is measured by Chinn-Ito financial openness index from Chinn-Ito (2006). Domestic credit to private sector (private credit) is used as a proxy for financial depth from the World Bank's World Development Indicators Database. I also use the other two risk ratings produced by International Country Risk Guide (ICRG), the exchange rate stability risk measure and inflation stability risk measure.

## 3.3 Demand Shock as a Discrete Treatment

### 3.3.1 Constructing a Treatment Indicator

For my initial empirical work, I divide the set of LAC countries into two clusters, creating an indicator variable to identify engagement with China's rising demand for primary goods, based on whether the change in a country's share of exports to China was above or below the sample mean over the period 2001-2014.

Following the Inter-American Development Bank (IDB), I name the treatment group the "Brazilian cluster"and control group the "Mexican cluster"[4]. Countries displaying values below the regional mean fall into the Mexican cluster. These countries either have low export shares to China to begin with in 2001 and kept them low or even cut them. This group of countries is close to the origin in Figure 3.2. For example, Mexico increased its share of exports to China from 0.19 percent in 2001 to 1.5 percent in 2014: an increase in export share, but not a significantly large one. Another example is Paraguay, whose export share to China fell from 0.68 percent

[4]Brazilian cluster–Argentina, Brazil, Chile, Columbia, Panama, Peru, Uruguay; Mexican cluster–Antigua and Barbuda, Bahamas, Barbados, Belize, Bolivia, Costa Rica, Cuba, Dominica, Dominica Republic, Ecuador, EL Salvador, Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, St.kitts and Nevis, St.Lucia, St.Vincent and the Grenadines, Suriname, Trinidad and Tobago, Venezuela,RB

in 2001 to 0.5 percent in 2014. Clearly, these countries did not experience a trade boom with China in the last fifteen years and thus did not receive the treatment. The Brazilian cluster is those countries that both could and did increase exports to China markedly between 2001 and 2014: they had lower export shares to China to begin with but increased them significantly. These countries are shown above the diagonal in Figure 3.2. For example, Brazil had a share of exports to China of 1.97 percent in 2001, which rose to 18.04 percent in 2014. Chile had a share of exports to China of 4.95 percent in 2001, rising to 24.57 percent in 2014. It is obviously this cluster of countries that were fully exposed to the increased Chinese demand. Finally, it is worth noting that the Brazilian cluster has a relatively higher export share to China compared with the Mexican cluster at the beginning of the treatment.

To further describe the evolution of exports to China in the sample, Figure 3.3 plots the average export share to China for the two clusters from 1996 to 2015 using the World Integrated Trade Solution (WITS) export data. The Mexican cluster saw very little movement in their average export share to China, which stayed on average at about 1 percent to 3 percent throughout. In other words, the Mexican cluster thus experienced relatively minor changes in its trade links with China over the period from 2001 to 2014. However, the Brazilian cluster experienced the dramatic changes. Initially in 2001, their average export share to China was around 3.5 percent. But as Chinese demand rose, these countries increased their export shares to China to a much higher level, around 17 percent. Exploiting the contrast between the Mexican cluster and the Brazilian cluster should allow us to identify any pro-growth impacts of the Chinese demand shock.

### 3.3.2 Discrete Treatment Estimates

I begin my empirical work using the discrete treatment, a variable to capture countries thought to have treatment (Brazilian cluster=1) versus those that have not (Mexican cluster=zero), using the definitions given in the previous section. By replacing $\Delta TS^i$ with the treatment indicator, the differenced regression can be rewritten as

$$\Delta Growth_i = \alpha(\text{treatment indicator}) + \beta\Delta\mathbf{X}_i + \mu_i \tag{3.2}$$

Difference-in-difference regression estimates of the form in equation (2) offer a clean test of the hypothesis that after 2001 growth has accelerated in the Brazilian cluster compared with the Mexican cluster. If the hypothesis is valid, we would expect to have a positive and significant $\alpha$ estimate.

Table 3.1 shows the regression results with various controls added. The estimates of $\alpha$ are positive and significant using any estimation methodology. The Brazil Cluster countries grew about 1.1 to 1.2 percentage points per annum faster than the Mexican cluster countries in this period. Column 2 through 4 repeats the exercise with the inclusion of commonly used control variables from the growth literature. Note that the choice of these variables reflect the concern that reduced form estimates of a growth regression should only include those variables that have been shown to be exogenous, such as initial log of GDP per capita, initial schooling and institutions.

The coefficients of the lagged growth variable are negative and statistically significant. Over the fourteen year period, it implies an annual convergence speed of about 0.6 percentage (0.081/14) in line with typical Ramsey model calibration results. I also find that the growth results are robust to the inclusion of institutional controls, which is to be expected as institutions do not typically change much in the short to medium run. Similarly, changes in schooling are not significantly related with growth accelerations. Overall, these results suggest that Chinese demand for commodities played a major role in the economic performance of LAC during the last fourteen years. The Brazilian cluster has enjoyed growing exports volumes and high prices for their products, and thus has experienced high levels of economic growth. Conversely, Mexican cluster has not experienced a similar acceleration in its growth rates.

A summary of this finding is shown in Figure 3.1. I take the Brazilian cluster and Mexican cluster and calculate the 1987-2000 trend of average GDP per capita in each cluster. I detrend the actual values in all years using these trends respectively for both clusters. As is evident, GDP per capita patterns of the two clusters track each other closely before the treatment. But after the treatment, these two clusters diverge dramatically. The difference in the trends of the two clusters is a nontrivial 1.5 percent per year. By 2014, Brazilian cluster is almost 60 percent above 1987-2000 trend, but Mexican cluster has increased by only 35 percent above the trend, creating a 25 percent gap in de-trended GDP per capita outcomes. Overall, before the higher Chinese demand period, the Brazilian cluster and the Mexican cluster were not that different in terms of growth. After 2001, however, a divergent dynamic clearly separated the two clusters.

### 3.3.3 Robustness: Testing a Placebo Treatment

One concern may be that there is a preexisting difference in economic performance between the Brazilian cluster and Mexican cluster. As a check for whether the Brazilian cluster has experienced growth acceleration before the actual treatment in the 2000s, I use a "placebo" treatment by introducing a new period, 1973-1986 and define it as period 0. The pre-treatment period (1987-2000) now becomes period 1 and the post-treatment period (2001-2014) becomes period 2. I repeat the empirical exercise investigating growth acceleration from period 0 to period 1 for the Brazilian cluster. The dependent variable is the difference in the average change per annum of log GDP per capita between period 0 and period 1. In this robustness analysis, the country-specific GDP per capita data before 1975 are obtained from PWT (rgdpch) due to the limitation of WDI data.

Table 3.2 shows the results of "placebo" treatment. The treatment indicator is no longer significant in any of the columns, suggesting that the Brazilian cluster shows no growth acceleration in period 1 relative to period 0, as compared to the Mexican cluster. The variable that consistently enters with statistical significance is still the lagged growth. Overall, there is no evidence that the two clusters show significant difference in their economic performance in the two periods before the period of increased demand from China.

### 3.3.4 Robustness: was growth acceleration in the Brazilian cluster due to less intense competition ?

So far I have argued that exposure to the increasing Chinese demand in the Brazilian cluster countries was associated with a growth acceleration. However, one can imagine that it might be export competition with China that underlies the growth difference between Brazilian cluster and Mexican cluster. It might be the case that the latter was exposed to more intense competition from China in its export markets and as a result its growth rates were lower than that of the countries in the Brazilian cluster.

To see why this might matter, note that since the early 2000s, China significantly increased its exports globally. Between 2001 and 2011, China's exports increased 400 percent, with manufacturing exports rising 410 percent. The massive growth of Chinese manufacturing exports has represented a large supply shock and imposed significant competitive pressure on other regions, mainly those competing in the same export markets. Therefore, a natural question to ask is whether the Mexican cluster fared worse than the Brazilian one because the exports of the former were affected more negatively than the latter as they both faced Chinese competition in their export markets.

To estimate the effect of Chinese competition on LAC's exports, the relation of interest is captured by the following equation

$$EG_{it} = \beta_0 + \beta_1 Ch_t + \beta_2 Ch_t * Group + \mu_{it} \tag{3.3}$$

where $EG_{it}$ denotes annual export growth for LAC country i in year t. The variable $Ch_t$ is the log of China's exports at time t. The estimated effect of exposure to import competition from China on LAC's exports is denoted by $\beta_1$. Group is an indicator variable, it equals one if the country belongs to the Brazilian cluster, and zero otherwise. Finally, $\mu_{it}$ is an error term that captures other determinants of export growth. If Chinese exports had the same effect on the exports of Mexican and Brazilian clusters, we would expect $\beta_2$ equals zero. The country-specific data in the 2000s are obtained from the World Bank's World Development Indicators.

Table 3.3 shows the results with various controls added. In all columns, there is a negative and significant relationship between the Chinese competition and LAC's exports. For instance, the significantly estimated $\beta_1$ by OLS is approximately -1.1 in column 1, suggesting that when China's exports are increased by 1 percent, on average, the export growth in LAC will decrease approximated by 1.1 percent in the 2000s. Column 2 includes the time fixed effects to control for aggregate shocks and policy. Column 3 adds the country fixed effects to allow for country specific time trends in its export growth. The estimate of $\beta_2$ is insignificant in all columns, suggesting that there is no evidence against the hypothesis that Chinese exports had the same effect on the exports of two clusters. This result shows that growth acceleration in the Brazilian cluster could not be attributed to facing less intense competition from China in their export markets.

## 3.4 Demand Shock as a Continuous Treatment

In this section, I use of the fact that changes in the share of exports to China during the period 2001-2014 provide a continuous treatment measure and run the following regression:

$$\Delta Growth_i = \alpha \Delta \ln(1 + s_i) + \beta \Delta \mathbf{X}_i + \mu_{t_i} \tag{3.4}$$

where $s_i$ is the share of exports to China for country i. The effect of a change in trade links with China by export share change is defined as

$$\Delta \ln(1 + s_i) \equiv \ln(1 + s_{i,2014}) - \ln(1 + s_{i,2001}) \tag{3.5}$$

The regression equation suggests that if a country has grown faster (i.e., if $\Delta Growth_i > 0$) than the other countries in LAC due to export expansion with China (i.e., if $\Delta \ln(1 + s_i) > 0$), we would expect to have a positive and significant $\alpha$ estimate.

The estimation results are given in Table 3.4. The estimates of $\alpha$ are positive and statistically significant, independent of including the control variables. As is evident in column 1, the significantly estimated $\alpha$ by OLS is approximately 0.1, suggesting that when the share of exports to China is increased by 10 percent, on average, growth will accelerate approximately by 1 percent per annum after 2001. Moreover, the coefficient of lagged growth is negative, as expected, where the coefficient estimate takes a value of about -0.08. Again, institution changes enter positively and significantly at the 10% level only in column 4; schooling change appears not to drive growth accelerations at conventional significance levels. Overall, these results suggest that China's demand for primary goods did deliver significantly higher growth rates to some LAC countries in the sample.

### 3.4.1 Robustness: was growth acceleration due to other policy reforms?

The analysis that I have achieved so far has been controlled for institution changes and schooling changes. As a further robustness analysis, I examine several other policy reforms that have been claimed as promoting economic growth in the existing literature, namely, financial development, inflation stability, and exchange rate stability.

The results are given in Table 3.5 and Table 3.6, where the former is based on the continuous treatment and the latter is based on the discrete treatment. As is evident, none of the policy reform variables have the significant effect on growth acceleration. Column 1 in Table 3.5 replicates the result from Column 1 in Table 3.4 for comparison purposes. Columns 2-5 add each of the policy reform variables one at time. Specifically, column 2 adds the financial openness as a control, column 3 controls for financial depth, column 4 adds exchange rate stability as a control, and column 5 controls for inflation stability. The results show that none of these policy reforms is statistically significant. In column 6, I combine these policy reform variables and find that there is still no significant effect of each policy reform on growth acceleration. Furthermore, the institutions and schooling variables are added in column 7. There remains no significant relationship between these policy reforms and growth acceleration. Again, the coefficient on the change of export share to China remains positive and statistically significant.

For completeness, Table 3.6 repeats the exercise based on discrete treatment and obtains the similar results. Column 1 is the basic specification. Columns 2 to 7 add policy reform variables as controls, both singly and jointly. The results once again show that none of these policy reforms is ever significant, either singly or jointly. The coefficients on the treatment indicators is positive and always statistically significant at the 5% level. Also, the lagged growth has the negative and significant effect on the growth acceleration in all regressions. In sum, the results confirm that growth acceleration in some countries of LAC could not be attributed to policy reforms such as financial development and macroeconomic conditions.

### 3.4.2 Self-Selection Issues

Although Ordinary Least Squared (OLS) is my benchmark method, I employ Two Stage Least Squares (TSLS) to tackle possible endogeneity issues. We need a source of exogenous variation in the export exposure of Chinese demand in the 2000s. A country that has the rising trade exposure with China may be different from other countries in many observed and unobserved characteristics, and it might be these characteristics that have driven a difference in economic performance after 2001. Thus, the finding of a correlation between expanded exports with China and higher economic growth rates does not necessarily indicate a causal effect of the former on the latter. Therefore, I seek to construct an instrument for the variation in export exposure based on the comparative advantage and trade linkage across countries in LAC.

To see what is involved note that a country's comparative advantage is a key determinant of export exposure to China. China's demand for LAC commodities is concentrated on primary commodities. Over the past fifteen years, the commodities that played a prominent role in LAC exports to China were petroleum oil, iron ore and concentrates, different forms of copper, soybeans, fishmeal, and sugar. Some countries in LAC that are competitive in these primary commodities production have the means to intensify their specialization and benefit from higher demand from China. For example, Argentina and Brazil have a comparative advantage in soybean production (Table 3.7). As we saw, during the period 2001-2014, Argentina and Brazil have found an important market in China for their soybean exports and indeed experienced very significant increases in soybean exports to China. In contrast, some countries in LAC did not have a comparative advantage in producing the commodities demanded by China and thus their potential to export to China was very low. Thus, no significant response to demand shocks originating from China could be expected for countries like Bahama and Barbados.

Further, a country's trade links matters in their export performance. Even among LAC countries with similar comparative advantage in exports of primary commodities, there exists a varying degree of engagement in trade with China. For instance, the major petroleum oil exporters in LAC are Venezuela, Mexico, and Argentina. However, the majority of Venezuelan and Mexican oil exports are destined for the United States due to their geographic advantage, while it is understandable in this context that Argentina became the main oil exporter to China in the region and benefited from export expansion over the last fourteen years. According to Figure 3.3, we observe that countries that have relatively higher shares of exports to China at the beginning of the treatment period have markedly expanded their exports to China over the period 2001-2014. However, countries that have relatively lower shares of exports to China at the beginning of the treatment period saw very little movement in their export share to China in the last fourteen years. In other words, initial established trade linkage with China did play an important role on the subsequent export performance. Based on those considerations, I construct the following country-specific instruments,

$$IV_1^i = \ln(1 + s_{i,2001}) \times (\frac{\textit{Exports of primary commodity}}{GDP})_{i,2001} \tag{3.6}$$

$$IV_2^i = \ln(1 + s_{i,2001}) \times (\frac{\textit{Agriculture raw material exports}}{\textit{Total merchandise exports}})_{i,2001} \tag{3.7}$$

$$IV_3^i = \ln(1 + s_{i,2001}) \times (\frac{\textit{Food exports}}{\textit{Total merchandise exports}})_{i,2001} \tag{3.8}$$

$$IV_4^i = \ln(1 + s_{i,2001}) \times (\frac{\textit{Ore and Metals exports}}{\textit{Total merchandise exports}})_{i,2001} \tag{3.9}$$

Note that all instruments are defined as the interaction of the country's initial trade linkage and comparative advantage in primary commodity production. Specifically, the initial trade linkage is proxied by the export share to China in 2001. The indicators of comparative advantage in primary goods use the share of primary commodities in GDP, agriculture raw material exports share of total merchandise exports, food exports share of total merchandise exports, and ore and metals exports share of total merchandise exports, respectively[5]. For a country in LAC to have a larger export exposure to China over the period from 2001 to 2014, not only it would have a comparative advantage in primary commodities production, but it would also have the relatively closer initial trade linkage with China.

In the first stage of TSLS, given the logic behind the instrument, I run the following regressions:

$$\Delta \ln(1 + s_i) = \gamma IV_i + \theta \Delta \mathbf{X}_i + \mu_i \tag{3.10}$$

The coefficient $\gamma$ in front of the instrument representing the "export exposure" is expected to be positive because higher "export exposure" leads to a higher share of exports to China. The value of R-squared for this first-stage regression, together with the corresponding the F-test, can be used as indicators for the strength of the instrument. The results of the first stage are given in Table 3.8. Each column represents a different instrument. As is evident, all instruments significantly enter the regression with the expected sign. The value of R-squared takes values up to 0.63, and the F-test results all have a p-value of 0.00, which are both indicators of a strong instrument.

The fitted values of the first stage regressions, which represent the change in export exposure determined by different instruments based on comparative advantage and

[5]Primary goods consist of agricultural raw materials, ores, metals and food exports. It comprises SITC section 0 (food and live animals), 1(beverages and tobacco), 2(crude materials except fuels), 4(animal and vegetable oils and fats), 22(oil seeds, oil nuts, and oil kernels), 27(crude fertilizer, minerals nes), 28(metalliferous ores and scrap). Source: World Development Indicator

initial trade linkages, are further used to investigate the effects of Chinese demand on economics growth. The results are given in Table 3.9. As in the benchmark case, the estimates of $\alpha$ remain positive and statistically significant, independent of the set of instruments used, suggesting that some countries in LAC have seen expanded trade with China contributing to high levels of GDP growth while other countries have not reaped such benefits from trade with China. Moreover, the point estimate is slightly larger than in the OLS estimates, suggesting that endogeneity problems are not so severe. The coefficients for lagged growth remain negative and statistically significant, as expected.[6]

## 3.5 Conclusion

In this paper, I explore the effects of China's demand for primary goods on the economic growth of LAC countries after 2001 by using a classic treatment-and-control method. I view the increased Chinese demand in the 2000s as a quasi-natural experiment and consider it as a "treatment" to which a part of the LAC region was subjected. Even though there is always a concern that China's growth might push LAC countries out of the world market through competition and de-industrialization, the results show that China's demand did deliver significantly higher growth rates to some LAC countries over the last decade and a half. The results are robust to many control variables and alternative estimation methodologies.

Now, China is undergoing a profound social-economic transformation that poses challenges and opens opportunities for Latin America's development. The commodity

[6] I also consider the 2SLS estimation with several controls variables, including change in schooling, change in institutions, change in financial development, change in exchange rate stability and change in inflation stability. All of these investigations resulted in virtually the same result: Chinese demand delivers significantly higher growth rates to some countries in LAC over the period 2001-2014.

exports will significantly decline given China's growth model shifts its focus from investment and exports towards consumption. It is therefore important for Latin America to re-evaluate how to maximize the benefits of and the challenges posed by China's new growth policy. In particular, as stressed by Latin American Economic Outlook (2016):

> "China has been and will continue to be a game changer for the region. Ties between Latin America and China are now evolving well beyond just trade, challenging Latin American countries to adopt specific reforms to boost inclusive growth and build a mutually beneficial partnership with China."

## Tables and Figures

Table 3.1: Discrete Treatment

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Treatment Indicator | 0.012** | 0.011** | 0.012** | 0.011** |
| | (0.004) | (0.005) | (0.005) | (0.005) |
| Growth lagged | -0.081*** | -0.082*** | -0.081*** | -0.082*** |
| | (0.008) | (0.007) | (0.008) | (0.008) |
| Change in Institutions | | 0.002 | | 0.002 |
| | | (0.001) | | (0.002) |
| Change in Schooling | | | -0.008 | 0.003 |
| | | | (0.022) | (0.023) |
| R-squared | 0.808 | 0.820 | 0.809 | 0.820 |
| N. of cases | 33 | 33 | 33 | 33 |

Notes: Dependent variable is difference in the average change per annum of log GDP per capita. “pre” is period 1, 1987-2000; “post” is period 2, 2001-2014. All regressions include a constant. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.2: Placebo Treatment

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Treatment Indicator | 0.001 | 0.000 | 0.001 | 0.000 |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| Growth lagged | -0.083*** | -0.082*** | -0.083*** | -0.082*** |
| | (0.008) | (0.009) | (0.008) | (0.009) |
| Change in Institution | | 0.000 | | 0.000 |
| | | (0.002) | | (0.003) |
| Change in Schooling | | | -0.004 | -0.002 |
| | | | (0.034) | (0.037) |
| R-squared | 0.776 | 0.776 | 0.776 | 0.776 |
| N. of cases | 33 | 33 | 33 | 33 |

Notes: Dependent variable is difference in the average change per annum of log GDP per capita. "pre" is period 0, 1973-1986; "post" is period 1, 1987-2000. The treatment indicator is for the period 2. All regressions include a constant. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.3: Effects of Chinese competition on the export growth of LAC countries

| | (1) | (2) | (3) |
|---|---|---|---|
| China's exports | -1.100* | -3.174*** | -2.784** |
| | (0.551) | (0.904) | (0.938) |
| China's exports × Group | 0.052 | 0.050 | -0.720 |
| | (0.033) | (0.029) | (1.042) |
| Time fixed effects | No | Yes | Yes |
| Country fixed effects | No | No | Yes |
| R-squared | 0.016 | 0.246 | 0.342 |
| N. of cases | 403 | 403 | 403 |

Notes: The dependent variable is export annual growth (%). All regressions include a constant. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3.4: Continuous Treatment

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\Delta \ln(1+s)$ | 0.100** | 0.092** | 0.098** | 0.097** |
| | (0.044) | (0.043) | (0.046) | (0.044) |
| Growth lagged | -0.083*** | -0.084*** | -0.083*** | -0.085*** |
| | (0.008) | (0.008) | (0.008) | (0.008) |
| Change in institutions | | 0.002 | | 0.003* |
| | | (0.001) | | (0.002) |
| Change in schooling | | | -0.003 | 0.012 |
| | | | (0.023) | (0.024) |
| R-squared | 0.798 | 0.816 | 0.798 | 0.817 |
| N. of cases | 33 | 33 | 33 | 33 |

Notes: Dependent variable is difference in the average change per annum of log GDP per capita. "pre" is period 1, 1987-2000; "post" is period 2, 2001-2014. All regressions include a constant. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.5: Continuous treatment, control for other policy reforms

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| $\Delta \ln(1+s)$ | 0.100** | 0.100** | 0.102** | 0.104** | 0.105* | 0.135** | 0.136** |
| | (0.044) | (0.044) | (0.044) | (0.048) | (0.056) | (0.065) | (0.066) |
| Growth lagged | -0.083*** | -0.082*** | -0.085*** | -0.084*** | -0.083*** | -0.084*** | -0.087*** |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.009) | (0.009) |
| ΔFinancial Openness | | 0.001 | | | | 0.002 | 0.001 |
| | | (0.001) | | | | (0.002) | (0.002) |
| ΔFinancial depth | | | 0.009 | | | 0.011 | 0.003 |
| | | | (0.014) | | | (0.015) | (0.016) |
| ΔExchange Rate | | | | -0.000 | | -0.001 | -0.001 |
| | | | | (0.001) | | (0.001) | (0.001) |
| ΔInflation | | | | | -0.000 | -0.000 | -0.000 |
| | | | | | (0.001) | (0.001) | (0.001) |
| Change in Institutions | | | | | | | 0.003 |
| | | | | | | | (0.002) |
| Change in Schooling | | | | | | | 0.016 |
| | | | | | | | (0.026) |
| R-squared | 0.798 | 0.799 | 0.800 | 0.798 | 0.798 | 0.808 | 0.826 |
| N | 33 | 33 | 33 | 33 | 33 | 33 | 33 |

Notes: Dependent variable is difference in the average change per annum of log GDP per capita. "pre" is period 1, 1987-2000; "post" is period 2, 2001-2014. All regressions include a constant. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.6: Discrete treatment, control for other policy reforms

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Treatment Indicator | 0.012** | 0.012** | 0.012** | 0.013** | 0.016** | 0.019** | 0.018** |
| | (0.004) | (0.005) | (0.005) | (0.005) | (0.006) | (0.007) | (0.008) |
| Growth lagged | -0.081*** | -0.081*** | -0.082*** | -0.082*** | -0.081*** | -0.079*** | -0.082*** |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.009) | (0.009) |
| ΔFinancial Openness | | 0.000 | | | | 0.002 | 0.001 |
| | | (0.001) | | | | (0.002) | (0.002) |
| ΔFinancial Depth | | | 0.003 | | | 0.002 | -0.003 |
| | | | (0.014) | | | (0.014) | (0.015) |
| ΔExchange Rate | | | | -0.000 | | -0.000 | -0.000 |
| | | | | (0.001) | | (0.001) | (0.001) |
| ΔInflation | | | | | -0.001 | -0.001 | -0.001 |
| | | | | | (0.001) | (0.001) | (0.002) |
| Change in Institutions | | | | | | | 0.003 |
| | | | | | | | (0.002) |
| Change in Schooling | | | | | | | 0.001 |
| | | | | | | | (0.025) |
| R-squared | 0.808 | 0.808 | 0.808 | 0.810 | 0.812 | 0.821 | 0.834 |
| N. of cases | 33 | 33 | 33 | 33 | 33 | 33 | 33 |

Notes: Dependent variable is difference in the average change per annum of log GDP per capita. "pre" is period 1, 1987-2000; "post" is period 2, 2001-2014. All regressions include a constant. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.7: LAC Export to the World before Demand shock from China

| | Top Four Exporter(1985-2000) |
|---|---|
| Peroleum Oil | Mexico, Venezuela, Columbia, Argentina |
| Iron ore and concentrates | Brazil, Chile, Venezuela, Peru |
| Copper (different forms) | Chile, Peru, Argentina, Mexico |
| Soy bean | Brazil, Argentina, Paraguay, Bolivia |
| Fishmeal | Chile, Costa Rica, Argentina, Colombia |

Source: UN Comtrade Database, 2016

Table 3.8: First Stage of TSLS Estimation

| | (1)<br>Instrument#1 | (2)<br>Instrument#2 | (3)<br>Instrument#3 | (4)<br>Instrument#4 |
|---|---|---|---|---|
| IV | 28.686*** | 0.447*** | 0.073*** | 0.078*** |
| | (4.045) | (0.063) | (0.015) | (0.014) |
| Growth lagged | -0.008 | -0.014 | 0.016 | 0.006 |
| | (0.020) | (0.020) | (0.024) | (0.023) |
| F-test (instrument) | 50.30 | 49.86 | 23.70 | 30.77 |
| | [0.0000] | [0.0000] | [0.0000] | [0.0000] |
| R-squared | 0.628 | 0.626 | 0.444 | 0.509 |
| N. of cases | 33 | 33 | 33 | 33 |

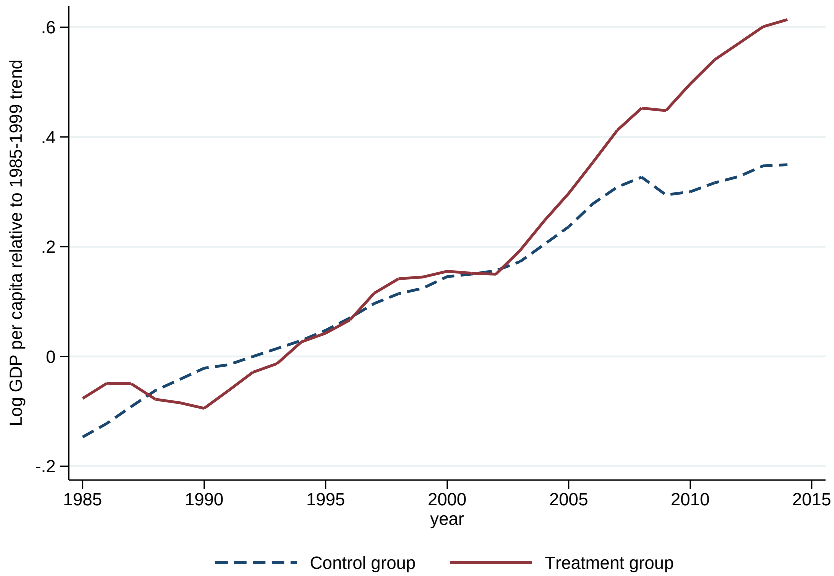
Notes: Dependent variable is the change of export share to China. Standard errors in parentheses. All regressions include a constant. F-test (instrument) shows the Sandeson-Windmeijer F-stat on the excluded instrument and the corresponding p-values are given in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.9: Second Stage of TSLS Estimation

| | (1)<br>Instrument#1 | (2)<br>Instrument#2 | (3)<br>Instrument#3 | (4)<br>Instrument#4 |
|---|---|---|---|---|
| $\Delta \ln(1+s)$ | 0.115** | 0.117** | 0.137** | 0.114* |
| | (0.053) | (0.053) | (0.063) | (0.059) |
| Growth lagged | -0.083*** | -0.083*** | -0.084*** | -0.083*** |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| R-squared | 0.797 | 0.797 | 0.793 | 0.797 |
| N. of cases | 33 | 33 | 33 | 33 |

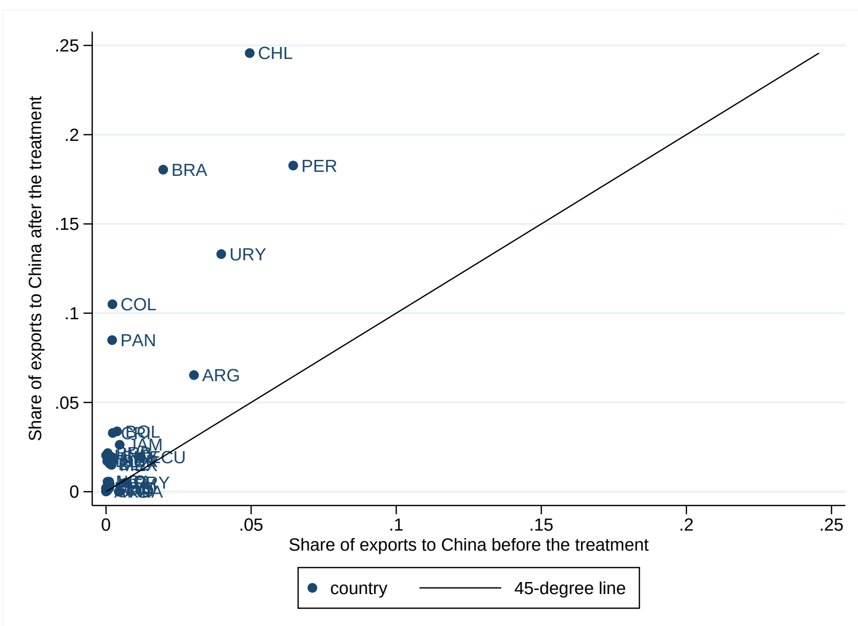
Notes: Dependent variable is the change of export share to China. Standard errors in parentheses. All regressions include a constant. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 3.1: GDP per capita relative to 1987-2000 Trend in Treatment group and Control group



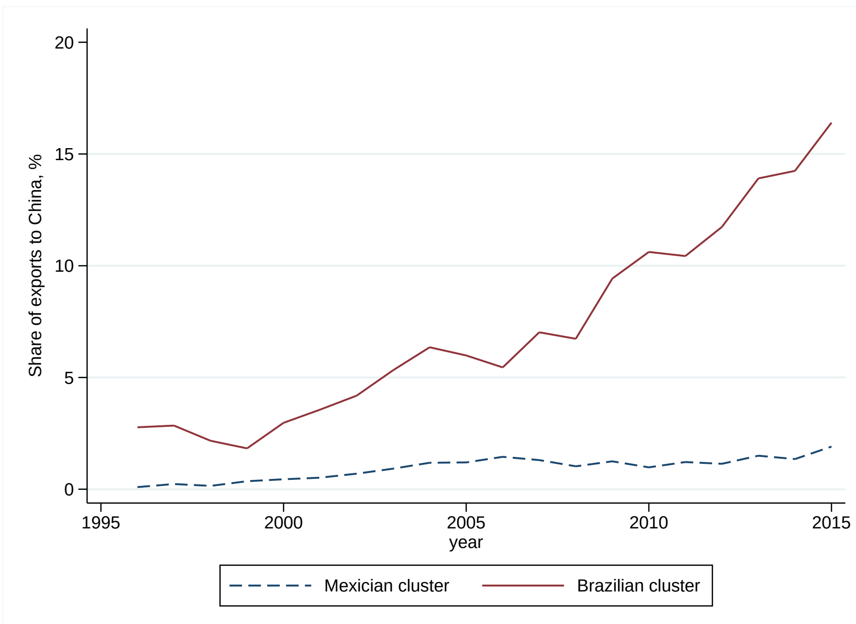

Source: World Development Indicators

Figure 3.2: Share of exports to China-After versus Before




Source: World Integrate Trade Statistics Database, 2016.

Figure 3.3: Share of exports to China in Brazilian cluster versus Mexican cluster




Note: The sample are as follows: Brazilian cluster–Argentina, Brazil, Chile, Columbia, Panama, Peru, Uruguay; Mexican cluster–Antigua and Barbuda, Bahamas, Barbados, Belize, Bolivia, Costa Rica, Cuba, Dominica, Dominica Republic, Ecuador, EL Salvador, Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, St. kitts and Nevis, St.Lucia, St.Vincent and the Grenadines, Suriname, Trinidad and Tobago, Venezuela,RB. Source: World Integrate Trade Statistics Database, 2016.

CHAPTER 4

# CONCLUSION

According to the World Trade Organization, the volume of world trade increased from \$296 billion in 1950 to \$16.5 trillion in 2015. As a result of international trade, consumers around the world enjoy a broader selection of products than they would if they only had access to domestically made products. Although increased international trade has spurred tremendous economic growth across the globe-raising incomes, creating jobs, reducing prices, and increasing workers earning power-trade can also bring about economic disruption. This dissertation aims to investigate the relationship between international trade and economic growth.

This dissertation consists of three related empirical studies on trade and growth. The first study investigates the relationship between exports of primary goods and human capital accumulation in the long run. The second study looks at the effects of gravity variables in international trade. The third study addresses the development experiences of Latin American countries in the context of China's economic rise.

Specifically, the research question in the first study is whether the content of what economies export matters for human capital accumulation. Many developing countries have experienced export-led growth in the last half-century. The existing literature has found that exporting firms pay higher wages and that export expansion is often associated with rises in the returns to skill. From these stylized facts, it is tempting to conclude that educational attainment will increase with the arrival of new export opportunities. However, such an inference ignores the fact that new exports jobs have the potential to raise significantly the opportunity cost of schooling. If the rise in the opportunity cost of schooling is greater than the increase in the return to schooling, the process of human capital will slow down. In this study, we focus on the effects of exports of primary goods, which consist of agricultural raw materials, food, ore and metal exports, on human capital accumulation.

This study first develops a small open economy model to provide guidance to the empirical work. In this model, competitive firms in the economy produce two final goods: an agricultural good and a manufactured good, both of which are tradable. Firms produce the final goods by employing labor as the only input. In the agriculture sector, firms use only unskilled labor. Skilled workers are employed in the manufacturing sector. Individuals in the first period of their lives can either start working in the agriculture sector as unskilled workers or invest in human capital and become skilled workers. Given the trade shocks that raise the relative world price of agricultural goods, export expansion in agricultural goods can lead to lower levels of human capital accumulation.

The central hypothesis of this study, that a shift towards primary exports reduces the levels of human capital accumulation, is supported by empirical evidence based on Latin American data over the period from 1965 to 2010. Latin America provides a perfect setting to study the effect of primary exports on human capital accumulation as the region is characterized by a large share of primary goods in its exports over this period. Two different empirical approaches are taken to test the model's predictions. The first one uses panel estimates to study the association between primary exports and human capital accumulation. The second one employs two instrumental variable specifications, using resource discoveries and international primary goods exports index to investigate the casual effect of primary exports. The results are shown to be robust to the consideration of many control variables and alternative methodologies. From the policy perspective, these results are relevant for designing industrial and trade policies. Many developing countries that pursue export-led growth strategies also want to upgrade the skill levels of their workforces, as they expect that positive externalities from education would drive long-run growth rates. Therefore, the results of this paper suggests a potential role for policy intervention.

The second study investigates the effects of gravity variables (distance, adjacency, colony relationship, free trade agreement, or language) on preference and trade costs. In the existing literature, the gravity variables are directly linked to any policy investigation due to their representation of direct trade costs and indirect trade costs. Direct trade costs refer to measurable costs such as transportation costs and duties/tariffs, while indirect trade costs correspond to intangible costs such as information costs or search costs. Although models in the existing literature imply that gravity variables capture trade costs and mostly correspond to the difference between the source and destination prices, it is understood implicitly that these gravity variables may also capture the effects of preference in the destination country. A recent paper by Anderson (2011) points out that it is difficult to distinguish demand-side home bias form the effect of trade costs since the gravity variables used in the literature plausibly pick up both demand and cost differences. The aim of this study is to differentiate empirically the effects of gravity variables on preferences and trade costs. The research questions this study focuses on as follows: Do gravity variables in trade also capture consumer preferences in the destination countries? Which one of the gravity channels contributes more to trade flows for each of the gravity variables under consideration?

This study uses the U.S. imports data from the U.S. International Trade Commissions, covering 224 countries at the SITC-4 digit good level over the period from 1996 to 2013. First, this study models the imports of the U.S. at the individual good level by incorporating the solution of the optimization problems of individuals in the importing country and the firms in the source countries. Two types of preferences were considered. The first type is the random preference, which implies that gravity variables only capture the effects of measured trade costs in a typical gravity regression. The second type is a dyadic preference, which implies that gravity variables not only capture the effects of measured trade costs but also those of preferences in a typical gravity regression.

Accordingly, this study decomposes the overall effects of gravity variables on trade into three gravity channels: duties/tariffs (DC), transportation costs (TC), and dyadic-preferences (PC). The results imply that, when the dyadic-preference channel is ignored in existing studies in the literature, it is shown that nearly all gravity effects are due to distance, 29 percent through DC and 71 percent through TC. The tables turn as the additional channel of PC is introduced and shown to dominate other channels, with common border contributing about 45 percent, distance about 32 percent, colony about 14 percent, free trade agreement about 7 percent, and language about 2 percent. In summary, this study finds that gravity variables in trade mainly chapter the effects of demand shifters rather than supply shifters. From the policy perspective, policy tools such as duties/tariffs or investment on transportation technologies are implied as simply not enough to have any impact on trade; it is rather globalization itself that should be promoted to shift the preferences of destination countries toward partner country products.

Finally, the third study examines the effects of increased demand from China on economic growth of the Latin American and the Caribbean (LAC) countries. After 2001, the booming trade between China and LAC has led to concerns about a potential "resource curse" and losses in manufacturing due to rising import competition. In the existing literature, litter attention was paid to potential gains to LAC from increased Chinese demand for primary commodities. Therefore, this study explores the effects of Chinese growth on LAC from the demand side.

The research question in the third study is: How does demand from China affect the economic growth of the LAC countries. The answer to this question is essential for our understanding of the economic performance in LAC both in the current period and in the near future. This study is designed to provide a quantitative answer to the question and to attend to problems of causality and identifications while avoiding biases by using a difference-in-difference approach. This study views the increased Chinese demand in the early 2000s as a quasi-natural experiment and considers it as a treatment to which a part of the LAC region was subjected. Using a treatment-and-control partition of countries based on the significance of their engagement in the trade with China, this study tests whether some countries in LAC experienced a higher economic growth rate due to increased Chinese demand in the last fifteen years. Two different empirical methods are taken. The first one uses the demand shock as a discrete treatment, whereas the second one treats the demand shock as continuous treatment. Furthermore, to address the potential self-selection problem, this study uses an instrumental variables approach. Even though there is always a concern that China's growth might push LAC countries out of the world market through competition and de-industrialization, the results show that China's demand did deliver significantly higher growth rates to some LAC countries over the last decade and a half.

In summary, my dissertation focuses on the growth and development experiences of different regions of the globe from the international trade perspective. My future research objectives include investigating the role international trade plays in the structural transformation of developing countries. The primary goal of the planned work is to develop a multi-sector small open economy model and to conduce a quantitative analysis. As the understanding of trade and growth improves over time, there will be more and more scope for facts to influence the debate in economics.

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