IS FREE TRADE GOOD FOR GROWTH? RECONCILING MACRO- AND MICROECONOMIC EVIDENCE AND DATA

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Abstract

By exploiting the intertemporal, intersectorial and international variation in trade policy, this paper uses macro- and microeconomic data from six Latin American countries between 2006 and 2010 to investigate the extent and channels by which artificial trade barriers impact firm growth. Using a structural procedure, the effect of tariff barriers on firm growth is mediated by its impact on import flows. Counterfactual changes in imports are estimated within the gravity framework, and then used on representative survey data to estimate the differentiated effects of import-competition and imported inputs on firm growth. Main findings suggest generalized static and dynamic gains in productivity from the free inflow of imported inputs. Gains are higher for firms where policies and institutions are supportive. The elusive effect of import-competition, on the contrary, is very heterogeneous across firms, industries and countries, kicking in depending on firms' technology intensity, comparative advantage and relative productivity.

JEL classification: F13, F14, O12, O24, O47, O54
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1 Introduction

Trade policy has been widely used during different historical episodes and by different countries as basis for a comprehensive development strategy. From growth miracles in East Asia to crises episodes in Latin America, the contribution of trade policy to country development has been long investigated. Findings on this matter, however, have been as diverse as the postulated theories supporting them (Hirschman, 1971; Luong, 2011; Page, 1994; Winters, 2004). Revisionists argue that market forces alone do not guarantee the rise of industrial sectors in developing countries preventing what would have caused greater investments. Thus, government interventions are seen as required for the generation of proper incentives in industries that would have otherwise not developed under the rule of comparative advantage (Asian Development Bank, 1997b). On the other side, supporters of free trade claim that distortionary policies are counterproductive as integration to world markets improves access to foreign technology, expands input availability and unleashes competitive forces that rise efficiency (Goldberg et al., 2010; Grossman and Helpman, 1991; Melitz, 2003; Taylor, 1998). While recent studies tend to favor trade openness over trade protection, the heterogeneity of its impact across and within countries is enormous (Rodrıguez and Rodrik, 2000; Schor, 2004). For many countries and in many circumstances, this relationship is far from being conclusive (see Rodrik et al., 2004; Winters, 2004).

Yet, one commonality among the vast majority of empirical studies is the analysis of this relationship in periods of deeper transformation of the economy. Namely, during far-reaching trade liberalization episodes in Chile 1979-1986 (Pavcnik, 2002), Brazil 1988-90 (Ferreira and Rossi, 2003), Colombia 1977-1991 (Fernandes, 2007), Indonesia 1991-2001 (Amiti and Konings, 2007), India 1987-2001 (Topalova and Khandelwal, 2011), among others. Since macroeconomic conditions and economic structures of those countries can be dramatically different today from how they were back then, determining whether the effect of trade liberalization is driven by a unique set of circumstances during the 80s and 90s or whether it is replicable today may have policy implications[1].

Therefore, this paper explores the link between trade openness and growth in six Latin American countries (Argentina, Chile, Colombia, Mexico, Peru and Venezuela) between 2005 and 2009. Since the observation of microeconomic dynamics enriches the impact assessment of macroeconomic policies, this study relies on standardized survey data representative for the entire firm population of the aforementioned countries. In this context, and in contrast to most case studies, this paper exploits the intertemporal, intersectorial and also international variation in tariff barriers to estimate the impact stemming from import tariffs on labor productivity and total factor productivity.

The identification strategy combines empirical methods employed in Frankel and Romer (1999) and Amiti and Konings (2007) with theoretical developments in Anderson and van Wincoop (2003),

[1] While tariff barriers are relatively low in most developed countries (less than 5 percent), they are still relative high (above 10 or 20 percent) in many developing countries (Anderson and Van Wincoop, 2004).

Melitz (2003) and Goldberg et al.(2010). In this context, the effect of trade openness on firm growth is estimated in a two-step procedure, where the first step captures the response of imports to tariff barriers, and the second step the effect of this response on firm growth. Consequently, the extent to which tariff barriers impacts firm growth is predicated on how it affects the inflow of imports. This transmission channel is then differentiated on whether the imported product is an intermediate good or final good, as both are expected to deliver the firm different incentives. Namely, imported final goods represent inflowing competition from abroad, while imported intermediate goods may be valuable factors of production. As a result, the ambiguous link between trade openness and growth is assessed by targeting the effects from tariff barriers that are mediated by the extent of the market, as proposed by Alesina et al. (2005)[2].

To best knowledge of the author of this paper, there is no empirical investigation assessing the differentiated effects of tariff barriers on firm growth in a structural approach. This study attempts to contribute to the literature in several ways. First, it provides an empirical assessment of the relationship between trade openness and growth from a non-liberalizing environment. Second, it uncovers the impact heterogeneity across firms and industries by exploiting the both macro- and microeconomic variations over six different countries. Third, it incorporates the role of foreign tariffs in the openness-growth relationship. And lastly, it analyzes, in parallel, the incidence of tariff barriers on the so often ignored service sector.

Main findings from this paper suggest that increasing imported inputs by 10 percent leads to a raise in labor productivity and total factor productivity by 1.4 percent and 1.9 percent respectively. Gains from imported inputs are higher for firms with macroeconomic stability, low market failures and greater access to world input markets. On the other hand, increasing import-competition has no statistically significant effect on labor productivity on average. Yet, across firms, the often elusive effect of import-competition appears by increasing average productivity of firms at the bottom of the productivity distribution, in comparative disadvantaged industries and in medium to high-tech industries.

These results suggest that free trade causes widespread gains through the input channel. Gains from imported inputs can be magnified with complementary policy. The impact of import-competition, however, is limited to sectors with higher technology requirements, and firms with lower productivity. As a result, efficiency gains from reallocation of resources may follow. Naturally, this may have implications on the labor market, income distribution, specialization path, social stability and other topics that go beyond the scope of this study.

The rest of the paper is organized as follows. Section 2 presents a review of most relevant theories and empirical findings in the literature. Section 3 provides the theoretical framework underlying this

[2] Alesina et al. (2005) claim that there are many reasons why trade openness (however measured) may display a positive coefficient on growth. For instance, trade openness may induce improved functioning of institutions, increased foreign direct investment, scale effects, etc.

analysis. Section 4 presents, describes and depicts relevant features of the data. Section 5 implements the empirical analysis of data using both the direct and two-step procedure. Section 6 tests the robustness of the baseline results. Section 7 performs a group analysis for heterogeneous effects. Section 8 analyzes empirically the transmission channels. Section 9 summarizes the main findings. Section 10 presents a discussion about the challenges, validity and limitations of the study. Section 11 concludes.

2 Literature Review

There are diverse views explaining how trade openness affects growth. In this section, the most prominent theories covering the macro- and microeconomic aspects of the trade-growth relationship are introduced. Survey reviews and empirical evidence addressing the validity of these theories will be exposed towards the end of this section.

2.1 Theories of Trade Policy and Economic Growth

The accumulation of production factors is an important driver of economic growth. In this sense, Ventura (1997) analyzes the macroeconomic link between free trade and factor accumulation, suggesting that countries advocated to free trade are able to defy the law of diminishing returns for a long time period, fostering capital accumulation and structural transformation. This model combines the factor-equalization theorem of international trade with the Ramsey model of economic growth, yielding a neoclassical growth model, in which trade integration helps, through its effects on factor prices, to avoid the curse of diminishing marginal returns. This insight explains growth miracles in East Asia, where capital accumulated more rapidly without raising the interest rate or diminishing returns (Donaldson, 2011).

The theoretical relationship between free trade and growth has also found reception within innovation-based models. Romer (1990) model of endogenous growth is based on technological change as a key driver of economic growth. In this setting, larger markets make research more profitable, thus integration into world markets raises long-run growth. This three sector model is characterized for the generation of new or improved inputs in the intermediate sector from investments in the research. This model suggests that human capital, and not population, is a central factor for growth. Thus, the integration to world markets, especially to countries with larger amount of human capital enables higher growth rates.

Grounded on endogenous growth models, Grossman and Helpman (1991) present a model of repeated product improvement progressing up in a quality ladder. As in Romer (1990), growth is the consequence of profit incentives to research. Thus, international trade creates incentives for all improvements to take place in high-wage countries with comparative advantage in research and development. This feature explains the inter-industry pattern of international trade predicted by the Heckscher-Ohlin model. Nonetheless, firms in low-wage countries are able to imitate products through reverse engineering. This dynamic reallocates the locus of the production of a particular good back and forth between high-wage and low-wage countries.

Baldwin and Forslid (2000) incorporate trade barriers explicitly in the openness-growth relationship, using Tobin's q-theory. The main findings of their model suggest that when the traded goods are input factors, a reduction of trade barriers promotes growth by diminishing the marginal cost of replacement capital. Additionally, it unleashes pro-competitive effects that are able to reduce the markup on intermediate goods, altering the market structure and enabling the exploitation of economies of scale by surviving firms.

Melitz (2003) encompass the aforementioned feature in a heterogeneous firm model, where the selection effect triggered by competition is fundamental in the determination of gains from trade. According to this model, firms with different levels of productivity but with equal fixed entry and export costs compete for domestic and foreign markets. Since trade liberalization leads to higher competition, least productive firms exit the market while high-productivity firms grow and expand to foreign markets. The model predicts efficiency gains from intra-industry reallocation of resources towards more productive firms, raising, by construction, the industry's average productivity.

Nevertheless, when it comes to the relationship between import-competition, innovation and *within*-firm growth, economists do not seem to have reached a general consensus (Lawrence and Weinstein, 1999). Romer (1990) and Schumpeter (1934) models consider that temporary monopolistic rents and large market sizes are necessary for promoting innovation. Lawrence and Weinstein (1999), on the contrary, suggest that competition, especially international competition, spurs innovation in less advanced import-competing industries through imitation and learning from foreign rivals. This latter suggestion is in line with models of knowledge spillovers and technology diffusion (Grossman and Helpman, 1991; Keller, 2001). From the behavioral perspective, competition may boost innovation by generating sufficient external stimuli to bounded-rational entrepreneurs, pushing them to change, overcome the inertia and adapt themselves to new dynamics (Hurley and Hult, 1998). Nevertheless, more recent models on competition and growth consider that the positive effect of international competition is predicated on the distance of domestic firms to the world's technology frontier. Thus, import-competing industries far away from (close to) the world's technology frontier are likely to be damaged (benefited) by trade liberalization (Aghion and Griffith, 2008).

In this line, Bloom et al. (2016) develop a "trapped factor" model of trade-induced innovation to explain the relationship between import-competition and firm growth. In this framework, firms can allocate factors of production to either generate "old" goods or innovate new ones. While all firms can produce old goods, not all of them can easily innovate and produce new ones. Capital and human resources employed are firm-specific, penalizing their reallocation with readjustment costs (therefore "trapped"). In this setting, the reduction of tariff barriers on old goods diminishes their profitability among domestic firms in import-competing industries, dropping the opportunity cost of using trapped factors for innovation. In this scenario, import-competition induces the use of firm-specific resources towards more productivity-enhancing activities.

Shifting focus from import-competing industries to input markets, more recent studies, as Goldberg et al.(2010), provide theoretical foundation for the microeconomic mechanisms through which imported inputs impacts firm growth. Goldberg et al. (2010) central premise is based on static and dynamic gains arising from the availability of new input varieties as predicted by endogenous growth models. In their framework, the effect of input tariffs on the total availability of input varieties operates through two different channels: the price of previously imported inputs, and the inflow of new input varieties. In the former, diminishing prices enable the production of previously unprofitable products, while through the latter new imported varieties expands the set of intermediate inputs. This effect is predicated on the substitutability between imported and domestic products. Namely, whether the imported input variety is essential in the production of a particular output, or whether it is perfectly substitutable.

Finally, Halpern et al. (2015) incorporates features of both the quality-ladder and the product-variety models to explain gains from using imported inputs. In their model, firms face fixed costs from importing different input varieties, which they can compensate by ripping off efficiency gains from higher input quality (or technology) and wider range of varieties, from which an optimal combination between (imperfect substitute) foreign and domestic inputs can be reached. In this setting, similar to Goldberg et al. (2010) the reduction of tariff barriers increases productivity by reducing the price of imports and raising the number of input varieties.

2.2 Empirical Findings

At the macroeconomic level, the positive relationship between trade openness and growth finds empirical support from cross-country regressions. For instance, Levine and Renelt (1992) find that while most economic policies are fragile to small variations in the control strategy, the correlation between trade openness and investment growth withstand robustly the sensibility analysis. In other cross-sectional studies, the positive relationship between trade openness and growth is likewise confirmed by Harrison (1996), Edwards (1997), Dollar and Kraay (2003) and Berggren and Jordahl (2005). Greenaway et al. (2002), however, find that trade liberalization deteriorates growth on average. Wacziarg and Welch (2008) claim that, on the contrary, on average trade openness does promote growth, and that countries experiencing negative or no growth effects are those subject to political instability or counterproductive macroeconomic policies. In studies such as Levine and Renelt (1992) and Wacziarg and Welch (2008) the accumulation of physical capital is identified as an important transmission channel for the effect of trade openness on growth. This is in line with neoclassical models as Ventura (1997), where trade openness is an enhancing factor of capital accumulation.

Nevertheless, Rodriguez and Rodrik (2000) reveal that weaknesses in growth regressions are endemic, as they present questionable measures of trade openness, unresolved issues in reverse causality, widespread impact heterogeneity and generalized indifference regarding the transmission channels between trade policy, production and firm performance.

In this sense, Frankel and Romer (1999) address reverse causality by using the geographic component of bilateral trade as an instrument for the estimation of the impact of trade on growth. To that end, instruments are built based on the aggregation of the part of bilateral trade that is explained by geographical characteristics. These estimates are determined by means of the gravity model. Their findings indicate that international trade has a large, positive but statistically moderate effect on income.

On the other hand, subsequent investigations turn to case studies to better cope with some of the issues criticized in Rodriguez and Rodrik (2000). For instance, Lawrence and Weinstein (1999) use sectorial data from Japan to identify the effect of trade liberalization on growth. They find that lower tariffs and higher import volumes are responsible for substantial increases in productivity in Japan between 1964 and 1973, suggesting that Japan's economic miracle may have taken place despite and not because trade protectionism. For Latin America, Ferreira and Rossi (2003) find in Brazil the trade liberalization from 1988-90 incremented the productivity growth rate by 6 percent.

At the plant level, Pavcnik (2002) finds in Chile that trade liberalization during 1979-1986 increased *within* plant productivity in import-competing industries. Plants exiting the market due to import-competition are 8 percent less productive than the average. Similarly, Bernard et al. (2006) find for US plants between 1977 and 2001 that a reduction in trade costs brings gains within and across industries and plants, where plants with low productivity are more likely to exit the market. For India, however, Balakrishnan et al. (2000) do not find evidence for the acceleration of productivity growth due to trade liberalization in 1991. Bloom et al. (2016) use half million firms over 1996-2007 from twelve European countries to estimate the impact of import competition stemming from low-wage countries on innovation and total factor productivity, finding that import-competition from China increases innovation and TFP within firms in developed countries. Particularly, it reallocates production factors towards more high-tech firms.

Productivity gains found in Pavcnik(2002), Bernard et al. (2006) and Bloom et al. (2016) provide empirical support for the Melitz (2003) model. However, the estimated gains from free trade may not only stem from competition-driven innovation and selection effects. Namely, Fernandes (2007) find for Colombian plants in 1977-1991 that the positive impact of tariff reductions is also associated with higher imports of intermediate goods, higher skill intensity and heavy machinery investment. Thus, in order to disentangle the effects in import-competition from those in imported inputs, more recent studies incorporate input tariffs in their empirical analysis.

In this line, Amiti and Konings (2007) use plant census data from Indonesia between 1991 and 2001 to estimate productivity gains from output and input tariffs. Input tariffs are computed as the weighted average of output tariffs, where weights are cost shares constructed from input-output tables. By using plant fixed effects they find that lowering output and input tariffs increase plant productivity. The inclusion of input tariffs halves the effect of output tariffs, yielding an effect that is twice as high as the effect of output tariffs. In this sense, Amiti and Konings (2007) claim that not controlling for input tariffs leads to omitted variable bias that overestimates competition-driven effects entailed in low output tariffs. By interacting input tariffs with importer dummies, they further find that gains from lower input tariffs are mostly accrued by importing firms. This provides empirical evidence for theoretical models developed in Halpern et al. (2015), where improved access to high-quality inputs and differentiated varieties are responsible for the positive impact of imported inputs on productivity.

In this line, other papers including Schor (2004), Topalova and Khandelwal (2011) and Nataraj (2011) agree upon the large and positive effect of reducing input tariffs on plant productivity. Nevertheless, the heterogeneity of its impact and the role of output tariffs vary across studies. For instance, for Schor (2004), the effect of output tariffs found in Brazil between 1986 and 1998 is subject to substantial variation depending on the size of the firm and its position in the productivity distribution. For Topalova and Khandelwal (2011), however, lowering output tariff in India from 1987 to 2001 has a clear positive effect on firm productivity. Their finding is robust to serial correlation, which is controlled by including lagged productivity and estimating it using the Arellano and Bond (1991) GMM framework. Yet, they claim that this effect vanishes in industries, where heavy licensing may have prevented locals from importing foreign goods. For Nataraj (2011), the reduction of output tariffs in India between 1989 and 2001 increases productivity of plants positioned at two extremes: small informal plants and formal plants in top quantiles of the productivity distribution. These studies suggest that import-competition effects in output tariffs may be conditioned on sectorial and firm characteristics.

A disagreeing result is presented by Muendler (2004). In contrast to Amiti and Konings (2007), Schor (2004) and Topalova and Khandelwal (2011) which use a semiparametric estimation of the production function in unbalanced panels, or Nataraj (2011) which uses difference-in-difference on representative pooled data, Muendler (2004) uses nominal exchange rate and foreign price indexes as instruments for input and output tariffs. Based panel data from Brazil between 1986 and 1998, Muendler (2004) finds that the efficiency gains from employing foreign inputs relative to domestic inputs is most of the times not statistically significant.

In light of these facts, the latest studies have shifted focus from input and output tariffs as proxies for imports variations to actual import information. Particularly, these studies are interested in shedding light on the mechanisms by which firms respond to openness to international trade.

Therefore, based on plant panel data from Colombia in 1982-1988, Kugler and Verhoogen (2009) assess the relationship between importers, input prices and productivity. Empirical facts provided in their study suggest that firms importing intermediate goods tend to employ a wider range of input varieties, acquire higher-quality inputs and spend on average more on them. More importantly, more-productive firms are found to self-select into import markets. Since this raise new empirical challenges, Kasahara and Rodrigue (2008) address simultaneity between productivity and importing by using the within-group estimator, the Arellano and Bond (1991) GMM and the proxy estimator à la Levinsohn and Petrin (2003). They find that for Chilean plant between 1979 and 1986 switching from being a non-importer to an importer improves productivity by 3.4 to 22.5 percent.

Divergent results are found in Vogel and Wagner (2010), which by using matching techniques to overcome self-selection do not find evidence for the positive impact of importing on productivity based on German manufactures between 2001 and 2005.

To address any source of endogeneity, Goldberg et al. (2010) use instrumental variables on panel data from India between 1989 and 2003. In this setting, the effect of imported inputs on productivity is disentangled by assessing its impact through input prices and input varieties. In this sense, they investigate whether resulting lower prices and higher input variety triggers the introduction of new products by domestic firms. For that purpose, input tariffs and trade fixed costs are employed as instruments for variations in input prices and input varieties. Goldberg et al. (2010) find that new input varieties lower the overall price for intermediate goods. More importantly, new imported inputs due to lower tariff barriers are responsible for almost a third of all new products introduced by domestic firms, generating sizeable dynamic gains instead of just making existing imported inputs cheaper. The expansion of input varieties within an economy is a key driver of long-run growth according to endogenous growth models. In this sense, Goldberg et al. (2010) present empirical evidence for the transmission channels by which tariff barriers impacts growth.

Similarly, Halpern et al. (2015) find for Hungary between 1993 and 2002 that firms importing 10 percent more inputs increase their productivity by 2.2 percent. Imported inputs are 19 percent better than domestic inputs per dollar of expenditure, accounting for 48 percent of per-product import gain. The remaining 52 percent go through the variety channel as the result of imperfect substitutability between foreign and domestic goods. They attribute one-quarter of all productivity growth during the period studied to imported inputs, where 80 percent of all import-related gains are due to the overall increase in volume and number of imported inputs and only 20 percent from efficiency premium from importing foreign firms. This study disentangles the positive effect of imports on productivity by providing empirical evidence for the effect of quality and variety in imported inputs as transmission channels as proposed by models developed in Goldberg et al. (2010) and Halpern et al.(2015).

Indeed, according to recent survey reviews, empirical evidence tends to favor the positive effect of trade liberalization on growth (López, 2005; Winters, 2004). Evidence from case studies suggests that the causal link seems to run from trade to growth, yet part of its benefits depends upon other policies and institutions of being supportive (Winters, 2004). Nevertheless, while analyzing its transmission channels, results regarding the homogeneity of its impacts across firms and the presence or not of learning-by-importing (and exporting) differ widely across studies (Schor, 2004; Wagner, 2012).

To sum up, the link of trade openness and growth may not only be grounded on physical capital accumulation, but also on how it changes incentives to innovate, accumulate human capital and become more efficient (1997). In this sense, while import-competition may induce the reshuffle of resources towards more efficient allocations, importing goods may entail per se benefits in terms of technology, quality, variety and price that generate static and dynamic gains in productivity.

3 Theoretical Background

Given the growing importance of clearer transmission channels, the theoretical framework underlying this study is grounded, on the one hand, on the theory-consistent gravity model by Anderson and van Wincoop (2003) to establish the link between trade policy and trade, and on the other hand, on theories of trade-induce productivity growth from Melitz (2003) and Goldberg et al.(2010) to establish the link between trade and growth.

In this sense, the premise of this paper is not to search for a direct connection between trade policy and growth but instead to exploit the abovementioned theoretical models to link stepwise trade policy, trade and growth. To establish the link between trade policy and trade, the gravity model developed by Anderson and van Wincoop (2003) is fine-tuned to best suit the research interest of this study.

Following the principles of the gravity model, countries are expected to trade in proportion to their relative size and proximity. This relationship is formalized as in Anderson and van Wincoop (2003):

$$X_{ijkt} = \frac{Y_{ikt}Y_{jkt}}{Y_{kt}}\left(\frac{T_{ijkt}}{\mathrm{P}_{ikt}\Pi_{jkt}}\right)^{1-\sigma} \qquad \text{(T.1)}$$

where i is subscript for the importer country, j for the exporter country, k for the industry and t for the year. X represents the import value, Y the economic size (demand and supply) and T the costs of trade. P and Π denote i's inward and j's outward multilateral trade resistance respectively. They relativize the costs of bilateral trade by capturing, on the one hand, the facility with which country i can be accessed by product k from other countries at year t (P_{ikt}), and, on the other hand, the facility with which product k from country j can access other countries at year t (Π_{jkt}). $\sigma > 1$ is the elasticity of substitution. As a result, equation (T.1) predicts bilateral import volumes explained by the relative size of both the importer's demand and the exporter's supply as well as the costs of bilateral trade relative to the costs of trading with the rest of the world.

When it comes to trade costs, however, the model does not really differentiate the sources. On the contrary, it comprises all costs of bringing a good to its final user. Particularly, these costs include transportation, distribution and currency costs, tariffs and non-tariff barriers, and costs related to information acquisition, contract enforcement and regulation compliance (Anderson and Van Wincoop, 2004). Therefore, following the search interest of this study, trade costs caused exclusively by tariff barriers are disentangled from other costs of trade:

$$X_{ijkt} = \frac{Y_{ikt}Y_{jkt}}{Y_{kt}}\left(\frac{T'_{ijkt}\cdot W_{ijkt}^{\frac{\omega}{(1-\sigma)}}}{\mathrm{P}_{ikt}\Pi_{jkt}}\right)^{1-\sigma} \qquad \text{(T.2)}$$

where W denotes the tariff rate, ω the elasticity of imports with respect to tariffs and T' all non-tariff trade costs. Equation (T.2) establishes the macroeconomic link between trade policy, namely, tariff barriers and trade (import volumes).

In this relationship, since import tariffs work as taxes on foreign goods, buying products from abroad becomes more expensive. As a result, the demand for imports may deviate (shrink) from their otherwise natural level, leading to new import volumes. Therefore, in order to establish the bridge between this process and its repercussions for microeconomic agents, quantifying the variation in import volumes caused by tariff barriers is required. In other words, one would like to observe the magnitude of additional goods that would have been imported, had the tariff been zero instead. It is worth noticing that this counterfactual is not observable, and the reason why this is not observed is not because tariffs are not observed, but because the elasticity of imports with respect to tariffs is not directly observable (Wooldridge, 2010, pp. 115-118). Yet, grounded on a theory-consistent model, the elasticity of imports with respect to tariffs, ω, can be determined from equation (T.2). As a result, the counterfactual imports responding to tariffs W_{ijkt} can be identified. According to Melitz (2003) model, foreign competition kicks in irrespective of its origin. Therefore, the extent to which product k is prevented from being imported is formalized as follows:

$$XW_{ikt} = f\left(W_{ijkt}, \omega\right) \tag{T.3}$$

where XW_{ikt} denotes the magnitude of product k deterred from being imported in country i at year t, f is a function, W the tariff rate, and ω the elasticity of import with respect to tariffs. Consequently, the resulting import volumes modeled in equation (T.3) depend exclusively on tariffs rates and on the elasticity of imports with respect to tariffs.

After having modeled the tariff-induced contraction in imports, the relationship between imports and microeconomic growth is next examined. First, Melitz (2003) model of firm heterogeneity suggest that the exposure of firms to foreign competition raises the level of productivity required for firms to remain profitable, fostering the exit of least productive firms. In this sense, for purposes of this study, it is assumed that higher competition from abroad materializes as domestic firms start competing against incoming imports for a share in the domestic market. Consequently, XW_{ikt} is a measure of prevented import-competition.

Second, as not every imported good competes with all domestic products for a share in the domestic market, whenever these goods are instead used as factors of production, theories developed by Goldberg et al. (2010) and Halpern et al. (2015) of trade-induced productivity growth via imported inputs enter into force. Thus, the magnitude of tariff-deterred inputs z is modeled as follow:

$$IW_{ikt} \quad = \quad f(XW_{izt}, s_{izkt}) \tag{T.4}$$

where i is subscript for the importer country, k for the (output) product, z for the input product and t for year. IW is the flow of production-weighted inputs deterred by tariffs barriers, f is a function,

XW the tariff-deterred imports (counting as inputs) from equation (T.3) and s the weight of different inputs in the production of a particular output.

According to Halpern et al. (2015), the link between imports and growth is grounded on the quality and variety channel. Namely, access to higher quality inputs and expanding range of input varieties, enables the most efficient combination between foreign and domestic inputs. Similarly, from endogenous growth models, Goldberg et al. (2010) establish that the link between imports and growth is not only static but also dynamic. Namely, it is the extensive margin of imports and not only the reduction of input tariffs the responsible for diminishing input prices and wider input variety. In turn, more and cheaper inputs enable the production of previously unprofitable products, triggering the introduction of new products by domestic firms (Goldberg et al., 2010). Product innovation of this nature characterizes growth in endogenous growth models developed by Grossman and Helpman (1991). On the other hand, low factor prices trigger factor accumulation as predicted by neoclassical growth models, enhancing the process of capital deepening (Ventura, 1997).

4 The Data

To assess the strength of the hypothesized relationships in the theoretical framework, this study must collect data from multiple sources. First, it gathers disaggregated trade data to estimate the gravity model. Second, it uses input-output tables to identify the necessary input weights. And third, it collects firm-level data to estimate the impact of trade policy on firm performance from a structural approach.

It is worth mentioning, however, that the structural approach (performed in two stages) is deployed together with the direct approach for comparison reasons, as the latter is often used in the empirical literature (see Amiti and Konings, 2007; Topalova and Khandelwal, 2011). Therefore, in this section, the trade data is not only presented for the estimation of the gravity model but also for the direct estimation. The description, characteristics and properties of the data are provided next.

4.1 Macroeconomic Data

The main macroeconomic data employed in this study gathers import and tariff information. A detailed description of this data is presented in this subsection. Other macroeconomic data, including country's GDP, exchange rates, demographic and geographical data is employed for different purposes throughout the paper. A more detailed overview of these data is provided in the Data Appendix.

4.1.1 Domestic Output Tariffs

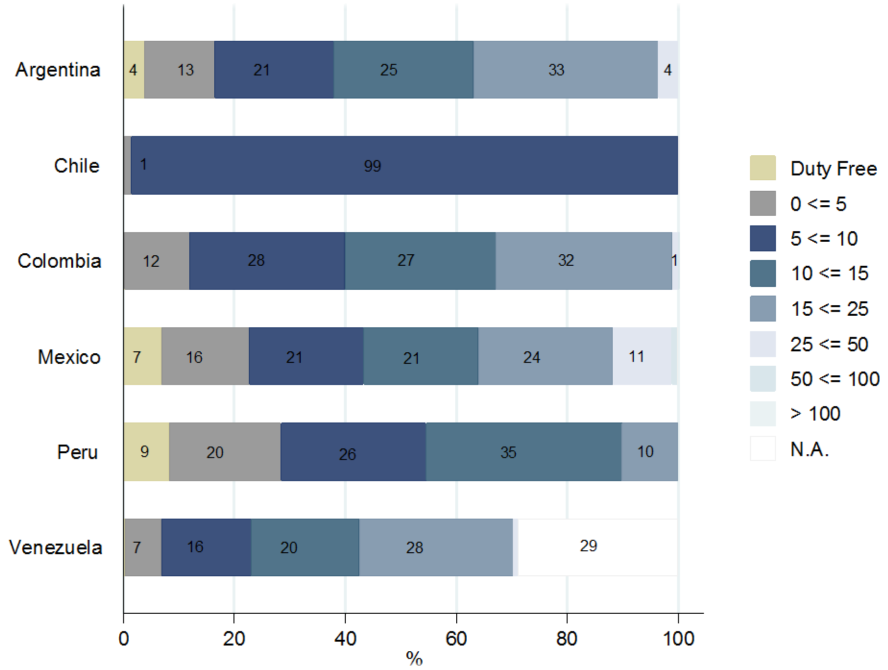
Data on import tariffs levied by six major Latin American countries (Argentina, Chile, Colombia, Mexico, Peru and Venezuela) between 2000 and 2010 is taken from the WITS-WTO database. The extracted dataset gathers trade-weighted tariffs based on effectively applied rates upon commodity lines aggregated at the two-digit level of the ISIC Rev.3 industrial classification[3]. Thus, the data has

[3] Performing the analysis at two-digits represents a good compromise between a large information loss in total aggregation, and a loss of synthetic value in excessive disaggregation (Bacchetta et al., 2012, p. 70). Moreover, excessively disaggregated data is more likely to be noisy (Halpern et al., 2015).

information on tariffs imposed by 6 importing countries on 33 exporting industries from 132 trading partners during 11 years, building a dataset with 287'496 observations. This represents 99.9% of total imports for the aforementioned Latin American countries, and involves 97.26% of the world population as trading partners[4].

Since WITS database records tariff information only if actual trade took place, tariff information is not always available, even at higher levels of aggregation. In fact, most countries do not trade with all partners, in all industries and in all years. Nevertheless, the resulting unbalanced panel is still notably large: 111'608 non-missing observations. In order to illustrate this large dataset, raw tariffs are classified in eight categories according to their rate level. Figure 1 and Figure 2 depicts their frequency distribution by country and industry ("product group") respectively.

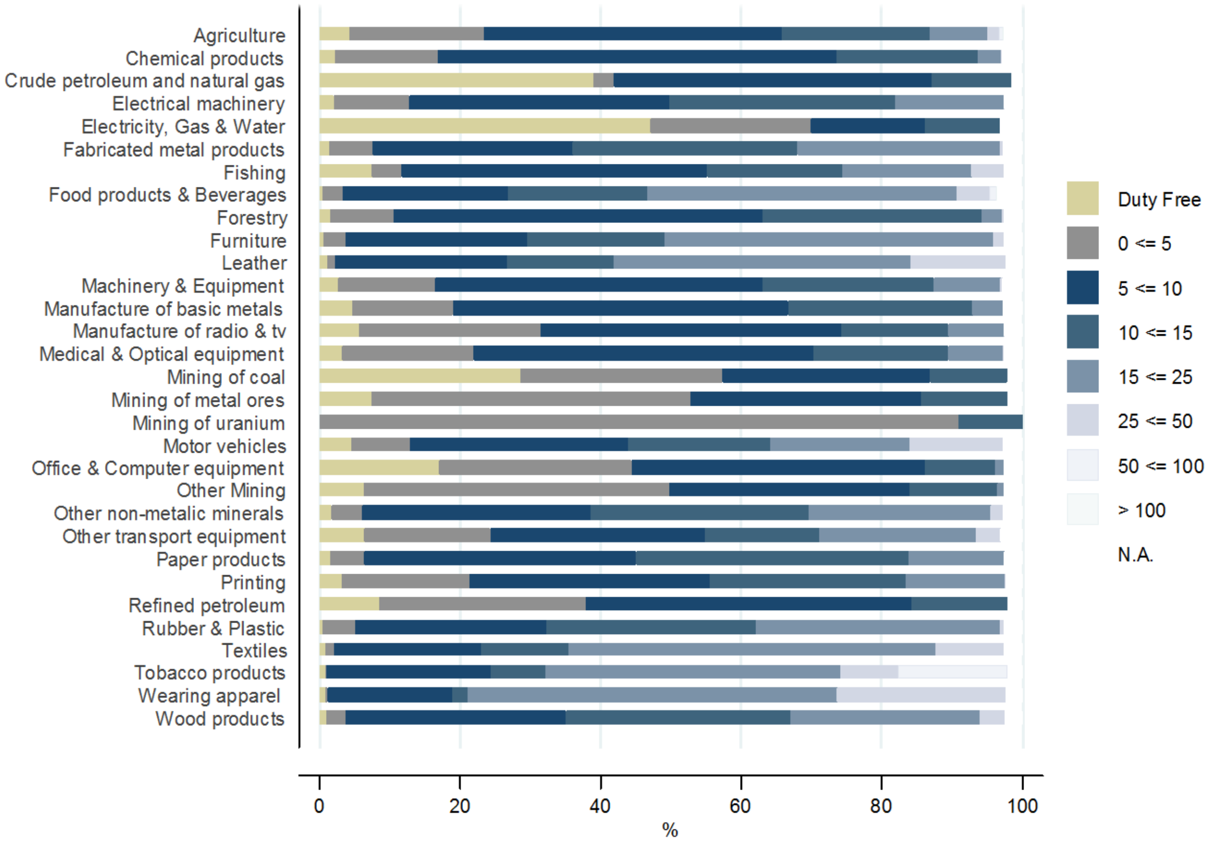
Figure 1. Disaggregated bilateral tariffs: frequency distribution by country



Source: Own elaboration from WITS-WTO database

4 Own calculations based on import values from WITS, and GDPs and population information from the World Bank's Development Indicators. Further details about the data are provided in the Data Appendix.

Figure 2. Disaggregated bilateral tariffs: frequency distribution by product group, ISIC Rev. 3



Source: Own elaboration from WITS-WTO database

Figure 1 and 2 pictures the variety of rates in applied tariffs within and across countries and product groups. In this sense, while Chile has 99% of their tariffs ranging between 5 – 10%, in Argentina 62% of them are higher than 10%, and in Peru 29% of them are lower than 5%. Similarly, for minerals, fuels, radio and computer equipment more than 25% of the recorded tariffs are below 5%, while on the other extreme, for wearing apparel, tobacco products, leather, furniture and food and beverages more than 70% of the recorded tariffs are above 10%.

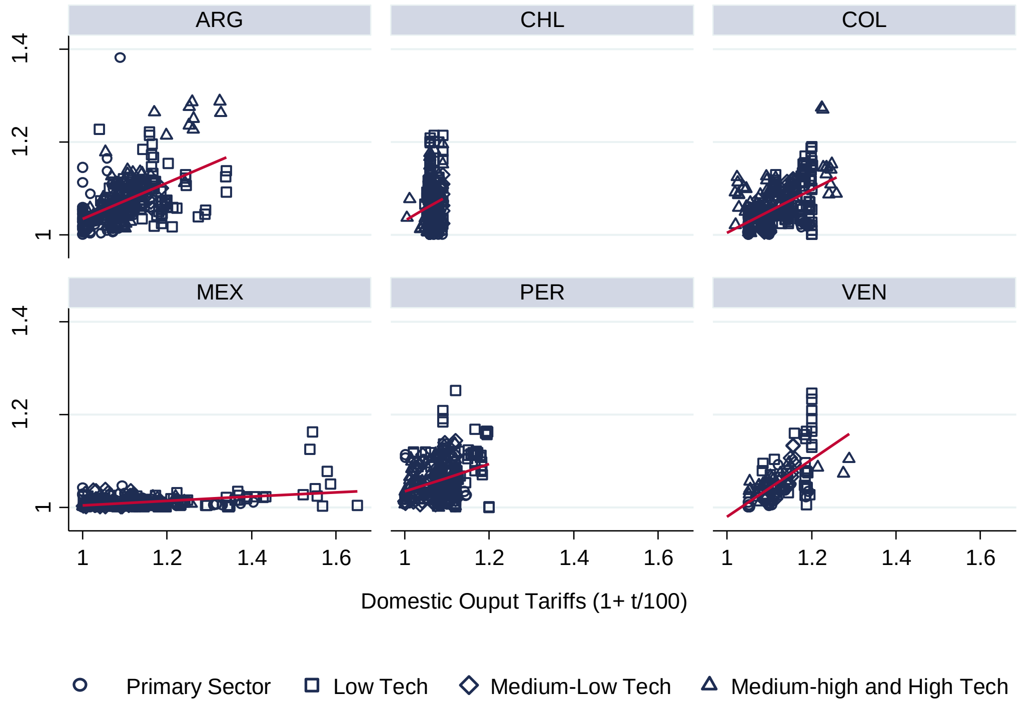
The raw tariffs presented above vary over country, partner, product and year, and are suitable for the gravity model. However, for the direct estimation, tariffs are required to vary over country, product and year only. In this sense, raw tariffs are averaged over trading partners using import-weights following the same methodology employed in WITS (WITS User's Manual 2011, p. 134). This methodology is provided in the Data Appendix. To illustrate the resulting variable, Figure 3 and Figure 6 will compare them against foreign (output) tariffs and firm performance respectively.

4.1.2 Foreign Output Tariffs

In contrast to past periods of unilateral trade liberalization, variations in import tariffs from 2000 to 2010 are more likely to be related with bilateral trade negotiations. Thus, in order to enrich the scope of this study, import tariffs levied by countries to exports from Argentina, Chile, Colombia, Mexico, Peru and Venezuela are likewise taken from the WITS-WTO database. The type of tariff, classification system and level of aggregation is the same as the one used for domestic tariffs. Thus, the data on foreign tariffs comprises tariff rates imposed by 121 countries on 33 industries from 6 partner countries in Latin America during 11 years, leading to a dataset with 286'440 observations[5]. This data represents 99.9% of their total exports, and covers a wide range of importing countries holding 99.65 % of the world population[6].

Similar to domestic tariffs, most countries do not import in all industries and in all years from Latin America, creating an unbalanced panel with 100'705 non-missing observations. Still, information from this large dataset is directly used in the survey estimation. Thus, foreign tariffs are averaged over importing countries analogously to domestic tariffs. Figure 3 displays average foreign tariffs plotted against its domestic counterpart.

Figure 3. Disaggregated country average: foreign tariffs vs domestic tariffs



Source: Own calculations from WITS-WTO database

As shown in Figure 3, average foreign tariffs are most of the time below 20%. The correlation between foreign tariffs and domestic tariffs is strong for Argentina, Colombia, Peru and Venezuela. For Chile and Mexico, however, this link is rather weak. For instance, in Chile domestic tariffs are uniform and low even when foreign tariffs increase, while in Mexico domestic tariffs may be on average very high even when on average foreign tariffs are very low.

[5] 121 instead of 132 since state members of the European Union are treated as a single entity, which impose a common external tariff scheme.

[6] Own calculations based on import values from WITS, and GDPs and populations information from the World Bank.

4.2 Input-Output Tables

To perform the direct estimation as Amiti and Konings (2007) or Topalova and Khandelwal (2011), the concept of input tariffs is first introduced as the weighted average tariff on tradable and non-tradable goods used as inputs in the production of final products. Thus, in order to construct this variable, information on sale-purchase linkages across industries is required. For that purpose, national Input-Output tables are drawn from OECD's harmonized database. This data reports inter-industrial flows at the two-digit level of the ISIC Rev.3 industrial classification, and is available for OECD members (Chile and Mexico) as well as for non-OECD members (Argentina and Colombia) for the years 2005 and 2009. For Peru and Venezuela, the production matrix is constructed from Input-Output tables available in neighboring countries[7].

From these input-output matrices, the share of inputs in each output is derived for every input-output relationship, yielding 41'772 input shares. These shares vary over country, industry, input and year, and are complemented with tariff information from WITS, such that every input is provided with both an input share and a tariff. Formally, input tariffs are computed as Goldberg et at.(2010), Topalova and Khandelwal (2011) and Bas (2012):

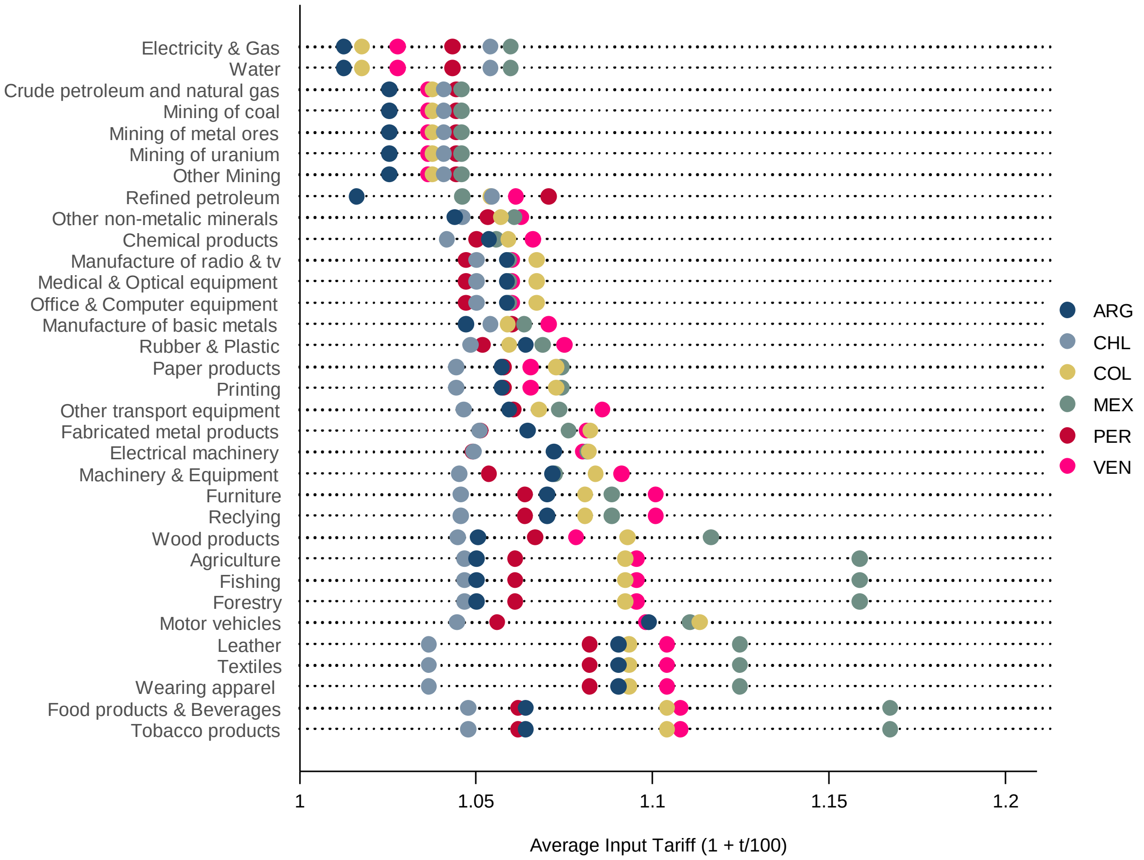
$$InputT_{ikt} = \sum_{z}^{Z} s_{izkt} \cdot OutputT_{izt} \qquad \text{(D.1)}$$

where i is subscript for the importer country, k for the (output) product, z for the input product and t for year. $OutputT$ is the trade-weighted (output) tariff averaged over trading partners computed in section 4.1.1, and s the weight of every input in the production of every output. Weights are the share of input z in the production of output k calculated from the Input-Output tables[8]. To illustrate the computed variable per country and product group, input tariffs are time-averaged and depicted in Figure 4.

[7] For being in the same region and having the closest GDP per capita (PPP), Colombian and Brazilian Input-Output tables are used for Peru and Venezuela respectively.

[8] As Goldberg et al.(2010), the output tariff used on non-tradable products is zero.

Figure 4. Average input tariffs per country and product (manufacturing only)



Source: Own calculations from the WITS-WTO database and OECD's Input-Output tables

Figure 4 pictures a common feature across countries and products: input tariffs are almost never greater than 15%, making them on average lower than output tariffs (see Amiti and Konings, 2007). This regularity is based on the fact that most industries use, to some extent, non-tradable products as inputs, and these are characterized for being unaffected from import tariffs. Figure 4 reveals that industries producing fuels, minerals and some high tech products (as computers and medical equipment) are subject to relatively low input tariffs regardless of the country. For other product groups, however, input tariffs are on average lower in Chile, Argentina and Peru, than in Colombia, Mexico and Venezuela, especially when it comes to agricultural, low-tech industries (i.e. tobacco, food, beverages, textiles, leather and wearing apparel) and motor vehicles.

4.3 Microeconomic Data

In order to observe the response of microeconomic agents to trade policy, this paper uses firm-level data based on the World Bank's Enterprise Survey in 2006 and 2010. These surveys cover 11'521 firms from Argentina, Chile, Colombia, Mexico, Peru and Venezuela, and are representative at the national level, accounting for ~ 2.6 trillion USD or 62% of the GDP in Latin America[9].

[9] Own calculations are based on World Bank's Development Indicators of nominal GDPs in 2010. Calculations are approximates as the survey does not represent the public sector of the economy.

The World Bank's Enterprise Survey uses standardized survey instruments and uniform sampling methodology since 2005. This minimizes measurement error and makes all the survey data employed in this study comparable across years and countries. To guarantee the representativeness of the economy, both waves use stratified random sampling with sampling weights adjusting for varying probabilities of selection across different strata (Enterprise Survey Manuals, 2009: Sampling Note). A more detailed description of the survey is provided in the Data Appendix.

The survey collects rich information about firm characteristics, investment climate, business environment, production costs, capital flows, balance of sheets and workforce statistics across diverse industries and locations. While deployed in 2006 and 2010, the survey collects information on firm performance from retrospective questions (from 2006/05 and 2010/09). Industries are classified with ISIC Rev.3 codes (at two-digits), and include the manufacturing (ISIC 15-37) as well as the service (ISIC 45-72) sector.

From this data, firm performance is measured by total sales, labor productivity and total factor productivity (TFP). *Total sales* is the value of annual sales in USD reported by the managing director or accounting department of the firm (Enterprise Survey Manuals, 2009: Implementation Note)[10]. *Labor productivity* is the log of sales to employment ratio. *TFP* is computed as in Gorodnichenko and Schnitzer (2013) [11]:

$$\ln TFP_{qikt} = \ln Y_{qikt} - s_{ik}^{L} \ln L_{qikt} - s_{ik}^{M} \ln M_{qikt} - s_{ik}^{K} \ln K_{qikt} - \ln CU_{qikt} \qquad \text{(D.2)}$$

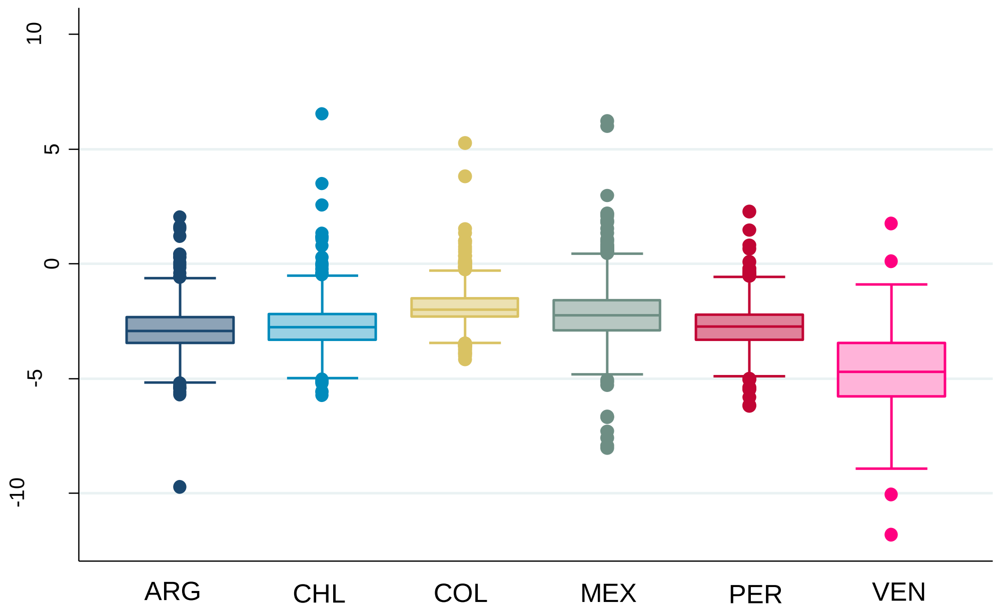
where q is a subscript for firm, i for country, k for industry and t for year. Y denote the value of total sales, L the number of employees, M the value of production inputs, K the replacement value of physical assets, and CU the share of capacity utilization. s^L, s^M and s^K are labor, material and capital shares of total costs[12]. As this information is not asked in the services module, *TFP* can be only constructed for the manufacturing subsample. Figure 5 depicts the estimated *TFP*.

Figure 5. Distribution of total factor productivity by country

[10] All monetary quantities are originally asked in local currency units. To achieve comparability across countries in that regard, values are converted from Argentinean pesos, Chilean pesos, Colombian pesos, Mexican pesos, Peruvian soles and Venezuelan bolivars into USD using nominal exchange rates from currency data provided by an official exchange dealer (http://www.oanda.com/currency/historical-rates/)

[11] Common techniques used for the estimation of production function parameters include Olley and Pakes (1996) and Levinsohn and Petrin (2003). Nevertheless, they only apply to panel data. Plus, the estimation à la Olley and Pakes (1996) requires investment to be strictly positive in all years (Petrin et al., 2004), precondition that is not fulfilled by the data.

[12] Shares are calculated for each firm, aggregated by industry and allowed to vary across country and year. Capacity utilization (CU) is used to correct for demand shocks. This is critical for the estimation of total factor productivity, since otherwise productivity gains may be potentially overestimated (De Loecker, 2011).

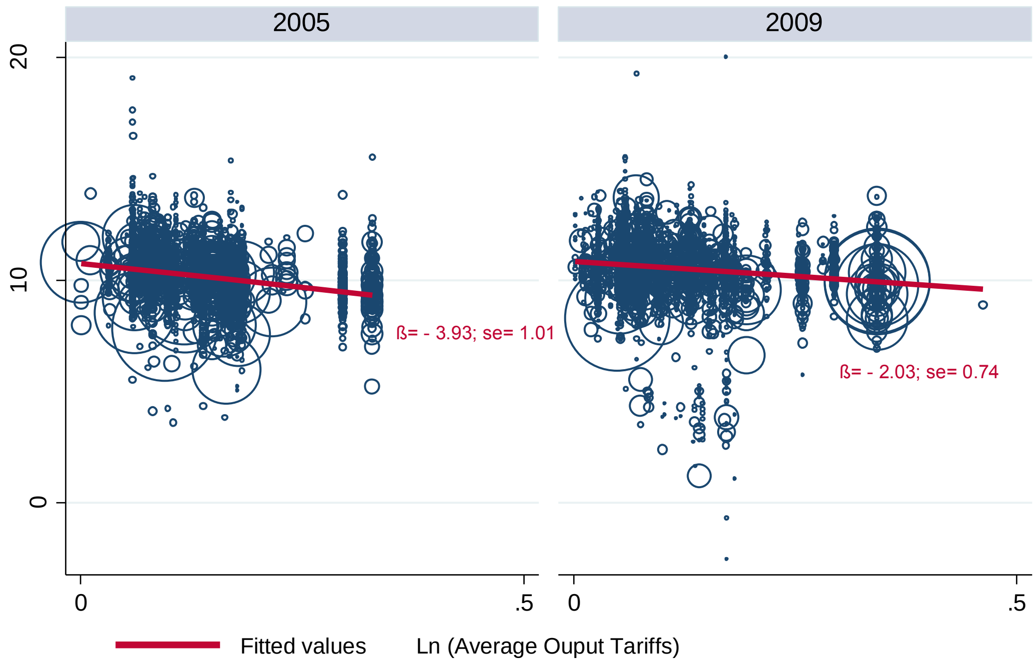


Source: Own elaboration from the World Bank's Enterprise Survey

Figure 5 shows that after correcting for demand shocks during the commodity-boom decade, *TFP* is on average very small, signalizing significant widespread inefficiencies afflicting Latin American economies. Particularly, between 2006 and 2010, firms from Venezuela were, on average, the least productive ones. Another performance indicator of interest in this study is *labor productivity*. As mentioned earlier, this indicator measures per capita output, and represents the main focus of this study as it enables the assessment of trade policy, productivity and capital deepening. Its illustration is shown later, when compared against average output tariffs in Figure 6.

For the empirical implementation of the direct estimation, Enterprise Survey data is matched with the computed trade-weighted output, input and foreign tariffs derived from WITS-WTO and OECD databases. As a result, average tariffs varying over country, industry and year are assigned to firms moving along the same dimensions. Based on the research interest in this study, the main indicator of firm performance (*labor productivity*) is plotted against *average (output) tariffs*. Figure 6 depicts this relationship for years 2005 and 2009.

Figure 6. Labor productivity and average (output) tariffs



Note: The size of the hollow marker is scaled according to the sampling weight

Source: Own elaboration from the World Bank's Enterprise Survey and WITS database

As shown in Figure 6, *labor productivity* is negatively correlated with *average (output) tariffs*. Particularly, this link is somewhat stronger in 2005 than in 2009. The above depicted negative relationship is line with the vast majority of empirical analysis. Yet, as argued by Amiti and Konings (2007), a sizeable part of this correlation may be explained by input tariffs. It is worth noticing that the use of logarithms in Figure 5, and its use afterwards in the regression analysis, enables the study of non-linear relationships between firm performance and trade policy (see Benoit, 2011) [13].

5 Methodology

In this section, the relationship between tariff barriers and firm performance is examined empirically using the introduced data. The underlying effects in tariff barriers are identified using two approaches: the direct and the two-step approach.

It is worth mentioning that these procedures share both the same control variables in their respective specifications. The difference, however, relies on how the policy variable is measured. As documented in the empirical literature, the direct approach uses average tariffs as proxies for import restrictions. In the two-step approach, restricted imports are estimated within the gravity model in the first stage and

[13] Using logarithms is also convenient since it transforms highly skewed variables into more normally distributed ones. The resulting distribution is then commonly known as "log-normal"(Benoit, 2011). This is useful here as tariffs are highly skewed towards zero. Also because, sales and even sales per worker display a few outliers which disappear once the variable is log-transformed. In this context, Wagner (2012) reveals that the estimated exporter premium is dramatically reduced after dealing with outliers. It is also worth noticing that during the log-transformation of these variables, no valid observation is lost, since non-missing values on sales, number of employees and tariffs (1+t) cannot have zero values.

used as regressors in the second step. While the main identification strategy in this paper relies on the two-step approach, the direct estimation is performed first to deliver preliminary results.

5.1 Direct Estimation

Similar to Topalova and Khandelwal (2011), the identification strategy in this first part of the paper consists in observing the direct effect of trade protection on labor productivity by exploiting the intertemporal, intersectorial and international variations in import tariffs. For this purpose, average tariffs from the WITS-WTO database, Input-Output tables and firm-level data from the World Bank's Enterprise Survey are used to estimate the following baseline specification:

$$\begin{aligned} \ln(Y/L)_{qikt} \; = \; & \alpha_0 + \; \delta_1 \ln\,(OuputT)_{ikt} + \delta_2 \ln\,(InputT)_{ikt} + \delta_3 \ln\,(ForeignT)_{ikt} \\ & + \alpha\, FirmCharact_{qikt} + \sum_{k}^{K}\sum_{t}^{T} \eta_{kt} I_{it} + \sum_{i}^{I}\sum_{t}^{T} \lambda_{it} I_{it} + \varepsilon_{qikt} \end{aligned} \tag{1}$$

where q is a subscript for firm, i for country, k for ISIC product group at the two-digit level and t for year. Y/L denotes labor productivity, $OuputT$ domestic output tariffs, $InputT$ domestic input tariffs and $ForeignT$ foreign (output) tariffs. These policy variables are the variables of interest. In order to account for the variety of potential observed and unobserved forces confounding with the variables of interest, the baseline specification considers a wide range of relevant control variables believed to be important in the literature. Therefore, $FirmCharact$ constitutes a vector of ten covariates capturing firm characteristics concerning demographics, productivity, business environment and demand and supply conditions, exploiting in this manner the richness of the data. In addition, country-year and product-year fixed effects are captured by the corresponding set of dummy variables I. The total number of dummies capturing time-varying country and product effects are IT and KT respectively. ε is the error term. The detailed list of variables in $FirmCharact$ and the rationale behind them is provided next.

Firm Demographics

Empirical literature on industrial economics suggests a strong connection between firm performance and the *age*, *size* and *ownership* of the firm.

For instance, aging favors capital accumulation and raises probability of firm survival (Evans, 1987). Nevertheless, empirical evidence reveals that younger firms enjoy higher productivity growth rates despite of being less engaged in innovation (Evans, 1987; Huergo and Jaumandreu, 2004). More recent literature claims, however, that keeping pace with the constant release of cutting-edge innovations may be increasingly difficult for firms developing well-structured routines as they age, reflecting an inherent trade-off between organizational learning and innovation processes (Sørensen and Stuart, 2000).

Similarly, empirical studies find that larger firm *size* raises the probability of survival, yet larger firms also tend to display diminishing growth rates (Evans, 1987; Hall, 1986). More recent studies, however, present evidence indicating that firm size may indirectly determine the extent to which financial and institutional constraints affect firm growth. More precisely, growth constraints are consistently more severe among the smallest firms (Beck et al., 2005).

On the other hand, in the economic literature, foreign *ownerships* and domestic-foreign joint ventures are associated with higher firm performance (Estrin et al., 2009). This finding holds even after controlling for the fact that highly productive firms tend to self-select into foreign ownership (Criscuolo and Martin, 2009; Estrin et al., 2009). Particularly, foreign firms are more likely to use relatively advanced systems of corporate governance, invest heavily in internationally-qualified managers and exploit existing global distributional networks (Estrin et al., 2009).

Besides origin, in the literature, the concept of firm ownership also refers to the legal distribution of liabilities across owners (*legal origin*). Empirical studies reveal that when liability is limited and ownership is dispersed the idiosyncratic risk is reduced, especially in countries with weak institutions (Laeven and Woodruff, 2007). Therefore, firms organized in corporations or limited partnerships may have performance advantages over sole proprietorships, for which the unrestricted risk is concentrated in a single owner. Additionally, differences between corporations, partnerships and proprietorships also arise from differences in the source of finance: shareholders in publicly listed corporations and financial institutions may have divergent ways of influencing allocation of resources, management of risks and time-preferences of firms (Levine, 2000).

In this context, the literature on international trade and political economy suggests that lobbying for a particular level of trade protection or liberalization may be related to political factors driven by certain firm demographics such as age, size and ownership (Campos and Giovannoni, 2007; Topalova and Khandelwal, 2011). Therefore, these firm characteristics may be determining variations in both tariff barriers and firm performance based on the arguments presented above. Thus, in line with Topalova and Khandelwal (2011), firm *age*, *size* and *ownership* are incorporated in the model as relevant covariates.

Productivity

Firms can be different in several ways. Particularly, in international trade, productivity is a relevant factor reflecting firm heterogeneity (Melitz, 2003). The incorporation of firm productivity as control variable would enable the estimation of parameters holding an important sign of firm heterogeneity constant. Nevertheless, total factor productivity is itself an outcome variable built on technological progress and innovation. Recent studies are increasingly adhering to the idea that whenever trade liberalization favors firms' productivity it must be through improved access to foreign inputs, higher exposure to foreign technology and improved incentives to innovate (Amiti and Konings, 2007; Ben-David and Loewy, 1998; Topalova and Khandelwal, 2011). Thus, productivity is one major channel through which trade policy impacts growth (Frankel and Romer, 1999). Consequently, productivity would be a *bad control* considering it is itself heavily influenced by the variable of interest (Angrist and Pischke, 2008, pp. 47-48). Instead, an alternative but widely used covariate is employed to account for this type of firm heterogeneity: intensity of participation in export markets (*export shares*). Empirical studies demonstrate that exporting firms are more productive than non-exporters, as high productive firms tend to self-select into import and export markets (Amiti and Konings, 2007; Bernard et al., 2007; Wagner, 2012)[14]. Moreover, relative to the universe of exporting firms, exporters appear to be a significantly heterogeneous group in which export volumes, varieties and destinations are substantially unequally distributed (Bernard et al., 2007). Thus, *export shares* allow controlling for clear differences in productivity even among exporting firms without absorbing all the effect from the variable of interest.

A second covariate capturing variations in firm productivity is *information technologies*. The vast majority of research studies at country and firm level after 1980s confirm the positive and significant effect of the use of information technologies on productivity (Dedrick et al., 2003). It is worth noticing that in this study, the concept of information technologies does not refer to the use of a particular software or electronic device. Instead, it refers to a much inclusive concept: the use of e-mail and own website for storing, retrieving and exchanging information with customers and suppliers. In this sense, the use of information technologies may have implications that go beyond the efficient management of information: it also enables the emergence of organizational reforms and innovations capable of bringing additional productivity gains (Black and Lynch, 2001; Dedrick et al., 2003).

Similar to age, size and ownership, political economy literature suggests that firms with relatively competitive or uncompetitive productivities may exert lobbying efforts to influence trade policy, i.e. firms with low productivity may campaign for higher trade protection to deter additional competition incoming from abroad (Ferreira and Rossi, 2003). In order to prevent that a transmission channel becomes an omitted confounder, *export shares* and *information technologies* are employed as wide-ranging covariates capturing confounding effects in productivity.

Business Environment

Macroeconomic factors including efficient legal system and solid fiscal and monetary policy improve firm performance by raising country's overall competitiveness. Yet, they are not sufficient if favorable microeconomic *business environments* are not in place (Porter, 2004). For instance, the persistent lack of skilled labor, quality inputs, financial services, physical infrastructure and efficient regulations will limit the capability of firms of improving their productivity and raising overall competitiveness (Schwab and Sala-i-Martin, 2011)[15].

Thus, in light of these facts, multidimensional indexes capturing heterogeneous business environments at deeper levels of disaggregation are constructed from the available data in the survey. These indexes are based on firms' valuation of the constraining factors affecting their operation and growth. Their construction is reported in the data appendix and is similar to the "limiting factor index" presented in

[14] Wagner (2012) point out that the use of imported inputs increases firm productivity, but only highly productive firms may import directly as importing entails (sunk) fixed costs from searching, inspection, negotiation, contract formulation, etc.

[15] Recent literature on international economics argues that real competitiveness should not be measured by market shares but by productivity (Porter, 2004; Schwab and Sala-i-Martin, 2011).

Gorodnichenko and Schnitzer (2013), which summarizes all business obstacles in one measure. Nevertheless, given the self-reporting nature of the data, some questions are more likely to unleash politically-driven answers. Therefore, firm's position regarding tax rates, political instability and labor regulations are comprised under the *political factor* index, while firm's valuation of business obstacles arising from market inefficiencies are captured by the *transaction cost* index. These inefficiencies include deficiencies in transportation, electricity, access to land, access to finance, educated workforce; burdensome licensing, permits, tax administration, non-tariff custom regulations, corruption, crime, and competition from the informal sector. This information discloses the perceived business environment and may reveal additional information regarding firm productivity and the stance of country competitiveness at disaggregated levels.

The view of competitiveness as the mere "share of world markets" had led to the idea that one country's gain can be made at the expense of others, an understanding that has often justified the use of industrial policy as a governmental maneuver in the creation of comparative advantage (Porter, 2004). In this sense, the perception of the authorities regarding the competitiveness of local firms relative to its foreign counterparts may motivate or inhibit the implementation of protective or liberal trade measures (Topalova and Khandelwal, 2011). For instance, governments may be more willing to deploy or at least keep protectionism as compensation mechanism for persistent inefficiencies (Soesastro and Basri, 2005), protecting less competitiveness sectors with higher tariff barriers. Thus, in order to avoid these confounding effects in competitiveness, *political factor* and *transaction cost* indexes are used as control variables for the microeconomic business environment.

Demand and Supply Conditions

The 2000s has been an extraordinary growth period, especially for economies that have over-proportionally benefited from the super cycle of commodity prices. In this context, improving firm performance can be rather the result of a strong and growing demand stimulating a multiplier process of high investment and innovation (Cornwall and Cornwall, 2002). Apart from external factors, internal factors regarding public investment, redistributive measures and structural transformation may also shape the demand and supply conditions underlying firm performance.

It is possible that trade policies, business cycles and structural transformations are trending within the sample, leading to a spurious relationship. Moreover, trade protection or openness may correlate with undertaken socioeconomic policies, if both driven by political ideologies. Nevertheless, even neglecting political factors, variations in tariff barriers may appear, in several cases, as a technical response to fiscal and external imbalances (Fernandes, 2007). For instance, governments may attempt to offset imported inflation by reducing tariff duties, or to stop an increasingly worsen balance of payments by raising import barriers (Fernandes, 2007).

Thus, including country-year effects will account for variations in demand and supply conditions arising from time-varying policies and business cycles specific to a country. Similarly, the inclusion of product-year interactions account for product-specific cyclical effects, including variations in output prices (Fernandes, 2007; Vogel and Wagner, 2010). Nevertheless, country-year and product-year effects do not fully capture variations in demand and supply conditions if the incidence and direction of the effect is heterogeneous across industries within a country. For instance, country's real exchange rate variations may affect firms differently if industries have a different trade orientation (Fernandes, 2007). Similarly, with diminishing macroeconomic risks, firms in some sectors may be more encouraged than others to invest and expand their operations, especially if the demand has pushed them near the capacity limit (Cornwall and Cornwall, 2002). Thus, several macroeconomic policies and business cycles at the country level may determine different demand and supply conditions at the industry level. Unfortunately, since the variable of interest also varies across countries, years and industries, the addition of country-year-industry interactions would lead to perfect collinearity. Instead and by exploiting the underlying microeconomic data, firm's *ratio of temporary workers* relative to permanent workers is used to account for industry-specific variations in the state of aggregate demand and supply (Gorodnichenko and Schnitzer, 2013)[16].

Once having exhausted the sources of endogeneity highlighted in the literature, the baseline model in equation (1) is estimated using OLS with sampling weights on pooled cross-sections of representative survey data[17]. The model is estimated for the whole economy as well as for manufacturing and services subsamples. Results are reported in Table 3, columns (1), (2) and (3) respectively.

Preliminary results from the direct approach suggest that the impact of input, output and foreign tariffs depend upon the sector and scope of sample. For the whole economy, input tariffs have a sizeable negative effect on labor productivity (-9.26 %). Yet, this negative effect stems from firms in the service sector, as firms in the manufacturing sector report no statistical significant effect. On the other hand, output tariffs have a positive effect for the whole economy (2.78 %) but this effect is once again not confirmed within the manufacturing sector. Higher foreign tariffs, on the contrary, have a negative effect on labor productivity among manufacturing firms (-4.19 %).

Results produced by the direct estimation on the group of countries sampled between 2005/06 and 2009/10 are not line with empirical findings provided by Amiti and Konings (2007) and Topalova and Khandelwal (2011) for Indonesia and India in the late 80s and 90s[18]. In spite of using an equivalent unstructured approach, results suggest that input tariffs have a negative effect only for firms in services, and output tariffs have no statistically significant effect. However, unlike input and output tariffs, foreign tariffs are indeed detrimental for labor productivity.

[16] Gorodnichenko and Schnitzer (2013) also include two additional variables to control for demand and supply conditions. One of them (*share of optimal employment*) is available only in the 2002 – 2005 survey. The other (*capacity utilization*) is available in the current survey but may capture all incentives to invest even if they are produced by lower tariffs. For instance, Amiti and Konings (2007) claim that lowering input tariffs is a direct way of reducing the price of investment goods. Similarly, Wacziarg and Welch (2008) confirm previous findings on the role of investment as an important channel through which trade openness affects growth.

[17] The strata and sampling weights are provided by the survey. Firms are stratified by size, product group and geographic region. Sampling weights correct for varying probabilities of strata selection. The survey is representative for the whole economy's private sector. Its design is considered before performing the analysis using the STATA command "svyset".

[18] Both papers use *labor productivity* as an alternative dependent variable to *TFP* finding similar results, namely, a negative effect of both input and output tariffs among manufacturing firms.

5.2 Two-Step Estimation

Instead of establishing a direct and unstructured connection between artificial trade barriers and firm growth, in this part of the paper the causal effect of import tariffs on firm growth is derived through its actual impact on import flows. The effect is estimated in two stages. Since the gravity equation has proven to be tremendously successful in the prediction of trade flows, in the first step, the impact of tariff barriers on imports is estimated within the gravity framework. In the second step, it is only the tariff-explained part of the resulting gravity-predicted imports that is further used to investigate the structural connection between macroeconomic trade protection and microeconomic growth.

5.2.1 First Step Estimation: The Gravity Model

A theory-consistent estimation of the gravity model of bilateral trade requires an econometric strategy that fully accounts for those aspects described in section 3, namely those related to demand and supply factors and bilateral and multilateral trade resistance. Whereas within the existing trade literature several econometric strategies have been developed for that purpose, major empirical trade economists support the fixed effects approach as the most recommended alternative, not only because it does not rely on strong structural assumptions but because it controls for atheoretical unobservable tendencies that may systematically be shifting trade volumes (Head and Mayer, 2014).

Alternative strategies suggest the extension of the gravity model into a system of equations in order to account for the importance of firm heterogeneity in international trade (Helpman et al., 2008). It is worth mentioning, however, that these strategies aim at estimating the impact of trade barriers on firm-level trade, decomposing the overall effect into the intensive and extensive margin (Helpman et al., 2008)[19]. Nevertheless, firm-level trade is not of interest in this paper. Instead, in this study, the impact of trade barriers on growth includes both the intensive and extensive margin of trade in order to capture how aggregate import flows may modify the incentives to compete, innovate and adopt new technologies. Therefore, correcting for the extensive margin is neither necessary nor desirable in this setting.

As the research interest of this paper is limited to the impact of import barriers arising from trade policy, more precisely from import tariffs, the appropriate fixed effect approach is not required nor constrained to accommodate in order to yield estimates for all or any other variable than for import tariffs. For instance, estimates of demand and supply factors may be omitted due to collinearity within some fixed effects framework. These approaches are yet preferred as long as they aim at yielding unbiased estimates of import tariffs.

Nevertheless, unbiased estimates are in general hardly ever accomplished in presence of endogeneity. In this sense and despite of a theory-based gravity model, import tariffs, as any other trade policy, may be still endogenous (Bacchetta et al., 2012, p. 118; Baier and Bergstrand, 2007). Thus, the econometric

[19] Helpman et al. (2008) suggest that if the proportion of exporting firms is left out from the gravity equation, the effect of trade barriers on firm-level trade is upward biased.

strategy should incorporate mechanisms to test and deal with endogeneity that go beyond the theory-consistent estimation of the model. Thus, instead of limiting the macroeconomic trade and tariff data to those single years covered by the Enterprise Survey (2005/06 and 2009/10), this part of the paper is based on the entire available size of the panel (2000-2010). A larger panel data offers a straight-forward solution to problems of endogeneity stemming from unobserved time-invariant heterogeneity while it likewise enables the use of tests and alternative estimation techniques that copes with reverse causality and measurement error (Baier and Bergstrand, 2007; Bond et al., 2001; Wooldridge, 2010, pp. 247-251). In this sense, this approach should facilitate an unbiased estimation of tariff-deterred imports required from the first step.

Consequently, based on the entire panel data, the theory-consistent gravity model presented in equation (T.2) is estimated using the fixed effects approach as baseline estimation. For comparison purposes, three versions of this model are estimated following three different possible scenarios: multilateral resistance is time-invariant; multilateral resistance is time-varying; and the effect of tariffs is heterogeneous across sample groups. This should enable a progressive comparison between different econometric identification strategies and facilitate the sensibility and stability assessment of the first stage estimates.

5.2.1.1 Time-Invariant Multilateral Trade Resistance

If multilateral trade resistance remains constant over time, at least within the sampled period, terms for multilateral resistance in equation (T.2) can be replaced by country fixed effects (Anderson and Van Wincoop, 2004; Bacchetta et al., 2012, p. 107)[20]. In this sense, the log-linear transformation of equation (T.2) allows the following empirical implementation of the gravity model:

$$\ln X_{ijkt} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln T_{ijkt} + \sum_{i}^{I}\sum_{k}^{K} \varphi_{ik} I_{ik} + \sum_{j}^{J}\sum_{k}^{K} \vartheta_{jk} I_{jk} + \sum_{t}^{T} \tau_t I_t + \varepsilon_{ijkt} \qquad (2)$$

where i is subscript for the importer country (reporter), j for the exporter country (partner), k for the ISIC product group at the 2-digit level of aggregation and t for the year. X denotes import values, Y nominal GDPs and T trade costs[21]. Country, product and year fixed effects are captured by the corresponding set of dummy variables $\sum I$. Since GDPs are not always good proxies for demand and supply factors at higher levels of disaggregation, importer and exporter fixed effects are interacted with product fixed effects (Bacchetta et al., 2012, p. 114; Head and Mayer, 2014). Thus, the total number of dummies required to capture the disaggregated importer and exporter country fixed effects

[20] Baldwin and Taglioni (2006) claim that in reasonably short samples multilateral resistance may not vary tremendously over time (Bacchetta et al., 2012, p. 110).

[21] According to De Benedicts and Taglioni (2011), it is widely accepted that nominal variables are the measures to be used.

is IK and JK respectively. $\beta, \varphi, \vartheta$ and τ are coefficients to be estimated by the model and ε the idiosyncratic error term[22].

As specified in equation (T.2), import tariffs W are disentangled from other sources of trade costs in T. Therefore, trade costs T take the following form (see Bacchetta et al., 2012, p. 107):

$$T_{ijkt} = dist_{ij}^{\beta_4} \cdot exp(\beta_5 cont_{ij} + \beta_6 comlag_{ij} + \beta_7 col_{ij}) \cdot W_{ijkt}{}^{\beta_8} \quad (3)$$

where $dist$ is the distance in km between the most populated cities within a pair of countries, W the trade-weighted tariffs (as 1 + t/100), and $cont, comlag, col$ dummy variables, where $cont$ is equal to 1 if pair of countries have geographical contiguity, $comlag$ is equal to 1 if they share a common official language and col is equal to 1 if they ever had a colonial relationship. Whereas these variables are found to be significant determinants of trade, naturally, any other time-invariant trade cost that is country-product specific will be captured by disaggregated importer and exporter country fixed effect.

The gravity model with time-invariant multilateral resistance specified in equation (2) is estimated using OLS. Results are reported in Table 1, column (1). Additionally, equation (2) is further estimated using the fixed effect estimator (or within estimator). For the within estimation, all time-invariant factors in equation (2), and by extension in equation (3), are excluded, yielding the following equation:

$$\ln X_{ijkt} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \omega \ln W_{ijkt} + \sum_{t}^{T} \tau_t I_t + u_{ijkt} \quad (4)$$

where $\omega = \beta_3 \cdot \beta_8$ is the coefficient of interest, namely, the elasticity of imports with respect to tariffs and $u_{ijkt} = v_{ijk} + \varepsilon_{ijkt}$ the composite error. v_{ijk} denotes the country-pair product-level time-invariant heterogeneity. Equation (4) is transformed following the so-called *within transformation* to eliminate v_{ijk}, the unobserved time-invariant factor in u_{ijkt}**Fehler! Textmarke nicht definiert.** (Wooldridge, 2010, pp. 265-269). Results are reported in Table 1, column (2).

In line with the theory and the empirical literature, both estimation techniques yield negative and statistically significant coefficients for the effect of tariffs on imports, yet the size of its impact is considerably reduced when the within estimator is employed. If specified correctly, both estimation techniques are equivalent (Wooldridge, 2012, p. 488), yet in this setting, trade costs are modeled as in equation (3), which explicitly specifies the OLS estimation not to control for all possible bilateral fixed effects but to use instead a handful number of bilateral covariates commonly used in the trade literature. Thus, the results presented so far differ in the extent to which actual bilateral fixed trade costs are accounted for. Given that the within estimation only uses information from time variations within each cross-sectional unit, it is resilient to biases arising from any fixed factor (Wooldridge, 2010, pp. 265-269). Thus, these results suggest that biases from unobserved bilateral fixed trade

[22] β_3 is the coefficient estimating the actual elasticity of substitution $1-\sigma$ (see Chen and Novy, 2011).

barriers at disaggregated levels may be indeed significant and should therefore be taken into account. Consequently, if multilateral trade resistance is time-invariant, a 1 percent increase in import tariffs leads to a reduction of 2.67 percent in import volumes c.p.

5.2.1.2 Time-Varying Multilateral Trade Resistance

On the other hand, if multilateral trade resistance is not constant over time, the use of the within estimation alone does not overcome the problem of omitted variable bias (Baier and Bergstrand, 2007). Namely, only biases stemming from cross-sectional correlations will be eliminated by the within estimator (Baldwin and Taglioni, 2006). In this sense, the inclusion of time-varying individual effects can properly account for time-series correlations, in particular for the time-varying part of multilateral trade resistance (Bacchetta et al., 2012, p. 108; Baier and Bergstrand, 2007; Baldwin and Taglioni, 2006; Head and Mayer, 2014). Thus, equation (4) is extended to account for time-varying effects in the importer, exporter and product group dimension:

$$\ln X_{ijkt} = \beta_0 + \omega \ln W_{ijkt} + \sum_{i}^{I}\sum_{t}^{T}\gamma_{it}I_{it} + \sum_{j}^{J}\sum_{t}^{T}\psi_{jt}I_{jt} + \sum_{k}^{K}\sum_{t}^{T}\theta_{kt}I_{kt} + u_{ijkt} \qquad (5)$$

where γ, ψ and θ are the time-varying coefficients to be estimated by the model. The total number of dummies required to account for time-varying importer, exporter and product effects are IT , JT and KT respectively. $u_{ijkt} = v_{ijk} + \varepsilon_{ijkt}$ is the composite error. v_{ijk} denotes the country-pair product-level time-invariant heterogeneity. Since country-year effects do not only control for multilateral trade resistance but also for variations in GDP over time, importer and exporter GDPs are neither needed nor included in equation (5) (Baier and Bergstrand, 2007). Equation (5) is estimated using the within estimator. Results are presented in Table 1, column (3).

In line with previous estimates, the effect of import tariffs on imports volumes is negative and very statistically significant. Yet, it is once again the magnitude of the impact that varies. After additionally controlling for the time-varying part of multilateral resistance, the negative impact of tariffs on imports becomes slightly stronger, rising from -2.67 up to -2.73. This is consistent with findings from Baldwin and Taglioni (2006) for the impact of the Euro zone, for which stronger effects are found after including time-varying individual effects.

5.2.1.3 Impact Heterogeneity

Since the sampled data gathers a significant number of countries, years and products, it is possible that import tariffs do not have the same effect on trade flows across all countries and product groups. To further explore this, equation (5) is re-estimated twice: once including tariff-country interactions and the other including tariff-product interactions. These extensions are formalized in equation (6) and (7) respectively:

$$\ln X_{ijkt} = \beta_0 + \omega_I \ln W_{ijkt} + \sum_{i}^{I-1} \omega_i (I_i \times \ln W_{ijkt}) + \sum_{i}^{I} \sum_{t}^{T} \gamma_{it} I_{it} + \sum_{j}^{J} \sum_{t}^{T} \psi_{jt} I_{jt} + \sum_{k}^{K} \sum_{t}^{T} \theta_{kt} I_{kt} + u_{ijkt} \quad (6)$$

$$\ln X_{ijkt} = \beta_0 + \omega_K \ln W_{ijkt} + \sum_{k}^{K-1} \omega_k \, (I_k \times \ln W_{ijkt}) + \sum_{i}^{I} \sum_{t}^{T} \gamma_{it} I_{it} + \sum_{j}^{J} \sum_{t}^{T} \psi_{jt} I_{jt} + \sum_{k}^{K} \sum_{t}^{T} \theta_{kt} I_{kt} + u_{ijkt} \quad (7)$$

where $(\mathrm{I_i} \times \ln \mathrm{W_{ijkt}})$ denote tariff-country interactions, $(\mathrm{I_k} \times \ln \mathrm{W_{ijkt}})$ tariff-product interactions, and ω_i and ω_k their corresponding effect. The total number of tariff-related interactions amount $I-1$ in equation (6) and $K-1$ in equation (7). The *main effect* is represented by ω_I and ω_K and capture the total effect of import tariffs for the baseline category[23]. γ, ψ and θ are the time-varying coefficients to be estimated by the model, $u_{ijkt} = v_{ijk} + \varepsilon_{ijkt}$ the composite error and v_{ijk} the country-pair product-level time-invariant heterogeneity. Equation (6) and (7) are estimated using the within estimator. Results are reported in Table 2, Panel A and B.

As displayed in Table 2, Panel B, the total effect of import tariffs on import volumes is negative and statistically significant for all six Latin American countries covered in this study. Nevertheless, the elasticity of imports with respect to tariffs is not found to be the same across all countries. Namely, in three out of five countries the effect is statistically significantly different from the baseline: a substantially stronger impact is found for Chile, contrasting with the relatively weaker impact in Mexico and Peru. No significant impact heterogeneity is found across Argentina, Colombia and Venezuela, sharing therefore the same negative slope. F-test of joint significance rejects the null hypothesis of all interactions being jointly and statistically equal to zero. As a result, Table 2, Panel B presents empirical evidence for the impact heterogeneity of tariffs across countries: a 1 percent increase in tariffs reduces imports from 0.66 to 12.08 percent depending on the country.

Likewise, across product groups, the total effect of tariffs on imports is most of the times negative and statistically significant. The heterogeneity of the impact across product groups is considerable: 16 out of 30 product groups have statistically different tariff elasticities of import, particularly, the primary sector and medium to high-tech industries report, on average, higher elasticities than low-tech industries. F-test of joint significance rejects the null hypothesis of all interactions being jointly and statistically equal to zero. These results confirm the so often unexplored impact heterogeneity existing

[23] The baseline country is Argentina, the baseline year is 2000 and the baseline product group is the ISIC 33 (manufactures of medical, precision and optical instruments).

across product groups. Namely, a 1 percent increase in tariffs decreases imports from -4.36 to 10.46 percent depending on the product.

5.2.2 Second Step Estimation

After investigating how trade responds to trade policy, more precisely, how and to which extent import tariffs affect imports flows, in this second part of the study, gravity-predicted estimates are further used to analyze empirically the connection and channels by which tariff-induced variations in imports impact microeconomic growth.

5.2.2.1 Tariff-Deterred Imports

Estimates of the gravity model derived from equation (2) to (7) suggest a negative relationship between imports and tariffs, predicting on average lower trade volumes for higher tariff barriers. In order to re-introduce the concept of *tariff-deterred imports* let's assume a world without artificial trade barriers. In this scenario, the international exchange of goods is driven solely by "natural" forces underlying the gravity model. Thus, tariff barriers can be then interpreted as one "artificial" measure deterring trade beyond its "natural" predicted level (Baier and Bergstrand, 2007). As a result, for each tariff value, there is a counterfactual level of imports that would have realized had the tariff barrier not taken place. In order to predict this counterfactual, denoted in the theoretical framework as XW_{ikt}, the unobserved elasticity of imports with respect to tariffs ω is required.

As part of the empirical strategy of this paper, unobserved elasticities ω are estimated in section 5.2.1 within an empirically powerful and theory-consistent model of trade. To raise precision of these estimates, elasticities are further allowed to vary across product groups, considering that recent empirical evidence finds a substantial variations in the elasticity of substitution across industries (Chen and Novy, 2011; Halpern et al., 2015)[24]. Then, counterfactual imports *deterred* by the corresponding tariff barrier are predicted as follows[25]:

$$\ln \widehat{XW}_{ijkt} = -(\widehat{\omega}_K + \widehat{\omega}_k) \times \ln W_{ijkt} \qquad (8)$$

where $\widehat{XW}$ denotes predicted imports deterred by tariffs and W trade-weighted tariffs. $\widehat{\omega}_K$ and $\widehat{\omega}_k$ are import elasticities with respect to tariffs estimated in equation (7). As first stage estimates, $\widehat{\omega}_K$ and $\widehat{\omega}_k$ are constrained to be equal to zero if not statistically significant at least at the 10% level. Estimated elasticities are robust to time-invariant unobserved heterogeneity, importer, exporter and product time-varying effects and impact heterogeneity across product groups.

[24] By allowing trade costs to be heterogeneous across industries, Chen and Novy (2011) estimate industry-specific substitution elasticities within the gravity framework. Their results suggest that elasticities do vary substantially across industries, leading to low trade integration for industries producing perishable goods as well as for those with traditionally high transport costs. For high-tech industries, on the other hand, high trade integration is identified. Similarly, by using simulations, Halpern et al. (2015) show that when foreign goods are close to be perfect substitutes, even a small price change can bring about a large import substitution.

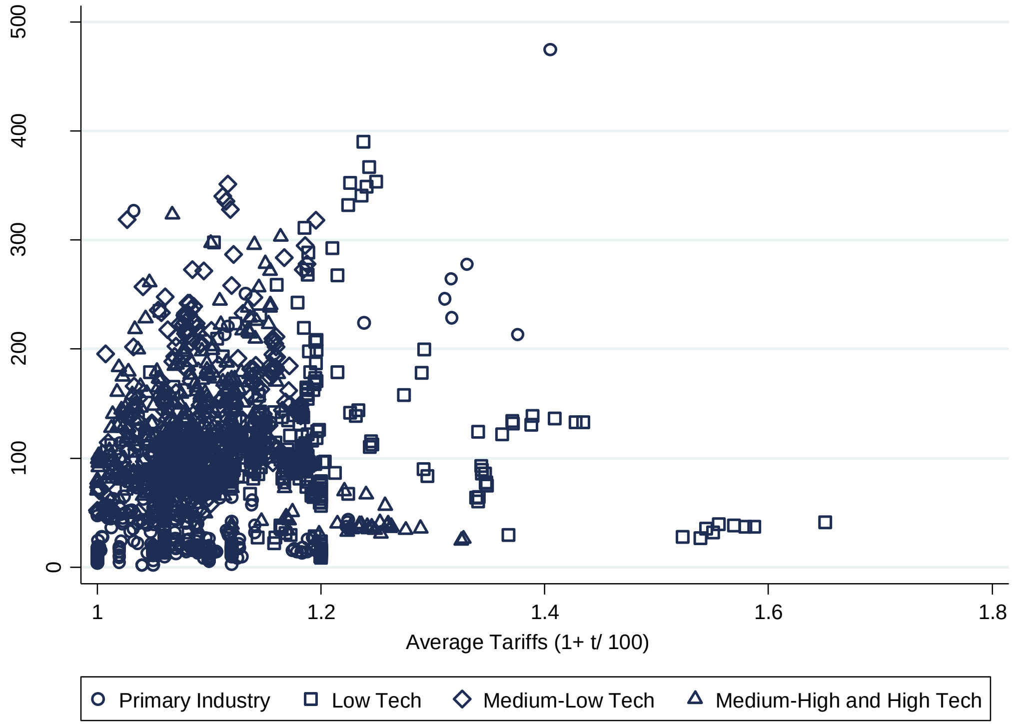
[25] Predicted variations in import volumes "caused" by tariffs would require no negative sign in equation (8), if we were interested in interpreting (negative) variations/growth. Yet, equation (8) aims at estimating (positive) magnitudes of import "deterred" by tariffs.

Tariff-deterred imports calculated in equation (8) vary over four dimensions (importer, exporter, product group and year). Nevertheless, as mentioned earlier, the scope of this investigation is centered on the impact of import flows on domestic markets irrespective of the origin of the traded good. Thus, tariff-deterred imports are aggregated over all trading partners as in Frankel and Romer (1999) and Badinger (2008):

$$\widehat{XW}_{ikt} = \sum_{j \neq i}^{J} e^{\ln \widehat{XW_{ijkt}}} \tag{9}$$

where e is the exponential operator and $\widehat{XW}_{ijkt}$ the predicted imports deterred by tariffs derived from equation (8). Equation (9) aggregates them in arithmetic units rather than in logarithmic units. As a result, tariff-deterred imports do not longer vary across partner country. Thus, it represents the extent to which product k in country i at year t that is prevented from being imported as response to tariffs barriers. To illustrate this new variable, estimates from equation (9) are compared against the average import tariffs used in section 5.1 for the direct approach. This relationship is depicted in Figure 7.

Figure 7. Tariff-deterred imports vs average tariffs (at the two-digit level)



Source: Own elaboration from WITS-WTO database

Figure 7 is based on 1’771 observations varying across 6 importer countries, 31 products groups and 11 years. Its plots a commonly used measure of trade protection (average tariffs) against the predicted level of imports deterred by tariff barriers (tariff-deterred imports). In spite of been two concepts closely related to each other, a particularly strong correlation between them is not empirically supported by the evidence presented in Figure 1. Since tariff-deterred imports, as specified in equation (8), is derived not only from tariff values but also from industry-specific elasticities, how each measure accounts for the heterogeneous response of imports to tariffs seems to be contributing to significant differences between them two. These differences, however, may also operate through the extensive margin, since tariff-deterred imports are aggregated over partner countries as shown in equation (9), whereas import tariffs are averaged over the same using import weights[26]. In this context, Figure 7 compares graphically the two measures of artificial trade protection that are used in the survey data to determine the relationship, significance and transmission channel between free trade and growth.

Similar to the direct approach, the differentiated effect of tariff-deterred imports is disentangled by the use they would have had. In this sense, deterred imports would have been used either as final goods (output products) or as intermediate goods (input products). While the incoming output products

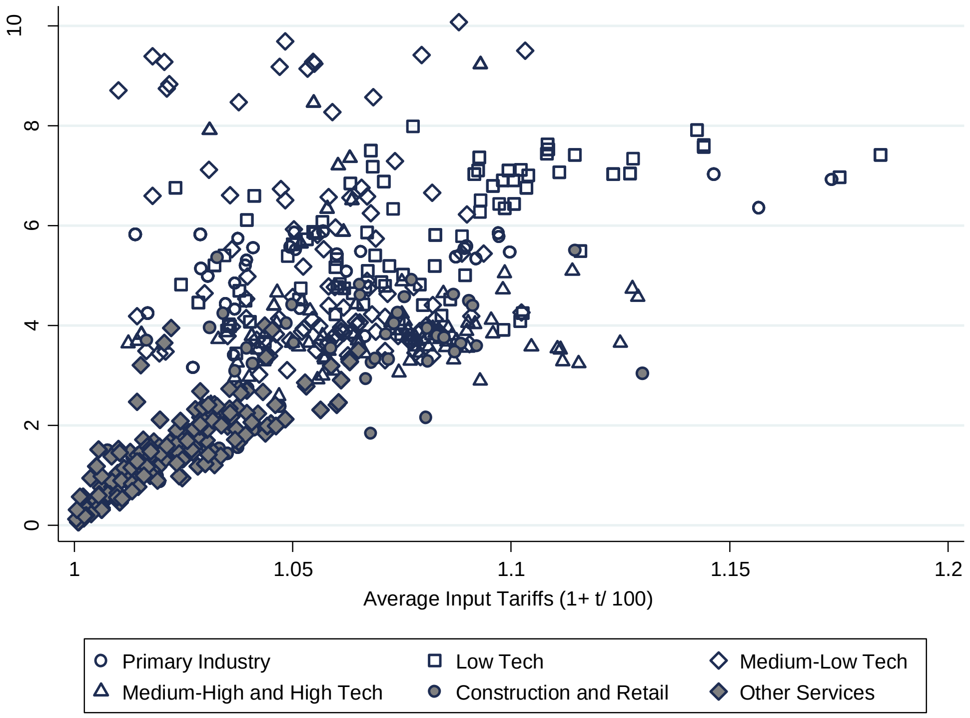
[26] Amiti and Konings (2007) argue that while the use of trade-weighted tariffs may introduce a problem of endogeneity, simple averaged tariffs may, on the other hand, overstate average import tariffs.

would have competed against local firms for a share in the domestic market, incoming intermediate goods would have been instead employed as production factors (Amiti and Konings, 2007). Thus, the effect of input flows deterred by tariff barriers is disentangled by using a weighting scheme:

$$\ln \widehat{IW}_{ikt} = \sum_{z}^{Z} s_{izkt} \ln \widehat{XW}_{izt} \tag{10}$$

where i is subscript for the importer country, k for the (output) product, z for the input product and t for year. $\widehat{XW}$ denotes the tariff-deterred imports derived from equation (9), s the weight of every input in the production of a particular output. As in the direct estimation, weights s are constructed from Input-Output tables as the share of input z in the production of output k. The production-weighted magnitude of inputs deterred by tariffs barriers is predicted by $\widehat{IW}$. This variable is derived under the same rationale used for the derivation of input tariffs in section 5.1. Thus, equation (10) disentangles the effect of tariff-deterred inputs from tariff-deterred outputs analogously to methods employed in Goldberg et al. (2010) and Topalova and Khandelwal (2011). To illustrate this new variable, estimates from equation (10) are compared against their tariff equivalent: average input tariffs. This comparison is pictured in Figure 8.

Figure 8. Tariff-deterred inputs vs input tariffs (at the two-digit level)



Source: Own elaboration from the WITS-WTO database and OECD Input-Output tables

Figure 8 is constructed from 1'044 observations varying across 6 importers, 58 product groups and 3 years. The common measure of input tariffs as computed in the literature is plotted against predicted levels of inputs deterred by tariff barriers (tariff-deterred inputs). Similar to the previous relationship, tariff-deterred inputs and input tariffs are expected to be highly correlated given that they both share the exact same weighting scheme. Whereas there is indeed a higher correlation between them compared to the previous case, the closer relationship seems to be driven by the inclusion of a particular type of services, namely, financial intermediation, real state, public administration, education, etc. classified in Figure 8 under “Other Services”. According to the data, this kind of services relies notoriously less on tradable goods as factors of production, leaving, for these product groups, less space for significant differences between gravity-based measures and conventional measures of trade protection.

5.2.2.2 Survey Analysis

Once determined the effect of tariff barriers on imports, its transmitting effect trickling down into the microeconomy is subsequently examined. Before proceeding with the second stage, it is worth noticing that first stage predictions are estimated from a theory-grounded, literature-consistent and empirically powerful gravity model based on a cross-country panel dataset containing over hundred thousand observations disaggregated at bilateral and product group levels.

Since the premise of this paper is to observe how and to which extent deviations from natural levels of sectorial trade affects microeconomic growth, at this second stage of the estimation, the identification strategy is to determine the causal effect resulting from tariff-deterred imports on firm performance. In this sense, the use of tariff-deterred imports is convenient for the establishment of causal relationships as they are by construction and definition isolated from a substantial number of macroeconomic confounders[27]. Since the actual level of tariff-deterred imports is in reality not observable, first stage estimates are used instead. If $\widehat{\omega}$ is estimated consistently, the use of predicted instead of actual levels of tariff-deterred imports poses no problems for consistency in ordinary least squares estimations (Wooldridge, 2010, pp. 115-118)[28]. The impact of tariff barriers on firm performance is channeled through two separate explanatory variables, identifying whether the effect in tariff-deterred imports stems from import restrictions of final goods or intermediate inputs.

In this context, based on representative survey data from the World Bank’s Enterprise Survey in 2006 and 2010, the following baseline model is estimated:

$$\begin{aligned} \ln(Y/L)_{qikt} \; = \; & \alpha_0 + \delta_1 \ln \widehat{XW}_{ikt} + \delta_2 \ln \widehat{IW}_{ikt} + \delta_3 \ln(ForeignT)_{ikt} \\ & + \alpha \, FirmCharact_{qikt} + \sum_{k}^{K}\sum_{t}^{T} \eta_{kt} I_{it} + \sum_{i}^{I}\sum_{t}^{T} \lambda_{it} I_{it} + \varepsilon_{qikt} \end{aligned} \tag{11}$$

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[27] Since trade is not likely to be shielded from macroeconomic shocks, the use of imports as weights for the construction of average tariffs introduces an endogeneity problem (Amiti and Konings, 2007). This is not an issue for tariff-deterred imports.

[28] The predicted variable is often known as the “generated regressor”. If ω can be estimated consistently, then $plim\, \widehat{\omega} = \omega$ by law of large numbers. Thus, the usual assumption of no correlation of between (generated) regressors and the error term is sufficient for yielding consistent estimates in the second stage (Wooldridge, 2010, pp. 115-118).

where q, i, k and t are subscripts for firm, country, ISIC product group at the two-digit level and year respectively. $\ln(Y/L)$ denotes labor productivity, $\widehat{XW}$ the predicted tariff-deterred imports from equation (9), $\widehat{IW}$ the predicted tariff-deterred inputs from equation (10) and $ForeignT$ the trade-weighted average foreign tariffs. In the two-step approach, these are the policy variables of interest. In order to account for potential observed and unobserved confounding factors, the far-reaching set of control variables used in equation (1) is likewise considered for the two-step baseline model. In this line, $FirmCharact$ is a vector of ten covariates capturing firm characteristics concerning firm demographics, productivity, business environment and demand and supply conditions as described in section 5.1. Country-year and product-year fixed effects are captured by the corresponding set of dummy variables I. The total number of dummies capturing the time-varying country and product fixed effects are IT and KT respectively. ε is the error term.

Using OLS with sampling weights on pooled cross-sections of representative survey data, equation (11) is estimated for the whole economy as well as for manufacturing and services subsamples. Results are reported in Table 3, columns (4), (5) and (6) respectively. Regression results from the two-step procedure provide three main findings. First, preventing inputs from being imported is indeed detrimental for manufacturers' labor productivity. Second, preventing final goods from being imported has no statistical significant effect. And third, foreign tariffs impacts negatively on labor productivity.

In this context, the direct and two-step estimation have some commonalities and discrepancies regarding the effect of tariff barriers on firm growth. Namely, both approaches report that among manufactures, trade protection against foreign competition has no significant effect. Likewise, both approaches agree that tariff restrictions in foreign markets are significantly harmful for labor productivity of domestic firms. For the effect of restricting access to world input markets, however, the direct and two-step estimation yield two different results. More particularly, while the direct estimation rejects any statistically significant effect of input tariffs, the two-step estimation finds a negative and very statistically significant effect. This latter finding suggests that if by using tariffs countries diminish their imported inputs by 10 percent, labor productivity of their firms shrinks by 1.4 percent c.p[29].

In this sense, the effect of tariff-deterred inputs estimated through the two-step procedure is in line with Amiti and Konings (2007), Schor (2004), Topalova and Khandelwal (2011) and Nataraj (2011), which find a negative impact of input tariffs on productivity, and with Goldberg et al. (2008), Kugler and Verhoogen (2009) and Halpern et al.(2015) which find a positive effect of imported inputs on productivity. On the other hand, the non-significance of tariff-deterred outputs does not contradict the

[29] Wooldridge (2010, pp. 115-116) state that in the two-stage procedure, the standard errors and test statistics obtained in the second step are generally invalid as the sampling variation in $\hat{w}$ is ignored. However, he argues that this uncertainty in $\hat{w}$ can be ignored, when the conditional mean condition of the approximated variable is zero. After bootstrapping errors in 2000 replications using resampling weights for survey data à la Kolenikov(2010), the standard errors are somewhat higher but do not jeopardize the significance of these findings.

heterogeneity of findings existent in literature[30]. More importantly, the diversity of the results reported on this aspect stems not only from differences across studies but also within them, as the effect of output tariffs has found to vary across firm groups. Therefore, in order to explore these heterogeneous relationships bypassed in the baseline model, a group analysis is presented in section 7. First, the robustness and sensibility of these findings is examined.

6 Robustness Checks

In this section of the paper, results from the first and second stage estimation are tested against multiple sources of bias, especially against those highlighted in the literature. In this line, the internal validity of this paper is tested empirically and presented throughout this section in order to minimize the probability of landing at any misleading conclusion.

6.1 First Stage

Estimating reliable and robust coefficients from the gravity equation is fundamental for the empirical strategy of this paper, as they constitute the variable of interest in the second stage. As shown in the previous section, the empirical strategy underlying the first stage estimates already accounts for time-invariant heterogeneity, time-varying heterogeneity and product impact heterogeneity. Nevertheless, according to the literature, the employed fixed effects estimation with time-varying effects and tariff-product interactions does not necessarily prevent bias in the estimated coefficient if reverse causality, sample selection, heteroskedasticity and trade dynamics are in place (Bacchetta et al., 2012, pp. 112-113; Baier and Bergstrand, 2007; Helpman et al., 2008; Martínez-Zarzoso et al., 2009; Silva and Tenreyro, 2006).

6.1.1 Reverse Causality

Reverse causality can be a major source of concern if the estimated coefficients capturing partial correlations between dependent and independent variables are in reality capturing causation stemming from the dependent variable onto the independent variable and not the opposite as originally intended. In this scenario, drawing conclusions from regression coefficients can be widely misleading.

Similarly, as indicated in Baier and Bergstrand (2007), gravity equations are not exempt from "feedback effects" moving reversely from trade outcomes to trade policy. For instance, rapid increments in import volumes may trigger some Latin American governments to turn to artificial trade measures in order to slow down or smooth future imports[31].

[30] As presented in the literature review, in Schor (2004) the effect of output tariffs depends on the size of the firm and its position in the productivity distribution. In Topalova and Khandelwal (2011) the positive effect of low output tariff vanishes for industries with burdensome import licensing and regulation. In Nataraj (2011), the reduction of output tariffs increases productivity for either small firms or firms on the top of the productivity distribution. In Amiti and Konings (2007) output tariffs lose their significance when they are measured with trade-weighted instead of simple average tariffs.

[31] Bair and Bergstrand (2007) suggest that trade volumes do not necessarily cause trade policy as trade volumes could rise or sink in anticipation to free trade agreements. For instance, they claim that sunk costs related to infrastructure and delivery systems may diminish prior to the implementation of the agreement, or on the contrary, trade may sink if agents decide to delay imports until the agreement enters in force.

In this sense, given that contemporary imports are less likely to cause foregone tariffs, lagged tariffs (instead of contemporary tariffs) are used in the fixed effect estimation specified in equation (5). Results are presented in Table 4, column (1). As expected, estimated coefficients for lagged tariffs are negative and very statistically significant. Nevertheless, the strength of the effect shrinks from -2.73 down to -0.94. Thus, in light of this fact, equation (5) is estimated again with both, contemporary and lagged tariffs to determine whether the nature of the relationship is in fact contemporary or lagged (Bellemare et al., 2015). Results are reported in Table 4, column 2. This new regression yields negative and statistically significant coefficients for contemporary and lagged tariffs, yet the effect of contemporary tariffs is, in line with the baseline specification, substantially higher and considerably more statistically significant. Thus, whereas past tariffs are less likely to be contaminated by reverse causality, the relationship between tariffs and imports is mostly driven by contemporary rather than by lagged variations.

In this scenario, any bias arising from contemporary reverse causality can be rule out, if the independent variable is strictly exogenous. Following this logic, to test strict exogeneity, Wooldridge (2010, p. 285) proposes adding a future level of the variable of interest into the model and test whether it has a statistically significant effect. In the gravity equation, this implies that, if import tariff are strictly exogenous, future tariffs should not correlate with contemporary imports. This approach has been used in Baier and Bergstrand (2007) to test strict exogeneity of free trade agreements within the gravity framework. Thus, following the econometric and trade literature, future tariffs are included as explanatory variables in the fixed effects specification in equation (5). Results are displayed in Table 4, column (3). The coefficient of future tariffs is 0.2130, yet is not statistically significant. As a result, the null-hypothesis of strict exogeneity cannot be rejected. Partial correlation between contemporary tariff barriers and contemporary imports are not driven by reverse causality. More specifically, in this context, empirical evidence from the underlying data suggests that bilateral tariffs are under this specification “strictly exogenous”.

6.1.2 Sample Selection

The trade data employed in this study contains missing observations from pairs of countries reporting no trade for a particular product in a given year. In this context, Bacchetta et al. (2012, p. 112) argue that while zero trade is indeed more common at deeper levels of disaggregation, its incidence is not likely to be randomly distributed: zero trade may be the result of prohibitive trade costs and/or weak demand and supply. Under these circumstances, dropping missing values when estimating the gravity equation may lead to biased estimates (Bacchetta et al., 2012, pp. 112-116; Helpman et al., 2008). Nevertheless, in a fixed effects context, sample selection is a problem only when the selection is related to the idiosyncratic error (Wooldridge, 2010, p. 581).

Thus, following Wooldridge (2010, pp. 581-585), biases arising from sample selection are tested using methods developed by Nijman and Verbeek (1992), Mundlak (1978) and Wooldridge (1995). For the former method, a “selection indicator” is required. This dummy variable is equal to 1 if imports are positive and 0 otherwise. The lagged of the selection indicator is added to the baseline regression and estimated on the unbalanced panel using fixed effects as specified in equation (5). Under the null hypothesis, the idiosyncratic error is uncorrelated with the selection indicator, thus the coefficient on the lagged selection indicator should not be statistically significant (Wooldridge, 2010, p. 581). Results are presented in Table 5, Panel A, column (1). Test results reject the null hypothesis of the lagged selection variable being statistically equal to zero, suggesting the presence of sample selection bias.

Before drawing any further conclusion, Mundlak (1978) and Wooldridge (1995) tests are additionally performed. For the former test, time-means are taken from time-varying variables (i.e. tariffs, GDPs) and are used as additional determinants of positive trade in a pooled probit estimation[32]. Under the null hypothesis, these time-means are jointly unrelated to the selection indicator. Similarly, Wooldridge (1995) suggests creating an inverse Mills ratio from the probit estimation and testing whether it is statistically significant in the gravity model[33]. Under the null hypothesis the inverse Mills ratio is not statistically significant. Test results are presented in Table 5, Panel A, column (2) and (3) respectively. For both tests, the null hypothesis is rejected confirming the presence of sample selection bias.

In light of these facts, two sample correction measures are pursued. If performed successfully, results from these estimations can be used in the second stage to test whether final results are sensitive to the sample selection bias found in the first stage.

In this line, in order to correct for sample selection bias, Chamberlain (1986) suggest to construct a set of inverse Mills ratios using probit estimations for each year and incorporate them in the gravity equation. In this sense, theory-consistent variables such as GDPs and trade costs as in equation (3) are used in the probit model to determine the probability of positive trade. The resulting inverse Mills ratios are incorporated into the gravity model by interacting them with time dummies (Wooldridge, 2010, p. 583). The gravity equation is estimated using pooled OLS on the unbalanced panel. In contrast to previous tests, for this estimation the regressors in the gravity equation are restricted to be a subset of those used in the probit estimation (Wooldridge, 2010, pp. 581-585). Thus, if bilateral tariffs are of interest in the gravity equation, they are inevitably required in the probit estimation even though they are perfectly collinear with the dependent variable (WITS-WTO data reports tariff information only for strictly positive imports. Thus, whenever trade is missing, so is the tariff information). In this context, this approach is not feasible.

In this line, a second attempt is made using a methodology proposed in Helpman et al.(2008). This methodology consists in creating the inverse Mill's ratio from the probit estimation of a single

[32] The probit model is fitted using maximum likelihood estimation, where the "selection indicator" ρ is regressed on geographical variables as specified in equation (3), importer and exporter GDPs, and year fixed effects. For Mundlak (1978) time-means are additionally included into the probit estimation.

[33] The inverse Mills ratio is computed as $\phi(z)/\Phi(z)$, where z are the predicted values of the probit estimation, $\phi(\cdot)$ the standard normal density function and $\Phi(\cdot)$ the cumulative distribution function of the standard normal distribution.

selection equation and using it in the gravity model to correct for sample selection bias[34]. Yet, in contrast to Chamberlain (1986), the gravity model is fitted by non-linear least squares, and the probit model is estimated using random-effects on the pooled sample (Bacchetta et al., 2012, pp. 115-116) [35]. Through the "exclusion restriction", regressors in the gravity model are once again restricted to be a subset of those used in the probit model. In this sense, Helpman et al. (2008) suggest that the exclusion of variables capturing fixed trade barriers satisfy this condition. Nevertheless, as in Chamberlain (1986), the lack of tariff information for zero trade makes the correction of the sample selection bias unfeasible in this setting.

Under these circumstances, missing data on the variable of interest makes the correction of sample selection bias difficult without giving up accuracy. In this sense, the problem arising from missing tariffs is bypassed by simple-averaging bilateral tariffs up to a level, where variations are at least still at the year, product group and country level[36]. The resulting variable contains tariff information even when trade is missing, solving the underlying collinearity problem between dependent and independent variables in the probit estimation. In this setting, sample correction methods employed in Chamberlain (1986) and Helpman et al. (2008) are performed. As the model and data used for these regressions are different as those in the baseline model, Chamberlain (1986) and Helpman et al. (2008) estimates are compared against the exact same specification and data but without the sample selection correction. Results are presented in Table 5, Panel B, columns (1), (2) and (3). In line with the empirical literature, for the underlying data, the omission of zero trade seems to produce a downward bias in the tariff coefficient (Helpman et al., 2008). Namely, the effect of tariffs goes from -4.12, in the comparison model, to -5.81, in the model with the sample selection correction.

Nevertheless, it is worth noticing that the use of simple-averages to overcome the lack of tariff information does not solve the real problem of missing data, especially in a context, where controlling for unobserved time-invariant and time-varying heterogeneity is substantially limited[37]. Under these circumstances, the use of sample selection models may correct for some bias at the expense of introducing others.

Therefore, even though tests results confirm the presence of some sort of sample selection bias, correcting it as attempted above implies making important concessions. Yet, in this line, the empirical literature asserts that potential misspecification biases arising from atheoretical sources are corrected by using fixed effects (Head and Mayer, 2014). Moreover, in absence of computational restrictions, fixed effect estimations and more sophisticated sample selection models may yield highly comparable

[34] The sample selection correction method used is the standard Heckman (1979) (Helpman et al., 2008). The estimated proportion of exporting firms is not included in the second stage for reasons mentioned earlier.

[35] Since estimating the probit model using fixed effects may induce an "incidental parameter problem", using random effects is suggested as a feasible solution (Bacchetta et al., 2012, p. 115).

[36] Even after filling bilateral tariffs missing in previous years with lastly reported bilateral tariffs, the share of missing values still extremely high (45.22 percent). Much of the values missing persist over time by reflecting no trade between a pair of countries for some product groups in all years.

[37] The latent "incidental parameter problem" in non-fixed effects estimations and computational constraints arising from non-linear estimations on large datasets reduce the capability of including all necessary controls.

results (Linders and De Groot, 2006). In order to settle the sensibility of two-step estimates with respect to sample selection bias in the first step, Chamberlain (1986) estimates are further used to build alternative measures of tariff-deterred imports in the second stage (see robustness checks in section 6.2.3).

6.1.3 Heteroskedasticity

The best linear unbiased estimation relies on the validity of the homoskedasticity assumption. If errors are heteroskedastic, estimates are still unbiased but no longer efficient. Thus, heteroskedasticity may seem less of a concern if predictions are based on unbiased estimates. Nevertheless, Silva and Tenreyro (2006) claim that in log-linearized models in general, and in the gravity model in particular, the presence of heteroskedastic errors leads to biased estimates even after controlling for fixed effects.

In order to address this potential source of bias, the adequacy of the baseline estimation is assessed by means of the REST test (Silva and Tenreyro, 2006). This test detects functional form misspecification by including a non-linear function of the independent variables into the model and tests whether it is statistically significant (Wooldridge, 2012, p. 306). In order to save degrees of freedom, squared fitted values $(x'b)^2$ are included instead of the entire set of quadratic terms (Silva and Tenreyro, 2006; Wooldridge, 2012, p. 306). Under the null hypothesis, the functional form of the model is correctly specified (Wooldridge, 2012, p. 307). Thus, the REST test is performed to test functional form misspecification in the estimation of interest: the baseline specification in equation (5) and the product heterogeneity specification in equation (7). Results are presented in Table 6, column (1) and (2) respectively.

For both specifications, test results reject the null hypothesis of the model's functional form being correctly specified. In order to overcome this issue, the baseline specification is re-estimated using an estimation technique that is fully robust to distributional misspecification: the Poisson-pseudo-maximum-likelihood estimator (Wooldridge, 2010, p. 646). The Poisson regression has the property of assigning less weight to observations with larger variance without assigning too much weight to contaminated and less informative observations (Silva and Tenreyro, 2006). This estimator can be adapted to panel data models and has been increasingly employed for the estimation of gravity models (Bacchetta et al., 2012, p. 113). Thus, due to the strong properties in the estimation of parameters in the conditional mean (Wooldridge, 2010, p. 675), equation (5) and (7) are regressed using the fixed effects Poisson estimation[38]. Results are presented in Table 6, column (3) and (4) respectively.

In line with in Silva and Tenreyro (2006), the effect of trade barriers on import volumes is heavily reduced. Namely, according to the Poisson estimation, a one percent increase in import tariffs leads to a 0.68 percent decrease in import volumes, contrasting to the 2.73 percent decrease found in the

[38] If tariff information were not missing, this approach could also address the problem of sample selection bias (Bacchetta et al., 2012, p. 113). In contrast to models that require log-transformations, in the Poisson regression, the dependent variable is allowed to be modeled in levels, preserving observations with zero trade (Silva and Tenreyro, 2006). Nevertheless, for the underlying data, the problem of zero trade arises from real missing tariffs, not from losing zero values in the log-transformation of the model.

baseline specification. It is worth noticing that for the Poisson regression, the null hypothesis of correct specification of the model's functional form cannot be rejected.

In this sense, for the gravity model estimated in this paper, the presence of heteroskedasticity leads to considerably different estimates. In light of this fact, Poisson coefficients are used to build alternative measures of tariff-deterred imports. Resulting Poisson-based measures are therefore employed in the sensibility assessment of the second stage estimation (see section 6.2.3).

6.1.4 Trade Dynamics

So far, regardless of the estimation technique, all gravity equations presented in this paper have been modeled as static relationships. Nevertheless, recent studies provide economic arguments and empirical evidence supporting the idea that trade is in reality a dynamic process (Bun and Klaassen, 2002; De Benedictis and Taglioni, 2011; Eichengreen and Irwin, 1998; Martínez-Zarzoso et al., 2009). Thus, neglecting its dynamic nature may lead to incorrect inferences (Bun and Klaassen, 2002; Eichengreen and Irwin, 1998).

Evidence from numerous data analysis reveals that country pairs with a close trading relationship today tend to exhibit a significant trading relationship in the past. In fact, this strong persistence in aggregate trade does not lack of micro-economic foundations (De Benedictis and Taglioni, 2011). Namely, from the heterogeneous firms' model, domestic firms entering the foreign market are confronted with entrance and exit barriers resulting from distribution and marketing sunk costs (Eichengreen and Irwin, 1998). Therefore, today's decision of selling abroad is directly linked to the past ability of firms in serving foreign markets, making trade an autoregressive process (De Benedictis and Taglioni, 2011).

In this context, in order to rule out biases stemming from the omission of trade dynamics, namely of the effect of past trade on current trade, lagged imports are included in the model as explanatory variable (Bun and Klaassen, 2002; Martínez-Zarzoso et al., 2009). Nevertheless, the introduction of dynamics brings new econometric challenges. Namely, estimation techniques employed in the static panel i.e. ordinary least squares and fixed effects estimators cannot longer produce unbiased estimates in a dynamic setting (De Benedictis and Taglioni, 2011; Martínez-Zarzoso et al., 2009)[39]. Thus, Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) GMM estimators are employed. In fact, for dynamic gravity models, these estimation techniques have become increasingly popular (De Benedictis and Taglioni, 2011), particularly, when the explanatory variable is not strictly exogenous, heteroskedasticity and autocorrelation are present, and panels are short in T but large in N (Roodman, 2009a).

First, the gravity model is estimated using Arellano and Bond (1991) difference GMM. Fixed effects are removed without magnifying gaps in the unbalanced panel using orthogonal deviations for

[39] The lagged dependent variable correlates with the error term due to serial correlation in the disturbance of within estimations (Martínez-Zarzoso et al., 2009), or due to the presence of unobserved individual-specific effects in ordinary least squares (De Benedictis and Taglioni, 2011)

transformation of data (Roodman, 2009a). While the data transformation fully controls for time-invariant heterogeneity, the incorporation of trade dynamics (or lagged imports) controls for the time-varying component in multilateral trade resistance (Baldwin, 2006; Martínez-Zarzoso et al., 2009). In addition, two time-varying multilateral resistance terms à la Baier and Bergstrand (2009) are included. In this context, neither fixed effects nor time-varying dummies are incorporated in the model (Martínez-Zarzoso et al., 2009). Thus, the following dynamic gravity equation is estimated:

$$\ln X_{ijkt} = \beta_0 + \ln X_{ijkt-1} + \omega \ln W_{ijkt} + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_8 \ln E_{ijt} + \beta_9 \ln R_{ijkt} + \sum_{t}^{T} \tau_t I_t + u_{ijkt} \qquad (12)$$

where X_{ijkt-1} denotes disaggregated bilateral imports in period $t-1$, E_{ijt} the exchange rate-based multilateral resistance term and R_{ijkt} the tariff-based multilateral resistance terms proposed in Baier and Bergstrand (2009) and Suvannaphakdy (2013). $u_{ijkt} = v_{ijk} + \varepsilon_{ijkt}$ is the composite error, v_{ijk} the country-pair product level time-invariant heterogeneity. Equation (12) is transformed using orthogonal deviations to eliminate v_{ijk}. The model is fitted in two-steps to adjust standard errors for heteroskedasticity and autocorrelation. In the transformed model, lag levels of X_{ijkt-1} and W_{ijkt} are used as instruments to orthogonalize them from the error term (see Roodman, 2009a). To that end, the instruments used start from the fourth lag. Equation (12) is estimated with and without tariff-product interactions. Results are presented in Table 7, column (1) and (2) respectively.

First, in both specifications, the regression coefficient of lagged imports is positive and statistically significant confirming the presence of persistence in imports. And second, the regression coefficient of import tariff is very similar to the one found in the static model, yet it is only statistically significant when impact heterogeneity is specified. Both estimations pass the Arellano and Bond test of third and fourth order autocorrelation and the Hansen test of overidentifying restrictions. Namely, the null hypothesis of both no third and fourth order autocorrelation and joint instrument validity cannot be rejected.

Equation (12) is further estimated using Arellano and Bover (1995) and Blundell and Bond (1998) system GMM. This technique expands the difference GMM estimator by using both the previously transformed equation and the untransformed equation in levels in order to increase efficiency when the dependent variable is close to a random walk (Roodman, 2009a) [40]. Instruments of X_{ijkt-1} and W_{ijkt} are, as before, in lagged levels for the transformed equation, but in lagged differences for the equation in levels (Bacchetta et al., 2012, p. 118). In the level equation, lagged differences serve the purpose of orthogonalizing instruments from the error, as long as initial deviations from long-term value do not correlate with the fixed effect (Roodman, 2009a). In this sense, geographical controls, importer,

[40] For random walk processes, past levels are less informative of future changes, making lagged levels weak instruments of the transformed variables (Roodman, 2009a).

exporter and product fixed effects are included in the equation in levels (Martínez-Zarzoso et al., 2009). The system of equations is fitted using the two-step system GMM with and without tariff-product interactions. Results are presented in Table 7, column (3) and (4) respectively.

Estimates from the system GMM do not pass the Hansen test of overidentifying restrictions. The null hypothesis of joint validity of instruments is rejected in either specification. This implies that the key assumption underlying the system GMM do not hold despite all additional controls included in the equation in levels[41]. Consequently, system GMM estimates are disregarded for not fulfilling the required criteria.

On the other hand, since difference GMM estimates are generated from valid instruments and are robust to persistence and hysteresis in trade, omitted variable bias, simultaneity and measurement error (Martínez-Zarzoso et al., 2009), valid coefficients from Table 7, column (2) are therefore used for the construction of a GMM-based measure of tariff-deterred imports for the sensibility analysis of the second stage estimation[42].

6.2 Second Stage

Baseline findings from the second stage are tested against potential econometric issues reported in the literature. In particular, threats of multicollinearity and endogeneity have been a constant source of concern for the estimation of trade policy variables (Amiti and Konings, 2007; Bas, 2012; Goldberg et al., 2010; Topalova and Khandelwal, 2011). Furthermore, the sensibility of second stage estimates is assessed by using alternative first-stage predictions. To that end, the second step baseline model is tested and re-estimated under several alternative specifications. This sensibility analysis is likewise performed for estimates from the direct approach for comparison purposes.

6.2.1 Multicollinearity

One major issue reported in the empirical literature concerns the simultaneous use of input and output tariffs as explanatory variables. As presented in the data section, input tariffs are constructed from a linear combination of output tariffs. Thus, at high levels of aggregation, both variables are likely to be highly correlated (Amiti and Konings, 2007). This is a very undesirable outcome as multicollinearity may potentially lead to higher parameter variance, unstable coefficients, incorrect signs or even implausible magnitudes (Greene, 2002, pp. 56-59).

Consequently, in order to detect multicollinearity, two regression diagnostics are drawn from the baseline estimation: the variance inflation factor (VIF) and the bivariate correlation between the estimated coefficients. Results are presented in Table 8, Panel A, specification 1.

The diagnostics statistics display a very high correlation coefficient between input and output tariffs (-0.9129). This correlation statistic is well above the reference thresholds (0.90, 0.70 and 0.35) proposed

[41] In the attempt of satisfying the initial condition, unobserved time-invariant heterogeneity is reduced by adding product and country fixed effects. Yet, while these time-invariant regressors are allowed in the levels equation, the widespread inclusion of fixed-effects dummies would generate "panel bias" as in within-groups transformations (Roodman, 2009a).

[42] As the Chamberlain-based tariff-deterred imports, the GMM-based version is built following equations (8), (9) and (10).

in the econometric literature (Mela and Kopalle, 2002). Signals of collinearity between input and output tariffs are detected in the direct estimation.

In the two step estimation, tariff-deterred inputs and tariff-deterred outputs have a correlation coefficient substantially lower than its counterpart (0.2000). Correlation coefficients for *output* and *foreign*, and *foreign* and *input* are in both approaches well below the suggested thresholds, representing a less source of concern.

Regarding the variance inflation factor (VIF), input and output diagnostic statistics are higher than 10, the commonly reference threshold (Mela and Kopalle, 2002)[43]. In this context, it is worth noticing that in most of the cases, VIFs from the two-step estimation is considerably lower than those in the direct estimation. Nevertheless, setting a particular cutoff value for VIF may be considered arbitrary, given that the standard deviation of the estimated parameters also depends on sigma and SST, and the latter can be increased by increasing the sample size (Wooldridge, 2012, pp. 95-98). In this sense, the VIF as collinearity diagnostic may be of limited use.

Overall, compared to the direct estimation, the two-step approach yields lower correlation coefficients (and VIFs). This is important since when input and output-based tariff measures are both required and included in the model, the risk of multicollinearity is substantially reduced even at high levels of aggregation. Mela and Kopalle (2002) argue, however, that the presented collinearity diagnostics are rather referential since identical diagnostic statistics may be more or less problematic under different correlation structures. To determine whether the slightest signal of multicollinearity is problematic, symptoms of multicollinearity (wide swings and interchangeable signs) will be examined throughout the remaining sensibility analysis of this paper.

6.2.2 Endogeneity

If variations in import tariffs are the result of variations in the performance of firms, the extent to which goods are prevented from being imported is indirectly linked to variations in firm performance. Thus, in order to assess whether baseline results are driven by reverse causality, the baseline model is re-estimated using lagged instead of contemporaneous trade policy variables (Fernandes, 2007) [44]. Results are presented in Table 8, Panel A, specification 2. In either the direct or the two-step approach, estimated coefficients of tariffs or tariff-deterred imports remain very similar to those estimated in the baseline model, suggesting that the estimated effects are not simply the reflection of reserve causality.

Despite the comprehensive set of controls included in the baseline model, it is still possible that some variations in productivity and competitiveness confound with trade policy and firm performance. In this sense, the normalized revealed comparative advantage (*NRCA*) is included into the model. This variable is constructed à la Balassa (1965) and Laursen (2000) from the entire bilateral trade data available in WITS between 2000 and 2010 (comprising about 2 million non-missing observations). It

[43] VIFs are heavily increased by reporter-year and product-year dummies.

[44] Reverse causality cannot be tested for tariff-deterred inputs using one lag, since the panel data provided for Latin American countries in OECD's input-output tables is unbalanced. The next available lag for tariff-deterred inputs is in $t - 5$, which may be too far in past to capture the expected relationship.

captures the normalized ratio of export shares of industry *k* within country *i* against the export share of industry *k* in the entire world (see formula in the Data Appendix). Moreover, another source of concern is whether tariff-deterred imports capture the effect of either tariffs or imports, and not the effect from inhibiting imports through tariffs as it is originally intended. In this scenario, the estimated effect may be driven by self-selection of productive firms into importing or the reflection of a buoyant demand calling for more products from abroad. Thus, *output*- and *input tariffs*, as well as the number of *trading partners* and the actual volume of *imported inputs* and *-outputs* are included as additional covariates. These six controls are sectorial indicators varying over industries, countries and years. Results are displayed in Table 8, Panel A, specification 3. For the service sector, input tariffs lose their statistically significant negative effect and tariff-deterred inputs gain a positive and significant effect. For the manufacturing sector, however, most coefficients in both, the direct and the two step approach, remain in line with their baseline estimations. More importantly, the effect of tariff-deterred imports, in the two-step estimation, is still negative and statistically significant even in presence of all kinds of import tariffs and import volumes.

Even though the inclusion of a three-way interaction between product-country-year dummies would cause perfect collinearity with trade policy variables, the partial inclusion of product-year, country-year and product-country effects is, however, feasible. Thus, product-country interactions are incorporated to product-year and country-year interactions from the baseline model in order to control for permanent differences across industries within countries[45]. Results are presented in Table 8, Panel A, specification 4. When product-country interactions are included, the effect of (input, output and foreign) import tariffs in the direct estimation is considerably different to its baseline estimation, while in the two-step approach the effects of tariff-deterred imports (of inputs and outputs) remain remarkably robust to product-year, country-year and product-country effects interactions, signalizing robustness against potential confounding factors stressed in the political economy literature.

The survey data employed in this paper is predominately cross-sectional, yet some firms were asked in 2006 and once again in 2010, endowing the data with a relative small panel component. Therefore, the problem of unobserved time-invariant heterogeneity is addressed, as in the gravity model, by means of the fixed effect estimator. Results are reported in Table 8, Panel A, specification 4. In the direct approach, estimated effects of tariff duties experience dramatic changes. Namely, signs reverse and some coefficients even gain implausible magnitudes. On the contrary, in the two-step approach, the negative effect of tariff-deterred inputs holds, yet the precision with which it is estimated shrinks, turning it statistically insignificant. Nevertheless, these findings are expected as the sample size is heavily reduced from 10’250 to 3’433 observations, diminishing variation in the data, and leading to a

[45] Similar to Fernandes (2007), which include a variable at the 3-digit industry level as control in a model specified at the 4-digi, the product-country interaction included in this sensibility analysis is based on a product dummy specified at one higher digit.

sample that is no longer representative of the firm population[46]. In a model, where self-selection occurs through market exit, these results are hardly reliable. Plus, the fixed effects estimator may exacerbate the attenuation bias existing in any noisy variable (Griliches and Hausman, 1986).

As in the first stage, dynamics are incorporated in the survey estimation. More specifically, if success breeds success, then past firm performance may be an important determinant of subsequent performance. More importantly, if this dynamic escalates at the industry level, and affects trade policy, it is likely to bias the effect of tariffs and tariff-deterred imports. Thus, *past labor productivity* is incorporated as an additional covariate[47]. Results are shown in Table 8, Panel A, specification 5. Estimates in the direct approach are the opposite of their baseline findings. In the two-step estimation, the negative effect of tariff-deterred inputs holds (but it is estimated with lower precision yielding a statistically significant effect only at the 10 % level). It is worth noticing that if some independent variables are trending over time, the incorporated autoregressive term may falsely dominate the regression, suppressing legitimate effects of other variables (Achen, 2000).

The heterogeneity of firms and industries within a country may be shaped by the place they are located. For instance, industries that self-select into areas with lower transportation costs may display both higher performance and an extensive participation in world markets. Since the incidence of import tariff and tariff-deterred imports may vary across industries depending on their location, firm's *city* is included as additional control to the baseline estimation. Results are presented in Table 8, Panel B, specification 1. Both, the direct and the two-step approach withstand the control for location heterogeneity, reporting very similar coefficients to those yielded in the baseline model.

If governments attempt to protect industries where market failures are more severe, it is possible that tariff barriers correlate with financial market frictions. Moreover, well-functioning financial markets are necessary to support the global exchange of goods as international trade requires routine access to external capital (Manova, 2013). In order to address this issue, the extent to which firms have access to credit is accounted for by including their *credit line* availability and *loan* disposal in the past three years. Results are displayed in Table 8, Panel B, specification 2. In general, the resulting coefficients are very similar to those estimated from the baseline model: in the direct approach, the effect of output and input tariffs remains statistically insignificant, while in the two step approach, the effect of tariff-deterred inputs remains negative and statistically significant.

Industries dominated by unskilled labor may foster the rise of organizations seeking coordinated actions against adverse trade policy (Amiti and Konings, 2007; Topalova and Khandelwal, 2011). Thus, in order to avoid endogeneity stemming from the political influence and pressure of vulnerable labor, the *industry average of employee's education* is included as additional covariate. Results are

[46] The sample size is 2'463 and 986 observations for the manufacturing and service sector respectively. Amiti and Konings (2007) argue that a reduced significance may be the result of a reduced variation in the tariff-related variables. Furthermore, the representativeness of the data, and by extension, unbiasedness with respect to sample selection is rather questionable.

[47] Despite its cross-sectional nature, the survey additionally asks for the value of sales and the number of employees three years ago, with which *past labor productivity* (Y/L) is built.

shown in Table 8, Panel B, specification 3. While the effect of input and output tariffs reverses sign without any statistical significance, the effect of tariff-deterred inputs remains negative (but statistically significant only at the 10% level). For the first time, tariff-deterred outputs gain statistical significance displaying a strong negative effect. These findings suggest that decisions on trade policy may not be independent from average human capital across industries. This implies that when sectorial human capital is held constant, preventing import-competition is detrimental to average labor productivity.

On the other side of the struggle, interest groups with *lobbying power* or with relative importance in country's economy may succeed in their manners of influencing trade policy. In this sense, powerful firms may use trade policy to protect their investments or interfere in trade negotiations with the expectation of generating higher returns for their shareholders. Thus, firm's position in the country distribution of total sales is used as additional control. Results are displayed in Table 8, Panel B, specification 4. While the direct approach yields only statistically insignificant results, tariff-deterred imports remain negative and very statistically significant. However, it is worth noticing that this time in both estimations, foreign tariffs lose their high statistical significance completely. This may suggest that the positive link between higher access to foreign markets and firm performance may be dominated by self-selection of high performers.

Finally, baseline findings may poorly capture the effect stemming from import tariffs, if sampled firms produce a wide range of products. Since firms are matched with import tariffs depending on their main product, the link between the assigned tariff and the matched product may be too weak for highly diversified firms. Particularly, insignificant effects estimated for tariff-deterred outputs may be precisely because the firm's main product is a small share of its total output. In order to address this issue, the baseline model is estimated for only for firms, for which the *main product* accounts at least 50 percent of their sales[48]. Results are displayed in Table 8, Panel B, specification 5. As expected the negative effect of tariff-deterred inputs is estimated with higher precision, yielding statistically significant effects even for the service subsample. Consistent with baseline findings the effect of tariff-deterred outputs is still statistically insignificant.

6.2.3 Operational Variables

In this part of the analysis, the sensibility of the second stage estimation is tested against alternative dependent and independent variables. In this line, three different measures of tariff-deterred imports derived from the first stage estimation are employed. In addition to labor productivity, the effect of trade policy on total sales and total factor productivity is further examined.

Aiming at correcting biases from missing trade, in section 6.1.2 the first stage equation is estimated using sample selection correction mechanisms suggested by Chamberlain (1986) and Helpman et al. (2008). In this line, tariff-deterred imports derived from Chamberlain's sample-corrected estimates are

[48] The sample size is reduced from 7'525 to 6'232 for the manufacturing subsample, and from 2'725 to 2'383 for the services subsample

used as alternative explanatory variables[49]. Results are presented in Table 8, Panel C, specification 1. The Chamberlain-based tariff-deterred inputs remain negative and statistically significant (yet only at the 10% level). This may be attributed to the fewer precision with which tariff-deterred imports are estimated in the first stage. For instance, the impact heterogeneity of tariffs across products is ignored[50]. Tariff-deterred outputs remain as before statistically insignificant.

As demonstrated before, the baseline estimation of the gravity model do not pass the RESET test. In order to test whether the second stage is sensitive to first stage's functional misspecification, Poisson estimates are used to compute heteroskedastic-robust predictions for tariff-deterred imports. In this manner, biases from heteroskedastic errors in log-linear models are prevented (Silva and Tenreyro, 2006)[51]. Results are presented in Table 8, Panel C, specification 2. The effect of Poisson-based tariff-deterred inputs remains negative and similar in magnitude, but not statistically significant. However, it does gain significance under specifications used throughout this sensibility analysis[52]. On the other hand, the effect of tariff-deterred outputs yields for the first time a positive and statistically significant effect on labor productivity.

Earlier results for the gravity equation confirm the importance of trade dynamics. Thus, in order to assess whether second stage estimates are sensitive to unspecified trade dynamics in the first stage, GMM-based estimates of tariff-deterred imports are used. Besides accounting for persistence and hysteresis in trade, GMM estimates à la Arellano and Bond (1991) are robust to omitted variables, simultaneity and measurement error (Martínez-Zarzoso et al., 2009). Results are presented in Table 8, Panel C, specification 3. GMM-based variables yield slightly stronger yet still very similar results to estimates from the baseline model.

Finally, the effect of import tariffs and tariff-deterred imports are estimated on two other important indicators of firm performance: total sales and total factor productivity (*TFP*). Results are presented in Table 8, Panel C, specifications 4 and 5 respectively. In both approaches, the estimated effect on total sales is very similar to the one found on labor productivity. The difference between these two approaches is once again confirmed through its effects on *TFP*. Namely, in the direct estimation, the impact of input and output tariffs reverses and gains statistically significance. On the contrary, estimates of tariff-deterred imports on *TFP* are in line with those found on labor productivity. Raising tariff-deterred inputs decreases *TFP*, while raising tariff-deterred outputs has no statistically

[49] Chamberlain-based estimates are preferred over Helpman's, as it estimates the model using time-varying inverse Mills ratios, derived from a probit estimation, for which bilateral fixed effects are controlled.

[50] Additionally, this regression may have biases heading in two opposite directions. The sample-corrected estimates may underestimate tariff-deterred imports since it uses trade-weighted tariffs to predict imports from non-trading partners. On the other hand, it may overestimate import volumes by predicting tariff-deterred imports for non-trading partners, for which trade will not naturally arise, even at zero tariffs.

[51] It is worth mentioning that for Poisson predictions, the back-transformation from logarithmic units to arithmetic units is not required as the estimation of the dependent variable is in performed in levels not in logs (Baum, 2009).

[52] By including *country-product interactions* and *industry average of employee's education,* the negative effect of tariff-deterred inputs become statistically significant.

significant effect. On the other hand, in contrast to labor productivity, for *TFP* foreign tariffs do not have a statistical significant effect.

7 Group Analysis

After confirming the detrimental effects of preventing inputs from being imported, the incidence and distribution of its impact is further examined for different macro- and microeconomic characteristics of the sample. Likewise, the non-significant effect of preventing outputs from being imported is challenged by allowing impact heterogeneity across different types of firms, industries and countries. To that end, similar to Amiti and Konings (2007), the baseline model is re-estimated using interactions between trade policy variables and economic features of special interest[53].

7.1 Macroeconomic Impact Heterogeneity

Rodriguez and Rodrik (2000) bring into discussion whether the impact of trade restriction operates differently depending on the country, its size and its comparative advantage. To shed light on this enquire, the effects of tariff-deterred inputs, tariff-deterred outputs and foreign tariffs are assessed by countries' economic size, countries' political orientation and industry-specific comparative advantage. Results are displayed in Table 9, Panel A, specifications 1, 2 and 4 respectively. Regression results suggest that larger economies (Argentina, Mexico and Venezuela) benefit slightly more from allowing higher inflows of intermediate goods, than smaller economies (Chile, Colombia and Peru). Smaller economies, on the other hand, have significantly more gains from opening up foreign markets than larger economies.

Next, in order to assess the impact across different types of countries, the studied Latin American economies are divided into two groups depending on their political/ trade orientation. Countries implementing high distortions in favor of immediate social justice but in detriment of macroeconomic stability are grouped into *Mercosur* (Argentina and Venezuela), whereas more market-oriented economies are classified under the *Pacific Alliance* (Chile, Colombia, Mexico and Peru). Estimation results find higher gains from allowing imported inputs for countries in the *Pacific Alliance* than in *Mercosur*. Nevertheless, manufacturing firms in *Mercosur* seem to profit more from improved access to foreign markets. This result may suggest that in *Mercosur* lower foreign tariffs allow firms to reduce their exposure to domestic risks by diversifying sources of demand across countries (Caselli et al., 2015).

To assess the relationship between trade policy, growth and comparative advantage, industries are divided in four quantiles based on their comparative advantage (disadvantage). In this sense, industries with the lowest comparative advantage are grouped in the *lowest quantile*, while industries with the highest comparative advantage are gathered in the *highest quantile*. Regression results suggest that allowing imported inputs brings benefits for all industries regardless of their comparative advantage, yet the magnitude of these gains are higher for industries in the middle of the distribution and lower

[53] All regressions using interactions include the main effect from the additional variable.

for those in the extremes. A reduction of foreign tariffs is, however, only beneficial for industries holding a clear comparative advantage.

One stylized fact of the manufacturing sector is that there is huge heterogeneity of firms in different industries (Schor, 2004). In order to investigate the extent, to which this heterogeneity is reflected in their respond to trade policy, industries are grouped according to their *technology intensity* using *OECD (2011) technology intensity classification*. Results are displayed in Table 9, Panel A, specification 3. Indeed, results reveal that the heterogeneity in response to trade policy is remarkable. Labor productivity gains from allowing more imported inputs are accrued only by *low tech* industries (ISIC 15 – 22). Moreover, in this setting, even the elusive impact in permitting more imported outputs in the economy gains more clarity: import-competition foster labor productivity in *medium-low tech* industries. It is worth mentioning that these effects are not extendible to *TFP*, as labor productivity does not disentangle efficiency effects (*TFP*) from physical and human capital accumulation. The higher access to foreign markets favors *low tech* and *medium-low tech* industries. This result may be heavily driven by particularities of the region. Latin American countries hold the comparative advantage in *low* to *medium-low tech* industries connecting this result to previous findings on the comparative advantage. Thus, opening foreign markets may be only effective to domestic industries sufficiently competitive in world markets.

Import tariffs have been diminishing over time and are today relative low compared to some decades ago. In this sense, it is sensible to expect diminishing gains in labor productivity from further marginal reductions in import tariffs. To assess this empirically, the effect stemming from trade policy is allowed to be heterogeneous across different tariff levels, taking fully advantage of the intertemporal, intersectorial and international variation in tariffs barriers. Results are presented in Table 9, Panel A, specification 5. Regression results suggest that in contrast to initial beliefs gains from allowing more imported inputs are higher for firms in sectors burden with lower tariff rates. This is in line with Halpern et al. (2015)which found larger effects of tariffs in more open economies. They claim that while this may seem surprising, the idea behind this finding is that costs reductions in imported inputs are higher when firms already use more kinds of foreign inputs.

7.2 Microeconomic Impact Heterogeneity

Even within countries and industries, some firms may be more or less sensitive to changes caused by trade policy. In this sense, the effect from allowing more inputs and outputs from abroad is examined by firm’s size and age. Results are displayed in Table 9, Panel B, specification 1 and 2 respectively. While gains from allowing imported inputs are present irrespective of the size of the firm, higher gains are observed for *medium-sized* firms (16-60 employees), followed by *small* firms (1-15 employees). *Large* firms (> 60 employees), on the other hand, profit more from opening foreign markets, possibly, due to economies of scale. Regarding the maturity of firms, *young* firms (1-12 years) and *old* firms (over 26 years) accrue the highest gains from letting more foreign inputs in. *Middle-aged* firms (13-

26) display, on the other hand, the highest gains from lowering foreign tariffs. These results are in line with non-linearities in the effect of firm age commonly found in the literature.

Melitz (2003) introduces formally the concept of firm heterogeneity and demonstrates through this framework how productivity differences within industries may explain gains from international trade. In order to assess how trade policy impacts firms differently according to their productivity level, firms are divided into two groups: *least productive* firms on one hand, and the rest on the other. According to the literature, *TFP* is one channel through which imports impact growth, thus the inclusion of a set of interactions comprising *TFP* will absorb legitimate effects stemming from trade policy. Instead, firms are separated in two subsamples and the baseline model is estimated for each group separately. Results are presented in Table 9, Panel B, specification 3. Regression results are clear: average labor productivity rises by allowing more imported inputs for regular firms, or by allowing more import-competition to *least productive* firms. These results confirm one important source for the unequal distribution of gains from trade. In this sense, while the effect from imported inputs is persistent across specifications, the effect from imported outputs turns from being non-significant most of the times to strong and highly significant for the *least productive* group. It is, nevertheless, premature to determine whether the positive effect of allowing import-competition on labor productivity are driven by the exit of *least productive* firms or by imitation or competition-driven incentives to invest more and become more efficient.

Finally, particularities of the survey data are exploited in order to determine whether trade policy produces asymmetrical changes in firm performance depending on the intensity of *market failures*. Instead of relying on country-wide development indicators, valuable information regarding the incidence of market failures is provided by the survey at microeconomic levels. As the firms were asked to disclose private information about their obstacles in doing business, *market failures* capture the firm-level incidence of deficient transportation, electricity, educated workforce, access to land and finance, heavy corruption, crime etc. (see Data Appendix). Firms are divided into four quantiles depending on the degree of *market failure* they encounter. Results are presented in Table 9, Panel B, specification 4. The effect from allowing more imported inputs is higher and more statistically significant for firms in lower quantiles of the *market failure* distribution. This suggests that imported inputs may be used more efficiently in well-functioning markets, generating additional gains from trade. On the other hand, the positive effect of opening up foreign markets on labor productivity is higher for higher firms in higher quantiles of the *market failure* distribution. This suggests that reducing foreign tariff barriers may overproportionally benefit firms facing higher hurdles at home.

8 Transmission Channels

While rising labor productivity is important for the economy as it is itself per capita growth, this boost may be driven by two different forces: factor accumulation or total factor productivity (*TFP*). In this section, the effect from preventing (or allowing) more imports on firm performance is examined by observing its impacts through the *TFP* channel[54].

Theoretical frameworks developed by Goldberg et al. (2010) and Halpern et al. (2015) indicate that the inflow of imported inputs enhance the availability of imperfect substitutable inputs, the access to high-quality inputs and the dynamic expansion of new input varieties. They regard of all these factors as key drivers of productivity growth. In order to investigate whether the estimated gains from trade operate through these channels, firms are divided into *importers* and *non-importers*. *Non-importers* are firms using all inputs exclusively from domestic origin, while *importers* use at least some inputs from foreign origin[55]. This variable is interacted with trade policy variables to differentiate the impact for users and non-users of imported inputs. Results are displayed in Table 10, specification 1. Regression results reveal that both, *importers* and *non-importers* display significant productivity gains from allowing more imported inputs. This implies that productivity gains from imported inputs cannot be limited to static gains arising from higher availability of foreign inputs or greater input quality/ technology. Instead, the evidence suggests that even non-users of imported inputs benefit from higher inflows of foreign inputs. This finding is in line with Goldberg et al.(2010), which claim that imported inputs create dynamic gains by forcing general input price reductions that enable the introduction of new varieties by domestic firms.

While the elusive effect of import-competition is predicated on certain firm characteristics as shown earlier, whenever a statistically significant gain is indeed found, attributing it to exiting firms (Melitz, 2003), or to imitation and knowledge spillovers (Grossman and Helpman, 1991), is not straight forward. In order to explore these channels, the effect of trade policy on *TFP* is estimated on a balanced panel of firms interviewed in 2006 and 2010, relying exclusively on *within* variations. In this setting, if the observed increment in average productivity is caused entirely by the exit of less-productive firms, surviving firms should not present significant gains in *TFP* from higher import-competition. Results for surviving firms and also for firms surviving with the lowest productivity in their industry are presented in Table 10, specification 2. Regression results suggest that *least productivity* firms interviewed in both waves have higher productivity from induced import-competition. The effect is statistically significant only at 10%, yet it still provides some evidence that some import-competition stimuli trigger product, process or organizational innovation that increase within firm productivity. This result is in line with Topalova and Khandelwal (2011), which by testing its model on a constant of subsample of firms find that productivity gains from import-competition are not entirely driven by the exit of less efficient firms.

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[54] *TFP* is estimated as Gorodnichenko and Schnitzer (2013) in equation (D.2), and employed as dependent variable in the baseline model specified equation (11). To isolate *TFP* from human capital accumulation and demand and supply shocks, *average employee's education* and *capacity utilization* are used as additional controls in all *TFP* regressions.

[55] It is worth noticing that the survey differentiates *importers* from *direct importers*. The variable use to test the above-mentioned hypothesis is *importers*. On the other hand, *domestic origin* refers to "a good produced, transformed, cultivated, or extracted and sold by an entity residing in the country (Enterprise Surveys, 2009: Questionnaire Note)

After having found evidence for the static and dynamic gains from imported inputs, as well as for the average and *within* productivity gains from import-competition, the distribution of these effects within the economy is examined. To that end, this paper finalizes the empirical analysis by estimating the heterogeneous effects of trade policy on *TFP* across industries with different technology intensity, comparative advantage and degree of market failure. Results are presented in Table 10, specifications 3, 4 and 5.

Regression results display a higher rise in *TFP* among *medium to high tech* industries. This increment is triggered by both more imported inputs and higher import-competition. This finding suggests that more sophisticated industries profit more from more open input markets and from tougher foreign competition. The latter effect, however, suggest that *medium to high tech* industries are indeed more sensitive to foreign competition than any other industry. In this sense, from the theory and empirical evidence, the elastic response of these industries can be explained by a combination of "fat trimming", active innovation and substantial firm dropout.

The importance of comparative advantage is less pronounced yet still decisive. Gains from imported inputs are evenly distributed across industries with dissimilar comparative advantage. Higher import-competition, however, raises average *TFP* among industries positioned at lower quantiles of the comparative advantage distribution (at the 10% level of significance). These results are in line with the above findings, reflecting the close link between technology intensity and comparative advantage.

Finally, when it comes to well-functioning markets, more imported inputs do increase *TFP* regardless the degree of market failure. Nevertheless, those gains in efficiency are consistently higher among firms in more favorable business environments. This finding is in line with Winters (2004), which claim that part of the benefits of free trade is predicated upon other policies and institutions of being supportive.

9 Summary of Findings

First, higher flows of imported inputs increase both labor productivity and total factor productivity among manufacturing firms irrespective of their characteristics. Second, this finding is robust to twelve out of fourteen alternative specifications. Third, gains from imported inputs are higher for firms in countries with macroeconomic stability and reduced market failures. Fourth, productivity gains from imported inputs are not only benefiting importers but also non-users of foreign inputs, suggesting dynamic gains from fostering the introduction of new varieties by domestic firms (Goldberg et al., 2010). Fifth, gains from imported inputs on labor productivity are heavier in sectors with already low input tariffs. Namely, deeper integration to world markets brings greater benefits from the diminishing input costs (Halpern et al., 2015). Sixth, the larger the economy, the greater are the gains from imported inputs. Seventh, efficiency gains ripped from imported inputs are higher for industries using medium to high technologies.

Eight, the net effect of import-competition is on average not statistically significant. This finding is robust to thirteen out of fifteen alternative specifications. Ninth, the effect of import-competition is highly heterogeneous, varying over firms depending on their productivity, technology intensity and comparative advantage. Tenth, low-productivity firms near the entry cut-off and technology-intensive industries are the most sensitive to import-competition. Eleventh, import-competition brings gains in industry's average productivity not only by getting rid of least productive firms, but also by raising productivity of less-productive firms surviving fiercer competition.

Twelfth, reducing foreign tariffs on domestic exports is on average widely beneficial but only through labor productivity, not through *TFP*. This finding is robust to ten out of fourteen alternative specifications. Thirteenth, opening up foreign markets through low foreign tariffs is more important for firms burdened with higher transaction costs and unstable domestic markets. Fourteenth, gains from lower foreign tariffs are higher for firms in smaller economies and with the comparative advantage.

10 Discussion

When it comes to determine the effect of trade policy on economic growth, the long path of research in this field has brought a remarkable diversity in findings and insights. In this context, the empirical literature has no restraint in pointing out the most problematic issues along the way. In this section, these issues are briefly examined in order to determine whether they pose a threat for the identification strategy in this paper. The challenges, strengths and limitations of this study are introduced in this context. A broader interpretation of the main findings in this paper is discussed towards the end of this section.

Prominent studies over the 90s were heavily criticized for how they measured trade openness. In this line, Winters (2004) claims that liberal trade regimes should be identify as those having low artificial trade barriers. Nevertheless, these measures are rarely used in empirical investigations. The fact is that data limitation on disaggregated tariff rates is not trivial. For instance, Anderson and van Wincoop (2004) reveal that only 0.8 percent of the countries reported trade data to TRAINS in 1989. This percentage rose up to 36.4 in 2000. The increasing availability of standardized data today enables the use of these direct measures of trade openness across different countries, even at higher levels of disaggregation.

However, Dollar and Kraay (2003) argue that when average tariffs are used, a weak correlation with trade volumes is observed. They claim that Mexico experienced huge increases in trade but moderate tariff reductions and that this growth in trade is mostly due to far-reaching reductions in administrative barriers during the 90s as part of the NAFTA agreement. This argument suggests that for the impact assessment of trade openness on growth, the link between tariff barriers and trade is not unimportant. Likewise, this also applies to input tariffs, which are often used as proxy for greater availability of foreign inputs (see Schor, 2004).

On the other hand, the use of actual imports as weights for averaging tariffs may assign too low weights for high tariffs, introducing an endogeneity problem (Amiti and Konings, 2007). Yet, the bias in trade-weighted average tariffs may be worrisome only if tariffs reach prohibitive levels (Bacchetta et al., 2012, pp. 67-68). A solution proposed by Kee et al. (2008) is the use of a weighting scheme that captures the importance of each product on the overall trade restrictiveness. To that end, they use weights as a function of import shares and import demand elasticities (Bacchetta et al., 2012, p. 68).

Even when using appropriate average tariffs, Winters (2004) claim that establishing causation between trade openness and growth is extremely difficult as pressures for protection rises when growth falters. Moreover, a reduction of tariffs may be a small component of a series of measures implemented in regional integration agreements (Bacchetta et al., 2012, p. 109). Therefore, estimating the direct link between tariffs and growth may erroneously attribute some of the non-trade effects to tariffs as if they were their own. Similarly, Baldwin (2002) claim that isolating the effects of trade liberalization on growth is misguided, as trade liberalization has never been implemented as an isolated policy Winters (2004). This is particularly relevant for the existing empirical literature, as most of them investigate the relationship between trade openness and growth in transforming economies during the 80s and 90s.

Internal Validity

In this study, however, the validity of the identification strategy depends upon the consistency of the first stage estimates and the zero-correlation between the generated regressor and the error term in the second stage (Wooldridge, 2010, p. 115). In this sense, multiple efforts have been carried out in order to yield reliable first stage estimates. First, estimates are grounded on a comprehensive, theory-consistent and empirically powerful model of international trade. Second, they are estimated from a large dataset using an estimation technique that eliminates biases from unobservable tendencies without relying on strong structural assumptions (Head and Mayer, 2014). Third, their precision is enhanced by including tariff-product interactions, which allow for product-varying elasticities (see Angrist and Pischke, 2008, p. 93; Chen and Novy, 2011). And fourth, the sensibility of the main findings is tested against alternative first stage estimates, yielding in two out of three similar results.

Numerous investigations cited in this paper use panel data with individual fixed effects. Indeed, cross-sectional data is generally not useful to deal with individual-specific effects (Paulsen and Smart, 2013, p. 328). Thus, one would like to use an instrumental variable technique, yet it is hard to find valid instruments (Bacchetta et al., 2012, p. 118). In this context, Angrist and Pischke (2010) claim that aggregation of individual data up to group levels works as an instrumental variable procedure. In this sense, the aggregation of tariff-deterred imports over all trading partners makes the policy variable more resilient to bilateral variations in trade protection and to influences from micro-economic agents. This implies that bias stemming from unobserved heterogeneity can be successfully controlled at the same level of aggregation, even within cross-sectional data (Paulsen and Smart, 2013, p. 328). In this context, Schor (2004) argue that industry dummies control for a large part of the political economy of trade liberalization. Therefore, the possible correlation between the generated regressor and the error term is minimized with country-year and product-year fixed effects. Moreover, endogeneity stemming from variations at the country-product-year level are largely accounted by an extensive set of controls capturing lobbying, competitiveness and economic shocks[56].

Effect Identification

Amiti and Konings (2007) claim that to separate the effects of input and output tariffs on productivity, it is necessary to have tariffs at higher level of aggregation. Nevertheless, even at the three-digit level main inputs still often come within the same industry as the output (Amiti and Konings, 2007). Consequently, a high correlation between input and output tariffs may follow. In this context, if collinearity is solved by dropping a variable that belong to the model, the remaining estimates will be biased, possibly severely so (Greene, 2002, p. 58). Nevertheless, since collinearity in this study has proven not to be problematic, the assessment of these differentiated effects even at higher levels of aggregation is feasible.

Similarly, Goldberg et al. (2010) believes that the contribution of the extensive margin of imports to growth is substantial. In this context, they admit that relying on product-specific import data aggregated at higher levels instead of firm-level data on input use has two main advantages: first, the aggregate data is a census, and second, firms frequently access foreign inputs through intermediaries rather than by importing directly. Indeed, by using aggregated import data, this study provides some evidence backing Goldberg et al. (2010) hypothesis.

One popular argument among politicians is that a reduction in tariff protection causes the free entrance of an overwhelming amount of imports forcing many domestic firms out of the market. This view is not entirely inaccurate, as competitive-driven selection of productive firms has often found theoretical and empirical support (Melitz, 2003; Pavcnik, 2002). In this scenario, Nataraj (2011) claim that even when trade liberalization affects firms' decision to enter and exit, representative samples (as the one used in this analysis) can properly capture selection effects affecting average firm productivity[57]. Consequently, the sampled data needs to be either representative for the whole firm population or corrected for the selection problem caused by liquidated firms (Pavcnik, 2002)[58].

Further Result Assessment

Results from the group analysis reveals additional gains in labor productivity from imported inputs for firms in the *Pacific Alliance* (+0.3), in the group with the lowest *market failure* (+ 0.3), with the lowest *tariff level* (+0.8) and with a *low-tech* industries (+1.4). On the contrary, for *TFP* additional

[56] Amiti and Konings (2007) argue that productivity indicators are likely to capture price-costs markups. However, Topalova and Khandelwal (2010) asserts that as long as price-costs markups are correlated with true efficiency then the revenue-based *TFP* measure captures technical efficiency.

[57] Wooldridge (2010, p. 553) argue that a random sample is nothing but a sample representative of the population.

[58] Common estimation techniques employed in the literature that address the issue on unrepresentative panels are based on Olley and Pakes (1996) and Levinsohn and Petrin (2003).

gains stem from firms at the bottom of the *productivity* distribution (+1.1) and in *medium to high-tech industries* (+5.2). These results suggest that governments complementing tariffs reductions with macroeconomic stability, market efficiency and persistent commitment to international trade generate gains that are higher than those generated by deploying each policy separately. Additionally, while more and cheaper imported inputs favors capital deepening in *low-tech* industries, less *productive* firms and *medium to high-tech* industries benefit from better inputs that help them to become more efficient.

On the other hand, the elusive effect of import-competition kicks in among *least productive* firms, firms in *medium to high tech* industries and in industries with no *comparative advantage*. These results suggest a strong gain on average productivity from an efficient re-allocation of resources. On the other hand, no significant gain from preventing import-competition is found for any type of firm. This may suggest two conflicting issues. First, import-competition may force more fiercely the exit of firms in industries, where Latin America has the greater distance to the world's technology frontier, as proposed by Aghion and Griffith (2008). Second, if in pursuit of other economic goals, one wishes to avoid this outcome, selective trade protection comes at the expense of higher productivity at least in the short-run.

Therefore, one important limitation of this study is the short horizon, in which the relationship between trade policy and growth is examined. Muendler (2004) argue that in short horizons it cannot be tested whether free trade induces specialization of less developed economies in low-growth sectors. On the other hand, Winters (2004) claims that trade openness induce policy improvements.

Another limitation concerns the channels through which imported inputs and outputs promote growth. It is not clear whether productivity gains from imported inputs are driven by access to foreign technology, higher quality of inputs or greater input variety. Likewise, it is hard to specify with clarity which of the two effects found in import-competition dominate: *within* productivity gains or gains produced by reallocation.

Finally, the consequences of free trade for firms in the service sector are most of the times negligible. However, a strong effect is indeed found for the firms in *Mercosur*. As the service sector use final or consumption goods as inputs, higher trade protection in unstable domestic markets may jeopardize growth in services, a sector that has the highest contribution to GDP in the studied economies.

11 Conclusion

Despite being widely examined, the role trade policy has to play in the growth strategy of less developed economies has not reached general consensus. This is partially because its repercussions are multidisciplinary. Yet, when it comes to the trade-growth relationship, more and more evidence tip the balance in favor of freer trade. How to reconcile divergent results found in the empirical literature? This paper attempts to shed light on this enquire.

If results vary across countries and industries, pooling the source of variation into a larger trade data enables the generation of first stage estimates from an identical econometric model that can be used in the second stage to explain cross-country variations (Wagner, 2012). Indeed, main findings in this study suggest that the impact of reducing tariff barriers is not independent from firm, industry and country characteristics.

Particularly, while gains from lesser restrictions in importing inputs are stable across type of firms, part of these gains are indeed predicated on the adequacy of policies and institutions as claimed by Winters (2004) and Wacziarg and Welch (2008). Additionally, generated gains are not only static from relaxing the technological constraint but also dynamic from fostering the introduction of new domestic varieties as proposed by Goldberg et al.(2010). More importantly, these benefits are still significant even in non-liberalizing periods as today.

The controversial effect in import-competition may be driving important differences in findings across studies. Namely, whether import-competition generates gains or not depends on characteristics that are likely to differ across countries, such as the comparative advantage, the position of firms in the international productivity distribution, and its distance to the world's technological frontier.

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REGRESSION TABLES

Table 1. The Gravity Model

Dependent var: Ln (Imports)	Naïve	Multilateral Resistance	
	(1)	(2)	(3)
	OLS	Time-invariant FE	Time-varying FE
Ln (Tariffs)	-3.2594***	-2.6703***	-2.7308***
	(0.1898)	(0.2627)	(0.2943)
Ln (Importer GDP)	1.0933***	1.0412***	
	(0.0417)	(0.0453)	
Ln (Exporter GDP)	0.4002***	0.3519***	
	(0.0404)	(0.0480)	
Ln (Distance)	-1.3901***		
	(0.0272)		
Contiguity	0.9423***		
	(0.0415)		
Common Language	4.4195***		
	(0.6527)		
Colony	5.0908***		
	(0.3222)		
Constant	-10.2939***	-23.5822***	15.2991***
	(1.5718)	(1.6595)	(0.5522)
Observations	104,263	104,263	108,623
Number of unit		14,795	15,481
R-squared	0.7738	0.0824	0.1505
Country-Product FE	YES		
Year FE	YES	YES	
Country-Year FE			YES
Product-Year FE			YES

Note: Table 1 reports estimates of equation (2), (4) and (5) in columns (1), (2) and (3) respectively. Equation (2) is fitted by ordinary least squares. Equation (4) and (5) are fitted with the within estimator. If specified, fixed effects and time-varying effects are included but not reported. *Country-Product FE* denotes both importer-product and exporter-product fixed effects. *Country-Year FE* and *Product-Year FE* denote importer, exporter and product time-varying effects respectively. Robust standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Table 2. The Gravity Model and Impact Heterogeneity

Panel A. Effect of Tariffs on Imports by Products

	Elasticity	Total Effect		Elasticity	Total Effect
Main effect					
Ln (Tariffs)	-5.6331***		Leather and Footwear [19]	1.3172	-5.6331
	(1.0612)			(1.4023)	
			Television & Comun. Equip. [32]	2.0700	-5.6331
Interaction effect: Primary Sector				(1.4802)	
			Rubber & Plastic Products [25]	2.0718	-5.6331
Agriculture [1]	3.0177	-5.6331		(1.3727)	
	(1.9122)		Electricity and Gas [40]	6.9451	-5.6331
Forestry [2]	-0.4869	-5.6331		(11.5860)	
	(1.9112)		Printing of Recorded Media [22]	2.8737**	-2.7594
Mining of Coal [10]	-5.7857	-5.6331		(1.3825)	
	(4.2592)		Other Non-Metallic Minerals [26]	3.1076**	-2.5255
Crude Petroleum & Gas [11]	1.6644	-5.6331		(1.4493)	
	(8.3354)		Paper Products [21]	3.3676*	-2.2655
Other Mining [14]	4.3987*	-1.2344		(1.9664)	
	(2.5921)		Fabricated Metal Products [28]	3.6524***	-1.9807
Fishing [5]	5.2284***	-0.4047		(1.3543)	
	(1.8919)		Food Products & Beverages [15]	4.0011***	-1.632
Mining of Uranium [12]	-	-		(1.3012)	
			Textiles [17]	4.0247***	-1.6084
Mining of Metal Ores [13]	9.9973**	4.3642		(1.3327)	
	(4.0235)		Computing Machinery [30]	4.1461***	-1.487
				(1.5463)	
Interaction effect: Manufacturing			Furniture [36]	4.6157***	-1.0174
				(1.4227)	
Chemical Products [24]	-4.8308**	-10.4639	Tobacco Products [16]	5.1884***	-0.4447
	(1.8757)			(1.4339)	
Other Transport Equip. [35]	-2.7713*	-8.4044	Wearing Apparel [18]	6.1868***	0.5537
	(1.4767)			(1.2109)	
Coke, Refined Petroleum [23]	-4.6399	-5.6331	Motor Vehicles & Trailers [34]	9.6127***	3.9796
	(3.2085)			(1.2724)	
Basic Metals [27]	-1.9134	-5.6331	Constant	15.2908***	
	(1.7988)			(0.5501)	
Electr. Machinery [31]	0.0606	-5.6331	Observations	108,623	
	(1.4142)		R-squared	0.1556	
Machinery and Equip. [29]	0.4181	-5.6331	Number of units	15,481	
	(1.3268)		Country-Year FE	YES	
Wood Products [20]	0.6691	-5.6331	Product-Year FE	YES	
	(1.4671)				

Note: Table 2, Panel A reports estimates of equation (7). Equation (7) is fitted using the within estimator. Exporter, importer and product time-varying effects are included but not reported. Elasticites are the regression coefficients resulting from the estimation of equation (7). Total effects are computed as the sum of the main effect with the corresponding interaction effect. Total effects are based on statistically significant results only. ISIC codes are provided in brackets. The baseline product group category is ISIC 33. Robust standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Panel B. Effect of Tariffs on Imports by Countries

	Elasticity	Total Effect		Elasticity	Total Effect
Main effect					
Ln (Tariffs)	-3.8962***		Peru [604]	3.2364***	-0.6598
	(0.6586)			(1.0801)	
			Venezuela [862]	-1.2129	-3.8962
Interaction: Country				(1.5686)	
			Constant	15.3659***	
Chile [152]	-8.1823**	-12.0785		(0.5567)	
	(4.0067)		Observations	108,623	
Colombia [170]	0.8618	-3.8962	R-squared	0.1509	
	(1.1541)		Number of unit	15,481	
Mexico [484]	1.5559**	-2.3403	Country-Year FE	YES	
	(0.7595)		Product-Year FE	YES	

Note: Table 2, Panel B reports estimates of equation (6). Equation (6) is fitted using the within estimator. Exporter, importer and product time-varying effects are included but not reported. Elasticites are the regression coefficients resulting from the estimation of equation (6). Total effects are computed as the sum of the main effect with the corresponding interaction effect. Total effects are based on statistically significant results only. Country codes are provided in brackets. The baseline country category is Argentina. Robust standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level.

Table 3. Survey Estimation: The Baseline Model

Dependent var: Ln (Labor Productivity)

	Direct Estimation			Two Step Estimation		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Manufacturing	Services	All	Manufacturing	Services
Ln (Input Tariff)	-9.2568**	-2.7839	-12.9378**			
	(3.7993)	(3.2400)	(5.7025)			
Ln (Output Tariff)	2.7802**	0.7359				
	(1.3770)	(1.2414)				
Ln (Foreign Tariff)	-2.5548*	-4.1887***		-3.4120***	-3.3736***	
	(1.3175)	(1.0311)		(1.2891)	(1.0973)	
Ln (Tariff-Deterred Inputs)				-0.1096*	-0.1401***	-0.1036
				(0.0586)	(0.0517)	(0.0881)
Ln (Tariff-Deterred Outputs)				0.1048	0.0773	
				(0.2371)	(0.2364)	
Ln (Age)	0.1153**	-0.0423	0.2330***	0.1160**	-0.0412	0.2345***
	(0.0539)	(0.0387)	(0.0828)	(0.0546)	(0.0387)	(0.0836)
Ln (Employees)	-0.0677	0.0951***	-0.1392	-0.0690	0.0999***	-0.1450
	(0.0715)	(0.0257)	(0.0950)	(0.0723)	(0.0256)	(0.0953)
Foreign	0.1698	0.8032***	-0.1098	0.1570	0.7968***	-0.1182
	(0.3218)	(0.1731)	(0.3922)	(0.3229)	(0.1701)	(0.3911)
% Exports Sales	0.0101***	0.0028**	0.0195***	0.0102***	0.0028**	0.0195***
	(0.0026)	(0.0011)	(0.0041)	(0.0026)	(0.0011)	(0.0042)
Information Technologies	0.2596***	0.2323***	0.2530**	0.2628***	0.2361***	0.2538**
	(0.0696)	(0.0494)	(0.1017)	(0.0703)	(0.0490)	(0.1026)
Temporary Employment	0.0884**	0.0723**	0.0897**	0.0895***	0.0755***	0.0906**
	(0.0347)	(0.0289)	(0.0397)	(0.0343)	(0.0291)	(0.0392)
Transaction Costs	-0.1912***	-0.1412**	-0.1488*	-0.1813***	-0.1314**	-0.1399
	(0.0660)	(0.0584)	(0.0869)	(0.0664)	(0.0584)	(0.0870)
Political Factors	0.1205*	0.1743***	0.0849	0.1128*	0.1679***	0.0758
	(0.0650)	(0.0403)	(0.0893)	(0.0653)	(0.0403)	(0.0896)
Constant	6.0514***	3.6483***	6.2745***	6.0149***	3.6554***	6.2532***
	(0.7216)	(0.5967)	(0.7732)	(0.7196)	(1.3016)	(0.7789)
Observations	10,250	7,525	2,725	10,250	7,525	2,725
R-squared	0.4866	0.5393	0.5029	0.4857	0.5410	0.5005
Legal Origin Dummies	YES	YES	YES	YES	YES	YES
Product-Year FE	YES	YES	YES	YES	YES	YES
Country-Year FE	YES	YES	YES	YES	YES	YES

Note: Table 3 reports estimates from the *direct* and *two step* approach for the whole economy, as well as for manufacturing and services subsamples. The *direct* estimation is based on equation (1), the *two step* estimation on equation (11). The survey's stratas and sample weights are employed in all estimations (using the STATA command "svyset"). State-owned firms are excluded from the samples in all specifications. All equations are fitted by ordinary least squares. *Legal origin* dummies, time-varying country and product fixed effects are included but not reported. *Input*, *Output* and *Foreign Tariffs* are trade-weighted averaged tariffs. *Tariff-deterred inputs* and *-outputs* are aggregated input and output products prevented from being imported. They are latent variables derived from first stage estimation of the gravity model specified in equation (7). Robust standard errors in columns are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Table 4. First Stage Robustness Check: Reverse Causality and Lagged Effects

Dependent var: Ln (Imports)	Fixed Effects Estimation		
	(1)	(2)	(3)
	Lagged only	Contemporary vs Lagged	Strict Exogeneity Test
Ln (Tariffs) $_{t-1}$	-0.9365***	-0.5450**	
	(0.2442)	(0.2365)	
Ln (Tariffs) $_{t}$		-2.5687***	-2.8076***
		(0.3016)	(0.3017)
Ln (Tariffs) $_{t+1}$			0.2130
			(0.2463)
Constant	13.7871***	13.1241***	12.6164***
	(0.2393)	(0.3790)	(0.3441)
Observations	85,560	85,548	85,554
Number of unit	12,488	12,488	12,491
R-squared	0.1727	0.1756	0.1811
Country-Year FE	YES	YES	YES
Product-Year FE	YES	YES	YES

Note: Table 4 reports estimates of equation (5) when tariffs are not only contemporary. Lagged only, contemporary and lagged, and contemporary and lead tariffs are used instead in columns (1), (2) and (3) respectively. Column (2) and column (3) are based on tests proposed by Bellemare et al. (2015) and Wooldridge (2002) respectively. All specifications are fitted using the within estimator. Time-varying effects are included but not reported. Robust standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Table 5. First Stage Robustness Checks: Sample Selection

Panel A. Sample Selection Tests

	Nijman & Verbeek (1992)	Mundlak (1978)	Wooldridge (1995)
	(1)	(2)	(3)
	Ln (Imports)	Selection Indicator ρ	Ln (Imports)
Ln (Tariffs) $_{ijkt}$	-2.6626***		-2.6752***
	(0.3123)		(0.2626)
$\mathrm{Ln}(\overline{\mathrm{Tariffs}})_{ijk}$		0.0227	
		(0.0208)	
$\mathrm{Ln}(\overline{\mathrm{GDP}})_{i}$		-0.6948***	
		(0.0646)	
$\mathrm{Ln}(\overline{\mathrm{GDP}})_{j}$		-0.1317***	
		(0.0231)	
Selection indicator ρ $_{t-1}$	0.5116***		
	(0.0375)		
Inverse Mills ratio			-1.3255***
			(0.2987)
Constant	11.1142***	-14.3951***	-10.8200***
	(0.2700)	(0.1499)	(2.9753)
Prob > F: p-value		0.0000	
Observations	98,239	159,065	104,263
Number of unit	15,220		14,795
R-squared	0.1501		0.0827
GDPs and Year FE		YES	YES
Geographical Controls (eq. 3)		YES	
Country-Year FE	YES		
Product-Year FE	YES		

Note: Table 5, Panel A reports estimates for three different sample selection tests. Column (1) fits the gravity model using the within estimator, time-varying effects and lagged selection indicator ρ. ρ is a dummy variable equal to 1 if imports are equal to zero, and 0 if otherwise. Column (2) is a probit regression of ρ on the most basic gravity variables: GDPs and geographical controls from equation (3). Overbar on *GDP* and *Tariffs* denotes time-means and are additionally included into the probit model. The provided p-value is the probability that time-mean variables are jointly equal to zero. Column (3) fits the gravity model using the within estimator with GDPs, year effects and the inverse Mills ratio. The inverse Mills ratio is constructed from the abovementioned probit model (without time means). Robust standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Panel B. Sample Selection Correction

	Baseline	Chamberlain (1986)	Helpman et al. (2008)
	(1)	(2)	(3)
	Ln (Imports)	Ln (Imports)	Ln (Imports)
Ln (Tariffs)	-4.1205***	-5.8083***	-5.41268***
	(0.1977)	(0.3344)	(0.2472752)
Ln (Importer GDP)	0.8344***	0.7571***	1.016575***
	(0.0118)	(0.0185)	(0.0102)
Ln (Exporter GDP)	1.3747***	1.2940***	1.66335***
	(0.0055)	(0.0182)	(0.0068)
Constant	-39.4422***	-36.1187***	
	(0.4054)	(0.8038)	
Inverse Mills ratio			1.088271***
			(.0234081)
Observations	104,263	104,297	121,889
R-squared	0.4367	0.4536	0.4495
Geographical Controls (eq. 3)	YES	YES	YES
Product FE	YES	YES	YES
Year FE	YES	YES	YES
Inverse Mills ratio $_t$ - Year interactions		YES	

Note: Table 5, Panel B reports estimates for two different sample selection correction models. Tariffs are averaged over bilateral partners. Column (1) is the baseline and fits the basic gravity model via OLS. Column (2) and (3) estimate the baseline model including inverse Mills ratios. Inverse Mills ratios are derived from probit estimations of the selection indicator ρ on GDPs, bilateral controls, product and year fixed effects. Column (2) differs from column (3) by using bilateral FE instead of geographical controls and performed the probit regression for each year. The baseline model is then fitted using pooled OLS in column (2); and non-linear least squares in column (3). In both columns, *Colony* is the "excluded" variable. *Inverse Mills ratio* $_t$ *- Year interactions* includes their interactions as well as their main effects. Robust standard errors in columns (1) and (3) and bootstrapped errors in column (2) are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Table 6. First Stage Robustness Checks: Heteroskedasticity

Dependent var: Ln (Imports), Imports

	RESET Test		Poisson Estimation	
	(1)	(2)	(3)	(4)
	Impact Homogeneity	Impact Heterogeneity	Impact Homogeneity	Impact Heterogeneity
Ln (Tariffs)	-3.3898***	-5.1366***	-0.6823**	-3.5573*
	(0.3407)	(1.0725)	(0.2798)	(2.0562)
Ln (Importer GDP)			0.7146***	0.7955***
			(0.0962)	(0.0818)
Ln (Exporter GDP)			0.7012***	0.6849***
			(0.1108)	(0.1052)
Squared fitted values: $(xbu)^2$	-0.0108***	0.0025***		
	(0.0023)	(0.0009)		
Constant	17.4953***	13.9488***		
	(0.9015)	(0.7791)		
Observations	108,623	108,623	102,366	102,366
Number of unit	15,481	15,481	12,884	12,884
R-squared	0.1509	0.1558		
Tariff-Product Interactions		YES		YES
Year FE			YES	YES
Country-Year FE	YES	YES		
Product-Year FE	YES	YES		
RESET p-value	0.0000	0.0046	0.3989	0.3653

Note: Table 6 reports regression outcomes of the RESET test in columns (1) and (2) and Poisson estimations in column (3) and (4) for models with impact homogeneity and impact heterogeneity. Impact homogeneity is specified as in equation (5), impact heterogeneity as in equation (7). For the RESET test, equations (5) and (7) are fitted using the within estimator. For the Poisson regression, equations (5) and (7) are fitted using the fixed effect Poisson estimator with the dependent variable specified in levels. For the within estimation, time-varying effects are included but not reported. In the Poisson regression time-varying effects are not included due to region discontinuities. Under impact heterogeneity in columns (2) and (4), tariff-product interactions are included but not reported. Robust standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Table 7. First Stage Robustness Checks: Trade Dynamics

Dependent var: Ln (Imports)

	Difference GMM		System GMM	
	(1)	(2)	(3)	(4)
	Impact Homogeneity	Impact Heterogeneity	Impact Homogeneity	Impact Heterogeneity
Ln (Imports) $_{t-1}$	0.3744***	0.4133***	0.9943***	0.9895***
	(0.0728)	(0.0698)	(0.0022)	(0.0026)
Ln (Tariffs)	-2.6821	-5.7428***	3.7482***	4.2631***
	(2.1028)	(0.9428)	(0.7544)	(0.8304)
Ln (Importer GDP)	0.7147***	0.7223***	0.0092	0.0058
	(0.0628)	(0.0614)	(0.0056)	(0.0059)
Ln (Exporter GDP)	0.0907*	0.0670	0.0035	0.0066
	(0.0489)	(0.0473)	(0.0035)	(0.0040)
Ln (Tariff-based MTR)	0.4583	0.2707	-4.0076***	-3.4618***
	(1.9911)	(0.4059)	(0.7371)	(0.7593)
Ln (EER-based MTR)	2.1914***	2.1599***	0.2226	0.2540
	(0.4724)	(0.4509)	(0.1626)	(0.1773)
Constant			0.0176	0.0761
			(0.1851)	(0.1985)
Observations	62,312	62,312	72,641	72,641
Number of groups	9,254	9,254	10,329	10,329
Tariff-Product Interactions		YES		YES
Bilateral controls, level eq			YES	YES
Product FE, level eq			YES	YES
Country FE, level eq			YES	YES
Year FE	YES	YES	YES	YES
Instruments	21	51	166	166
AR(3), p-value	0.8000	0.8223	0.7080	0.720
AR(4), p-value	0.6420	0.4435	0.3330	0.329
Hansen test, p-value	0.2360	0.1184	0.0000	0.0000

Note: Table 7 reports difference and system GMM estimates of equation (12) for models with impact homogeneity and impact heterogeneity. Equation (12) is specified considering impact homogeneity. For impact heterogeneity, equation (12) is expanded with tariff-product interactions, included in columns (2) and (4) but not reported. The difference GMM transforms equation (12) using orthogal deviations. The system GMM estimates equation (12) in both levels and orthogonal deviations. For the equation in levels, bilateral controls, product and country fixed effects are additionally included. *Ln(Imports)* $_{t-1}$ and *Ln(Tariffs)* are instrumentalized with lagged levels for the transformed equation, and lagged differences for the equation in levels. GMM-instruments start from the 4th lag and end in the 7th lag. AR(3) and AR(4) are Arellano and Bond 3rd and 4th order autocorrelation tests. The GMM-instrument-matrix is collapsed in all specifications to prevent instrument proliferation. Hansen test of overidentifying restrictions assesses the joint validity of instruments. Two-step Windmeijer-corrected standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Table 8. Robustness Checks: Survey Estimation

Panel A. Main Challenges	Direct Estimation		Two Step Estimation	
	(1)	(2)	(3)	(4)
	Manufacturing	Services	Manufacturing	Services
1. Multicollinearity				
Ln (Input) *with Ln (Output)*	-0.9129		0.2000	
	27.18	6.5	18.35	3.62
Ln (Output) *with Ln (Foreign)*	-0.0762		-0.0310	
	28.33		18.18	
Ln (Foreign) *with Ln (Input)*	0.0850		-0.2817	
	6.7		7.09	
2. Reverse Causality / Lagged Effects				
Ln (Input) $_t$	-1.9413	-12.9378**	-0.1451***	-0.1036
	(2.9212)	(5.7025)	(0.0504)	(0.0881)
Ln (Output) $_{t-1}$	0.4335		0.1133	
	(1.1499)		(0.2296)	
Ln (Foreign) $_{t-1}$	-4.3931***		-3.8687***	
	(1.0466)		(1.0838)	
3. Sectorial Indicators				
Ln (Input)	-3.8491	-12.8530	-0.3509**	1.1168*
	(3.6492)	(7.9706)	(0.1637)	(0.6125)
Ln (Output)	0.7481		0.1177	
	(1.3062)		(0.2748)	
Ln (Foreign)	-3.6513***		-3.4162***	
	(1.1652)		(1.1568)	
4. Fixed Effects Interactions				
Ln (Input)	-6.4380*	-4.6057	-0.1627***	-0.0205
	(3.7648)	(7.8768)	(0.0594)	(0.1053)
Ln (Output)	-0.3595		0.1806	
	(1.2753)		(0.2407)	
Ln (Foreign)	-1.7216		-1.9956	
	(1.2430)		(1.2611)	
5. Panel Sample				
Ln (Input)	-2.2199	78.5438**	-0.0921	0.1226
	(6.7029)	(35.0441)	(0.0877)	(0.3068)
Ln (Output)	-1.5846		-0.2880	
	(2.3672)		(0.2994)	
Ln (Foreign)	-0.4676		-2.1915	
	(2.2419)		(2.7969)	
6. Dynamics				
Ln (Input)	-4.1280**	5.0870	-0.0499*	0.0399
	(1.6595)	(4.5502)	(0.0300)	(0.0664)
Ln (Output)	1.1112*		-0.0365	
	(0.6265)		(0.2173)	
Ln (Foreign)	-1.0027		-0.7909	
	(0.6751)		(0.7251)	

Note: Table 8, Panel A extends the baseline model presented in Table 3. Only estimates of the variables of interest are displayed, other variables are included but not reported. *Ln(Input)*, *Ln(Output)* and *Ln(Foreign)* refer to *Ln(Input Tariff)* and *Ln(Output Tariff)* in the direct approach, and *Ln(Tariff-Deterred Inputs)* and *Ln(Tariff-Deterred Ouputs)* in the two-step approach. *Ln(Foreign)* refers to *Ln(Foreign Tariffs)* in both. Specification 1 (*Multicollinearity*) displays in the first row, bivariate correlations of estimated coefficients, in the second row, VIFs of *Ln(Input)*, *Ln(Output)*, *Ln(Foreign)* in that order. Specification 2 (*Reverse Causality*) fits the baseline model using lagged *Ln(Ouput)* and lagged *Ln(Foreign)* instead of current values. For *Ln(Inputs),* one lag is not available. Specification 2 (*Sectoral Indicators*) adds *NRCA*, the number of *trading partners* and actual *imported inputs* and *outputs* as control variables, columns (3) and (4) also include *input* and *output tariffs*. Specifcation 3 (*Macroeconomic Interactions*) includes Importer-Product interactions (at 1st digit). Specification 4 (*Panel Sample*) fits the baseline model using the within estimator for the panel subsample (manufacturing: 2'463 obs.; service: 986 obs.) Specification 5 (*Dynamics*) includes one lag of the dependent variable as an additional regressor. Regressions are performed for the manufacturing and services subsamples only. Robust standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Panel B. Additional Controls	**Direct Estimation**		**Two Step Estimation**	
	(1)	(2)	(3)	(4)
	Manufacturing	Services	Manufacturing	Services
1. Location				
Ln (Input)	-2.4973	-11.5035**	-0.1330**	-0.0993
	(3.2067)	(4.9106)	(0.0526)	(0.0865)
Ln (Output)	0.6681		-0.0249	
	(1.1952)		(0.2218)	
Ln (Foreign)	-4.1023***		-3.3313***	
	(1.0002)		(1.0682)	
2. Access to Financial Services				
Ln (Input)	-0.8011		-0.1100**	
	(3.2397)		(0.0508)	
Ln (Output)	0.1790		0.1151	
	(1.2194)		(0.2200)	
Ln (Foreign)	-3.9612***		-3.3014***	
	(1.0251)		(1.0831)	
3. Human Capital				
Ln (Input)	0.3523		-0.0853*	
	(2.9830)		(0.0514)	
Ln (Output)	-0.3330		-0.5431**	
	(1.2117)		(0.2401)	
Ln (Foreign)	-4.5731***		-4.0428***	
	(1.0416)		(1.0666)	
4. Lobbying Power				
Ln (Input)	-2.2578	-3.5049	-0.0903***	-0.0082
	(1.6929)	(2.8220)	(0.0309)	(0.0463)
Ln (Output)	0.6946		-0.1884	
	(0.6528)		(0.1202)	
Ln (Foreign)	-0.3629		0.0947	
	(0.5389)		(0.5470)	
5. Target Subsample				
Ln (Input)	-3.0521	-16.6082**	-0.1627***	-0.1479*
	(3.5464)	(6.4808)	(0.0558)	(0.0895)
Ln (Output)	1.0322		0.2209	
	(1.3262)		(0.2442)	
Ln (Foreign)	-4.2526***		-3.4137***	
	(1.0978)		(1.1715)	

Note: Table 8, Panel B extends the baseline model presented in Table 3. Only estimates of the variables of interest are displayed, other variables are included but not reported. *Ln(Input)*, *Ln(Output)* and *Ln(Foreign)* refer to *Ln(Input Tariff)* and *Ln(Output Tariff)* in the direct approach, and *Ln(Tariff-Deterred Inputs)* and *Ln(Tariff-Deterred Ouputs)* in the two-step approach. *Ln(Foreign)* refers to *Ln(Foreign Tariffs)* in both. Specification 1 (*Location*) adds firm's *city* as control variable into the baseline model. Specifcation 2 (*Access to Financial Services*) adds dummy variables for *credit line* availability and *loan* disposal in the past 3 years. Specification 3 (*Human Capital*) includes *industry average of employees' education*. Specification 4 (*Lobbying Power*) adds firm's position in the distribution of total sales within its country. Specification 5 (*Target Subsample*) fits the baseline model only for firms where the main product represents at least 50% of their sales (8'615 observations). Regressions are performed for manufacturing and services subsamples, except for specification 2 and 3 for which the specified controls are only available for the manufacturing sector. Robust standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and

Panel C. Operational Variables	Direct Estimation		Two Step Estimation	
	(1)	(2)	(3)	(4)
	Manufacturing	Services	Manufacturing	Services
Explanatory variable				
1. Chamberlain-based				
Ln (Input)			-0.0561*	-0.0923
			(0.0296)	(0.0638)
Ln (Output)			0.1146	
			(0.1681)	
Ln (Foreign)			-3.6227***	
			(1.1017)	
2. Poisson-based				
Ln (Input)			-0.1155	-0.2130**
			(0.1296)	(0.1011)
Output			0.0059**	
			(0.0024)	
Ln (Foreign)			-3.4513***	
			(1.0939)	
3. GMM-based				
Ln (Input)			-0.1707***	-0.1047
			(0.0547)	(0.0886)
Ln (Output)			-0.3634	
			(0.2504)	
Ln (Foreign)			-3.2079***	
			(1.1232)	
Dependent Variable				
4. Total Sales				
Ln (Input)	-3.3071	-14.2687***	-0.1370***	-0.0970
	(3.2659)	(5.3484)	(0.0524)	(0.0857)
Ln (Output)	0.8225		0.0523	
	(1.2669)		(0.2393)	
Ln (Foreign)	-4.4343***		-3.6442***	
	(1.0321)		(1.0992)	
5. Total Factor Productivity				
Ln (Input)	9.8853***		-0.1852***	
	(2.9670)		(0.0583)	
Ln (Output)	-3.6890***		-0.2566	
	(1.2533)		(0.2502)	
Ln (Foreign)	-0.0682		0.7709	
	(1.0862)		(1.1373)	

Note: Table 8, Panel C extends the baseline model presented in Table 3 using alternative operational variables. Only estimates for the variables of interest are displayed, other variables are included but not reported. *Ln(Input)*, *Ln(Output)* and *Ln(Foreign)* refer to *Ln(Input Tariff)* and *Ln(Output Tariff)* in the direct approach, and *Ln(Tariff-Deterred Inputs)* and *Ln(Tariff-Deterred Outputs)* in the two-step approach. *Ln(Foreign)* refers to *Ln(Foreign Tariffs)* in both. Specifications 1, 2 and 3 re-estimate the baseline model using alternative first stage estimations of *Ln(Tariff-Deterred Inputs)* and *Ln(Tariff-Deterred Outputs):* specification 1 is based on Chamberlain's sample-corrected estimates from Table 5, Panel B, column (2); specification 2 on Poisson estimates from Table 6, column (4); and specification 3 on GMM estimates from Table 7, column (2). Specification 4 and 5 re-estimate the baseline model using alternative dependent variables. Specification 4 uses *Ln(Total Sales)*, while specification 5 uses *Ln(TFP)* as dependent variable and *average education* and *capacity utilization* as additional controls. *Ln(TFP)* is computed as as Gorodnichenko and Schnitzer (2013) in equation (D.2). Components of *Ln(TFP)* are only asked in the manufacturing module. Robust standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Table 9. Subgroup Analysis

Panel A. Macroeconomics

	Manufacturing				Services	
	Elasticity				Elasticity	
	Inputs	Outputs	Foreign	Group Obs.	Inputs	Group Obs.
1. Economy Size						
Small	-0.1148*	0.1598	-4.0566***	3,776	-0.0640	1,377
	(0.0693)	(0.3145)	(1.4235)		(0.1034)	
Large	-0.1443***	0.1074	-2.5426*	3,749	-0.1727*	1,348
	(0.0521)	(0.2360)	(1.5233)		(0.0964)	
2. Trading Blocks						
Mercosur	-0.1457***	0.0080	-3.7375**	1,894	-0.3274***	1,043
	(0.0546)	(0.2356)	(1.7774)		(0.1228)	
Pacific Alliance	-0.1700***	0.2414	-2.9892**	6,423	-0.0516	2,112
	(0.0593)	(0.2614)	(1.2404)		(0.0919)	
3. Industry Classification						
Low Tech	-0.2437***	0.2059	-3.0547**	3,959		
	(0.0835)	(0.3416)	(1.1953)			
Medium-low Tech	-0.0697	-0.5068*	-6.4815***	2,671		
	(0.0699)	(0.2904)	(1.9924)			
Medium to High Tech	-0.1149	0.6632	-2.7403	895		
	(0.1041)	(0.4394)	(2.6330)			
4. Comparative Advantage						
Lower quantile	-0.1561**	0.1501	-1.7421	1,944		
	(0.0672)	(0.2373)	(2.0101)			
Middle-low quantile	-0.1833**	0.0452	-2.1866	1,918		
	(0.0730)	(0.2480)	(2.2567)			
Middle-high quantile	-0.2147***	-0.0130	-4.7972***	1,809		
	(0.0623)	(0.2175)	(1.3275)			
Upper quantile	-0.1453*	-0.1743	-4.1116**	1,854		
	(0.0786)	(0.2802)	(1.9360)			
5. Tariff Level						
Lower quantile	-0.2159***	0.3973	-14.8708*	1,905	0.2561	712
	(0.0700)	(0.2771)	(8.4066)		(0.3020)	
Middle-low quantile	-0.1732***	0.3640	-4.5486	1,930	0.1665	702
	(0.0663)	(0.2721)	(3.3375)		(0.2011)	
Middle-high quantile	-0.1304**	0.3004	-5.0672**	1,890	0.0723	678
	(0.0615)	(0.2729)	(2.3291)		(0.1378)	
Upper quantile	-0.1520**	0.3087	-3.6668**	1,800	-0.0848	633
	(0.0650)	(0.2816)	(1.5213)		(0.0833)	

Note: Table 9, Panel A reports group-varying estimates of the baseline model presented in Table 3, column (5) and (6) (the two-step approach). Only estimates of the variables of interest are displayed, other variables are included but not reported. Columns *Inputs*, *Outputs* and *Foreign* report regression coefficients (elasticities) of *Ln(Tariff-Deterred Inputs), Ln(Tariff-Deterred Outputs)* and *Ln(Foreign)* respectively. For all regressions, the variables of interest are interacted with the group variable described in specification 1-5. For specification 1, the group variable *Economy Size* is "Small"= Chile, Colombia and Peru; and "Large"= Argentina, Mexico and Venezuela. For specification 2, "Mercosur"= Argentina and Venezuela; and "Pacific Alliance"= Chile, Colombia, Mexico and Peru. For specification 3, *Industry Classification* is "Low-tech"= ISIC 15-22, 36-37, "Medium-low tech"= ISIC 23-28, "Medium to High tech"= ISIC 29-35 (OECD, 2011; see Data Appendix). For specification 4, C*omparative Advantage* ranks industries in four quantiles according to their *NRCA.* For specification 5, *Tariff Level* ranks firms according to their level of input, output and foreign tariffs. The number of observations per group is displayed under the column *Group Obs.* All regressions include the group variable not only as interaction but also as main effect. Specifications are performed only for the manufacturing and services subsamples. Standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Panel B. Microeconomics

	Manufacturing				Services	
	Elasticity				Elasticity	
	Inputs	Outputs	Foreign	Group Obs.	Inputs	Group Obs.
1. Firm's Size						
Lower quantile (1-15 workers)	-0.1453***	0.1434	-3.9347***	2,339	-0.1175	1,020
	(0.0556)	(0.2362)	(1.4556)		(0.0930)	
Medium quantile (16-60 workers)	-0.1770***	0.0277	-2.1861*	2,636	-0.0637	859
	(0.0574)	(0.2222)	(1.2684)		(0.0931)	
Upper quantile (> 60 workers)	-0.1053*	-0.1439	-4.6085***	2,550	-0.0528	846
	(0.0568)	(0.2478)	(1.5381)		(0.1184)	
2. Firm's Age						
Lower quantile (1-12 years)	-0.1640***	0.2247	-3.0635**	2,293	-0.1076	1,154
	(0.0581)	(0.2495)	(1.3667)		(0.1023)	
Medium quantile (13-26 years)	-0.0995*	0.0330	-4.1412***	2,519	-0.0400	910
	(0.0539)	(0.2327)	(1.3424)		(0.1034)	
Upper quantile (> 26 years)	-0.1598***	-0.0825	-1.5904	2,713	-0.1365	661
	(0.0531)	(0.2651)	(1.6139)		(0.1328)	
3. Firm's Productivity						
Least productive (lowest 30%)	-0.0508	-0.9084***	-5.3442***	1,777		
	(0.0774)	(0.3188)	(1.7815)			
Non-least productive	-0.1933***	-0.0696	-2.4808**	5,748		
	(0.0594)	(0.2540)	(1.2344)			
4. Degree of Market Failure						
Lower quantile	-0.1699***	0.2393	-2.8029*	1,953	-0.1142	708
	(0.0637)	(0.2605)	(1.4904)		(0.1242)	
Middle-low quantile	-0.1411**	0.0901	-2.3344	1,941	-0.1609*	634
	(0.0647)	(0.2293)	(1.5486)		(0.0949)	
Middle-high quantile	-0.1221**	-0.0446	-2.5522*	1,897	-0.0831	695
	(0.0533)	(0.2166)	(1.4701)		(0.1063)	
Upper quantile	-0.1521***	-0.0852	-5.8507***	1,734	-0.0505	688
	(0.0570)	(0.2319)	(1.6458)		(0.0949)	

Note: Table 9, Panel B reports group-varying estimates of the baseline model presented in Table 3, column (5) and (6) (the two-step approach). Only estimates of the variables of interest are displayed, other variables are included but not reported. Columns *Inputs* , *Outputs* and *Foreign* report regression coefficients (elasticities) of *Ln(Tariff-Deterred Inputs), Ln(Tariff-Deterred Ouputs)* and *Ln(Foreign)* respectively. For regressions 1, 2 and 4, the variables of interest are interacted with the group variable described in their specification. For specification 1 and 2, the group variable *Firm's Size, Firm's Age* ranks firms into three quantiles according to the number of employees and years of operation respectively. For specification 3, *Productivity* is "Least productive"= subsample of firms in the lowest 30% of the *TFP* distribution within their industry, "Non-least productive"= subample of firms of the remaining 70%. For specification 4, *Degree of Market Failure* ranks firms within each industry into four quantiles according to the average score rating their obstacles in doing business (or *transaction costs;* from 0=none to 4=severe obstacles). The number of observations per group is displayed under the column *Group Obs.* Regressions 1, 2 and 4 include the group variable not only as interaction but also as main effect. Regression 3 estimates the baseline model for each group in different subsamples. Specifications are performed for the manufacturing and services subsamples. Standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Table 10. Transmission Channel: TFP

Dependent var: Ln (TFP)	Manufacturing			
	Elasticity			
	Inputs	Outputs	Foreign	Group Obs.
1. Importer vs Non-Importer				
Non-Importer	-0.2163***	-0.3830	2.4369	1,327
	(0.0722)	(0.2596)	(1.5244)	
Importer	-0.1799***	-0.2048	0.4126	2,430
	(0.0617)	(0.2631)	(1.1494)	
2. Panel Sample				
All	-0.1333*	0.2204	-1.0785	1,300
	(0.0780)	(0.5725)	(2.4973)	
Least productive (< 30%)	-0.2954***	-0.8663*	-3.3468*	783
	(0.0871)	(0.5123)	(2.0159)	
3. Industry Classification				
Low Tech	-0.1554	-0.1946	0.9203	2,105
	(0.0958)	(0.3142)	(1.3493)	
Medium-low Tech	-0.1900**	-0.0894	1.3538	1,213
	(0.0774)	(0.3630)	(1.9723)	
Medium to High Tech	-0.7107**	-0.7727**	-4.0523	448
	(0.3442)	(0.3878)	(3.3730)	
4. Comparative Advantage				
Lower quantile	-0.1853***	-0.6090*	-3.2508	794
	(0.0684)	(0.3444)	(2.4372)	
Middle-low quantile	-0.2286***	-0.4913*	2.3497	1,026
	(0.0759)	(0.2959)	(2.3515)	
Middle-high quantile	-0.2380***	-0.3196	3.2198*	871
	(0.0801)	(0.2538)	(1.8809)	
Upper quantile	-0.2282**	-0.0810	0.6474	1,075
	(0.1163)	(0.3761)	(1.7544)	
5. Degree of Market Failure				
Lower quantile	-0.2061***	-0.1756	2.3920	957
	(0.0676)	(0.2912)	(1.4811)	
Middle-low quantile	-0.2376***	-0.1824	1.7673	988
	(0.0642)	(0.2630)	(1.3122)	
Middle-high quantile	-0.1953***	-0.2460	-1.1395	941
	(0.0714)	(0.2630)	(1.2020)	
Upper quantile	-0.1561***	-0.3514	0.5535	880
	(0.0585)	(0.2611)	(1.6024)	

Note: Table 10, reports group-varying estimates for the effect of tariff-deterred inputs, tariff-deterred outputs and foreign tariffs on *TFP*. *TFP* is computed as Gorodnichenko and Schnitzer (2013) in equation (D.2). The estimation model follows equation (11) but it includes *Ln(TFP)* instead of *Ln(LP)* as dependent variable and *education* and *capacity utilization* as additional covariates. Only estimates of variables of interest are displayed, other variables are included but not reported. Columns *Inputs*, *Outputs* and *Foreign* report regression coefficients (elasticities) of *Ln(Tariff-Deterred Inputs)*, *Ln(Tariff-Deterred Outputs)* and *Ln(Foreign)* respectively. For regressions 1, 3, 4 and 5, the variables of interest are interacted with the group variable in each specification. For specification 1, the group variable *Importer vs Non-Importer* is "Non-Importer"= firm using inputs from domestic origin only, "Importer"= firms with at least 1% of their inputs from foreign origin. For specification 2, *Panel Sample* is "All"= subsample of firms interviewed in 2006 and 2010, "Least-productive"= subsample of firms interviewed in 2006 and 2010 that are in the lowest 30% of the *TFP* distribution within their industry. For specification 3, *Industry Classification* is "Low-tech"= ISIC 15-22, 36-37, "Medium-low tech"= ISIC 23-28, "Medium to High tech"= ISIC 29-35 (OECD, 2011; see Data Appendix). For specification 4, *Degree of Market Failure* ranks firms within each industry into four quantiles according to the average score rating their obstacles in doing business (where 0=none, 4=severe obstacle). The number of observations per group is displayed under the column *Group Obs.* All regressions include the group variable not only as interaction but also as main effect. Standard errors are shown in parentheses. ***, **, * denote significance at 0.01, 0.05 and 0.10 level

Appendix

Appendix Table 1. Summary Statistics: Survey Estimation

	Variables	Min.	Max.	Std Dev.	Mean	Obs.
Firm Performance	Ln (Total Sales)	0.96	29.28	2.31	13.97	10,596
	Ln (Labor Productivity)	-2.54	20.07	1.46	10.42	10,586
	Ln (TFP)	-11.79	6.53	1.11	-2.42	6,021
Trade Policy	Ln (Output Tariff)	0.00	0.46	0.08	0.09	11,461
	Ln (Input Tariff)	0.00	0.16	0.03	0.06	11,472
	Ln (Foreign Tariff)	0.00	0.25	0.05	0.05	11,461
	Ln (Tariff-Deterred Outputs)	0.00	5.85	2.15	3.45	11,461
	Ln (Tariff-Deterred Inputs)	0.23	9.39	2.20	4.39	11,472
Baseline Controls	Ln (Age)	0	5.35	0.87	2.84	11,356
	Ln (Employees)	0	10.06	1.48	3.60	11,500
	Foreign	0	1	0.26	0.07	11,521
	Legal Origin	1	6	0.79	2.21	11,505
	% Exports Sales	0	100	21.06	8.83	11,508
	Information Technologies	0	2	0.68	1.50	11,500
	Temporary Employment	0	60	1.17	0.26	11,358
	Transaction Costs	0	3.91	0.72	1.53	11,521
	Political Factors	0	4	1.00	1.82	11,516
	Average Employee Educ	0	4	0.87	2.12	5,025
	Capacity Utilization	0	100	20.24	72.00	7,632
Additional Controls	NRCA	-1	1	0.65	0.15	11,461
	Trading Partners	0	126	41.27	63.38	11,461
	Ln (Imported Outputs)	0	24.06	9.55	15.36	11,461
	Ln (Imported Inputs)	1.59	63.81	10.05	20.39	11,472
	Industry Average Employee Educ.	0.67	4	0.67	2.44	9,278
	Credit Line	0	1	0.50	0.56	11,354
	Loan	0	1	0.50	0.49	11,097
	Lobbying Power	1	10	2.88	5.48	10,596
	% Main Product Sales	1	100	26.79	71.49	9,169
Alternative First-Stage	Tariff-Deterred Outputs:					
	GMM-based (ln)	0.00	5.56	2.12	3.40	11,461
	Poisson-based	-18.95	108.28	23.06	12.83	11,461
	Chamberlain-based (ln)	0.00	7.59	2.51	4.04	11,461
	Tariff-Deterred Inputs:					
	GMM-based (ln)	0.22	9.36	2.11	4.27	11,472
	Poisson-based (ln)	-0.68	3.73	0.77	2.42	11,472
	Chamberlain-based (ln)	0.44	19.06	2.96	5.64	11,472
Group Variables	Industry Classification	2	6	1.36	3.33	11,472
	Economy Size	0	1	0.50	0.51	11,521
	Trading Block	0	1	0.44	0.75	11,521
	Comparative Advantage	1	4	1.12	2.48	8,306
	Output Tariff Level	1	4	1.11	2.47	8,306
	Input Tariff Level (Manufact.)	1	4	1.10	2.47	8,317
	Input Tariff Level (Service)	1	4	1.11	2.46	3,155
	Foreign Tariff Level	1	4	1.12	2.48	8,306
	Firm's Size	1	3	0.81	2.00	11,500
	Firm's Age	1	3	0.82	1.99	11,356
	Exporter	0	1	0.46	0.30	11,521
	Importer	0	1	0.47	0.67	7,643
	Firm's Productivity	1	10	2.87	5.48	6,021
	Degree of Market Failure	1	4	1.12	2.44	11,521

Appendix Table 2. Summary Statistics: Gravity Estimation

Variable	Min	Max	Mean	Std. Dev.	Obs
Ln (Imports)	0	23.75	12.25	3.96	108,659
Ln (Tariffs)	0	0.81	0.10	0.07	108,641
Ln (Importer GDP)	24.65	27.73	25.99	0.85	270,072
Ln (Exporter GDP)	20.48	30.34	24.67	1.96	253,704
Ln (Tariff-based MTR)	-0.15	0.99	0.10	0.06	221,152
Ln (EER-based MTR)	-0.17	0.10	0.00	0.02	227,106
Ln (Distance)	5.37	9.89	9.08	0.67	265,980
Contiguity	0	1	0.03	0.17	265,980
Common Language	0	1	0.16	0.37	265,980
Colony	0	1	0.01	0.09	265,980

Data Appendix

Appendix Table 3. Data Sources

Data	Level	Source	Scope
Survey dataset			2006, 2010
Sales, labor, costs and assets	Firm	World Bank's Enterprise Survey	6 countries
Other firm characteristics	Firm	World Bank's Enterprise Survey	6 countries
Input-Output tables			2005, 2009
Input-Output matrix	ISIC (2 digits)	OECD ICIO Tables	5 countries
Trade dataset			2000-2010
Import values	ISIC (2 digits)	WITS	6 Reporters, All Partners
Domestic tariff rates	ISIC (2 digits)	WITS	6 Reporters, All Partners
Foreign tariff rates	ISIC (2 digits)	WITS	All Reporters, 6 Partners
Complementary data			
For gravity:			2000 - 2010
GDPs	Country	World Bank's Dev. Indicators	All countries
Geographical variables	Country	CEPII's Geodist	All Reporters, All Partners
EER-based MTR	Country	United Nations's Eff. Exchange Rate	All countries
Tariff-based MTR	ISIC (2 digits)	WITS	All Reporters, All Partners
For survey:			2005 - 2009
NRCA	ISIC (2 digits)	WITS	All Reporters, All Partners
Trading partners	ISIC (2 digits)	WITS	6 Reporters, All Partners
Industry classification	ISIC (2 digits)	OECD (2011)'s Techn. Intensity Def.	6 countries
Conversion exchange rates	Country	Oanda	6 countries