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IMPORTS, INNOVATION AND EMPLOYMENT AFTER CRISIS: EVIDENCE FROM A DEVELOPING COUNTRY

Caroline Paunov*
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Abstract

Imports are often perceived as a threat to employment. However, access to imported intermediate inputs can be essential to stimulate innovation and generate employment. We investigate this question based on a unique dataset of Ecuadorian manufacturing firms, their final products and intermediate inputs. Using fixed effects instrumental variable estimation we find that firms' importing activities lead to product innovation, increase firms' product scope, reduce production costs and create employment. These impacts arise not only for producers in high-tech industries but also for firms in more traditional sectors. Employment effects are much stronger several years after the country's economic crisis.

Keywords: Imports, product innovation, product scope, employment, input production costs, intermediate inputs, multi-product firms, economic crises, Ecuador

JEL Codes: F16, O30, D22, O12, O54, L6

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IMPORTATIONS, INNOVATION ET EMPLOI APRÈS LA CRISE : ANALYSE DE DONNÉES D'UN PAYS EN DÉVELOPPEMENT

Caroline Paunov*
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Résumé

Les importations sont souvent perçues comme une menace pour l'emploi. Cela étant, l'accès à des intrants intermédiaires importés peut être essentiel pour stimuler l'innovation et créer des emplois. Nous étudions cette question à l'aide d'un ensemble de données couvrant les entreprises manufacturières équatoriennes, leurs produits finaux et leurs intrants intermédiaires. À l'aide d'une estimation à effets fixes par la méthode des variables instrumentales, nous concluons que les activités d'importation des entreprises donnent lieu à une innovation de leurs produits, enrichissent leurs gammes de produits, abaissent leurs coûts de production et créent des emplois. Ces effets se font sentir non seulement sur les entreprises des secteurs de la haute technologie mais aussi sur celles de secteurs plus traditionnels. Les effets sur l'emploi sont bien plus importants plusieurs années après la crise économique qu'a connue le pays.

Mots clés : Importations, innovation des produits, gamme de produits, emploi, coûts de production des intrants, intrants intermédiaires, entreprises multi-produits, crises économiques, Équateur

Codes JEL : F16, O30, D22, O12, O54, L6

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Introduction

In the aftermath of the global financial crisis job creation is at the top of most governments' agendas. At the height of the crisis well-known arguments in favour of trade protectionism nurtured by fears of potential negative effects of free trade on employment became quite prominent. Few protectionists are unhappy about facilitating exports since successful exports are expected to create rather than destroy jobs. It is the penetration of imports into national markets that is regarded by opponents of free trade as the negative downside to bilateral trade liberalisation policies since foreign competition might threaten local businesses and, therefore, employment. The fact that imports constitute one of the most valuable channels to access advanced technologies and know-how is often disregarded.[1] This role of imports is even more relevant for developing countries as the technology gap with leading economies is much more substantial and, by consequence, much could be gained by using foreign inputs. Constraints on available physical capital and human resources can render producing valuable high-tech inputs for other producers impossible.[2] The adoption of embodied know-how – specifically in intermediate inputs in production processes – can notably foster firms' innovation activities and, via that channel, generate employment.[3]

The objective of this paper is to provide evidence on the impacts of firms' importing activities on firm product innovation, product scope and employment for a developing economy, Ecuador, in the aftermath of a major national economic crisis. We also explore the impacts of firms' importing activities on their production costs since cost reductions can generate an additional source of consumer welfare from intermediate input imports beyond access to new products if cost reductions are passed on to consumers in the form of lower prices. Moreover, we analyse whether imports mainly benefit producers in high-tech sectors or whether positive effects are also attainable for importers in natural resource-based industries. These findings provide useful information on whether a certain type of industrial specialisation reduces potential benefits that firms can reap from importing. Finally, we examine whether Ecuador's major economic crisis in 1999 had an impact on how importing affected innovation and employment outcomes.

Analysing how firms' importing activities affect their production and input factor choices requires dealing with endogeneity since firms' self-selection into importing is a valid concern: innovative and large firms are more likely to import for several reasons, one of which being the fact that only those firms are able to incur fixed costs of importing.[4] Therefore, we employ firm fixed-effect estimation techniques to control for any time-invariant firm-specific factors which could be correlated with firms' importing activities and bias our results. The use of fixed effects is, however, insufficient to identify effects of importing as time-varying factors might still bias our estimates. Therefore, we use firm fixed-effects instrumental variable estimation so as to eliminate any additional endogeneity concerns over firms' importing decisions. The analysis relies on three instruments, *i)* firm-specific input real exchange rates; *ii)* tariff changes for firm inputs; and *iii)* an indicator of the availability of national producers of firms' inputs. Our evidence indicates that importing has significant positive effects on firms' product innovation and product scope. We do not identify effects on labour productivity. Moreover, we find significant positive employment effects also for unskilled labour. We submit our evidence to several robustness tests; our evidence is maintained throughout. We also identify that importing leads to substantial average product cost reductions; this suggests that access to foreign inputs facilitates cost-reducing production process innovations. Moreover, we do not find that our evidence is driven by producers in certain high-tech industries and show that the impact on natural resource-based producers is very similar to the average impact across all producers. Importers in other sectors are as likely to benefit. Also, while innovation activities are not significantly different we find that the positive employment effects of imported inputs are much more pronounced several years after the crisis compared to its immediate aftermath.

Our paper makes several contributions to the existing literature which is discussed in detail in Section 1 below. First, it provides rigorous evidence on the importance of a firm's imports of intermediate inputs for product innovation, product scope, production costs and employment. Few studies have explored how importing affects firm product scope and innovation so far. To the best of our knowledge this is the first paper that also studies the employment effects of importing. Moreover, by focusing on the period 2000-2007, our dataset allows exploring the effects of a substantial national crisis (which occurred in 1999). Hence, it provides a unique opportunity to explore possible delays in innovation and/or employment performance caused by the general macroeconomic context. The recent global financial crisis has revealed the importance of such evidence for the formulation of adequate post-crisis recovery policies. Second, our dataset allows constructing an objective firm-level time-varying measure of product innovation based on the observation of whether a given product is newly manufactured by a firm in a year. This is a clear advantage relative to the many previous studies that use data from innovation surveys and rely on measures of innovation based on subjective perceptions of managers for a cross-section of firms.[5] Our measure captures product innovations that are new to a plant but not necessarily new to the country or the world. While these types of innovation may be considered "minor", their cumulative effects are important drivers of growth (Puga and Trefler, 2010). More importantly, in emerging market economies such as Ecuador, "minor" innovations account for the lion's share of innovation activities in contrast to path-breaking innovations associated with innovations based on research and development (R&D) and patents. Also, we have unique data on commonly unavailable product unit production costs. Third, we provide evidence for a developing country, Ecuador, that has not been well studied to date and is particularly suitable for this analysis because it is a lower middle income economy that is well integrated in international trade and requires significant innovation capacity improvements for its sustained economic growth.

Several policy implications arise based on our findings. Most importantly, we reject the notion that firms' imports necessarily have negative employment effects on importing firms. Notably, innovation in products – which are facilitated by imports of intermediate inputs – might generate employment. Increments in product scope and import-facilitated product cost reductions can have similar effects. Based on a rough occupation-based differentiation across skills levels, our evidence indicates that less skilled employees do not necessarily suffer employment losses in response to imports of intermediate inputs. This suggests that the response of employees to incorporating foreign intermediate inputs will not be negative out of concerns over possible employment losses. It is worth noting, however, that this conclusion does not necessarily hold for aggregate employment impacts of trade in intermediate inputs since we also find that increased import competition in firms' main product markets, a share of which are intermediate inputs for other firms, has negative employment effects. Moreover, the fact that firms, independently of the industry they operate in, benefit from foreign intermediate inputs (by reducing production costs, expanding product scope and introducing new products) with positive employment effects has substantial relevance for developing countries' growth strategies. Simplistic industrial policies aimed at developing particular industries that do not take into account performance of industries' downstream suppliers might have limited success as poor performance in downstream industries can be a binding constraint for upstream industrial performance. Imports can be an alternative but will only be an option for the selection of firms that can afford additional costs imposed by importing.[6] This also implies that policies – even if successful at addressing shortcomings for producers in some industries – will not always have the strong impact policymakers expect as reforms in supplier industries might also be necessary.[7] This is a non-negligible argument for more inclusive support policies targeted at a broader range of industries. Third, our finding of significantly stronger employment effects taking place several years after Ecuador's economic crisis suggests that labour adjustments are sluggish. Even if innovation activities recover relatively quickly firms might not immediately adjust employment but wait until they are certain the economy will not relapse into a follow-up recession. Since considerable uncertainties over a lasting recovery characterise the aftermath of the global financial crisis, sluggish employment adjustments irrespective of firm innovation activities are a likely outcome.

The remainder of the paper is structured as follows: Section 1 provides an overview of the related literature, while Section 2 discusses the conceptual framework. Section 3 focuses on the specific economic context of Ecuador, its economic crisis of 1999 and the data used for our empirical analysis. This is followed in Section 4 by an explanation of the empirical framework implemented in this paper and a discussion of results in Section 5. Section 6 concludes this paper.

1. Overview of the related literature

This paper contributes to three specific strands of the literature. First, it relates to research on the relationship between trade and firm performance. Empirical evidence has documented effects of import competition in firms' product markets on total factor productivity (TFP) (*e.g.* Harrison, 1994; Pavcnik, 2002; and Fernandes, 2007, among others). Only a handful of recent papers analyse the impacts of competition on innovation. Bloom *et al.* (2011) evaluate how Chinese import competition affects patenting, information and communication technology, R&D, and TFP across twelve European countries. Bustos (2011) and Teshima (2009) focus on firms in developing countries and examine the effects of import competition on R&D spending while Fernandes and Paunov (2010) study impacts on product quality. This study differs from theirs in that it focuses on the impacts of imported intermediate inputs, not import competition, on a distinct set of firm outcomes. A few studies have produced mixed evidence on the effects of imports of intermediate inputs: Amiti and Konings (2007) identify significant TFP gains of reductions in input tariffs for Indonesian manufacturing firms. Similarly, Kasahara and Rodrigue (2008) and Blalock and Veloso (2007) find positive effects of importing intermediate goods for Chilean and Indonesian manufacturing firms' TFP. By contrast, Van Biesebroeck (2003), Muendler (2004) and Vogel and Wagner (2009) uncover only small or no evidence for positive contributions of foreign inputs to firm TFP and its growth. Halpern *et al.* (2009) find, based on detailed input data, that about two-thirds of overall TFP gains from imports of intermediate inputs are due to resulting variety gains. Goldberg *et al.* (2010) study the impacts of input tariff reductions at the industry level in India on firms' product scope, and identify, as well, that the effects are largely driven by access to new input varieties. Differently from this study they do not study the effects on importers themselves but rather the effects on firms of easier access to imports at the industry level. Also, Kugler and Verhoogen (2009a) explore descriptively the characteristics of firms' intermediate imported imports. Finally, Damijan and Kostvec (2010) study the impact of importing on firms' innovation activities and on exporting activities based on self-reported measures of product and process innovations.[8] None of the above-mentioned studies consider employment effects.

Second, our study relates to the research on the employment impacts of trade and innovation. An early study by Revenga (1992) investigates the question of import competition in the firms' final product sector of activity. Since the focus of this paper is on intermediate inputs, it relates more closely to the literature on the employment effects of international outsourcing. The latter, however, has mainly examined the effects of outsourcing on employment security and relative wages rather than on firm employment decisions *per se*.[9] To the extent that intermediate inputs foster innovation, the literature on the employment-innovation link is also relevant for our analysis. Pianta (2005) provides a useful review of the related literature. Most of these studies, however, use self-reported innovation measures and are constrained in their identification strategies as panel data are often absent (*e.g.* Harrison *et al.*, 2008, Hall *et al.*, 2008 and references made therein). Findings generally point to a positive relationship between innovation and employment growth.

Third, more generally our study relates to the emerging literature of multi-product firms which, following Bernard *et al.* (2010), explores within-firm product adjustments based on newly available datasets on firms final output products.

2. Conceptual framework

Several theoretical arguments have been provided as to why firms' performance – namely innovation – can benefit from increased access to imported intermediate inputs. Gains from importing may arise as imported intermediate inputs can be *i)* new, previously unavailable varieties of inputs that allow better producing or different final outputs; *ii)* products that incorporate new improved knowledge and provide learning opportunities; and *iii)* goods of higher quality that positively impact output quality. Both *ii)* and *iii)* depend on foreign inputs having higher quality or knowledge content compared to local inputs.[10] Kugler and Verhoogen (2009b) propose a model where input quality and plant productivity are complementary to generate output quality. Note that the relevance of foreign inputs for both product quality and product innovation depends directly on the extent to which they complement domestic inputs. Therefore, they might be much more important for developing countries as industrial sectors are weaker and less diversified. Imported inputs can facilitate production improvements in various ways including product innovations (*e.g.* as new and/or better inputs allow producing new goods), product cost reductions (*e.g.* as the use of new inputs in production processes leads to efficiency gains) and product scope (*e.g.* as process innovations reduce sunk costs required to produce certain goods expanding the variety of firm products).

The impact on employment of the use of foreign inputs by firms will depend on *i)* whether new inputs reduce unit production costs thus stimulating demand for firm products and consequently their labour demand; *ii)* whether (and if so to what extent) these foreign inputs alter the capital-labour mix of the firm's production; and more broadly, *iii)* how foreign intermediate inputs affect process innovations and/or product innovations and thus, firm revenues and employment. As to the production possibility of cost reductions, two factors could explain how access to new inputs reduces unit production costs. First, inputs might simply be cheaper and could in that way reduce costs. However, we do not find such evidence in our case as the price for imported inputs is, on average, higher. Foreign imports tend to be more expensive rather than the reverse. Kugler and Verhoogen (2009a) find corresponding evidence for Colombia; we confirm findings for Ecuador as discussed in Appendix B. Also, the fact that importing is more costly than domestic purchases due to additional transport costs, among other costs, suggests it will in practice not often be the case that imported inputs are indeed cheaper. A more likely explanation is that these new inputs facilitate process innovations which encourage corresponding production cost reductions. Process innovations can produce such benefits if efficiency gains influence production costs and provide opportunities for firms to compete with the same products at lower prices and/or gain new markets with new and/or improved products. Therefore, in all three cases innovation plays a potentially substantial role in determining the relationship between intermediate inputs and employment. Harrison *et al.* (2008) provide a useful simple conceptual framework on the innovation-employment relationship which illustrates the role of product and process innovations: a firm produces two kinds of products in period *t*: old or only marginally modified products ("old products," denoted Y_{1t}) and new or significantly improved products ("new products," denoted Y_{2t}). Firms are observed for two periods, $t = 1$ and $t = 2$. Innovation can occur between both periods. Therefore, by definition only old products are available in period *1*. The basic set-up further assumes that production functions for old and new products both have constant returns to scale in capital, labour, and intermediate inputs and are identical except for a Hicks-neutral efficiency parameter, which depends on firms' investments in process innovation. Production functions are separable across old and new products. New products can be made with higher or lower efficiency with respect to old products. According to Shephard's Lemma and assuming that the derivative of the marginal cost with respect to wage does not change over time and is equal for old and new products, the following holds approximately:

$$\frac{\Delta L}{L} \cong -\left(\frac{\theta_{12}-\theta_{11}}{\theta_{11}}\right)+\left(\frac{Y_{12}-Y_{11}}{Y_{11}}\right)+\frac{\theta_{11}}{\theta_{22}}\frac{Y_{22}}{Y_{11}} \qquad (1)$$

That is, employment is determined by three terms, *i)* the rate of change in efficiency in the production of old products – stimulated by successful process innovation; *ii)* the change in the level of production of old products; and *iii)* the change in production due to the introduction of new products or the effects of product innovation on employment growth which depends on the relative efficiency θ_{11}/θ_{22} of the production processes of old and new products. If new products are made more efficiently than old ones, this ratio is less than unity, and employment does not grow at the same pace as the output growth accounted for by new products. The conceptual framework above is based on the assumption of competitive markets. If the assumption does not hold, then the characteristics of competition faced by firms' products and the impact of firms' innovations on these characteristics will affect employment trends. For instance, if product innovations decrease the price elasticity of demand, then such innovations might allow firms to increase prices and result in lower production and employment. Similarly, in markets that are not competitive, process innovations resulting in lower production costs might not translate into output price reductions and, in consequence, no sales and employment effects will result. This discussion illustrates that process innovation and the introduction of new and/or higher quality products has, from a theoretical perspective, an ambiguous impact on firms' employment.

3. Data description and overview of Ecuador's economy and trade policies

3.1 Data

We use a Census panel dataset collected by the Ecuadorian Institute of Statistics (INEC) of formal manufacturing plants (corresponding to ISIC Rev. 3 category D) with 10 or more employees for the period 1997- 2007.[11] The full baseline manufacturing dataset contains 16 678 manufacturing plant-year observations and provides information on plants' overall sales and value-added, employment, capital investments as well as expenditures on production as provided in most firm census data. The distinctive feature of our data is that we link this information to two additional datasets which contain information on plants' intermediate inputs and on plants' output products, respectively. The first dataset gives annual plant-level information on primary materials, auxiliary materials, replacements and accessories, packing materials used for production. For each intermediate input plants provide information on the purchasing price and quantity separately for national and foreign supplies. The second dataset provides information for each plant's final products. An advantage of our dataset compared to other product databases is that we have information on products' production costs in addition to products' sales values. The use of production costs allows us to take out product-market conditions that can influence prices and are more related to shifts in firm market power than to firms' production processes. We implement several data cleaning procedures and check the quality of our dataset following Bernard *et al.* (2010), Kugler and Verhoogen (2009b) and Goldberg *et al.* (2010). Appendix A describes these tests in detail. In this context it is also worth mentioning that replicating the analysis Kugler and Verhoogen (2009a) conduct for a sample of Colombian firms on the characteristics of importers and their imported input prices for Ecuadorian firms leads to qualitatively similar results.[12] The consistency of our findings with theirs provides additional confidence in using this novel dataset for empirical analysis. Second, we also use COMTRADE data for Ecuadorian imports by detailed HS 6-digit product category and country of origin. We link these data to the main dataset by establishing a product correspondence to the 11-digit ISIC-Rev. 3 categories of Ecuadorian firms' input and output products.

3.2 Ecuador's economy, the 1999 crisis and its trade policy

With a GDP per capita of USD 3 970 in 2009 Ecuador classified as a lower middle-income country in the World Bank's country classification; it is, based on this measure, behind most of Latin America's leading economies. Ecuador faces several developmental challenges including a high incidence of poverty: 36% of the population live with an income below the national poverty line.[13] Over the 1994-2007 period Ecuador's economic situation was quite unstable if compared to, *e.g.* the performance of the United States or Brazil over the same period as illustrated in Figure 1. Particularly striking is the crisis of 1999 which led to a recession that reduced GDP per capita by 7.63%. Many factors contributed to this crisis including *i)* the El Niño weather phenomenon in 1997; *ii)* a sharp drop in global oil prices in 1997-1998; and *iii)* international emerging market instability in 1997-1998. A few simple descriptive statistics reported in

Table 1 based on our dataset illustrate the impacts of the crisis on Ecuadorian manufacturing firms. Both firms' output production and output sales (columns 1 and 2 of panel A), average output quantities and unit prices (columns 1 and 2 of panel B) and employment (column 3 of panel A) dropped in 1999 compared to other years. Firms' trading behaviour was also negatively affected with, on average, fewer firms exporting and importing (columns 4 and 5 of panel A). For the latter both import expenditures (reported in column 6 of panel A), prices (column 3 of panel B), quantities (column 4 of panel B) and the number of imported inputs (column 7 of panel A) were lower. One of the accompanying features of the crisis was a substantial increase in inflation and a severe devaluation of the national currency, the Sucre, with respect to those of major trading partners, including notably the United States. The crisis led to the adoption of the US dollar as Ecuador's national currency in January 2000.

Since our study focuses on importing it is worth summarising briefly the trade policies Ecuador has undertaken over the past two decades. First, following the general trend across Latin American economies, Ecuador introduced major reforms to reduce trade barriers in the early 1990s. As part of these efforts, Ecuador joined the WTO in January 1996 and has continued – as summarised in a 2005 WTO assessment – to reduce tariff and other barriers to trade. This reflects the government's commitment to foster the country's trade integration (WTO, 2005). Ecuador grants at least most-favoured-nation (MFN) treatment to all its trading partners. Agricultural products have kept highest levels of tariff protection. Ecuador's regional trade agreements with the Andean Community, the Latin American Integration Association (LAIA) and members of the Mercado Común del Sur (MERCOSUR) have offered, to differing extents, more favourable trade opportunities to several Latin American countries (WTO, 2005). Beyond tariff reductions, Ecuador has implemented measures to reduce non-tariff barriers to trade including legal and administrative simplifications. Notwithstanding, many non-tariff barriers such as customs formalities and complex technical standards remain high and restrain imports (Wong, 2007).

4. Empirical framework

4.1 Baseline estimation set-up

We are interested in exploring how imports of intermediate inputs affect firms' performance and employment decisions. Thus, our starting point is the following set-up:

$$performance_{it} = \alpha^1 + \beta^1_M M_{it} + \delta^1_{ind} * ind + \delta^1_{reg} * reg + \delta^1_{year} * year + \varepsilon^1_{it} \quad (2)$$

$$employment_{it} = \alpha^2 + \beta^2_M M_{it} + \delta^2_{ind} * ind + \delta^2_{reg} * reg + \delta^2_{year} * year + \varepsilon^2_{it} \quad (3)$$

where i designates a firm and t a time period. $Performance_{it}$ refers to three aspects of a firm's production characteristics: *i)* product innovations ($prod\_inno_{it}$); *ii)* product scope ($prod\_scope_{it}$); and *iii)* labour productivity ($lprod_{it}$). $Prod\_inno_{it}$ is defined as a dummy variable that takes on value *1* if a firm produces a new product (defined at the 11-digit ISIC Rev. 3 level) at t that it did not produce previously and *0* otherwise. $Prod\_scope_{it}$ is defined as the number of products produced by a firm. $Lprod_{it}$ is the ratio of the firm's real sales value over employment. $Employment_{it}$ refers to three variables: *i)* overall employment ($total\_empl_{it}$), *ii)* skilled employment ($skilled\_empl_{it}$); and *iii)* unskilled employment ($unskilled\_empl_{it}$); each is defined in logarithms. Following Berman *et al.* (1998) and Haskel and Slaughter (2002) among many others, we interpret non-production workers as skilled workers and production workers as unskilled workers. Our variable of interest, *M*, refers to firm *i*'s importing activities and is defined as a dummy variable which takes on value *1* if a firm imports any of its manufacturing inputs in period *t* and *0* otherwise. Note that as part of our robustness tests we will also use imported input values instead. *Ind*, *reg* and *year* are 6-digit industry, region and year fixed effects, respectively, to ensure the comparisons are done within more appropriate groups of firms while ε_{it} is an independent and identically distributed (i.i.d.) residual. All variables are described in Appendix C.

4.2 Identification strategy

A first challenge for identification is that, as described in Section 5.1, there are substantial performance differences across importing and non-importing firms; importers are on average larger, more likely to be exporters and more productive. Estimating (2) and (3) by OLS will most likely pick up better performance characteristics of importers rather than identify the impacts of importing. It is, therefore, important to include firm–fixed effects to eliminate systematic fixed differences across firms. However, this is insufficient as firm–fixed effects will only take into account time-invariant firm characteristics but no performance improvements over time which might in turn influence firms' importing decisions. Therefore, the results could still be biased. For this reason, in addition to firm fixed effects, we will instrument for firms' import decisions.

We use the following three instruments: *i)* firm-specific input real exchange rates; *ii)* firm-specific variations in input tariffs; and *iii)* an indicator of the availability of national producers of firm-specific inputs. Our first measure, firm-specific input real exchange rates, follows a large amount of trade literature which uses exchange rates at the industry level (*e.g.* Revenga, 1992) and more recently at the firm level (*e.g.* Park *et al.*, 2010). In the case of Ecuador, exchange rate variations are clearly exogenous to national firms' performance as the country adopted the US dollar as its national currency in 2000 so that national policies cannot affect the exchange rate at all. What is novel in our approach is that we implement a real exchange rate measure based on the firm's input(s) rather than its output(s): first, we obtain the logarithmic real exchange rate of Ecuador *vis-à-vis* its trading partners, ex_{jt} , a higher value denotes an increase in the purchasing power of the national currency – the US dollar – relative to foreign currencies.[14] In terms of Ecuadorian firms' purchasing power a higher exchange rate will render imports more affordable. Second, we compute the product-specific real exchange rate. We have information on the inputs purchased by firm at the 11-digit product code level and establish a correspondence to the 8-digit HS-codes included in the COMTRADE dataset. Based on the COMTRADE dataset we obtain 11-digit product-level exchange rates as follows (following Park *et al.*, 2010 who compute firm-specific real exchange rates):

$$prod\_ex_{Jpt} = \sum_{j \varepsilon J} \theta_{pj} ex_{jt} \qquad (4)$$

where the weights, θ, describe the 1998 share of each country in Ecuador's imports of product *p*. We use the share of imports to Ecuador in 1998 as it is prior to the period we will use for our empirical estimation and before the economic crisis of 1999, in order to exclude the possibility that product import decisions themselves reflect exchange rate changes. Third, we allocate to each firm the weighted average of the product exchange rate variable corresponding to the inputs the firm imports in 1998 and their distribution across input categories (for the same reasons specified before), labelled λ.

$$firm\_ex_{it} = \lambda_{i1} * prod\_ex_{Jpt} + \lambda_{i2} * prod\_ex_{Jpt} + ... + \lambda_{in} * prod\_ex_{Jpt} \qquad (5)$$

We will include the one-period lag of the firm-level input real exchange rate as our instrument.

The second measure we use is tariffs, which have also been widely used to assess the impacts of trade liberalisation (*e.g.* Amiti and Konings, 2007, Fernandes, 2007, Goldberg *et al.*, 2010). Tariff barriers will increase the cost of importing. We would therefore expect tariffs to be inversely related to the proportion of firms importing. We use average tariffs by HS 6-digit product codes and make use of the same correspondence mentioned above to compute firm-level exchange rates to obtain product tariff measures, $tariff_{pt}$. We then allocate to each firm input tariffs as the weighted average of the product tariff changes corresponding to the inputs the firm imports in 1998 and their distribution across input categories (for the same reasons set out in our discussion of exchange rate instruments above), λ (Equation 6). One of the shortcomings of using tariffs as an instrument is that political economy arguments could significantly challenge our instrument: the most innovative and best performing firms may have successfully lobbied for tariff reduction for the specific inputs they require and thus, our instruments may turn out to be invalid. However, tariff reductions in Ecuador were initiated with WTO membership and therefore it seems unlikely that firms' lobbying still had substantial impacts on which product tariffs were reduced more than others. Since we cannot discard the possibility entirely, we will use two year lagged changes in tariffs:

$$firm\_\Delta tariffs_{it-2} = \lambda_{i1} * \Delta tariffs_{pt-2} + \lambda_{i2} * \Delta tariffs_{pt-2} + ... + \lambda_{in} * \Delta tariffs_{pt-2} \qquad (6)$$

Our third instrument is a variable that captures the availability of input suppliers in Ecuador. The rationale for this instrument is as follows: if there are no local suppliers of the inputs that firms require, then firms have to import their inputs. We obtain this measure at the 6-digit product level since a more disaggregate measure would not adequately reflect the fact that firms have the option to substitute between inputs. At significantly more aggregate levels, however, such substitution would be very costly or even impossible for the firm's output production. In itself the absence of national production of specific products is not directly related to upstream firms' employment decisions other than through the import channel. Similarly it is unlikely that the presence of national downstream producers directly affects upstream firms' product innovation, their product scope and performance. A potential relation could exist if national supplier-producer linkages generate knowledge spillovers which might affect firms' production performance differently from foreign supplier-producer linkages. The possibility of such spillovers, however, is not obvious and depends on many suitable characteristics of downstream industries such as the level of competition, their innovation capacities, the presence of FDI, etc. Since we restrain our measure to a simple dummy variable, this possibility is not relevant for our outcome variables of interest.

4.3 Additional details on the specification

As discussed in Section 1, the empirical evidence shows that import competition in firms' product markets stimulates their productivity and innovation performance. We therefore extend our baseline specification (referred to as specification A in Section 5) in two distinct ways: *i)* we include a measure of import competition instrumented by firm-level real exchange rates for their final products; and *ii)* we directly add the firm-level exchange rates for final products to our specification to capture effects of import competition in the product market. We choose these modifications in order to avoid introducing endogeneity concerns which would arise if we included a measure of import competition in the firm's final product market. We refer to these as specifications B and C respectively when discussing findings in Section 5. Furthermore, while our estimation set-up ensures that any time-invariant firm characteristics cannot influence results in addition to our instrumental variable estimation strategy, adding other firm-level controls to our specification might be an option to strengthen our identification strategy further. However, such additions raise endogeneity concerns and hence we omit them from our baseline estimation framework. As part of our robustness analysis, we will test whether our results are maintained if suitable firm controls are added. Finally, note that we select the 2000-2007 period for our empirical analysis since we are interested in studying the post-crisis period and to reduce any potential endogeneity concerns of using 1998 firm-specific weights based on product imports and production characteristics as described above. This also allows avoiding any biases caused by the adoption of the US dollar as the national currency. We will however test whether the resulting reduction in sample size drives our results.

5. Empirical findings

5.1 Some descriptive evidence

Simple comparisons of importers with non-importing firms in Ecuador indicate that on average importers are larger in terms of employment, sales and production size. They are also more likely to export, introduce new products and have higher labour productivity. Importers tend to have more input products than non-importers, a fact that is consistent with the idea that importing facilitates access to more product varieties. Among importing firms the share of imports in total inputs tends to be high; this indicates that for these firms, foreign products are the main production inputs.[15] We next explore descriptively the relationships set out in equations (2) and (3) adding, however, firm fixed effects for reasons described above. Results reported in Table 2 show that product innovation, product scope as well as employment, skilled and unskilled employment are significantly positively correlated with firm importing activities. We do not find a corresponding impact on labour productivity. Note that we report robust standard errors clustered at the firm level. Moreover, we explore characteristics of importers and their imported input prices following the methodology proposed and implemented by Kugler and Verhoogen (2009a) for Colombian firms. They summarise their findings as suggesting that firms purchase higher-quality inputs in the import market. We find similar evidence for Ecuadorian firms. Specifically, our evidence confirms that, on average, importers *i)* are exceptional performers; *ii)* use more distinct categories of inputs; and *iii)* pay higher prices for imported compared to domestic inputs within narrow product categories. Appendix B describes the evidence in further detail.

Our focus in this paper is on two types of relationships: the first establishes impacts of importing intermediates on firms' production performance and the second uncovers how importing affects employment. In Table 3 we report transition probabilities for the importing-innovation-employment relationship.[16] The first section looks at importing and first-time product innovation; we find that a larger share of importing firms are innovators compared to non-importers (20% vs. 16%). This suggests importing might indeed, as discussed in Section 2, foster firm innovation activities. Among the group of first-time innovators after importing, employment growth was larger than for importers who did not innovate in products (38% and 42% at *t* and 39% vs. 35% at *t+1*).

5.2 Instrumental variable estimation results

Table 4 describes our main findings using firm fixed effects instrumental variable estimation as described in the empirical framework section. Panel A shows first-stage regression results for specification A, which does not take into account product market import competition. The findings are intuitive: higher exchange rates positively affect importing decisions. The availability of national producers reduces the likelihood of importing. While we find that tariffs have, as expected, a negative effect on firms' imports, the estimated coefficient is insignificant. We attribute this finding to the fact that tariffs were significantly reduced prior to our period of study (as discussed in Section 3). The value of our F-statistics of excluded instruments is 91.6; this means that our instruments are correlated with firm importing activities. Unreported first-stage results for specifications B and C are qualitatively similar. It is also important to point out that our specifications do not suffer from weak instrument problems, as reflected by the p-values for the Kleibergen-Paap under-identification test. Also, our instruments are adequate as indicated by the p-values from the Hansen over-identification tests reported in Panel B of Table 4.

Panel B of Table 4 reports the findings from the second-stage IV regressions for our six main variables of interest: product innovation, product scope, labour productivity, overall employment, skilled and unskilled employment. Specification A identifies positive significant effects of importing on product innovation as well as overall and unskilled employment. We do not find a significant effect on labour productivity. Results are qualitatively similar when adding import competition in specification B. In this case we find a significant positive effect of importing also on product adoption and firms' product scope. The latter finding is in line with the findings by Goldberg *et al.* (2010) for India. Overall employment is not significantly affected in this specification though the effect on unskilled employment is maintained. As for import competition in firms' final product markets, we find that it had a positive effect on product innovation and on labour productivity but a negative effect on overall and skilled employment. Specification C, which introduces exchange rate variation in the product market directly, is qualitatively very similar to specification B. This indicates that it correctly captures effects of import competition and, therefore, can serve as our main estimation model.

5.3 Robustness tests

We next submit our main results to several robustness tests as reported in Table 5. First, we want to uncover specific impacts of a firm's importing decision on performance and employment without capturing the average impacts of intermediate import activities of the firm's industry at the same time. One way to account for this is to add a measure of import penetration in the firm's input sector(s). We therefore introduce a measure of exchange rate variation for the firm's industry's inputs. Our results, reported in Section A of Table 5, are qualitatively maintained suggesting that we correctly identify effects of importing rather than capture any spillover effects of industry import activities. Interestingly, unreported estimates show a positive significant effect of exchange rate variation in the firm's input industry on firm labour productivity.[17] Second, we estimate our main specification including the following controls: *i)* the firm's share of sales in its final output industry; *ii)* dummies for firm size; *iii)* the share of skilled labour in the firm's workforce; *iv)* a dummy indicating the firm's export status; and *v)* the firm's investment-capital ratio for machinery.[18] Our results are qualitatively maintained (Section B of Table 5). Third, we test whether our results are robust to controlling for possible different industry trends over time by including 2-digit industry-year fixed effects. We find that our main evidence for product adoption, product scope and unskilled employment, is qualitatively maintained (Section C of Table 5). Fourth, we use the logarithm of firm's import spending as our explanatory variable. Results, shown in Section D of Table 5, are qualitatively comparable to our main evidence in Table 4. Fifth, as described in Section 5.2 we do not find a significant effect of the tariff measure on firms' importing decision. We therefore test whether the use of an alternative instrument, the relevance of importing in the firm's main output industry at the 2-digit ISIC Rev. 3 level, would produce similar results. This measure has a potential impact on importing since investments by other firms in finding suitable importers are likely to reduce information barriers for non-importers in the same industry. Our empirical evidence confirms the hypothesis; we find a positive significant effect of our new instrument on importing. Our final results are qualitatively confirmed (Section E of Table 5).

Sixth, our main results are based on using data for the 2000-2007 period in order to avoid possible endogeneity concerns regarding the exchange rate and tariff change instruments (which are based on the inputs the firm imports in 1998 and their distribution across input categories). This might, however, introduce a sample bias. We check whether the exclusion drives our results using the full 1997-2007 sample and the instrumental variable specification of Section E.[19] We find that results are maintained with the exception of evidence on product innovation (Section F of Table 5). Seventh, an admittedly imperfect alternative specification is to estimate a reduced-form model which directly estimates the effect of firm-level input exchange rates – which we use as an instrument for importing. We find positive significant effects for product innovation and employment (Section G of Table 5). Eighth, in order to learn more about the type of impacts we uncover we are interested in knowing whether results are driven by the best performing Ecuadorian firms. We therefore estimate our main specification excluding the top 10 performers per 4-digit ISIC Rev. 3 industry where performance is measured as labour productivity in 1998. We find results are maintained (Section H of Table 5). Interestingly, unreported results show that the same is true if we select the top 20 performers. This means that our results do not merely apply to a selected group of firms but hold more generally across the firm performance distribution. Finally, so far we have only considered one dimension of a firm's employment decision: whether or not the firm decides to employ more labour (including of different types). This disregards the possibility that firms might also adjust employment through wage changes. Our evidence on positive effects on unskilled labour might tell a misleading story about the effects of importing on these workers. Notably wages of unskilled workers could have been significantly reduced as a result of importing. In unreported regressions we analyse whether any type of wage adjustments took place as a result of importing activities and find no evidence of the former,[20] leading to the conclusion that our focus on employment is indeed sufficient in the context of this study.

5.4 Costs effects

Importing of intermediate inputs could have other effects on firms' production processes; namely it could result in a reduction of production costs. Section 5.1 shows that, on average, prices of imported inputs tend to be higher than the price of similar national inputs which might point to a higher quality of imports. Our evidence reported in Sections 5.2 and 5.3 further supports that hypothesis since we would expect that higher quality inputs support product innovation. Greater access to variety offers an alternative explanation. Therefore, we would not necessarily expect a reduction in production costs caused by cheaper imported inputs but rather because of beneficial effects of imports on production processes (*e.g.* via their possible role as a stimulus of process innovations). Data on per unit production costs are commonly unavailable. Even product datasets usually have only information on sales values and quantities. While average prices contain information on production costs they also reflect any mark-up firms charge for their products. It is therefore difficult to learn about production costs using product unit prices. Our dataset is unique in that it has information for each product on overall production costs and quantities manufactured. We use this information to obtain average firm-level product-level production costs ($prod\_cost_{it}$) following the two-step procedure proposed in Kugler and Verhoogen (2009b).[21] We then estimate the impact of importing on production costs implementing our main regression framework (described in Section 4). As reported in Table 6, we find a significant negative effect of importing activities on firm-level average production costs. This suggests cost-reducing process innovations were another channel for the contribution of imported intermediate inputs to the improvement of importing firms' production processes relative to non-importers.

5.5 Are effects different for producers in certain industries?

One of the features of the production structure of many Latin American countries is a low share of firms in high-tech industries while a substantial share of firms operate in natural resource-based industries. Among the Ecuadorian manufacturing firms in our sample 40% produce mainly natural resource-based products.[22] A much-debated question is whether this type of specialisation challenges the development opportunities for these economies. A prominent argument is that these sectors tend to be among the less innovative if traditional innovation measures such as evidence on business R&D spending or patent applications are used. It is worth pointing out that if a broader definition of innovation were applied the differences across sectors in terms of their innovation capacities might look quite different.[23] While addressing the question of industrial specialisation on firms' performance and subsequent employment effects is beyond the scope of our paper, we are interested in understanding whether the positive impact of importing we identify mainly arises for producers in high-tech industries. Therefore, we estimate our main specification excluding producers of chemicals (ISIC Rev. 3, 24) and machinery (ISIC Rev. 3, 30, 31, 32, 33, 34 and 35). We find that impacts on these firms do not drive our results as the effects also hold for our reduced sample (Section A of Table 7). Unreported estimations where firms in specific industries (*i.e.* textile and leather producers, producers of machinery, etc.) are sequentially removed from the sample indicate that our findings are not driven by any industry in particular.[24] Second, we estimate our model for the group of natural resource-based producers only. Results shown in Section B of Table 7 indicate that firms in natural resource-based industries benefitted similarly to others in terms of employment.

5.6 Are impacts different in the immediate aftermath of the crisis?

As described previously our estimating sample covers the immediate post-crisis period in Ecuador. The empirical evidence on firms' innovation activities indicates that such investments are highly pro-cyclical.[25] We are interested in exploring whether positive effects of importing take place in the years immediately following Ecuador's economic crisis or whether the effects are stronger several years afterwards. We therefore allow effects to differ across the 2000-2002 and the 2003-2007 periods. The results for firm fixed-effects OLS and IV estimates are reported in Sections A and B of Table 8, respectively. Section A suggests that the impact on product innovation was more significant in 2003-2007. Estimates for other performance outcomes are insignificant. We find strong positive effects on overall, unskilled and skilled employment in the 2003-2007 period which are significantly different from the effects in the immediate 2000-2002 post-crisis period. While IV estimates reported in Table 8 of Section B show no significant differences for product innovation, product scope and labour productivity across both periods, the estimates reported in column (4) show that overall positive employment effects are significantly stronger in 2003-2007. Similarly the effects on unskilled employment are stronger in 2003-2007 compared to the post-crisis period. A possible reason is that firms were hesitant to make adjustments to their labour force before they were fully certain that the economy would not relapse into a follow-up recession.

6. Conclusion

We investigate how firms' decisions to import intermediate inputs affect their product innovation, product scope, as well as employment in the case of a developing country, Ecuador. Based on a unique dataset of Ecuadorian manufacturing firms, their products and intermediate inputs we find that importing leads to significantly higher rates of product adoption, an increase in product scope and a reduction in product production costs. Thus, we find that importing generates two distinct types of benefits for importers which might, if suitable market conditions exist, in part accrue to consumers: an increase in variety and a reduction in the price of existing products. Since importing comes at a substantial cost it is not an option all Ecuadorian firms can select. The performance of a multitude of industries in Ecuador which are intermediate input suppliers to others is, therefore, of substantial importance. Simplistic industrial policies aimed at developing particular industries might not meet the expected success as badly performing downstream industries can significantly constrain the performance of upstream producers. Moreover, we show that imports of intermediate products generate employment including, interestingly, for the less skilled. Notably, innovations in products, increments in product scope and import-facilitated product cost reductions – which are facilitated by imports of intermediate inputs – might stimulate employment. It is worth noting, however, that this conclusion does not necessarily hold for aggregate employment impacts of trade in intermediate inputs since we also find that increased import competition in firms' main product markets, a share of which are intermediate inputs for other firms, has negative employment effects. Moreover, positive employment effects were, however, significantly less important in the immediate post-crisis period. Sluggish employment adjustments, in spite of a recovery of innovation performance, may, therefore, be a likely outcome in the aftermath of the current global crisis as uncertainties over the recovery persist. Finally, reductions in trade barriers of intermediate inputs could, by reducing firms' costs of importing, raise the number of importers and in this way foster innovation and employment. However, it might be the case that skills and/or capital shortages of various types reduce potential benefits of importing for these firms. Also, if trade intermediaries claim substantial mark-ups from firms with low bargaining power, this can be an alternative reason why some firms do not choose to import. Further research is needed to establish the binding constraint of firms' importing decisions.

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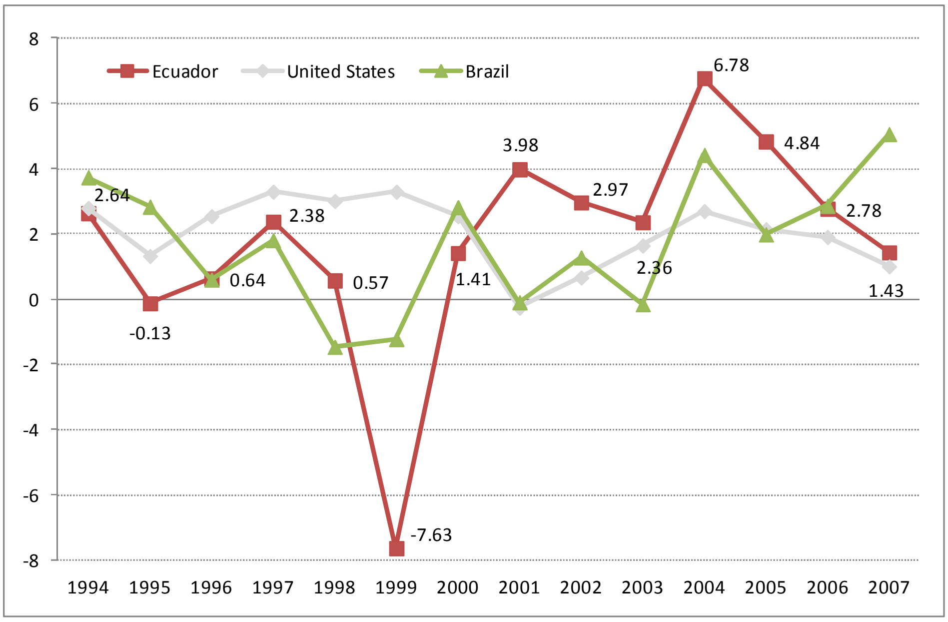
Figure 1: Ecuador's GDP per capita growth (annual %), 1994-2007



Source: World Bank World Development Indicators.

Table 1: Ecuadorian firms and the 1999 crisis: Some descriptive statistics

Panel A: Firm-level variables

	Real production	Real sales	Workers	Export identifier	Import identifier	Real purchasing value of imports	Number of input products
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Indicator of the 1999 crisis	-0.341***	-0.301***	-0.143***	-0.026***	-0.014*	-0.287***	-0.398***
	(0.023)	(0.023)	(0.014)	(0.007)	(0.007)	(0.026)	(0.047)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13056	13055	13056	13055	13037	13005	13037
R^2	0.25	0.25	0.15	0.13	0.28	0.25	0.24

Panel B: Input- and output-level variables

	Output prices	Output quantities	Input prices	Input quantities
	(1)	(2)	(3)	(4)
Indicator of the 1999 crisis	-0.259***	-0.167***	-0.213***	-0.201***
	(0.029)	(0.037)	(0.020)	(0.027)
Product-firm effects	Yes	Yes	Yes	Yes
Observations	71971	71972	98630	99987
R^2	0.92	0.90	0.91	0.91

Notes: For output price and quantity evidence reported in columns (1) and (2) of Panel B price and quantity are based on sales values and quantities respectively. For input prices and quantities and the number of imports we use the joint values for foreign and domestic inputs. Robust standard errors clustered at the firm level in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% confidence levels, respectively.

Table 2: Descriptive statistics of importing on firm product characteristics and employment

	Product innovation	Product scope	Labor productivity	Total employment	Skilled employment	Unskilled employment
	(1)	(2)	(3)	(4)	(5)	(6)
Importer	0.057**	0.163**	0.018	0.088***	0.114***	0.093***
	(0.022)	(0.078)	(0.039)	(0.025)	(0.033)	(0.029)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry 6-digit fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11786	11786	11786	11786	11786	11786
R^2	0.33	0.86	0.83	0.93	0.91	0.90

Notes: Robust standard errors clustered at the firm level in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% confidence levels, respectively.

Table 3: Transition probabilities between imports, innovation and employment changes

Imports at *t-1*	First-time product innovation				
	No product innovation at *t*		Product innovation at *t*		
	Nbr. of firms	*Share*	*Nbr. of firms*	*Share*	*Total firms*
No imports at *t-1*	5443	0.84	1006	**0.16**	6449
Imports at *t-1*	3007	0.80	759	**0.20**	3766
	8450		1765		10215

First-time product innovators at *t* conditional on imports at *t-1*	Employment at *t*						
	Negative employment changes		No employment changes		Positive employment changes		
	Nbr. of firms	*Share*	*Nbr. of firms*	*Share*	*Nbr. of firms*	*Share*	*Total firms*
No product innovation at *t*	921	0.31	958	0.32	1128	**0.38**	3007
Product innovation at *t*	209	0.28	225	0.30	325	**0.43**	759
	1130		1183		1453		3766

First-time product innovators at *t* conditional on imports at *t-1*	Employment at t+1						
	Negative employment changes		No employment changes		Positive employment changes		
	Nbr. of firms	*Share*	*Nbr. of firms*	*Share*	*Nbr. of firms*	*Share*	*Total firms*
No product innovation at *t*	786	0.30	913	0.35	932	**0.35**	2631
Product innovation at *t*	181	0.30	190	0.31	239	**0.39**	610
	967		1103		1171		3241

Table 4: Main results

Panel A: First-stage IV regression results

	Importer
Exchange rate$_{t-1}$	0.096**
	(0.040)
Tariff changes$_{t-2}$	-0.002
	(0.002)
Availability of national producers$_t$	-0.681***
	(0.042)
Firm fixed effects	Yes
Year fixed effects	Yes
First-stage F Statistic of excluded instruments	91.6
Observations	6399
Number of firms	1011

Panel B: Second-stage IV regression results

	Product innovation (1)	Product scope (2)	Labor productivity (3)	Total employment (4)	Unskilled employment (5)	Skilled employment (6)
Specification A						
Importer	0.540*	1.480	-0.069	0.447**	0.722**	0.241
	(0.293)	(0.904)	(0.425)	(0.226)	(0.312)	(0.249)
Kleibergen-Paap LM statistic (under-identification test)	0.05	0.05	0.05	0.05	0.05	0.05
Hansen J statistic (over-identification test)	0.47	0.37	0.18	0.37	0.21	0.53
Observations	6399	6399	6399	6399	6399	6399
Number of firms	1011	1011	1011	1011	1011	1011
Specification B						
Importer	0.689**	1.857*	0.245	0.294	0.579**	0.031
	(0.344)	(1.063)	(0.495)	(0.221)	(0.295)	(0.290)
Import competition	2.404**	4.531	4.711***	-1.957*	-1.318	-4.049**
	(1.019)	(3.102)	(1.768)	(1.168)	(1.571)	(1.819)
Kleibergen-Paap LM statistic (under-identification test)	0.09	0.09	0.09	0.09	0.09	0.09
Hansen J statistic (over-identification test)	0.42	0.40	0.29	0.34	0.19	0.63
Observations	6313	6313	6313	6313	6313	6313
Number of firms	996	996	996	996	996	996
Specification C						
Importer	0.530*	1.499	-0.123	0.474**	0.733**	0.335
	(0.287)	(0.918)	(0.402)	(0.230)	(0.317)	(0.243)
Exchange rate variation in the firm's product market	0.318***	0.519	0.544***	-0.188	-0.082	-0.485**
	(0.118)	(0.370)	(0.207)	(0.152)	(0.202)	(0.237)
Kleibergen-Paap LM statistic (under-identification test)	0.06	0.06	0.06	0.06	0.06	0.06
Hansen J statistic (over-identification test)	0.49	0.33	0.22	0.32	0.19	0.47
Observations	6313	6313	6313	6313	6313	6313
Number of firms	996	996	996	996	996	996
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Panel A reports first-stage estimates for specifications A. Unreported estimates for specifications for B and C use the same instruments. Specification B adds a measure of import competition instrumented for by exchange rate variation in the same market. Specification C includes the measure directly. Also included are 6-digit industry and region fixed effects. The main text provides additional detail on the specification. Robust standard errors clustered at the firm level in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% confidence levels, respectively.

Table 5: Robustness

	Product innovation (1)	Product scope (2)	Labor productivity (3)	Total employment (4)	Unskilled employment (5)	Skilled employment (6)
A: Including input sector exchange rates						
Importer	0.532*	1.480*	-0.153	0.456**	0.700**	0.355
	(0.283)	(0.900)	(0.399)	(0.229)	(0.310)	(0.247)
Kleibergen-Paap LM statistic (under-identification test)	0.04	0.04	0.04	0.04	0.04	0.04
Hansen J statistic (over-identification test)	0.51	0.37	0.25	0.33	0.21	0.45
Observations	6254	6254	6254	6254	6254	6254
Number of firms	988	988	988	988	988	988
B: Adding additional firm controls						
Importer	0.583*	1.701	-0.136	0.311**	0.434***	0.390*
	(0.321)	(1.039)	(0.336)	(0.132)	(0.144)	(0.200)
Kleibergen-Paap LM statistic (under-identification test)	0.07	0.07	0.07	0.07	0.07	0.07
Hansen J statistic (over-identification test)	0.43	0.32	0.16	0.40	0.32	0.16
Observations	6312	6312	6312	6312	6312	6312
Number of firms	996	996	996	996	996	996
C: Including 2-digit industry fixed effects						
Importer	0.495***	1.342*	-0.186	0.170	0.435*	0.072
	(0.183)	(0.700)	(0.418)	(0.199)	(0.249)	(0.235)
Kleibergen-Paap LM statistic (under-identification test)	0.05	0.05	0.05	0.05	0.05	0.05
Hansen J statistic (over-identification test)	0.41	0.45	0.11	0.55	0.38	0.58
Observations	6313	6313	6313	6313	6313	6313
Number of firms	996	996	996	996	996	996
D: Using import spending						
Log of real import expenditure	0.050*	0.137	-0.013	0.048**	0.074**	0.034
	(0.028)	(0.087)	(0.038)	(0.024)	(0.034)	(0.024)
Kleibergen-Paap LM statistic (under-identification test)	0.07	0.07	0.07	0.07	0.07	0.07
Hansen J statistic (over-identification test)	0.52	0.35	0.22	0.33	0.21	0.48
Observations	6313	6313	6313	6313	6313	6313
Number of firms	996	996	996	996	996	996
E: Using an alternative set of instruments						
Importer	0.446*	1.139*	0.286	0.374**	0.447*	0.494**
	(0.236)	(0.599)	(0.354)	(0.179)	(0.230)	(0.236)
Kleibergen-Paap LM statistic (under-identification test)	0.00	0.00	0.00	0.00	0.00	0.00
Hansen J statistic (over-identification test)	0.47	0.43	0.33	0.50	0.49	0.31
Observations	7110	7110	7110	7110	7110	7110
Number of firms	1102	1102	1102	1102	1102	1102

	Product innovation (1)	Product scope (2)	Labor productivity (3)	Total employment (4)	Unskilled employment (5)	Skilled employment (6)
F: Including all sample years						
Importer	0.344	1.349**	-0.0857	0.345*	0.408*	0.465*
	(0.210)	(0.616)	(0.349)	(0.199)	(0.248)	(0.245)
Kleibergen-Paap LM statistic (under-identification test)	0.00	0.00	0.00	0.00	0.00	0.00
Hansen J statistic (over-identification test)	0.26	0.86	0.50	0.55	0.68	0.76
Observations	9447	9447	9447	9447	9447	9447
Number of firms	1178	1178	1178	1178	1178	1178
G: Using firm-level exchange rates						
Exchange $rate_t$	0.114**	0.031	0.142	0.118*	0.142*	0.169*
	(0.056)	(0.162)	(0.104)	(0.064)	(0.077)	(0.089)
Observations	7290	7290	7290	7290	7290	7290
Number of firms	1183	1183	1183	1183	1183	1183
H: Removing the top 10 performers						
Importer	0.485*	1.636*	-0.142	0.272	0.524**	0.090
	(0.250)	(0.911)	(0.368)	(0.186)	(0.241)	(0.255)
Kleibergen-Paap LM statistic (under-identification test)	0.01	0.01	0.01	0.01	0.01	0.01
Hansen J statistic (over-identification test)	0.32	0.68	0.66	0.12	0.15	0.84
Observations	5329	5329	5329	5329	5329	5329
Number of firms	853	853	853	853	853	853
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Instruments used and additional variables included in the specification are as specified in Table 4 except for Section E as described in the main text and Section G which is estimated using firm fixed-effect ordinary least squares estimation. The value of the first-stage F-statistic of excluded instruments for importing is 88.71 for Section A, 87.19 for Section B, 47.51 for Section C, 82.20 for Section D, 73.96 for Section E, 121.6 for Section F and 86.98 for Section H. Robust standard errors clustered at the firm level in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% confidence levels, respectively.

Table 6: Impacts of importing on average production costs

	Product production cost
Importer	-3.807***
	(1.412)
Kleibergen-Paap LM statistic (under-identification test)	0.00
Hansen J statistic (over-identification test)	0.17
Observations	6183
Number of firms	979
Firm fixed effects	Yes
Year fixed effects	Yes

Notes: Firm product production costs are obtained by regressing product-level firm production costs on firm-year and product-year fixed effects. The estimated coefficients on firm-year fixed effects are average production costs at the firm level purged of effects due to the composition of products. We use these estimates in the regressions reported above. Further detail is provided in Kugler and Verhoogen (2009b). Instruments used are as in Specification E of Table 5 and additional variables included in the specification are as specified for Table 4. The value of the first-stage F-statistic of excluded instruments is 69.4. Robust standard errors clustered at the firm level in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% confidence levels, respectively.

Table 7: Differential effects across producers in diverse industries

	Product innovation	Product scope	Labor productivity	Total employment	Unskilled employment	Skilled employment
	(1)	(2)	(3)	(4)	(5)	(6)
A: Excluding producers of chemical products and machinery						
Importer	0.534*	1.496	-0.068	0.312*	0.553**	0.219
	(0.294)	(0.915)	(0.390)	(0.174)	(0.224)	(0.218)
Kleibergen-Paap LM statistic (under-identification test)	0.09	0.09	0.09	0.09	0.09	0.09
Hansen J statistic (over-identification test)	0.20	0.58	0.42	0.28	0.15	0.83
Observations	5701	5701	5701	5701	5701	5701
Number of firms	908	908	908	908	908	908
B: Natural resource-based producers						
Importer	1.140	2.389	1.053	1.390*	2.074*	1.117
	(0.776)	(2.025)	(1.022)	(0.824)	(1.183)	(0.907)
Kleibergen-Paap LM statistic (under-identification test)	0.09	0.09	0.09	0.09	0.09	0.09
Hansen J statistic (over-identification test)	0.38	0.39	0.24	0.49	0.43	0.83
Observations	2196	2196	2196	2196	2196	2196
Number of firms	344	344	344	344	344	344
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Section A excludes producers in the following ISIC Rev. 3 sectors: 24 (chemicals and chemical products), 30 (office, accounting and computing machinery), 31 (electrical machinery and apparatus n.e.c.), 32 (radio, television and communication equipment and apparatus), 33 (medical, precision and optical instruments, watches and clocks), 34 (motor vehicles, trailers and semi-trailers) and 35 (other transport equipment). Section B includes only producers operating in the following ISIC Rev. 3 sectors: 151, 152, 153 and 154 (food products), 155 (beverages), 160 (tobacco), 181 and 191 (leather products), 201 and 202 (wood products), paper (210), 231, 232 and 233 (petroleum refineries, petroleum and coal products, petroleum refineries), 2694, 2695 and 2696 (non-metallic mineral metal products). Instruments used and additional variables included in the specification are as specified in Table 4. The value of the first-stage F-statistic of excluded instruments is 88.13 and 23.45 for Sections A and B respectively. Robust standard errors clustered at the firm level in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% confidence levels, respectively.

Table 8: Impacts in the immediate aftermath of the crisis and beyond

	Product innovation (1)	Product scope (2)	Labor productivity (3)	Total employment (4)	Unskilled employment (5)	Skilled employment (6)
A. OLS estimation results						
Importer*Post-crisis years	0.017	0.040	0.083	0.017	0.027	0.039
	(0.032)	(0.117)	(0.053)	(0.036)	(0.042)	(0.044)
Importer*Beyond the post-crisis years	0.059*	0.157	0.004	0.105***	0.102**	0.150***
	(0.031)	(0.110)	(0.052)	(0.035)	(0.040)	(0.041)
P-value for F-Test of difference in coefficients across groups	0.07	0.08	0.05	0.00	0.03	0.00
Observations	6406	6406	6406	6406	6406	6406
Number of firms	1011	1011	1011	1011	1011	1011
B: IV estimation results						
Importer*Post-crisis years	0.452	1.648	-0.243	-0.067	0.023	0.030
	(0.307)	(1.052)	(0.421)	(0.277)	(0.329)	(0.285)
Importer*Beyond the post-crisis years	0.572**	1.614*	-0.135	0.407	0.628*	0.357
	(0.276)	(0.953)	(0.426)	(0.269)	(0.334)	(0.283)
P-value for F-Test of difference in coefficients across groups	0.47	0.95	0.72	0.02	0.02	0.12
Kleibergen-Paap LM statistic (under-identification test)	0.08	0.08	0.08	0.08	0.08	0.08
Hansen J statistic (over-identification test)	0.36	0.50	0.47	0.36	0.56	0.68
Observations	6254	6254	6254	6254	6254	6254
Number of firms	988	988	988	988	988	988
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The first-stage F-statistic of excluded instruments for importer in post-crisis years and importers beyond post-crisis years is 131.11 and 16.06 respectively. Post-crisis years refer to 2000-2002 and beyond post-crisis years to 2003-2007. Instruments used and additional variables included in the specification are as specified in Table 4. Robust standard errors clustered at the firm level in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% confidence levels, respectively.

APPENDIXES

A. Data appendix

Statistics of the main plant-level dataset

The original full manufacturing plant-level sample contains 17 001 plant-year observations, which is fairly balanced across 1997 – 2007 with at least 1512 (2002) and at a maximum 1655 (1999) firms each year.[26] Table A.1 shows the average split across 2-digit industries for the entire sample period; more than one in four observations are of food and beverage producers.

Table A.1: Number of plant-year observations by 2-digit ISIC rev. 2 industry

Industry	Plants	Share in Total
Food and beverages [15]	4563	26.84
Tobacco [16]	18	0.11
Textiles [17]	1232	7.25
Wearing apparel [18]	1221	7.18
Leather products, luggage, saddlery and footwear [19]	597	3.51
Wood and wood products [20]	619	3.64
Paper and paper products [21]	577	3.39
Publishing, printing and reproduction of recorded media [22]	765	4.50
Coke, refined petroleum products and nuclear fuel [23]	93	0.55
Chemicals and chemical products [24]	1206	7.09
Rubber and plastics products [25]	1318	7.75
Other non-metallic mineral products [26]	1062	6.25
Basic metals [27]	544	3.2
Fabricated metal products [28]	766	4.51
Machinery and equipment n.e.c. [29]	474	2.79
Office, accounting and computing machinery [30]	4	0.02
Electrical machinery and apparatus n.e.c. [31]	239	1.41
Radio, television and communication equipment and apparatus [32]	8	0.05
Medical, precision and optical instruments, watches and clocks [33]	62	0.36
Motor vehicles, trailers and semi-trailers [34]	419	2.46
Other transport equipment [35]	40	0.24
Furniture, manufacturing n.e.c.[36]	1174	6.91

Notes: For each industry ISIC Rev. 3 2-digit codes are provided in brackets.

We eliminate plant observations in any single year if no information on overall product sales, employment and wage payments is provided since these will be essential for our analysis.[27] Our baseline plant-level dataset contains 16 678 plant-year observations for 1997 to 2007.

Data treatment for input- and output-product data

We use two separate datasets at the input-plant and output-plant level for 1997-2007. The original datasets provide for each product of plants an 11-digit product code, a description of the product itself and the unit of measurement of the quantities.[28] The 11-digit product codes are based on the ISIC Rev. 3

classification. Baseline datasets include 1861 and 1606 distinct input and output 11-digit manufacturing product categories; these correspond to the intermediate inputs and outputs of the plant-level dataset defined above. The dataset on intermediate inputs includes also information on the purchasing price and quantity of goods across national and international purchases. The final products dataset has information on the production value and quantity as well as the sales value and quantity. Table A.2 provides a few examples of products in our dataset.

Table A.2: Examples of input and output products from the outputs and inputs datasets

Product description	ISIC Code	Unit
A. Outputs		
Sausages and similar products made of meat	15112113210	Kilograms
Woven fabrics of combed wool or of combed fine hair	17112654001	Metres
Ties, bow-ties and cravats	18102822903	Units
Footwear with uppers of leather or composition leather	19202933001	Pairs
Statuettes and other ornamental wooden articles	20293191302	Units
Gummed or adhesive paper and paperboard	21013214913	Kilograms
Exercise books	22213260001	Units
Preparations for use on the hair	24243532302	Litres
Brakes and servo-brakes and parts thereof	34304912901	Units
B. Inputs		
Tobacco extracts and essences	16002509002	Litres
Bovine leather and equine leather, without hair	19112912012	Units
Paper or paperboard lables of all kinds	21093219700	Units
Paraffin wax, crude or refined	23203350001	Kilograms
Prepared glues and other prepared adhesives	24293542005	Litres
Ceramic tableware, kitchenware and other ceramic household and toilet articles	26913722102	Units
Electrical plugs and sockets	31204621206	Units
Pressure regulators and controllers (manostats)	33134827001	Units
Spectacle lenses of glass	33204831102	Pairs

We applied several basic data cleaning procedures to obtain our final dataset. First, we removed those observations without any product code for both the input and the output datasets. Second, we also excluded observations on sub-contracted production since information on product values in such cases might not reflect actual market values. Third, the original dataset contains cases where firms have more than one output or import product with the same 11-digit product code. We eliminated duplicate observations. As for the remaining cases when firms have more than one input and/or output in the same year with the same 11-digit code we created a more disaggregate product category rather than aggregate these observations. Fourth, any within-product price and quantity comparisons will only be meaningful if the same units of measurement are used. While this is the case for most of the products in our datasets, in certain cases the same product is reported in a different unit of measurement by different firms. We create a supra-product category to deal with those cases whenever our analysis requires within-product comparisons. We eliminate those products without information on the unit of measurement for analysis involving price and quantity. (The information is used whenever we are interested in the number of input or output products only.)

Our final datasets contain 74 823 output-plant-year and 107 359 input-plant-year observations at the 11-digit ISIC Rev. 3 product level. We will use the dataset for our analysis including to compute product adoption, the number of product outputs or inputs and other measures which do not require comparisons within products and/or price and quantity product information. Excluding observations with no information on units of measurement and/or subcontracted products produces a final dataset of 72 300 output-plant year observations and 100 095 input-plant year observations at the 11-digit ISIC Rev. 3 product level with a fairly equal split across years as described in Tables A.3 and A.4 below. Note that final products and inputs datasets cover most firms across all years with the only exception of 2007. For 2007 we only have information on about 64% of plants both in terms of inputs and outputs.

Table A.3: Number of plant-outputs by year

Year	Plants-Products	Share in Total	Plants	Share of All Plants
1997	6507	9.00	1535	0.94
1998	6626	9.16	1523	0.94
1999	6427	8.89	1434	0.96
2000	6550	9.06	1438	0.96
2001	6669	9.22	1446	0.96
2002	6727	9.30	1427	0.97
2003	6885	9.52	1429	0.97
2004	7097	9.82	1462	0.97
2005	6936	9.59	1440	0.97
2006	7135	9.87	1456	0.98
2007	4741	6.56	961	0.64
Total	72300	100	15551	0.93

Table A.4: Number of plant-inputs by year

Year	Plants-Products	Share in Total	Plants	Share of All Plants
1997	9713	9.70	1584	0.97
1998	9582	9.57	1559	0.97
1999	9033	9.02	1462	0.98
2000	9088	9.08	1461	0.98
2001	9369	9.36	1469	0.98
2002	9247	9.24	1442	0.98
2003	9425	9.42	1451	0.98
2004	9534	9.52	1485	0.98
2005	9330	9.32	1460	0.98
2006	9713	9.70	1471	0.99
2007	6061	6.06	960	0.64
Total	100095	100	15804	0.95

Converting monetary indicators for 1997-1999

Our data are provided in Ecuadorian sucre for 1997-1999 and in US dollars for 2000-2007, reflecting the country's adoption of the US dollar in 2000. In order to create a common dataset we convert 1997-1999 monetary values into US dollars using annual exchange rates from the Ecuadorian Central Bank. Since the rate of inflation was significant specifically in 1999, we prefer to treat these data with caution and confine most of our econometric analysis to 2000-2007.

Data checks

We test the quality of our products data by identifying firms with irregular output product "drops" (*i.e.* products that disappear from production and then reappear again) and firms with product "jumps" (*i.e.* products that are produced only once in the intermediate years of firm presence in the sample). These tests, which follow Bernard *et al.* (2010), are satisfactory in that product "drops" and "jumps" are relatively infrequent.

We find similarities between a series of statistics based on our product level data and those obtained based on comparable data for other countries. Ecuadorian firms' core products represent 77%, 50% and 43% for plants that produce 2, 6 and 8 products respectively as reported in Table A.5. This compares to the evidence by Bernard *et al.* (2010) for the United States, Goldberg *et al.* (2010) for India, and Navarro

(2008) for Chile. Single-product firms represent, on average across 1997-2007, about 32% of overall output sales, a lower share compared to the numbers for Chile, India and the United States. Based on our inputs dataset we find a similar concentration for firm intermediate inputs (Table A.6). The number of inputs used in production is however less skewed than for outputs reflecting the multiple set of inputs needed for output production.

Table A.5: Share of output products in total plant products, average for 1997-2007

Outputs	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14+*
1	1	0.77	0.69	0.60	0.56	0.50	0.48	0.43	0.41	0.37	0.38	0.36	0.34	0.33
2		0.23	0.22	0.23	0.21	0.22	0.21	0.21	0.20	0.20	0.19	0.19	0.18	0.17
3			0.09	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.12	0.12	0.12	0.11
4				0.06	0.07	0.08	0.08	0.09	0.09	0.09	0.08	0.09	0.09	0.08
5					0.04	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06
6						0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05
7							0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04
8								0.02	0.02	0.03	0.03	0.03	0.03	0.04
9									0.01	0.02	0.02	0.02	0.03	0.03
10										0.01	0.01	0.02	0.02	0.03
11											0.01	0.01	0.02	0.02
12												0.01	0.01	0.02
13													0.01	0.01
14+														0.03
Nbr of Firms	451	198	166	105	96	72	55	46	36	36	32	31	37	70

Table A.6: Share of input products in total plant inputs, average for 1997-2007

Inputs	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14+*
1	1	0.82	0.71	0.64	0.59	0.56	0.55	0.52	0.46	0.45	0.45	0.42	0.38	0.41
2		0.18	0.20	0.21	0.21	0.20	0.19	0.19	0.20	0.19	0.19	0.19	0.18	0.17
3			0.08	0.10	0.11	0.11	0.11	0.11	0.12	0.12	0.11	0.11	0.11	0.11
4				0.05	0.06	0.07	0.07	0.07	0.08	0.08	0.07	0.08	0.08	0.07
5					0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.06
6						0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.04
7							0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.03
8								0.01	0.02	0.02	0.02	0.02	0.03	0.03
9									0.01	0.01	0.02	0.02	0.02	0.02
10										0.01	0.01	0.01	0.02	0.02
11											0.01	0.01	0.01	0.01
12												0.01	0.01	0.01
13													0.01	0.01
14+														0.01
Nbr of Firms	172	106	123	137	129	116	97	88	80	73	78	95	132	67

We also compare the standard deviations of "purged" unit values for 2-digit ISIC Rev. 3 industries with the same standard deviations obtained for a Colombian products dataset by Kugler and Verhoogen (2009b). "Purged unit values" are the residuals from regressions of log unit values on product fixed effects or from regressions of log unit values on product-year fixed effects. Our standard deviations are somewhat larger than theirs but are sufficiently within bounds to be explained by the fact that we consider more aggregate industry categories and a country with a distinct profile of manufacturing production.[29]

B. Implementation of Kugler and Verhoogen (2009a) for Ecuador

Kugler and Verhoogen (2009a), referenced as KV hereafter, present an interesting set of descriptive statistics on importers and import product prices. They interpret their findings as suggesting that

Colombian plants purchase higher-quality inputs on the import market than on the domestic market. We find similar evidence for our dataset on Ecuadorian manufacturing firms from 1997-2007.[30] Below is a brief description of specific results.

First, we study the relationship of importer status and plant-level performance across three dimensions: *i)* log real gross output; *ii)* log real annual earnings (per worker); and *iii)* log labour productivity controlling for region, industry and year effects in columns (1) and (2) of Table B.1 and for plant and year effects in columns (3) and (4) of Table B.1. Results of column (1) across Panels A to C indicate a positive relationship between firms' importer status and each of the three performance measures, including when their exporter status is taken into account (column 2). The gross output effect is maintained for the gross output measures for within-plant comparisons as well as indicated in columns (3) and (4). Similarly to KV we do not find conclusive evidence on productivity once firm fixed effects are included nor, differently from KV, for real annual earnings per worker.[31] This lends support to the importance of firm self-selection into importing.

Second, focusing on intermediate inputs and their unit values, results of panel D of table B.1 show that whether within industries (reported in columns 1 and 2) or within firms (shown in columns 3 and 4) importing has a positive impact on the number of input categories. This suggests that imports facilitate firms' access to input varieties. As for the unit values of inputs, computed as the expenditure in inputs over their quantity, Table B.2 looks at their relationship with importing. The analysis is at the input-product-firm-year level and therefore includes product-year fixed effects so as to exclude effects of differences across products, different units of measurement and different product-specific demand shocks on prices. The regressions reported in column (1) of Table B.2 include industry and region effects only, whereas columns (2), (3) and (4) incorporate plant, plant-product and plant-year effects respectively.[32] Panel A shows results of regressions where the log of input prices is regressed on an indicator of whether the product was imported or not. The coefficient indicates that imported products are on average more expensive than domestic inputs. Differently from KV we do not find that importers pay higher prices for all of their inputs; only our within-plant evidence (reported in column (2) of Table B.2) identifies a corresponding significant positive effect. Panel C treats imported and domestic prices as separate for those observations where firms purchase both from national and foreign producers by using a modified imports measure to indicate whether the price corresponds to the imported product or not. We find a confirmation that firms pay higher prices for products they import from abroad. Note that due to the limited number of observations on inputs that are both imported and purchased domestically we cannot include plant-product-year effects to exploit variation within those products as in KV. Finally, Panel D analyses whether domestic prices for imported inputs are higher for the importers of inputs, but we find no evidence that this is indeed the case for our sample of firms.

Table B.1: Plant-level variables versus importer status

	(1)	(2)	(3)	(4)
Panel A: Dependent variable: log real gross output				
Importer	1.461***	1.106***	0.101**	0.098**
	(0.078)	(0.069)	(0.041)	(0.041)
Exporter		1.566***		0.175***
		(0.072)		(0.034)
R^2	0.45	0.55	0.93	0.93
Panel B: Dependent variable: log real annual earnings (per worker)				
Importer	0.334***	0.265***	-0.014	-0.014
	(0.026)	(0.025)	(0.024)	(0.024)
Exporter		0.303***		-0.020
		(0.026)		(0.023)
R^2	0.50	0.52	0.77	0.77
Panel C: Dependent variable: log labor productivity				
Importer	0.617***	0.485***	0.011	0.011
	(0.045)	(0.044)	(0.036)	(0.036)
Exporter		0.581***		0.024
		(0.044)		(0.033)
R^2	0.40	0.43	0.82	0.82
Panel D: Dependent variable: number of inputs				
Importer	1.257***	1.180***	0.879***	0.875***
	-0.161	-0.159	-0.132	-0.132
Exporter		0.338**		0.215**
		-0.154		-0.084
R^2	0.40	0.40	0.86	0.86
Region effects	Yes	Yes	No	No
Industry effects	Yes	Yes	No	No
Plant effects	No	No	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
N (plant-year observations)	13037	13037	13037	13037
N (distinct plants)	1501	1501	1501	1501

Notes: Robust standard errors clustered at the plant level in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percentage level. Only plant-year observations with information on the number of input products are included in all regressions of Table B.1.

Table B.2: Input-price regressions

	(1)	(2)	(3)	(4)
Panel A: Dependent variable: log real input price				
Importer (of relevant input)	0.138***	0.284***	0.172***	0.302***
	(0.032)	(0.030)	(0.020)	(0.030)
Observations (plant-product-year)	81309	81309	81309	81309
R^2	0.83	0.86	0.95	0.89
Panel B: Dependent variable: log real input price				
Importer (of any input)	-0.008	0.070**	0.027	
	(0.026)	(0.027)	(0.031)	
Observations (plant-product-year)	81309	81309	81309	
R^2	0.83	0.86	0.95	
Panel C: Dependent variable: log real (domestic or imported) input price				
Imported product	0.206***	0.327***	0.261***	0.339***
	(0.030)	(0.022)	(0.031)	(0.028)
Observations (plant-product-year-origin)	86417	86417	86417	86417
R^2	0.82	0.85	0.94	0.88
Panel D: Dependent variable: log real domestic *input price*				
Importer (of relevant input)	-0.079	0.049	0.049	0.043
	(0.051)	(0.041)	(0.042)	(0.052)
Observations (plant-product-year)	64062	64062	64062	64062
R^2	0.84	0.87	0.95	0.90
Region, industry effects	Yes	No	No	No
Product-year effects	Yes	Yes	Yes	Yes
Plant effects	No	Yes	No	No
Plant-product effects	No	No	Yes	No
Plant-year effects	No	No	No	Yes
Plant-product-year effects	No	No	No	No

Notes: Robust standard errors clustered at the plant level in parenthesis. ***, ** and * indicate significance at the 1, 5 and 10 percentage level. Column 2-4 were calculated using Stata a2reg procedure (from Amine Ouazad) with bootstrapped standard errors, using 50 replications with draws on distinct cross-sectional units (plants).

C. Description of variables used in the empirical analysis

Table C. 1 Description of variables

A. Main variables	
Product innovation *[prod_inno $_{it}$]*	Variable takes on value 1 if firm *i* sells a product defined at the 11-digit ISIC Rev. 3 level at time *t* it did not produce previously and 0 otherwise
Product scope *[prod_scope $_{it}$]*	Defined as the number of products produced by plant *i* at period *t*
Labor productivity *[lprod $_{it}$]*	Variable obtained as the ratio of firm real sales over total employment, real sales are computed deflating using firm-price index obtained following Eslava *et al.* (2004).*[1]
Total employment *[total_empl $_{it}$]*	Defined as the number of production and non-production workers of firm *i* at time *t*
Skilled employment *[skilled_empl $_{it}$]*	Defined as the number of non-production workers of firm *i* at time *t*
Unskilled employment *[unskilled_empl $_{it}$]*	Defined as the number of production workers of firm *i* at time *t*
Importer *[M $_{it}$]*	Variable takes on value *1* if firm *i* imports any of its manufacturing inputs in period *t* and *0* otherwise
B. Instruments	
Firm-specific input real exchange rate	Real exchange rate at time *t* for firm *i* 's inputs obtained as described in Section 4.2 of the main text
Firm-specific variation in input tariffs	Variation in input tariffs for firm *i* at time *t* obtained as described in Section 4.2 of the main text
Availability of national producers of inputs	Measure takes on value of 1 if at time *t* a national producer of the the 6-digit input product(s) of firm *i* exists and 0 otherwise
C: Additional controls	
Import competition in the output sector	Computed as the ratio of the import value at the 6-digit sector of firm *i* 's main output product sector over the size of output product sector (computed as the sum of the import value and total national output) both at time *t*
Real exchange rate in the output sector	Computed as the real exchange rate in the 6-digit sector at time *t* of firm *i* 's main output product(s) sector following otherwise the same steps as in Section 4.2 of the main text
D. Other robustness variables	
Real exchange rate in the input sector	Computed as the real exchange rate in the 6-digit sector of firm *i* 's main input product sector at time *t* following otherwise the same steps as in Section 4.2 of the main text
Firm size dummies	Variables define four firm employment size categories: *i)* less than 25, *ii)* [25-50], *iii)*]50-100], *iv)*]100 and beyond
Firm's share sales in its industry	Share of firm *i* 's main product in total sales of the corresponding 6-digit ISIC Rev. 3 industry at time *t*
Share of skilled labor	Defined as the share of skilled employees in total employment for firm *i* at time *t*
Exporter status of the firm	Variable is equal to 1 if firm *i* exports at *time t* and 0 otherwise
Machinery investment-capital ratio	Obtained as the ratio of machinery investment over machinery capital. Machinery capital is obtained using the perpetual inventory method.*[2]
Import spending	Logarithm of the real value of total imports of firm *i* at time *t*
Relevance of importing across industries	Percentage of importing firms at the ISIC Rev. 3 2-digit level of firm *i* 's main product industry at time *t*
Production costs	Average firm-year production costs obtained following the procedure implemented in Kugler and Verhoogen (2009b) for unit production costs obtained as the ratio of production costs over the number of produced units for each of firm *i* 's products at time *t*

Notes: *1 Tornquist price indices are obtained based on a weighted average of the growth in price of firm *i*'s manufactured products between year $_{t-1}$ and year$_t$, ΔP_{it} . We construct firm *i* logarithmic price *levels* in year *t* as $\ln P_{it} = \ln P_{it-1} + \Delta P_{it}$ and then firm *i* price *levels* in year *t* as $P_{it} = \exp(\ln P_{it})$. *2 We compute net machinery investment flows as the sum of purchases of new capital minus the sales of capital. We then apply the PIM formula $K_{it+1} = (1 – δ) K_{it} + I_{it}$, where I_{it} are real net investment flows and δ is a depreciation rate. Since we have no data on depreciation rates in Ecuador, we use the 7% rate for machinery and equipment proposed by Pombo (1999) for Colombia. The initial value of the capital stock needed to apply the PIM formula is, if available, given by the book value.

NOTES

1 Eaton and Kortum (2001) show that most of the world's capital is produced in a small number of R&D-intensive countries while the rest of the world imports its capital equipment.

2 This argument is related to the North-South type model proposed by Grossman and Helpman (1995): innovative products are created in the North and, provided the South acquires needed production technologies, move progressively to the South as relative wages in the South are lower.

3 While foreign inputs could allow product innovation and, in consequence, lead to positive employment growth as firms expand into new markets, imported inputs could foster process innovation of a type that reduces a firm's required labour inputs. Section 2 provides a conceptual framework for thinking about the determinants of the innovation-employment relationship; it shows that from a theoretical perspective many factors influence whether innovation will have positive or negative effects on employment. Addressing the nature of the relationship is ultimately an empirical question. The related literature, reviewed in Section 1, tends to find a positive relationship between product innovation and employment.

4 Kasahara and Lapham (2008) propose an extended Melitz (2003) model to incorporate imported intermediate goods. Due to fixed costs of importing only inherently highly productive firms import intermediates. Sources of fixed costs of importance include costs of signing international contracts and search costs for finding suitable and reliable foreign input suppliers.

5 In a review of existing innovation surveys Mairesse and Mohnen (2010) point to the problems with subjective innovation measures that rely exclusively on perceptions by firms of whether they have introduced innovations at the process or product levels. They note that what is defined as a new or improved product is not always clear to the respondents and that the distinction between an innovation that is "new to the firm" and "new to the market" is also subject to a great deal of subjective judgment.

6 While foreign imports are an attractive substitute for inexistent or badly performing national suppliers of intermediate inputs, they cannot be complete substitutes for all intermediate product requirements. This is not only because there are many non-tradable inputs but also because there are substantial additional costs of accessing foreign products (including shipping and transportation expenses, exchange rate risks and other additional transaction costs involved when purchasing foreign products). Such additional costs are out of reach for a substantial number of firms in developing countries. See also footnote 4.

7 Jones (2011) discusses, based on a theoretical model, how the extent of complementarities across industrial sectors (arising from the fact that many industries' inputs are needed for any industry's output) render the performance of inputs sectors more relevant for any industry's products. He goes on to show how severe shortcomings in certain sectors in developing countries can, due to their relevance for many industries' production, have amplified negative impacts on per capital growth and, under certain conditions, explain substantial per capital income differences across developing and developed countries.

8 Bas (2011) finds that firms in industries that have experienced greater input tariff reductions had a higher probability of entering export markets compared to others.

9 Theoretical and empirical contributions include Deardorff (2000), Feenstra and Hanson (1996, 1999), Geishecker (2008), Hsieh and Woo (2005) and Kohler (2004), among others. It is also worth noting that the main debate in the early literature on trade and employment focused on wage inequality and the question to what extent trade rather than skill-biased technological change (SBTC) and labour market factors determined trends towards greater wage inequality. Goldberg and Pavcnik (2004) provide an overview of related studies on developing countries. Bustos (2011) presents a model and shows some

evidence that trade liberalisation may increase the profitability of new technologies in less developed countries. Trade may lead to skill-biased technology adoption and increase wage inequality in consequence. Csillag and Koren (2009) estimate the impact of capital imports on wage inequality using employer-employee data.

10 See discussion in Grossman and Helpman (1991).

11 The dataset collects information at the plant level. For convenience we refer to the terms "plant" and "firm" interchangeably.

12 We find that importers *i)* are exceptional performers, *ii)* use more distinct categories of inputs, *iii)* on average pay higher prices for imported compared to domestic inputs within narrow product categories. Appendix B describes our analysis and findings in detail.

13 Data are for 2009 based on the World Bank's World Development Indicators (WDI).

14 The real exchange rate is computed as follows: $ex_{jt} = \frac{foreign\_currency_{jt}}{national\_currency_{jt}} * \frac{national\_cpi_{jt}}{foreign\_cpi_{jt}}$ where *foreign_ currency / national_currency* is the amount of foreign currency for each unit of national currency and *national_cpi / foreign_cpi* is the ratio of foreign to national consumer price indices of Ecuador. We use data from the IMF International Financial Statistics database to compute real exchange rates.

15 The corresponding statistics are available from the author upon request.

16 This follows the type of descriptive statistics reported in Damijan and Kostevec (2010).

17 These results are available from the author upon request.

18 Appendix C provides further detail on how these variables are computed.

19 We use the IV specification of Section E of Table 6 rather than our main IV specification since the latter introduces lagged tariffs which reduce the sample more than is the case for the specification of Section E of Table 6.

20 Results are available from the author upon request.

21 Average firm production costs are obtained by regressing product-level firm production costs on firm-year and product-year fixed effects. The estimated coefficients on firm-year fixed effects are average production costs at the firm level purged of effects due to the composition of products. We use these estimates as a dependent variable for the regressions described here. Further detail is provided in Kugler and Verhoogen (2009b).

22 We include the following industries in the group of natural resource-based producers (ISIC Rev. 3 categories in parenthesis): food products (151, 152, 153, 154), beverages (155), tobacco (160), leather products (181, 191), wood products (201, 202), paper (210), petroleum refineries, petroleum, coal products (231, 323, 233), certain nonmetallic mineral products (2694, 2695, 2696).

23 However, while the value of non-technological innovation has been widely recognised (*e.g.* in marketing or organisational structures) the lack of suitable measures often leads to a focus on a more technology-based definition of innovation. Moreover, while a lot of anecdotal evidence exists to emphasise that non-technological innovations can generate substantial value to businesses, systematic evidence on the differential contributions of traditional and non-traditional types of innovation is still lacking.

[24] Results are available from the author upon request.

[25] Paunov (2012) provides evidence of significant reductions in innovation investment by Latin American firms due to the global financial crisis.

[26] Statistics on the number of plants by year are available from the author upon request.

[27] Note that we rely on sales information based on the product-plant data if sales data are missing in the plant-level dataset.

[28] The data contains the following 11 different units of measurement across inputs and outputs datasets: *i)* kilograms, *ii)* grams, *iii)* metres, *iv)* square metres, *v)* cubic metres, *vi)* units, *vii)* pairs, *viii)* litres, *ix)* barrils, *x)* gallons and *xi)* heads.

[29] Results are available from the author upon request.

[30] Note that results are qualitatively maintained for the sub-sample 2000-2007. Results tables are available from the author upon request.

[31] Note that differently from KV we use labour productivity as our productivity measure.

[32] Thus, column (2) compares relative prices for imports (defined alternatively as described below) within the same plant, column (3) compares relative price differences within the same plant and product, column (4) compares relative prices of importing plants to those of non-importers in the same plant and year.