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Import Competition in the Manufacturing Sector in Peru: Its Impact on Informality and Wages

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Abstract

This paper studies the impact of import competition from China on informality and wages in the Peruvian manufacturing sector in 2001–2010. Using data from the Peruvian Household Survey, we use a two-step procedure to evaluate the impact of the surge in imports from China on the likelihood of being hired in the informal sector and on wages in both the formal and informal sectors. The results suggest that greater import competition increased the chances of working in the informal sector among workers with only elementary education—arguably one of the less-skilled groups. Regarding the impact on real wages, we find that the increase in imports from China was also detrimental to the least-educated workers (those with an elementary-level education or no education at all). The evidence is more mixed among better-educated workers in the formal sector: their wages improved, but the result is only significant once industry output growth is accounted for.

JEL Codes: F14, F16, J23

Keywords: import competition, informality, and wages.

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1. INTRODUCTION

Following China's transition to a market-oriented economy and its accession to the WTO, its exports experienced outstanding growth, especially in 2000–2005. China has now become the leading trade partner for most countries around the globe. Its share in world exports tripled from 6% in 2000 to 18% in 2015; in manufacturing, its share went from 7% to 17% over the same period.

The impact of the surge in China's exports—the so-called China shock—on labor markets has been the focus of a growing body of literature. Although a considerable part of this literature has studied the heterogeneous impact of the surge in manufacturing employment in local markets in the United States (Autor et al., 2013 and 2016; Acemoglu et al., 2016), studies focusing on other regions (such as Europe, Asia, and Africa) reveal that the effects have been felt worldwide—see Mion and Zhu (2013) for a study of Belgium, Malgoyres (2016) on France, Yamashita (2017) on Japan, Balsvik et al. (2015) on Norway, Cabral et al. (2018) on Portugal, and Edwards and Jenkins (2015) on South Africa among others. In all these analyses, the authors find significant and heterogeneous—albeit in most cases negative—impacts on wages, employment, and inequality, with varying intensities depending on workers' skill levels.

Latin American countries have not been immune to the impact of the China shock either. Country-specific analyses within the region also reveal that China has had a heterogeneous negative impact on manufacturing employment. For instance, Blyde et al. (2016) find that the surge in Chinese manufacturing goods had a negative effect on formal employment in Mexico and increased informality there. However, this impact was more severe for production workers than nonproduction workers. In Colombia, Molina (2017) finds a detrimental impact on employment growth—a 1-percentage-point increase in import penetration reduced employment growth by 8 percentage points. In Brazil, Paz (2016) also finds a negative impact on the manufacturing employment level.

This paper adds to this series of analyses by evaluating the impact of the China shock on the labor market in the manufacturing sector in Peru, which is an interesting context for two reasons. First, the Peruvian labor market has one of the highest rates of informality in Latin America. In fact, Peru has the third-highest informality rate in the region among the poorest quintile of the per-capita family income distribution.[2] Within the manufacturing sector, nearly 80% of the labor force are workers who do not contribute to the social security system. While informality could be seen as being preferable to a paralyzed economy with regulation-induced rigidities (Loayza, 2007), it is generally deemed undesirable because firms in this sector are normally smaller and less productive (Levy, 2018); and jobs in the informal sector—whether in unregistered firms or registered firms that do not comply with labor-market regulations—are associated with worse working conditions (Goldberg and Pavcnik, 2003). Reducing informality is one of the most important challenges facing the Peruvian economy, so if we want to assess the impact of the China shock on the Peruvian labor market, it is important to understand how the inflow of manufacturing goods from a low-cost competitor like China impacted the state of informality in the Peruvian labor market. Did it push establishments to cut their labor costs such that it brought about a move from the formal to the informal sector? Did it affect workers in the informal sector differently to those in the formal sector?

Second, another aspect important to consider when studying the Peruvian manufacturing sector during the past decade is that Peru experienced unprecedented growth in parallel with and throughout the peak of the surge in China's exports to the world as a result of its own structural reforms and favorable external conditions (the commodities boom). In keeping with the growth of the economy as a whole, the Peruvian manufacturing sector's output and labor force expanded throughout the decade. In a context like this, marked by the interplay of two opposing forces, was the surge in import competition from Chinese manufacturing products strong enough to counteract the expansion of the sector and to slow growth for some firms or even push others from the market? Or did the surge act as a catalyst for some firms—that were already growing—to adjust their strategies product-wise, affecting their demand for the different types of labor in an attempt to become more competitive?

[2] Informality in Peru also ranks among the highest in the region in all other income quintiles, according to OECD/CIAT/IDB (2016).

Using data from the Peruvian Household Survey (*Encuesta Nacional de Hogares*, ENAHO) for 2001–2010 and following Paz (2014), we address these questions and study the impact of the China shock on transitions between the formal and informal sectors and then on wages in both sectors.[3] While we find no evidence that the China shock had an overall impact on the probability of being employed in the informal sector, we break down our analysis by workers' education levels and find that the surge in import competition increased the likelihood of being hired in the informal sector among workers with no more than elementary education—arguably, some of the less-skilled workers. Turning to the impact on wages, we find that the surge in import competition from Chinese manufacturing goods was detrimental to workers with either no education or elementary education, mainly in the informal sector. These results are robust to the use of an alternative exclusion restriction in the estimation of the probability of having a job in the informal sector. Finally, when we account for industry-level growth, we find that the results for the less educated groups remain robust. We also find evidence—albeit weaker—that the wages of workers with the highest levels of education in the formal sector improved.

Our work is related to different strands of the literature. First, regarding the impact of the China shock, we follow the group of studies that exploit variation in import exposure to Chinese competition at the industry level—Bernard, Jensen, and Schott (2006) and Mion and Zhu (2013).[4] One difference between our study and these papers is that our analysis focuses on workers and informality as opposed to plant-level outcomes. In terms of the findings themselves, our results are largely consistent with the results in all the aforementioned analyses of the China shock. We find significant heterogeneity in the effects of the import surge that vary according to workers' level of education.

Our study is not the first to have examined the impact of the China shock in Peru. In fact, previous research looking at the impact of the China shock on Peruvian exports suggests that the tougher competition from Chinese products acted as an incentive for some Peruvian exporting firms to become more productive and expand. For instance, Rabanal and Rabanal (2016) look at firm-level Peruvian exports from all sectors and find that Chinese competition had a positive effect on Peruvian firms' exports to a given destination. The authors find an explanation for this in the fact that tougher competition from Chinese goods may have forced Peruvian exporters to differentiate themselves from Chinese supply and/or enhance their productivity. This evidence is consistent with the experience of the Peruvian apparel industry, which responded to the intense competition from China by reallocating idle factors and upgrading quality (Medina, 2018).[5] This study complements the existing research by providing evidence on the impact of the China shock in Peru from the worker's perspective.

Finally, this paper is also connected to the literature that addresses the effect of trade shocks on informality and suggests that trade shocks such as greater exposure to import competition impact informality in a given country by pushing firms in the domestic market to hire more informal workers in an attempt to cut labor costs. Dix-Carneiro and Kovak (2017) find that regions in Brazil that were more exposed to trade as a result of larger tariff cuts experienced a prolonged decline in formal labor. In Vietnam, McCaig and Pavcnik (2015) explore the transitions between formal and informal employment by worker characteristics as the country developed. They find that less-educated workers (who are more likely to be older and female) are less likely to transition into formalization, while the more educated (mainly younger male workers) are more likely to move from the informal to the formal sector. In Peru itself, Cisneros-Acevedo (2016) identifies two margins of informality—workers in unregistered firms and workers in registered firms that are not complying with labor laws—and finds that while trade liberalization increases the likelihood of being hired as an "undeclared" worker by a registered firm, they also reduce informality by pushing unregistered, less efficient firms out of the market. When combined, the latter effect prevails. Our results are still consistent with these findings to a certain extent: given the definition of informality used in this paper, which is defined at the worker level regardless of the status

[3] For the purpose of this analysis, we define informality at the individual level, based on whether the worker makes payments to the social security system, regardless of whether they work for a formal or informal establishment.

[4] Another methodological approach that is widely used in the same literature exploits variation across local labor markets (Autor et al., 2013 and 2016 and Acemoglu et al., 2016). However, for reasons that will be explained later in the paper, we opted for the industry-level analysis.

[5] Similarly, Castellares (2015) also finds evidence of the quality-upgrading strategy in the apparel industry. He finds that more productive firms use more expensive intermediate inputs to produce higher-quality goods.

of the firm the individual works for, even if the share of formal firms increases (as Cisneros-Acevedo finds), the share of informality could still rise as formal firms may be hiring more workers "off-the-books."

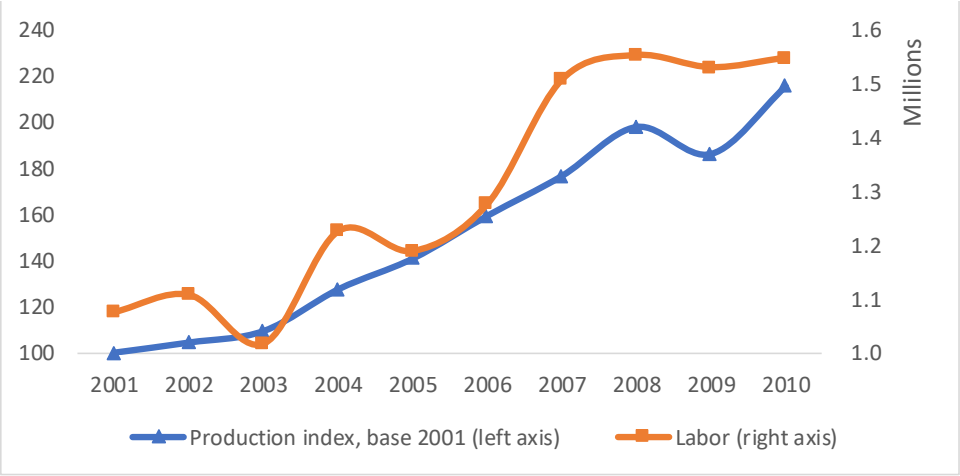
The paper is organized as follows. Section 2 provides an overview of the main trends and characteristics of the manufacturing sector in Peru, mainly over the past decade, and of the importance that China has gained as an import provider for Peruvian markets. Section 3 discusses the methodology used for the econometric analysis of the impact and presents the key features of the data on labor and informality. Section 4 reports on the results from the estimations of the model to assess the impact of the China shock. Section 5 concludes.

2. THE PERUVIAN MANUFACTURING SECTOR AND THE PRESENCE OF CHINESE MANUFACTURING IMPORTS

A. The Manufacturing Sector in Peru

Although the manufacturing sector is not as predominant in the Peruvian economy as it is in other countries in Latin America, it remains a nontrivial source of output and employment.[6] On average, it represented 16% of the country's GDP in 2001–2010 and concentrated 10.5% of the labor force in 2008–2012.[7] Looking at the sector's evolution during the first decade of the 2000s, although there was a slowdown after the financial crisis toward the end of the decade, both output and labor expanded steadily throughout (figure 1). The expansion in the number of workers in the manufacturing sector is particularly remarkable. In absolute terms, the labor force in the manufacturing sector grew 19% between 2001 and 2010, after only growing 1% in the previous decade. In relative terms, while the labor force in the manufacturing sector expanded substantially, labor decreased 22% in the agriculture sector in 2001–2010 and only increased by 10% in the services sector.[8]

FIGURE 1: MANUFACTURING OUTPUT AND LABOR IN PERU, 2001–2010



Source: Compiled by the authors based on INEI and ENAHO

Note: Total manufacturing labor includes formal and informal employment

Within the Peruvian manufacturing sector, the largest industries in terms of their contribution to the sector's total value-added are those related to metals, minerals, and apparel, in descending order. Together, these account for over a third of the country's manufacturing output on average for 2007–2010. They are followed by industries such as food, chemicals, and textiles.

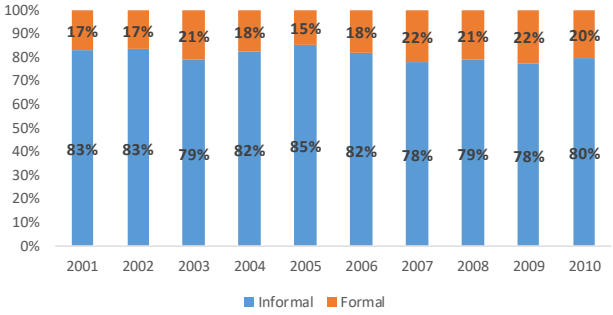
[6] Based on information from the World Development Indicators, the average value-added of the manufacturing sector as a share of GDP over 2001–2010 is slightly higher in Peru than the average for Latin America as a whole over the same period (15%).
[7] The source of this information is the Peruvian Central Bank (BCRP) and the National Institute of Statistics (INEI).
[8] World Development Indicators.

In terms of employment, the manufacturing labor force was 1.3 million workers on average in 2000–2010 and was heavily concentrated in a few industries. Over two-thirds of the workers in the sector were employed in just four industries: textiles and apparel combined accounted for almost one-third of the labor force, followed by food and furniture with 22% and 14%, respectively.

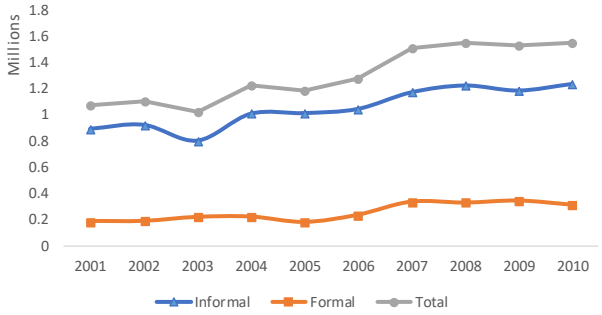
Setting aside the high concentration of the labor force among the manufacturing industries, the most outstanding feature of the manufacturing labor force in Peru is that most workers operate in the informal sector.[9] Peru has one of the highest rates of informality in the Latin American region (OECD/CIAT/IDB, 2016). Although the share of workers in the informal sector has slightly decreased in the last years, figure 2 (panel a) shows that 80% of the manufacturing labor force remains within it. Figure 2 (panel b) shows that labor in both the formal and informal sectors grew during the past decade, although the formal sector expanded at a faster pace until the financial crisis and contracted slightly after.

FIGURE 2: MANUFACTURING LABOR FORCE, FORMAL VS. INFORMAL SECTOR 2001–2010

A. Share of Workers: Formal vs. Informal Labor in Peru



B. Number of Workers: Manufacturing Labor Force, Formal vs. Informal Sector



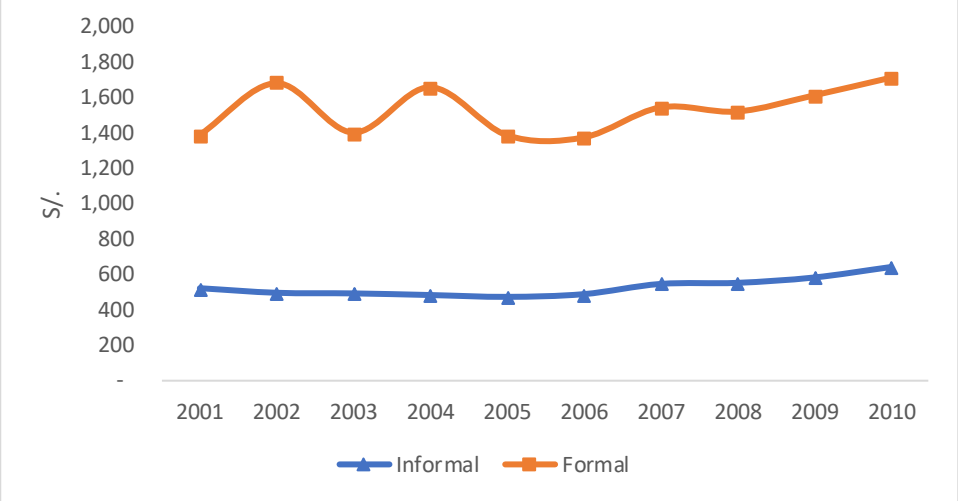
Source: Compiled by the authors based on ENAHO.

Informality permeates all industries in the manufacturing sector, but its intensity varies by industry. Table 1 shows that in 2010, industries such as leather and footwear, apparel, furniture, textiles, and wood—some of them labor-intensive—had the highest participation of informal workers, with levels above 80%. In contrast, basic metals and chemicals registered levels below 40%. With respect to changes in the presence of informal workers between 2001 and 2010, informality intensified in industries such as motor vehicles, paper, and printing products. Coincidentally, these sectors also experienced a significant increase in the presence of Chinese imports during the same period.

Finally, real average wages in both formal and informal sectors grew, albeit modestly, in tandem with the growth in the labor force over 2001–2010. Comparing the values from 2010 with those of 2001, we observe that wages in both sectors grew 23% (figure 3). However, there are major variations across industries. Table 2 reveals that workers in the wood, basic metals, and radio and TV industries saw their overall real salaries improve while the largest drops in both the formal and informal sectors were observed in publishing and printing, rubber and plastic, and textiles and motor vehicles, which were coincidentally some of the industries where informality grew the most.

[9] Following the definition stated for the Peruvian Household survey—our main source of information, described in the following sections—a job is considered informal when it corresponds to workers that do not report payments to the Social Security System.

FIGURE 3: MANUFACTURING REAL WEEKLY WAGES, FORMAL VS. INFORMAL SECTOR, 2001–2010

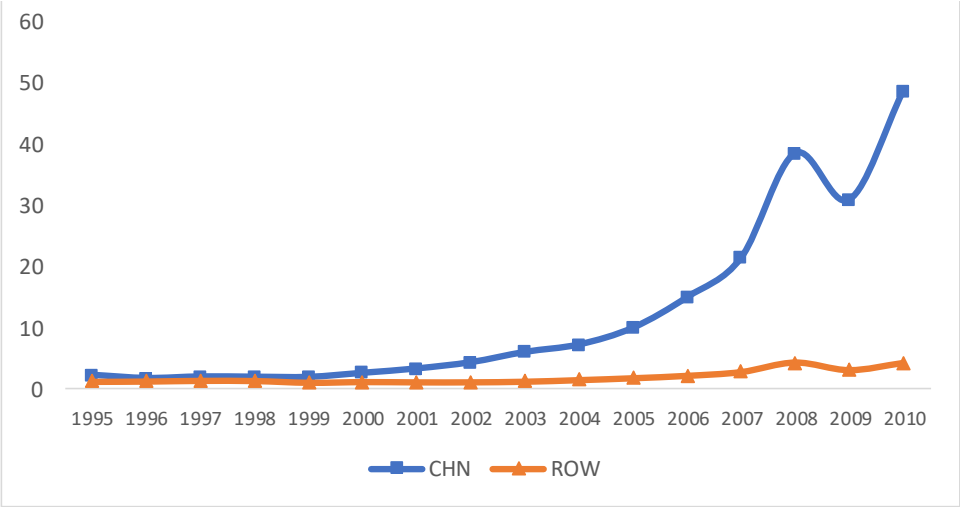


Source: Compiled by the authors based on ENAHO

B. The Rise of China as the Main Import Provider for Peru

As the manufacturing sector expanded over 2001–2010, so did the inflow of Chinese goods as a share of Peruvian manufacturing imports, which multiplied almost 15 times over the period. This variation is remarkable for two different reasons (see figure 4). First, the increase of Chinese imports during the 2000s was notoriously different from what was observed in imports from the rest of the world, which only multiplied fourfold over the same period. Second, although imports from China started growing in the late 1990s, the surge became noteworthy in the early 2000s (around the time of China's entry to the WTO) and grew steadily throughout the 2000s. Focusing the study of the impact of the surge in import competition from China in Peru in 2001–2010 thus seems to be an inappropriate choice timewise.

FIGURE 4: IMPORT GROWTH: CHINA VS. REST OF THE WORLD, 1995–2011. RATIO (IMPORTS Y_T/IMPORTS Y_{1994})



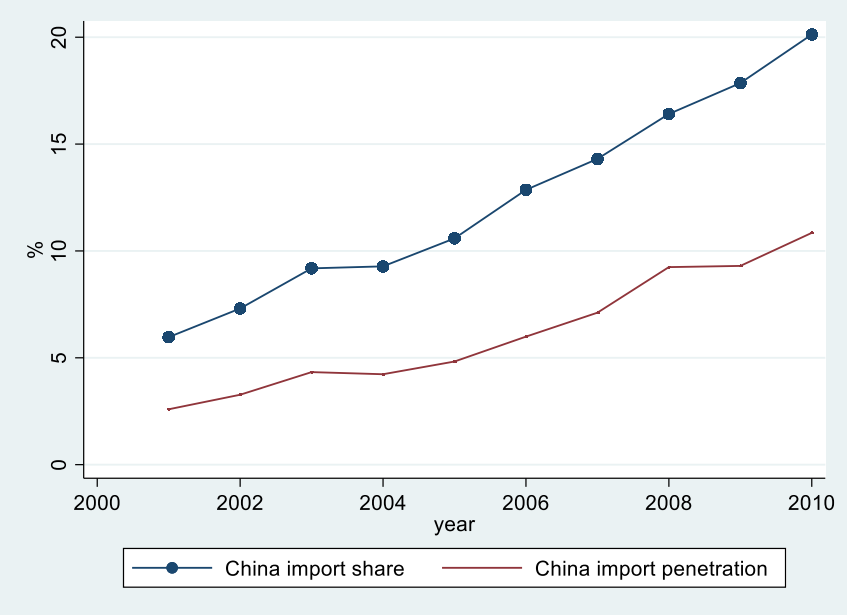
Source: Compiled by the authors based on INEI and COMTRADE.

To capture the exposure of Peruvian domestic markets to Chinese imports, an import penetration (IP) index is calculated as follows:

$$(1)\ IP_{Peru,jt} = \frac{M_{jt}^{China}}{P_{jt} + M_{jt}^{World}}$$

where IP_{jt} is the import penetration in industry j and year t, P_{jt} corresponds to the values of domestic production in industry j and year t, and M_{jt} is the total value of imported goods from either China, the rest of the world (ROW), or worldwide in industry j and year t. Figure 5 shows the import exposure variable as described above and the share of Chinese imports over the total of manufacturing imports.[10] Both measures increased significantly over time. The Chinese import share went from 5.9% in 2001 to 20.1% in 2010; meanwhile, the import exposure was 2.5% in 2001 and 10.8% in 2010.

FIGURE 5: CHINESE PRESENCE IN THE PERUVIAN MANUFACTURING SECTOR, 2000–2010



Source: Compiled by the authors based on INEI and COMTRADE.

Note: The manufacturing sector comprises sectors 15–36 in ISIC Rev. 3.

The rise of China as the main import provider for Peru is also evident when we break down the analysis by industry. On the one hand, table 3 shows that 10 out of the 18 industries in our sample had a different main provider in 2010 relative to 2001 and that China became Peru's main supplier in 8 out of these 10 industries. For instance, industries relating to computing machinery, electrical machinery, radio and TV products, rubber and plastic, metals, and nonmetallic minerals were mainly supplied by the US in 2001. In contrast, in 2010, these industries reported China as their main supplier. Furthermore, China gained importance as the main supplier during a period when the number of Peruvian trade partners in the manufacturing sector increased substantially.[11]

On the other hand, in terms of sheer Chinese presence by industry, table 4 shows that apparel, leather, and furniture were the three industries with the largest exposure to Chinese competition in 2010, with indexes of above 50%. Other industries with indexes of above 40% are textiles; radio, TV, and optical instruments; and nonmetallic products. In terms of changes in exposure to competition between 2001 and 2010, China's presence intensified in almost all

[10] The share of Chinese imports corresponds to $M\_share_{Peru,jt} = \frac{M_{jt}^{China}}{M_{jt}^{World}}$ and does not control for the domestic production of industry *j* in time *t*.

[11] The average number of trade partners by industry escalated from 58 to 83 in 2000–2010.

manufacturing industries. However, motor vehicles and paper—two of the industries where informality increased the most—were among the industries whose exposure also grew the most.

In sum, Peru has not been immune to the increased exposure to Chinese products during the period analyzed, when China has become one of the most relevant players in the Peruvian market. Despite having a greater number of trading partners in the various industries, China has managed to capture significant market share and position itself as Peru's main supplier, ahead of other key partners such as the United States.

3. EMPIRICAL METHODOLOGY AND DATA

Having described the expansion of the manufacturing sector and established the growing importance of Chinese manufacturing goods in the Peruvian market in the first decade of the 2000s, this section presents the data and the methodology used to assess how this surge in import competition affected the Peruvian manufacturing labor force.

A. Empirical Methodology

The empirical strategy follows Paz (2014), who studies the effect of tariff reductions on the share of informal manufacturing employment and wages in Brazil in 1989–2001.[12] This methodology consists of estimating the effect of growing Chinese import competition in Peru on two labor market outcomes: a) the probability of having an informal job and b) real weekly salaries in the formal and informal sectors. The model is specified as follows:

$$(2)\ y_{ijt} = \beta_0 + \beta_1 IP_{Peru,jt} + \alpha * \boldsymbol{X}_{ijt} + \beta_2 * size_{it} + \delta_t + \delta_j + e_{ijt}$$

where y_{ijt} corresponds to the outcome variable for worker i, industry j, and year t. The first outcome of interest is a binary variable that takes the value of 1 if the worker has an informal job and 0 otherwise.[13] The second outcome is the individual real weekly wage, distinguishing whether the worker is employed in the formal or the informal sector.[14]

As explanatory variables, we consider both industry- and worker-level variables. At the industry level, the main variable of interest for our analysis is IP_{jt}, which refers to the index of exposure to Chinese imports, explained in the previous section. At the individual level, we control for worker characteristics such as age, gender, and region of residence, denoted by the matrix X_{ijt}. We also include $size_{it}$, which denotes the size of the firm in which the individual works.[15] Finally, δ_t and δ_j refer to the fixed effects per year (t) and industry (j), respectively.

The model in (2) poses some econometric challenges that need to be addressed to avoid potential inconsistency and bias in the estimates.

First, as discussed in previous studies (Paz, 2014; Mion and Zhu, 2013; and Autor, Dorn, and Hanson, 2013), there is potential endogeneity between the import penetration measure (IP_{jt}) and the dependent variable in (2), to the extent that both variables might be positively correlated with unobserved shocks to Peruvian demand. Since the objective of this paper is to study how increasing import competition from China emerging from supply-driven factors affected the labor market in Peru, we need to purge the import penetration measure from other potential demand-driven shocks. For this purpose, we take an instrumental variable approach and use Chilean exposure to imports from China as an instrument. The choice of Chilean imports from China as an instrument is based on the following criteria: a) the import structure in Chile bears strong resemblance to that of Peru and b) the trade relationship between the two countries was

[12] Originally, the intention was to follow the methodology in Autor, Dorn, and Hanson (2013) and to exploit geographical variation. However, the employment shares that could be used as instruments following their methodology were heavily concentrated across local markets (provinces) in Peru. This would have introduced biases in the overall estimates (see Goldsmith-Pinkham et al., 2018, for a discussion on the plausibility of the research design implied by the use of the Bartik instruments).

[13] As stated previously, a worker is defined as being informal if they do not contribute to the social security system, regardless of the status of the firm that employs them (i.e., formal vs. informal establishments).

[14] The nominal wages are converted to real terms using Peru's consumer price index.

[15] Firm size is defined as a function of the number of workers in the following categories: micro—less than 3 workers; small—3–10 workers; medium—10–50 workers; and large—more than 50 employees.

modest during the period of analysis, therefore trade-related effects induced by Chinese competition in Chilean markets could be considered to be independent from domestic shocks that may have affected Peruvian labor outcomes.[16,17]

Additionally, the possible presence of reverse causality between labor market outcome variables and the Chinese import penetration index is a concern. For instance, industries with a higher share of informal workers (a situation which is associated with lower labor costs) might be competitive enough in the domestic market and thus face lower demand for imported goods from China, which are thus less expensive. This reverse causality concern is mitigated by the simultaneous use of outcome variables at the individual level and variables of interest at the industry level. As a worker-level decision is less likely to influence the aggregate industry-level variable of interest, potential reverse causality is less concerning.[18] In addition, as import penetration could also be correlated with unobserved industry characteristics, we will also use industry fixed effects to address this potential bias.[19]

Finally, Paz (2014) also discusses the presence of simultaneity between having an informal job and the wage reported by the worker. We follow his strategy to address this concern and use the estimates from the analysis of the probability of having a job in the informal sector as the first step in the two-step estimation process where we control for selection bias.

Thus, we estimate the worker-level probability of having an informal job as described below:

$$(3)\quad informal_{ijt} = \beta_0 + \beta_1 IP_{Peru,jt} + \beta_2 * size_{it} + \alpha * \boldsymbol{X}_{ijt} + \beta_3 * other_{it} + \delta_t + \delta_j + e_{ijt}$$

where we include a variable $other_{it}$ that is related to the individual decision to have an informal job but is not correlated with the salary that the individual receives. The "other" variable that we employ for this purpose is the current job situation of other family members in the household. Specifically, we consider whether the household reports that one of its members is being subemployed or unemployed.[20,21]

Once we estimate the first stage, we compute the inverse Mills ratio using the predicted values for informality. We use the ratio as a variable in the second stage to control for potential worker self-selection in the earning equations. The wage equations are described in (4) and (5) for the formal and informal workers, respectively.

$$(4)\quad \log\left(wage^{formal}\right)_{ijt} = \varphi_0{}^{for} + \varphi_1{}^{for} IP_{Peru,jt} + \alpha^{for} * \boldsymbol{X}_{ijt} + \varphi_2{}^{for} * size_{ijt} + \delta_t{}^{for} + \delta_j{}^{for} + \theta^{for}{}_{\varepsilon,v1}\left(\widehat{informal}_{ijt}\right) + v_{1_{ijt}}$$

$$(5)\quad \log\left(wage^{informal}\right)_{ijt} = \varphi_0{}^{inf} + \varphi_1{}^{inf} IP_{Peru,jt} + \alpha^{inf} * \boldsymbol{X}_{ijt} + \varphi_2{}^{inf} * size_{ijt} + \delta_t{}^{inf} + \delta_j{}^{inf} + \theta^{inf}{}_{\varepsilon,v2}\left(\widehat{informal}_{ijt}\right) + v_{2_{ijt}}$$

[16] In the past decade, the average annual share of Chilean imported goods in Peru's total manufacturing imports was 5%. On the export side, exports to Chile did not exceed 3% of Peru's total exports. Given that Colombia is the other South American country with similar characteristics to Chile vis-à-vis Peru, we also experimented using Colombia data as an alternative instrument. Unfortunately, the instrument built using the Colombian data did not pass the statistical tests to assess its quality and thus we only present the results using the instrument built with Chilean data.

[17] Paz (2014) uses Colombian import-tariff information as an instrument for the Brazilian trade liberalization process. In keeping with the criteria that we describe above, he evaluated similarities between the trade liberalization process that both countries underwent and the commercial ties between them, which was small relative to other partners.

[18] Ebenstein et al. (2014) present a similar argument on the reverse causality between industry-level trade variables and individual-level characteristics for their analysis of the US.

[19] See Goldberg and Pavcnik (2005) for a more detailed discussion of this type of simultaneity bias. It is also worth noting that as the individuals are not followed over time—the analysis is performed over a repeated cross-section—individual-level fixed effects cannot be included.

[20] According to the Peruvian household survey, a worker is considered subemployed if they work 30 hours or less per week but are willing to work more hours.

[21] Paz (2014) also uses the employment status of another member of the household—in this case, whether the household reports that another of its members is employed in the formal sector. We do not use this variable in our analysis as it would lead to the loss of a considerable number of observations.

Where, $\theta^{for}{}_{\varepsilon,v1}$ and $\theta^{inf}{}_{\varepsilon,v2}$ capture the potential correlation between the error term and the self-selection decision to participate in the formal or informal sector. If we ignore these components, the estimates for the impact of Chinese import penetration on wages could be biased.[22]

B. Data Description

First, as mentioned above, the worker-level variables used to observe labor outcomes come from the Peru's household survey (ENAHO) for 2001–2010. ENAHO provides information on the industry in which each respondent works. This information is available at the ISIC Rev. 3 4-digit level; however, to define an industry for our analysis, we aggregated the count of respondents at the 2-digit-level.[23] ENAHO provides a rich set of worker-level variables and allows us to control for observable individual characteristics such as gender, age, marital status, race, years and level of education, and geographic location, among others.

Second, the trade-related information needed to build the variables that capture exposure to Chinese manufacturing goods and export trends is taken from the UN COMTRADE database for 2001–2010. The domestic production data for Peru comes from the Peruvian National Institute of Statistics (*Instituto Nacional de Estadistica e Informatica*, INEI) in local currency (INEI, 2012). The domestic production data for Chile is taken from the country's National Industrial Survey (*Encuesta Nacional Industrial Annual*, ENIA). Given that the data on domestic production as presented in INEI follows a local industry classification that is slightly different to ISIC Rev. 3 (the groupings differ for some industries), we adjusted all the variables from the sources mentioned above such that they follow the classification used by INEI. There are 18 industries in total. The details of the concordance between the classifications can be found in appendix 1. Finally, the measure of import exposure is calculated in local currency to mitigate the impact of exchange-rate devaluations.[24]

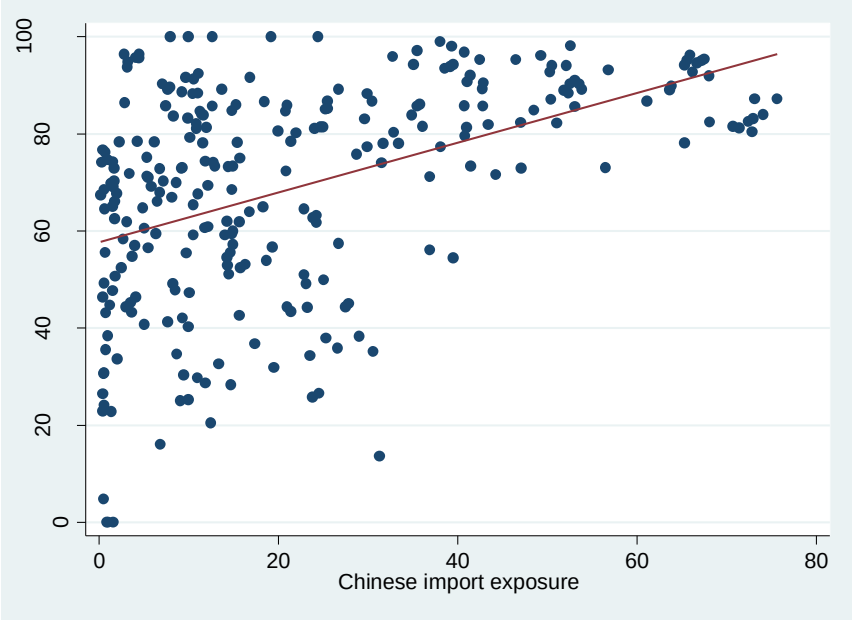
A preliminary correlation analysis between Chinese import exposure in Peru and the outcomes of interest suggests that more competition from China in manufacturing is associated with higher shares of informality (figure 6). Meanwhile, figure 7 reveals that more competition from China might be associated with lower real wages in the manufacturing sector. A robust analysis of these relationships follows.

[22] If $\boldsymbol{\theta^{for}}_{\varepsilon,v1}$ and $\boldsymbol{\theta^{inf}}_{\varepsilon,v2}$ are statistically significant in the second stage, it would suggest evidence of a correlation between the error terms and the importance of controlling for these components.

[23] The industrial activities considered in the sample fall between ISIC Rev. 3 classes 1500 and 3699. The purpose of aggregating to the 2-digit level is to have enough observations per industry while preserving a certain degree of variation across groups.

[24] In the event of a devaluation, the import penetration index increases because of currency adjustments, even though this might not be directly related to a real increase in imports. To address this issue, we use the real effective exchange rate (REER) reported by the IMF-IFS to build a nominal exchange rate that keeps the REER constant over 2001–2011. This exchange rate is employed to convert imports from USD to local currency.

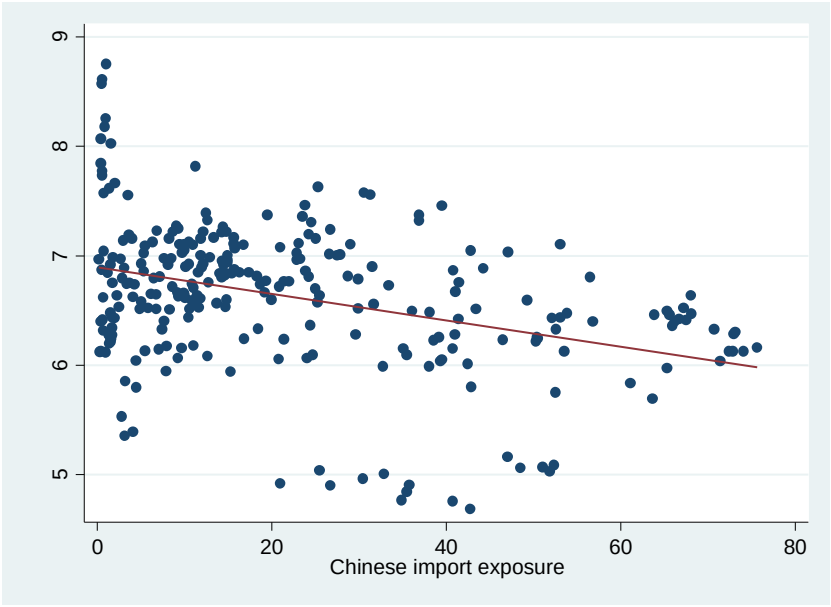
FIGURE 6: CORRELATION BETWEEN THE SHARE OF INFORMALITY AND CHINESE IMPORT EXPOSURE BY INDUSTRY WITHIN THE MANUFACTURING SECTOR



Source: Authors' calculations based on ENAHO, INEI, and COMTRADE.

Note: The unit in the graph represents the informality share in an industry-year, the industry is defined as 2-digits ISIC rev. 3 in categories 15 to 36.

FIGURE 7: CORRELATION BETWEEN LOG REAL WAGES AND CHINESE IMPORT EXPOSURE WITHIN THE MANUFACTURING SECTOR



Source: Authors' calculations based on ENAHO, INEI, and COMTRADE

Note: The unit in the graph represents the share of informality in an industry-year. The industry is defined at the 2-digit level and comprises categories 15 to 36 in ISIC Rev. 3.

4. ESTIMATION RESULTS

In this section, we present our results. We begin by estimating the effect of import competition from China on the likelihood of finding a job in the informal sector in Peru, and then evaluate the impact of import competition from China on the wages of formal and informal workers.

A. Probability of Being Hired in the Informal Sector

Table 5 presents the results from estimating equation (3). Columns (1) to (3) show the results considering the overall index for Chinese import exposure (IP). Each column reflects the results using a different technique: we use OLS in in column (1), probit in column (2), and IVprobit in column (3) using the Chinese import exposure in Chile as an instrument. Columns (4) to (6) follow the same structure in terms of econometric techniques but the impact of the import exposure index is allowed to differ according to workers' education levels.

We include four ENAHO education categories: a) no education at all, b) elementary education (whether complete or not), c) high-school education (whether complete or not), and d) college education (whether complete or not). Individuals in the high-school education category represent the largest share of workers, accounting for 50% of the labor force in manufacturing over the period analyzed, on average.[25] Their presence is more prominent in the leather, furniture, and apparel industries. However, the share of workers in the other groups is not trivial: workers with a college education represent 23% of the labor force in the manufacturing sector, workers with an elementary education represent 22%, and workers with no education represent 4%. Workers with a college education are the most prominent group in the formal sector and they are mostly employed in industries such as electrical machinery, metals, chemicals, office and computing equipment, and coke. Workers with an elementary education are more important in the informal sector, and in terms of industries, they are mostly employed in the textile, nonmetallic, and wood products sectors.

The results in columns (1) to (3) show that Chinese import penetration has no impact on the overall probability of being employed in the informal sector. However, when we allow the impact to differ by level of education in columns (4) to (6), we find evidence of a negative impact (greater informality) among the group of workers with lower levels of education (elementary) and a positive impact (less informality) among the better-educated workers using OLS and probit estimations (columns 4 and 5). When we use the IVprobit estimation (column 6), the results only hold for the group of workers with an elementary-level education. The result for this latter group of workers means that the probability of a typical member finding a job in the informal sector increases by 7.8% as a result of the increase in the Chinese import penetration index between 2001–2010.[26] The results for workers with a college education are no longer significant.

As we mentioned earlier, Peru experienced remarkable growth throughout the past decade in parallel with the peak of the China shock. Therefore, as a robustness check for the result in (6), we also control for the average growth rate for domestic production in each industry over 2001–2010 in column (7). The coefficient mentioned above for the group of workers with an elementary education remains robust. Higher exposure to imports of Chinese manufacturing goods increases informality among workers with an elementary-level education. If for example, we consider a worker with the same characteristics described for the results in (6)—that is, someone who is employed in the average industry with annual growth of 8.4%—the probability their finding a job in the informal sector increases 8.9% as result of Chinese import competition.[27]

Finally, in column (8), we used an alternative variable to control for selection bias in the second step—we consider whether the household reports that another of its members is unemployed. The result for workers with an elementary-

[25] The percentages for these categories were nearly the same within the formal and informal sectors.

[26] To obtain marginal effects, we computed the observed change in the probability of having an informal job by setting the explanatory variables at the sample mean and exploring the changes in this probability that derived from the increase in Chinese import exposure from 2.5 to 10.9, as reported between 2001 and 2010. For the estimation of the marginal effect reported here, the average individual in the sample corresponds to a single male worker who is 35 years old, has 10 years of education, and works in a small firm located in Lima.

[27] The average annual industry growth corresponds to the sample mean for the industry development variable in the period analyzed.

level education holds with a similar magnitude as in (6). The likelihood of finding a job in the informal sector for a worker with an elementary-level education and the same features as described before increases by 7.7% due to Chinese import competition, which is consistent with the results reported for model (6).

B. Impact on Average Formal and Informal Wages

Table 6 shows the results from the second stage, in which we analyze the impact of exposure to manufacturing imports from China on wages. We use two-stage least squares as the econometric technique in all columns. Columns (1) to (3) show the results for impact of overall exposure to Chinese imports on overall wages, and then wages in the informal and formal sectors, respectively. We find no evidence of overall impact from Chinese imports in either sector.

However, when we decompose the impact by workers' education levels as we did in the previous table, columns (4) to (6) show that the least educated workers—those with either no education or an elementary-level education only—saw their wages negatively affected, mainly in the informal sector (where they are more prominent). For example, for workers with no education in columns (4) to (6), the results suggest that a 1-percentage-point increase in exposure to Chinese import competition lowered salaries by 2.5% in the informal sector and 2.7% overall. The results for workers with an elementary-level education reveal a similarly detrimental effect on wages. A 1-percentage-point increase in exposure to Chinese import competition decreases these workers' salaries by 1.2%. This result is significant for overall wages and in the informal sector, where their presence is larger. Therefore, considering that the Chinese import exposure index increased 8.4 percentage points in 2001–2010, these results suggest that real wages for workers with no education decreased 21% in the informal and 22.6% overall, whereas informal workers with only an elementary-level education experienced a reduction of 10% over the same period. The results for all other groups of workers are not statistically significant.

In columns (7) to (9), we use the inverse Mills ratios with the alternative exclusion restriction—another household member who is unemployed—and the results remain unchanged.

Two technical aspects to note in this estimation are that a) the coefficients for the Mills ratios built from the first-stage regression are significant in almost all the specifications, which suggests that controlling for self-selection into informal jobs is adequate when studying the effect of the China shock on wages; and b) using Chile's exposure to Chinese imports is an appropriate instrument.[28]

The results in table 7 repeat the estimation in columns (4) to (9) from table 6 but controlling for industry growth—output annual growth at the industry level—given the expansion of the manufacturing sector over this period. In columns (1) to (3), the inverse Mills ratios are built using the variable that considers whether another household member is subemployed, while columns (4) to (6) do the same using the variable that considers whether another household member is unemployed. The results for the least-educated workers—those with no education or an elementary-level education only—remain robust and are similar in magnitude. However, the results for workers with a college education—arguably the most-skilled workers—become significant, mainly in the formal sector, where their presence is more prominent. In particular, the results indicate that a 1-percentage-point increase in exposure to Chinese import competition improved the salaries of workers with a college education by 0.6%.[29]

5. CONCLUSIONS

[28] Using the conventional critical values for the weak identification test, the results in columns (4) to (9) would suggest that the F-test for the Chilean exposure variable for instrumenting Chinese imports is relatively low. Nonetheless, as the critical reference values suggested by Stock and Yogo (2005) are derived under a homoscedasticity assumption, we have no proper critical reference values to consider for the F-test and p-values obtained in table 6 based on clustered standard errors in our model.

[29] This result could suggest that some firms in industries that are more exposed to import competition from China may have followed skill-upgrading strategies as a response to more intense competition. In fact, this would also be consistent with the findings from previous work cited above on the effect of the China shock in Peru (Castellares, 2015; Medina, 2015). However, it is important to be cautious when interpreting this result. Although the industry development and the import exposure variables have a correlation coefficient of -0.11, they are not fully independent. In addition, the results for workers with a college education are barely significant in some cases and are generally not as significant and robust as the results for workers with no education or just an elementary-level education.

The impact of the surge in competition from Chinese manufacturing products on labor markets in different countries has been largely documented. This paper adds to the literature by presenting the experience of the labor market in the manufacturing sector in Peru—a country that experienced a decade of unprecedented growth at exactly the same time as the peak in the surge in China's exports to the world. Given the high proportion of informal workers in the Peruvian labor market, the focus of this work is the impact on informality and wages, accounting for the differences in the workers' level of education.

The literature on the impact of the China shock has already established the presence of heterogeneous effects across different groups of workers, and the results for Peru confirm this. We find robust evidence that the China shock has had a detrimental effect on informality and wages among the least educated, who are arguably the least-skilled workers in the sample. We also find mixed evidence for the better-educated workers: although the baseline estimations do not reveal a significant impact on their salaries, we find a positive and significant effect once we account for industry-level growth.

From a policy perspective, this paper sheds light on the on the importance of focusing on the more vulnerable groups of the population—workers with no education and those with an elementary-level education—when designing policies and programs intended to mitigate the impact of the increase in Chinese imports on the manufacturing sector in Peru.

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TABLES

TABLE 1: SHARE OF INFORMAL WORKERS BY INDUSTRY (LEVEL AND CHANGES), 2001–2010

Sector	Informality share 2001	Informality share 2010	Change 2001-2010
Leather and footwear	93%	93%	-0.73%
Furniture and manufacturing n.e.c.	96%	93%	-3.31%
Radio, TV, optical inst	100%	91%	-9.27%
Textiles	86%	89%	3.98%
Wood products	94%	89%	-4.85%
Apparel	90%	84%	-7.01%
Metal products, except m&e	84%	81%	-2.67%
Non-metallic products	88%	81%	-7.92%
Motor vehicles and transport equip, TV	51%	78%	54.52%
Food, beverages and Tobacco	74%	74%	0.07%
Publishing and printing	63%	73%	16.78%
M & E, & office & computing	71%	63%	-11.31%
Paper and paper products	46%	57%	21.84%
Electrical machinery	71%	44%	-37.47%
Rubber and plastics	40%	43%	7.85%
Coke and petroleum	100%	38%	-61.59%
Basic metals	36%	38%	6.67%
Chemicals	58%	30%	-47.95%

Source: Compiled by the authors based on ENAHO.

TABLE 2: REAL AVERAGE WEEKLY WAGES BY INDUSTRY, INCLUDES FORMAL AND INFORMAL SECTOR (LEVEL AND CHANGES), 2001–2010

Sector	2001 (/s.)	2010 (/s.)	Change 2001-2010
Food, beverages and Tobacco	642.1	848.0	32.1%
Textiles	447.5	334.2	-25.3%
Apparel	565.6	657.6	16.3%
Leather and footwear	847.7	781.7	-7.8%
Wood products	338.9	868.2	156.2%
Paper and paper products	1153.8	1782.3	54.5%
Publishing and printing	1896.6	1055.6	-44.3%
Coke and petroleum	793.4	5099.0	542.7%
Chemicals	2009.3	2901.0	44.4%
Rubber and plastics	1713.1	1039.8	-39.3%
Non-metallic products	769.4	909.4	18.2%
Basic metals	1565.7	3152.8	101.4%
Metal products, except m&e	1164.9	1558.0	33.7%
M & E, & office & computing	1504.1	1447.1	-3.8%
Electrical machinery	985.7	1395.7	41.6%
Radio, TV, optical inst	563.4	1071.3	90.2%
Motor vehicles and transport equip, TV	1519.7	1218.6	-19.8%
Furniture and manufacturing n.e.c.	582.4	822.6	41.2%

Source: Compiled by the authors based on ENAHO.

TABLE 3: MAIN TRADE PARTNER BY INDUSTRY, 2000 VS 2010

Sector	2000	2010
Food, beverages and Tobacco	USA	ARG
Textiles	KOR	CHN
Apparel	CHN	CHN
Leather and footwear	CHN	CHN
Wood products	CHL	CHL
Paper and paper products	CHL	CHL
Publishing and printing	USA	USA
Coke and petroleum	NGA	USA
Chemicals	USA	USA
Rubber and plastics	USA	CHN
Non-metallic products	USA	CHN
Basic metals	VEN	CHN
Metal products, except m&e	USA	CHN
M & E, & office & computing	USA	CHN
Electrical machinery	USA	CHN
Radio, TV, optical inst	USA	CHN
Motor vehicles and transport equip, TV	JPN	JPN
Furniture and manufacturing n.e.c.	CHN	CHN

Source: Authors' calculations based on COMTRADE.

TABLE 4: CHINESE IMPORT EXPOSURE IN PERUVIAN BY INDUSTRY (%), 2001 VS 2010

Sector	2001	2010	Change 2001-2010
Food, beverages and Tobacco	0.3	1.5	398.9%
Textiles	21.0	42.8	104.1%
Apparel	52.5	74.1	41.1%
Leather and footwear	38.6	66.2	71.7%
Wood products	3.1	7.6	143.5%
Paper and paper products	0.4	5.4	1317.1%
Publishing and printing	1.7	9.3	435.6%
Coke and petroleum	9.9	1.0	-90.1%
Chemicals	2.7	9.4	252.4%
Rubber and plastics	9.9	21.4	115.5%
Non-metallic products	11.0	41.0	272.0%
Basic metals	0.7	25.3	3434.7%
Metal products, except m&e	8.3	25.0	202.1%
M & E, & office & computing	5.3	24.3	353.4%
Electrical machinery	5.5	21.0	284.0%
Radio, TV, optical inst	7.9	41.1	418.1%
Motor vehicles and transport equip, TV	1.8	15.4	760.3%
Furniture and manufacturing n.e.c.	32.8	50.3	53.6%

Source: Authors' calculations based on INEI and COMTRADE.

TABLE 5: ESTIMATION RESULTS, FIRST STAGE—PROBABILITY OF HAVING A JOB IN THE INFORMAL SECTOR

VARIABLES	(1) Informality	(2) Informality	(3) Informality	(4) Informality	(5) Informality	(6) Informality	(7) Informality	(8) Informality
Chinese Import Exposure (%)	3.53e-05	-0.000904	-0.00173					
	(0.000248)	(0.00175)	(0.00571)					
China I.E. * workers with no education				0.000390	0.00828	0.00784	0.00840	0.00786
				(0.000346)	(0.00655)	(0.00831)	(0.00830)	(0.00828)
China I.E. * workers with elementary education				0.000418	0.00833***	0.00934*	0.0107**	0.00923*
				(0.000276)	(0.00243)	(0.00527)	(0.00523)	(0.00528)
China I.E. * workers with high school education				0.000134	-2.93e-06	0.000186	0.00164	8.40e-05
				(0.000279)	(0.00176)	(0.00443)	(0.00421)	(0.00444)
China I.E. * workers with college education				-0.000497*	-0.00401**	-0.00350	-0.00222	-0.00361
				(0.000300)	(0.00184)	(0.00426)	(0.00415)	(0.00426)
Other family member is sub employed	0.0155	0.229**	0.229**	0.0158*	0.225**	0.225**	0.253**	
	(0.0106)	(0.115)	(0.114)	(0.00893)	(0.101)	(0.101)	(0.114)	
Industry development							-0.167	
							(0.129)	
Other family member is unemployed								0.204
								(0.165)
1st stage results - IV Probit								
Chinese Import Exposure (%)			0.613***					
			(0.1464)					
China I.E. * workers with no education						0.990***	0.984***	0.990***
						(0.0608)	(0.0584)	-0.0608
China I.E. * workers with elementary education						1.032***	1.041***	1.032***
						(0.0602)	(0.0639)	(0.0602)
China I.E. * workers with high school education						0.905***	0.980***	0.905***
						(0.0778)	(0.1253)	-0.0778
China I.E. * workers with college education						1.085***	1.107***	1.085***
						(0.0351)	(0.0460)	-0.0351
Observations	25,801	25,801	25,801	25,801	25,801	25,801	23,155	25,801
R-squared	0.469			0.470				
Instrument	No	No	IP Chile	No	No	IP Chile	IP Chile	IP Chile
Method	OLS	PROBIT	IVPROBIT	OLS	PROBIT	IVPROBIT	IVPROBIT	IVPROBIT
Exogeneity Test p-value	N/A	N/A	0.870	N/A	N/A	0.665	0.781	0.665

Note: Errors are clustered at the sector-year level. Industry and year fixed effects included in all specifications. Individual controls included: age, age^2, gender, race, firm-size, location. Sample weights used. *** p<0.01, ** p<0.05, * p<0.1

TABLE 6: ESTIMATION RESULTS, SECOND STAGE

VARIABLES	(1) Wages All	(2) Wages Informal	(3) Wages Formal	(4) Wages All	(5) Wages Informal	(6) Wages Formal	(7) Wages All	(8) Wages Informal	(9) Wages Formal
Chinese Import Exposure (%)	-0.00226	-0.00359	-0.00196						
	(0.00872)	(0.00986)	(0.00216)						
China I.E. * workers with no education				-0.0269***	-0.0252***	-0.00420	-0.0270***	-0.0252***	-0.00473
				(0.00571)	(0.00582)	(0.00567)	(0.00571)	(0.00583)	(0.00564)
China I.E. * workers with elementary education				-0.0124***	-0.0119***	0.000235	-0.0124***	-0.0119***	-0.000721
				(0.00435)	(0.00456)	(0.00336)	(0.00435)	(0.00456)	(0.00334)
China I.E. * workers with high school education				-0.00125	-0.00170	-0.00368	-0.00128	-0.00170	-0.00371
				(0.00313)	(0.00353)	(0.00308)	(0.00313)	(0.00353)	(0.00302)
China I.E. * workers with college education				0.00455	0.00367	0.00137	0.00454	0.00370	0.00176
				(0.00285)	(0.00337)	(0.00337)	(0.00285)	(0.00337)	(0.00329)
Inverse mills ratio (sub-employed)	0.120	-0.198	1.634***	-0.107	-0.444***	1.312***			
	(0.120)	(0.169)	(0.268)	(0.0799)	(0.0879)	(0.209)			
Inverse mills ratio (unemployed)							-0.138*	-0.479***	1.135***
							(0.0812)	(0.0896)	(0.223)
1st stage results - Instruments 2SLS									
Chinese Import Exposure (%) - 1st stage	0.614***	0.602***	0.661***						
	(0.1490)	(0.1450)	(0.1825)						
China I.E. * workers with no education - 1st stage				0.979***	0.977***	0.962***	0.978***	0.977***	0.965***
				(0.059)	(0.060)	(0.081)	(0.059)	(0.060)	(0.080)
China I.E. * workers with elementary education - 1st stage				1.028***	1.012***	1.123***	1.027***	1.012***	1.121***
				(0.061)	(0.061)	(0.078)	(0.061)	0.061	(0.078)
China I.E. * workers with high school education - 1st stage				0.907***	0.899***	0.916***	0.906***	0.890***	0.917***
				(0.078)	(0.076)	(0.105)	(0.078)	0.076	(0.105)
China I.E. * workers with college education - 1st stage				1.082***	1.107***	0.945***	1.082***	1.108***	0.944***
				(0.035)	(0.033)	(0.063)	(0.035)	(0.033)	(0.062)
Observations	23,931	19,837	4,094	23,931	19,837	4,094	23,931	19,837	4,094
R-squared	0.500	0.464	0.272	0.523	0.486	0.284	0.523	0.486	0.281
Instrument	IP Chile	IP Chile	IP Chile	IP Chile	IP Chile	IP Chile	IP Chile	IP Chile	IP Chile
Method	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Weak IV F-test	17.60	16.79	18.72	4.277	4.344	3.241	4.276	4.344	3.250
Underidentification p-value	0.0957	0.0936	0.111	0.00193	0.00184	0.00498	0.00193	0.00184	0.00496

Note: Errors are clustered at the sector-year level. Industry and year fixed effects included in all specifications. Individual controls included: age, age2, gender, race, firm-size, location. Sample weights used. *** p<0.01, ** p<0.05, * p<0.1

TABLE 7: ESTIMATION RESULTS, SECOND STAGE, INCLUDING INDUSTRY DEVELOPMENT

VARIABLES	(1) Wages All	(2) Wages Informal	(3) Wages Formal	(4) Wages All	(5) Wages Informal	(6) Wages Formal
China I.E. * workers with no education	-0.0249***	-0.0239***	-3.37e-05	-0.0250***	-0.0239***	-0.00120
	(0.00504)	(0.00520)	(0.00567)	(0.00505)	(0.00520)	(0.00567)
China I.E. * workers with elementary education	-0.0109***	-0.0111***	0.00489	-0.0110***	-0.0112***	0.00295
	(0.00372)	(0.00402)	(0.00361)	(0.00372)	(0.00402)	(0.00364)
China I.E. * workers with high school education	0.000152	-0.00101	0.00158	9.66e-05	-0.00103	0.00112
	(0.00239)	(0.00296)	(0.00306)	(0.00239)	(0.00296)	(0.00306)
China I.E. * workers with college education	0.00597***	0.00446	0.00616*	0.00595***	0.00446	0.00643**
	(0.00220)	(0.00292)	(0.00325)	(0.00220)	(0.00292)	(0.00321)
Inverse mills ratio (sub-employed)	-0.0890	-0.454***	1.318***			
	(0.0840)	(0.0887)	(0.216)			
Inverse mills ratio (unemployed)				-0.121	-0.488***	1.025***
				(0.0849)	(0.0895)	(0.225)
Industry development	0.140**	0.156**	-0.134*	0.141**	0.156**	-0.106
	(0.0570)	(0.0691)	(0.0698)	(0.0572)	(0.0693)	(0.0696)
1st stage results - Instruments 2SLS						
China I.E. * workers with no education - 1st stage	0.974***	0.972***	0.964***	0.975***	0.973***	0.964***
	(0.057)	(0.057)	(0.080)	(0.057)	(0.572)	(0.080)
China I.E. * workers with elementary education - 1st s	1.034***	1.022***	1.107***	1.035***	1.024***	1.105***
	(0.064)	(0.066)	(0.077)	(0.064)	(0.065)	(0.078)
China I.E. * workers with high school education - 1st s	0.980***	0.973***	0.974***	0.975***	0.967***	0.975***
	(0.128)	(0.122)	(0.164)	(0.127)	(0.122)	(0.166)
China I.E. * workers with college education - 1st stage	1.106***	1.126***	1.010***	1.104***	1.126***	1.010***
	(0.460)	(0.040)	(0.087)	(0.045)	(0.040)	(0.086)
Observations	21,457	17,756	3,701	21,457	17,756	3,701
R-squared	0.526	0.490	0.282	0.526	0.491	0.277
Instrument	IP Chile	IP Chile	IP Chile	IP Chile	IP Chile	IP Chile
Method	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Weak IV F-test	2.521	2.565	2.565	2.520	2.565	2.565
Underidentification p-value	0.0127	0.0115	0.0115	0.0127	0.0115	0.0115

Note: Errors are clustered at the sector-year level. Industry development corresponds to the annual output growth by industry. Industry and year fixed effects included in all specifications. Individual controls included: age, age2, gender, race, firm-size, location. Sample weights used. *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX

CORRESPONDENCE TABLE BETWEEN THE ISIC 2-DIGIT CLASSIFICATION AND THE INEI CLASSIFICATION

2-digit Sector	ISIC REV 3	Classification following INEI
15	Manufacture of food products and beverages	1
16	Manufacture of tobacco products	
17	Manufacture of textiles	2
18	Manufacture of wearing apparel; dressing and dyeing of fur	3
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	4
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	5
21	Manufacture of paper and paper products	6
22	Publishing, printing and reproduction of recorded media	7
23	Manufacture of coke, refined petroleum products and nuclear fuel	8
24	Manufacture of chemicals and chemical products	9
25	Manufacture of rubber and plastics products	10
26	Manufacture of other non-metallic mineral products	11
27	Manufacture of basic metals	12
28	Manufacture of fabricated metal products, except machinery and equipment	13
29	Manufacture of machinery and equipment n.e.c.	14
30	Manufacture of office, accounting and computing machinery	14
31	Manufacture of electrical machinery and apparatus n.e.c.	15
32	Manufacture of radio, television and communication equipment and apparatus	16
33	Manufacture of medical, precision and optical instruments, watches and clocks	
34	Manufacture of motor vehicles, trailers and semi-trailers	17
35	Manufacture of other transport equipment	
36	Manufacture of furniture; manufacturing n.e.c.	18

Source: Compiled by the authors based on INEI and ISIC Rev. 3.