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Unfolding Trade Effect in Two Margins of Informality. The Peruvian Case

Abstract

This paper studies the effect of an increase in import competition on informality along two margins. I consider the extensive margin, where workers are hired by unregistered employers and the intensive margin, where even though jobs are carried out in registered firms, employees are off the books. Peru's relentless informal employment and its unprecedented trade-driven growth provides an ideal case study. Using a rich household survey, I find that exposure to trade impacts on informality through two competing and contrasting mechanisms. On the one hand, extensive-informal employment declines as unregistered employers shrink or exit due to their low productivity. On the other hand, intensive-informal employment rises as registered employers reduce costs by hiring informal workers. Furthermore, results suggest that the intensive margin drives the overall effect. Hence, I find that trade liberalisation increases informality.

JEL-Codes: F160, F140, J460.

Keywords: trade liberalization, labour informality, Peru.

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1 Introduction

The International Labour Organization (ILO) defines informality as the sum of employment in unregistered firms and the portion of employment in registered firms that does not comply with labour legislation.[1,2] In this way, ILO acknowledges the existence of two types of informal workers. Surprisingly this distinction has been mostly overlooked in the literature. In this paper, I study the effect of trade liberalisation on informal labour by distinguishing two crucial margins of informality. Following Ulyssea (2018), the *extensive margin* refers to workers hired by firms that are not legally registered with the tax collection agency; and the *intensive margin* refers to workers employed "off the books" in registered firms.

The growing literature addressing the effect of trade liberalisation on informality has treated informality as a binary decision to comply or not with taxes and regulations (Goldberg and Pavcnik, 2003, 2007; Menezes-Filho and Muendler, 2011; Bosch et al., 2012; Paz, 2014; Dix-Carneiro and Kovak, 2015, 2017; Pavcnik, 2017; Dix-Carneiro et al., 2018; Ulyssea and Ponczek, 2018; McCaig and Pavcnik, 2015, 2018; Cruces et al., 2018; Ulyssea, 2020).[3] Papers looking at firm-informality focus on the extensive margin of informality and those looking at worker-informality combine both margins. I build on this literature and take a novel approach as I disentangle these two margins of informality when studying a reduction in tariffs. In doing so, I can study in isolation two different economic mechanisms.

I show that putting together these margins under the tag of "informal labour" obscures the nature of the effect that trade has on informality. A reduction in tariffs affects each margin of informality through two different channels. On the one hand, a reduction in tariffs forces the least productive firms to exit the market. Since unregistered employers are less productive than registered ones (Perry et al., 2007; Maloney, 2004; Ulyssea, 2018; Díaz, 2014), informal firms that hire only these type of workers are not efficient enough to survive and are forced to exit or shrink. In this way, trade liberalisation reduces extensive-informal employment in the economy. On the other hand, as a tariff reduction intensifies import competitions, firms may look for ways to cut costs. Since informal workers are "cheaper" than formal workers, because of taxes associated with formality, a reduction in

[1] As Kanbur (2009) points out, informality can be described as a "conceptual incoherence" since the literature has not reached consensus regarding its definition. Loosely, informal labour refers to jobs that do not comply with taxation nor the regulations that ensure protection to workers such as paid holidays, parental leave and retirement.

[2] The informal sector accounts for over 50 per cent in Latin America, over 58 per cent in Asia and 76 per cent of total employment in Africa (ILO, 2018; WB, 2018).

[3] In the past, the relationship between informality and trade seemed weak. Bosch et al. (2012) establish that trade liberalisation explains to a very small extent, the increase in the size of the informal sector in Brazilian metropolitan labour markets. Goldberg and Pavcnik (2003) study the effect that an increase in foreign competition has on Brazil and Colombia. They conclude that trade policy is of second order of relevance in the effect on informal employment.

tariffs could translate into an increase in the fraction of informal workers as an adjustment mechanism to remain competitive. I argue that before the tariffs cut, firms restrain themselves from hiring informal workers, despite being cheaper, because hiring them comes with a risk of, for example, paying a fine in case of getting caught. This risk is worth taking only after import competition increased as the alternative could be bankruptcy. In this way, intensive-informal employment escalates with trade liberalisation.

Shedding light on the mechanisms at play on the effect that trade liberalisation has on informal labour has important policy implications. If a tariff cut reduces on its own the extensive margin of informality, policies that aim to lessen informal employment in unregistered firms are not required. However, if the intensive margin increases when tariffs drop, it would be wise to enforce policies that focus on preventing formal firms from hiring informal workers. In recent decades, the reduction of informality has been one of the core goals for policy-makers, especially, in developing countries. Due to lack of resources, countries cannot always implement policies that attack informal labour from different angles. This paper provides guidelines on a more efficient allocation of resources. For instance, in the context of trade liberalisation, inspection enhancement of labour law compliance among registered firms would be a more appropriate policy than reducing the administrative costs associated with formalisation.

Using a very rich household survey on the Peruvian manufacturing sector that identifies worker informality, I am able to distinguish the intensive and the extensive margins of informality. Because the dataset is not a firm survey, I can only speculate as to what drives firms decisions. However, I can examine the outcome of these decisions on employment. Furthermore, since the household survey is representative of the Peruvian population, I observe employment in all types of firms, including firms operating under the radar.

Peru provides a very suitable context to study the effect of trade liberalisation on informality. Approximately 70 per cent of total employment in manufacturing was informal in 2014, the highest in the region. At the same time, Peru exhibited a practically unprecedented annual growth rate of 6 per cent for more than a decade.[4] Furthermore, Peru was also the most open country in Latin America in 2014 when its average applied tariff was less than 5 per cent while the norm in the region was 15 per cent.

I examine firms' labour outcomes and study the effect on informal employment in both margins when tariffs go down. The empirical strategy is twofold. First, I study the effect at the individual level on the probability to be hired as an informal employee in each margin. Second, I examine how employment composition shifts at the industry level when tariffs drop. Results are robust to these two different approaches.

I find that when tariffs drop, both the probability to hire informally in the extensive margin and the fraction of workers hired as extensive-informal employees at the indus-

[4]Peru's growth only slowed down in the crisis period of 2008-2009 ranking second for growth in Latin America from 2002 to 2013.

try level decrease. Conversely, as competition tightens, the probability to be employed in the intensive margin of informality, rather than as formal employees, increases in industries where employers, on average, have less than 50 employees. Similarly, in those same industries, the share of intensive-informal employment on total employment within registered firms increases.[5] Crucially, results suggest that the intensive margin of informality drives the effect of trade liberalisation on informal labour. Namely, the impact on informal labour employed by registered employers is stronger than the effect on labour employed by unregistered employers. Hence, informality as a whole increases with trade liberalisation.

This paper relates to a vast literature on informality. There are three different views on informality and this paper encompasses all of them (La Porta and Shleifer, 2008, 2014). Some authors consider informal firms as a consequence of burdensome regulations that prevents productive firms to formalise (De Soto, 1989, 2000). Others, believe that informal firms are parasites that choose to remain informal to avoid paying taxes (Farrell, 2004; Levy, 2008). Conversely, many believe that informal workers and firms are inherently inefficient and could not operate in the formal sector (Rauch, 1991; Maloney, 2004; Amaral and Quintin, 2006; Perry et al., 2007; De Paula and Scheinkman, 2011). Since I consider the intensive and the extensive margin of informality, I contribute to all of these views. They are not competing frameworks. They are echoing the presence of firm heterogeneity when deciding what taxes to pay and which regulations to obey (Ulyssea, 2018).

Hence, this paper's most significant contribution is the distinction between the intensive and the extensive margin when looking at the effect of trade on informality. While this distinction is not new, I am the first one to consider these two margins in an open economy framework.[6]

This paper also relates to recent work on trade and local labour markets (Dix-Carneiro and Kovak, 2015, 2017; Dix-Carneiro et al., 2018; Ulyssea and Ponczek, 2018; Dix-Carneiro and Kovak, 2019). They show that informality acts like a buffer that absorbs displaced workers from trade liberalisation. When studying the Peruvian manufacturing sector, a local labour market approach is not suitable because the economic activity is highly concentrated.[7] Thus, I contribute to the body of literature that takes an industry-level approach (Acosta and Montes-Rojas, 2014; Cruces et al., 2018; Paz, 2014).

[5]There are no systematic differences in changes in tariffs cut across employer size. See the discussion in Section 4.1.

[6]Ulyssea (2018) uses an estimated model to conduct counter-factual analysis of a reduction in the payroll tax, an increase in law enforcement on hiring off the books, and a change in entry cost for formal and informal firms. He finds that there are winners and losers in all policies and that a reduction on informality does not necessarily mean higher GDP, TFP or welfare. Samaniego de la Parra (2016) studies empirically an increase in the inspections in the Mexican market. She finds that spouses of informal workers change their labour market participation decision and reservation wage after an inspection.

[7]Nuñez (2014) documents that 55 per cent of manufacturing firms are in the capital of Peru, Lima. Moreover, he also highlights that most firms that are not in Lima, are located in one of three regions: Arequipa, La Libertad and Junin.

The paper is organised as follows: Section 2 describes the dataset and the definitions used throughout the paper. Section 3 characterizes the Peruvian economy focusing on the manufacturing sector. It discusses its liberalisation process, some relevant labour policy changes, and addresses potential concerns regarding the endogeneity of trade policy. Section 4 discusses the estimation strategy and presents the empirical results. Section 5 reviews robustness checks. Section 6 concludes.

2 Data and Definitions

The empirical analysis in this paper uses two main data sources. The data on informality comes from the Peruvian National Household Survey (ENAHO) provided by the Peruvian National Institute of Statistics and Informatics (INEI) and the information on tariffs comes from the World Trade Organization's Tariff Analysis Online (WTO's TAO) Database. I also construct input tariffs using the 2007 input-output Peruvian table provided by the INEI.

The ENAHO is a continuous survey which began in May 2003. However, since the questions I use to classify workers' informality status are only present from 2007, the analysis started in 2007. Also, the question I use to identify the intensive margin of informality changes in 2015. Hence, the period of analysis is 2007-2014 to minimize differences in definitions of informal worker. The survey is representative of the Peruvian population. It comprises information regarding all households and its occupants surveyed in all 24 Peruvian regions.[8] In this paper, I am only interested in the population that is employed.[9] Hence, I mainly use data from the section regarding the independent worker (ENAHO.04) and labour and income (ENAHO.500), which contain information on individuals who are at least fourteen years old.

All individuals in the dataset are classified as either intensive-informal, extensive-informal or formal employees. To do so, I follow the methodology proposed by the INEI and the International Labour Organization's agency for the Formalization in Latin America and the Caribbean (FORLAC). First, I distinguish the extensive margin of informality. When workers declare that their employer does not keep books in a way that agrees with the Peruvian Tax Collection Agency (SUNAT), the employer is classified as an "informal employer".[10] In case the worker is self-employed, it is considered to have a registered employer if it is registered as a legal person or as a legal entity (with Tax Identity Number: RUC, RUS, RER).[11] Otherwise, it is considered to have an unregistered employer and is

[8] Peru's first-level administrative subdivisions of Peru are called "departamentos", these are the regions I use as a geographic indicator.

[9] The unemployment rate in Peru during the period of study dropped from 4.8 in 2007 to 3.7 in 2014 (INEI, 2018).

[10] SUNAT requires all firms to keep books using either an online platform or with a specific software.

[11] RUC comes from its acronym in Spanish *registro unico del contribuyente*, it uniquely registers all

classified as an informal worker in the extensive margin.

Second, I characterize the intensive margin of informality. Intensive-informal workers can be employed in a family firm or as a salaried employee. Individuals employed by a registered family firm but as a non-paid family worker are considered intensive-informal. Due to a change in the questionnaire, salaried workers are classified as intensive-informal using different criteria before and after 2011. Salaried workers surveyed between 2007 and 2011 are classified as informal workers if they declare that the tax collection agency does not deduct their income in any way. Individuals surveyed between 2012 and 2014 are considered informal workers if, contrary to Peruvian legislation, their employer does not pay health insurance on their behalf.[12] In the empirical analysis, I also study the sub-period 2007-2011 as a robustness check to make sure that the change on the way I classify intensive-informal employment does not tamper results.

Throughout this paper, I define as *extensive-informal workers* those employed by an unregistered employer and all the self-employed individuals who do not pay taxes for their income. Moreover, *intensive-informal workers* are those that are defined as informal workers and are employed by an employer registered with SUNAT.[13]

As with all self-reported surveys, individuals' answers reliability is a concern. However, since my interest is mostly in how informality changes across time rather than measuring it in one specific point in time, the measurement error would arguably not alter my results. Moreover, both the dataset and the method to calculate informality are widely used by academic papers and policy reports from the ILO and OECD (Chacaltana, 2017; FORLAC, 2014a,b; OECD, 2019; Villagomez and Chafloque, 2019; Chong et al., 2008).

The survey contains information on individuals' socio-demographic characteristics such as age, gender, civil status, race, education level and region of residence. This information is valuable as it allows me to build a profile of the informal worker in each margin of informality. Crucial to my empirical strategy is that, even though it is a household survey, individuals are also asked specific questions on their employer. They are asked how many people work in their place of work and the employer's industry at ISIC 4-digit level revision 3. This information is fundamental to my analysis as it allows me to link worker's data with trade data through the worker's employer industry affiliation.[14]

I measure trade openness with the average Most Favoured Nation tariff (MFN). The MFN tariffs are what countries promise to impose on imports from other members of the

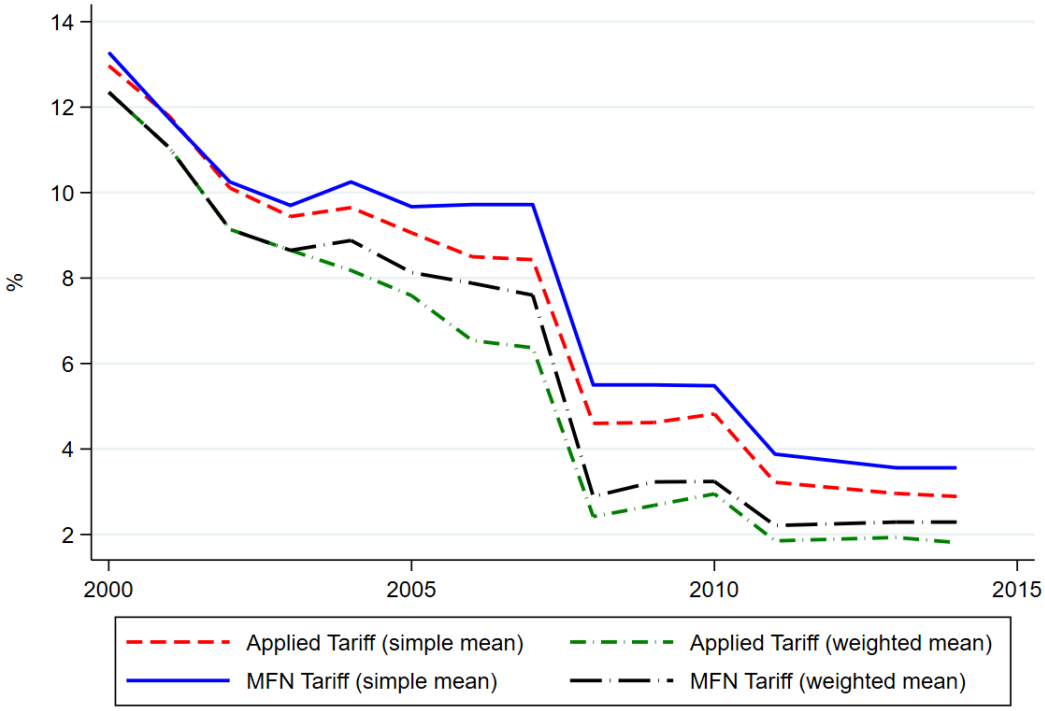
taxpayers, firms or individuals. RUS is a tax system that was created to motivate formalization. It targets small firms and tax them based on their sales. RER is a system that targets only people whose annual income does not excessed the USD 61200.

[12]The question regarding income deductions only exists between 2007 and 2011. The question regarding health insurance only exists between 2012 and 2014.

[13]Note that self-employed workers might be classified as extensive-informal or formal employees. As a robustness check I also exclude all self-employed workers and find similar results.

[14]The MFN tariffs published by the WTO are at the HS code 6-digit level and I convert them to 4-digit ISIC code to be able to link the trade data to the data from ENAHO.

Figure 1: Tariffs in Manufacturing



Source: World Development Indicators.

WTO, unless the country is part of a preferential trade agreement (such as a free trade area or customs union). Thus, MFN rates are the highest (most restrictive) that WTO members charge one another. As shown in Figure 1, the MFN tariff is higher than the applied tariff because it does not take into account trade agreements. Even though the MFN tariff is a conservative measure of the country's openness, to my knowledge, it is the only tariff available for Peru at 6-digit level of disaggregation.[15]

I obtain the MFN tariffs from the WTO's Tariff Analysis Online (TAO) for the period 2007-2014 without information for 2012. For a reason I am not aware of, information for 2012 was not published in the WTO, but it was available in the Peruvian Central Bank's (BCRP) website.[16] The WTO publishes the data using the Harmonized System of commodity classification (HS) at a 6-digit level of aggregation in three editions.[17] I link the informality data to the trade data using several correspondences tables from the World Integration Trade Solution (WIITS). I also obtain imports and exports data at a HS 6-digit level of aggregation from Comtrade. I use this information for a robustness check (Appendix B.2).

[15]The World Development Indicators database (source of the data in Figure 1) only provides the average for the manufacturing sector.

[16]Data published by the BCRP for other years is consistent with WTO datasets. However, as a robustness check, I also conduct the analysis for the period 2007-2011 so that I avoid the change in the data source and results are very similar.

[17]For 2007 and 2008 the information is expressed in the 2007 edition (HS07), and for the following periods it is in the 2012 edition (HS12).

3 Peru: Overview

3.1 Trade Liberalisation

Peru underwent a major trade liberalisation in the 1990s that focused on dismantling the import substitution industrialisation policy, a protectionist scheme set in 1970s. An additional opening process happened in the 2000s during one of the fastest economic growth periods recorded in Peru. In this way, Peru concluded its liberalisation process by reducing its average tariffs from 14 per cent to 5 per cent.

While the first wave is more drastic, it was also more homogeneous. The reduction in tariffs on the 2000s shows much more heterogeneous tariff reduction across industries. I study the second wave of liberalisation to take advantage of this heterogeneity. Moreover, during this period, informality varies across industries both in terms of importance and in terms of the margin of informality.

Table 1: Tariffs in Manufacturing (%)

	2007	2008	2009	2010	2011	2012	2013	2014
Food products and beverages	17.04	10.37	4.23	4.09	2.4	2.13	2.31	2.31
Textiles	18.21	15.33	14.62	14.41	10.95	9.18	9.45	9.39
Wearing apparel	19.55	16.53	16.52	16.53	12.61	10.71	10.72	10.73
Tanning and dressing of leather	17.36	15.56	15.32	14.14	10.68	9.74	9.29	9.53
Wood products, except furniture	11.44	6.56	5.75	5.4	3.64	3.82	3.89	3.67
Publishing, printing and media	11.18	7.32	6.39	5.27	4.87	4.82	4.69	4.4
Chemicals and chemical products	6.8	5.18	4.75	4.69	2.96	3.37	2.66	2.82
Rubber and plastics products	8.47	4.27	4.96	5.23	3.41	3.44	3.38	3.61
Other non-metallic mineral products	4.08	2.39	1.32	2.51	1.84	2.25	1.36	1.19
Basic metals	9.36	5.6	4.95	5.55	2.93	3.33	3.12	2.08
Fabricated metal products	11.44	2.9	1.85	2.39	0.89	1.08	1.05	1.01
Machinery and equipment	2.41	0.6	1.42	0.86	0.75	0.85	0.47	0.71
Other transport equipment	1.12	0.22	0.65	0	0.1	0.01	0.05	0.04
Furniture	11.27	8.04	7.97	8.04	5.36	5.36	5.37	5.34
Average in Manufacturing	14.72	10.55	7.99	8.15	5.56	5.15	5.17	5.14

Source: Own elaboration based on WTO.
Notes: Average MFN tariff at the 2-digit ISIC level within the Manufacturing sector.

As shown in Table 1, the level of protection varies significantly from one industry to another. All tariffs are falling after 2007, and they do so at different rates in different industries. For example; food, textiles, clothing, wood and furniture experienced a stronger liberalisation than chemicals and machinery. In any case, it is evident by looking at the last row that Peru experienced a continuous liberalisation process in terms of average output tariffs during the period of study.

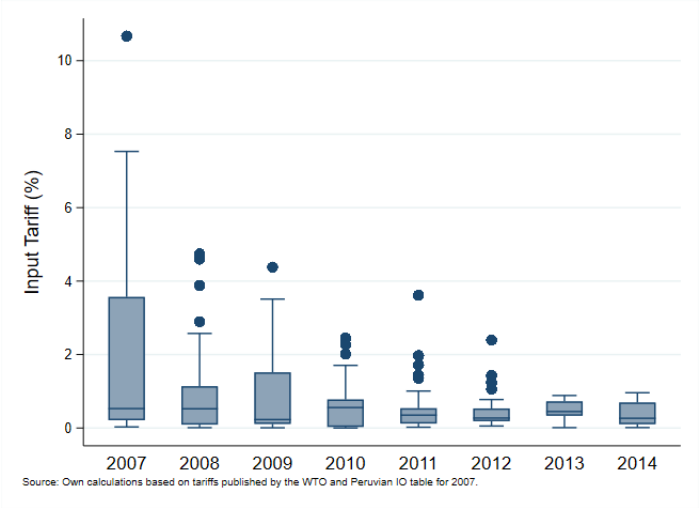
When countries cut down tariffs across industries, they might also reduce tariffs on intermediate inputs. As a result, the increase in import competition that firms face might be offset by a reduction in the cost of their imported inputs. I construct input tariffs as in Topalova and Khandelwal (2011) to ensure that firms are indeed facing an increase in import competition as a result of a reduction in tariffs. Then, input tariffs are estimated as follows:

$$IT_{jt} = \sum_{s} \alpha_{js} * OT_{st} \tag{1}$$

where IT_{jt} is the input tariff in industry j in year t, α_{js} is the share of input s in the value of output j, and OT_{st} is the output tariff in industry s in year t. The α's are calculated using the Peruvian Input-Output table for 2007 made available by the National Institute of Statistics and Informatics (INEI).

As shown in Figure 2, not only output tariffs were dropping during the period of study, input tariffs were also significantly cut.[18] Then, it could be argued that firms' costs might have declined enough to offset the increase in import competition. Hence, I control for input tariffs in all the specifications that I discuss in the next Section.

Figure 2: Input Tariffs in Manufacturing



Source: Own elaboration based on tariffs published by WTO and Peruvian IO table for 2007.
Notes: Outliers from the following industries are not included in the Figure: Manufacture of food products and beverages, Manufacture of textiles, Manufacture of wearing apparel, Tanning and dressing of leather and Manufacture of wood products and cork.

Coupled with a reduction in tariffs, Peru's manufacturing sector experienced unprecedented growth and an increase in the domestic demand during the period of analysis (Chacaltana, 2017). I control for this favourable economical context to ensure that it did not play a role in the evolution of informality. I discuss in more detail this potential threat to identification in Section 5.

Furthermore, during the period of analysis, Peru signed free trade agreements (FTA) with the United States (US) and with China. In February 2009, entered into force the

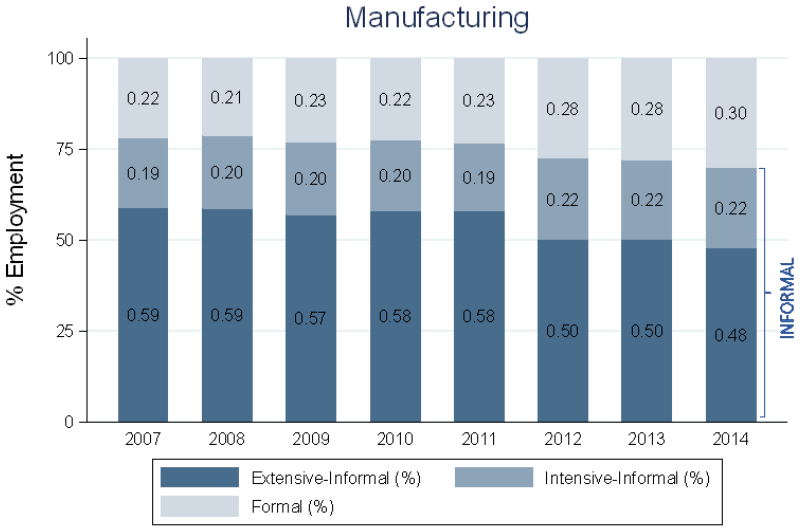
[18]Figure 2 shows a box plot for input tariffs in manufacturing. The box upper limit is the third quartile (Q3), and the lower limit is the first quartile (Q1). The line in the middle of the box is the median. The ends of the whiskers are the most extreme values within Q3+1.5(Q3-Q1) and Q1-1.5(Q3-Q1), respectively. The points on top of the whiskers are outliers. The graph shows that input tariffs' dispersion has decreased significantly during the period of analysis.

FTA with the US, and in March 2010 the one with China. These FTAs mean that China and the US might have lower tariffs than the MFN tariff in some products. Since both China and the US are important partners for Peru, I also control for the impact that these FTAs might have had in the evolution of informality. More details can be found in Section 5.

3.2 Informal Labour

I take advantage of a rich dataset and study informal labour in the manufacturing sector. Total employment is composed of three types of labour: i) informal labour in the *extensive margin* (jobs carried out in unregistered firms), ii) informal labour in the *intensive margin* (workers hired by registered firms but in an employment relationship that does not comply with labour legislation) and iii) formal labour in registered firms. As Figure 3 shows, informal employment accounted for almost 80 per cent of total employment in 2007 and even though it decreased in importance, by 2014, it still accounted for 70 per cent.

Figure 3: Total Employment



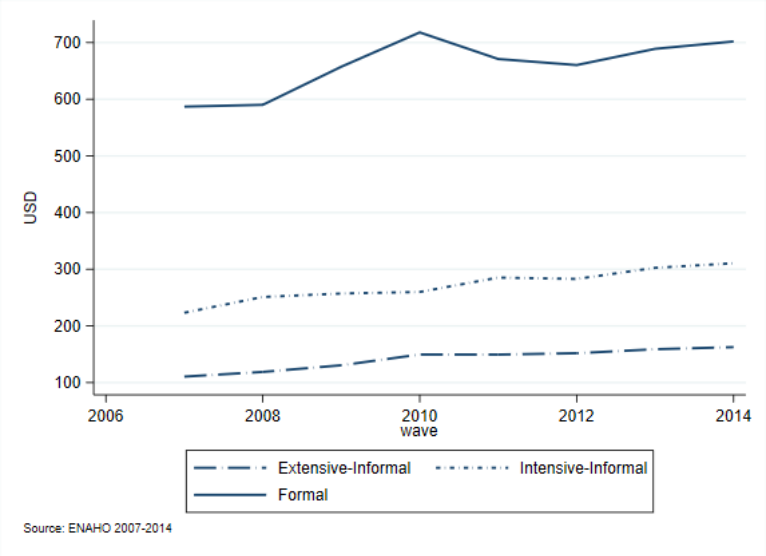
Source: Peruvian National Household Survey (ENAHO) 2007-2014

It is more likely to understand the underlying mechanisms through which trade affects informal labour when opening up the informal sector in these two margins of informality. The analysis in Section 4 recognizes that informal employment's reaction to an increase in import competition might be different for each margin of informality. On the one hand, extensive-informal workers might struggle to retain their job as they tend to be the least efficient workers in the economy (Ulyssea, 2018; Maloney, 2004). On the other hand, intensive-informal workers might benefit from being cheaper than formal workers and manage to preserve their position.

As Figure 4 shows, extensive-informal workers consistently earn a lower income than

all other workers. Moreover, extensive-informal employees' average income is lower than the minimum wage.[19] Also, from Figure 4, it is evident that there is a big difference between wages for workers in the intensive margin of informality and formal employees. Intensive-informal employees earn on average half of formal workers' monthly salary.

Figure 4: Average Monthly Income by Informality Status



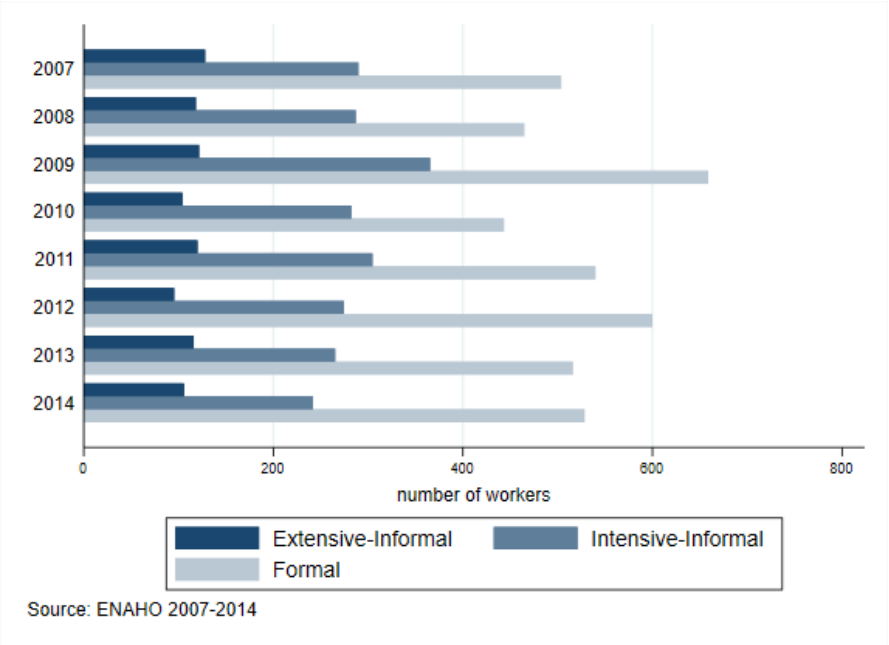
Registered and unregistered employers are different, even if both hire informally. It is widely documented in the literature that extensive-informal workers' employers are smaller than the ones hiring intensive-informal workers (Maloney, 2004; Paz, 2014; Perry et al., 2007). This is often driven by Tax and Labour legislation that favours smaller firms. In the Peruvian case, in order to access those benefits firms had to have less than 10 employees up to 2008 when the law changed and small enterprises were defined as those with less than 100 workers.[20] I find that throughout the period 2007-2014, approximately 60 per cent of individuals in Peru are hired by employers with less than 100 workers while only 10 per cent are hired by employers with more than 500 workers. Moreover, firms size distribution is skewed to the right. Figure 5 shows that extensive-informal workers are employed in industries where employers tend to have less than 100 workers. In the same way, intensive-informal jobs are more likely to be in industries where employers, on average, have between 200 and 300 workers. Finally, formal workers are, on average, hired in industries where employers tend to have more than 400 workers.

In the identification strategy discussed in Section 4, I also take into account that the literature often describes informal workers as single women with low education. I find that description is somewhat accurate when equating the extensive margin of informality with the totality of informal employment. However, the intensive margin of informality

[19]The minimum wage in 2007 was the equivalent to 160 US dollars, and in 2014, 264 US dollars.

[20]More details on the Promotion and Formalization of Micro and Small Enterprises Act discussed in Section 3.2.1.

Figure 5: Average Industry Size by Informality Status



Notes: All surveyed individuals are asked how many workers are employed in their workplace. With this information I calculate an industry-year average at the 4-digit level. This Figure presents the average industry size per informality status in each year of the sample.

is not necessarily composed by that demographic. Columns 1-3 in Table 2 show that extensive-informal workers' individual characteristics are significantly different from that of workers hired by registered employers. Similarly, Columns 4-6 in Table 2 show that workers employed in the intensive margin of informality are different from those formally hired.

Columns 1-3 in Table 2 confirm that married women with less than 45 years old and with no education or primary education are more likely to be hired in the extensive margin of informality than in any other type of contract. Also, individuals identified with the Quechua ethnicity are more likely to be in the extensive margin of informality. As expected, extensive-informal workers tend to be the most vulnerable in the workforce as they are also the ones with very little bargaining power and take the job that is offered.

Columns 4-6 in Table 2 show that single men with a secondary or lower level of education are more likely to be hired in the intensive margin of informality than formally. Moreover, older workers employed by registered employers are less likely to be informally hired. As I do not have more information, I can only speculate. However, it appears that informal workers are entry-level posts with registered employers. Since they are probably healthy and do not think about retirement yet, they are willing to renounce to the benefits that come with a formal job such as a pension, health insurance and parental pay.

Table 2: Individual Characteristics

	Extensive-informal workers		Registered Employer Employees		Diff: 1 - 2	Intensive-informal workers		Formal workers in Reg. Employer		Diff: 4 - 5
	(1)		(2)		(3)	(4)		(5)		(6)
	mean	sd	mean	sd	b	mean	sd	mean	sd	b
Married	0.32	0.47	0.29	0.45	-0.03***	0.15	0.36	0.40	0.49	0.25***
Male	0.43	0.50	0.72	0.45	0.29***	0.68	0.46	0.76	0.43	0.07***
Age: 14-29	0.31	0.46	0.39	0.49	0.07***	0.57	0.50	0.24	0.43	-0.33***
Age: 30-44	0.30	0.46	0.35	0.48	0.05***	0.28	0.45	0.41	0.49	0.12***
Age: 45-64	0.30	0.46	0.24	0.43	-0.06***	0.13	0.34	0.33	0.47	0.20***
Age: > 65	0.09	0.28	0.02	0.15	-0.06***	0.02	0.13	0.03	0.17	0.01***
No Education	0.08	0.27	0.00	0.07	-0.07***	0.01	0.07	0.00	0.06	-0.00*
Primary Education	0.32	0.46	0.10	0.30	-0.21***	0.12	0.32	0.09	0.29	-0.02***
Secondary Education	0.46	0.50	0.53	0.50	0.07***	0.61	0.49	0.47	0.50	-0.14***
Technical Education	0.10	0.29	0.21	0.41	0.12***	0.17	0.37	0.25	0.43	0.08***
UG-PG degree	0.05	0.22	0.15	0.36	0.10***	0.10	0.30	0.19	0.39	0.09***
Quechua ethnicity	0.16	0.36	0.11	0.31	-0.05***	0.10	0.30	0.11	0.32	0.02***
N	16883		14126		31009	6380		7746		14126

Source: Own elaboration based on ENAHO 2007- 2014.
Notes: Columns 1, 2, 4 and 5 present the mean and standard deviations for a specific group of workers. In Column 1, I only take into account employees in the extensive margin of informality and in Column 2, all employees hired by registered employers (both formal and intensive-informal workers). Column 4, refers only to intensive-informal workers and Column 5, solely formal employees. Column 3 presents the results from comparing the difference in the means of employees in a registered firm (intensive-informal and formal), and extensive-informal workers. Column 6 reports the results from comparing the difference in the means of informal and formal employees hired by a registered employer.

3.2.1 Labour Market Policies

Informality and its unremitting rise in past decades has been a long-lasting challenge for the Peruvian economy. Hence, the shift of trend towards formalization in recent years is the most striking development in the Peruvian labour market. In this paper, I focus on the effect that tariffs dropping had on informal employment. However, the reduction in tariffs was accompanied by major institutional changes. The two most important ones for the labour market were the Promotion and Formalization Act that reduced costs for smaller firms, and the implementation of an electronic payroll system that might have increased the State's ability to enforce labour laws (Chacaltana, 2017).

The Promotion and Formalization of Micro and Small Enterprises Act passed in 2003. It reduced non-wage costs such as holiday pay significantly, and also cut dismissal costs to a third for micro-enterprises (firms with less than 10 workers). In 2008, this special regime was extended for firms with up to 100 workers, and it came into effect in 2009. Chacaltana (2017) documents that micro-enterprises account for 70 per cent of wage employment in Peru and that the reduction in non-wage labour costs fell from 54 per cent to 17 per cent in 2003 in weighted terms. Even though the decrease in costs was significant in 2003, according to Chacaltana (2017) own calculations, the index of labour costs remains fairly stable during the period 2007-2014. Since the focus of this paper is precisely that period, this new policy would not have affected the results discussed in Section 4.

Furthermore, in 2006, the Ministry of Labour and Employment Promotion (MTPE)

and the Office of the National Superintendent of Tax Administration (SUNAT) put in place an electronic payroll system. Before 2006, all registered firms had to annually submit hard copies of their payrolls to the MTPE, including information on workers, wages and type of contracts. After the electronic payroll system was set up, they had to submit it monthly to SUNAT together with the firm's tax return. Chacaltana (2017) states that since SUNAT has demonstrated a more reliable inspection capability than MTPE, the shift towards the electronic payroll system might have meant an increase in inspections and on the likelihood of infractions being detected, at least for firms registered with SUNAT.

Chacaltana (2017) finds that despite the scale of the institutional changes, the variables associated with the labour market reforms and inspections strength did not have a significant effect on the formalization process. He states that these findings are not surprising as at least two of every three workers with an informal job in Peru are employed by economic units that are not registered for tax purposes. In other words, due to the size of the extensive margin of informality, policies that target formal employers do not have a significant effect on the evolution of informality. Results might be different after 2013 when the National Labour Inspection Authority (SUNAFIL) started to operate to strengthen the inspection service. To ensure that the creation of SUNAFIL does not influence my results in the last two years of the sample, I also conduct the study detailed in Section 4 for the period 2007-2011 and results are very similar.

3.3 Manufacturing Sector

Díaz (2014) finds that over 40 per cent of the reduction of informality in the period 2002-2011 in Peru is due to a change in the structure of employment by firm size. Moreover, Infante and Chacaltana (2014) study the same period in Peru and show that medium-sized firms are more dynamic in terms of output employment and productivity. Furthermore, Kleven et al. (2016) states that the proportion of informal workers in a firm's labour force diminishes with the size of the firm as larger firms are more likely to face an inspection. Putting Kleven et al. (2016)'s result, together with Levy (2008)'s result that unregistered firms tend to be smaller than registered ones, it seems that firm size plays an important role when studying the evolution of informality. Moreover, size is especially relevant when distinguishing between the intensive and the extensive margin of informality.

It would be ideal to have firm-level data that reveals both the informality status of the firm itself and the informality status of its workers. Due to the illegal nature of informality, that type of dataset if very hard to come by. Nevertheless, the Peruvian household survey, ENAHO, asks all individuals in the survey how many workers are employed in their workplace. I acknowledge that it is quite unlikely for an individual to know the exact amount of workers employed. However, I claim that most workers

have a rough idea of how many people work with them. Intending to correct for this measurement error, I calculate the average size of each 4-digit industry in every given year. In other words, based on individuals' declaration on how big their employer is in term of number of workers, I calculate an average employer size per industry and year.

I prefer to take this approach instead of mixing sources. If I replaced the industry size measure obtained using the household survey with another one constructed from a firm-level survey, I would not be able to observe workers in informal firms as these are not present in these type of surveys. As a result, the industry size measure for industries abundant on informal firms would be underestimating the size of the average employer significantly. Nevertheless, as a check, I compare the average industry size I calculate using household data with a similar calculation made using firm-level data for industries where formal employers employ most workers. I find that the industry size distribution I construct with data from ENAHO is akin to the one obtained when using firm-level data. More details can be found in Appendix C.

Hence, I argue that any inaccuracies on workers' knowledge on the size of their employer cancel out when I average them up. Table 3 groups manufacturing industries at the ISIC 2-digit level. It shows that most employers in *food products and beverages* tend to have over 50 employees. In contrast, in *textiles*, employers tend to have between 16 and 50 workers. Also, while in industries such as *basic metals* and *furniture*, average industry size does not vary much over time, in industries such as *food products* and *other transport equipment*, there is quite a change on employers' size between 2007 and 2014.

Table 3: Employer Size in Manufacturing (%)

	2007			2014		
	Average Employer Size <16	Average Employer Size 16-50	Average Employer Size >50	Average Employer Size <16	Average Employer Size 16-50	Average Employer Size >50
	(1)	(2)	(3)	(4)	(5)	(6)
Food products and beverages	7.81	4.85	87.34	8.58	36.1	55.32
Textiles	27.5	53.53	18.97	27.65	58.53	13.82
Wearing apparel			100			100
Tanning and dressing of leather	30.08	69.92		25.95	74.05	
Wood and of products, except furniture	35.61		64.39	35.11	59.92	4.96
Publishing and printing		6.8	93.2	4.27	0.85	94.87
Chemicals and its products			100		2.3	97.7
Rubber and plastics products	11.11		88.89			100
Other non-metallic mineral products	61.97	20.42	17.61	6.81	49.74	43.46
Basic metals			100			100
Fabricated metal products		20.66	79.34		12.38	87.62
Machinery and equipment	15.22	20.65	64.13		12.39	87.61
Other transport equipment	48.65	2.7	48.65	2		98
Furniture	0.84	94.14	5.02	6.22	93.78	
Total	13.29	28.01	58.71	10.64	39.11	50.25

Source: Own elaboration based on ENAHO 2007 and 2014.

Notes: Columns 1-3 show how total employment in a given industry was distributed in 2007. Similarly, Columns 4-6 show total employment distribution in 2014. From employees declaration on their workplace size in terms of the number of workers, I calculate the average industry size at the 4-digit level for every year in the sample. This Table shows the distribution within industries at the 2-digit level.

As some industries seem to have smaller employers consistently, it is also possible to see that some industries tend to be characterized by one of the informality margins. As Table 4 shows, *furniture*, *textiles* and *wearing apparel* are the industries where most workers are hired as extensive-informal employees. Conversely, workers employed in *basic metals* are mostly formally employed.

Table 4: Two Margins of Informality in Manufacturing (%)

	2007			2014		
	Extensive Informal	Intensive Informal	Formal worker	Extensive Informal	Intensive Informal	Formal worker
	(1)	(2)	(3)	(4)	(5)	(6)
Food products and beverages	47.78	23	29.22	40.75	24.04	35.21
Textiles	82.35	6.47	11.18	82.08	7.34	10.58
Wearing apparel	59.57	20.21	20.21	51.47	22.96	25.57
Tanning and dressing of leather	54.47	28.46	17.07	46.49	36.76	16.76
Wood and of products, except furniture	52.2	34.15	13.66	50	26.72	23.28
Publishing and printing	18.45	44.66	36.89	14.53	40.17	45.3
Chemicals and its products	26.58	26.58	46.84	6.9	17.24	75.86
Rubber and plastics products	13.89	30.56	55.56	12.5	22.5	65
Other non-metallic mineral products	75.35	8.45	16.2	56.54	12.04	31.41
Basic metals	7.41	18.52	74.07	10.42	18.75	70.83
Fabricated metal products	57.85	21.07	21.07	33.88	25.73	40.39
Machinery and equipment	21.74	33.7	44.57	15.04	27.43	57.52
Other transport equipment	51.35	16.22	32.43	38	30	32
Furniture	73.43	13.39	13.18	53.53	23.03	23.44
Total	58.76	19.38	21.86	47.82	22.14	30.04

Source: Own elaboration based on ENAHO 2007 and 2014.
Notes: Columns 1-3 show the labour composition in a given industry in 2007 and Columns 4-6 in 2014. This Table shows how total employment is composed of intensive-informal, extensive-informal and formal workers within industries at the 2-digit level.

Since the main data source is a household survey, I can only observe labour outcomes. More specifically, through these data is not possible to understand the underlying reason as to why firms choose to register or why registered firms decide to hire informal workers. I can only observe the consequence of their decisions on employment. Nevertheless, it might be helpful to have at least a vague idea of what motivates firms to make these choices. Hence, looking at data from the World Bank Enterprise Surveys (WB-ES) I provide some insights on the matter.[21]

In 2006, 2010 and 2017, firms were asked if they were registered when they started operations, above 90 per cent of them answered that they were. However, in 2006, only 71 per cent affirmed to report 100 per cent of their sales for tax purposes. Moreover, only 12 per cent declared up to 50 per cent of their sales. Interestingly, when firms were asked as to why they decided to register, 65 per cent confirmed that they wanted to comply with the law, 16 per cent affirmed that customers and suppliers only deal with registered entities, and 15 per cent stressed the need of being registered to access financing. On the

[21]Table 23 in the Appendix provides more detailed information regarding how many firms were surveyed and their industry within manufacturing. Many of the relevant questions are only available in the 2006 survey. Hence, I only provide details about that wave of the WB-ES.

other hand, more than 50 per cent of firms argued that tax administration and tax rates are a moderate or major obstacles to their daily operations. Furthermore, 25 per cent of firms singled out competing with informal firms as their biggest obstacle, even above corruption and access to finance.

Still looking at data from the 2006 WB-ES, I find that only 65 per cent of firms declare 100 per cent of their workforce for tax purposes. Furthermore, 17 per cent of firms affirmed to declare up to 50 per cent of their workforce. Additionally, 30 per cent of firms claimed that their decision to hire or fire a permanent worker was affected by labour regulations. Moreover, 60 per cent of firms considered labour regulations as a moderate, major or severe obstacle to their daily operations.

From firms' answers to the WB-ES, it seems that firms would like to register to comply with the law. However, when they do so, they are inclined to not comply fully either by not declaring total sales or not declaring their entire workforce. Possibly because they still have to compete with informal firms. Moreover, firms seem to hire in the intensive margin of informality to avoid having to comply with labour regulations.

3.4 Endogeneity of Trade Policy

In this Section, I address possible concerns regarding the endogeneity of trade policy. First, it might be the case that certain industries have higher lobby power and might be able to get more favourable treatment. Second, it may be that the relatively more informal industries may have enjoyed greater protection if the Peruvian authorities considered they needed it due to lower efficiency or for political reasons.

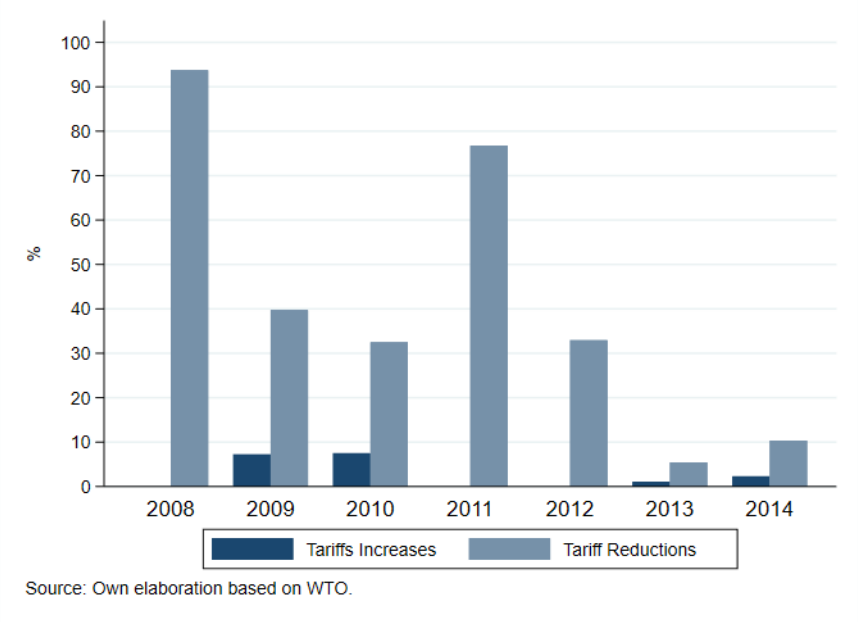
If more informal industries were not liberalized as intensely as other industries, small reductions in tariffs might be associated with a decline in informality and wrongfully infer that trade liberalization reduces informality. Hence, following Topalova (2007), I examine if tariffs moved together by analysing the changes in tariffs for 102 ISIC 4-digit products in manufacturing over the period 2008-2014. Figure 6 shows that most of the tariff changes across products are in the same direction.[22] Moreover, in Appendix D, I examine the change in tariffs in 2-digit products and show that the majority of the products move with a very similar trend to the average manufacturing tariff. Additionally, I also add industry-specific trends to the empirical strategy explained next in Section 4. I control for possible pre-existing trends in trade policy and find that results are not very different. See Table 14 in the Appendix.[23]

In the spirit of Topalova and Khandelwal (2011), I test if measures of trade protection are correlated with industry characteristics associated with political importance. I regress changes in output tariffs and changes in input tariffs on the average wage, the share of

[22]Figure 6 does not feature products which tariffs remained unchanged.

[23]Since the possibility to identify these two margins of informality is only possible after 2007, I am not able to examine the effect of tariffs at a prior date. Hence, I cannot conduct placebo tests.

Figure 6: Tariff Changes 2008-2014
(in percent of total ISIC codes)



women, share of skilled workers, the share of married workers and average workers' age. Policy-makers may choose to protect industries where income is lower, where there are more women, where workers are less skill, where there are less married workers or where workers are younger. Results are presented in Table 5. The table reveals no statistical correlation between changes in output tariffs and any of the industry characteristics. Similar to Topalova and Khandelwal (2011)'s findings, except for average wages, none of the other industry characteristics are correlated with changes in input tariffs.

Finally, I examine if policy-makers adjusted tariffs in response to industries' informality level or due to industries' size. If they did so, one should expect that past informality and past industry size predicts current trade policy. Therefore, I regress changes in output tariffs and changes in input tariffs in t, on the share of informal employment at industry-level and on industry size in $t-1$. Results are presented in Table 6. In Columns 1 and 2, I report the correlation between changes in tariffs and the share of informal employment on total employment without distinguishing margins. In Columns 3 and 4, I present the relationship between the proportion of intensive-informal employment on total employment in registered firms and changes in tariffs. In Columns 5 and 6, I measure the correlation between the change in tariffs and the proportion of extensive-informal employment on total employment. Lastly, in Columns 7 and 8, I show the results when regressing the average industry size calculated with data from ENAHO and the change in tariffs. Table 6 reveals that the correlation between past share of informal employment and current trade protection is statistically insignificant for all measures of informality. Similarly, there is no correlation between past industry size and current change in tariffs.

Table 5: Change in Tariffs and Industrial Characteristics

	Output Tariffs	Input Tariffs	Output Tariffs	Input Tariffs	Output Tariffs	Input Tariffs	Output Tariffs	Input Tariffs	Output Tariffs	Input Tariffs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log Wage	0.0056	-0.5333***								
	(0.143)	(0.187)								
Share of Women			-0.1680	0.7246						
			(0.518)	(0.471)						
Primary Education (share)					-0.3653	-1.8004				
					(1.212)	(2.571)				
Secondary education (share)					0.2620	-1.0793				
					(1.148)	(2.438)				
Technical education (share)					0.2790	-1.1753				
					(1.096)	(2.512)				
UG-PG degree (share)					0.2802	-1.1806				
					(1.126)	(2.394)				
Share of Married Workers							-0.1855	-0.8851		
							(0.273)	(0.541)		
Workers Age									-0.0083	-0.0195
									(0.010)	(0.013)
Observations[∓]	595	595	596	596	596	596	596	596	596	596
R^2	0.51	0.15	0.51	0.14	0.52	0.14	0.51	0.15	0.51	0.14

Notes: Robust standard errors for industrial clusters in parenthesis. All specifications include a constant, year and industry fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[∓] Observations in Columns 1 and 2 are one less than in the other columns because there is no information on monthly income for ISIC code 2912 (Manufacture of pumps, compressors and valves) in 2011.

Table 6: Change in Tariffs, Share of Informal Employment and Industry Size

	Output Tariffs	Input Tariffs	Output Tariffs	Input Tariffs	Output Tariffs	Input Tariffs	Output Tariffs	Input Tariffs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share Informal employment (-1)	-0.1363	0.1024						
	(0.189)	(0.162)						
Share Intensive-informal (-1)			0.1269	0.1193				
			(0.210)	(0.224)				
Share Extensive-informal (-1)					-0.2500	0.0615		
					(0.168)	(0.153)		
Industry Size (-1)							0.0001	-0.0001
							(0.000)	(0.000)
Observations	574	574	547	547	574	574	574	574
R^2	0.41	0.09	0.41	0.10	0.42	0.09	0.53	0.14

Notes: Informality measures without distinguishing margins and extensive-informal employment refers to the share of informal employment on total employment. Intensive-informal refers to the share of intensive-informal employment on total employment working for registered employers. Industry size is calculated as the average industry-year number of workers individuals declare to work with them. Standard errors for industrial clusters in parenthesis. All specifications include a constant and year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4 Identification Strategy and Results

In this Section, I estimate the impact of an increase in import competition on informal employment. First, I study informal labour as a binary phenomenon as I do not discriminate between type of informal worker. These baseline estimations are presented in Section 4.1. Second, I study the intensive margin of informality in Section 4.2. Third, I focus on the extensive margin in Section 4.3. Since the two margins of informality are not independent, the analysis on each margin is done separately.

In Sections 4.1, 4.2 and 4.3, the analysis is twofold. On the one hand, I study the effect of a reduction in tariffs on the probability to be hired as an informal worker. In this way, the analysis is conducted at the individual level, and I control for individual characteristics that might influence workers' probability to be informal.[24] On the other hand, I calculate the impact of an increase in import competition at the industry level by estimating the effect on the importance of informal employment on total employment.

4.1 Baseline estimations

Even though the data allows to distinguish between informal workers in the intensive and in the extensive margin of informality, in this Section, I do not make this distinction. In this way, the results are comparable to those obtained in the literature (Acosta and Montes-Rojas, 2014; Ulyssea and Ponczek, 2018; Goldberg and Pavcnik, 2003; Cruces et al., 2018). I estimate the linear probability model described by Equation 2:

$$INF_{\ell jt} = \alpha_0 + \alpha_\tau OT_{jt} + \alpha_g S_{gjt} * OT_{jt} + \alpha_s S_{gjt} + \alpha_i IT_{jt} + \alpha_H \boldsymbol{H'_{\ell t}} + F_j + F_t + \varepsilon_{\ell jt} \quad (2)$$

where $INF_{\ell jt} = 1$ if individual ℓ working in industry j in year t is informal either in the extensive margin or in the intensive margin, and 0 otherwise. OT_{jt} is the output tariff in industry j in year t and, its coefficient provides the effect of import competition on informal employment.

Since I identify the increase in import competition as a reduction in tariffs, I have to make a distinction between input and output tariffs. Input tariffs are the tariffs that a domestic firm pays for all imported inputs while output tariffs are the entry cost paid by foreigner competitors when selling at home. Then, a cut in input tariffs is a reduction in domestic firms' costs. As such, it could compensate for an increase in competition coming from abroad, i.e., a decrease in output tariffs. For example, a domestic firm might import leather for the manufacture of shoes. If the tariffs for leather go down, the firm's costs also go down. On the other hand, if tariffs for shoes produced abroad are also cut, firm's

[24] These individual characteristics are included as proxy variables of unobservable characteristics, such as ability or bargaining power, that might influence workers' probability to accept an informal job.

import competition increases. While the reduction in input tariffs is a positive effect for the domestic firm, the cut on output tariffs is a negative effect. Hence, in Equation 2 I also control for input tariffs with IT_{jt} which is the input tariff in industry j in year t. In this way, I can make sure that the effects do not cancel each other out when all tariffs diminish.

Equation 2 also includes an industry-size indicator calculated each year (S_{gjt}) and interaction terms with output tariffs ($S_{gjt} * OT_{jt}$). Since the average industry-size is constructed each year based on workers' answer regarding the size of their employer, it changes with time for a given industry.[25] Then, it is possible to control for size variation within industries over time. I do so by indexing size with the variable S_{gjt} where $g = s, m, l$. When $g = s$, employers in industry j in time t have on average less than 15 employees, when $g = m$ they have between 15 and 50 and when $g = l$ they have more than 50 workers. Since S_{gjt} is an industry size indicator variable, each of the coefficients of the interaction term, α_g, is the differential effect of output tariffs on informality on industries with different average size. Henceforth, I classify small, medium and large industries according to the definition given by S_{gjt}.

It can be argued that informality is the result of a bargaining process between the worker and the employer. Hence, the individual's attributes are critical in determining the outcome of the bargain. For example, it is expected that more educated individuals are less likely to be hired as informal workers (Table 2). I control for these characteristics by including the vector for each individual $H_{\ell t}$ that contains observable attributes of worker ℓ in year t such as age, education, gender, civil status, ethnic background and region of residency.[26] Finally, I control for industry time-invariant characteristics and aggregate shocks by adding industry fixed effects, F_j and year fixed effects, F_t.

I use a linear probability model to estimate Equation 2. I account for heteroskedasticity and serial correlation in the error term by using robust (Huber-White) standard errors clustered by industry at 4-digit level. Results are in Table 7 in Columns 1-4. Column 1 suggests that there is no significant relationship between the reduction of tariffs and the probability to be hired as an informal worker. In Column 2, I also control for average industry size, and output tariffs remain statistically insignificant. In Column 3, when I add industry size interacted with output tariffs, I find that a reduction in output tariffs increases the probability to be hired as an informal worker in industries where on average employers have less than 15 employees. In particular, a 1-percentage point (pp) decrease in output tariffs generates a 0.55-pp increase in the probability to be hired as an informal worker in such an industry. To a lesser extent, this is also true for medium size industries

[25] Note that this industry-size indicator does not capture industry-specific trends as it can change with time for any given industry if the industry's average size changes. Moreover, I control for industry trends as a robustness check and results are very similar.

[26] Region refers to Peru's first-level administrative subdivision, "departmento".

as a 1-pp reduction in output tariffs translates in a 0.23-pp boost in the probability to be hired as an informal worker. Moreover, these results are robust to controlling for input tariffs in Column 4. However, in this case, I also find that there is a positive significant relation between output tariffs and informality. Then, when controlling for input tariffs, the effect in small and medium industries is counteracted, eliminating the effect on medium industries and reducing the effect on small firms significantly. Furthermore, the impact on large industries goes in the opposite direction, and when output tariffs are cut, informal employment in these industries is also reduced.

The reduction in tariffs is not systematically different across industry size. For instance, in 2008 the average tariff reduction took place among large industries. Conversely, in 2011 medium industries experienced the most significant tariff cut and large industries the lowest. During the period of study all industries experienced a reduction in tariffs and the extent of the contraction is not correlated with the average employer size of the industry.[27] Hence, these results are consistent with the hypothesis that an increase in import competition would motivate small employers to hire more informal workers in the extensive margin of informality as they are less likely to be detected transgressing the law. On the other hand, the probability to be informally hired in industries where employers have more than 15 employees goes down as they are more notorious, and it is more likely to be audited.

The reduction in output tariffs not only has an impact on the decision to hire an informal worker but also on the proportion of informal workers employed in a given industry and year. Thus, after estimating the effect on the probability to hire informal workers, I estimate Equation 3.

$$ShareINF_{jt} = \psi_0 + \psi_\tau OT_{jt} + \psi_g S_{gjt} * OT_{jt} + \psi_s S_{gjt} + \psi_i IT_{jt} + F_j + F_t + \eta_{\ell jt} \qquad (3)$$

where

$$ShareINF_{jt} = \frac{\text{Total Informal Employment}}{\text{Total Employment}} \text{ in industry } j \text{ in year } t$$

This identification strategy is somewhat comparable with the two-stage approach used by Goldberg and Pavcnik (2003) and Acosta and Montes-Rojas (2014). Instead of estimating the propensity to be informal, I directly calculate the share of informal labour in total employment. I report the OLS estimation of Equation 3 in Columns 5-8 in Table 7. The regressors are the same as the ones described in Equation 2, but in this case, the dependent variable is the proportion of informal labour in total employment. Table 7 presents results in Columns 5-8.

[27] See Appendix E for more details.

In Columns 5 and 6, I find that there is no significant effect on the importance of informal employment when output tariffs are cut. However, when including the average industry-year size indicators interacted with output tariffs in Column 7, I find a statistically significant relationship between the share of informal employment on total employment and output tariffs.[28] Namely, I find that a 1-pp decrease in output tariffs cuts the share of informal labour by 0.77-pp. However, this is only true for industries where employers on average are large as in industries with mostly small and medium firms this effect is counteracted. The results suggest that when import competition increases because tariffs are cut by 1-pp, industries that on average have small firms, increase their share of informal employment by 1.30-pp and by 1.09-pp in industries with mostly medium firms. This result remains almost unchanged when controlling for input tariffs in Column 8.

From the results presented in Table 7, it is possible to infer that two mechanisms go in opposite direction when studying the impact of an increase in import competition on informal labour. On the one hand, when tariffs drop, the probability to be hired as an informal worker increases only in industries that on average have less than 50 workers. In all other industries, the probability of working as an informal employee goes down. Interestingly, this result is slightly different when discussing the effect of a reduction of tariffs on the proportion of informal employment. Notably, industries with average-size firm between 15 and 50 increase their share of informal employment. In any case, results suggest that there are two mechanisms at play. In the following sections, I show that when unfolding informality in two margins, these mechanisms are revealed in more detail.

4.2 Intensive Margin

To gain some insight into what is driving the effect of the reduction in tariffs on informality suggested in Table 7, I take advantage of the detailed individual Peruvian data and distinguish informal employees between informal in the intensive and in the extensive margin. First, I estimate Equation 4 where the dependent variable, $INT_{\ell jt}$, takes the value of 1 if the individual ℓ is informal in the intensive margin in industry j in year t and 0 if the individual is a formal worker. Note that the regression of Equation 4 is conditional on individuals being hired by a registered firm.[29]

$$INT_{\ell jt} = \beta_0 + \beta_\tau OT_{jt} + \beta_g S_{gjt} * OT_{jt} + \beta_s S_{gjt} + \beta_i IT_{jt} + \beta_H \boldsymbol{H'_{\ell t}} + F_j + F_t + \varepsilon_{\ell jt} \quad (4)$$

[28] In Appendix E, I show that the distribution of tariffs cut is not systematically different across industry sizes.

[29] In Appendix A.1, I report the results for a multinomial logit model where the dependent variable has three categories: extensive-informal, intensive-informal and formal. I find that when testing for the violation of the IIA assumption, results are ambiguous hinting that being hired by a registered employer (as a formal or as an intensive-informal worker) and being intensive-informal are not independent. Hence, I estimate Equation 4 conditional on being hired by a registered employer.

Table 7: Informal Employment without distinguishing margins

	Informality Indicator				Share of Informal Employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output Tariff	0.0014	0.0015	0.0023	**0.0027***	0.0044	0.0043	**0.0077****	**0.0075****
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)
Input Tariff				-0.0017				0.0011
				(0.002)				(0.007)
S*Output Tariff			**-0.0055*****	**-0.0055*****			**-0.0130***	**-0.0130***
			(0.001)	(0.001)			(0.007)	(0.007)
M*Output Tariff			**-0.0023***	**-0.0025***			**-0.0109***	**-0.0109***
			(0.001)	(0.001)			(0.006)	(0.006)
Small Industry (S)		0.0201	0.0593***	0.0588***		0.2143***	0.2685***	0.2686***
		(0.013)	(0.017)	(0.017)		(0.043)	(0.061)	(0.061)
Medium Industry (M)		0.0232**	0.0333**	0.0337**		0.1235***	0.1691***	0.1688***
		(0.011)	(0.014)	(0.014)		(0.039)	(0.056)	(0.056)
Married	-0.0686***	-0.0686***	-0.0687***	-0.0688***				
	(0.010)	(0.010)	(0.010)	(0.010)				
Male	-0.1307***	-0.1307***	-0.1306***	-0.1306***				
	(0.010)	(0.010)	(0.010)	(0.010)				
Primary Education	-0.0424	-0.0425	-0.0426	-0.0426				
	(0.028)	(0.028)	(0.028)	(0.028)				
Secondary Education	-0.1191***	-0.1191***	-0.1193***	-0.1193***				
	(0.035)	(0.035)	(0.035)	(0.035)				
Technical Education	-0.2358***	-0.2357***	-0.2358***	-0.2358***				
	(0.038)	(0.038)	(0.038)	(0.038)				
UG-PG degree	-0.2861***	-0.2862***	-0.2863***	-0.2862***				
	(0.038)	(0.038)	(0.038)	(0.038)				
Quechua ethnicity	-0.0026	-0.0024	-0.0036	-0.0036				
	(0.007)	(0.007)	(0.007)	(0.007)				
Age: 30-44	-0.1259***	-0.1259***	-0.1258***	-0.1259***				
	(0.013)	(0.013)	(0.013)	(0.013)				
Age: 45-64	-0.1253***	-0.1253***	-0.1254***	-0.1254***				
	(0.019)	(0.019)	(0.019)	(0.019)				
Age: >65	-0.0557***	-0.0559***	-0.0560***	-0.0560***				
	(0.016)	(0.016)	(0.016)	(0.016)				
Observations	31009	31009	31009	31009	695	695	695	695
R^2	0.31	0.31	0.31	0.31	0.61	0.65	0.65	0.65

Notes: Robust standard errors for industrial clusters in parenthesis. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. Specifications in Columns 1-4 include region of residence fixed effects. All specification include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

I use a linear probability model to estimate Equation 4, and I account for heteroskedasticity and serial correlation in the error term by computing Huber-White standard errors clustered by industry at the 4-digit level of aggregation. Results are in Columns 1-4 in Table 8. All specifications in Columns 1-4 in Table 8 control for individual characteristics and include industry, year and region of residence fixed effects. Results show that married men with above technical education and older than 30 years old are less likely to be hired as intensive-informal workers instead of formal ones.

In Column 1, I only control for individual characteristics. In Column 2, I also control for average firm size in each industry-year. In both specifications, I find that the reduction in output tariffs does not have a statistically significant impact on the probability to be hired as an intensive-informal worker. However, when I also control for industry-year size in Column 3, I find that in industries that on average have employers with less than 50 employees, a reduction in output tariffs translates into an increase in the probability to hire informal-intensive workers.[30]

Interestingly, this result remains the same when controlling for input tariffs in Column 4. I find that a 1-percentage point (pp) reduction in output tariffs generates an increment of 1.3-pp in the probability to be hired as an intensive-informal worker in an industry where, on average, firms are small. The effect is quantitatively lesser in industries that have mostly medium-size firms as in these industries a 1-pp decrease in tariffs increases the likelihood to be hired as an intensive-informal worker by 0.59-pp.[31] This result is consistent with the hypothesis that smaller registered employers tend to hire informal workers as a mean to reduce costs and remain competitive when there is an increase in import competition. I find that this is the case in industries where firms mostly have less than 50 employees. These firms are less likely to get caught when avoiding the payroll taxes that come with hiring formal workers.

To get a more detailed picture at the industry level, I study the effect that a reduction in output tariffs has on the importance of informal labour within registered firms. I estimate Equation 5, where the dependent variable is the proportion of informal employment in registered employers.

$$ShareINT_{jt} = \delta_0 + \delta_\tau OT_{jt} + \delta_g S_{gjt} * OT_{jt} + \delta_s S_{gjt} + \delta_i IT_{jt} + F_j + F_t + \eta_{jt} \qquad (5)$$

[30] In Appendix B.1, I run all regressions in Sections 4.2 and 4.3 including an industry trend to make sure that the industry-year size indicator is not capturing any industry-specific trends. I find that results are qualitatively similar.

[31] I test the joint significance of the industry size indicators for the regression reported in Column 4. I find that the F-statistic is 4.21 and the corresponding p-value is 0.0176. Thus, I can reject the null hypothesis that both coefficients are zero. I also test if the coefficients of the industry size indicators are different from each other. I find that the F-statistic is 3.08 and the corresponding p-value is 0.0824. Hence, I can reject the null hypothesis that coefficients for the indicators for small and medium industries are the same.

where

$$ShareINT_{jt} = \frac{\text{Total Intensive-Informal Employment}}{\text{Total Employment in Registered Firms}} \text{ in industry } j \text{ in year } t$$

I present the results from the OLS estimation of Equation 5 in Columns 5-8 in Table 8.[32] I compute Huber-White standard errors clustered by industry at 4-digit level of aggregation. All specifications also control for industry and year fixed effects. In Columns 5 and 6, I find no statistically significant relation between the share of informal employment on total employment in registered employers and output tariffs. However, when controlling for average industry-year size in Column 7, I find that a reduction in output tariffs changes the labour composition towards intensive-informal employment in industries where employers have less than 50 workers.

Moreover, this effect is not offset by the reduction of input tariffs for which I control in Column 8. The coefficients remain almost the same. I find that a 1-pp reduction of output tariffs increases the share of intensive-informal workers in 1.9-pp in industries that, on average, have firms with less than 15 employees. Similarly, the same reduction in output tariffs translates in a 1.3-pp increase in the share of intensive-informal employment in registered employers in medium-size industries.[33]

Results are consistent with the hypothesis that when tariffs drop, registered employers might be motivated to increase their share of informal employment. Since intensive-informal workers are cheaper than formal ones, and they might be facing a substantial reduction in profits, employers would be willing to risk getting caught when hiring informal workers only after import competition increases. Moreover, I find that this is true for industries where employers are, on average, small or medium size. Assuming that smaller firms are less likely to be audited, this result is not surprising.

This result strengthens the validity of policies that would enhance inspection of labour regulation compliance by registered firms such as the one implemented by SUNAFIL (See Section 3.2.1). Importantly, it provides a guideline to such institutions as it would advice to shift the focus from larger firms towards small and medium size firms. Especially, when resources are of the essence, these sort of direction could translate into a more efficient policy implementation.

[32]Since the dependent variable is a proportion, I also estimate a fractional logit model. The results are very similar, and are in the Appendix in Table 12.

[33]I test the joint significance of the industry size indicators for the regression reported in Column 8. I find that the F-statistic is 4.44 and the corresponding p-value is 0.0142. Thus, I can reject the null hypothesis that both coefficients are zero. I also test if the coefficients are different from each other, I find that the F-statistic is 0.06 and the corresponding p-value is 0.0809. Hence, I reject the null hypothesis that they are the same.

Table 8: Intensive Margin of Informality

	Informality Indicator				Share of Informal Employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output Tariff	0.0005	0.0006	0.0014	0.0018	-0.0013	-0.0013	0.0030	0.0027
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Input Tariff				-0.0025				0.0021
				(0.003)				(0.007)
S*Output Tariff			**-0.0129*****	**-0.0130*****			**-0.0196****	**-0.0196****
			(0.004)	(0.004)			(0.009)	(0.009)
M*Output Tariff			**-0.0057****	**-0.0059****			**-0.0133****	**-0.0132****
			(0.002)	(0.002)			(0.006)	(0.007)
Small Industry (S)		0.0184	0.0991***	0.0988***		0.0893*	0.1755**	0.1757**
		(0.021)	(0.037)	(0.037)		(0.049)	(0.074)	(0.074)
Medium Industry (M)		0.0112	0.0367**	0.0369**		0.1040**	0.1583**	0.1577**
		(0.017)	(0.018)	(0.018)		(0.043)	(0.060)	(0.060)
Married	-0.1166***	-0.1166***	-0.1165***	-0.1166***				
	(0.014)	(0.014)	(0.014)	(0.014)				
Male	-0.0682***	-0.0681***	-0.0679***	-0.0678***				
	(0.010)	(0.010)	(0.010)	(0.010)				
Primary Education	-0.0628	-0.0633	-0.0616	-0.0616				
	(0.077)	(0.077)	(0.077)	(0.077)				
Secondary Education	-0.1262	-0.1267	-0.1252	-0.1252				
	(0.078)	(0.078)	(0.078)	(0.078)				
Technical Education	-0.2460***	-0.2463***	-0.2448***	-0.2448***				
	(0.077)	(0.077)	(0.077)	(0.077)				
UG-PG degree	-0.2794***	-0.2799***	-0.2784***	-0.2784***				
	(0.081)	(0.081)	(0.081)	(0.081)				
Quechua ethnicity	-0.0274*	-0.0274*	-0.0275*	-0.0276*				
	(0.014)	(0.014)	(0.014)	(0.014)				
Age: 30-44	-0.2399***	-0.2399***	-0.2401***	-0.2400***				
	(0.017)	(0.017)	(0.017)	(0.017)				
Age: 45-64	-0.3337***	-0.3339***	-0.3342***	-0.3341***				
	(0.024)	(0.024)	(0.024)	(0.024)				
Age: >65	-0.3182***	-0.3186***	-0.3201***	-0.3202***				
	(0.037)	(0.037)	(0.037)	(0.037)				
Observations$^{\mp}$	14126	14126	14126	14126	660	660	660	660
R^2	0.25	0.25	0.25	0.25	0.37	0.39	0.40	0.40

$^{\mp}$ All specifications are conditional on individuals being hired by a registered firm.

Notes: Robust standard errors for industrial clusters in parenthesis. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. Specifications in Columns 1-4 include region fixed effects. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

4.3 Extensive Margin

In this Section, I study the impact of an increase in import competition on the extensive margin of informality. First, I explore the effect on the probability to be hired as an extensive-informal worker when output tariffs drop. Second, I analyse the impact on the employment composition between labour in the extensive margin of informality and formal or extensive-informal employment.

I estimate Equation 6:

$$EXT_{\ell jt} = \gamma_0 + \gamma_\tau OT_{jt} + \gamma_g S_{gjt} * OT_{jt} + \gamma_s S_{gjt} + \gamma_i IT_{jt} + \gamma_H \boldsymbol{H'_{\ell t}} + F_j + F_t + \varepsilon_{\ell jt} \quad (6)$$

where the dependent variable is $EXT_{\ell jt} = 1$ if individual ℓ is informal in the extensive margin and 0 otherwise. In other words, $EXT_{\ell jt} = 0$ if the individual is an intensive-informal worker or a formal worker. As in the previously estimated linear probability models, I measure import competition with output tariffs, OT_{jt}, while controlling for input tariffs, IT_{jt}, and individuals' demographic characteristics, $\boldsymbol{H'_{\ell t}}$. Furthermore, I control for the average size in industry j in time t in which the individual ℓ is employed by indexing size with variable S_{gjt} where $g = s, m, l$. When $g = s$, firms in the industry have on average less than 15 employees, when $g = m$ they have between 15 and 50 and when $g = l$ they have more than 50 workers.

Unlike when studying the intensive margin of informality, the sample of analysis is not constrained, and I take into account all individuals as I did when I estimated Equation 2. However, the dependent variable, in this case, takes the value of 1 only for extensive-informal individuals rather than informal in any margin. I estimate Equation 6 with a linear probability model and compute Huber-White robust standard errors clustered by industry at the 4-digit level of aggregation. I include industry, year and region fixed effects in all specifications.

Results for Equation 6 are in Columns 1-4 in Table 9.[34] In Column 1, I only control for individual characteristics. I find that young married men with above primary education are less likely to be hired as extensive-informal workers. These results are consistent in all specifications. Furthermore, I find that when output tariffs are cut, the probability to be hired as an extensive-informal worker also drops. This result is robust to the inclusion of industry-year size indicator in Column 2. In the same way, results are not altered by the addition of interaction terms between industry-year size indicator and output tariffs in Column 3. From Columns 2 and 3 is evident that the average industry size does not impact on the probability to be hired as an extensive-informal worker when import competition increases. More interestingly, the result remains unchanged when including

[34]The results are also similar when estimating logit models and are in the Appendix in Table 11.

input tariffs in Column 4.

The result in Column 4 suggests that a 1-percentage point (pp) reduction in output tariffs decreases the probability to be hired as an extensive-informal worker by 0.35-pp. In other words, a 50-pp decline in tariffs would diminish the probability to be employed in the intensive margin of informality by 17.5-pp.[35] Thus, the magnitude of the effect is lesser than that of the intensive margin. Nevertheless, the impact on the extensive margin is on all industries, while the effect in the intensive margin is only on industries that, on average, have small and medium size firms. This result is consistent with the hypothesis that unregistered employers are the least productive ones. Consequently, the probability to be hired in the extensive margin of informality drops when import competition increases.

Next, I estimate Equation 7 to gain insight on the effect that a reduction in output tariffs has on the proportion of employment in unregistered employers in the manufacturing sector. In Columns 5-8 in Table 9, I report the results from the OLS estimation. I compute Huber-White robust standard errors clustered by industry at 4-digit level of aggregation. I include industry and year fixed effects in all specifications. I also estimate Equation 7 as a fractional logit response model. The results are very similar and are reported in the Appendix in Table 13.

$$ShareEXT_{jt} = \phi_0 + \phi_\tau OT_{jt} + \phi_g S_{gjt} * OT_{jt} + \phi_s S_{gjt} + \phi_i IT_{jt} + F_j + F_t + \eta_{\ell jt} \qquad (7)$$

where

$$ShareEXT_{jt} = \frac{\text{Total Extensive-Informal employment}}{\text{Total Employment}} \text{ in industry } j \text{ in year } t$$

Columns 5-8 in Table 9 show that a reduction in output tariffs diminishes the share of extensive-informal employment on total employment. This result holds when adding industry-year size indicator and when including interaction terms between these size indicators and output tariffs. Moreover, the relationship between import competition and the relative importance of extensive-informal employment remains unchanged both quantitatively and qualitatively when controlling for input tariffs in Column 8. From Column 8, the results suggest that a 1-percentage point (pp) decrease in output tariffs translates on 0.55-pp reduction in the share of extensive-informal employment in the manufacturing

[35] I test the joint significance of the industry size indicators for the regression reported in Column 4. I find that the F-statistic is 3.39 and the corresponding p-value is 0.0377. Thus, I can reject the null hypothesis that both coefficients are zero. I also test if the coefficients of the industry size indicators are different from each other. I find that the F-statistic is 5.89 and the corresponding p-value is 0.0170. Hence, I can reject the null hypothesis that coefficients for the indicators for small and medium industries are the same.

sector.[36] Additionally, Columns 6-8 show that industries with average firm size below 15 employees are more likely to show an increase in the proportion of extensive-informal employment.

Results from Table 9 are consistent with findings that the least productive firms are the first ones to leave the market when a trade liberalisation process takes place.[37] Since the literature tends to describe unregistered firms as unproductive (Ulyssea, 2018; La Porta and Shleifer, 2014), it makes sense that when import competition increases, the probability to be hired in the extensive margin of informality decreases and the share of extensive-informal employment on total employment also drops.

This finding contradicts those that advocate for a reduction on entry regulations in the formal market as a necessary measure to reduce informality (De Soto, 1989, 2000). In fact, it suggests that, in the context of globalisation, it is not necessary for policy makers to implement regulations that would help informal firms formalize as these unproductive firms will naturally disappear and their workers would have to seek employment in registered (more productive) firms. Nevertheless, in order for informality in both margins to decrease, globalisation on its own is not enough. As discussed in Section 4.2, it should be coupled with strong policies that ensure registered firms compliance with labour law regulations.

[36] I test the joint significance of the industry size indicators for the regression reported in Column 8. I find that the F-statistic is 12.87 and the corresponding p-value is 0.0000. Thus, I can reject the null hypothesis that both coefficients are zero. I also test if the coefficients are different from each other, I find that the F-statistic is 15.23 and the corresponding p-value is 0.0002. Hence, I reject the null hypothesis that they are the same.

[37] This finding is widely accepted in the literature following Melitz (2003).

Table 9: Extensive Margin of Informality

	Informality Indicator				Share of Informal Employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output Tariff	**0.0034****	**0.0035****	**0.0035***	**0.0035***	**0.0054****	**0.0054****	**0.0058****	**0.0055***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Input Tariff				-0.0002				0.0021
				(0.003)				(0.007)
S*Output Tariff			-0.0035	-0.0035			-0.0042	-0.0042
			(0.003)	(0.003)			(0.008)	(0.008)
M*Output Tariff			0.0017	0.0017			0.0008	0.0009
			(0.003)	(0.003)			(0.005)	(0.005)
Small Industry (S)		0.0171	0.0503**	0.0503**		0.2475***	0.2667***	0.2669***
		(0.021)	(0.021)	(0.022)		(0.039)	(0.053)	(0.053)
Medium Industry (M)		0.0166	0.0052	0.0052		0.0316	0.0254	0.0248
		(0.015)	(0.017)	(0.017)		(0.027)	(0.032)	(0.032)
Married	-0.0184**	-0.0184**	-0.0186**	-0.0186**				
	(0.009)	(0.009)	(0.009)	(0.009)				
Male	-0.1726***	-0.1726***	-0.1727***	-0.1727***				
	(0.019)	(0.019)	(0.019)	(0.019)				
Primary Education	-0.0235	-0.0236	-0.0232	-0.0232				
	(0.030)	(0.030)	(0.030)	(0.030)				
Secondary Education	-0.1337***	-0.1338***	-0.1332***	-0.1332***				
	(0.037)	(0.037)	(0.037)	(0.037)				
Technical Education	-0.2226***	-0.2226***	-0.2220***	-0.2220***				
	(0.040)	(0.040)	(0.040)	(0.040)				
UG-PG degree	-0.2559***	-0.2560***	-0.2552***	-0.2552***				
	(0.041)	(0.041)	(0.041)	(0.041)				
Quechua ethnicity	0.0105	0.0107	0.0101	0.0101				
	(0.010)	(0.010)	(0.010)	(0.010)				
Age: 30-44	0.0070	0.0071	0.0072	0.0072				
	(0.012)	(0.012)	(0.012)	(0.012)				
Age: 45-64	0.0679***	0.0678***	0.0679***	0.0679***				
	(0.022)	(0.022)	(0.021)	(0.022)				
Age: >65	0.1504***	0.1503***	0.1505***	0.1505***				
	(0.025)	(0.025)	(0.025)	(0.025)				
Observations	31009	31009	31009	31009	695	695	695	695
R^2	0.38	0.38	0.38	0.38	0.71	0.76	0.76	0.76

Notes: Robust standard errors for industrial clusters in parenthesis. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.Specifications in Columns 1-4 include region fixed effects. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

5 Robustness

Peru recorded high rates of growth rates in the 2000s and an increase in domestic demand. Chacaltana (2017) studies the effect of sectoral growth on formalization. He finds that growth reduces informality on employment-intensive sectors such as Farming, Commerce and Services. Moreover, he highlights the importance of growth composition. He points out that regional value-added per worker and regional output share of labour-intensive sectors are crucial in the formalization process. Chacaltana (2017) finds that growth did not have an effect on formalization in manufacturing, which is the focus of this paper. Nevertheless, I perform a robustness check on this matter.

Due to data constraints, I cannot control directly for GDP or Domestic Demand at the ISIC 4-digit level. However, I can control for imports and exports growth. If imports increase while the GDP is also increasing, imports growth would proxy an increase in domestic demand. Given that national production is growing, an increase in imports would mean that more consumers at home have increased their demand for manufacturing goods. Hence, in Appendix B.2 I conduct an analysis similar to the one discussed in Sections 4.2 and 4.3. I find that results are almost identical for the intensive margin. I also control for exports growth as it could be that the excess of supply in the domestic market is sent abroad, and results remain almost unchanged. Findings are slightly different for one of the results concerning the extensive margin of informality. Nevertheless, the overall conclusions are qualitatively similar. More details can be found in Appendix B.2.

In Sections 4.2 and 4.3 I control for input tariffs. However, it might be relevant also to interact input tariffs with industry size. If workers in the sample are employed by exporting firms, which are known to be larger, it might be the case that the reduction in input tariffs benefit them more than the increase in import competition harms them.[38] With that in mind, I conduct similar regressions and report them in Appendix B.3. Results remain very similar to the ones reported in Sections 4.2 and 4.3.

During the period of analysis, China and the United States of America (US) signed FTAs with Peru. Both countries are important trade partners for Peru. Since the measure of trade liberalisation I use are MFN tariffs, the preferential treatment granted to China and the US would not be reflected on the chosen measure of trade policy. To my knowledge, there is no availability of applied tariffs disaggregated at the 4-digit level within manufacturing as there is of MFN tariffs. Hence, to alleviate concerns regarding the potential effect that the FTA with China and the US might have had on informal labour in Peru, I control for the share of imports coming from China and the US on total Peruvian imports.

An increase in import competition due to an increase in trade coming from China or the US might be the cause of the effects on informality I document in this paper. Thus, I

[38] Nataraj (2011) finds that larger-formal firms' productivity increase when input tariffs drop.

control for the importance of imports coming from the US and China in regressions similar to the ones presented in Sections 4.2 and 4.3. Results are presented in the Appendix B.4. I find that even when controlling for these potential confounding factors, results remain the same. Conclusions are almost the same, both qualitatively and quantitatively.[39]

I also conduct a similar analysis to the one reported in Sections 4.2 and 4.3 for the period 2007-2014. I do so to address concerns over three different issues. First, due to a change in the questionnaire in 2012, the definition of intensive-informal workers change. Second, for some unknown reason, Peru did not report tariffs to the WTO in 2012. Hence, I obtained the data for the tariffs for that specific year from the BCRP. Third, based on Chacaltana (2017), I claim that the introduction of the electronic payroll system's effect is negligible on the evolution of informality. However, I do acknowledge that this may no longer be true after SUNAFIL started to operate in 2013. For these reasons I estimate equations 4-7 for the period 2007-2014 and report results in Appendix B.5. I find that the main conclusions remain unchanged.

Finally, results in Sections 4.2 and 4.2 include both self-employed workers and employees. Most self-employed workers declare to be in the extensive margin of informality and to be employed mostly in "Textiles", "Wearing Apparel", "Furniture" and "Food products and beverages". I keep them in the analysis in Section 4 as I think that they are most likely employed by a small informal undertaking and is not entirely accurate to classify them as "self-employed". However, if they do not work for an employer, the mechanisms I claim in previous sections would not apply. Hence, in Appendix B.6, I estimate equations 4-7 excluding self-employed workers and find very similar results.[40]

6 Conclusions

In this paper, I highlight the importance of distinguishing informal workers employed by a registered firm from those working in an unregistered one. Specifically, I show that disentangling these two margins of informality is vital when studying the effect of trade liberalisation on informal labour. First, I present a descriptive analysis of employees in the Peruvian manufacturing sector and show that the demographic characteristics of informal workers in the intensive margin differ from those in the extensive margin of informality. Hence, it is essential to control for individual features when relating trade to informal

[39]Pierola et al. (2019) find that greater import competition due to the surge of imports from China in 2001-2010, increased the chances of working in the informal sector among workers with only elementary education. This result does not necessarily contradict my findings as they put together the intensive and the extensive margin of informality.

[40]It is worth noting that 1 per cent of self-employed workers declared to be formal. Hence, as results in Table 22 eliminate all extensive-informal self-employed workers, results in Table 21 omit formal self-employed workers. Formal workers excluded from the analysis are mostly employed in the following industries: "Wearing Apparel", "Fabricated metal products", "Food products and beverages" and to a lesser extent, "Publishing and printing".

employment.

I also show that several features that tend to describe the informal sector in the literature, such as low wages and small firm size, are present in the Peruvian informal sector. Moreover, I provide a descriptive analysis that highlights how some industries within the manufacturing sector are more prone to one margin of informality than the other. Hence, when studying informality at the industry level it is also important to distinguish these two margins of informality.

Furthermore, the empirical analysis demonstrates that an increase in import competition impacts the two margins of informality through entirely different channels. A reduction in tariffs triggers a decrease of extensive-informal employment and an enlargement of intensive-informal employment.

Even though, it is not possible to observe firms' decisions due to data constraints, it is possible to observe the labour outcomes of those decisions in the context of globalisation. On the one hand, registered employers respond to the increase in import competition by hiring cheaper (informal) workers. Moreover, since small and medium size firms are less likely to be audited by the Tax Agency, they hire more prone to hire informal workers than larger firms. Hence, I find that the share of intensive-informal employment expands in industries that, on average, have small and medium size employers. In this way, informal labour in the intensive margin increases.

On the other hand, extensive-informal workers are characterized by very low productivity. As a result, their employers are not able to cope with stronger competition and are less likely to survive when tariffs drop. Thus, when I study the effect of an increase in import competition on the probability to be hired in the extensive margin of informality and on the share of extensive-informal employment on total employment, I find that it goes down in both settings. Importantly, these results do not depend on the average size of employers in any given industry. These results are for all industries.

Since the two margins of informality are not independent, I conduct the analysis separately for each margin. By comparing results presented in Sections 4.2 and 4.3, it is evident that the tariff reduction effect on the intensive margin is stronger than the impact on the extensive margin. Hence, I infer that the intensive margin of informality drives the trade liberalisation effect on informality. In this way, trade increases informality.

This result is disconcerting as many anticipated globalisation to reduce informality. This paper provides valuable insight as it acknowledges that trade reduces informality but only on the extensive margin. When considering both, the intensive and the extensive margin, trade no longer weakens informal labour overall. Nevertheless, this finding is not entirely pessimistic as it can contribute to a more targeted policy aiming to eradicate informality.

Given this paper's findings, policy makers might obtain better results when implementing a policy that focus on encouraging registered firms to hire workers formally

during a trade liberalisation process. Even though, red tape reduction and taxes cut for small (informal) firms are potentially helpful in the fight against the extensive margin of informality, they might not be the most adequate use of resources as trade liberalisation shrinks this portion of informal employment on its own.

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A Additional Estimations

A.1 Multinomial Logit

I classify all individuals into three categories. They might be employed in a registered firm as a formal employee or as informal in the intensive margin. Alternatively, they might be hired by an unregistered firm and be informal in the extensive margin. Hence, I estimate the multinomial logit model described in Equation 8.

$$Status_{\ell jt} = \beta_0 + \beta_\tau OT_{jt} + \beta_g S_{gjt} * OT_{jt} + \beta_s S_{gjt} + \beta_i IT_{jt} + \beta_H \boldsymbol{H'_{\ell t}} + I_j + Y_t + \epsilon_{\ell jt} \quad (8)$$

where

$$Status_{\ell jt} = \begin{cases} = 0 & \text{if individual } \ell \text{ is a formal wkr in a registered firm} \\ = 1 & \text{if individual } \ell \text{ is intensive-informal} \\ = 2 & \text{if individual } \ell \text{ is extensive-informal} \end{cases}$$

where $Status_{\ell jt}$ is a categorical variable describing the informality-formality status of individual ℓ who works in industry j at time t. The remaining regressors in Equation 8 are the same controls described in Section 4.

The results are in Table 10. The table reports average marginal effects so that they are comparable with the output from the OLS estimation in Table 2. Note that the output tariff average marginal effect takes into account the effect for the interaction terms between tariffs and size indicator, $S_{gjt} * OT_{jt}$. Interestingly, the estimated effect without distinguishing the two margins of informality (Table 7 is between the marginal effect found for each margin separately in Table 10.

I find that a reduction in output tariffs increases the probability to be informal in the intensive margin while reducing the probability to be hired in the extensive margin of informality. This result is robust to the inclusion of input tariffs controls, and the coefficients remain almost unchanged when I add input tariffs as regressors (Columns 3 and 4). On the one hand, an increase in import competition translates into registered firms reducing costs by being more likely to hire cheaper workers, i. e. intensive-informal workers. On the other hand, unregistered firms are more likely to either exit the market or hire fewer workers when import competition increases.

A limitation of the multinomial logit model is the assumption of the "independence of irrelevant alternatives" (IIA) which implies that the relative odds of being a formal worker in a registered firm are unaffected by the relative odds of being informal in any of the margins. A Haussman test for the violation of the IIA assumption is not conclusive.

Table 10: Multinomial Logit - Average Marginal Effects

	Model 1		Model 2	
	Intensive Margin	Extensive Margin	Intensive Margin	Extensive Margin
	(1)	(2)	(3)	(4)
Output Tariff	-0.0020***	0.0033***	-0.0020***	0.0033***
	(0.001)	(0.001)	(0.001)	(0.001)
Input Tariff			0.0002	0.0008*
			(0.000)	(0.000)
Small Industry	-0.0013	0.0167	-0.0012	0.0157
	(0.010)	(0.010)	(0.010)	(0.010)
Medium Industry	-0.0042	0.0194**	-0.0043	0.0179**
	(0.008)	(0.009)	(0.008)	(0.009)
Married	-0.0565***	-0.0075	-0.0565***	-0.0075
	(0.006)	(0.006)	(0.006)	(0.006)
Male	0.0417***	-0.1534***	0.0417***	-0.1534***
	(0.005)	(0.005)	(0.005)	(0.005)
Primary	0.0497***	-0.1305***	0.0497***	-0.1307***
	(0.019)	(0.018)	(0.019)	(0.018)
Secondary	0.0854***	-0.2389***	0.0854***	-0.2391***
	(0.019)	(0.018)	(0.019)	(0.018)
Technical	0.0686***	-0.3249***	0.0686***	-0.3251***
	(0.019)	(0.019)	(0.019)	(0.019)
UG-PG Educ	0.0613***	-0.3645***	0.0614***	-0.3645***
	(0.020)	(0.019)	(0.020)	(0.019)
Quechua Ethnic Group	-0.0172**	0.0062	-0.0171**	0.0062
	(0.007)	(0.007)	(0.007)	(0.007)
Age: 30-44	-0.1140***	0.0002	-0.1140***	0.0003
	(0.006)	(0.006)	(0.006)	(0.006)
Age: 45-64	-0.1788***	0.0580***	-0.1788***	0.0580***
	(0.006)	(0.007)	(0.006)	(0.007)
Age: > 65	-0.1976***	0.1418***	-0.1976***	0.1419***
	(0.010)	(0.012)	(0.010)	(0.012)
Observations	31009	31009	31009	31009

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry size included both as dummy and as an interaction with output tariff, where S: <15 workers, M: 16-50 workers, L: >50 workers. The dependent variable is individual's status of informality. Base category is "Formal worker".

A.2 Probability to be informal: Logit models

Table 11: Logit Estimations: Average marginal effects

	Intensive Margin			Extensive Margin		
	Uncond	Size=S	Size=M	Uncond	Size=S	Size=M
	(1)	(2)	(3)	(4)	(5)	(6)
Output Tariff	-0.0007	-0.0119***	-0.0039*	0.0032**	0.0002	0.0049**
	(0.002)	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)
Input Tariff	0.0018***	0.0017***	0.0017***	0.0008	0.0008	0.0008
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Small Industry	0.0118	0.0118	0.0118	0.0170	0.0170	0.0170
	(0.022)	(0.022)	(0.022)	(0.019)	(0.019)	(0.019)
Medium Industry	-0.0050	-0.0050	-0.0050	0.0191	0.0191	0.0191
	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)
Married	-0.1175***	-0.1170***	-0.1173***	-0.0203**	-0.0204**	-0.0202**
	(0.013)	(0.013)	(0.013)	(0.009)	(0.009)	(0.009)
Male	-0.0666***	-0.0664***	-0.0665***	-0.1569***	-0.1579***	-0.1564***
	(0.009)	(0.009)	(0.009)	(0.014)	(0.014)	(0.014)
Primary Education	-0.0522	-0.0514	-0.0524	-0.1407***	-0.1392***	-0.1378***
	(0.069)	(0.068)	(0.069)	(0.027)	(0.028)	(0.027)
Secondary Education	-0.1174*	-0.1159*	-0.1176*	-0.2539***	-0.2525***	-0.2498***
	(0.070)	(0.069)	(0.071)	(0.030)	(0.030)	(0.030)
Technical Education	-0.2330***	-0.2308***	-0.2328***	-0.3391***	-0.3384***	-0.3348***
	(0.070)	(0.069)	(0.070)	(0.032)	(0.033)	(0.033)
UG-PG degree	-0.2678***	-0.2655***	-0.2674***	-0.3819***	-0.3819***	-0.3778***
	(0.074)	(0.073)	(0.074)	(0.032)	(0.032)	(0.032)
Quechua ethnicity	-0.0274*	-0.0273*	-0.0274*	0.0061	0.0062	0.0061
	(0.014)	(0.014)	(0.014)	(0.009)	(0.009)	(0.009)
Age: 30-44	-0.2324***	-0.2289***	-0.2323***	0.0053	0.0053	0.0053
	(0.016)	(0.015)	(0.016)	(0.011)	(0.011)	(0.011)
Age: 45-64	-0.3308***	-0.3274***	-0.3298***	0.0623***	0.0627***	0.0621***
	(0.023)	(0.022)	(0.022)	(0.018)	(0.018)	(0.018)
Age: >65	-0.3092***	-0.3056***	-0.3084***	0.1503***	0.1506***	0.1491***
	(0.035)	(0.036)	(0.035)	(0.021)	(0.021)	(0.021)
Observations$^{\ominus}$		14119			30967	
$Pseudo - R^2$		0.2082			0.3383	

$^{\ominus}$ Model 1 (Columns 1-3) eliminates 7 observations and Model 2 (Columns 4-6) eliminates 9 observations because an outcome of the regressors would mean a perfect prediction resulting in an infinite coefficient.

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include region, industry and year fixed effects. Average industry size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

A.3 Share of informal labour: Fractional models

In this Section, I report the results from estimating equations 5 and 7 using a fractional model. Tables 12 and 13 present the results as Average Marginal Effects (AME). I report AME in order to make the results comparable to the OLS estimations reported in Columns 5-8 in Tables 8 and 9 in Section 4.

Columns 1-3 in Tables 12 and 13 present the Average Marginal Effects (AME) from a model that estimates the share of intensive-informal workers on output tariff, average industry size and the interaction of average industry size and output tariff. Columns 4-5 in Tables 12 and 13 report the results from estimating a fractional model that also includes a control for input tariffs.

Since I report AMEs, even though I estimate an equation with interaction terms ($S_{gjt} * OT_{jt}$), I have to report the AME for each covariate separately. Then, the AME of the output tariffs takes into account its interaction with average industry size. Since I am aware that industry size is crucial in understanding informal labour's behaviour, Columns 2 and 5 report marginal effects conditional on the average industry size being *small* (less than 15 workers) and Columns 3 and 6 present average marginal effects conditional on industries being of *medium* size (between 16 and 50 workers). Columns 1 and 4 show unconditional marginal effects.

Table 12: Share of Intensive-Informal Employment

	Fractional Model 1			Fractional Model 2		
	Unconditional AME	AME Conditional on Average Industry Size <=15	AME Conditional on Average Industry Size 16-50	Unconditional AME	AME Conditional on Average Industry Size <=15	AME Conditional on Average Industry Size 16-50
	(1)	(2)	(3)	(4)	(5)	(6)
Output Tariff	-0.0035	**-0.0168****	**-0.0108***	-0.0037	**-0.0170****	**-0.0110***
	(0.003)	(0.008)	(0.006)	(0.003)	(0.008)	(0.006)
Input Tariff				0.0018	0.0018	0.0019
				(0.006)	(0.006)	(0.006)
Small Industry	0.0807*	0.0807*	0.0807*	0.0809*	0.0809*	0.0809*
	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
Medium Industry	0.0937**	0.0937**	0.0937**	0.0937**	0.0937**	0.0937**
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Observations		660			660	
R^2		0.0972			0.0972	

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry size included both as dummy and as an interaction with output tariff.

Table 13: Share of Extensive-Informal Employment

	Fractional Model 1			Fractional Model 2		
	Unconditional AME	AME Conditional on Average Industry Size <=15	AME Conditional on Average Industry Size 16-50	Unconditional AME	AME Conditional on Average Industry Size <=15	AME Conditional on Average Industry Size 16-50
	(1)	(2)	(3)	(4)	(5)	(6)
Output Tariff	**0.0054****	0.0048	0.0061	**0.0049***	0.0043	0.0056
	(0.003)	(0.007)	(0.004)	(0.003)	(0.007)	(0.004)
Input Tariff				0.0034	0.0038	0.0036
				(0.005)	(0.006)	(0.006)
Small Industry	0.2222***	0.2222***	0.2222***	0.2234***	0.2234***	0.2234***
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
Medium Industry	0.0250	0.0250	0.0250	0.0254	0.0254	0.0254
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Observations		695			695	
R^2		0.3128			0.3129	

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry size included both as dummy and as an interaction with output tariff.

B Robustness Estimations

In this Section, I entitle columns with "Indicator" to signal that the dependent variable is an Informality Indicator and that the regression is run at the individual level. Hence, in these cases, I also include workers' region of residence. I entitle "Share" columns where the dependent variable is the share of informal employment. Note that in the same way as in Section 4.2, when evaluating the intensive margin of informality, the universe of analysis is individuals working for a registered employer.

B.1 Industry Trend

Table 14: Estimations with Industry Trend

	Intensive Margin		Extensive Margin	
	Indicator	Share	Indicator	Share
	(1)	(2)	(3)	(4)
Output Tariff	0.0025	0.0014	0.0068***	0.0064*
	(0.003)	(0.005)	(0.001)	(0.004)
Input Tariff	-0.0044	0.0001	-0.0022	0.0028
	(0.003)	(0.007)	(0.002)	(0.006)
S*Output Tariff	-0.0146***	-0.0213***	-0.0016	-0.0049
	(0.004)	(0.008)	(0.002)	(0.006)
M*Output Tariff	-0.0065**	-0.0132**	0.0028*	0.0012
	(0.003)	(0.006)	(0.001)	(0.005)
Small Industry (S)	0.1049***	0.1786***	0.0366**	0.2734***
	(0.036)	(0.066)	(0.017)	(0.048)
Medium Industry (M)	0.0377*	0.1520***	-0.0018	0.0271
	(0.020)	(0.059)	(0.013)	(0.034)
Married	-0.1170***		-0.0191***	
	(0.009)		(0.005)	
Male	-0.0670***		-0.1725***	
	(0.009)		(0.006)	
Primary Education	-0.0587		-0.0239***	
	(0.056)		(0.008)	
Secondary Education	-0.1228**		-0.1343***	
	(0.055)		(0.009)	
Technical Education	-0.2413***		-0.2229***	
	(0.056)		(0.011)	
UG-PG degree	-0.2757***		-0.2557***	
	(0.056)		(0.011)	
Quechua ethnicity	-0.0269**		0.0092	
	(0.012)		(0.007)	
Age: 30-44	-0.2416***		0.0075	
	(0.009)		(0.006)	
Age: 45-64	-0.3350***		0.0682***	
	(0.011)		(0.007)	
Age: > 65	-0.3202***		0.1507***	
	(0.027)		(0.010)	
Observations	14126	660	31009	695
R^2	0.25	0.41	0.38	0.76

Notes: Robust standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry trend, and industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

B.2 Imports and Exports Growth

In this Section, I control for imports and exports growth when studying the effect that a reduction in tariffs had in each margin of informality. Results in Columns 1-4 in Table 15 are qualitatively identical to results presented in Table 8.

Table 15: Controlling for Imports and Exports Growth

	Intensive Margin				Extensive Margin			
	Indicator		Share		Indicator		Share	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output Tariff	0.0026	0.0025	0.0026	0.0025	0.0025***	0.0025***	0.0057*	0.0054*
	(0.002)	(0.002)	(0.004)	(0.004)	(0.001)	(0.001)	(0.003)	(0.003)
Input Tariff	-0.0023	-0.0023	0.0022	0.0025	0.0001	0.0001	0.0019	0.0024
	(0.003)	(0.003)	(0.007)	(0.007)	(0.002)	(0.002)	(0.007)	(0.007)
S*Output Tariff	-0.0137***	-0.0137***	-0.0187**	-0.0188**	-0.0038**	-0.0038**	-0.0042	-0.0043
	(0.004)	(0.004)	(0.009)	(0.009)	(0.002)	(0.002)	(0.008)	(0.008)
M*Output Tariff	-0.0060**	-0.0060**	-0.0133**	-0.0134**	0.0013	0.0013	0.0015	0.0013
	(0.002)	(0.002)	(0.007)	(0.007)	(0.001)	(0.001)	(0.005)	(0.005)
Small Industry (S)	0.1013***	0.1014***	0.1498**	0.1506**	0.0523***	0.0522***	0.2673***	0.2674***
	(0.038)	(0.038)	(0.073)	(0.073)	(0.017)	(0.017)	(0.054)	(0.054)
Medium Industry (M)	0.0360**	0.0360**	0.1459**	0.1462**	0.0061	0.0060	0.0291	0.0316
	(0.018)	(0.018)	(0.060)	(0.060)	(0.012)	(0.012)	(0.031)	(0.031)
Imports Growth	0.0099**	0.0099**	0.0000	-0.0009	-0.0129***	-0.0129***	-0.0018	-0.0040
	(0.005)	(0.005)	(0.030)	(0.030)	(0.003)	(0.003)	(0.017)	(0.017)
Exports Growth		-0.0000		-0.0001		0.0000		-0.0002
		(0.000)		(0.000)		(0.000)		(0.000)
Married	-0.1165***	-0.1165***			-0.0194***	-0.0194***		
	(0.015)	(0.015)			(0.005)	(0.005)		
Male	-0.0667***	-0.0667***			-0.1729***	-0.1729***		
	(0.010)	(0.010)			(0.006)	(0.006)		
Primary Education	-0.0623	-0.0623			-0.0227***	-0.0227***		
	(0.077)	(0.077)			(0.008)	(0.008)		
Secondary Education	-0.1260	-0.1260			-0.1330***	-0.1330***		
	(0.078)	(0.078)			(0.009)	(0.009)		
Technical Education	-0.2458***	-0.2458***			-0.2223***	-0.2222***		
	(0.077)	(0.077)			(0.011)	(0.011)		
UG-PG degree	-0.2785***	-0.2785***			-0.2551***	-0.2551***		
	(0.081)	(0.081)			(0.012)	(0.012)		
Quechua ethnicity	-0.0270*	-0.0270*			0.0104	0.0104		
	(0.014)	(0.014)			(0.007)	(0.007)		
Age: 30-44	-0.2403***	-0.2403***			0.0078	0.0078		
	(0.017)	(0.017)			(0.006)	(0.006)		
Age: 45-64	-0.3340***	-0.3340***			0.0689***	0.0688***		
	(0.024)	(0.024)			(0.007)	(0.007)		
Age: > 65	-0.3196***	-0.3196***			0.1521***	0.1521***		
	(0.038)	(0.038)			(0.010)	(0.010)		
Observations$^{\mp}$	14062	14062	653	653	30908	30908	681	681
R^2	0.25	0.25	0.39	0.39	0.38	0.38	0.76	0.77

$^{\mp}$ The number of observations does not coincide with the observations in Tables 8 and 9 because 14 industries (ISIC 4-digit) do not have information on imports and exports. Columns 1-4 include 7 of these industries, and Columns 5-8 include all 14 of these industries in Tables 8 and 9, respectively.

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

Namely, when tariffs go down, the intensive margin of informality increases in industries where, on average, employers have less than 50 employees. In Columns 1 and 2, I conduct the individual level study discussed in Section 4.2. In Column 1, I only control for Imports growth and find that industries, where imports growth rate was positive, ex-

perienced an increase in the intensive margin of informality. Results in Column 2 are very similar despite also controlling for exports growth. These results are consistent with the claim that employers facing a boost in import competition would hire more workers in the intensive margin of informality. Moreover, when conducting the industry-level analysis detailed in Section 4.2 and controlling for imports and exports growth, they are both insignificant. I show in Columns 3 and 4 in Table 15 that when tariffs decrease, the share of intensive-informal employment increases in industries that, on average, have less than 50 workers.

When adding imports and exports growth to the regressions that study the effect of tariffs on the extensive margin of informality at the individual level, I find that there are slight differences with the results presented in Table 9. The analysis remains the same as the one found in Section 4.3 for most industries. However, in industries where on average employers hire less than 15 workers, the probability to be employed in the extensive margin of informality increases. I believe this result is capturing that in Peru, the extensive margin of informality sometimes replaces the unemployment safety nets that more developed countries provide.

Moreover, when conducting the analysis presented at the industry level, I find that controlling for exports and imports growth does not alter results. Results presented in Table 9 in Columns 5-8 are also qualitatively identical to what I show in Table 15 in Columns 7 and 8. I find that a reduction in tariffs translates into a reduction of the proportion of workers in the extensive margin of informality in all industries.

B.3 Input Tariffs

Table 16: Input Tariffs and Size

	Intensive Margin		Extensive Margin	
	Indicator	Share	Indicator	Share
	(1)	(2)	(3)	(4)
Output Tariff	0.0023	0.0026	0.0041**	0.0051*
	(0.002)	(0.003)	(0.002)	(0.003)
Input Tariff	-0.0053	0.0018	-0.0027	0.0061
	(0.004)	(0.006)	(0.004)	(0.006)
S*Output Tariff	-0.0140***	-0.0175*	-0.0041	-0.0045
	(0.004)	(0.009)	(0.003)	(0.008)
M*Output Tariff	-0.0070**	-0.0138**	0.0010	0.0020
	(0.003)	(0.007)	(0.003)	(0.005)
S*Input Tariff	0.0065	-0.0246	0.0025	0.0025
	(0.008)	(0.022)	(0.006)	(0.016)
M*Input Tariff	0.0275**	0.0273	0.0150*	-0.0237
	(0.011)	(0.018)	(0.008)	(0.021)
Small Industry (S)	0.1022***	0.1858**	0.0528**	0.2659***
	(0.039)	(0.075)	(0.022)	(0.054)
Medium Industry (M)	0.0265	0.1384**	-0.0014	0.0396
	(0.017)	(0.064)	(0.019)	(0.037)
Married	-0.1164***		-0.0187**	
	(0.014)		(0.009)	
Male	-0.0676***		-0.1724***	
	(0.010)		(0.019)	
Primary Education	-0.0623		-0.0237	
	(0.077)		(0.030)	
Secondary Education	-0.1255		-0.1335***	
	(0.078)		(0.037)	
Technical Education	-0.2454***		-0.2225***	
	(0.077)		(0.040)	
UG-PG degree	-0.2791***		-0.2556***	
	(0.081)		(0.041)	
Quechua ethnicity	-0.0279*		0.0098	
	(0.014)		(0.010)	
Age: 30-44	-0.2403***		0.0074	
	(0.017)		(0.012)	
Age: 45-64	-0.3342***		0.0682***	
	(0.024)		(0.022)	
Age: > 65	-0.3194***		0.1511***	
	(0.037)		(0.025)	
Observations	14126	660	31009	695
R^2	0.25	0.40	0.38	0.76

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

B.4 China and US Imports

Table 17: Intensive Margin of Informality

	Informality Indicator			Share of Informal Employment		
	(1)	(2)	(3)	(4)	(5)	(6)
Output Tariff	0.0018	0.0021	0.0021	0.0027	0.0027	0.0027
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Input Tariff	-0.0025	-0.0031	-0.0031	0.0024	0.0020	0.0022
	(0.003)	(0.003)	(0.004)	(0.007)	(0.007)	(0.007)
S*Output Tariff	**-0.0130*****	**-0.0135*****	**-0.0135*****	**-0.0195****	**-0.0197****	**-0.0197****
	(0.004)	(0.004)	(0.004)	(0.009)	(0.009)	(0.009)
M*Output Tariff	**-0.0059****	**-0.0068*****	**-0.0067*****	**-0.0131****	**-0.0133****	**-0.0132****
	(0.002)	(0.002)	(0.002)	(0.007)	(0.007)	(0.007)
Small Industry (S)	0.0975**	0.0982***	0.0970**	0.1751**	0.1760**	0.1754**
	(0.038)	(0.037)	(0.037)	(0.074)	(0.074)	(0.074)
Medium Industry (M)	0.0367**	0.0445**	0.0443**	0.1586**	0.1584**	0.1593***
	(0.018)	(0.018)	(0.018)	(0.060)	(0.060)	(0.060)
Share US Imports	-0.0129		-0.0127	-0.0417		-0.0423
	(0.018)		(0.019)	(0.059)		(0.059)
Share Chinese Imports		-0.0356	-0.0355		-0.0155	-0.0163
		(0.024)	(0.024)		(0.048)	(0.047)
Married	-0.1166***	-0.1160***	-0.1160***			
	(0.014)	(0.015)	(0.015)			
Male	-0.0678***	-0.0667***	-0.0668***			
	(0.010)	(0.009)	(0.009)			
Primary Education	-0.0617	-0.0621	-0.0622			
	(0.077)	(0.077)	(0.077)			
Secondary Education	-0.1253	-0.1262	-0.1263			
	(0.078)	(0.078)	(0.078)			
Technical Education	-0.2449***	-0.2455***	-0.2456***			
	(0.077)	(0.077)	(0.077)			
UG-PG degree	-0.2784***	-0.2794***	-0.2794***			
	(0.081)	(0.081)	(0.081)			
Quechua ethnicity	-0.0275*	-0.0273*	-0.0272*			
	(0.014)	(0.014)	(0.014)			
Age: 30-44	-0.2401***	-0.2410***	-0.2411***			
	(0.017)	(0.016)	(0.016)			
Age: 45-64	-0.3341***	-0.3353***	-0.3353***			
	(0.024)	(0.024)	(0.024)			
Age: >65	-0.3204***	-0.3211***	-0.3213***			
	(0.037)	(0.037)	(0.037)			
Observations$^{\pm}$	14126	14096	14096	660	659	659
R^2	0.25	0.25	0.25	0.40	0.40	0.40

Notes: Robust standard errors for industrial clusters in parenthesis. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

$^{\pm}$ Observations in Columns 2 and 3 are less than in Column 1 because China does not import weapons and ammunition to Peru (ISIC code 2520). However, there are 30 individuals employed in this industry hired by registered employers. Consequently, Columns 5 and 6 have one observation less than Column 4 because of the lack of imports from China to Peru of products ISIC code 2520.

Table 18: Extensive Margin of Informality

	Informality Indicator			Share of Informal Employment		
	(1)	(2)	(3)	(4)	(5)	(6)
Output Tariff	**0.0035***	**0.0031***	**0.0031***	**0.0055***	**0.0054***	**0.0054***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Input Tariff	-0.0002	0.0006	0.0006	0.0018	0.0026	0.0024
	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)
S*Output Tariff	-0.0035	-0.0032	-0.0032	-0.0043	-0.0026	-0.0027
	(0.003)	(0.003)	(0.003)	(0.008)	(0.008)	(0.008)
M*Output Tariff	0.0017	0.0026	0.0026	0.0008	0.0017	0.0016
	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
Small Industry (S)	0.0501**	0.0514**	0.0513**	0.2668***	0.2526***	0.2527***
	(0.022)	(0.022)	(0.022)	(0.053)	(0.052)	(0.052)
Medium Industry (M)	0.0052	-0.0038	-0.0038	0.0238	0.0167	0.0158
	(0.017)	(0.018)	(0.018)	(0.032)	(0.032)	(0.032)
Share US Imports	-0.0027		-0.0014	0.0506		0.0485
	(0.011)		(0.012)	(0.043)		(0.044)
Share Chinese Imports		0.0363***	0.0363***		0.0508	0.0517
		(0.009)	(0.009)		(0.040)	(0.040)
Married	-0.0186**	-0.0190**	-0.0190**			
	(0.009)	(0.009)	(0.009)			
Male	-0.1727***	-0.1729***	-0.1729***			
	(0.019)	(0.019)	(0.019)			
Primary Education	-0.0232	-0.0229	-0.0229			
	(0.030)	(0.030)	(0.030)			
Secondary Education	-0.1332***	-0.1328***	-0.1328***			
	(0.037)	(0.037)	(0.037)			
Technical Education	-0.2220***	-0.2221***	-0.2221***			
	(0.040)	(0.040)	(0.040)			
UG-PG degree	-0.2552***	-0.2550***	-0.2550***			
	(0.041)	(0.041)	(0.041)			
Quechua ethnicity	0.0101	0.0104	0.0104			
	(0.010)	(0.010)	(0.010)			
Age: 30-44	0.0072	0.0074	0.0074			
	(0.012)	(0.012)	(0.012)			
Age: 45-64	0.0679***	0.0682***	0.0682***			
	(0.022)	(0.022)	(0.022)			
Age: >65	0.1505***	0.1507***	0.1507***			
	(0.025)	(0.025)	(0.025)			
Observations	31009	30974	30974	695	693	693
R^2	0.38	0.38	0.38	0.76	0.76	0.76

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

$^{\pm}$ Observations in Columns 2 and 3 are less than in Column 1 because China does not import weapons and ammunition (ISIC code 2520) nor structural metal products (ISIC code 2511). However, there are 34 individuals employed in the former and 1 in the latter. Consequently, Columns 5 and 6 have one observation less than Column 4 because of the lack of imports from China to Peru of products ISIC codes 2520 and 2511.

B.5 Period of Analysis: 2007-2011

Table 19: Intensive Margin of Informality (2007-2011)

	Informality Indicator				Share of Informal Employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output Tariff	0.0016	0.0019	0.0025	0.0024	-0.0019	-0.0021	0.0030	0.0029
	(0.002)	(0.002)	(0.002)	(0.002)	(0.009)	(0.009)	(0.009)	(0.009)
Input Tariff				0.0004				0.0018
				(0.003)				(0.010)
S*Output Tariff			-0.0091	-0.0090			-0.0267*	-0.0267*
			(0.006)	(0.006)			(0.015)	(0.015)
M*Output Tariff			-0.0054**	-0.0054**			-0.0171*	-0.0170*
			(0.003)	(0.003)			(0.009)	(0.009)
Small Industry (S)		0.0073	0.0696	0.0699		0.0464	0.2054	0.2053
		(0.029)	(0.056)	(0.057)		(0.086)	(0.147)	(0.147)
Medium Industry (M)		0.0171	0.0521*	0.0521*		0.0581	0.1508*	0.1499*
		(0.025)	(0.029)	(0.029)		(0.063)	(0.086)	(0.087)
Married	-0.1350***	-0.1348***	-0.1345***	-0.1345***				
	(0.012)	(0.012)	(0.012)	(0.012)				
Male	-0.0452***	-0.0452***	-0.0447***	-0.0448***				
	(0.010)	(0.010)	(0.010)	(0.010)				
Primary Education	-0.1477*	-0.1484*	-0.1467*	-0.1467*				
	(0.087)	(0.087)	(0.087)	(0.087)				
Secondary Education	-0.2288***	-0.2295***	-0.2282***	-0.2282***				
	(0.083)	(0.084)	(0.084)	(0.084)				
Technical Education	-0.3386***	-0.3393***	-0.3378***	-0.3378***				
	(0.083)	(0.083)	(0.084)	(0.084)				
UG-PG degree	-0.3628***	-0.3635***	-0.3624***	-0.3624***				
	(0.090)	(0.091)	(0.091)	(0.091)				
Quechua Ethnic Group=1	-0.0570***	-0.0568***	-0.0565***	-0.0565***				
	(0.018)	(0.018)	(0.018)	(0.018)				
Age: 30-44	-0.2249***	-0.2249***	-0.2255***	-0.2255***				
	(0.023)	(0.023)	(0.023)	(0.023)				
Age: 45-64	-0.3262***	-0.3264***	-0.3270***	-0.3270***				
	(0.033)	(0.033)	(0.033)	(0.033)				
Age: > 65	-0.3623***	-0.3626***	-0.3630***	-0.3630***				
	(0.057)	(0.057)	(0.057)	(0.057)				
Observations[∓]	7697	7697	7697	7697	404	404	404	404
R^2	0.22	0.22	0.22	0.22	0.62	0.62	0.63	0.63

[∓] All specifications are conditional on individuals declaring to work for a registered employer.

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

Table 20: Extensive Margin of Informality (2007-2011)

	Informality Indicator				Share of Informal Employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output Tariff	0.0019***	0.0035***	0.0040***	0.0025***	0.0191***	0.0192***	0.0137***	0.0135***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.003)	(0.003)
Input Tariff				0.0137***				0.0127
				(0.002)				(0.009)
S*Output Tariff			-0.0013	-0.0012			0.0176***	0.0173***
			(0.001)	(0.001)			(0.006)	(0.006)
M*Output Tariff			-0.0019	-0.0004			0.0056	0.0061
			(0.001)	(0.001)			(0.007)	(0.007)
Small Industry (S)		0.2525***	0.2646***	0.2674***		0.4092***	0.3069***	0.3088***
		(0.008)	(0.016)	(0.016)		(0.031)	(0.051)	(0.051)
Medium Industry (M)		0.2353***	0.2524***	0.2440***		0.2108***	0.1772***	0.1728***
		(0.009)	(0.015)	(0.015)		(0.039)	(0.056)	(0.057)
Married	-0.0269***	-0.0270***	-0.0268***	-0.0262***				
	(0.008)	(0.007)	(0.007)	(0.007)				
Male	-0.2183***	-0.2123***	-0.2128***	-0.2143***				
	(0.008)	(0.007)	(0.007)	(0.007)				
Primary Education	-0.0562***	-0.0386***	-0.0398***	-0.0428***				
	(0.009)	(0.010)	(0.010)	(0.010)				
Secondary Education	-0.2492***	-0.2017***	-0.2038***	-0.2062***				
	(0.011)	(0.011)	(0.011)	(0.011)				
Technical Education	-0.4095***	-0.3415***	-0.3433***	-0.3459***				
	(0.013)	(0.013)	(0.013)	(0.013)				
UG-PG degree	-0.4586***	-0.3948***	-0.3964***	-0.3998***				
	(0.015)	(0.015)	(0.015)	(0.015)				
Quechua Ethnic Group=1	0.0308***	0.0192*	0.0196*	0.0191*				
	(0.012)	(0.011)	(0.011)	(0.011)				
Age: 30-44	-0.0289***	-0.0273***	-0.0274***	-0.0266***				
	(0.009)	(0.008)	(0.008)	(0.008)				
Age: 45-64	0.0342***	0.0363***	0.0361***	0.0355***				
	(0.010)	(0.009)	(0.009)	(0.009)				
Age: > 65	0.1327***	0.1244***	0.1240***	0.1231***				
	(0.014)	(0.014)	(0.014)	(0.014)				
Observations	18329	18329	18329	18329	428	428	428	428
R^2	0.17	0.23	0.23	0.23	0.08	0.37	0.38	0.38

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

B.6 Only Wage Workers (excluding Self-Employed)

Table 21: Intensive Margin of Informality (Only Wage Workers)

	Informality Indicator				Share of Informal Employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output Tariff	0.0001	0.0001	0.0008	0.0012	-0.0011	-0.0011	0.0036	0.0036
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Input Tariff				-0.0018				0.0004
				(0.004)				(0.007)
S*Output Tariff			-0.0123**	-0.0124**			-0.0233**	-0.0233**
			(0.005)	(0.005)			(0.010)	(0.010)
M*Output Tariff			-0.0055**	-0.0057**			-0.0134**	-0.0134**
			(0.002)	(0.002)			(0.007)	(0.007)
Small Industry (S)		0.0256	0.1031**	0.1028**		0.1071**	0.2123**	0.2123**
		(0.021)	(0.044)	(0.044)		(0.053)	(0.082)	(0.082)
Medium Industry (M)		0.0175	0.0424**	0.0426**		0.1066**	0.1603***	0.1602***
		(0.016)	(0.018)	(0.018)		(0.043)	(0.060)	(0.061)
Married	-0.1209***	-0.1209***	-0.1209***	-0.1210***				
	(0.017)	(0.017)	(0.017)	(0.017)				
Male	-0.0676***	-0.0676***	-0.0674***	-0.0673***				
	(0.010)	(0.010)	(0.010)	(0.010)				
Primary Education	-0.0776	-0.0784	-0.0780	-0.0780				
	(0.074)	(0.074)	(0.074)	(0.074)				
Secondary Education	-0.1509**	-0.1517**	-0.1512**	-0.1512**				
	(0.075)	(0.075)	(0.075)	(0.075)				
Technical Education	-0.2744***	-0.2749***	-0.2744***	-0.2743***				
	(0.073)	(0.073)	(0.073)	(0.073)				
UG-PG degree	-0.3101***	-0.3110***	-0.3108***	-0.3107***				
	(0.077)	(0.078)	(0.078)	(0.078)				
Quechua ethnicity	-0.0186	-0.0185	-0.0184	-0.0185				
	(0.014)	(0.014)	(0.014)	(0.014)				
Age: 30-44	-0.2144***	-0.2145***	-0.2147***	-0.2146***				
	(0.015)	(0.015)	(0.015)	(0.015)				
Age: 45-64	-0.2809***	-0.2812***	-0.2816***	-0.2815***				
	(0.022)	(0.022)	(0.022)	(0.022)				
Age: > 65	-0.1913***	-0.1913***	-0.1920***	-0.1921***				
	(0.044)	(0.044)	(0.044)	(0.044)				
Observations$^{\mp}$	13248	13248	13248	13248	653	653	653	653
R^2	0.26	0.26	0.26	0.26	0.39	0.40	0.41	0.41

$^{\mp}$ All specifications are conditional on individuals declaring to work for a registered employer.

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

Table 22: Extensive Margin of Informality (Only Wage Workers)

	Informality Indicator				Share of Informal Employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output Tariff	0.0047***	0.0047***	0.0043**	0.0040**	0.0053**	0.0052**	0.0053**	0.0052*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Input Tariff				0.0012				0.0008
				(0.004)				(0.007)
S*Output Tariff			-0.0022	-0.0021			-0.0022	-0.0022
			(0.005)	(0.005)			(0.007)	(0.007)
M*Output Tariff			0.0041	0.0042			0.0013	0.0013
			(0.004)	(0.004)			(0.005)	(0.005)
Small Industry (S)		0.0333	0.0567**	0.0569**		0.2304***	0.2411***	0.2412***
		(0.026)	(0.027)	(0.028)		(0.036)	(0.049)	(0.049)
Medium Industry (M)		0.0161	-0.0053	-0.0055		0.0267	0.0196	0.0194
		(0.016)	(0.019)	(0.019)		(0.026)	(0.030)	(0.030)
Married	-0.0210*	-0.0209*	-0.0212*	-0.0212*				
	(0.011)	(0.011)	(0.011)	(0.011)				
Male	-0.1261***	-0.1260***	-0.1261***	-0.1261***				
	(0.015)	(0.015)	(0.015)	(0.015)				
Primary Education	-0.1164***	-0.1172***	-0.1170***	-0.1171***				
	(0.028)	(0.027)	(0.027)	(0.027)				
Secondary Education	-0.2337***	-0.2344***	-0.2340***	-0.2341***				
	(0.028)	(0.028)	(0.028)	(0.027)				
Technical Education	-0.3202***	-0.3208***	-0.3204***	-0.3205***				
	(0.029)	(0.029)	(0.029)	(0.029)				
UG-PG degree	-0.3429***	-0.3439***	-0.3432***	-0.3433***				
	(0.030)	(0.030)	(0.030)	(0.030)				
Quechua ethnicity	-0.0063	-0.0060	-0.0057	-0.0057				
	(0.011)	(0.011)	(0.011)	(0.011)				
Age: 30-44	-0.0552***	-0.0552***	-0.0551***	-0.0551***				
	(0.010)	(0.010)	(0.010)	(0.010)				
Age: 45-64	-0.0250	-0.0254	-0.0250	-0.0251				
	(0.015)	(0.015)	(0.015)	(0.015)				
Age: > 65	0.0692**	0.0688**	0.0688**	0.0687**				
	(0.031)	(0.031)	(0.031)	(0.031)				
Observations	20874	20874	20874	20874	684	684	684	684
R^2	0.29	0.29	0.29	0.29	0.73	0.77	0.77	0.77

Notes: Robust standard errors for industrial clusters in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include industry and year fixed effects. Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.

C Industry Size

Results in Section 4 rely on a measure of average industry size based on workers' declaration. Since workers might be mistaken on how big their place of work is in terms of number of employees, I construct a measure of average employer size by industry at the 4-digit level. In this Section, I check if the average industry size constructed in this manner is comparable to the firm size distribution obtained when using firm-level data.

The Peruvian National Institute of Statistics and Informatics (INEI) publishes a firm-level dataset every year, *"Encuesta Economica Anual"*. However, these surveys include only firms with net sales above 150 UIT. The threshold is set in UIT, "Unidad impositiva tributaria", which is a reference unit set annually by the Peruvian Ministry of Economy, 150 UIT is approximately 200000 US dollars.[41] Hence, the survey excludes micro-enterprises which, according to Peruvian legislation are defined as firms with net sales below 150 UIT and with less than 10 workers.

The INEI also conducted in 2015 its first National Firm Survey, *"Encuesta Nacional de Empresas"*. In this case, the INEI pushed the threshold down for annual sales to 20 UIT. The survey gathered information on firms' operations in 2014. Note that according to the Peruvian Ministry of Production, in 2014, 56.8 per cent of the formal micro-enterprise had sales below 13 UIT and 83 per cent below 25 UIT.[42]

According to the Peruvian Ministry of Production, 99 per cent of the labour force in Peru is employed by micro-enterprises. Since this paper's focus is on employment, it would be fair to argue that most of the employers in the INEI surveys do not employ most of the workers in which the study in Section 4 is based.

Hence, I look at The World Bank Enterprise Survey. As Table 23 shows, these are not large surveys and some industries are more represented than others. However, they include most of the period of analysis in this paper, and there is a fair amount of firms in most 2-digit industries in manufacturing.

Since this survey does not include informal firms, for comparison purposes, I focus on the industries where the extensive margin of informality is small in terms of employment. Namely, Publishing and printing, Chemicals and chemical products, Rubber and plastics products, Basic Metals, and Machinery and equipment.[43] Comparing Table 3 with Table 24, it is apparent that the size distribution is similar for these industries.

For instance, Table 3 shows that, using household survey data, the industry of publishing and printing, and the production of chemicals and chemical products, concentrates

[41] In 2008, 1 UIT was equivalent to 3500 soles (approximately 1206 US dollars), and in 2014, 1 UIT was 3800 soles (approximately 1357 US dollars).

[42] Industrial Statistic Yearbook for small enterprise and internal commerce,"Anuario Estadistico Industrial, Mipyme y Comercio Interno" in Spanish.

[43] See Table 4. In this Section, I consider 2-digit industries with less than 22 per cent of employment in the extensive margin of informality.

Table 23: World Bank Enterprise Survey
Number of firms

	2006	2010	2017
	(1)	(2)	(3)
Food products and beverages	122	162	165
Textiles	37	52	50
Wearing apparel	118	113	96
Tanning and dressing	0	23	14
Wood products, except furniture	0	1	6
Publishing, printing and media	**0**	**25**	**19**
Chemicals and chemical products	**81**	**111**	**43**
Rubber and plastics products	**1**	**42**	**31**
Other non-metallic mineral products	0	20	10
Basic metals	**0**	**13**	**3**
Fabricated metal products	0	125	55
Machinery and equipment	**0**	**25**	**13**
Other transport equipment	0	1	3
Furniture	0	14	14
Total	359	727	522

Source: Own elaboration based on The World Bank-Enterprise Surveys. Panel data set for Peru.

more than 90 per cent of employment in firms with more than 50 employees. Looking at the firm level data in Table 24, I find similar results. Even though the World Bank only surveys 13 firms in 2010 and 3 in 2017 that produce basic metals, 100 per cent of them also have more than 50 employees. Exactly the same result I obtain with household survey data.

The World Bank enterprise survey in 2006 only featured one firm producing rubber and plastics. Thus, disregarding the information for 2006 and looking at 2010 and 2017, I find that while the household survey estimates around 89-100 per cent of employees in firms with more than 50 employees, the firm level survey estimates between 83 and 100 per cent of workers in firms of that size. Finally, according to the household survey, between 64 and 87 per cent of firms producing machinery and equipment, have more than 50 employees. From the enterprise survey I gather that around 74 per cent of workers are employed in firms with that size.

After comparing the construction of industry size I presented in Section 2 with the data provided by the World Bank Enterprise Survey, I feel confident that my calculations are fairly accurate. Even though it might be tempting to use the industry size obtained from a firm level database, it comes with large costs. Specifically, it would entail overlooking all workers hired by informal employers.

Table 24: Employer Size in Manufacturing (%)

	2006			2010			2017		
	Average Employer Size <=15	Average Employer Size 16-50	Average Employer Size >50	Average Employer Size <=15	Average Employer Size 16-50	Average Employer Size >50	Average Employer Size <=15	Average Employer Size 16-50	Average Employer Size >50
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food products and beverages		38.52	61.48		36.42	63.58		35.76	64.24
Textiles		16.22	83.78		11.54	88.46		8.00	92.00
Wearing apparel			100.00			100.00			100.00
Tanning and dressing of leather					30.43	69.57		50.00	50.00
Wood products, except furniture					100.00		50.00	50.00	
Publishing, printing and media					**8.00**	**92.00**		**21.05**	**78.95**
Chemicals and chemical products		**3.70**	**96.30**		**9.91**	**90.09**		**6.98**	**93.02**
Rubber and plastics products			**100.00**		**16.67**	**83.33**		**12.90**	**87.10**
Other non-metallic mineral products					10.00	90.00		20.00	80.00
Basic metals						**100.00**			**100.00**
Fabricated metal products					7.20	92.80		1.82	98.18
Machinery and equipment				**15.79**	**10.53**	**73.68**		**25.00**	**75.00**
Other transport equipment					100.00		66.67	33.33	
Furniture						100.00			100.00

Source: Own elaboration based on The World Bank-Enterprise Surveys.
Notes: The table is based on the variable *Num. Permanent, Full-Time Employees at the end of last fiscal year* in the panel dataset for Peru.

D Tariffs by Industry

Figure 7: Industries with *high* Tariffs

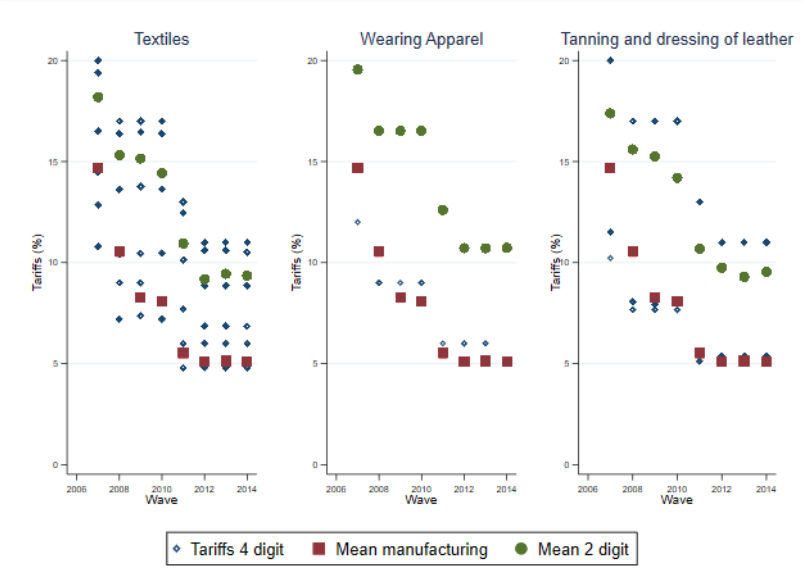


Figure 8: Industries with Tariffs similar
to the Manufacturing average

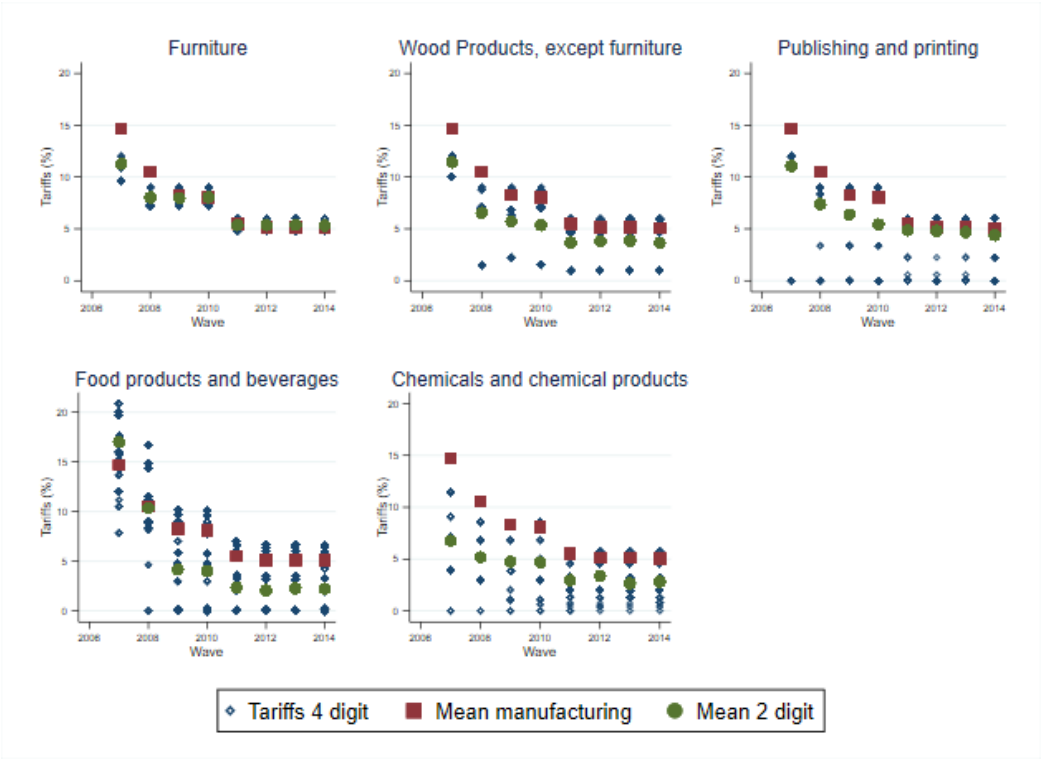
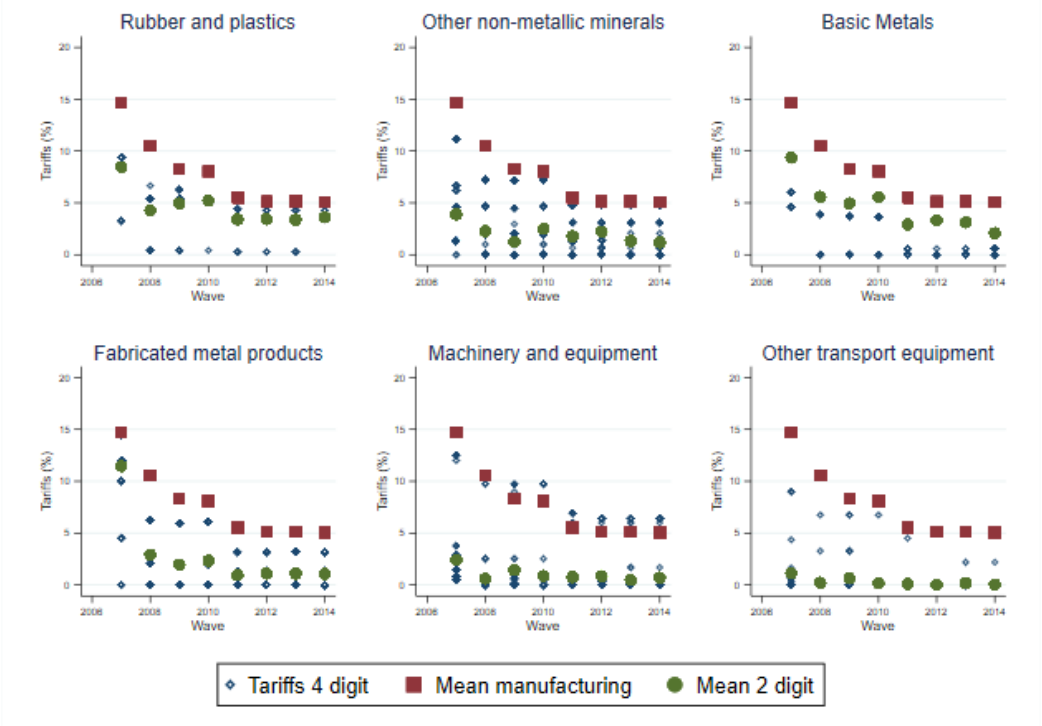


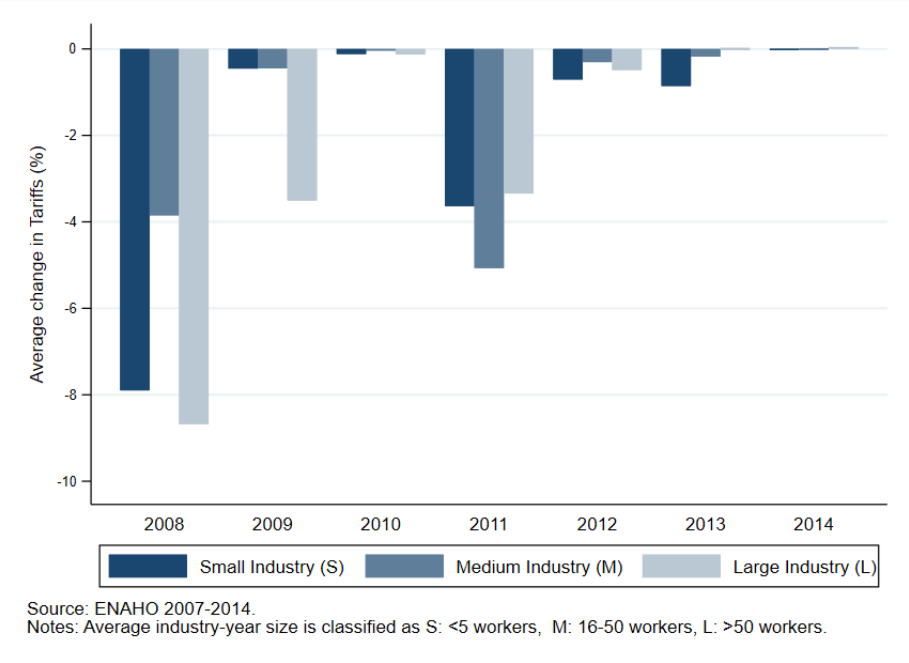
Figure 9: Industries with *low* Tariffs



E Tariff Changes and Industry Size

As shown in Figure 10, tariffs reduction was widespread among all industries during the period of analysis. From a rapid inspection it becomes evident that tariffs did not systematically decrease more in industries with larger (or smaller) employers.

Figure 10: Average Tariff Changes by Industry Size



Source: ENAHO 2007-2014.
Notes: Average industry-year size is classified as S: <5 workers, M: 16-50 workers, L: >50 workers.

Columns 1 and 5 in Table 25 show the average change in tariffs by industry size. The average change does not vary significantly by industry size over the years. Moreover, in 2008 industries where "large" employers presented the most significant tariff reduction, -0.09%. In 2011, the greatest tariff cut took place among industries with "medium" size employers, -0.05%. Furthermore, in 2013 industries with "small" size employers where the ones with the above mean change.

Columns 2 and 6 in Table 25 show that, in terms of variation, the change in tariffs is also heterogeneous among the different industry's size. For instance, in 2008, 2009 and 2014 the highest variation happen among "large" industries. In 2012 and 2013, "small" industries experienced the greatest standard deviation in tariff change.

Hence, I find that there is no relationship between tariff reduction and industry size.

Table 25: Tariff Changes by Industry Size (%)

	Mean	SD	Min	Max	Mean	SD	Min	Max
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2008				**2012**			
Small Industry (S)	-0.08	0.70	-11.00	0.00	-0.01	0.13	-3.00	0.10
Medium Industry (M)	-0.04	0.34	-3.82	0.00	-0.00	0.07	-2.00	0.00
Large Industry (L)	-0.09	0.70	-12.00	0.00	-0.00	0.10	-3.64	0.06
Total	-0.07	0.63	-12.00	0.00	-0.01	0.10	-3.64	0.10
	2009				**2013**			
Small Industry (S)	-0.00	0.11	-2.20	0.75	-0.01	0.20	-5.34	0.64
Medium Industry (M)	-0.00	0.10	-2.20	0.16	-0.00	0.05	-1.64	0.00
Large Industry (L)	-0.04	0.48	-9.00	0.88	-0.00	0.00	-0.10	0.02
Total	-0.02	0.38	-9.00	0.88	-0.00	0.08	-5.34	0.64
	2010				**2014**			
Small Industry (S)	-0.00	0.04	-0.75	0.67	-0.00	0.00	-0.09	0.00
Medium Industry (M)	-0.00	0.01	-0.23	0.14	-0.00	0.00	-0.06	0.00
Large Industry (L)	-0.00	0.03	-0.88	0.26	0.00	0.02	-0.06	0.70
Total	-0.00	0.03	-0.88	0.67	0.00	0.01	-0.09	0.70
	2011							
Small Industry (S)	-0.04	0.32	-4.00	0.00				
Medium Industry (M)	-0.05	0.35	-2.94	0.00				
Large Industry (L)	-0.03	0.33	-7.71	0.00				
Total	-0.04	0.33	-7.71	0.00				

Notes: Average industry-year size is classified as S: <15 workers, M: 16-50 workers, L: >50 workers.
Source: Industry size constructed based on ENAHO 2008-2014. Change in Tariff constructed based on WTO's TAO.