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Import Competition and Informal Employment: Empirical Evidence from China*

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Abstract

This paper investigates the effects of trade liberalisation induced labour demand shocks on informal employment in China. We employ a local labour market approach to construct a regional measure of exposure to import tariffs by exploiting initial differences in industrial composition across prefectural cities and then link it with the employment status of individuals. Using three waves of household survey data between 1995 and 2007, our results show that workers from regions that experienced a larger tariff cut were more likely to be employed informally. Further results based on firm-level data reveal a consistent pattern; tariff reductions increased the share of informal workers within firms. Such effects are more salient among smaller and less productive firms. Our findings suggest an important margin of labour market adjustment in response to trade shocks in developing countries, i.e. employment adjustment along the formal-informal dimension.

Keywords: Trade liberalisation; Import competition; Informal employment; Firms; China

JEL classifications: F14; F16; F66; J46

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1 Introduction

Many developing countries around the globe have undergone extensive trade liberalisation reforms in the last decades and subsequently integrated into the world economy rapidly, bringing both challenges and opportunities for domestic producers and workers. The existing literature has documented fruitful evidence of labour market effects of trade liberalisation (e.g. Goldberg and Pavcnik, 2007; Dix-Carneiro and Kovak, 2019). Labour reallocation between formal and informal sectors, however, is relatively less studied. Indeed, informal employment is pervasive in the developing world, even overtaking formal employment in some countries. For example, 43.2%, 58.2%, and around 70% workers are employed in the informal sector in Brazil, Mexico and Peru, respectively (Arias et al., 2018; Cisneros-Acevedo, 2021). Informal businesses employ as much as 85% workers in Vietnam (McCaig and Pavcnik, 2018) and nearly 80% of employees in Indian manufacturing (Nataraj, 2011). The existence of the informal sector allows workers to move to the informal sector relatively easily in response to trade induced adverse labour demand shocks due to the significantly lower mobility costs than those of moving between industries (Arias et al., 2018). It also provides firms the possibility of reducing labour costs by employing more informal workers as a way of raising competitiveness or even surviving with increased competition (Ulyssea, 2018; Ponczek and Ulyssea, 2021). Labour market adjustment along the formal-informal divide is thereby a potentially crucial margin to understand the employment effects of trade shocks. This paper examines the impact of trade liberalisation on informal employment in the Chinese context from the perspectives of both workers and firms.

China presents an appealing case to study this question due to two reasons. First, since its application for the WTO membership in 1995 followed by its official accession to the WTO in 2001, China has reduced its tariffs on imported products substantially, from an average of over 40% in the early 1990s to around only 10% in 2005. This round of remarkable trade reforms has affected the Chinese economy greatly, including raising firm-level productivity (Brandt et al., 2017), reducing markup dispersion (Lu and Yu, 2015), increasing wage inequality (Han et al., 2012), inducing household-level adjustment (Dai et al., 2021), as well as a net positive employment effect (Rodriguez-Lopez and Yu, 2017; Wang et al., 2020). Second, China's informal labour market has experienced a rapid expansion during the same period. According to our own calculation, the share of informal workers increased from around only 3% in 1995 to over 28% in 2007. Compared to other countries such as Colombia and Brazil where major labour reforms occurred simultaneously with trade reforms (Goldberg and Pavcnik, 2003; Bosch et al.,

2012; Paz, 2014; Ponczek and Ulyssea, 2021), which makes it challenging to disentangle effects of the two reforms, Chinese labour market regulation was relatively weak during the course of trade liberalisation. This allowed for relatively flexible adjustments of both workers and firms along the formal-informal dimension. Hence the Chinese case is ideal for exploring labour market changes attributed to trade reforms.[1] In this paper, we specifically examine whether and to what extent the rising informality in China can be explained by trade induced competition.

To answer this question, we use a local labour market approach to investigate the differential prevalence of informal employment across Chinese prefectures due to heterogeneous exposure to tariff cuts over the period between 1995 and 2007. This approach relies on a Bartik-type shift-share measure (Bartik, 1991) that combines industry-level tariff changes over time and initial variations in industrial composition of employment across regions to construct a regional measure of tariff reductions, and then link it to labour market outcomes. It has been widely used in the literature to study the labour market effects of trade, such as Topalova (2010), Kovak (2013), Dix-Carneiro and Kovak (2017, 2019), among many others. An important assumption of this approach is limited labour mobility across regions while allowing for labour reallocation across sectors within regions. This assumption generally holds in the Chinese context due to the strict household registration (hukou) system that prohibits inter-region labour mobility (Meng, 2012) during the examined period. We show evidence that our main findings are not sensitive to migration. An additional concern of identifying a causal effect is the possible endogeneity of tariff changes due to, for instance, politically strong industries or firms lobbying the government for more protection (Goldberg and Pavcnik, 2005). The nature of tariff cuts in the Chinese context, however, leaves little room for political economic factors to play a role as the target tariff rates were pre-determined prior to its accession to the WTO such that initially more protected industries experienced larger tariff cuts (Brandt et al., 2017; Wang et al., 2020; Dai et al., 2021).

The definition of informal employment is rather complex and inconclusive in the literature (Perry et al., 2007; Lehmann, 2015; Lehmann and Pignatti, 2018). In our paper, we rely on workers' contract type and define informal employment as workers without a contract, temporary workers or those with a shorter-term contract. The latter two categories are often not registered, not protected by labour law or not covered by social security contributions. We thus use a broad variant of the "legalistic" definition of informal employment, characterized by the non-compliance to the state in terms of labour laws and social security systems (Khamis,

[1] Existing studies on Brazil find that the effects of trade liberalisation on informal employment become minimal once labour market institutions are accounted for (e.g. Bosch et al., 2012; Paz, 2014; Ponczek and Ulyssea, 2021).

2012). Different from other countries where self-employed individuals and those working in small firms are usually not formally registered and thereby also considered as informal employment (e.g. Paz, 2014; Dix-Carneiro and Kovak, 2019), all businesses in China including the self-employed are required to register with local authorities (Park et al., 2012). We therefore exclude the self-employed from our main sample but also check whether including them affects the main results in our empirical analysis.

We use three waves of the individual-level data collected by the China Household Income Project (CHIP) as our main dataset, namely 1995, 2002, and 2007 (CIID, 2018), and relate each individual's employment status to regional tariff rates based on their location. Then we explore whether those from more exposed regions have a differential probability of working informally relative to those from less exposed regions. The rich information on individuals' demographic characteristics and their households reported by the CHIP data allows us to control for factors that may affect individuals' self-selection into informal employment relations, which enables us to concentrate on the effects of import induced labour demand shocks.

The second, complementary dataset is a short firm panel spanning 2001 to 2004 obtained from the World Bank Enterprise Surveys (The World Bank, 2018). The distinctive feature of this dataset is that it reports the number of temporary workers for each firm. As we equate the label "temporary workers" with informal employment, we are thus able to explicitly measure the share of informal workers within firms and to explore how firms adjust their worker composition along the formal-informal dimension with rising competitive pressure, which has not yet been investigated empirically in the literature.

Our empirical results reveal that individuals from regions hit by larger tariff reductions were more likely to work informally. An average tariff cut during our sample period increased the probability of informal employment by roughly 15 percentage points, accounting for approximately 48 percent of the average increase in informality. This finding is robust to alternative measures of informality and tariffs, controlling for potential confounding policy changes, as well as alternative specifications accounting for the role of migration. We also find that the effects of import competition on informality were more prominent for those working in tradable sectors, for low-skilled workers and for females.

To understand how trade liberalisation causes rising informality in the local labour market, we turn to firm-level analysis and specifically investigate how firms adjust their worker composition. Our results show that firms significantly increased their share of informal workers with larger tariff cuts in the region. Interestingly, the rise in the share of informal workers was

predominately driven by an increased number of informal workers whereas formal workers were not affected. This suggests that firms expanded their employment size on average, but this was largely due to more hiring of informal workers. We also find that state-owned enterprises (SOEs), domestic private, smaller, and less productive firms tended to increase their share of informal workers with import competition whereas larger and more productive firms did less so. They were set to improve their investment in R&D to cope with the intensified competitive pressure.

Our paper is closely related to the growing literature that studies trade openness and informality in other developing countries. Goldberg and Pavcnik (2003) is among the first examining this question by exploiting trade liberalisation in Colombia and Brazil. They find that sectoral tariff cuts increased informality but such an impact was only present in Columbia when the labour market was relatively flexible. Subsequent industry-level analysis focusing on Brazil finds statistically significant but only modest effects of tariff reductions on informality once labour market institutions are accounted for (Bosch et al., 2012; Paz, 2014), highlighting the dominant role of labour market conditions in shaping informal employment. More recent studies by Dix-Carneiro and Kovak (2019) and Ponczek and Ulyssea (2021) adopt the local labour market approach that allows for an inclusion of the non-tradable sectors. They find sizable effects of tariff declines on informality in Brazilian regions, and the effects are stronger in regions with weaker enforcement of labour market regulations. Studies on Mexico and Peru document similar, consistent evidence that tariff reductions are associated with higher informality, especially among those working in small firms (Ben Yahmed and Bombarda, 2020; Cisneros-Acevedo, 2021). An alternative set of studies focusing on the export side finds that export market expansion due to lower tariffs in the foreign markets reduces informality (Paz, 2014; McCaig and Pavcnik, 2018; Dix-Carneiro et al., 2021).

This paper distinguishes itself from those studies in at least two aspects. First, existing studies primarily focus on Latin American countries with a predominant concentration on Brazil. This paper provides complementary evidence from the Chinese labour market, and enriches the understanding of the relationship between trade liberalisation and informality in the developing world. This complementary evidence is also insofar very relevant as the existing empirical evidence from Latina America on the causal impact of trade liberalisation on informal employment is at least equivocal, if not contradictory. Second, although theoretical arguments are often built from the perspective of firms (e.g. Goldberg and Pavcnik, 2003; Ulyssea, 2018; Ponczek and Ulyssea, 2021), the existing empirical analysis by and large relies on individual-level data from household surveys, population censuses, or labour force surveys, and analyses

individual workers' responses to trade shocks or aggregated labour market changes at the industry or region level. Besides an individual-level analysis similar to existing studies, this paper distinctively conducts a firm-level analysis, explicitly investigating how firms adjust their workforce structure along the formal-informal divide when confronting adverse trade shocks.[2] We find that firms, especially small and less productive firms, tended to raise the share of informal workers with increased competition. This provides the first empirical evidence at the firm level supporting predictions of earlier theories.

Our findings also contribute to the mushrooming literature that studies the consequences of trade liberalisation in China, notably the employment effects. A few recent studies document that trade openness following China's accession to the WTO raises employment and employment adjustment at both the firm level (Rodriguez-Lopez and Yu, 2017; Wang et al., 2021) and the aggregate industry or city level (Ma et al., 2015; Wang et al., 2020). These findings on aggregated employment, however, mask possible differential adjustment of formal and informal employment. To the best of our knowledge, this is the first paper that analyses the labour market effects of trade liberalisation from the perspective of informal employment in the Chinese context. Our result that import competition increased the share of informal employment in local prefectures underlines changes in employment composition along the formal-informal dimension in the local labour market despite aggregate positive employment effects. We find direct evidence that although firms expanded their total employment size with lower tariff rates, such effects are entirely driven by the growth of informal workers. Our findings also speak to the literature documenting higher wage inequality (Han et al., 2012) following China's trade liberalisation in the sense that informal worker are often paid lower wages.

The remainder of the paper is organised as follows. In the next section we introduce more background information about the Chinese labour market dynamics and trade liberalisation reforms. Section 3 describes the data sources that are used in this paper as well as measures of informal employment and regional exposure to tariff rates. Section 4 discusses the empirical methodology, followed by Section 5 where we present empirical results at both the individual level and the firm level. Finally, Section 6 concludes.

[2]Menezes-Filho and Muendler (2011) use linked employer-employee data in their analysis of labour reallocation in response to trade reforms in Brazil. However, with these data they can only look at separations and accessions of formal workers across sectors and firms. What happens to *informal employment* as a consequence of import penetration and tariff reductions is investigated with the help of the standard Brazilian household level data used by all of the above cited studies on Brazil.

2 Labour market dynamics and trade liberalisation in China

2.1 The Chinese labour market and informal employment

China's labour market is relatively rigid compared to other countries due to the presence of the hukou system, which has restricted labour movement across regions and segregated the labour market into rural and urban parts (Meng, 2012). Due to the fact that state-owned and collective enterprises were historically the primary job providers in the urban labour market, workers had a low risk of losing jobs. The employment rate stayed high until the early 1990s when the employment rate was over 90% according to the 1990 population census (Wang et al., 2020). Since the middle 1990s, China implemented a massive privatisation reform, aiming to push the low-productivity firms to the market while keeping only the most productive 1,000 SOEs. These reforms have induced large lay-offs of workers, some of whom were absorbed by the expanded private sector while some exited the labour market, leading to a substantial reduction in employment rates (Meng, 2012).

To solve the problem of rising unemployment, academics and policy makers advocated informal employment as a means to absorb unemployed workers (Cooke, 2011; Yao and Zhong, 2013). In 1995, the share of informal employment was only around 3% of total urban employment according to our own calculation. This share increased rapidly to 20% following the privatisation reform in 2002, reaching 28% in 2007 and 42% in 2013 (see also Liang et al., 2016).

While the privatisation reforms are a critical factor shaping the dynamics of Chinese labour market, the expansion of the informal sector is also related to other factors such as migration and weak labour protection regulations. With a relaxation of the hukou system since the late 1990s, there has been a large inflow of rural migrant workers to the urban market (Wang et al., 2021). Those migrant workers are often low-skilled and are not allowed to work in certain industries and occupations due to their rural hukou status (Démurger et al., 2009). In addition, they are often discriminated by local social security systems (Yao and Zhong, 2013). As a result, a large majority of rural migrant workers is only employed informally (Park et al., 2012; Yao and Zhong, 2013; Liang et al., 2016). At the same time, urban natives, especially the low-skilled, are more likely to be employed informally with higher competition from migrants. In our later analysis, we include rural migrant workers in our sample to account for such possibilities but also check the sensitivity of our main findings by excluding them.

An alternative reason that accounts for the high informal employment in China is related to the weak enforcement of employment protection legislation during our sample period. China

introduced its first Labour Contract Law in 1994. However, it, together with a series of other employment related regulations, was not strictly implemented, hence providing only limited protection to workers (Cooke, 2011). This only changed in 2008 when a new Labour Contract Law was issued, which was also vigorously enforced. But before 2008, the weak enforcement of employment protection regulations along with the rapidly expanding labour supply in the urban labour market owing to the ownership reforms and the massive influx of migrant workers have provided firms with the flexibility to employ informal workers, especially in the face of adverse economic shocks.

The absence of stringent labour market regulations in the Chinese labour market makes it an ideal setting to assess to what extent import competition has affected the rapid growth of informal employment. A number of studies have documented that stringent labour market regulations would weaken the effects of trade openness on labour market outcomes (Goldberg and Pavcnik, 2003; Bosch et al., 2012; Paz, 2014; Ponczek and Ulyssea, 2021). Given the weak labour market institutions in China during our investigation period, we can concentrate on the effects of trade without worrying about the confounding influence of labour market conditions.

2.2 Trade liberalisation in China

Since China's application for WTO membership in 1995 and especially after its formal access to the WTO in 2001, China has reduced it tariff rates substantially. As shown in Figure B.1 in Appendix B, average tariff rates on imported products reduced from above 40% in the early 1990s to around 10% 2005, when China fulfilled the majority of its commitments to the WTO in reducing tariffs.[3] The average tariff rate has remained rather stable thereafter. This process is accompanied with a surge in imports, bringing large competitive pressure on import-competing firms but also improving access to imported high-quality inputs at lower costs.

A growing strand of literature has documented substantive labour market effects of trade liberalisation in China. Trade openness simultaneously caused job creation and job destruction in formal manufacturing industries, with a net positive impact on job growth (Ma et al., 2015). At the firm level, import competition led high-productivity firms to expand employment whereas less productive firms to shed labur (Rodriguez-Lopez and Yu, 2017), contributing to increased employment adjustment within firms (Wang et al., 2021). In the meantime, import induced negative income shocks also triggered household-level adjustment in the short run, such that households raised labour supply, reduced savings, and increased co-residence to save living

[3] http://www.china.org.cn/government/whitepaper/node_7143951.htm

costs (Dai et al., 2021). Consistent with the micro-level evidence, reduced tariff rates had a positive effect on aggregate, prefecture-level employment. Such a positive employment effect was mainly driven by female workers (Wang et al., 2020).

Built on existing studies that document aggregated employment effects of import competition, this paper focuses on the effects on informal relative to formal employment. Theoretically, import competition can induce an expansion of the informal sector if less productive formal firms deregister and enter the informal sector with higher competition, raising informality along the extensive margin, or if firms increase their share of informal workers as a strategy to reduce labour costs and to improve competitiveness, which raises informality along the intensive margin. Meanwhile, increased competition can reduce informality by driving the least productive informal firm to exit the market, or if firms invest in technology and subsequently expand production. This might allow them to hire more formal workers (Ulyssea, 2018; Ponczek and Ulyssea, 2021). This paper will examine the effects of intensified competition due to lower tariff rates on informal employment first at the individual worker level and then at the firm level.

The positive overall employment effects observed in the literature, however, mask possible labour market adjustment along the form-informal dimension. As we will show later, informal employment has expanded considerably in the course of China's trade liberalisation reform. This could be because firms increase informal employment as a way to reduce labour costs and through this route improve competitiveness in response to intensified import competition as informal workers are usually less costly (Goldberg and Pavcnik, 2003). This is especially true for low-productivity firms that are less able to invest in technology with rising competitive pressure, and informality becomes a "cheaper" way or even a survival strategy for them (Ulyssea, 2018). The existing literature finds that trade liberalisation increased informality in developing countries (e.g. Goldberg and Pavcnik, 2003; Bosch et al., 2012; Paz, 2014; Dix-Carneiro and Kovak, 2019). But, the empirical evidence at the firm level is yet scarce. We are among the first exploring the trade-informality linkages at the firm level and also the first examining the labour market effects of trade liberalisation in China from the perspective of informal employment.

Aside from the import competition channel, tariff rates reduction could also affect the labour market through the input tariffs channel by allowing firms to import intermediate inputs at a lower price, thereby improving productivity and raising labour demand (Amiti and Cameron, 2012), and potentially reducing informality (Dix-Carneiro et al., 2021). This channel, however, plays a limited role in the Chinese context as firms use only a small share of imported inputs (Liu and Qiu, 2016; Brandt et al., 2017). In our empirical analysis, we are unfortunately not able

to examine this channel due to the high correlation between output tariffs and input tariffs in the local labour market setting.

As a part of its commitments to the WTO, China has also reduced its non-tariff barriers (NTBs) and restrictions to FDI during our sample period. Similar to lower tariffs, reduced NTBs would also increase import competition for domestic competing firms. The impact of FDI on employment is less clear cut as it depends on job creation within foreign firms and possible spillover effects on domestic firms. Existing studies find a positive net employment effect of FDI in China (Karlsson et al., 2009).

Following its accession to the WTO, China's trade partners have also reduced tariffs on Chinese products. Improved access to the foreign markets has attracted migration from less exposed regions (Facchini et al., 2019) and affected dynamics in human capital accumulation (Li, 2018). Compared to import tariffs, the reduction in export tariffs is much smaller, as shown in Figure B.1 in Appendix B, and is unlikely to be a major channel. In our sensitivity analysis, we will control for all these contemporary policy changes.

3 Data and measures

3.1 Data sources and measures of informal employment

Our main data source is the China Household Income Project (CHIP) collected and administrated by a team of international scholars since the 1980s. We obtained the data from *China Institute for Income Distribution* (CIID, 2018).[4] The survey samples are drawn from the larger annual sample of household income survey conducted by the National Bureau of Statistics (NBS), and are nationally representative. There are five waves available, namely 1988, 1995, 2002, 2007, and 2013. For the purpose of our research, we use the urban samples of 1995, 2002, and 2007. The main reason for such a selection is that these three years cover the major period of China's trade liberalisation and of rising informal employment, and that trade openness predominantly affects the urban labour market.[5] It covers 12 out of 31 provinces in 1995 and 2002 and 9 in 2007, covering 18 to 58 prefecture-level cities across years. The urban sample of 1995 includes only urban residents while the 2002 and 2007 samples also include a sub-sample

[4]More details of the project can be found in: http://www.ciidbnu.org/chip/index.asp. Detailed descriptions of the survey are provided by Li et al. (2008) and Luo et al. (2013).

[5]Specifically, the reason why we do not use the 1988 wave is that informal employment was rare in 1988 when the Chinese economy was dominated by the state sector. Moreover, data on tariff rates is not available in 1988. For the 2013 wave, the main reason is that tariff changes after 2007 are only minimal, with a reduction of the average tariff rates only 0.07% between 2007 and 2013.

of rural-to-urban migrant workers.[6] We include rural migrant workers in our sample because they are part of the urban labour market who are affected by trade liberalisation, and because urban natives might potentially have to compete with migrants for jobs. In our later analysis, we show evidence that our main findings are not sensitive to the inclusion of migrant workers.

The CHIP data reports a fairly rich set of information on individual's demographics, households, as well as employment status. Such rich information allows us to include a comprehensive set of control variables in our empirical analysis that are correlated with individual's labour market outcomes. Summary statistics of those variables are reported in Table B.1 in Appendix B.

More importantly, individual's employment status in the CHIP data allows us to identify whether individuals are temporary workers without a work contract or with a short-term contract, employed with a long-term or permanent contract, or self-employed. This infomration is crucial for defining informal employment. The definition of informal employment is complex and inconclusive in the literature. There are two broad groups of definitions: the "productivity-based" and the "legalistic" or social protection definitions (Khamis, 2012; Lehmann and Zaiceva, 2015; Lehmann and Pignatti, 2018). The first category is based on an individual's job characteristics: the unprofessional self-employed, low-skilled, those working in marginal jobs, those working in family-based small businesses or in firms with less than five workers are considered as informal workers. The second category relies on a definition that entails non-compliance to the state in terms of labour laws and social security systems. In this paper, we use the second definition and define informal employees as salaried workers who are temporary and without a contract and those with a temporary contract less than a year.[7] These workers are for the most part not covered by social security and/or pension contributions.[8] One concern with this definition is the inclusion of workers with a temporary or short-term contract. Those workers indeed face high uncertainties about their future employment in spite of a formal work contract.[9] In addition, they are often not fully covered by social security contributions. We exclude them from our sample in one robustness check and the main results

[6]Migration in 1995 was still strictly prohibited with only a small share of rural migrant workers in the urban labour market.

[7]The 1995 survey and the 2002 migrant survey combine workers without a formal work contract and those with a temporary contract as one group, thereby does not allow for a distinction between the two types. According to the urban sample of 2002 and the 2007 sample, short-term contract workers take 11% and 7% in total employment respectively versus 7% and 21% of workers without a contract.

[8]In our data, only 4% of informal employees in 2007 report that their workplace paid or partially paid all four types of social security contributions (unemployment insurance, pension insurance, injury insurance, and housing funding). Distinguishing between non-contract workers and those with a short-term contract, 2% of the former and 12% of the latter are fully covered by social security contributions. By contrast, 32% of formally employed workers are fully covered by social security contributions. Due to missing information on insurance-related variables in 2002 and 1995, we rely on workers' contract status to define informal employment.

[9]Many of these contracts include unfavourable clauses that allow the employers to evade responsibilities when work-related injuries occur (Cooke, 2011).

remain essentially unchanged. More details about the definition of informal employment can be found in Appendix A.

The second concern with the definition of informal employment is related to the self-employed. The self-employed who do not register their business with the state are also considered as informal workers in the literature (e.g. Bosch et al., 2012; Dix-Carneiro and Kovak, 2019). Different from this literature, we exclude them from our sample because individual businesses in China are all required to register with the local administration (Park et al., 2012).In addition, self-employed individuals include both low-skilled small business owners and high-skilled entrepreneurs. It makes little sense to define the latter as informal employment. In our later analysis, however, we also show evidence that including the self-employed does not change the main results much. We constrain our sample to the employed population aged between 15 and 64 years old. Conditional on being employed, we are interested in whether one is employed informally.

Table 1: Employment composition across years in urban China

	1995	2002	2007
Employment rate, of which	0.775	0.677	0.762
Formal employees	0.925	0.539	0.549
Informal employees	0.028	0.200	0.281
Self-employed	0.014	0.211	0.148
Other	0.034	0.051	0.022

Notes: Table shows shares of the employed individuals aged 15-64 by employment status in urban China for the years 1995, 2002, and 2007 based on the CHIP data. Formal employees are permanent workers or those with a long-term contract; informal employees include workers without a contract, temporary workers and those with a short-term contract.

Table 1 reports worker composition over our sample period based on the CHIP data. The overall employment rates reduced from 78% in 1995 to 68% in 2002 and then rebounded to to 76% in 2007. The substantial decline in employment rates between 1995 and 2002 was mainly due to the large-scale privatisation reform in the end of the 1990s, which resulted in a large number of laid-off workers, some of whom were absorbed later by the private sector (Meng, 2012). Within the employed workers, the share of formal workers reduced substantially from 93% in 1995 to 54% in 2002, and remained roughly the same with 55% in 2007. This was accompanied with a rapidly rising share of informal employees from merely 3% in 1995 to 20% in 2002 and 28% in 2007. The share of the self-employed also increased substantially between 1995 and 2002, whereas declined mildly afterwards. The statistics in Table 1 show that the China's labour market experienced remarkable dynamics during our sample period, featuring a sizable

contraction of formal employment and a rapid expansion of informal employment. In this paper, we aim to explain such a rise in informality from the perspective of import competition. To do so, we match the CHIP data with prefecture-level tariffs based on an individual's location and investigate whether individuals exposed differently to tariff cuts have a differential probability of having an informal employment relationship.

The secondary, supplementary dataset that we use in this paper is the firm-level data maintained by the World Bank Enterprise Surveys (The World Bank, 2018). The World Bank conducted four waves of firm surveys in China, namely in 2002, 2003, 2005, and 2012. The first survey was conducted in only five big cities in China and the second one was extended to other 18 cities. The coverage of cities increased to 120 in 2005 and 25 in 2012. In this paper we only use the two waves of 2003 and 2005 due to several reasons. First, the 2002 wave surveyed firms in only five big cities, which are not representative of the whole nation.Second, 2012 is already after China's committed deadline of tariff reductions to the WTO, namely 2010, and any tariff changes between the two years could be endogenous. An additional reason is that tariff reductions between 2005 and 2012 were limited, as shown in Figure B.1 in Appendix B. Last but not least, the 2003 and 2005 waves both focused on the investment climate in China, whereas the 2002 wave focused on competitiveness, technology and firm linkages and the 2012 wave was a general enterprise survey. We, therefore, believe that the 2003 and 2005 waves are more consistent.

The two waves of the World Bank investment climate survey cover cities across all geographical regions in China. Firms in each city are randomly selected, including those from all sizes, those from both manufacturing and service sectors, and those of different ownership types, thereby providing a representative sample of Chinese firms. The data reports rich information on firms' financial statement, labour statistics, linkages to suppliers and clients, as well as on the relationship with the government, etc. The most relevant information for our paper is the number of permanent and temporary workers reported by each firm, which makes it possible to precisely measure worker composition along the formal-informal divide within firms. Formally, we use the share of temporary workers in total employment as our measure of firm-level informality. Notice that this measure captures informality along the intensive margin within formally registered firms. Different from other countries where firms are likely to transit from formal to informal types with import competition (Dix-Carneiro et al., 2021), labour market adjustment along the extensive margin can hardly play a role in China as all firms are required to register with local authorities. More details about the definition of informal employment at the firm level are presented in Appendix A.

Each wave of the investment climate survey collects key firm-level information retrospectively in the past three to four years, i.e. 1999 to 2002 for the 2003 wave, and 2002 to 2004 for the 2005 wave. This enables us to construct an unbalanced panel and to control for firm fixed effects in our empirical analysis. As the number of temporary workers is only available for 2001 and 2002 for the 2003 wave, we eventually have a short panel spanning 2001 to 2004.

Compared to individual-level analysis using the CHIP data, firm-level analysis allows us to specifically investigate how firms adjust employment as a response to import competition, which helps to understand the mechanism through which trade liberalisation affects the local labour market. The rich firm-level information also makes it possible to explore heterogeneous effects across different types of firms, such as small versus large firms, low- versus high-productivity firms. In addition, the yearly panel nature of the firm-level data provides the opportunity to uncover short-run employment adjustment with competitive pressure, which complements our results based on the CHIP data that more reflect labour market adjustment in the medium run. Specifically, we match firm-level data with city-level tariff rates, as defined below, based on firms' location and examine whether firms located in regions more exposed to tariff cuts deferentially changed their share of informal workers relative to those from less exposed regions. Summary statistics of key firm-level variables are reported in Table B.1 in Appendix B. On average, firms have slightly less than one third of informal workers.

3.2 Measuring regional exposure to tariff reductions

In order to measure regional exposure to tariff reductions, we use a Bartik type shift-share approach (Bartik, 1991) which exploits differences in initial industrial composition across regions. Specifically, prefecture-level tariff rates are calculated as follows:

$$Tariff_{ct} = \sum_{j=1}^{J} \frac{E_{jc,0}}{E_{c,0}} \times Tariff_{jt} \tag{1}$$

where c stands for prefecture-level city and $E_{jc,0}/E_{c,0}$ measures the initial employment share of industry j in total prefecture-level city employment. We calculate employment shares using the 1995 industrial census collected by the NBS of China. It covers the universe of firms from the mining, manufacturing and public utility sectors. Notably, it reports a four-digit Chinese industry classification (CIC) code for each firm and allows for a precise measure of industrial structure within regions.[10] $Tariff_{jt}$ denotes industry-level tariff rates across time. We collect

[10]Kovak (2013) considers the entire tradable sector when calculating the employment shares. However, given that we consider only the urban labour market where the agriculture sector plays a minor role, we believe that

data on tariff rates at the six-digit HS product level from the World Integrated Trade Solution (WITS) database (World Bank, 2019) and concord them to the four-digit CIC level relying on the concordance table provided by Brandt et al. (2017). Variations in the regional tariff measure derive from the initially differential employment shares within local industrial sector and tariff changes at the industry level over the years; regions initially specialising in industries that are more exposed to tariff changes would be affected more strongly. Notice that regions differ not only in industry mix within the industrial sector, but also in the importance of the industrial sector in the local economy such that regions specialising in non-tradable sectors are less exposed to import competition relative to those concentrating on tradable sectors. In our empirical analysis, we follow Autor et al. (2013) and control for the employment shares of the primary and the secondary sectors to account for the differential exposure to tariffs stemming from differences in broad sector composition.

Table 2 presents summary statistics of the prefecture-level tariffs. The average tariff rates reduced from 27% in 1995 to 12% in 2002 and further to 8% in 2007, amounting to a total reduction of 18% points over the sample period. Major tariff reductions had occurred even before China's WTO accession whereas afterwards tariffs decreased relatively less. Variations across regions are substantial. The tariff rate is 13% at the 5% percentile and 39% at the 95% percentile in 1995 and the reductions of tariffs from 1995 to 2007 ranged between 8% points and 29% points across regions. The sizable spatial variations in tariff reductions ensure an identification of the effects on informality derived from heterogeneous exposures to tariffs among individual workers or firms across regions.

Table 2: Summary statistics of prefecture-level tariffs (%)

	1995	2002	2007	2007-1995
Mean	26.84	11.56	8.49	18.35
95th percentile	38.91	16.62	12.06	28.62
75th percentile	32.06	13.85	9.86	22.04
50th percentile	26.87	11.71	8.57	18.15
25th percentile	21.84	9.43	7.10	14.78
5th percentile	12.88	5.67	4.41	7.89

Notes: Table shows summary statistics of city-level tariffs across 319 Chinese prefecture-level cities.

the employment structure of the industrial sector could well capture the effects of tariff rates on the urban labour market. In a robustness check, we calculate tariff rates using the employment shares within the entire tradable sector that are calculated based on the 1% sample of the 1990 population census obtained from Minnesota Population Center (2019), and the main results are qualitatively similar.

4 Empirical methodology

Using three waves of repeated cross-sectional household survey data from the CHIP, we examine the effects of tariff rates on the probability of being employed informally by estimating the following linear probability model:

$$Inf_{ict} = \alpha + \beta Tariff_{ct} + \mathbf{\Gamma}_1 \mathbf{X}_{it} + \mathbf{\Gamma}_2 \mathbf{X}_{ct} + \theta_c + \theta_{rt} + \varepsilon_{ict} \tag{2}$$

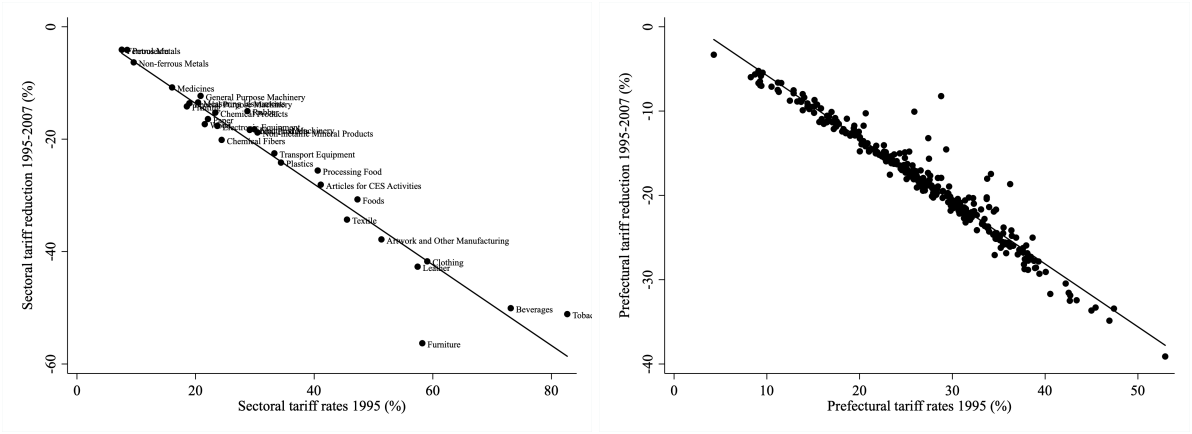
where the outcome variable Inf_{ict} is a binary variable indicating whether an individual i from city c works as an informal worker in year t. Our main explanatory variable is $Tariff_{ct}$, measuring regional exposure to tariff rates in year t for prefectural city c, defined by Equation (1). $\mathbf{X}_{it}$ is a rich set of individual and household-level characteristics that may affect one's employment status, including gender, age, age squared, marital status, ethnicity, an indicator for household head, a rural or urban hukou type, household size, as well as a dummy variable indicating whether a household has at least one child at or below six years old. In addition, we control for a battery of variables that are specifically related to jobs, including occupation type (blue or white collar), eight industry dummies, and five categories of the workplace. These individual and household-level variables also control for possible voluntary sorting effects into informal employment relations following tariff reductions and assure that the identified effects on informality are attributed to changes in labour demand. For example, childbearing mothers or those with stronger household responsibilities may prefer informal jobs that allow for flexible working hours (Berniell et al., 2021). The dummy variable indicating a household having a pre-school child can capture labour supply factors related to parenthood. $\mathbf{X}_{ct}$ denotes a set of city-level control variables, consisting of the log of local GDP, log population, urbanisation rates, and the employment shares of the primary and the secondary sectors. θ_c indicates city fixed effects, capturing all time-invariant characteristics at the city level that might be correlated with employment. We add region-year fixed effects, θ_{rt}, to control for differential trends in average informality across eight economic regions (Bombardini and Li, 2020). This is especially important in the Chinese context given its large geographic area and the imbalanced economic development across regions. As such, the identification of the effects on informal employment originates from within-region variations across cities. Finally, ε_{ict} is the error term. We cluster standard errors at the city-year level to allow for possible correlations among individuals within cities in a specific year.

The main coefficient of interest, β, measures the effects of tariff rates on the probability of informal employment. The identification of such effects relies on comparing the likelihood of

being employed informally between individuals with identical observed characteristics but exposed differently to tariff changes. Possible threats to the identification of the causal effect could be unobserved factors that jointly affect tariff rates and the labour market. While it is less likely the case that individual-level unobserved characteristics can be correlated with tariff rates, industry- or city-level factors could still matter. A common concern in the literature is that politically strong firms or industries may lobby the government for protection during the course of trade reforms (Goldberg and Pavcnik, 2005). In our local labour market setting, regions with such firms or a high share of politically powerful sectors in the local economy could experience a relatively lesser reduction in tariff rates and thereby have different labour market outcomes.

We carefully address the endogeneity concern in several steps. First, we include the ownership type of individual's workplace in all regressions. As SOEs are more likely to have political connections to the government, the inclusion of ownership types ensures that we compare individuals working in the same type of workplace but exposed differentially to tariff rates, and thereby alleviating the endogeneity problem arising from the uneven presence of SOEs across regions. The inclusion of local sectoral composition as control variables as well as city fixed effects could additionally account for the endogeneity that is correlated with local economic structure or unobserved city-specific characteristics. Moreover, tariff reductions following China's WTO accession could hardly be affected by local political factors as the target tariff rates were pre-determined by the WTO and the Chinese government before 2001 (Brandt et al., 2017; Wang et al., 2020; Dai et al., 2021). As shown in Figure 1, tariff rates reductions between 1995 and 2007 are highly correlated with the initial level at both the industry level (left figure) and the city level (right figure). Similar patterns are observed in many other developing countries that implemented trade liberalisation reforms following their accession to the WTO or free trade agreements, such as Colombia (Goldberg and Pavcnik, 2005), Mexico (Ben Yahmed and Bombarda, 2020), Brazil (Dix-Carneiro and Kovak, 2017), and Indonesia (Amiti and Cameron, 2012). This suggests that initially highly protected industries and/or regions experienced a larger reduction of tariffs, thereby leaving little room for political factors to play a role.

While tariff cuts over the entire sample period are less likely to be endogenous, the timing of tariff cuts within the period could still be endogenous if for example, the government reduced tariffs in selected industries that were more competitive in the first place and protected certain industries until the committed deadline of reaching the target level. So, tariff changes between 1995 and 2002, and between 2002 and 2007, could still be endogenous. However, as shown in Figure B.2 and Figure B.3 in Appendix B, tariffs cuts during the two time intervals display very similar patterns to those over the entire period as in Figure 1; industries and cities that



(a) Tariffs at two-digit industry level (b) Tariffs at prefecture level

Figure 1: Import tariff declines (1995-2007) and initial tariff rates in China

Notes: The two figures show scatter plots of import tariff declines between 1995 and 2007 against initial tariff rates at the two-digit CIC industry level (left) and at the prefecture level (right). Industry-level tariff rates are calculated based on the product-level data obtained from the WITS. Prefecture-level tariff rates are calculated according to equation (1).

had a higher initial tariff rate in 1995 experienced larger tariff declines. This demonstrates little supportive evidence of possible endogenous timing of reducing tariffs in China. As the second step addressing the possible endogeneity problem, we consider an instrumental variable approach that employs the pre-determined maximum allowable tariff rates (Brandt et al., 2017; Dai et al., 2021) and the initial tariff rates times a post 2001 dummy (Goldberg and Pavcnik, 2005; Fieler and Harrison, 2018) as alternative instrumental variables.

To understand the mechanism through which import competition affects informal employment in the local labour market, especially from the perspective of firms, we turn to firm-level analysis. We are specifically interested in how firms adjust their worker composition along the formal-informal dimension to trade induced adverse labour demand shocks using the following empirical specification:

$$Informsh_{ict} = \alpha + \beta Tariff_{ct} + \gamma Sale_{it} + \mathbf{\Gamma X}_{ct} + \theta_i + \theta_{rt} + \varepsilon_{ict} \tag{3}$$

where the outcome variable $Informsh_{ict}$ measures the share of informal workers in total employment for firm i located in city c in year t. Compared to the informal employment indicator in Equation (2) that measures employment status at the individual level and that also captures the share of informal employment at the prefecture level, the outcome variable in Equation (3), however, measures employment adjustment within firms. Similar to Equation (2), $Tariff_{ct}$ defines prefecture-level tariff rates. We include firm's annual sales to capture possible

productivity effects. The same set of city-level characteristics as in Equation (2) is also included, denoted by $\mathbf{X}_{ct}$. The panel structure of the firm-level data allows us to include firm fixed effects (θ_i) so as to absorb all time-invariant firm-level characteristics that may affect firm's decision of employing informal workers. As such, we explore within-firm variations in the share of informal employees over time. Notice that firms did not change industry affiliation, ownership type, or city location during the sample period, firm fixed effects also capture all time-invariant systematical differences between industries, ownership types, and cities. We include region-year fixed effects, θ_{rt}, in our estimations to account for all time-variant region-specific characteristics. Again, ε_{ict} is the error term. We cluster standard errors at the city-year level to allow for possible across-firm correlations within cities in a specific year.

5 Tariff rates and informal employment: Empirical results

5.1 Baseline results from individual-level analysis

Table 3 reports the estimation results of the linear probability model as specified in Equation (2), where the dependent variable indicates whether an individual works as an informal worker. Column (1) controls for an array of individual and household-level characteristics that might be correlated with individual's labour market position as well as year fixed effects and city fixed effects. Columns $(2) - (4)$ gradually add job-related control variables, city-level control variables, and region-year fixed effects.

The coefficient estimates of import tariffs are negative and statistically significant in all specifications with the size of coefficient not varying much across specifications. The negative coefficients suggest that individuals from regions that experienced a larger reduction in import tariffs had a higher probability of working as an informal worker. The coefficient in our preferred specification (column 4) indicates that an individual would have a 8.3 percent higher probability being employed in the informal sector if tariff rates reduce by 10 percentage points than those from regions without tariff cuts. Alternatively, an average tariff cut between 1995 and 2007 (18.32 percentage points) would increase informality by roughly 15 percentage points in the local labour market. This explains about 48 percent of the increase in informality during our sample period, and hence is economically sizable. These results highlight the significant role of tariff reductions in affecting the rise of informality in China.

Table B.1 in Appendix B reports the full results with all control variables. The coefficients on the control variables are generally consistent with our expectations. Males, those with a higher

Table 3: Import tariffs and the prevalence of informal employment: Baseline results

Dep. variable:	OLS				2SLS	
Informal worker (=1)	(1)	(2)	(3)	(4)	(5)	(6)
Import tariffs	-0.0082***	-0.0069***	-0.0067***	-0.0083***	-0.0078***	-0.0074**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Job related controls	No	Yes	Yes	Yes	Yes	Yes
City controls	No	No	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No
Region-year FE	No	No	No	Yes	Yes	Yes
First-stage SW F-statistics					1948.112	466.387
Dependent mean	0.182	0.182	0.185	0.185	0.185	0.185
Observations	34,811	34,811	34,130	34,130	34,130	34,130
R^2	0.237	0.332	0.334	0.336	0.224	0.224

Notes: Dependent variable indicates whether one works as an informal worker. Column (1) controls for individual and household-level characteristics. Columns (2)-(4) add job related control variables, city-level control variables, as well as region-year fixed effects, respectively. Columns (5) and (6) report the results of 2SLS estimations. Column (5) uses maximum allowable tariff rates as the instrumental variable. Column (6) uses initial tariff rates times a post 2001 dummy as the instrumental variable. Individual characteristics include gender, age, age squared, education level, marriage status, ethnicity, and a household head dummy. Household controls include household size and a dummy variable indicating whether the household has at least one child at or below six years old. Job related controls include a blue collar dummy, eight industry categories, and six workplace types. City-level controls include the employment shares of the primary and the secondary sectors, log of local GDP, log of total population, and urbanisation rates. Robust standard errors clustered at the city-year level are reported in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

education level, household heads, those with an urban hukou, those from a smaller household and white-collar workers are less likely to work as informal employees. Service sectors tend to have a higher share of informal employment than tradable sectors. The type of workplace also matters; individuals working in enterprises and running small businesses have a higher prevalence of being informal workers than those working in government departments or public institutions. Interestingly, individuals from cities with a higher economic growth are more likely to work informally whereas local population growth and urbanisation rates are related to lower informality.

As discussed earlier, the nature of the trade liberalisation reform especially due to China's WTO accession makes tariff cuts during our sample period plausibly exogenous. We check this assumption by using an instrumental variable approach and estimating Equation (2) using the pre-determined maximum allowable tariffs under the WTO agreement as the instrumental

variable for the actual, applied tariff rates (Brandt et al., 2017; Dai et al., 2021). We use maximum allowable tariffs at the four-digit CIC industry level provided by Brandt et al. (2017) and compute prefecture-level measures according to Equation (1). Alternatively, we exploit the nature of China's tariff cuts during our sample period that sectoral tariff reductions are highly correlated to the initial level (as shown in Figure 1) and use the initial tariff rates times a post 2001 dummy as the instrumental variable (Goldberg and Pavcnik, 2005; Fieler and Harrison, 2018). The second-stage 2SLS estimation results using these two alternative instrumental variables are reported in columns (5) and (6), respectively.

We report the first-stage results in Table B.3 in Appendix B. Both the maximum allowable tariffs and the initial tariffs are strong predictors of the actual, applied import tariffs. The large value of F-statistics reported at the bottom of Table 3 excludes the possibility of weak instruments. The second stage estimation results show very similar coefficients on import tariffs compared to the one obtained from the OLS regression (column 4), suggesting that the OLS estimation result could be safely interpreted as causal effects.

The baseline results that import tariff reductions increased informal employment are in line with earlier findings in other countries, such as Brazil (Bosch et al., 2012; Paz, 2014; Dix-Carneiro and Kovak, 2019), Columbia (Goldberg and Pavcnik, 2003), and Mexico (Ben Yahmed and Bombarda, 2020). In the case of Brazil, Bosch et al. (2012) and Paz (2014) find only a mild impact of tariff cuts on informal employment when strong labour market intuitions are present. In the Chinese context, however, labour market regulations and worker protection were relatively weak during our sample period (Cooke, 2011). Hence, it is less likely that labour market institutions played a dominant role in affecting informality.

5.2 Robustness checks

In this section, we perform several robustness checks to examine whether our results are sensitive to alternative measures of informality and tariffs, contemporary policy changes related to openness and domestic market reforms, and migration.

5.2.1 Alternative measures of informal employment and tariff rates

Our main measure of informal employment includes workers without a work contract and those with a temporary or short-term contract. In columns (1) of Table 4, we exclude workers with a temporary or short-term contract from the sample. Notice that the 1995 sample and the 2002 migrant sample combine those without a contract and those with a short-term contract

in one category, which does not allow for a distinction between the two types. We therefore can only exclude the latter from the 2002 urban sample and the 2007 sample. The coefficient estimate of import tariffs based on this reduced sample is close to the baseline result.

In column (2) we address the role of self-employment by including the self-employed in the informal worker pool. The average informal employment rate consequently increases from 18.5% (see Table 3) to 25.1%. We continue to find a negative, significant coefficient on import tariffs, suggesting that self-employment is unlikely to drive our main findings. As mentioned earlier, considering that all business units including the self-employed are required to officially register with local authorities in China, we exclude the self-employed from our main sample.

Table 4: Import tariffs and the prevalence of informal employment: Alternative measures of informality and import tariffs

Dep. variable:	Excl. short-contract workers	Incl. self-employment	1990 weight
Informal worker (=1)	(1)	(2)	(3)
Import tariffs	-0.0059***	-0.0076**	-0.0167***
	(0.002)	(0.003)	(0.003)
Individual controls	Yes	Yes	Yes
Job related controls	Yes	Yes	Yes
City controls	Yes	Yes	Yes
City FE	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes
Dependent mean	0.139	0.251	0.185
Observations	32,305	37,131	34,130
R^2	0.322	0.461	0.337

Notes: This table reports estimation results that use alternative measures of informal employment and regional tariffs. Informal workers in column (1) exclude those with a short-term work contract for the survey waves where short-term contract workers and those without a work contract are distinguishable. Those waves include the 2002 urban sample and the 2007 urban as well as migrant samples. Informal workers in column (2) additionally include the self-employed besides short-term contract workers and those without a work contract. Column (3) uses prefecture-level tariff rates that are calculated using sectoral employment shares of *all tradable sectors* within prefectures based on the 1990 population census as weights. Tradable sectors consist of agriculture, mining and quarrying, and manufacturing industries. All specifications include a full set of control variables as in column (4) of Table 3. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

Column (3) assesses the robustness of our main results by using an alternative measure of regional import tariffs. Our prefecture-level tariff rates are computed using employment shares of the mining and manufacturing industries within prefectures based on the 1995 industrial census, thereby measuring regional exposure to tariff rates of the industrial sectors. One concern with this measure is that it ignores the agricultural sector which could also

experience tariff changes during the sample period. Since our focus is the urban labour market where the agricultural sector takes a minor share in the local economy, tariff changes of agricultural products can hardly be the main driver of urban employment changes. However, two possibilities could still arise. One is through migration. If import competition due to lower tariffs on agricultural products reduces incomes in the rural area, rural workers could migrate to the urban area, which could increase informal employment in the urban market as rural migrants mainly get informal jobs. Rising competition with migrant workers might also raise informal employment of natives. The role of migration will be formally discussed in Section 5.2.3. The other concern is that urban labour market could be indirectly affected by lower tariffs on agricultural products through input-output linkages.

To address possible effects of agriculture, we follow Dix-Carneiro and Kovak (2017) and calculate regional tariff rates using employment shares of the entire tradable sector, including the agricultural sector. Employment shares are calculated based on the 1990 population census, obtained from Minnesota Population Center (2019). Column (3) in Table 4 reports the results using this updated tariff measure. The coefficient on import tariffs remains negative and highly significant, thereby confirming our baseline results based on tariff changes of the industrial sector. However, employment shares calculated from the 1990 population census are inferior to the ones from the 1995 industrial census for two reasons. First, the 1990 population census may not precisely reflect industry structures in 1995. Second, the 1990 population census reports only three-digit industry codes following the 1984 industry classification whereas the 1995 industrial census uses a four-digit industry classification updated in 1994, hence providing a granular measure of the local industry composition in 1995. We therefore use the 1995 employment weighted tariffs as our preferred measure.

5.2.2 Contemporary policy changes

In the course of lowering tariff rates on imported products, China has also been integrated into the world economy due to additional policy changes. In this section, we check whether those policy changes may confound the effects of import tariffs on informal employment. The first is export tariffs imposed by trade partners on China's exported products. We collect industry-level tariffs of each country from the WITS and calculate average industry-level export tariffs using the GDP shares of each country in world total GDP as weights. Using the GDP-based weights could well capture the potential of exporting markets due to lower tariffs (Wang et al., 2020). We then calculate regional exposure to export tariffs according to Equation (1). The estimation

results including export tariffs are reported in column (1) in Table 5. The positive coefficient implies that export market expansion reduced informality, consistent with what other studies find in the context of other countries (Paz, 2014; McCaig and Pavcnik, 2018; Safojan, 2019; Dix-Carneiro et al., 2021). However, such effect in this case is statistically indistinguishable from zero, though it turns significant when we control for more policy variables in columns $(2) - (6)$. The coefficient on import tariffs, however, is not affected much by including export tariffs.

Table 5: Import tariffs and the prevalence of informal employment: Controlling for contemporary policies

Dep. variable: Informal worker (=1)	(1)	(2)	(3)	(4)	(5)	(6)
Import tariffs	-0.0089***	-0.0148***	-0.0173***	-0.0174***	-0.0193***	-0.0187***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Export tariffs (%)	0.0031	0.0177**	0.0241**	0.0250**	0.0238*	0.0212*
	(0.006)	(0.009)	(0.010)	(0.010)	(0.012)	(0.012)
NTBs		0.3662**	0.3915**	0.4091**	0.3491**	0.2505
		(0.155)	(0.156)	(0.157)	(0.162)	(0.157)
FDI restrictions			-0.2840**	-0.2832**	-0.2470**	-0.1842
			(0.114)	(0.115)	(0.115)	(0.113)
Non-SOE employment shares (%)				0.0003	0.0003	0.0004
				(0.001)	(0.001)	(0.001)
Minimum wages (ln)					0.1625**	0.1701***
					(0.072)	(0.064)
College graduate shares (%)						0.0094***
						(0.003)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Job related controls	Yes	Yes	Yes	Yes	Yes	Yes
City controls	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,130	34,130	34,130	33,963	33,201	33,201
R^2	0.336	0.337	0.337	0.336	0.336	0.336

Notes: This table reports estimation results that control for additional contemporary policies. Columns $(1) - (3)$ consider openness related policies including export tariffs, non-tariff barriers, and FDI restrictions, and columns $(4) - (6)$ add policies of domestic reforms, all of which are measured at the prefecture level. All specifications include a full set of control variables as in column (4) of Table 3. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

In columns (2) and (3) of Table 5, we add prefecture-level measures of non-tariff barriers (NTBs) and FDI restrictions. Like import tariffs, reducing NTBs and FDI restrictions is also part of the commitment to the WTO. Lower NTBs would increase imports and lower FDI restrictions would allow more FDI inflows, both of which raise competition in the local market and may potentially

increase informal employment in analogue to import tariffs. To account for such a possibility, we use industry-level data on NTBs and FDI restriction from Brandt et al. (2017), both of which are binary variables indicating whether there is at least one NTB or FDI restrictions in each four-digit CIC industry. We then weigh industry-level NTBs and FDI restrictions using the 1995 within-prefecture employment share of each industry to construct prefecture-level measures of these two policies. A lower value indicates a lower NTB or a relaxed FDI policy. The results show that individuals from regions with lower NTBs tended to be less likely to work informally while those from regions with lower FDI restrictions were more likely to get an informal job. The coefficient on import tariffs, however, remains robust.

Columns $(4) - (6)$ consider various domestic reforms that may affect the labour market. The first reform is the massive privatisation reform starting from the mid-1990s. The aim of this reform was to keep the largest 1,000 state-owned enterprises and push the remaining to the market through, e.g. merges and acquisitions, and bankruptcies (Meng, 2012). This has led to a large amount of laid-off workers from the state sector, raising labour market competition substantially. In the meantime, entry barriers for new firms have been considerably reduced, especially in regions with less SOE presence (Brandt et al., 2020). This allows the private sector to expand and absorb the majority of the workers who were formerly employed in the state sector. We account for the differential exposures to the privatisation reforms by including the employment share of non-SOEs as an additional control variable. Interestingly, the results show no evidence that prefectures with a higher presence of non-SOEs experienced a differential trend than those with a lower share. This could be because we include the type of individual's workplace in the regression, which essentially ensures that individuals working in the same ownership type of workplace are compared. Not surprisingly, the effects of import tariffs do not change much.

Although employment protection legislation was generally weak during our sample period, China enacted a minimum wage reform in 2004 that has formalised the minimum wage system comprehensively. In response to the increased labour costs due to the stringent minimum wage policy, firms may substitute away from labour to capital, thereby reducing employment growth (Hau et al., 2020), or reduce labour costs by cutting fringe benefits (Long and Yang, 2016). These potential actions might result in an increase in informal employment, since this type of employment is not formally covered by Labour Contract Law. To address this possibility, we collect data on minimum wages at the prefecture level and add minimum wages as an additional control variable. The results in column (5) of Table 5 show a significant correlation between minimum wages and the prevalence of informal employment; individuals from regions

with higher minimum wages had a higher prevalence of working informally. The coefficient on import tariffs keeps significantly negative controlling for minimum wages.

An additional reform during our sample period that may affect the labour market is the college expansion reform starting in 1999, which caused the number of college graduates increase tremendously by almost five-fold until 2008 (Knight et al., 2017). This has created a huge labour supply shock to the market, especially to high-skilled workers, and has raised the unemployment rates of college graduates (Knight et al., 2017). Although the demand of skilled workers has also been increasing due to rapid economic growth, fierce competition in the labour market could still induce college graduates to take up an informal employment relationship. In column (6) of Table 5, we add the share of college graduates in total working-age population in each prefecture, capturing labour supply shocks to the skilled individuals. Prefecture-level shares of college graduates are calculated from the three waves of population census in 1990, 2000, and 2005. The estimation results show a significantly higher prevalence of informal employment related to rising labour supply of college graduates. The effects of import tariffs are robust to the inclusion of the additional control variables.

In sum, the results in Table 5 suggest that the earlier identified effects of import tariffs on informal employment are not confounded by contemporary policy changes.

5.2.3 The role of migration and sampling weights

The local labour market approach assumes no migration across regions. In reality, workers may move to regions experiencing a rising labour demand following trade liberalisation (Facchini et al., 2019), which creates under-estimation of the employment effects of trade liberalisation. Due to the presence of the hukou system, migration across regions is highly costly (Meng, 2012). According to the population census, the share of migrants from other prefectures (including those from other provinces) accounts for merely 2.5% of the working-age population in 1990. This share increased to 8.2% in 2005. The increased share of migrants is related to a hukou reform since the early 2000s in selected prefectures that has relaxed labour mobility barriers from rural to urban areas (Wang et al., 2021). We assess the role of migration in two steps.

Our first step is to exclude migrants from our sample. In column (1) of Table 6, we define rural migrants according to their hukou type and individuals with a rural hukou type are excluded. Notice that this coarse identification approach cannot effectively identify urban migrants from other prefectures, while at the same time it could exclude rural migrants within the same prefectures, who do not essentially invalidate the local labour market approach. Taking

advantage of the rich information on each individual's hukou type in column (2), we exclude workers whose hukou were registered in other counties or cities. There are four hukou types in the data: non-agriculture hukou in the local county or city, non-agriculture hukou in other counties or cities, agriculture hukou in the local county or city, and agriculture hukou in other counties or cities. This excludes both rural and urban migrants from other regions but can also exclude migrants from other counties within the same prefectures.[11] Keeping these caveats in mind, the estimation results based on the two alternative samples show that the coefficient on import tariffs does not change much.

Table 6: Import tariffs and the prevalence of informal employment: The role of migration and sampling weight

Dep. variable:	Urban hukou holders	Natives	+Migrant shares	WLS
Informal worker (=1)	(1)	(2)	(3)	(4)
Import tariffs	-0.0079**	-0.0069**	-0.0087***	-0.0069*
	(0.003)	(0.003)	(0.003)	(0.004)
Migrant shares			0.0014	
			(0.001)	
Individual controls	Yes	Yes	Yes	Yes
Job related controls	Yes	Yes	Yes	Yes
City controls	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes
Dependent mean	0.119	0.137	0.185	0.185
Observations	28,423	29,437	34,130	34,130
R^2	0.280	0.323	0.336	0.316

Notes: This table reports estimation results accounting for the role of migration (columns 1-3) and sampling weight (column 4). Column (1) considers only urban hukou holders, thereby excluding rural migrant workers. Column (2) excludes those from other counties/cities. Column (3) controls for the share of migrants over total working-age population within each prefecture. The share of migrants is calculated based on the 1990, 2000, and 2005 population censuses. Column (4) uses the weighted least squares estimation approach that employs the share of sample size over total population of each prefecture as weights. All specifications include a full set of control variables as in column (4) of Table 3. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

The second step is to include the share of migrants when estimating Equation (2) to account for possible effects of migrants on the local labour market. Prefecture-level migrant shares for the years under investigation are not readily available. We therefore rely on the three waves of the population census in 1990, 2000, and 2005 and calculate the share of migrants from other prefectures in total working-age population of each prefecture, which is then added to the

[11] A county in China refers to an admin 4 level region.

estimation as a proxy for migrant rates of 1995, 2002, and 2007, respectively. Column (3) in Table 6 shows that individuals in regions with a higher share of migrants tended to have a higher average likelihood to be employed informally, though the effect is statistically insignificant. Controlling for migration, the impact of import competition stays essentially the same as the baseline results in Table 3. Overall, these results do not support the presence of migrants being a threat to our identification.

Column (4) of Table 6 considers the weighted least squares (WLS) estimation approach to estimate Equation 2. This addresses the possible uneven distribution of sampled individuals across prefectures. Specifically, we construct an individual-level weight using the ratio of sample size over total population for each prefecture, both of which are calculated based on the working-age population. Due to missing data of working-age population at the prefecture level for the years 1995, 2002, and 2007, we again rely on the population censuses of 1990, 2000, and 2005 and compute working-age population for each prefecture accordingly. The weighted estimation approach assigns a smaller weight to individuals from over-sampled prefectures. The results show that using weights does not alter the main findings much, and we continue to find a negative impact of tariff rates on the prevalence of informal employment.

5.3 Heterogeneous effects

Our main results suggest that import competition induced an increase in informality in the local labour market. Such an overall effect may mask possible heterogeneity across workers with various backgrounds. In this section, we explore heterogeneity of the effect by sector, skill level, gender, and age.

Columns $(1) - (2)$ in Table 7 report estimation results for the tradable and non-tradable sectors separately. This arises from the concern that trade liberalisation directly affects tradable sectors whereas only indirectly affects non-tradable sectors through labour reallocation across sectors, through agglomeration effects, or through input-output linkages (Autor et al., 2013; Dix-Carneiro and Kovak, 2017; Helm, 2020). The estimation results show negative coefficients on import tariffs for both tradable and non-tradable sectors and the magnitude of the effect is larger for tradable sectors. This indicates that the impact of trade liberalisation on informal employment is mainly through the direct effects in tradable sectors while indirect effects in non-tradable sectors overall play a lesser role.

An additional explanation for the relatively weaker effects in non-tradable sectors could be the inclusion of certain industries with a low presence of informal employment, such as government

Table 7: Import tariffs and the prevalence of informal employment: Heterogeneous results

Dep. variable:	Sector		Skill level		Gender	
Informal worker (=1)	(1)	(2)	(3)	(4)	(5)	(6)
	Tradable	Non-tradable	High	Low	Male	Female
Import tariffs	-0.0127***	-0.0076**	-0.0063**	-0.0118***	-0.0077***	-0.0095**
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Job related controls	Yes	Yes	Yes	Yes	Yes	Yes
City controls	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Dependent mean	0.104	0.235	0.138	0.261	0.166	0.209
Observations	11,522	21,374	21,016	13,114	18,454	15,676
R^2	0.213	0.361	0.285	0.377	0.321	0.362

Notes: This table reports estimation results by sector, skill level, and gender. Columns $(1) - (2)$ show results for those working in tradable and non-tradable sectors; columns $(3) - (4)$ distinguish between individuals with high and low skills; columns $(5) - (6)$ distinguish between males and females. Skilled workers are those with high-school education or above. All specifications include a full set of control variables as in column (4) of Table 3. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

and public institutions. To check this possibility, we first decompose our sample by the type of workplace into those working in enterprises, those in individually owned small businesses, and those employed in government and public institutions. The results are set out in Table B.4 in Appendix B. Descriptively, 17% of workers in enterprises are employed informally. This share is the highest in individually owned small businesses, reaching 73%, and the lowest in government and public institutions, which is only 8%. Not surprisingly, import competition increased the prevalence of informal employment only in enterprises and individual businesses whereas those in government and public institutions were not significantly affected. Although the size of the effect on individually owned small businesses is much larger than that on workers in enterprises, it is unlikely that individual businesses play a dominant role given their much smaller sample size.

In Table B.5, we estimate Equation (2) separately for tradable and non-tradable sectors but constrain the sample to those working in enterprises and individually owned small businesses. The results show that workers in both tradable and non-tradable sectors were affected alike with the magnitude of the effect in non-tradable sectors even slightly stronger. This demonstrates that although workers in non-tradable sectors can only be *indirectly* affected by import competition,

the effects could be as strong as those in tradable sectors.

In columns $(3) - (6)$ of Table 7, we report results by skill level and by gender. On average, the shares of informal employment were higher for low-skilled workers and females. Tariff declines raised the likelihood of informal employment for all types of workers, with stronger effects on low-skilled workers and on females. These results coincide with the findings in other countries where low-skilled workers and females are more likely to work informally with import competition (e.g. Ben Yahmed and Bombarda, 2020; Ponczek and Ulyssea, 2021).

In Table B.6 in Appendix B, we also examine possible heterogeneity across age groups. The impact of import tariffs on the prevalence of informal employment is mainly driven by middle-aged workers.

5.4 Understanding the mechanism: Evidence from the perspective of firms

Our baseline results reflect the overall effects of trade liberalisation on informality in the local labour market, including direct effects on workers in the tradable sectors and indirect effects on those working in the non-tradable sectors. In theory, import competition affects firm-level adjustment in the tradable sectors along various margins which subsequently affects informality. First, as a response to increased competition in the market, firms may raise the use of informal relative to formal workers either through transmitting formal workers to informal types or hiring more informal workers as a way to improve competitiveness or even as a strategy to survive (Ulyssea, 2018). This is especially true for low-productivity firms that are not profitable enough to invest in technology. By contrast, high-productivity firms may increase their investment in technology and innovation with higher competitive pressure (Bloom et al., 2016). This subsequently induces production expansion and allows them to employ more formal workers. Trade induced competition may also cause employment changes along the extensive margin, that is, due to less productive formal firms entering the informal sector, or the least productive informal firms exiting the market (Ulyssea, 2018; Dix-Carneiro et al., 2021). While the former increases informality, the latter reduces informality. As a result, the net effects of trade induced competition on informality depend on which channel dominates. In the Chinese context, however, since all firms are required to register, informal employment changes along the extensive margin do not apply.[12] We therefore focus on employment adjustment along the intensive margin, i.e. changes in the share of informal workers within formally registered firms.

[12]Informality could still be affected due to exiting of the least productive firms as they tend to have a higher share of informal workers.

Table 8: Import tariffs and the share of informal employment within firms

Dep. variable:	OLS	2SLS
Informal share (%)	(1)	(2)
Import tariffs	-0.5082***	-0.8063***
	(0.178)	(0.255)
Firm sales (ln)	1.3422***	1.3428***
	(0.233)	(0.233)
Primary sector employment share (%)	0.0118	0.0119
	(0.013)	(0.013)
Secondary sector employment share (%)	-0.0015	-0.0050
	(0.016)	(0.016)
Local GDP (ln)	0.0440	0.2003
	(0.976)	(0.966)
Population (ln)	0.5691	0.4113
	(0.861)	(0.885)
Urbanisation rate (%)	-0.0056	-0.0053
	(0.009)	(0.009)
Constant	17.4195**	
	(7.650)	
Firm FE	Yes	Yes
Region-year FE	Yes	Yes
First-stage SW F-statistics		84.663
Dependent mean (%)	30.892	30.892
Observations	41,910	41,910
R^2	0.983	0.014

Notes: This table reports estimation results using firm-level data. The dependent variable is the share of informal workers in total employment within each firm. Column (1) reports the OLS estimation results and column (2) the 2SLS estimation results, using the maximum allowed tariff rates as the instrument. Both specifications include the natural logarithm of firms' annual sales, deflated to the 2002 level, a set of city controls, firm fixed effects, as well as region-year fixed effects. City controls include the employment shares of the primary and secondary sectors, the log of local GDP, the log of total population, and urbanisation rates. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

In this section, we aim to understand the local labour market effects of informality due to trade liberalisation from the perspective of firms by specifically analysing how firms adjust their worker composition with increased competition. To this end, we use data from the World Bank Enterprises Survey and estimate Equation (3) at the firm level. Different from estimations based on the individual-level data, the outcome variable of firm-level estimations is the share of temporary workers within firms, where temporary workers constitute the pool of informal workers for us. The regression results are reported in Table 8 where column (1) shows the

OLS regression results and column (2) reports the 2SLS results using the maximum allowable tariffs as the instrumental variable.[13] Descriptively, formal enterprises employ 31% temporary workers. Conditional on firm and city characteristics, firms in regions with lower tariff rates tended to raise the share of informal workers. The coefficient estimate in column (2) implies that an average tariff reduction between 2001 and 2004 induced firms to increase the share of informal workers by roughly 4 percentage points (5.193×0.806). This is equivalent to 14% of the average share of informal workers. Unlike in Table 3 where OLS and 2SLS estimates are virtually the same, the difference between the two for firm-level estimations is more distinguishable. This implies that the endogeneity concern of year-on-year tariff changes in this setting is more a problem. We therefore rely on 2SLS estimates in all our firm-level estimations.

In Table B.7 in Appendix B, we regress total employment, as well as formal and informal employment separately on import tariffs to examine changes in employment size.[14] It shows that import tariff cuts increased overall employment size within firms, consistent with recent findings based an alternative firm-level dataset by Rodriguez-Lopez and Yu (2017). Such a positive employment effect, however, is completely driven by the growth of informal employment, as shown in columns (2) and (3). These results reveal that the rise in informal worker shares is attributed to newly hired informal workers rather than shifting formerly employed formal workers to the informal type.[15] This set of results also buttresses an important yet less studied channel of recent findings that trade liberalisation raised aggregated employment in China (e.g., Ma et al., 2015; Rodriguez-Lopez and Yu, 2017; Wang et al., 2020).

In Table 9, we explore heterogeneous responses by ownership type, firm size, and productivity level, aiming to understand whether firms adjusted uniformly to import competition. Columns $(1) - (3)$ show that both SOEs and domestic private firms increased their informal employment share with higher competitive pressure, whereas foreign invested firms did not adjust the share of informal workers. While the strong effects on private firms are easily expected due to their relatively smaller size, the effects on SOEs are less straightforward. One possible explanation is that SOEs, though often benefiting from policy support owning to their close connection to the government, are nevertheless less productive and profitable than private and foreign firms (Brandt et al., 2012; Berkowitz et al., 2017). In addition, formal workers in SOEs are often paid better, receive more generous fringe benefits, and have a stronger bargaining power and much

[13] Here we are not able to use the alternative instrumental variable as in column (6) of Table 3 since our sample is post 2001.

[14] We add 1 to employment before taking logs to account for 0 employment in some cases.

[15] One reason why formal employment size is not significantly affected could be the relatively high firing costs of long-term or permanent contract holders, especially for SOEs (Cooper et al., 2015; Feng and Guo, 2021). It is also likely that hiring and firing occurred simultaneously within firms with higher competitive pressure such that the net employment effect turned insignificant. The data, however, does not allow us to observe hiring and firing separately.

Table 9: Import tariffs and the share of informal employment within firms: Heterogeneity by ownership, size and productivity level

Dep. variable:	Ownership			Size group			Productivity		
Informal share (%)	(1) SOE	(2) Private	(3) Foreign	(4) Small	(5) Medium	(6) Large	(7) Low	(8) Middle	(9) High
Import tariffs	-0.6498**	-0.8076***	0.1301	-1.7549***	-0.1328	-1.1120*	-1.1111**	-0.7973*	-0.4181
	(0.307)	(0.307)	(0.632)	(0.611)	(0.317)	(0.572)	(0.507)	(0.407)	(0.464)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage SW *F*-statistics	58.551	102.577	40.305	70.200	85.738	91.189	63.745	92.560	87.346
Dependent mean (%)	21.877	34.581	28.151	35.225	32.531	23.563	32.153	32.797	26.001
Observations	7,971	25,698	7,778	10,031	21,085	10,737	9,813	21,281	10,816
R^2	0.001	0.018	0.019	0.023	0.009	0.010	0.028	0.009	0.009

Notes: This table reports 2SLS estimation results by ownership type, firm size and productivity level. Firms are classified into three size groups based on their average employment size over the sample period, and into three productivity levels based on their average labour productivity level. Labour productivity is measured as annual sales per worker. The maximum allowable tariff rates are used as the instrumental variable for actual applied import tariffs. All specifications control for the log of firm sales, the employment shares of the primary and secondary sectors, the log of local GDP, the log of total population, urbanisation rates, as well as firm fixed effects and region-year fixed effects. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

higher job stability than other workers (e.g. Yao and Zhong, 2013; Berkowitz et al., 2017; Feng and Guo, 2021),[16] which are all associated with high labour costs (Cooper et al., 2015). These two factors jointly make SOEs less able to compete with foreign imports and consequently more likely to adjust employment along the formal-informal margin to reduce labour costs.

To understand how firms of different ownership types adjusted their formal and informal employment with import competition, we replicate the regressions in Table B.7 for these three types of firms, and the results are set out in panel A of Table B.8 in Appendix B. SOEs tended to raise informal employment while reducing formal employment, though neither is statistically significant. Domestic private firms, however, showed clear evidence of employing more informal workers with import competition. Foreign firms, in contrast, increased the size of formal rather than informal employment.

To further uncover possible heterogeneity across firm sizes and productivity levels, we classify firms into three groups based on their average employment size and repeat the estimation of Equation (3) for the three size groups separately in columns $(4) - (6)$ of Table 9. Consistent with our expectations, the effects on small firms are much stronger than those on medium and large firms. This may be because smaller firms were less productive and were not capable to respond to competition through other means such as investment in technology and innovation. We investigate such a plausibility in columns $(7) - (9)$ where we classify firms based on their average labour productivity into low-, middle-, and high-productivity firms. Labour productivity is simply measured by annual sales per worker. The results display a clear pattern that the effects of import competition on within-firm informal employment shares are the strongest for the least productive firms and decrease monotonically with productivity levels.

Panels B and C of Table B.8 in Appendix B report the effects on formal and informal employment separately by size group and by productivity level. Smaller and less productive firms tended to raise the number of informal workers while reducing the number of formal workers with increased import competition. By contrast, larger and more productive firms appeared to expand both formal and informal employment, yielding much weaker composition effects.

The results in Table 9 and Table B.8 show that smaller and less productive firms tended to reduce labour costs in response to intensified competitive pressure by hiring more informal workers. To understand whether larger and more productive firms adopt a different strategy, we examine the effects of tariff cuts on firms' investment in technology in Table B.9 in Appendix B

[16] Jobs in SOEs were once called the "iron rice bowl" during the planned economy period in China (Berkowitz et al., 2017). Even after the restructuring reform, SOEs still have substantively high costs of laying off redundant workers due to their critical role of maintaining job stability (Cooper et al., 2015; Feng and Guo, 2021).

by size group and by productivity level. We use the log of annual R&D expenditure to measure technology investment. The results show that larger and more productive firms increased their R&D expenditure with lower tariffs while smaller and less productive firms did not do so. Taken together, our findings provide evidence of two alternative ways in which heterogeneous firms respond to import competition.

To summarise, we find consistent evidence based on the firm-level data that import competition increased informality in China. Such effects are predominately attributed to SOEs, domestic private, smaller, and less productive firms.

6 Conclusions

Informal employment is pervasive in the developing world, even exceeding formal employment in many countries. In the meantime, many developing countries have implemented comprehensive trade liberalisation reforms in the last decades. In this paper, we examine the effects of trade liberalisation on informal employment by exploiting China's accession to the WTO as a natural experiment.

We employ both individual-level and firm-level data to establish a causal link between tariff reductions and informality. Using a local labour market approach, we find that individuals from regions that were more exposed to tariff cuts had a higher likelihood of finding themselves in an informal employment relationship. Our preferred estimates imply that an average tariff decline between 1995 and 2007 increased informality by 15 percentage points in the local labour market, equivalent to 48 percent of the rise in informality during our sample period. This finding is robust to alternative measures of informal employment and tariffs, and specifications controlling for contemporary globalisation-related policy changes, various domestic reforms, as well as the effect of migration. Our results also reveal that the trade induced increase in informality is more pronounced in tradable sectors, among low-skilled individuals, and among females.

To understand the mechanisms through which trade liberalisation affects informal labour market, we turn to firm-level analysis and analyse how firms adjust their worker composition in response to import competition. We find that firms significantly increased the share of informal workers on average with intensified import competition. Such effect is stronger for SOEs, domestic private, smaller sized, and less productive firms. These results suggest substantive differences among heterogeneous firms in responding to import competition. Smaller, less productive firms tend to adjust their labour composition along the formal-informal divide to

reduce labour costs as a strategy to compete with foreign imports, whereas more productive firms respond differently by improving investment in technology.

Our findings have important welfare implications. While the expansion of informal employment following trade liberalisation may provide more job opportunities and act as an employment buffer (Ponczek and Ulyssea, 2021; Dix-Carneiro et al., 2021), workers' welfare may be deteriorated as informal workers are often not protected by labour laws, thereby facing inferior working conditions, lower payment, as well as higher job instability. Due to the relatively lower income level of informal workers, the rise of the informal employment share also implies higher aggregated wage inequality, which amplifies the uneven distributional effects of trade liberalisation (Goldberg and Pavcnik, 2007).[17] From the perspective of firms, employing more informal workers may reduce productivity at the firm level and also generate total productivity losses due to resource misallocation to less productive firms (Hsieh and Klenow, 2009; Ulyssea, 2018; Dix-Carneiro et al., 2021). The net effects on workers' welfare and on productivity require formal theoretical modelling and are beyond the scope of this paper. We leave it for future research.

[17] Dix-Carneiro et al. (2021) conclude that trade liberalisation reduces aggregated wage inequality due to export expansion reducing the size of the informal sector.

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Appendix

A Defining informal employment

A.1 Informal employment in the CHIP data

Informal employment is defined based on worker's employment type. All waves of the CHIP survey collected information on each individual's contract type, but the classification of contract types is not uniform across waves. Our main identification of informal employment consists of salaried workers who are temporary and without a work contract and those with a temporary or short-term contract. These two types of employment are reported separately only in later years. Below we show the corresponding questionnaire question and our identification of informal workers for each case.

- 1995 urban sample: Question 29 – Nature (tenure) of primary employment

  1) Permanent worker/employee of an enterprise or institution (including state cadres and civil servants);
  2) Long-term contract worker or employee;
  3) Temporary (including short-term contract) worker;
  4) Private enterprise proprietor or self-employed;
  5) Other.

  Informal workers are those who answered number 3 for this question.

- 2002 urban sample: Question 140 – Employment characteristics

  1) Permanent staff member of enterprise or institution (including cadres and public servant);
  2) Long-term contract worker;
  3) Temporary worker or short-term contract worker;
  4) Employed without contract;
  5) Private businessman or self-employed;
  6) Other.

  Informal workers are those who answered number 3 or 4 for this question.

- 2002 rural-urban migrant sample: Question 125 – Employment characteristics

  1) Permanent staff member of enterprise or institution (including cadres and public servant);
  2) Long-term contract worker;
  3) temporary or short-term contract worker;
  4) Private businessmen or self-employed;
  5) Other.

  Informal workers are those who answered number 3 for this question.

- 2007 urban sample: Question C22 – What is the nature of your current primary job:

  1) Permanent;
  2) Long term contract worker (one year or above);
  3) Short term contract worker (less than one year);
  4) Non-contract casual;
  5) Family workers without pay
  6) Self-employed;
  7) Temporary job;
  8) Other (Please specify).

  Informal workers are those who answered number 3, 4, 5, or 7 for this question.[A.1]

- 2007 rural-urban migrant sample: Question C108 – The nature of your current primary job:

  1) Permanent;
  2) Long term contract worker (one year and above);
  3) Short term contract worker (less than one year);
  4) Non-contract casual;
  5) Family workers without pay
  6) Self-employed;
  7) Temporary job;

[A.1] We consider family workers (category 5) as informal ones, though they do not receive salaries. There are 13 individuals providing this answer.

8) Other (Please specify).

Informal workers are those who answered number 3, 4, 5, or 7 for this question.

Table A.1 shows the share of workers by contract type for each of the above sample.

Table A.1: Share of workers by contract type

	1995	2002		2007	
	(1)	(2)	(3)	(4)	(5)
	Urban	Urban	Migrant	Urban	Migrant
Permanent or long-term contract	0.925	0.703	0.052	0.715	0.374
Short-term contract		0.111		0.063	0.086
No contract		0.073		0.105	0.314
Short-term contract or no contract	0.028		0.246		
Self-employed	0.014	0.067	0.639	0.076	0.225
Other	0.034	0.047	0.063	0.041	0.002
N	12,971	10,376	3,491	7,413	7,061

Notes: This table shows the share of workers aged 15-64 by contract type for each CHIP survey sample.

We define informal workers alternatively by excluding workers with a temporary or a short-term contract. Due to the 1995 urban sample and the 2002 migrant sample combining them with workers without a contract in one group, we are able to do this only for the 2002 urban sample and the 2007 sample.

Considering that the literature often defines the self-employed as informal workers, we test the robustness of our main finding by including them in the informal worker pool. However, since all business units in China including the self-employed are required to register with local authorities, we prefer excluding them from the sample. As shown in Table 6 in the main text, our main finding is robust to the two alternative definitions of informal employment.

A.2 Informal employment in the World Bank Investment Climate Survey data

The World Bank Investment Climate Survey 2003 classified workers by contract type into two categories: 1) permanent workers; 2) temporary workers, interns/apprentices/seasonable workers and collected information on the number of each type at the end of 2001 and 2002 for each firm (question C2 in the questionnaire). We consider the second category as informal workers.

The World Bank Investment Climate Survey 2005 classified workers by contract type into two

categories: 1) permanent workers; 2) peasant workers or temporary workers. It collected information on the share of each type in 2002, 2003, and 2004 for each firm (question C1 in the questionnaire). We consider the second category as informal workers.

B Additional figures and tables

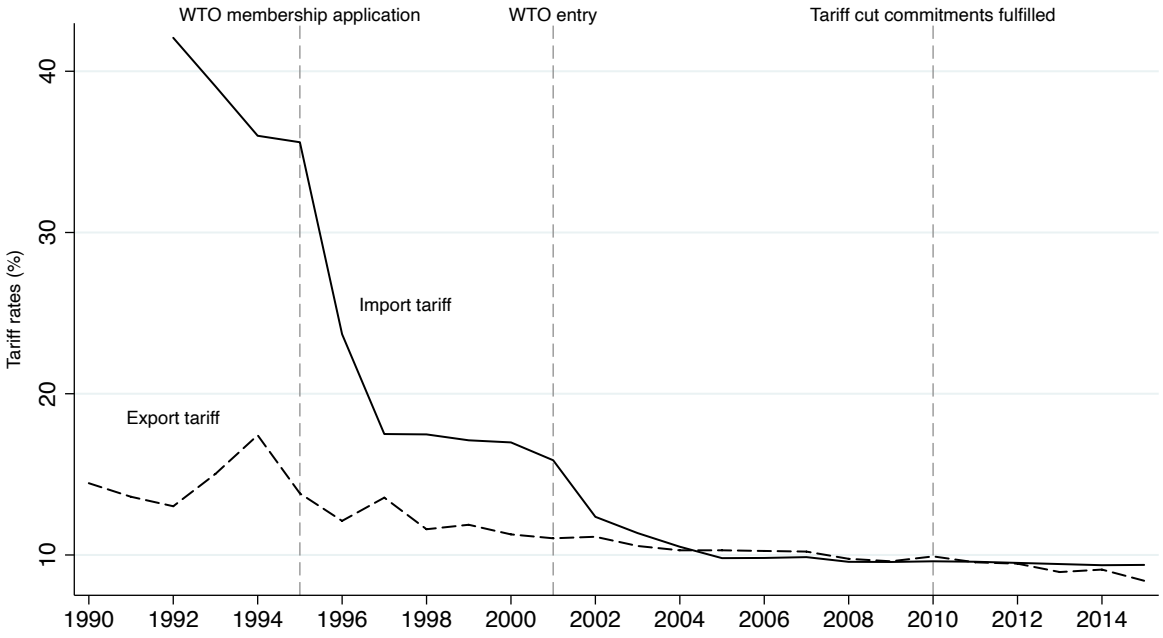
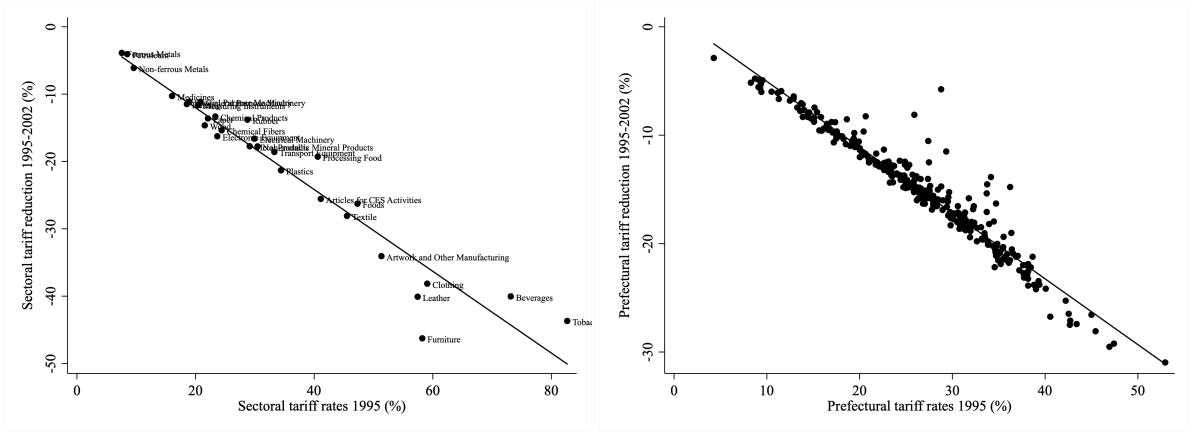


Figure B.1: Average tariff rates in China: 1990-2015

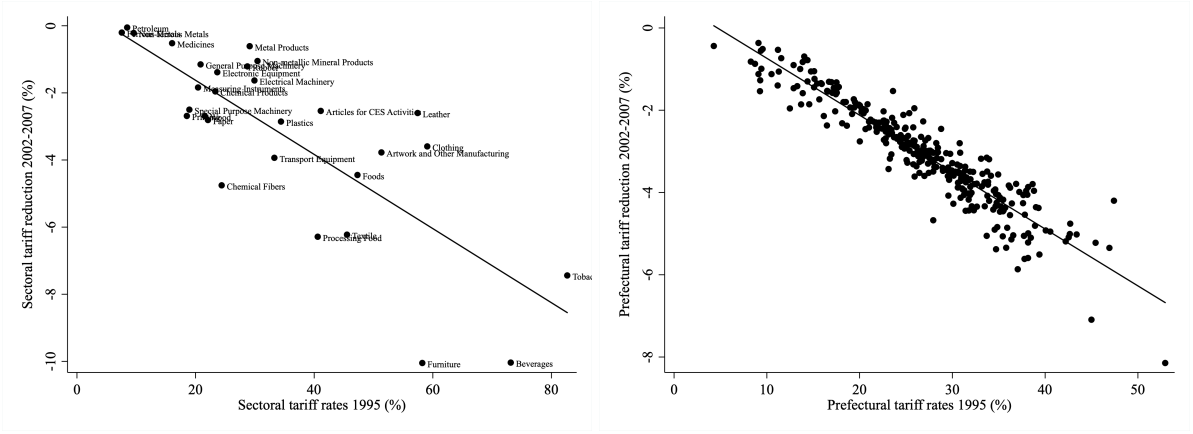
Notes: This figure shows average import tariffs and export tariffs between 1990 and 2015. Average tariffs are calculated over tariff rates at HS 6-digit product level collected from the WITS.



(a) Tariffs at two-digit industry level (b) Tariffs at prefecture level

Figure B.2: Import tariff declines (1995-2002) and initial tariff rates in China

Notes: The two figures show scatter plots of import tariff declines between 1995 and 2002 against initial tariff rates at the two-digit CIC industry level (left) and at the prefecture level (right). Industry-level tariff rates are calculated based on the product-level data obtained from the WITS. Prefecture-level tariff rates are calculated according to Equation (1).



(a) Tariffs at two-digit industry level (b) Tariffs at prefecture level

Figure B.3: Import tariff declines (2002-2007) and initial tariff rates in China

Notes: The two figures show scatter plots of import tariff declines between 2002 and 2007 against initial tariff rates at the two-digit CIC industry level (left) and at the prefecture level (right). Industry-level tariff rates are calculated based on the product-level data obtained from the WITS. Prefecture-level tariff rates are calculated according to Equation (1).

Table B.1: Summary statistics of variables

	Mean	SD	Min.	Max.
Individual-level variables				
Informal worker (=1)	0.185	0.389	0.000	1.000
Female (=1)	0.459	0.498	0.000	1.000
Age	39.070	10.968	15.000	64.000
Education level				
Primary school or below	0.070	0.255	0.000	1.000
Middle school	0.314	0.464	0.000	1.000
High school	0.346	0.476	0.000	1.000
College or above	0.270	0.444	0.000	1.000
Marriage status				
Single	0.161	0.367	0.000	1.000
Married	0.820	0.384	0.000	1.000
Divorced or widowed	0.018	0.133	0.000	1.000
Others	0.001	0.032	0.000	1.000
Minority (=1)	0.029	0.167	0.000	1.000
Household head (=1)	0.497	0.500	0.000	1.000
Rural hukou (=1)	0.167	0.373	0.000	1.000
Household size	2.991	0.999	1.000	8.000
With children at 6 or below (=1)	0.138	0.345	0.000	1.000
Blue collar (=1)	0.523	0.499	0.000	1.000
Industry affiliation				
Agriculture	0.012	0.108	0.000	1.000
Industry	0.326	0.469	0.000	1.000
Construction	0.046	0.209	0.000	1.000
Information and transportation	0.062	0.241	0.000	1.000
Merchandise and catering	0.160	0.366	0.000	1.000
Real estate and finance	0.048	0.214	0.000	1.000
Other services	0.311	0.463	0.000	1.000
Others	0.036	0.187	0.000	1.000
Workplace type				
Government and public institutions	0.279	0.448	0.000	1.000
State-owned and collective enterprises	0.451	0.498	0.000	1.000
Foreign enterprises and joint ventures	0.029	0.169	0.000	1.000
Domestic private enterprises	0.148	0.355	0.000	1.000
Individually owned small businesses	0.066	0.249	0.000	1.000
Others	0.027	0.163	0.000	1.000
City-level variables				
Import tariffs (1995 weight, %)	18.638	9.717	6.699	42.704
Maximum allowable tariffs (%)	18.559	9.397	4.602	41.408
Import tariffs (1990 weight, %)	20.666	9.445	9.311	40.496
Export tariffs (%)	5.382	1.542	1.697	12.401
NTBs	0.125	0.098	0.002	0.383
FDI restriction	0.203	0.102	0.031	0.492
Employment share: primary sector (%)	21.669	24.448	0.120	79.250
Employment share: secondary sector (%)	36.353	13.008	5.510	66.420
Local GDP (ln)	15.023	1.284	11.738	18.401
Population (ln)	6.060	0.762	3.379	8.082
Urbanisation rate (%)	33.659	19.082	0.000	100.000
Non-SOE employment share (%)	32.357	25.494	0.240	89.944
Minimum wages (ln)	5.452	0.364	4.862	6.390
College graduate share (%)	4.380	4.224	0.097	19.798

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Table B.1 – continued from previous page

	Mean	SD	Min.	Max.
Migrant share (%)	13.892	15.427	0.733	87.615
Firm-level variables				
Informal employment share (%)	30.892	41.189	0.000	100.000
Employment (ln)	5.479	1.505	0.000	13.502
Formal employment (ln)	4.419	2.377	0.000	13.502
Informal employment (ln)	2.082	2.577	0.000	10.610
Firm sales (ln)	10.502	2.180	0.000	18.862
R&D expenditure (ln)	3.210	3.515	0.000	15.246
Ownership type				
SOE	0.192	0.394	0.000	1.000
Domestic private	0.620	0.485	0.000	1.000
Foreign	0.188	0.390	0.000	1.000
Size group				
Small	0.240	0.427	0.000	1.000
Middle	0.504	0.500	0.000	1.000
Large	0.257	0.437	0.000	1.000
Productivity level				
Low	0.234	0.423	0.000	1.000
Middle	0.508	0.500	0.000	1.000
High	0.258	0.438	0.000	1.000

Notes: Table shows summary statistics of variables that are used in this paper. The number of observations at the individual level is 34,130, 126 at the city level, and 41,910 at the firm level. Data at the individual level is from the China Household Income Project (CHIP) 1995, 2002, and 2007; data at the city level is from authors' own calculation based on data collected from various sources; data at the firm level is from the World Bank Enterprises Survey 2003 and 2005 waves.

Table B.2: Import tariffs and the prevalence of informal employment: Full results of the baseline estimation

	(1)
Import tariffs	-0.0083***
	(0.003)
Female (=1)	0.0309***
	(0.006)
Age	-0.0079***
	(0.002)
Age squared	0.0001***
	(0.000)
Education level (Reference: Primary school or below)	
Middle school	-0.0490***
	(0.010)
High school	-0.0715***
	(0.011)
College or above	-0.1053***
	(0.013)
Marriage status (Reference: Single)	
Married	-0.0357***
	(0.010)
Divorced or widowed	-0.0073
	(0.018)
Others	-0.0177
	(0.081)
Minority (=1)	0.0049
	(0.012)
Household head (=1)	-0.0255***
	(0.004)
Rural hukou (=1)	0.1139***
	(0.023)
Household size	0.0133***
	(0.004)
With children at 6 or below (=1)	-0.0088
	(0.007)
Blue collar (=1)	0.0723***
	(0.007)
Industry affiliation (Reference: Agriculture)	
Industry	-0.0207*
	(0.012)
Construction	0.1330***
	(0.025)
Information and transportation	0.0017
	(0.011)
Merchandise and catering	0.0702***
	(0.014)
Real estate and finance	0.0559***
	(0.015)
Other services	0.0529***
	(0.015)
Others	0.0197

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Table B.2 – continued from previous page

	(1)
	(0.013)
Workplace type (Reference: Government and public institution)	
State-owned and collective enterprises	-0.0043
	(0.007)
Foreign enterprises and joint ventures	0.0875**
	(0.037)
Domestic private enterprises	0.2035***
	(0.020)
Individual businesses	0.4490***
	(0.034)
Others	0.2513***
	(0.025)
Primary sector employment share (%)	0.0009
	(0.001)
Secondary sector employment share (%)	0.0021
	(0.001)
Local GDP (ln)	0.1458***
	(0.045)
Population (ln)	-0.1753***
	(0.055)
Urbanisation rate (%)	-0.0041**
	(0.002)
Constant	-0.7287**
	(0.355)
City FE	Yes
Region-year FE	Yes
Observations	34,130
R^2	0.336

Notes: Dependent variable indicates whether one works as an informal worker. Robust standard errors clustered at the city-year level are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table B.3: Import tariffs and the prevalence of informal employment: First-stage estimation results

Dep. variable:	Instrument 1	Instrument 2
Import tariffs	(1)	(2)
Maximum allowed tariffs	0.8989***	
	(0.020)	
Tariffs in 1995× Post 2001		-0.6492***
		(0.030)
Individual controls	Yes	Yes
Job related controls	Yes	Yes
City controls	Yes	Yes
City FE	Yes	Yes
Region-year FE	Yes	Yes
Observations	34,130	34,130
R^2	1.000	0.998

Notes: This table reports the first-stage estimation results of columns (5) and (6) in Table 3. The instrumental variable in column (1) is the maximum allowable tariffs and in column (2) is the initial tariffs times a post 2001 dummy. Both specifications include a full set of control variables as well as city fixed effects and region-year fixed effects as in Table 3. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

Table B.4: Import tariffs and the prevalence of informal employment: Heterogeneity across workplace type

Dep. variable:	Enterprises	Individual businesses	Government and institutions
Informal worker (=1)	(1)	(2)	(3)
Import tariffs	-0.0116***	-0.1789**	-0.0037
	(0.004)	(0.069)	(0.004)
Individual controls	Yes	Yes	Yes
Job related controls	Yes	Yes	Yes
City controls	Yes	Yes	Yes
City FE	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes
Dependent mean	0.165	0.733	0.080
Observations	21,429	2,251	9,506
R^2	0.229	0.141	0.185

Notes: This table reports estimation results by workplace type. Columns $(1) - (3)$ correspond to samples of those working in enterprises, individually owned small businesses, and government and public institutions, respectively. All specifications include a full set of control variables as in column (4) of Table 3. Robust standard errors clustered at the city-year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table B.5: Import tariffs and the prevalence of informal employment: Heterogeneity between tradable and non-tradable sectors for those working in enterprises

Dep. variable:	Tradable	Non-tradable
Informal worker (=1)	(1)	(2)
Import tariffs	-0.0164***	-0.0182***
	(0.002)	(0.005)
Individual controls	Yes	Yes
Job related controls	Yes	Yes
City controls	Yes	Yes
City FE	Yes	Yes
Region-year FE	Yes	Yes
Dependent mean	0.117	0.297
Observations	9,262	13,602
R^2	0.156	0.311

Notes: This table reports estimation results for those working in tradable and non-tradable enterprises. All specifications include a full set of control variables as in column (4) of Table 3. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

Table B.6: Import tariffs and the prevalence of informal employment: Heterogeneous results by age group

Dep. variable:	15-25	26-35	36-45	46-55	56-64
Informal worker (=1)	(1)	(2)	(3)	(4)	(5)
Import tariffs	-0.0038	-0.0085**	-0.0088**	-0.0119***	-0.0074
	(0.006)	(0.004)	(0.004)	(0.003)	(0.007)
Individual controls	Yes	Yes	Yes	Yes	Yes
Job related controls	Yes	Yes	Yes	Yes	Yes
City controls	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes
Dependent mean	0.379	0.193	0.151	0.140	0.090
Observations	4,664	8,223	11,308	7,395	2,531
R^2	0.270	0.337	0.382	0.317	0.372

Notes: This table reports estimation results by age group. All specifications include a full set of control variables as in column (4) of Table 3. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

Table B.7: Import tariffs and firm-level employment

Dep. variable:	Total	Formal employment	Informal employment
ln(employment+1)	(1)	(2)	(3)
Import tariffs	-0.0282**	-0.0007	-0.0670***
	(0.011)	(0.015)	(0.020)
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes
First-stage SW F-statistics	84.663	84.663	84.663
Dependent mean	5.479	4.419	2.082
Observations	41,910	41,910	41,910
R^2	0.162	0.030	0.026

Notes: This table reports the 2SLS estimation results of firm-level employment on prefecture-level tariff rates. Dependent variables in columns $(1) - (3)$ distinguish between total employment, formal employment, and informal employment, all in logs. We add 1 to employment before taking logs to account for 0 employment in some cases. All specifications control for the log of firm sales, the employment shares of the primary and secondary sectors of each prefecture, the log of local GDP, the log of total population, urbanisation rates, as well as firm fixed effects and region-year fixed effects. Robust standard errors clustered at the city-year level are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table B.8: Import tariffs and firm-level employment: Heterogeneity across firm groups

Dep. variable:	Formal employment			Informal employment		
ln(employment+1)	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Ownership	SOE	Private	Foreign	SOE	Private	Foreign
Import tariffs	0.0266	0.0065	-0.0544*	-0.0384	-0.0652***	-0.0332
	(0.018)	(0.020)	(0.030)	(0.024)	(0.021)	(0.050)
First-stage SW *F*-statistics	58.551	102.577	40.305	58.551	102.577	40.305
Dependent mean	4.868	4.153	4.823	1.613	2.242	2.057
Observations	7,971	25,698	7,778	7,971	25,698	7,778
R^2	0.010	0.032	0.041	0.002	0.037	0.023
Panel B: Firm size	Small	Medium	Large	Small	Medium	Large
Import tariffs	0.0503**	-0.0254	-0.0425	-0.0456*	-0.0609***	-0.1413**
	(0.022)	(0.020)	(0.035)	(0.027)	(0.019)	(0.064)
First-stage SW *F*-statistics	70.200	85.738	91.189	70.200	85.738	91.189
Dependent mean	2.637	4.222	6.479	1.532	2.221	2.324
Observations	10,031	21,085	10,737	10,031	21,085	10,737
R^2	0.028	0.034	0.037	0.049	0.029	0.014
Panel C: Firm productivity	Low	Middle	High	Low	Middle	High
Import tariffs	0.0483*	-0.0032	-0.0422	-0.0581*	-0.0756**	-0.0331
	(0.025)	(0.021)	(0.028)	(0.031)	(0.033)	(0.033)
First-stage SW *F*-statistics	63.745	92.560	87.346	63.745	92.560	87.346
Dependent mean	4.035	4.411	4.781	2.032	2.230	1.839
Observations	9,813	21,281	10,816	9,813	21,281	10,816
R^2	0.011	0.037	0.069	0.048	0.022	0.016
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports 2SLS estimation results of firm-level formal and informal employment (in log) on prefecture-level tariff rates by ownership, size group and productivity level. We add 1 to employment before taking logs to account for 0 employment in some cases. Firms are classified into three size groups based on their average employment size over the sample period, and into three productivity levels based on their average labour productivity level. Labour productivity is measured as annual sales per worker. The maximum allowable tariff rates are used as the instrumental variable for the actual applied import tariffs. All specifications control for the log of firm sales, the employment shares of the primary and secondary sectors of each prefecture, the log of local GDP, the log of total population, urbanisation rates, as well as firm fixed effects and region-year fixed effects. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.

Table B.9: Import tariffs and firm-level R&D expenditure

Dep. variable:	Size group			Productivity level		
ln(R&D expenditure+1)	(1)	(2)	(3)	(4)	(5)	(6)
	Small	Medium	Large	Low	Middle	High
Import tariffs	-0.0498	-0.0834	-0.1230	-0.0483	-0.0608	-0.2113***
	(0.038)	(0.053)	(0.087)	(0.051)	(0.047)	(0.075)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes
First-stage SW F-statistics	76.526	98.790	101.788	82.206	103.608	95.881
Dependent mean (%)	1.304	2.716	5.725	1.748	3.208	4.351
Observations	9,675	21,356	10,801	9,698	21,395	10,796
R^2	0.015	0.021	0.027	0.028	0.016	0.022

Notes: This table reports 2SLS estimation results of firm-level annual R&D expenditure (in log) on prefecture-level tariff rates by size group and by productivity level. We add 1 to R&D expenditure before taking logs to account for 0 values in some cases. Firms are classified into three size groups based on their average employment size over the sample period, and into three productivity levels based on their average labour productivity level. Labour productivity is measured as annual sales per worker. The maximum allowable tariff rates are used as the instrumental variable for the actual applied import tariffs. All specifications control for the log of firm sales, the employment shares of the primary and secondary sectors of each prefecture, the log of local GDP, the log of total population, urbanisation rates, as well as firm fixed effects and region-year fixed effects. Robust standard errors clustered at the city-year level are in parentheses. * p <0.1, ** p <0.05, *** p <0.01.