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Labour Market Reform and Firm-level Employment Adjustment: Evidence from the Hukou Reform in China

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Abstract

This paper empirically investigates whether the nature of firm-level employment adjustment is affected by the flexibility of the labour market. Specifically, we take advantage of differences in local labour market conditions created by the non-uniform implementation of the hukou reform in China. Variations in the implementation across cities and time allow us to identify the employment effects of the reform by comparing firms in regions with hukou reform to those in regions without. Combining firm-level data and city-level hukou reform data from 1998 to 2007, we adopt a difference-in-differences approach to address this question. The empirical results show that firms exposed to the hukou reform have higher employment adjustment rates on average than similar firms without reform, indicating that an increase in labour market flexibility allowed more employment adjustment. We also find evidence that tariff reductions are associated with greater employment adjustment in reform than non-reform cities.

Keywords: Labour market reform; Hukou; Employment adjustment; Trade liberalisation

JEL classification: D22; J42; J61; F16

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1 Introduction

In a well-functioning economy, firms are able to adjust factors of production freely in response to shocks to achieve a more efficient resource allocation. Recent empirical evidence suggests that misallocation exits broadly, especially in developing countries, which generates considerable productivity losses (Hsieh and Klenow, 2009; Brandt et al., 2013).[1] One critical source of such misallocation relates to factor market distortions, as modelled in Hsieh and Klenow (2009). While existing papers mainly focus on measuring the magnitude of misallocation and the resulting productivity losses, limited evidence is available on the way in which distortions affect economic adjustment. It is documented in the literature that labour market adjustment in response to shocks is often sluggish; possibly due to labour market regulations that impede labour movement across firms, industries or regions (e.g. Hasan, 2001 and Mouelhi, 2007). Micro-level evidence on how labour market flexibility affects firms' employment adjustment is, however, relatively scarce.

A recent strand of literature examines the impact of China's rise on firms and local labour market outcomes in both developing and developed countries.[2] However, relatively little is known about labour market adjustment in Chinese firms, particularly in light of various reforms and drastic economic growth in the late 1990s and 2000s. The aim of this paper is to examine employment adjustment at the firm level and in particular how such adjustment was affected by labour market conditions.

The Chinese labour market has traditionally been highly rigid, featuring a household registration system (or hukou system) that segregated the labour market into rural and urban sectors. A typical resident was registered as a certain hukou type in a region, which made the movement across agricultural and non-agricultural sectors and across regions difficult since social welfare, like medical care, children's education, was based on the hukou. Such rural-urban migration barriers have resulted in substantial labour misallocation (Meng, 2012; Brandt et al., 2013); labour surplus in the rural sector and labour shortage in the urban sector coexisted and yielded a wage gap between rural and urban areas.[3] These barriers to mobility have meant that firms in urban areas have been less able to reach the desired level of employment due to restricted labour supply and relatively high labour costs.

[1] Restuccia and Rogerson (2013) offer a comprehensive review of the recent literature that study misallocation and productivity.

[2] Autor et al. (2013) and Dauth et al. (2014) explore the effects of import competition from China on the local labour market in the U.S. and in Germany separately. Mion and Zhu (2013) and Bloom et al. (2016) examine firm-level adjustment in employment, skill upgrading, innovation and productivity with rising Chinese import competition in Belgium and European countries. Utar and Ruiz (2013), however, focus on the third-country competition effects and investigate the impact of intensified competition from China on Mexican maquiladoras in the U.S. market.

[3] China had one of the highest urban-rural income ratios in the world prior to our study period. Sicular et al. (2008) estimate that the urban-rural income ratio in China was 3.11 in 1995. This ratio for other Asian countries was below 2 during the same period, with the exception of the Philippines for whom the urban-rural income ratio was 2.17 which is still low in comparison (Eastwood and Lipton, 2004).

To address the segregation of the labour market, a hukou reform was launched in 2001 in selected cities. The aim was to abolish the distinction between rural and urban hukou types and to encourage labour movements from rural to urban areas. To achieve it, local governments in selected cities have taken specific actions to lower barriers to mobility and to attract rural workers. Such a policy change can be translated as a positive labour supply shock to the urban labour market allowing more rural workers to move to the urban area. It allowed firms in reform cities to have access to a larger pool of less expensive labour and to adjust employment more flexibly compared to those in non-reform areas. Figure 1 shows the estimated difference in non-agriculture population in urban areas between reform and non-reform cities across years relative to the difference in 1998. It is evident that the difference is not significantly different from zero until 2001 when the first cities adopted the hukou reform, whereas afterwards the share of non-agriculture population is significantly higher in reform cities compared to non-reform cities, with the difference even increasing over the years. This increase in labour supply might be expected to slow down the average rate of wage increases in reform cities below what it would otherwise have been, given the prevailing upward pressures on productivity and wages from technology improvements, increased demand in home and export markets and increased competitiveness of market conditions. This in turn would tend to increase overall and average firm-level employment, but the response of individual firms is less clear cut. Some firms may well have been output-constrained by labour shortages (overall and/or of specific skills) and responded immediately to the hukou reform by hiring additional workers. Other firms, however, may have been hoarding labour in the face of overall labour shortages pre-form, and responded to the greater availability of labour by releasing hoarded labour. While some firms may have built-up a mis-match between skills recruited and actually needed pre-reform, and faced with more flexible labour market conditions may have shed some labour before recruiting more suitably skilled labour. At the firm level, therefore, one may expect the hukou reform to increase employment adjustment in both directions in the reform cities.

The implementation of the reform in some but not all cities offers a basis for a quasi-natural experiment that enables us to evaluate the extent to which differences in labour market conditions between reform and non-reform cities affect firms' employment adjustment, provided that we can account for the selection of cities that have implemented the reform in our empirical strategy. Relying on a rich firm-level dataset, this study provides the first micro-level empirical evidence on firms' employment adjustment conditional on differential labour market conditions, which has so far only been investigated theoretically in the existing literature (e.g. Itskhoki and Helpman, 2015; Coşar et al., 2016).

In this paper, we seek to establish a causal relationship between employment adjustment and the hukou reform. One challenge in doing so is the potential endogeneity of the reform. Specifically, reform cities may not have been randomly selected and those selected reform cities might be systematically different from non-reform ones. If the determinants of the hukou reform are correlated with firms' employment adjustment, our empirical results would be misleading. To address the endogeneity issue, we adopt a difference-in-differences (DiD)

approach and control for initial differences between reform and non-reform cities that potentially determined the selection of reform cities in our main specification.

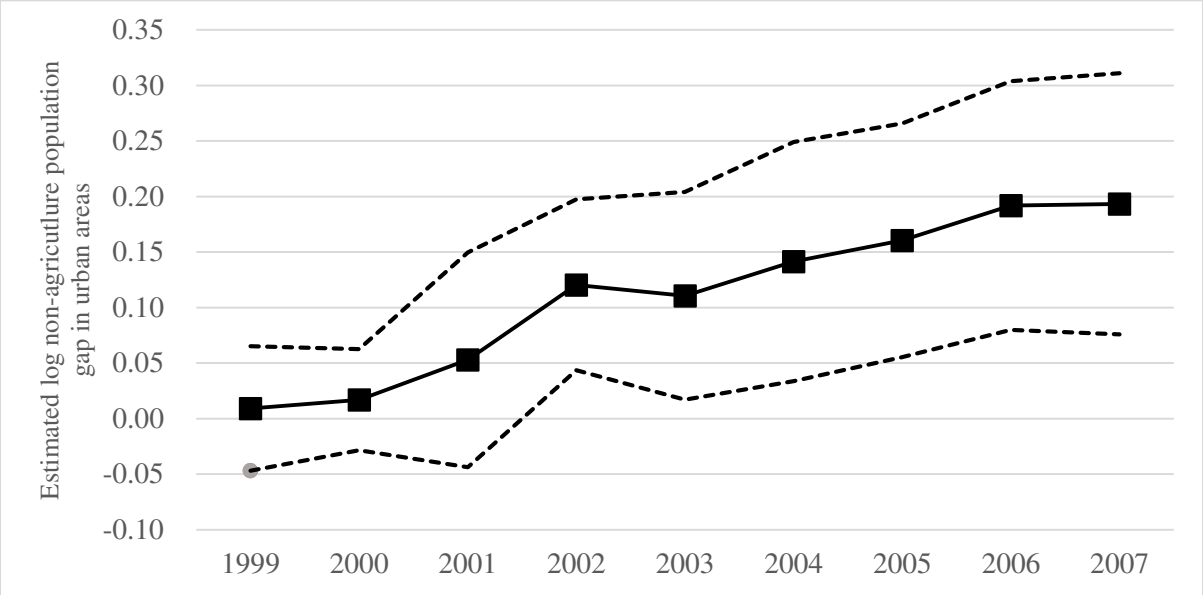


Figure 1 Difference in Urban Non-Agriculture Population between Reform and Non-Reform Cities: 1999-2007

Notes: Estimated coefficients (β_t) and 95 percent confidence interval from the regression: $\ln pop_{ct} = \alpha + \beta_t Reform_c \times \theta_t + \varphi_c + \theta_t + \varepsilon_{ct}$, where pop_{ct} is the log of non-agriculture population in urban areas in city c in year t, $Reform_c$ is a dummy variable indicating whether city c is a reform city, θ_t denotes year fixed effects, φ_c indexes city fixed effects and ε_{ct} is the error term. β_t measures the difference in urban non-agriculture population between reform and non-reform regions relative to the difference in 1998. City-level urban non-agriculture population is from various issues of the *China City Statistical Yearbook*.

Our main results show a positive effect of the hukou reform on net employment adjustment at the firm level; a more flexible labour market allowing firms to adjust their labour use in response to shocks more efficiently, as predicted by recent theories (Itskhoki and Helpman, 2015; Coşar et al., 2016). This finding is also consistent with recent studies on resource misallocation due to factor market distortions such as Hsieh and Klenow (2009) and Brandt et al. (2013) and implies that firms would have achieved higher productivity and output levels without the hukou system.

We further extend our analysis by considering trade liberalisation as a specific exogenous shock to evaluate the role of the hukou reform in shaping firms' employment adjustment. The empirical results suggest that firms in reform regions responded more strongly to reduced tariff rates in terms of employment adjustment than those in non-reform regions. This provides additional supportive evidence for our main finding that a more flexible labour market is associated with easier employment adjustment for firms.

The contribution of this paper to the existing literature is twofold. Firstly, the hukou system in China is a unique form of labour market regulations and is crucial to understand the Chinese labour market and economic growth. Existing studies have documented that the hukou system

has generated considerable barriers to labour mobility and factor misallocation and has therefore induced productivity losses in the non-agriculture sector (Brandt et al., 2013), a productivity gap between agriculture and non-agriculture sectors (Ngai et al., 2019), and large regional income disparities (Whalley and Zhang, 2007). Reducing migration costs would benefit the economy from, for instance, raising employment (Zi, 2019), increasing productivity (Tombe and Zhu, 2019), reducing trade-induced inequality (Fan, 2019), and smoothing consumption volatility for rural households (Kinnan et al., 2015). Most studies, however, have concentrated on aggregate analysis. Yet, little is known about how firms are affected by the hukou system and how a relaxation of the system would influence individual firm's adjustment. The high-quality firm-level data we use in this paper spans a period during which the Chinese government implemented comprehensive economic reforms that generated substantial shocks to firms. The non-uniform implementation of the hukou reform well equips us to gauge firms' differential responses to such shocks, conditional on labour market flexibility, which thereby contributes to a better understanding of the micro foundation of the aggregate effects of the hukou system. To the best of our knowledge, this paper is the first to provide empirical evidence on how the hukou reform has affected firms' employment decisions.

Second, existing studies have examined the effects of various forms of labour market institutions on firm-level outcomes in both developed and developing countries, such as dismissal protection (Autor et al., 2007; Hasan et al., 2007), trade unions (Montagna and Nocco, 2013), minimum wages (Mayneris et al., 2018), and heterogeneous enforcement of labour regulations (Almeida and Poole, 2017). The hukou reform exploited in this paper differs from these regulations in the sense that it affects firms indirectly through shaping local labour market conditions, whereas the above regulations are directly targeted at firms. This paper contributes to this strand of literature by providing additional, distinctive evidence on China and improves the understanding whether firms may adjust differently when confronting different labour market conditions.

The rest of the paper proceeds as follows. In the next section, we provide more background information on China's hukou system and the hukou reform. Section 3 presents relevant theories and empirical evidence. Details of the data and the sample frame used in this paper are described in Section 4. Section 5 discusses the empirical methodology and possible identification issues, followed by the empirical results that are reported in Section 6. Finally, Section 7 concludes.

2 Policy Background: Hukou Reform and Internal Migration

In the early stages of China's planned economic system, labour mobility was highly controlled by the government through a household registration (or hukou) system. This system divided residents into agricultural and non-agricultural population based on occupation, and into rural and urban population according to birthplace. Movements between rural and urban areas, and between agriculture and non-agricultural sectors were prohibited or subject to control. This

segmentation resulted in average wages being much higher in urban than in rural areas. To pursue higher wages, many rural residents wanted to move into cities, but such movement was costly (Zhao, 1999). Labelled as rural residents by their hukou status, migrant workers were allowed to work only in specific urban industries and were prevented from working in state-owned enterprises (SOEs) to limit competition with urban workers (Démurger et al., 2009). Migrant workers were also unable to obtain housing, medical care, and educational resources, which made it difficult for them to move into cities with the whole family. The high migration costs distorted the matching efficiency between firms and workers, which potentially restricted firms' decisions on choosing the optimal level of employment and slowed down their adjustment in the face of shocks.

These regulations were not changed until the late 1980s, when it became possible to purchase an urban hukou, though the total number of purchasable urban hukous in each province was constrained by a quota. A pilot reform in 1997 allowed rural residents to move into selected towns and small cities. However, this reform had limited effects as these towns and small cities were less attractive to rural residents. To promote labour movements from rural to urban areas, a new round of hukou reforms was started since late 2001 in selected prefectural cities by which the distinction between agricultural and non-agricultural hukou types has been abolished and the planned quotas have been replaced with entry conditions for granting a unified hukou.[4] This round of hukou reforms has increased the probability of obtaining a hukou in a city and has attracted surplus rural workers, which directly increased labour supply in the urban labour market.

Although we are unable to directly observe the labour supply to individual cities, we are able to provide indicative evidence of a positive labour supply effect post-hukou reform in the reform cities. Table 1 records the average share of working age (15-64) urban residents and migrants in the populations of reform and non-reform cities in 2000 (pre-reform) and 2005 (post-reform); with reform prefectures experiencing greater increases in urbanised population and in the share of migrants in urban population than non-reform prefectures.

Table 1 Average Urban Population Share and Migrant Share (2000 and 2005)

	Panel A: Urban population share (%)			Panel B: Migrant share (%)		
Type	2000	2005	Change	2000	2005	Change
Reform Cities	42.14	51.42	+ 9.28	7.89	11.09	+ 3.20
Non-reform Cities	37.25	43.77	+ 6.53	5.00	6.20	+ 1.20

Notes: Panel A shows the average urban population share in total prefectural population (aged 15-64); Panel B shows the average migrant share in total urban population (aged 15-64). Reform cities are those that implemented the hukou reform between 2001 and 2004. Data sources: 1% sample of the population census 2000 and the mini population census 2005.

[4] Strictly speaking, there were two main types of hukou reforms. The "Entry Barriers" reform involved an entry-condition scheme, whereby rural residents were eligible to apply for a local hukou and to benefit from local social welfare. Rural residents who a) have a legal and fixed residence, and b) have a stable income source in the urban area qualify to apply for a local hukou. The "Unified Hukou" reform allowed new residents to be registered as unified resident hukou holders, thereby eliminating the distinction between agricultural (urban) and non-agricultural (rural) hukou types. While some cities only enacted one of the above two types of reform, more cities conducted both at the same time.

Theoretically speaking, the increased labour supply would have resulted, other things constant, in a lower average wage and a higher level of employment overall in the urban labour market. However, over the time period we examine, China also experienced dramatic technological change and economic growth (Brandt et al., 2012) due to a series of internal reforms and trade openness (Autor et al., 2013). These sources of upward pressure on wages are likely to have swamped any downward pressure on wages associated with the hukou reform. With access to a larger pool of labour, firms are able to adjust their employment along various dimensions. Firms may directly increase labour use or substitute current workers with the less expensive newcomers. This is true particularly for some labour-intensive manufacturing firms that do not have strong skill requirements. Employment adjustment could also happen along the extensive margin. For example, one may find it easier to start a business due to reduced labour costs or the least productive firms that would have exited the market may have a higher probability to survive. Such firm-level employment adjustments are associated with increased hiring and firing, but changes in net employment are theoretically ambiguous.

We identify 74 cities that implemented the hukou reform before 2007 and restrict our empirical analysis to those cities that launched the hukou reform before the end of 2005 so as to allow at least two years for the policy to take effect. In Table 2 we summarise the pre- and post- reform changes in the average level of employment at the firm-level by reform year. In panel A we record the average change in employment in reform cities, and consistently identify increases in average firm-level employment post-reform and larger increases post-reform than pre-reform. Indeed, average employment levels were falling sharply prior to the reform in 2003, 2004 and 2005. In panel B we report on relative levels of average firm employment (in reform relative to non-reform cities) before and after reform (again by reform year). This indicates consistently rising relative (average firm-level) employment in reform cities post-reform, following declining relative employment prior to the reform up to and including 2003. The average firm-level effects are in line therefore with a positive average employment effect overall in reform cities. However, in the subsequent, detailed firm-level analysis we concentrate on how individual firms responded to the hukou reform, and in this context, we expect the reform to increase employment adjustment (increases and reductions in employment) rather than necessarily general increases in employment levels.

Table 2 Firm-level Employment before and after the Hukou Reform

	Panel A: Employment Change in Reform Cities		Panel B: Difference in Employment between Reform and Non-reform Cities	
Reform Year	Before	After	Before	After
2001	+ 32.59	+ 59.71	- 150.20	+ 24.59
2002	+ 13.54	+ 52.27	- 129.18	+ 23.46
2003	- 91.93	+ 51.44	- 28.94	+ 38.81
2004	- 122.03	+ 61.27	+ 99.08	+ 178.82
2005	- 433.25	+ 16.15	+ 258.26	+ 91.00

Notes: Panel A shows changes in average firm-level employment in reform cities before and after the hukou reform by reform year. Panel B shows the average difference in employment between reform and non-reform cities. Data source: Author's own calculation based on the annual survey of industrial firms (1998-2007).

3 Relevant Theories and Empirical Evidence

An efficient allocation of resources maximises overall output in a competitive environment by determining which establishments produce and how resources are allocated across those establishments (Restuccia and Rogerson, 2013). However, institutional factors that constrain either of those two decisions will induce resource misallocation and productivity losses. Productivity losses due to resource misallocation are found to be substantial, for instance, 30 to 50 percent in China and 40 to 60 percent in India (Hsieh and Klenow, 2009).

Labour market regulations are one main source that hinders the market from operating efficiently. In particular, rigid institutions that increase adjustment costs may hamper firms' hiring and firing decisions and prevent them from achieving the optimal level of labour use. There is considerable evidence that the extent of labour market regulations is negatively associated with employment. By considering job security protection regulations in a sample of OECD and Latin American Countries (LACs), Heckman and Pagés (2000) document a clear negative impact on employment. Based on survey data, Di Tella and MacCulloch (2005) construct a new dataset on hiring and firing costs for 21 OECD countries and find that countries with a more flexible labour market have a higher employment rate, a higher labour force participation rate, and a lower unemployment rate. Kaplan (2009) finds similar results by studying labour regulation reforms in 14 LACs. Feldmann (2009) separately examines five specific types of labour market regulations using data on 73 economies and concludes that stringent labour regulations are positively associated with unemployment rates around the globe. Despite the well documented negative relationship between labour market rigidity and employment, Nataraj et al. (2014) argue that in low-income countries (LICs) strict labour market institutions may push workers to move into the informal sector and therefore increase informal sector employment. While these studies are mainly based on cross-country or industry-level data, direct evidence on how labour market flexibility affects firms' adjustment is relatively scarce. Our study contributes to the literature by specifically examining the impact of labour market regulations on firms.[5]

In addition to distorting the optimal level of labour use for firms, labour market regulations impede the speed of firm's adjustment following external shocks. It is shown in the literature that the adjustment process is fairly sluggish and usually takes a long time (Hasan, 2001; Mouelhi, 2007). A lack of labour market flexibility is one source of such sluggish adjustment. Based on cross-country cross-sector data of 60 economies between 1980-2000, Caballero et al. (2013) find that countries with stricter job security legislations clearly experience slower employment adjustments to shocks. The speed of such adjustments could be slowed down by one third if the stringency of enforcement increases from the 20th to the 80th percentile. Kambourov (2009) specifically investigates cross-sector labour reallocation following trade

[5] Other country-specific studies using firm-level or plant-level data include Autor et al. (2007) for the case of the U.S., Almeida and Carneiro (2009) for the case of Brazil, and Eslava et al. (2010) for the case of Colombia, etc.

liberalisation. Significant labour reallocation across sectors after trade liberalisation is observed in countries with relatively flexible labour markets, whereas those with relatively rigid or distorted labour markets show no significant sectoral labour reallocation. In a dynamic general equilibrium setting, Kambourov (2009) finds that high firing costs account for a substantial part of the sluggish reallocation of labour.

Given the extensive empirical evidence, a number of recent papers try to model the role of labour market frictions on firms' adjustment following external shocks. Our paper builds on the spirit of the model by Itskhoki and Helpman (2015) who incorporate search and matching frictions into a Melitz (2003) model to study the dynamic of a firm's employment adjustment. As in Melitz (2003), low-productivity firms contract or even exit the market while high-productivity firms expand with a reduction in trade costs, leading to employment reshuffling across firms. However, labour market frictions slow down such reallocation, with the low-productivity incumbents reluctant to exit the market due to sunk hiring costs. In other words, declines in labour market frictions reduce adjustment costs and encourage productive firms to be more responsive to trade shocks, leading to larger adjustments in employment and higher job turnover rates. In the spirit of Itskhoki and Helpman (2015), the migration barriers set by the hukou system translate into greater search and matching frictions, which hamper an efficient matching between firms and workers. The relaxation of migration barriers is expected to result in higher employment adjustment for both low- and high-productivity firms by providing easier access to a larger pool of cheaper labour in the urban labour market.

Our paper is related to several country-specific studies that investigate the effects of trade openness on job reallocation using similar measures of employment adjustment to ours. For example, exchange rate appreciation is found to significantly affect job reallocation in France, Germany, Belgium, and the U.S. (Gourinchas, 1999; Kelin et al., 2003; Moser et al., 2010; Colantone, 2012). However, employment adjustment operates through different channels across countries. In the U.S and Belgium, currency appreciation induced rising job destruction while job creation was not significantly affected. In contrast, firms in Germany and France adjusted employment mainly through reducing job creation rather than raising job destruction following an increase in international competition. Such a difference could be due to high levels of labour market regulations in Germany and France, which prevent firms from easily firing workers when being faced with negative demand shocks (Moser et al., 2010; Colantone, 2012). Similar findings are confirmed in developing countries like India and Brazil. Specifically focusing on hiring and firing costs of labour in India, Hasan et al. (2007) find that the effects of trade liberalisation on the labour demand elasticity are much larger in magnitude in states with more flexible labour markets. Almeida and Poole (2017) find that trade openness is associated with higher job creation and lower job destruction, and such effects are weakened by the enforcement of labour market laws in Brazil. Our paper contributes to this strand of literature by providing additional, consistent evidence in China that increased labour market flexibility following the hukou reform allows for more profound employment adjustment by firms in the face of trade liberalisation.

This paper is closely related to the literature that specifically examines the hukou system in China. Whalley and Zhang (2007) find that the hukou system in China played a significant role in preventing labour movements and in generating large regional income disparities. Kinnan et al. (2015) investigate the effects of relaxation in migration constraints on rural households by specifically studying reforms to the hukou system, similar to ours, and the send-down youth policy in the 1960s and 1970s.[6] They find that increased migration due to the hukou reforms and the send-down youth policy raised consumption levels and reduced consumption volatility for rural households. By establishing a two-sector model of industrialisation, Ngai et al. (2019) analyse the impact of mobility barriers embedded in the hukou system on employment allocations and find that the hukou system induced over-employment in rural areas while under-employment in urban regions, which further led to a productivity gap between agriculture and non-agriculture sectors.

Tombe and Zhu (2019) evaluate the productivity effects of reductions in internal migration costs related to migration policy changes and in external trade costs following China's accession to the WTO. Their quantitative analysis reveals that lower internal trade and migration costs contributed to 28 percent of the aggregate productivity growth between 2000 and 2005 and declines in external costs explained 8 percent. Based on population census data, Zi (2019) documents that input trade liberalisation increased regional overall employment and such effects were more pronounced in regions with less stringent migration frictions. By developing a spatial-equilibrium model, Fan (2019) quantifies the distribution effects of trade liberalisation in the presence of high migration costs. He finds that international trade increased income inequality in China, and a decline in migration costs would reduce the trade-induced inequality. Imbert et al. (2019) explore the impact of migration on firm's production in China using external shocks to agriculture productivity to predict rural-urban migration. They find that migration induced manufacturing production to expand, and to become more labour-intensive but less productive.

These papers provide suggestive evidence that relaxing hukou restrictions would generate additional welfare gains by allowing for labour reallocation, aggregate productivity growth, and lower income inequality following, for instance, trade shocks, which complements the current study. Our paper, however, departs from those existing studies in various ways. First, most papers are limited to analyse the effects of the hukou system in theoretical settings or using numerical simulations (Whalley and Zhang, 2007; Ngai et al., 2019; Tombe and Zhu, 2019; Fan, 2019), whereas this paper provides rigorous empirical evaluation of changes in the hukou policy. Second, existing measures of the hukou system are either from predictions (Zi, 2019) or from theoretical hypothesis (e.g. Tombe and Zhu, 2019; Fan, 2019). The hukou reform examined in this paper, by contrast, provides a direct measure of the hukou relaxation, and

[6] Kinnan et al. (2015) study hukou reforms between 1995 and 2002, when a pilot reform was implemented in the selected towns and small cities and a new round of more comprehensive reforms in middle and large cities had just started. The latter is the one that we study in our paper. An additional difference from our paper is that their study only focuses on reform provinces whereas our paper covers all provinces, which allows for a comparison between reform and non-reform regions.

therefore allows for a relatively more precise evaluation of the impact of the hukou system. Third, existing studies focus on an aggregate analysis, e.g. regional employment (Ngai et al., 2019; Zi, 2019), overall productivity and income inequality (Tombe and Zhu, 2019; Fan, 2019). By contrast, this paper focuses on micro-level analysis and thereby contributes to a better understanding of how the hukou system affects individual firms.[7]

4. Data and Sample Frame

4.1 Firm-level data and measuring employment adjustment

The main data source for this study is the Annual Survey of Industrial Enterprises (ASIE) which is a rich firm-level panel dataset spanning 1998-2007. The data is collected by China's National Bureau of Statistics (NBS) in an annual survey of all industrial state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs) with annual sales over RMB 5 million (around $750,000). The number of firms included in this dataset increases steadily from around 150 thousand in 1998 to more than double that in 2007. All firms are required to report complete information on the balance sheet, profit and loss accounts, and cash flow. This dataset is the most comprehensive firm-level survey data for China. It accounts for around 95% of total industrial output, over 70% of industrial employment, and more than 97% of industrial exports (Ma et al., 2015). We constrain our sample to manufacturing firms.

The raw data cannot be used directly as some observations are misleading, largely due to misreporting by some firms.[8] First, we drop firms without an identification number and those reporting implausible values of the key variables. Then we drop observations if any of the following criteria is true, following Jefferson et al. (2008) and Yu (2015): (1) Liquid assets are greater than total assets; (2) total fixed assets are greater than total assets; and (3) the net value of fixed assets is greater than total assets. To minimise the possibility of misreporting, particularly from small firms, we drop firms with fewer than eight workers. Given that a few firms changed city location during the sample period and this may invalidate our identification strategy, we therefore also drop those firms from our sample.[9] In addition, since we are interested in changes in the employment adjustment rate following the hukou reform, only firms with at least two observations both before and after the reform are kept in the sample.

Table 3 reports the number of firms across years after cleaning. As shown in column (1), the number of firms in the full sample increases from 52,870 in 1998 and almost doubled in 2005 and then decreases slightly to 92,525 in 2007, generating 903,305 observations in total. Columns (2) and (3) give the numbers of observations for reform and non-reform cities separately. Consistent with the full sample, the number of observations in both regions peaks in 2005, having doubled in size as compared to the level of 1998, and then decreases slightly

[7] Imbert et al. (2019) investigate the effects of migration on firms' production but do not directly examine the role of the hukou system.
[8] A typical group of these firms is family-owned firms that have no formal accounting system.
[9] Around 0.17% firms changed city location during the sample period.

in the latter two years. Due to the relatively smaller number of reform cities, the reform sample is around half the size of the non-reform sample across years.

Table 3: Number of Observations by Year (1998-2007)

	Full sample	Reform locations	Non-reform locations
	(1)	(2)	(3)
1998	52,870	15,605	37,265
1999	63,939	18,829	45,110
2000	70,526	21,938	48,588
2001	92,102	27,916	64,186
2002	103,509	29,813	73,696
2003	115,623	30,800	84,823
2004	107,116	30,482	76,634
2005	105,419	30,587	74,832
2006	99,676	29,692	69,984
2007	92,525	27,931	64,594
Total	903,305	263,593	639,712

Notes: This table reports the number of firms by year in our sample. Reform locations are cities where the hukou reform under consideration was implemented by the end of 2005. Non-reform locations are cities where no hukou reform was implemented during the whole sample period (1998-2007). We exclude cities that implemented the hukou reform in 2006 and 2007 to allow at least two years for firms to adjust to the policy change.

As discussed, the effects of the hukou reform on changes in employment levels at the firm level are theoretically ambiguous since both hiring and firing are affected. However, we expect the reform to increase employment adjustment that may involve both increases and decreases in employment. We therefore use firm-level employment adjustment as our main outcome variable. To measure employment adjustment, we follow Autor et al. (2007) and calculate the absolute year-to-year employment change divided by the average employment level over the two periods. As such, this variable treats both positive and negative employment adjustments in a symmetric manner. The measure is as follows:

$$EAR_{it} = \frac{|E_{it} - E_{it-1}|}{(E_{it} + E_{it-1})/2} \quad (1)$$

where E_{it} is employment of firm *i* in year *t*. In contrast to the conventional employment growth rate, defined as the change in employment between period $t-1$ and t divided by the employment in period $t-1$, this index is constructed so as to constrain the proportionate changes in employment (in particular in the case of small and new firms), and thereby reduce outlier problems in the empirical analysis.[10] The index is bound between [0, 2], where the lower bound indicates no change in employment between t and $t-1$ and the upper bound is the adjustment rate for all newly established firms in year t (with employment in $t-1$ taken as

[10] This measure, however, increases monotonically with the absolute value of the conventional employment growth rate (Davis and Haltiwanger, 1992). The two are equal to each other when the growth rate is small.

zero).[11] For intermediate values the index is symmetric for increases and decreases in employment of the same absolute amount. Finally, note that the index tends towards zero (two) when the absolute employment change is small (large) relative to the two period (*t* and *t-1*) employment level.

To calculate employment adjustment using this dataset, a number of issues are worth noting. The first is that newly appearing firms cannot be identified as start-ups. Non-starting-up firms may enter the sample for the first time for several reasons: First, some non-SOEs may not have reached the threshold of RMB 5 million annual sales until year t when they were recorded for the first time. Second, some firms may have changed their identification number such that the newly appearing firms are not necessarily newly established ones.[12] Finally, a small fraction of firms may not be recorded in all years because of misreporting. To identify new firms, we rely on a firm's opening year following Dong and Xu (2009) and Ma et al. (2015). Specifically, firms that appeared for the first time (*t*) and that are less than two years old are defined as start-ups. The corresponding employment adjustment rate is 2 (in year *t*). All other newly entering firms are identified as continuing firms. For those firms, we follow Ma et al. (2015) and take a conservative approach to set the employment adjustment rate as 0.

Another issue is that some firms re-entered the sample after disappearing for one or more years. We refer to these as discontinuous firms. During the gap years, they were not included in the survey either because of the lower-than-threshold annual sales or due to misreporting. For the year when a firm re-entered the sample, we calculate the employment adjustment rate by assuming a constant (average) employment growth rate for each year during the gap period.[13] Therefore, our sample includes continuing firms (with observations available in both t and $t-1$), newly entered continuing firms, new firms and re-entered incumbents.[14]

4.2 City-level hukou reform

To identify reform cities, we carefully review the officially released reform documents and relevant media reports and successfully identify 74 cities that implemented the hukou reform by 2007.[15] Considering that we are interested in firms' employment adjustment as a result of the hukou reform, we constrain our sample to cities that implemented the reform before the end of 2005 to have at least two years of observations before and after the reform year. This reduces the number of reform cities to 65 and reduces the number of observations in 2006 and

[11] The upper bound could also apply to exiting firms in year *t*, with employment in *t+1* taken as zero. It may, however, be difficult to distinguish between closing firms and firms leaving the data set and continuing to operate. It may also be problematic to keep exiting firms in the empirical analysis if information on firm characteristics is required for any econometric modelling.

[12] A firm may receive a new ID if it goes through a change in its legal registration due to, for instance, restructuring, mergers or acquisitions. We follow the approach proposed by Brandt et al. (2012, 2014) and link firms over time based on firm ID, Chinese name, address, phone number, etc.

[13] The re-entered incumbents account for around 2.86% of the whole sample. We have checked all regressions by assigning the employment adjustments as missing for the re-entered year and our results are quite similar.

[14] We carry out some robustness analysis which allows also for exiting firms. We are constrained, however, by the absence or disappearance of other information about these firms associated with exit itself.

[15] We drop Zhengzhou that implemented the hukou reform in 2003 but terminated it one year later.

2007 as shown in Table 1. In 2001, only two cities launched the reform while the number of reform cities rises considerably to 10 in 2002, 22 in 2003, 21 in 2004 and 10 in 2005.

5 Empirical Strategy

5.1 Econometric specification

We initially explore the causal effects of labour market flexibility resulting from the hukou reform on firms' employment adjustment. Ideally, we would like to compare the observed employment adjustment of a firm subject to the change in policy conditions with what would have happened to that same firm in the absence of the hukou reform. However, this counterfactual is not observable. The non-uniform nature of the hukou reform under investigation allows us, however, to adopt a difference-in-differences (DiD) approach. Specifically, we categorise firms located in reform cities as the treatment group and those located in non-reform cities as the control group. Given that the timing of the hukou reform varies across reform cities, we constrain control firms to those located in areas that were never exposed to the hukou reform during the entire sample period.

Our multiple-group multiple-period DiD framework is therefore as follows:

$$EAR_{ict} = \beta_1 + \beta_2 policy_{ct} + \boldsymbol{X}_{ict}\gamma + \boldsymbol{Z}_{ct}\delta + \theta_i + \theta_t + e_{ict} \quad (2)$$

where *i* denotes firm, *c* is city and *t* is year. EAR_{ijct} is the firm-level employment adjustment rate in year *t* as defined earlier. $policy_{ct}$ indicates whether the hukou reform policy was in force in city *c* in year *t*. It is equivalent to an interaction term between a reform location dummy that indicates reform cities and a reform year dummy that indicates post-reform years. $\boldsymbol{X}_{ict}$ and $\boldsymbol{Z}_{ct}$ represent sets of firm-level and city-level control variables. The hukou reform may have heterogeneous effects across industries. For instance, firms in labour-intensive industries might react to the hukou reform more strongly compared to those in capital-intensive industries. We account for such industry-specific effects by including industry fixed effects. We also include ownership dummies in our regression to capture the potential differential employment adjustments across ownership types. θ_i denotes firm fixed effects that control for unobserved time-invariant firm characteristics that may affect a firm's employment adjustment. Notice that firms did not change their city location across years, which means that firm fixed effects also control for all time-invariant city-level characteristics, as city fixed effects do. θ_t denotes year dummies controlling for common shocks to all firms in a given year, e.g. changes in the macroeconomic environment. Such common shocks may be attributed to general demand increases in urban markets arising from rapid economic growth. Finally, e_{ict} is the error term. To correct for possible correlations of firms within cities, we cluster our standard errors at the city level in all specifications. The main coefficient of interest is β_2, which measures the mean shift in employment adjustment in reform regions following the implementation of the hukou reform relative to the adjustment in non-reform regions.

The summary descriptive data for the dependent and explanatory variables used to estimate equation (2) are set out in Appendix Table B.1, for the sample as a whole and for reform and non-reform cities separately.

5.2 Endogeneity of the hukou reform and identification strategy

One crucial threat to identifying the causal relationship between hukou reform and employment adjustment is the potential non-random selection of reform cities. If the determinants of the hukou reform are correlated with firms' employment changes, then the reform is endogenous and the empirical estimates are spurious. It is likely that the hukou reform was implemented in cities with a greater need for such a reform, for instance, due to more rapid economic growth that required more workers. Indeed, several provincial capital cities that are often the most developed in their own province were among the first to implement the reform. In this case, firms may be adjusting their labour use not because of the hukou reform but rather due to higher economic growth.

To address the endogeneity problem, we first include firm fixed effects in our regressions. City officials decided whether to implement the reform based on some pre-reform characteristics. If those initial differences across cities are time-invariant, one does not need to worry about the endogeneity problem once firm fixed effects are included as they control for all time-invariant determinants of the hukou reform at the city level provided that firms in our sample did not change city location.

However, since cities implemented the hukou reform in different years, the initial city characteristics that affect the decision to reform may be year-specific. In this case, the determinants of the hukou reform are not only city-specific but also time-specific. While city fixed effects could control for the former, the latter is still a problem. An alternative problem is that the effects of the pre-reform characteristics on firms' employment adjustment may vary across years. This could be the case, for example, if cities with a higher initial economic growth rate attract more migrant workers, which in turn promotes economic development and attracts even more workers and therefore affects firms' employment change. To account for these two possibilities, we further include a set of pre-reform city-level characteristics which we interact with year dummies. However, the decision to adopt the reform involved complicated discussions and there is no consensus in the literature on a clear set of determinants. We, therefore, consider several potential city-level factors, including the log of regional GDP per capita, the share of agriculture population in total population, the share of non-SOE employment, the share of industrial employment in total employment, and the log of fiscal expenditure per capita. More details about the choice of determinants can be found in Appendix A. By allowing the initial city characteristics to vary over time, we can also capture the general impact of rising demand for labour at the city level due to, for instance, regional economic growth, privatisation or changes in industrial structure. Descriptive statistics of these variables are reported in Table B.1 in the Appendix.

An alternative approach to deal with the potential non-random selection of reform cities is to use propensity score matching (PSM). The idea of matching is to select non-reform cities that are most similar to reform cities in terms of observable pre-reform characteristics. In practice, we use the same set of pre-reform city-level characteristics as stated above and run probit regressions based on which we select non-reform cities that have the most similar probability to be treated as a reform one. By doing so, we construct a more comparable control group and therefore largely alleviate the selection problem. Details of the PSM approach are given in Appendix A. The combination of PSM and DiD can improve the quality of non-experimental evaluation studies (Blundell and Dias, 2000) and is effective when dealing with an endogenous programme placement (Todd, 2008).

Technically, the PSM approach addresses the same endogeneity problem as the specification using the full sample and controlling for initial city-level conditions interacted with year dummies. However, because we have a much smaller number of reform cities, the PSM approach reduces the sample size substantially. Considering that PSM may be sensitive to the choice of a specific matching approach and to various parameter settings, we rely on the first specification as our main results and use matching as a robustness check.

6 Empirical Results

6.1.1 Baseline results

We start by estimating equation (2) based on the full sample and the results are summarised in Table 4 (Panel A). In column (1), we use a simple specification that only controls for firm and year fixed effects. Notice that firm-level fixed effects account for all time-invariant observable characteristics such as the location of a firm, as well as time-invariant unobservable factors that may affect a firm's employment adjustment. As discussed earlier, the inclusion of firm fixed effects also accounts for initial differences in city-level characteristics and therefore addresses the endogeneity of the hukou reform.

In column (2), we add firm-level characteristics. The log of sales is included to control for time-varying heterogeneity of firms such as changes in size. Following Nucci and Pozzolo (2010), we additionally control for the firm-level markup. The markup is calculated as the ratio of sales over the difference between sales and profits. To account for variations in ownership and industry affiliation, we additionally include a full set of ownership and industry dummies in the regression. If a firm did not change ownership or industry affiliation, the firm-level fixed effects can capture such time-invariant factors. However, we find that a considerable number of firms did experience changes in ownership and four-digit industry affiliation, in line with Brandt et al. (2014).[16] In column (3), we include the Herfindahl index as an additional city-level control variable. It captures the effect of competition across firms in the local market. We also include a set of initial city conditions interacted with year dummies. As discussed earlier, this controls for

[16] We drop firms that changed industries or ownership more than three times during the sample period since they were likely to be misreported.

cross-city variations in pre-reform characteristics that potentially influence the selection of reform cities. The interaction with year dummies allows such effects to vary across time.

Table 4: Hukou Reform and Firm-level Employment Adjustment: Baseline Results

	Panel A: Full sample			Panel B: PSM matched sample		
	Baseline	+Firm controls	+City controls	Baseline	+Firm controls	+City controls
	(1)	(2)	(3)	(4)	(5)	(6)
Policy	0.037***	0.046***	0.052***	0.036**	0.042***	0.042***
	(3.183)	(4.078)	(4.276)	(2.291)	(2.822)	(2.804)
ln(sales)		-0.080***	-0.078***		-0.076***	-0.076***
		(22.717)	(22.761)		(15.378)	(15.387)
Markup		0.004	0.006		-0.007	-0.007
		(0.525)	(0.814)		(0.862)	(0.839)
Herfindahl index			0.030			0.094
			(0.700)			(1.419)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	Yes	Yes	No	Yes	Yes
Ownership FE	No	Yes	Yes	No	Yes	Yes
Initial cond. × year	No	No	Yes	No	No	No
Observations	903,269	834,693	832,679	484,002	459,691	459,691
R^2	0.225	0.237	0.238	0.220	0.232	0.232

Notes: This table reports the DiD estimation results based on the full sample (Panel A) and the PSM matched sample (Panel B), respectively. All specifications control for firm and year fixed effects. Columns (2) and (5) control for firm-level characteristics, including the log of sales, the markup, four-digit industry indicators, and ownership types. Columns (3) and (6) further control for city-level characteristics, including the Herfindahl index, and initial city conditions interacted with year dummies. The initial city conditions include: the log of local GDP per capita, the share of agriculture population, the employment share of non-SOEs, the share of industrial employment and the log of local fiscal expenditure per capita. Robust standard errors are clustered at the city level in all specifications.

* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

The results in Table 4 show that the coefficients of the policy variable in all specifications are positive and highly significant, indicating that the hukou reform broadly raised average employment adjustment rates. This also reflects that firms were constrained in adjusting employment in the non-reform locations, and by implication that firms in reform locations would have faced constraints on employment adjustment in the face of shocks in the absence of the reform. Since we do not identify a specific source of shock that pushes firms to adjust, the DiD estimator is measuring the average effect of the hukou reform on firms' net employment adjustment arising from all types of shocks. The estimated coefficient of our preferred specification in column (3) in Table 4, 0.052, corresponds to a change rate of 5.2%. This is translated to a 22.6% increase in the employment adjustment rate for an average firm.[17]

With increased labour supply at relatively lower costs resulting from the hukou reform, it is likely that urban firms substitute the currently relatively expensive workers with less expensive

[17] The employment adjustment rate for an average firm is 23%, as shown in Table B.1.

ones, which implies that job destruction and job creation may occur simultaneously, or job turnover rates increase as in Coşar et al. (2016). However, given that the nature of our data does not allow us to investigate job destruction and creation, our estimates can be interpreted as a lower bound of employment adjustments.

Regarding the control variables, our results show that sales are negatively associated with the employment adjustment rates. This implies that larger firms have a higher capability to absorb economic shocks and their production is more stable such that labour adjustment is slower or on a smaller scale. We do not find significant effects of the firm-level markup and the city-level Herfindahl index on firms' employment adjustment.

Panel B shows regression results based on the PSM matched sample. It should be noted that different from column (3), we do not include initial city conditions interacted with year dummies in columns (4) - (6) as cities are matched based on the same set of pre-reform characteristics. By and large, the coefficient estimates of the policy variable are significantly positive in all specifications with a slightly smaller size than the estimates based on the full sample. This indicates that our preferred specification in column (3) successfully accounts for the selection problem of reform cities. Given that the sample size falls by over a half in the case of matching, we concentrate on the full sample results in the following discussions.

If the hukou reform is contemporaneously related to employment, there is a possibility that the construction of the employment adjustment index, as in equation (1), based on yearly changes violates the strict exogeneity assumption underlying the use of a fixed effects estimator. To check on this, we construct the EAR measure on a biannual basis (even years). The results of the estimations of the alternative specifications in (1) - (3) in Table 4 for the bi-annual panel are given in Appendix Table B.2. The coefficients on the policy variables are somewhat smaller than in the case of the annual panel, but they remain positive and highly significant throughout.

We also check at this stage whether our base results are sensitive or not to the inclusion in our sample of specific types of firms. The base results in Table 4 for instance include discontinuous firms, where a constant employment adjustment rate between exit and re-entry is assumed. The results for the estimation of our preferred specification - column (3) in Table 4 - with discontinuous firms dropped is reported in column (1) in Appendix Table B.3. The estimated coefficient on policy reform remains positive and highly significant. Next, we drop both the discontinuous firms and all new entrants from the sample and estimate the preferred specification for continuous firms only as reported in column (2) in Appendix Table B.3. The coefficient on the policy variable remains positive, albeit with reduced significance.

Finally, we consider the exclusion of exiting firms from our base estimates. We can set employment at zero in the year post-exit and record the employment adjustment rate for exited firms in $t+1$ as 2. We cannot, however, include firm controls for these firms post-exit, but do produce estimates of our model for a reduced specification for samples with and without exiting firms. Due to the nature of the ASIE dataset, all SOEs and only above-scale non-SOEs are covered. This means that we cannot consider a firm's disappearance from the sample as an exit

from the market because it could be excluded from the sample due to lower annual sales than the threshold. To identify exiting firms, we match the ASIE data with the firm registration dataset, obtained from the State Administration of Industry and Commerce (SAIC), which covers the universe of registered firms in China. A unique feature of this dataset is that it records a firm's de-registration date if it exited the market, which allows for an accurate identification of exiting firms. We only have access to a sample of the SAIC dataset that covers all textile and clothing firms and therefore in Appendix Table B.4 we check the robustness of our results based on textile and clothing firms. Again, the results indicate that our findings of a positive hukou reform effect on employment adjustment are not sensitive to whether exiting firms are or are not included in the data.

In order to give a more complete picture of the labour market adjustments associated with the hukou reform, we also report on similar DiD analysis of the employment level and wage effects of the reform. We re-estimate equation (2) for the same sample period (1998-2007) using first the employment level (measured by the number of employees) and then the wage (proxied by the average wage i.e. reported total wage bill divided by the number of employees) as the dependent variable. For brevity, we report only the fixed effects results (for the alternative specifications reported in columns (1) - (3) of Table 4) for the two models in Table 5.[18] At the city level, we expect an overall increase in employment in reform cities (relative to non-reform cities). As we discussed in Section 2, the impact of the hukou reform on employment at the firm level is, however, ambiguous depending for instance on whether or not firms in reform cities were hoarding labour prior to reform, with the more flexible post-reform conditions allowing a reduction of such hoarding. The reform did provide an opportunity to firms in reform cities to hire more workers, but also to fire workers in order to recruit workers better matching the firm's skill needs. This could be the case especially during our sample period when dismissing workers was relatively easy compared to the years after 2008 when firing costs increased substantially due to the enforcement of the new Labour Contract Law (Cooper et al. 2018; Akee et al. 2019). This ambiguity about the impact of the hukou reform on relative employment levels of firms in reform and non-reform cities is confirmed by the results reported in Table 5. The estimated sign on the policy variable varies across specifications (1) - (3) in panel A, but in none of the estimated models is the sign significant.[19]

We also find that there is no significant effect of the policy reform on the (relative) average wages of firms, though in this case the estimated coefficient on the policy variable is positive in all of the alternative specifications (4) - (6) in panel B of Table 5. Given that the reforms increased the supply of labour to reform cities relative to that in non-reform cities (see Figure 1 and Table 1), the positive sign on the average wage effect, albeit insignificantly different

[18] The PSM results are qualitatively identical to the fixed effects results and are available from the authors on request.

[19] The insignificant results of the employment effects could be also due to heterogeneous responses to the hukou reform between firms located in regions with high labour costs and those in regions with low labour costs. In our non-reported results, we find that firms in regions with a higher than median minimum wage rise during our sample period tended to reduce employment while others increased employment following the hukou reform. We explore more formally whether minimum wage rises affect our main results in Section 6.1.3.

from zero in all specifications, is unexpected. However, we must caution that our average wage variable may be a poor proxy for the wage rate or more precisely the average wage rate across different skill types in a firm, data of which is not available in our dataset. The average wage (total wages of the firm divided by the number of its employees) is likely to be influenced by differences between firms in the skill mix of their employees and in the use of overtime, as well as by differences in wage rates.[20] A more robust test of the impact of the reform on wage rates at the firm level would require better information on wage rates. Further, the present data source does not allow us to control for differences between firms in the skill mix of their employees or in working hours.

Table 5: Hukou Reform, Firm-level Employment Levels and Average Wages

	Panel A: Employment			Panel B: Average Wages		
	Baseline	+Firm controls	+City controls	Baseline	+Firm controls	+City controls
	(1)	(2)	(3)	(4)	(5)	(6)
Policy	0.033	0.023	-0.023	0.091	0.083	0.112
	(1.205)	(0.889)	(1.209)	(1.078)	(0.987)	(1.260)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	No	Yes	Yes	No	Yes	Yes
City controls	No	No	Yes	No	No	Yes
Observations	903,269	834,693	832,679	903,269	834,693	832,679
R^2	0.870	0.870	0.872	0.335	0.332	0.331

Notes: This table reports the DiD estimation results using the log of firm-level employment levels (Panel A) and averages wages (Panel B) as the dependent variables. Columns (1) - (3) and (4) - (6) include the same control variables as in Panel A of Table 4 except in columns (2) - (3) we exclude firm sales due to the concern that both sales and employment are firm size measures. Robust standard errors are clustered at the city level in all specifications.
$^{*}p$ <0.1, $^{**}p$ <0.05, $^{***}p$ <0.01. Absolute t values in parentheses.

In summary, therefore, we can conclude from our base modelling that the hukou reform did induce greater adjustment of employment at the firm level but had a mixed impact on firms' employment levels. Some firms in reform cities had been labour-constrained pre-form and expanded employment following the hukou reform, but other firms appear to have been hoarding labour in response to inflexible labour market conditions pre-reform and released labour as the labour market became more flexible following the reform; more flexible labour market conditions giving better access to labour immediately and the prospect of better access to it going forward. This ambiguity of the employment effect at the firm level is not necessarily inconsistent, however, with overall employment growth for reforming, relative to non-reforming, cities, especially when growth along the extensive margin, i.e. through new firm formation and growth, is allowed for. (We explore this issue in more detail in Section 6.1.5.) Finally, despite an increase in the supply of labour to reform cities relative to non-reform cities,

[20] In some contexts, differences in average wages between firms may be affected also by differences across firms in the mix of full- and part-time workers, but this is less of an issue in the case of China because there is limited incidence of part-time working.

we do not find that average wages of firms in reform cities have fallen relative to those in non-reform cities post-reform, though caution against the robustness of this finding.

6.1.2 Further identification checks

A key identification assumption underlying our DiD approach is that the average trends in employment adjustments are parallel between reform and non-reform cities before the implementation of the hukou reform. If the timing of the hukou reform is correlated with pre-treatment differences in employment adjustments across regions, the estimates obtained before would be biased. To test the plausibility of the common trend assumption, we augment equation (2) by including a set of leads and lags as follows:

$$EAR_{ict} = \alpha + \sum_{m=1}^{4} \beta_m^{+} D_{t+m} + \beta_0 D_{ct} + \sum_{n=1}^{4} \beta_n^{-} D_{c,t-n} \qquad (3)$$

$$+\boldsymbol{X}_{ict}\gamma + \boldsymbol{Z}_{ct}\delta + \theta_i + \theta_t + \varepsilon_{ict}$$

where D_{ct} is a dummy variable for the year of the implementation of the hukou reform for city c; $D_{c,t+m}$ is a dummy variable for m years before the reform and $D_{c,t-n}$ is a dummy variable for n years after the reform. In particular, $D_{c,t-4}$ denotes 4 years or more after the reform. The coefficients of the leads, β_m^{+}, measure the pre-reform time trend of the difference in employment adjustment; and the coefficients of the lags, β_n^{-}, measure the lagged effects of the hukou reform. We run the regression by controlling for a full set of firm-level and city-level characteristics and year fixed effects. Figure 2 displays the estimated coefficients.

Figure 2 shows that none of the coefficients of the pre-reform years and of the reform year itself are significantly different from zero. The significantly positive effects of the hukou reform on employment adjustment were realised one year after the launch of the reform. The persistently rising coefficients indicate that the hukou reform had strong lagged effects which increased across years. The results show that firms in reform and non-reform regions did not differ much in employment adjustment prior to the hukou reform, which further confirms the validity of our identification strategy.[21]

We also perform a falsification test to validate our identification strategy. We specifically generate a random reform year between 1998 and 2007 (the first and last year of our sample period) that is different from the actual reform year for each reform city, and we construct a placebo policy variable based on the random reform year. We then estimate equation (2) using the false policy variable and repeat the exercise 500 times. The distribution of the simulated coefficients is shown in Figure 3. As expected, the simulated coefficients are centered around zero and the estimated coefficient of our true policy variable (column (3) in Table 4) lies at the very end of the distribution with only one out of the 500 false estimates being on the right. This exercise suggests that our main results are unlikely to be biased.

[21] The corresponding tests of the common trend assumption for the DiD analysis of the firm-level employment and wage effects reported in the previous section are reported in Appendix Figures B.1 and B.2. They support the common trend assumption.

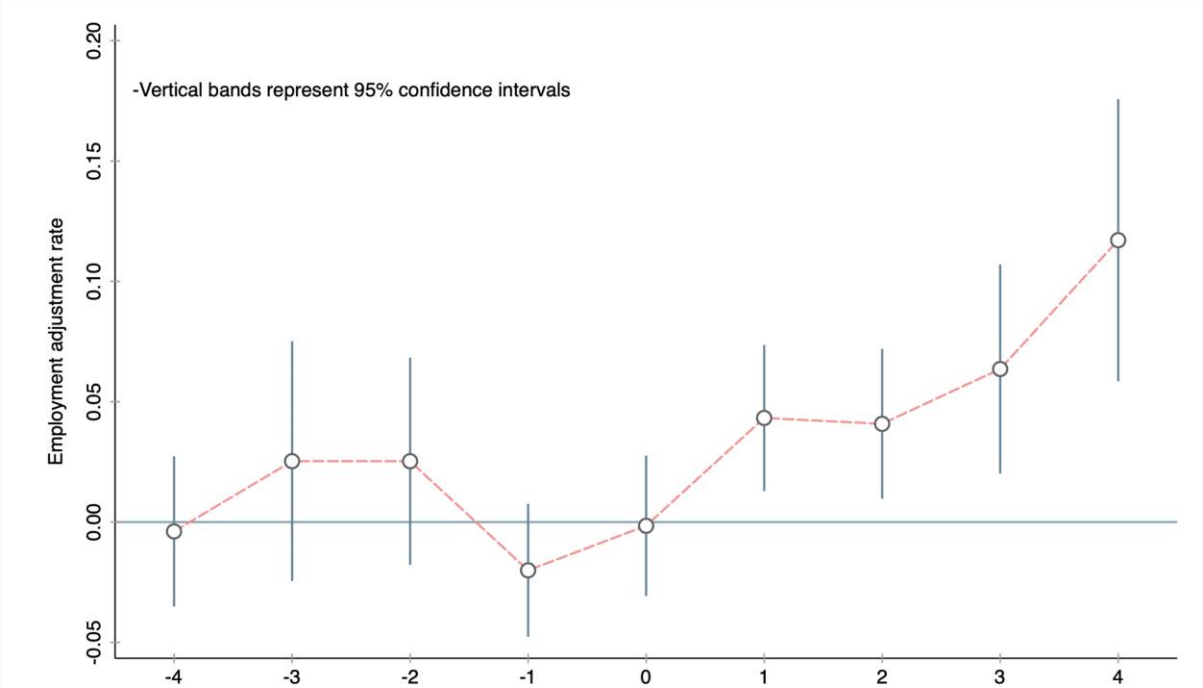


Figure 2: Time Trend of Employment Adjustment around the Year of the Hukou Reform

Notes: This figure shows the estimated coefficients and 95 percent confidence intervals from a regression of the employment adjustment rate on a set of reform time dummies controlling for firm-level and city-level characteristics as well as year fixed effects.

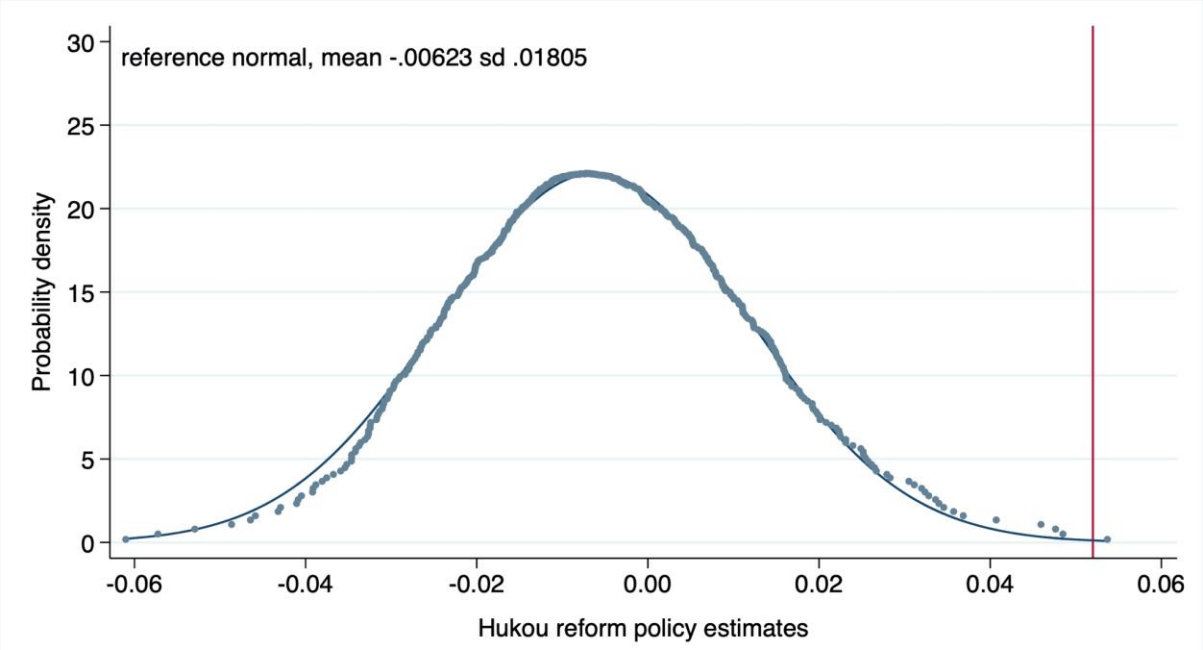


Figure 3: Density of the Estimated Coefficients with Random Reform Years

Notes: This figure shows the density function of 500 estimated coefficients from regressions of the employment adjustment rate on a placebo policy variable controlling for firm-level and city-level characteristics as well as year fixed effects.

6.1.3 Additional robustness checks

In this section, we perform various robustness checks of our main findings on the effects of the hukou reform on firms' employment adjustment. The first set of exercises deals with concerns about the comparability of treatment and control groups. Since our preferred specification relies on the full sample, one may worry that firms in the least developed, far western, non-reform cities are considerably different from those in reform regions. The inclusion of such firms may introduce biases in the estimation. To alleviate this concern, in column (1) of Table 6, we exclude firms in provinces where no reform was implemented in any city within the sample period. As such, treated firms are compared with those in non-reform cities within the same provinces and are therefore more comparable. Another factor that may affect our results is that a pilot hukou reform was implemented before 2001 in selected towns and small cities. In fact, the pilot reform had limited effectiveness in encouraging rural-to-urban migration as towns and small cities had limited attraction for rural workers. However, if the pilot reform had lagged effects on migration, our estimated policy effects may be affected by it. We, therefore, exclude cities where the pilot reform was enacted before 2001 and the result is reported in column (2). The regression results based on these refined samples show that the coefficients of the policy variable remain positive and highly significant, revealing that our main findings are robust to these different specifications.

Another issue about our identification strategy is that other reforms that happened during our sample period might also affect firm employment adjustment. China implemented several reforms during the early 2000s, such as a SOE reform, a minimum wage reform, etc. The policy variable in our empirical specification could hence capture a composite effect of all reforms rather than solely that of the hukou reform. Indeed, this is a problem only if other reforms were implemented in the same manner as the hukou reform, that is, with the same regional variations across reform and non-reform cities and the same time variations over pre- and post-reform years.

The SOE reform started from the mid-1990s when the Chinese government launched a comprehensive state-owned sector restructuring programme, aiming at supporting the growth of the largest 1,000 SOEs and pushing medium- and small-sized SOEs to the marketplace through privatisation, mergers and bankruptcies. This led to a significant reduction in the number of SOEs, which in turn resulted in a large number of workers being laid-off and was associated with the expansion of the urban private sector (Meng, 2012). Since SOEs tended not to employ migrant workers and if the hukou reform was implemented in cities which also reformed the SOE sector quite significantly, the impact of the hukou reform on employment adjustment may in fact have been moderated by this greater availability of labour released from the SOE sector. Of course, to the extent that the expansion of the private sector required different skills to those released by the SOE sector, then this moderating effect would be limited. Indeed, one might expect any moderating effect of the SOE reform to be more important for those early reform cities since the SOE reform mostly happened before the end of 2002. Further, our main specification controls for the city-level employment share of SOEs.

Table 6: Hukou Reform and Firm-level Employment Adjustment: Robustness Checks

	Excl. NR provinces	Excl. pilot ref. cities	Minimum wages	Exclude villages	Exclude towns	Two-way clustering
	(1)	(2)	(3)	(4)	(5)	(6)
Policy	0.060***	0.060***	0.048***	0.049***	0.035***	0.048***
	(4.366)	(3.533)	(4.061)	(4.070)	(3.330)	(4.089)
ln(sales)	-0.076***	-0.079***	-0.078***	-0.078***	-0.087***	-0.078***
	(17.188)	(19.346)	(22.756)	(22.780)	(21.807)	(19.283)
Markup	0.000	-0.010	0.005	0.005	0.023**	0.005
	(0.033)	(1.243)	(0.784)	(0.759)	(2.198)	(0.766)
Herfindahl index	0.023	0.048	0.034	0.035	-0.007	0.034
	(0.366)	(0.944)	(0.800)	(0.836)	(0.187)	(0.800)
Minimum wages			0.066***	0.065***	0.049**	0.066***
			(3.428)	(3.361)	(2.278)	(3.291)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
City Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	591,703	497,122	832,311	821,403	240,211	832,311
R^2	0.240	0.241	0.239	0.239	0.247	0.426

Notes: This table reports the results of various robustness checks. Column (1): firms in non-reform provinces where no hukou reform was implemented in any city during the sample period are excluded. Column (2): firms in cities that implemented the pilot hukou reform before 2001 are excluded. Column (3): log of city-level real minimum wages (deflated to the 1998 level) is included in the regression. Column (4) and (5): firms in rural areas are excluded from the sample. Rural areas are identified according to alternative criteria: a "wide" definition (column 4) and a "narrow" one (column 5). Robust standard errors are clustered at the city level in columns (1)-(5). Column (6): two-way clustered standard errors at both the city level and the industry level.
* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

Another important reform which was implemented during our sample period is the minimum wage reform. Minimum wage regulations in China were non-binding before 2004, the adjustment of the minimum wage level was infrequent, and its coverage was limited (Mayneris et al., 2018). New minimum wage rules were issued in 2004 that formalised the minimum wage system by increasing the minimum wage level, by extending the coverage, by setting regular adjustment intervals, and by significantly increasing non-compliance penalties. In theory, a firm's response to an increase in the minimum wage rate might be to deter the hiring of new workers and may even lead to increased dismissals of current workers. Incidentally, this might (in contrast to the effects of the hukou reform) be expected to increase employment adjustment.

To remove the potential impact of this reform, we include the city-level log of the minimum wage rate in our regression. The regression result is reported in column (3) of Table 6. The significant positive coefficient indicates that firms in cities with a higher minimum wage level tend to experience higher employment adjustment, in line with our expectations. An additional potential explanation is that higher minimum wages indicate better economic conditions in those cities, where firms often have higher employment growth. Controlling for minimum wages, the coefficient of the policy variable is hardly affected.

In columns (4) and (5), we constrain our sample to the urban market as the hukou reform encouraged rural-to-urban migration, which mainly affects urban firms. However, the data available does not allow us to precisely identify whether a firm is located in a rural or an urban area. We rely on a firm's name and the name of its administrative location. In column (4) we consider a narrow identification, that is, a firm that has the Chinese characteristic "*cun*" (or village) in its name or in the location name is treated as a rural firm. However, due to various ways of naming rural areas in China and the incomplete names of a large number of firms, this approach cannot well exclude some rural firms. In column (5) we consider a broader identification. That is, we additionally treat a "*zhen*" (or town) as a rural area. This approach, on the other hand, may incorrectly rule out some urban firms as some urban areas are named "*zhen*" in China. In fact, this approach reduces the sample size substantially. The regression results in columns (4) and (5), though not precisely defined, show that our main findings are robust.

Lastly, we cluster standard errors at both the city level and the industry level considering that firms may additionally cluster within industries. The results in column (6) show that the coefficient of the policy variable remains highly significant.

6.1.4 Heterogeneity issues

The above findings provide evidence that the hukou reform enabled firms to adjust employment more than similar firms located in non-reform regions. In this section, we consider the heterogeneity of these results based on firm ownership, region and exporter status.

We start by splitting the full sample into three sub-samples based on a firm's ownership, i.e. SOEs, private firms and foreign-invested firms.[22] This exercise is motivated by the fact that there are often strong barriers for rural migrants to find a job in SOEs whereas private and foreign firms are the main receivers of rural workers. The regression results are set out in columns (1) - (3) in Table 7. The results show that all types of firms have positive employment adjustment following the hukou reform; albeit small in magnitude and without significance in the case of SOEs. The stronger responses of private and foreign firms than SOEs confirm our expectation that the impact of the hukou reform on employment adjustment of SOEs is limited.

Considering the large geographical area of China, firms in different regions may react differently to the hukou reform. Our sample of reform cities spans widely across China from the most developed coastal region to the less developed western region. This allows us to explore possible regional differences in the effects of the hukou reform. To this end, we split the full sample into eastern, central and western regions, with economic and social development levels decreasing from east to west. We repeat our regressions for these three

[22] We run regressions based on firms without ownership changes during the sample period. We consider an alternative sample split that includes firms that changed ownership, the ownership of which is assigned as the one lasting for relatively longer, and the results are similar.

subsamples separately and the results are reported in columns (4) - (6). The coefficient of the policy variable is found to be significant in the eastern and the western regions while the impact of the hukou reform is insignificant in the central region. This implies that firms in the eastern and the western regions were more constrained by the hukou system before the reform. Of course, it must be recognised that pre- and post-hukou reform there was large scale, west-east migration taking place in China under the hukou system. This eastward migration can be expected to have contributed positively to labour shortages of firms in the western regions and negatively to those of firms in the east, albeit in the context of higher labour demand growth in the east than the west. Given, however, that this general or background migration was present throughout our sample period and that both reform and non-reform cities were affected by it, we do not believe that our estimated hukou reform effects are significantly affected.[23]

An additional concern is that exporters and non-exporters may respond differently to the hukou reform as exporters are often larger and more productive firms (Melitz, 2003; Bernard et al., 2003). In the last two columns of Table 7 we consider the difference between exporting and non-exporting firms. Following Almeida and Poole (2017), we define exporters as firms with positive exports in any of the sample years, and non-exporters as firms that never exported. As shown in Table B.1, 46% of firms exported at least once during the whole sample period. The regression results show that the hukou reform has a positive impact on both exporters and non-exporters. However, non-exporters responded more strongly than exporters. One potential explanation is that, to achieve higher productivity, exporters tend to use more capital-intensive inputs and high-skilled workers, and on average, shed employment (Menezes-Filho and Muendler, 2011). This also means for our case, that exporters were less sensitive to the hukou reform since this reform mainly induced the movement of relatively low-skilled rural workers into urban areas. Another possible explanation is that export firms are more likely to be located in special economic zones with less constrained labour market conditions prior to reform, and for whom the hukou reform involved a smaller labour supply shock and a smaller increase in labour market flexibility.[24]

[23] The insignificant coefficient for the central region could also be attributed to the relatively small number of reform cities. Only 8 out of 65 reform cities are from the central region. In unreported results, we include province-year fixed effects to capture the potential impact of migration at more aggregate level and our main results do not change much. The results are available upon request.
[24] We thank the anonymous referee for this explanation.

Table 7: Hukou Reform and Firm-level Employment Adjustment: Heterogeneous Results

	Panel A: Ownership			Panel B: Region			Panel C: Exporter Status	
	SOE	Private	Foreign	East	Central	West	Exporter	Non-exporter
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Policy	0.005	0.058***	0.041**	0.049***	0.010	0.057***	0.042***	0.055***
	(0.577)	(4.822)	(2.309)	(3.530)	(0.480)	(4.456)	(2.766)	(5.234)
ln(sales)	-0.043***	-0.079***	-0.096***	-0.070***	-0.096***	-0.101***	-0.078***	-0.079***
	(9.409)	(16.209)	(14.349)	(16.139)	(15.702)	(15.511)	(17.398)	(21.311)
Markup	0.004	0.016	-0.038***	-0.011	0.044**	0.038***	-0.007	0.015*
	(0.424)	(1.471)	(2.860)	(1.295)	(2.298)	(2.725)	(0.773)	(1.814)
Herfindahl index	-0.081*	0.064	-0.071	0.078	0.057	-0.051	0.107	-0.006
	(1.863)	(1.248)	(0.635)	(0.877)	(1.052)	(1.159)	(1.333)	(0.174)
Minimum wages	-0.047**	0.122***	-0.039	0.103**	0.075***	-0.032	0.059**	0.077***
	(2.582)	(5.118)	(0.765)	(2.615)	(2.758)	(0.950)	(2.376)	(3.686)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	57,767	495,784	168,362	605,151	145,668	81,487	406,496	425,814
R^2	0.299	0.239	0.248	0.238	0.248	0.253	0.238	0.242

Notes: This table reports various exercises that examine the heterogeneity of the main results. Eastern, central and western regions are divided based on firms' geographical location. The eastern region includes Liaoning, Beijing, Tianjin, Hebei, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, and Hainan. The central region includes Heilongjiang, Jilin, Shanxi, Henan, Anhui, Hubei, Hunan, and Jiangxi, and the western region includes Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang. A firm is defined as an exporter if it exported in any year of the sample period, and non-exporters are those that never exported. All specifications include firm and year fixed effects and a full set of firm-level and city-level control variables. Robust standard errors are clustered at the city level in all specifications.

* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

6.1.5 Nature and margins of employment adjustment

The above results reveal the impact of the hukou reform on employment adjustment along the intensive margin for firms that were established pre-reform. Employment adjustment could also be along the extensive margin, i.e. through firm entry. With increased labour supply, one may find it easier to start a business. We, therefore, expect that more firms were started-up in reform than non-reform regions, or that new firms were larger in terms of employment in reform than non-reform regions. To examine this hypothesis, we regress the log number of new firms and the log employment of new firms at the city level on the policy variable. The results are shown in Table 8. In columns (1) and (3) we control for city and year fixed effects. Columns (2) and (4) additionally control for initial city conditions interacted with year dummies to account for the potential endogeneity of the hukou reform. We can see that the coefficients of the policy variable are significantly positive in all specifications, indicating that more firms entered the market following the hukou reform and that those new firms employed more workers than those in non-reform regions. This provides supportive evidence that the hukou reform did not only affect employment adjustment along the intensive margin but also along the extensive margin.

Table 8: Hukou Reform and New Firms

	A: Number of New Firms		B: Total Employment of New Firms	
	(1)	(2)	(3)	(4)
Policy	0.263***	0.201**	0.325**	0.458***
	(3.340)	(2.515)	(2.494)	(3.373)
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Initial cond. × year	No	Yes	No	Yes
Observations	3,175	3,175	3,175	3,175
R^2	0.427	0.464	0.138	0.180

Notes: The dependent variables of panel A and B are the log number of new firms and the log employment of new firms for each city respectively. Initial city conditions include the log of local GDP per capita, the share of agriculture population, the employment share of non-SOEs, the share of industrial employment and the log of local fiscal expenditure per capita. Robust standard errors are clustered at the city level in all specifications.
* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

An alternative avenue for firm-level employment adjustment along the extensive margin is through firm exits. Increased labour supply following the hukou reform may allow relatively low-productivity firms that would have otherwise exited the market to stay. Due to missing information on firm exits, we are not able to examine this dimension of employment adjustment directly. We therefore turn to city-level analysis using aggregate employment levels as the dependent variable. Notice that city-level aggregate employment measures net employment dynamics incorporating employment adjustments along both the intensive margin for continuing firms and the extensive margin due to firm entry and exit. We report in Table 9 on the estimation of a city-level model of aggregate employment; in panel A for total manufacturing employment and panel B for total urban employment, in each case controlling

for city and year fixed effects and with and without initial city conditions interacted with year dummies. We find a positive hukou reform effect on aggregate employment for reform cities.

Table 9: Hukou Reform and City-level Employment

	A: Manufacturing Employment		B: Total Urban Employment	
	(1)	(2)	(3)	(4)
Policy	0.259***	0.090**	0.118***	0.084**
	(5.222)	(2.288)	(3.530)	(2.513)
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Initial cond. × year	No	Yes	No	Yes
Observations	3129	3129	3130	3130
R^2	0.096	0.259	0.294	0.389

Notes: The dependent variables of panel A and B are the log of manufacturing employment and total urban employment at the city level, respectively. Initial city conditions include the log of local GDP per capita, the share of agriculture population, the employment share of non-SOEs, the share of industrial employment and the log of local fiscal expenditure per capita. Robust standard errors are clustered at the city level in all specifications. * p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

6.2 Effects of trade liberalisation in the presence of the hukou reform

Our empirical results so far indicate that the hukou reform had a positive effect on firms' employment adjustment. In this section, we extend our empirical framework by considering trade liberalisation as one specific exogenous shock and evaluate the role of the hukou reform in shaping a firm's employment adjustment in response to trade shocks.

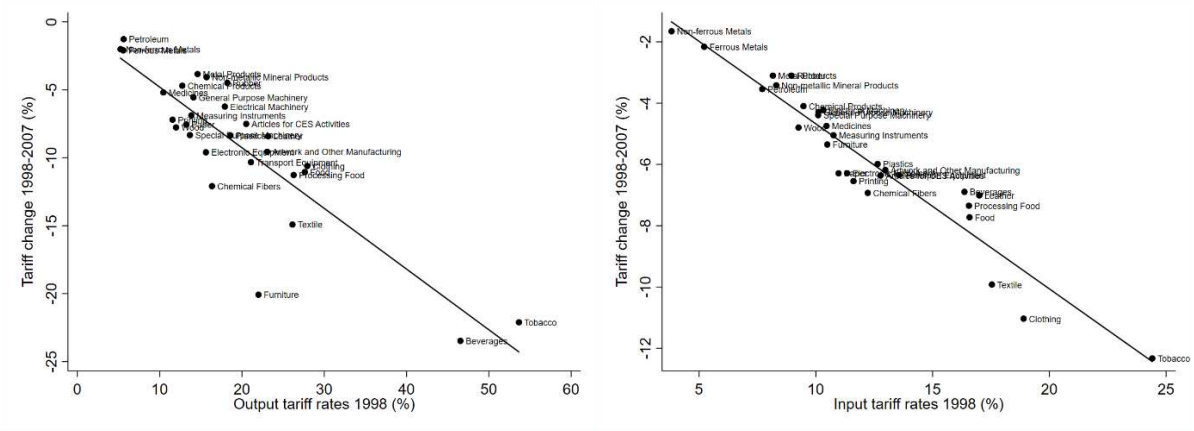
Table 10: Tariff Rates across Four-digit Manufacturing Industries (1998 and 2007)

	Output tariff rate (%)			Input tariff rate (%)		
	1998	2007	Change	1998	2007	Change
Mean	18.02	9.91	-8.11	11.47	6.16	-5.31
95th percentile	36.25	20.50	-22.00	18.41	9.67	-9.73
75th percentile	22.74	13.55	-11.38	13.14	6.87	-6.29
50th percentile	15.38	8.42	-6.19	10.49	5.74	-4.84
25th percentile	11.31	5.25	-3.01	9.33	5.21	-3.98
5th percentile	5.00	0.75	-0.50	6.40	3.69	-2.89

Notes: This table provides summary statistics for output and input tariff rates across 424 four-digit manufacturing industries in 1998 and 2007, respectively.

China joined the WTO during the sample period in 2001, and as a condition of accession was required to lower its tariffs on imports of both competing final goods (output tariffs) and intermediate goods (input tariffs) over the period up to accession and post-membership. The tariff rates used in our regressions are at the four-digit Chinese industry level. As shown in Table 10, the average output tariff rate was 18.02% in 1998 and dropped to 9.91% in 2007. There was significant variation in tariff rates across industries before China's accession to the WTO. Between the 5th and 95th percentiles output tariffs ranged from 5% to 36.25% and input tariffs from 6.4% to 18.41% in 1998. The nature of tariff reforms in China followed a similar

pattern to that in many other developing countries; industries with higher, initial tariffs experiencing larger tariff cuts, as shown in Figure 4 which plots the changes in tariffs against the initial (1998) rates for all (two digit) industries.



(a) Output tariffs (b) Input tariffs

Figure 4: Initial tariff rates and tariff changes between 1998-2007 for two-digit Chinese manufacturing industries

Our identification of the impact of tariff rates on employment adjustment rates relies on firms' differential exposure to tariffs across industries over time. Import competition induced by lower import tariff rates may have a negative effect on employment if firms shrink production or lower costs by reducing employment. However, if firms respond to competition by changing the production strategy, e.g. investing more in technology upgrading, this may increase employment if production expands as a result of higher efficiency. Reduced tariff rates on intermediate goods unambiguously allow firms to have access to imported inputs at lower costs, which contributes to productivity growth (Goldberg et al., 2010). This in turn may induce firms to expand employment.

A few studies have examined employment effects of tariff rate reductions in China. For example, Ma et al. (2015) find that trade openness increased industrial job creation but reduced job destruction. Using matched firm-level data and customs data, Rodriguez-Lopez and Yu (2017) document that output tariff reductions reduced employment for low-productivity firms and raised employment for high-productivity firms. The impact of input tariffs is similar in direction but weaker in significance and size. These findings offer important implications that firms adjust employment in response to trade liberalisation in China. Yet, none of these studies explore the role of labour market flexibility in shaping firm's employment adjustment.

To examine the conditioning effect of the hukou reform on firms' employment adjustment to the import liberalisation induced by tariff cuts, we modify equation (2) by including the lagged tariff rate and its interaction with the policy variable. The regression results are shown in Table 11.

Column (1) considers tariff rates on final goods. The coefficient on the output tariff is positive and significant; across the whole sample firms in more protected sectors are subject to higher employment adjustment, or alternatively, a larger reduction of output tariffs is associated with lower employment adjustments. The reliance on tariffs to measure protection for final goods producers may be an issue here, since lower tariffs may result in pressure for higher non-tariff measures (NTMs). This positive direct relationship between the output tariff and employment adjustment is maintained in column (3), albeit insignificant, where the direct hukou effect and its interaction with the output tariff are also included. The direct hukou effect on employment adjustment is positive, as we have already found. The coefficient of the interaction term, however, is negative and statistically significant. Taken together, the coefficients on these two variables imply that the positive hukou policy effect on employment adjustment tends to decline as the output tariff increases. Alternatively expressed in the context of a trade liberalisation episode, firms' employment adjustment in reform cities tended to increase as the output tariff declined; the larger the output tariff cut the greater the adjustment of employment in reform cities relative to non-reform cities. When input and output tariffs are simultaneously allowed for (column 4), we find no significant impact of output tariffs on firms' employment adjustment in non-reform cities; the greater employment adjustment with larger output tariff cuts being evident only for firms in cities subject to the hukou reform.

Table 11: Tariff Rate and Firm-level Employment Adjustment in the Presence of the Hukou Reform

	(1)	(2)	(3)	(4)
Output tariff	0.001**	0.000	0.001	0.000
	(2.056)	(1.165)	(1.449)	(0.191)
Input tariff		0.001		0.002
		(0.796)		(0.833)
Output tariff×Policy			-0.002***	-0.001***
			(5.113)	(3.098)
Input tariff×Policy				-0.004*
				(1.939)
Policy			0.072***	0.084***
			(6.007)	(4.732)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
City Controls	Yes	Yes	Yes	Yes
Observations	832,311	832,311	832,311	832,311
R^2	0.238	0.238	0.239	0.239

Notes: This table shows regression results of the impact of tariff rates on firm's employment adjustment conditional on the hukou reform. Input tariff rates are calculated as the weighted average of output tariffs using industry input shares as weights. Both output and input tariff rates are lagged by one year. All specifications include firm and year fixed effects, and a full set of firm-level and city-level control variables. Firm controls include the log of annual sales, the markup, four-digit industry indicators, and ownership types. City controls include city-initial characteristics interacted with year dummies, the Herfindahl index and the log of minimum wages. Robust standard errors are clustered at the city level in all specifications.
* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

Considering that imports of intermediate inputs subject to reduced tariff rates may affect firms' employment adjustment differently from final goods imports, we additionally include input

tariff rates in columns (2) and (4). Following the literature (e.g. Amiti and Konings, 2007 and Amiti and Cameron, 2012), input tariff rates are calculated as the weighted average of output tariffs using industry input shares as weights.[25] Imported intermediate goods are less likely to be subject to NTMs, however, and the taxing effect of import barriers is better captured therefore by our input tariff measure. The insignificant coefficients on input tariff rates in columns (2) and (4) of Table 11 indicate the absence of a direct effect of input liberalisation on employment adjustment. This is in line with Rodriguez-Lopez and Yu (2017) who find limited effects of input tariff reductions on firm-level employment in China. The insignificant coefficient in column (4) means that the reform of input tariffs did not influence firms' employment adjustment in non-reform cities. The coefficient of the interaction term between the hukou reform and the input tariff variable, however, is negative and significant. Any lowering of input tariffs during the tariff reform episode under consideration was associated, therefore, with increased employment adjustment for firms in reform cities only; the larger the input tariff cut the greater the adjustment of employment in reform cities. The coefficient estimates in column (4) in Table 11 imply that an average firm experiencing an average reduction in output tariff rates would have a 3.53% (0.001×8.11/0.23) higher employment adjustment rate following the hukou reform than the same firm that was not exposed to the hukou reform. An average firm experiencing an average reduction in input tariff rates would adjust employment by 9.23% (0.004×5.31/0.23) more with the hukou reform than the same firm without the hukou reform.

Given the concertina nature of the tariff reforms (with higher tariffs tending to be subject to absolutely larger cuts), we explore whether the findings in Table 11 for the whole sample are sensitive to the initial tariff level and the extent of tariff cuts. In Table 12 we report results of a re-estimation of specification (4) from Table 11 when the sample is split between firms facing imports subject to initially high (above median in 1998) and low (below median in 1998) output tariffs. The findings on how the hukou reform conditioned the effect of input tariff cuts is very similar to the full sample findings for both sub-samples. The conditioning effect of the hukou reform on output tariff cuts is only significant for firms for whom competing imports were subject to high initial tariffs and hence larger tariff cuts, although we continue to identify the same sign on the policy interaction term for the low initial tariff sample of firms. This pattern of findings is consistent with larger tariff cuts inducing more need to adjust employment by firms (than where smaller tariff cuts were involved), and for this adjustment it was more possible for firms located in reform cities.

In sum, the empirical results in this section suggest that trade liberalisation was associated with more employment adjustment by firms in cities subject to the hukou reform than in non-reform cities. Obviously, care is required in offering a causal explanation for this finding, but it is plausible to believe that economy-wide import liberalisation associated with national level trade reforms increased competition and opportunities for increased competitiveness as a result

[25] We use data of input tariffs from Brandt et al. (2017) who calculate input tariff rates using the 2002 China Input-Output table.

of the lower cost intermediate inputs within the Chinese economy. This increased the pressure on firms in both hukou reform cities and cities not subject to this reform to adjust, but the more flexible labour market conditions facing firms in reform cities allowed them to adjust employment more than firms in non-reform cities.

Table 12: Tariff Rate and Firm-level Employment Adjustment in the Presence of the Hukou Reform: Distinguishing Industries with High and Low Initial Output Tariff Rates

	Panel A: High Initial Tariff	Panel B: Low Initial Tariff
	(1)	(2)
Output tariff	0.000	-0.003***
	(0.433)	(2.876)
Input tariff	0.000	-0.002
	(0.095)	(0.704)
Output tariff×Policy	-0.002***	-0.001
	(2.653)	(0.864)
Input tariff×Policy	-0.006*	-0.005*
	(1.931)	(1.812)
Policy	0.106***	0.070***
	(4.210)	(4.058)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Firm Controls	Yes	Yes
City Controls	Yes	Yes
Observations	456,300	370,692
R^2	0.252	0.255

Notes: This table shows the estimation results of the impact of the hukou reform on firm-level employment adjustment by distinguishing industries with above median initial output tariffs (Panel A) and those with below median initial output tariffs (Panel B) in 1998. Firm controls include the log of annual sales, the markup, four-digit industry indicators, and ownership types. City controls include city-initial characteristics interacted with year dummies, the Herfindahl index and the log of minimum wages. Standard errors are clustered at the city level in all specifications.
* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

7 Conclusion

The recent literature on resource misallocation implies that a country suffers from productivity and output losses if resources are allocated inefficiently. One important source of misallocation comes from factor market distortions. In particular, in an economy with distorted factor markets, firms do not determine optimally their use of production inputs. This paper adds to the literature by empirically examining how a reduction in labour market distortions affects employment adjustment of firms in China, and thus sheds lights on understanding the mechanisms through which factor market distortions affect resource misallocation. China presents an especially interesting case due to its historically highly rigid labour market where distortions arise from the hukou system that restricts the free movement of workers across the country and the hukou reform initiated in 2001 that reduced barriers to mobility. This paper is also distinctive in providing the first empirical evidence of the impact of the hukou reform on firms' employment decisions in China.

In this paper, we use a rich panel of firm-level data of Chinese manufacturing firms between 1998 and 2007 and data on a set of cities that implemented the hukou reform by the end of 2005. Our identification of a causal relationship between the hukou reform and firms' employment adjustment relies on the non-uniform implementation of the reform across cities, which provides a useful source of variation that allows us to use a DiD approach, and information on the pre-reform market structures. Our main findings indicate that labour market flexibility induced by the hukou reform increased employment adjustment at the firm level. Greater employment adjustment by firms in reform cities post-reform induced, however, both increases and reductions in employment in individual firms, even though employment increased overall in reform cities through the intensive (existing firms) and extensive margins (firm entries and exits).

The paper specifically explores how the trade policy reforms associated with WTO membership fashioned the effects of hukou reform on employment adjustment. We find evidence of larger tariff cuts being associated with greater employment adjustment in hukou reform cities (relative to non-reform cities). This finding is consistent with national trade reforms inducing the need for greater adjustment by Chinese firms in general, but with firms operating under more flexible labour market conditions being able to adjust employment levels to a greater extent.

These findings offer important policy implications. Though some regions have attempted to remove barriers to labour movement in recent years, the Chinese labour market is still far from being flexible due to various additional constraints from the hukou system and the imperfect social welfare system. The positive impact of the hukou reform on firms' employment adjustment implies that many firms which continue to be subject to constrained labour mobility imposed by the hukou system are likely to have non-optimal factor mixes and lower productivity. Consequently, higher output levels could be achieved if those barriers were eliminated. Our findings also point to the potential benefits of labour market reforms in other countries that experience policy and other constraints that reduce the geographical mobility of labour.

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Appendices

A. Propensity score matching and the determinants of the hukou reform

The basic idea of matching is to select non-reform cities that are most similar to reform cities based on the propensity score. The propensity score is the *ex ante* probability of being treated conditional on a set of pre-treatment observable characteristics. To estimate the propensity score, we run the following probit model:

$$P(city_{ct} = 1) = F(\boldsymbol{X}_{c,t-1})$$

where $city_{ct}$ is an indicator variable that equals to 1 for reform cities and 0 otherwise, and $P(city_{ct} = 1)$ is the probability of being selected as a reform city. *t (=2001, 2002, 2003, 2004,* and *2005)* denotes reform cohorts. $F(\boldsymbol{X}_{c,t-1})$ is the normal cumulative distribution function of a set of lagged covariates $\boldsymbol{X}_{c,t-1}$. There is no conclusive evidence in the literature on the choice of the covariates. However, $\boldsymbol{X}_{c,t-1}$ should explain why a city was selected as a hukou reform city. The official reform guideline document indicates that cities with a need for workers but without a corresponding capacity to accommodate immigrants should be cautious of implementing the reform. Thus, the determinants of the hukou reform should at least include both the demand side and the capacity side. Specifically, we consider local GDP per capita, the share of non-SOEs, agricultural population share and industrial employment share to capture the demand effects and local fiscal expenditure per capita to capture the capacity effects.

Matching is performed based on the predicted probability, i.e. the propensity score, such that each reform city is matched with a non-reform city that has the closest probability. In other words, the matched counterpart city c_{nr} for reform city c_r is selected by minimizing $|P_r - P_{nr}|$, where P_r and P_{nr} are the estimated propensity score for cities c_r and c_{nr}, respectively.

One crucial assumption of the propensity score matching is the common support condition. It means that cities with the same pre-reform characteristics have a positive probability to be selected as a reform or a non-reform city. To satisfy this condition, all treated cities with a propensity score higher than the maximum or lower than the minimum score of the non-reform cities are dropped.

Since the timing of the hukou reform varied across cities, we do the matching year by year. For example, we treat cities that implemented the reform in 2003 as treatment group and all other non-reform cities as control group and match non-reform cities for the 2003 cohort. To avoid a potential impact of the timing on the selection of control cities, we use matched non-reform cities again for the matching of other cohorts.[A.1] As such, a non-reform city could be matched

[A.1] Considering that only two cities implemented the reform in 2001, we combine these two cities with the 2002 cohort and run regressions based on the city-level characteristics of 2000.

more than once, which guarantees the best matches.

Table A.1 shows the probit regression results that examine the determinants of the hukou reform. Cities with a higher level of GDP per capita and a higher proportion of agriculture population are more likely to implement the hukou reform. The coefficient of the share of non-SOE employment is positive and significant, indicating that a higher share of non-SOEs is associated with a higher probability of the reform. This is true given that migrant workers are usually not allowed to work in SOEs. Cities with a higher share of industrial employment tend to be more likely to reform. We use fiscal expenditure per capita to capture the fiscal pressure of the local government since the hukou reform is costly and potentially involves higher fiscal expenditure on the immigrants. As expected, the estimated coefficients are negative. This implies that cities with a high fiscal pressure are less motivated. Column (5) based on the full sample show similar results.

Table A.1: Determinants of the Hukou Reform: Probit Regressions

	Cohort				Full sample
	2002	2003	2004	2005	
	(1)	(2)	(3)	(4)	(5)
GDP p/c	0.093***	0.112***	0.096**	0.045*	0.247***
	(2.849)	(3.003)	(2.238)	(1.956)	(4.060)
Agriculture population share	0.006***	0.002*	-0.000	0.002**	0.006***
	(3.570)	(1.798)	(0.162)	(2.414)	(2.654)
Non-SOE employment share	0.000	0.003***	0.001*	-0.000	0.002**
	(0.969)	(3.304)	(1.730)	(0.217)	(2.443)
Industrial employment share	0.002**	0.001	0.009*	0.002***	0.002
	(2.378)	(0.645)	(1.897)	(3.172)	(1.027)
Fiscal expenditure p/c	-0.005	-0.107***	-0.046	-0.004	-0.110*
	(0.185)	(2.594)	(1.113)	(0.406)	(1.706)
Observations	223	274	274	257	275

Notes: This table reports the marginal effects derived from probit regressions: $reform_{ct} = \alpha + \beta \boldsymbol{X}_{c,t-1} + \varepsilon_{ct}$, where $reform_{ct}$ is a binary variable indicating whether a city implemented the hukou reform in year t, $\boldsymbol{X}_{c,t-1}$ is a vector of pre-reform city characteristics in year $t-1$, and ε_{ct} is the error term. Cohort 2002 includes cities that implemented the hukou reform in 2001 and 2002 and all non-reform cities. Cohorts 2003 to 2005 include cities that launched the hukou reform in that year and all non-reform cities. Columns (1) to (4) report the regression results based on each cohort respectively. Column (5) includes all reform and non-reform cities regardless of reform years, and the reform city dummy is regressed on the city characteristics of 2000. Robust standard errors are calculated in all specifications.
* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

Following the probit model regressions, we match reform and non-reform cities according to the propensity score. Table A.2 shows the number of cities and the number of firm-level observations for the treatment and the control groups before and after matching. We include all non-reform cities as the control group in the matching for each group of reform cities. While this ensures the best matching between reform and non-reform cities, it reduces the number of control cities as a non-reform city could be matched more than once. We eventually have 52 non-reform cities that are matched with 61 reform cities. The corresponding number of firm-

level observations reduces to 234,085 for the treatment group and 249,932 for the control group. After matching, reform and non-reform cities have no systematic difference in observed characteristics. In other words, the matched reform and non-reform cities have a similar probability to be selected as a reform city.

Table A.2: Number of Cities and Observations before and after Matching

	Before matching		After matching	
	Treatment	Control	Treatment	Control
Number of cities	65	262	61	52
Number of observations	263,593	639,712	234,085	249,932

B. Figures and Tables

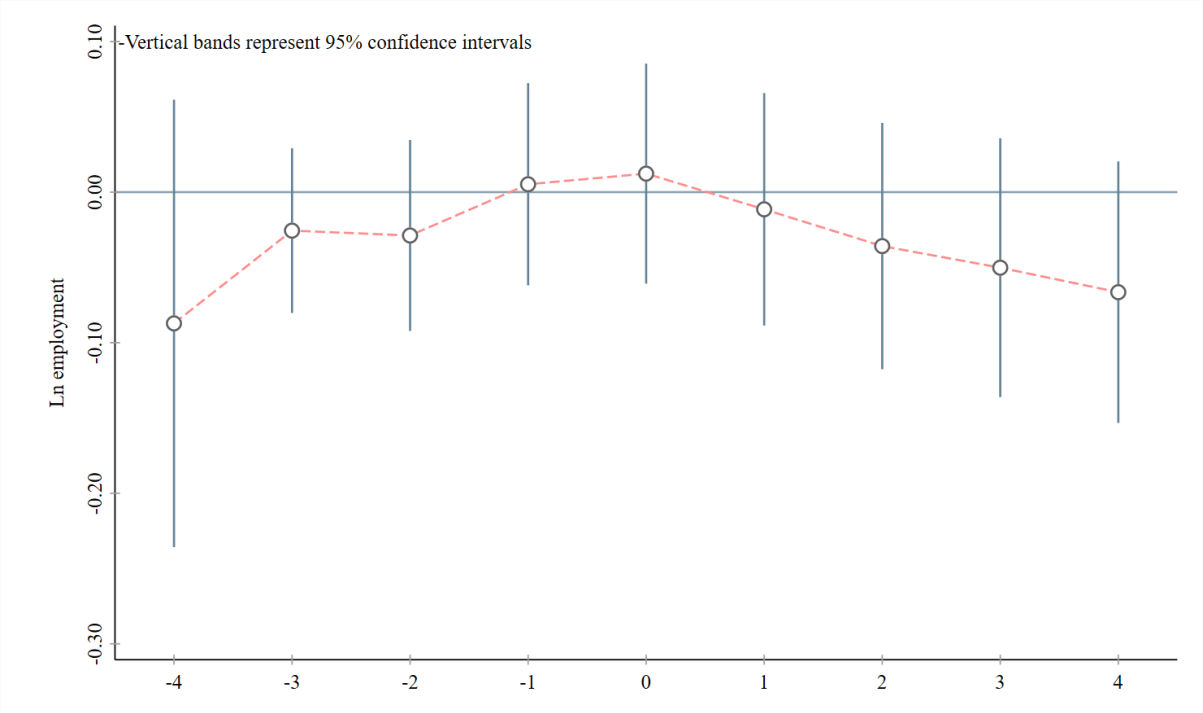

Figure B.1 Time Trend of Firm-level Employment around the Year of the Hukou Reform

Notes: This figure shows the estimated coefficients and 95 percent confidence intervals from a regression of the log of employment on a set of reform time dummies controlling for firm-level and city-level characteristics as well as year fixed effects.

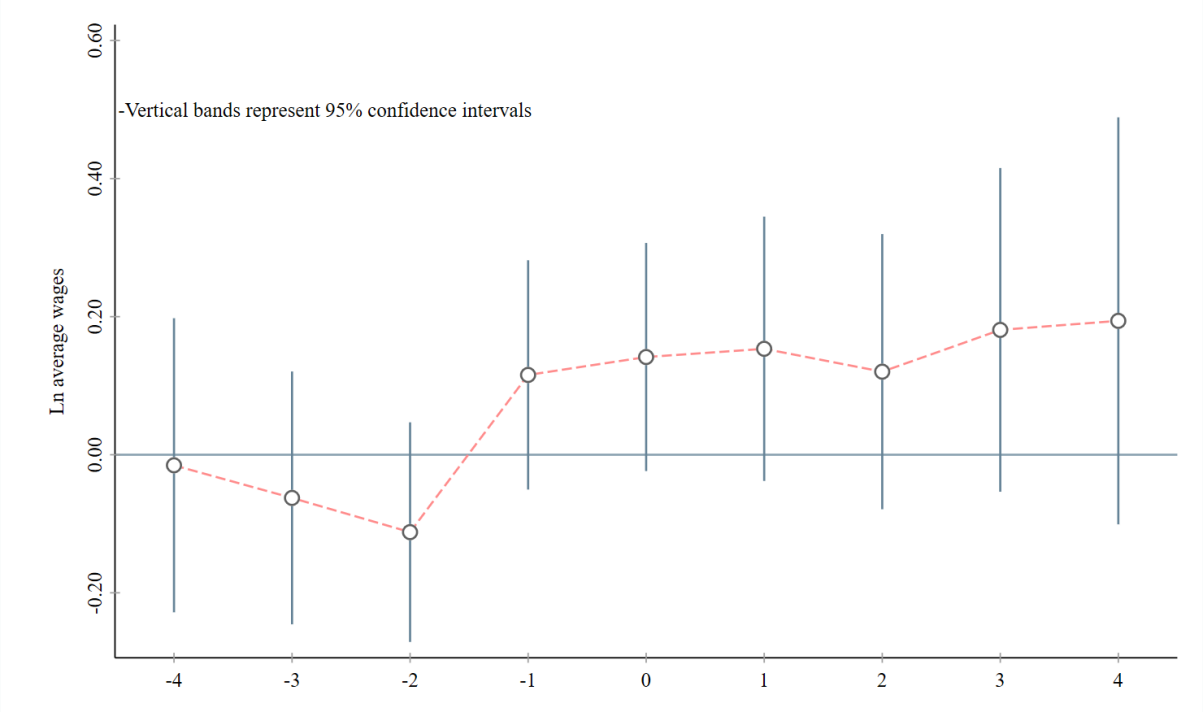

Figure B.2 Time Trend of Firm-level Average Wages around the Year of the Hukou Reform

Notes: This figure shows the estimated coefficients and 95 percent confidence intervals from a regression of the log of firm-level average wages on a set of reform time dummies controlling for firm-level and city-level characteristics as well as year fixed effects.

Table B.1: Summary Statistics

Variable	Full Sample		Reform Cities		Non-reform Cities	
	Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)
Firm-level Characteristics						
Employment adjustment rate	0.23	0.41	0.21	0.38	0.24	0.42
ln (sales)	10.15	1.38	10.41	1.33	10.03	1.39
Markup	1.04	0.15	1.04	0.12	1.04	0.16
SOEs	0.13	0.34	0.08	0.27	0.16	0.36
Private	0.65	0.48	0.67	0.47	0.64	0.48
Foreign	0.22	0.41	0.25	0.43	0.21	0.41
Exporter	0.46	0.50	0.51	0.50	0.44	0.50
Eastern region	0.70	0.46	0.86	0.35	0.63	0.48
Central region	0.19	0.39	0.03	0.18	0.25	0.43
Western region	0.11	0.31	0.11	0.31	0.11	0.32
Observations	903,305		263,593		639,712	
City-level Characteristics						
ln (GDP p/c) (2001)	8.80	0.68	9.17	0.66	8.70	0.65
Agricultural population share (2001)	70.33	17.52	70.82	14.74	70.20	18.17
Non-SOE share (2001)	54.58	22.31	69.14	16.92	50.96	22.01
Industrial employment share (2001)	6.54	0.62	6.57	0.72	6.53	0.60
ln (fiscal expenditure per capita) (2001)	0.21	0.12	0.26	0.12	0.20	0.11
Herfindahl index	0.13	0.15	0.08	0.11	0.14	0.15
ln (minimum wages)	1.15	0.32	1.24	0.35	1.13	0.30
Observations	3,213		641		2,572	

Table B.2: Hukou Reform and Firm-level Employment Adjustment: Robustness Checks Based on Even Years

	Baseline	+Firm controls	+City controls
	(1)	(2)	(3)
Policy	0.018*	0.029***	0.030***
	(1.800)	(2.848)	(2.716)
ln(sales)		-0.084***	-0.083***
		(22.740)	(22.818)
Markup		0.004	0.006
		(0.435)	(0.722)
Herfindahl index			-0.003
			(0.060)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm controls	No	Yes	Yes
City controls	No	No	Yes
Observations	433,460	399,304	398,359
R^2	0.333	0.347	0.348

Notes: This table reports the DiD regression results for even years. All control variables are the same as those in Table 4. Robust standard errors are clustered at the city level in all specifications.
* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

Table B.3: Hukou Reform and Firm-level Employment Adjustment: Robustness Checks Using Alternative Samples

	Exclude Discontinuous Firms	Continuous Firms Only
	(1)	(2)
Policy	0.054***	0.016*
	(4.334)	(1.659)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Firm controls	Yes	Yes
City controls	Yes	Yes
Observations	810,345	699,854
R^2	0.244	0.304

Notes: This table reports the DiD regression results by using alternative samples that exclude discontinuous firms and include continuous firms only, respectively. All control variables are the same as those in Table 4. Robust standard errors are clustered at the city level in all specifications.
* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

Table B.4: Hukou Reform and Firm-level Employment Adjustment: Robustness Check with Firm Exits

	Without Firm Exits	With Firm Exits
	(1)	(2)
Policy	0.070***	0.061***
	(3.389)	(2.943)
Firm FE	Yes	Yes
Year FE	Yes	Yes
Firm controls	Yes	Yes
City controls	Yes	Yes
Observations	106,553	107,126
R^2	0.237	0.267

Notes: This table reports the DiD regression results with and without exiting firms for the textile and clothing firms. The employment adjustment rate for the exiting year is set to 2. All control variables are the same as those in Table 4. Robust standard errors are clustered at the city level in all specifications.
* p <0.1, ** p <0.05, *** p <0.01. Absolute t values in parentheses.

Author Statement

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