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Abstract

In this paper we examine the impact of foreign direct investment (FDI) on local urban wage inequality in China. We find that the within-city college premium is larger for cities characterized by a higher degree of FDI penetration. We then try to establish the causal impact of FDI penetration on city inequality using historical Christian influence as an instrumental variable. In addition, firm-level evidence shows that FDI has amplified both between-firm inequality and within-firm inequality. FDI firms do not only hire relatively more high-skilled workers but also provide relatively higher wages to high-skilled workers compared to domestic firms. Finally, an individual-level analysis shows that FDI has a spillover effect on low-skilled workers, but the magnitude of that effect is much smaller than the effect on high-skilled workers.

Keywords: foreign direct investment; skill premium; inequality; China

JEL classification: F21; R11; I30

1 Introduction

It has been over three decades since the People's Republic of China (PRC) implemented its economic reforms and opening-up policy. Figure 1 shows that there is a strikingly increasing trend in FDI inflows since the 1980s. In 2012, China surpassed the United States for the first time to be the world's largest recipient of global foreign direct investment.[1] Undoubtedly, foreign direct investments have played a very important role in China's economic development. At the same time, overall inequality has been increasing in China, with a Gini coefficient around 0.3 in the early 1980s and as high as 0.47 in 2012.[2] There are a large number of studies on the connection between FDI and inequality (Goldberg and Pavcnik, 2007), but most of them focus on the potential contribution of FDI to regional development and thus interregional inequality (Lessmann, 2013; Wan, Lu and Chen, 2007; Yang, 2002). Little attention has been paid to how FDI can affect the local labor market and local inequality, which is the main focus of this paper.

In this paper, we will investigate the effect of FDI on within-city inequality. This is an important issue for several reasons. First, within-city inequality is a significant aspect of overall inequality. The most recent literature on urban economics has documented that the rising inequality in big cities has contributed significantly to the increase in overall inequality in the US (Baum-Snow and Pavan, 2013). A recent

[1] This refers to the FDI inflows in 2012 by Chinese mainland and Hong Kong. The data comes from the World Investment Report 2016 published by the United Nations.
[2] See Gustafsson, Li and Sicular (2008) and Wan, Ye and Zhuang (2012) for more information.

study on China has also shown that the proportion of within-city inequality in overall inequality has increased from 74% in 1992 to 81% in 2009 (Chen, et al, 2016). Second, recent studies have shown that within-city comparison is more closely related to people's happiness. Knight, Song, and Gunatilaka (2009) find that the comparison within a village is more relevant to local people's feeling of satisfaction. Jiang, Lu and Sato (2011) find that within-city inequality is strongly associated with local happiness. Therefore, understanding how FDI is connected to local inequality has implications for welfare. Moreover, by focusing on city-level urban inequality, we can avoid the potential measurement issue of interregional inequality. Li and Gibson (2013) have shown that the role of interregional inequality for rising inequality can be overestimated due to the lack of consistent measures of real income at the regional level. In addition, as the urbanization process progresses over time in China, the policy relevance of analyzing urban inequality should become increasingly significant. To the best of our knowledge, this paper is the first attempt to examine how local urban inequality is affected by FDI.

There have been a large number of studies on FDI and inequality in the literature, but the results are highly mixed. Some studies find evidence that FDI has contributed to countries' rising inequality (Feenstra and Hanson,1997; Wan, Lu and Chen, 2007; Basu and Guariglia, 2007; Sun and Chai,1998; Wei, Yao and Liu, 2009; Chen, Ge and Lai 2011). Other studies find that the impact of FDI on inequality is non-monotonic and that it depends on the level of economic development or human capital (see Pica, Mora and Rodríguez, 2011; Lin, Kim and Wu, 2013; Lessmann, 2013). The results in

these previous studies heavily depend on the level of inequality that is analyzed. Most of the existing contributions in this field focus on country-level or cross-regional inequality.

This paper contributes to the literature by examining this issue from a new angle, that of within-city inequality. We construct a skill premium for each city using individual information from the 2005 main census. The advantage of using city-level analysis is that it more effectively deals with the location sorting issue of FDI. We find a strong and positive association between the share of FDI in total capital and within-city inequality after controlling for factors that can affect FDI inflows and local inequality simultaneously, such as average income, city size, and infrastructure. This result is also robust to various measures of FDI penetration.

Furthermore, we explore the potential mechanisms using both individual and firm-level information. First, we find that the composition effect of FDI does exist. FDI firms on average employ relatively more skilled workers. This is consistent with Feenstra and Hanson (1997), who find that growth in FDI is positively correlated with the relative demand for skilled labor in Mexico. Additionally, we find that FDI firms pay higher average wages after controlling for employees' educational composition. This implies that FDI firms pay skilled workers relatively more than domestic firms. Since FDI firms are on average more productive than domestic firms, this finding is consistent with the theoretical prediction in Helpman, Itskhoki and Redding (2010).

This study is inspired by the recent increasing interest in local labor market impacts of foreign competition through imports. In an influential study, Autor, Dorn

and Hanson (2013) find a strong negative effect of imports from China on local employment and wages in the US. We pose the question of how FDI affects local inequality through its impact on local employment. Specifically, we want to examine whether FDI only changes the spatial distribution of labor (i.e. the composition effect), or if FDI firms also reward skills differently from domestic firms due to characteristics such as technology adoption (i.e. the wage effect). Our paper is most closely related to Sheng and Yang (2016), who focus on offshoring and wage inequality in China. They show that ownership structure can affect FDI's relative labor demand and thus the role FDI has for inequality. Our paper differs from their research by emphasizing a city-level analysis and dealing with potential endogeneity issues more explicitly using an instrument variable approach.

We adopt a novel instrument variable approach to deal with the endogeneity issue. Inspired by the literature related to the long-term influence of culture on development (Jia, 2014; Acemoglu and Robinson, 2012; Diamond and Robinson, 2010; Nunn, 2009), we explore the historical distributional pattern of Christian converts in China. The fact that the spread of church activities was not only determined by geographic or economic reasons, but also by exogenous natural disasters, such as floods, draughts or diseases makes it a valid instrument variable for FDI. The IV results are strongly consistent with the OLS results. In addition, we also provide evidence using individual-level information to further support our main findings.

This paper is in line with the large volume of literature on FDI and inequality. Lessmann (2013) finds that whether FDI increases regional inequality or not is

dependent on economic development. FDI expands regional inequality in poor countries, but has no significant effect in high-income countries with higher mobility and better policies. Wei, Yao and Liu (2009) argue that it is not FDI, but the uneven distribution of FDI that contributes to the increase in regional inequality. Lin, Kim and Wu (2013) find that there is a non-monotonic impact of FDI on income inequality, depending on the level of human capital. Basu and Guariglia (2007) find that FDI promotes both growth and inequality using country-level data. Pica, Mora and Rodríguez (2011) establish a theoretic model on FDI and income. The model predicts that FDI benefits the high- and low-income workers, but makes the middle-income workers worse off. This implies that the relationship between FDI and total income inequality could be ambiguous or non-monotonic.

Several studies have analyzed the relationship between FDI and inter-provincial inequality in China. Sun and Chai (1998) investigate the effect of FDI on growth in the eastern and western regions from 1986 to 1992. They find a growing effect of FDI in the east, but only weak effects in the west and conclude that FDI has contributed to the rise of regional inequality in China. Wan, Lu and Chen (2007) investigate the impacts of FDI on regional income inequality in China, and find that FDI contributes to the rising of income inequality across regions. Chen, Ge and Lai (2011) find that FDI can increase between-firm wage inequality and incur a negative spillover effect on wage paid by domestic firms. This paper contributes to this literature by investigating within-city inequality and FDI penetration, and how FDI affects within-firm inequality.

The following sections are organized as below: Section 2 describes the data sets used in the paper and provides some preliminary patterns. Section 3 shows the main empirical results. In the section 4, we explore the potential mechanisms. Section 5 concludes the paper.

2 Data

There are three main sources of data explored in this paper: individual-level information used to construct college premium at the city level, city-level data on other city characteristics, and firm-level information to discuss the mechanisms.

Our wage income data used to calculate skill premium come from China's population survey in 2005. It was conducted by the National Bureau of Statistics (NBS) and is nationally representative. It is the largest Chinese dataset available with individual wage income information. The respondents are randomly selected from each of China 2,861 counties using a three-stage cluster sampling method (Zhang et al., 2005). Our sample is a subset of the original survey,[3] which contains 2,585,481 observations that are randomly drawn from the NBS dataset.

In this paper, we use prefecture cities in 2005 as our geographic units. There are 339 cities in the census data, including four municipalities and 335 prefecture-level cities. One prefecture city includes a central urban area and its affiliated towns and rural areas. For the purpose of our analysis, we exclude the rural areas and focus on the urban neighborhoods only. To do this, we use information on Hukou identity. The

[3] The original data is not available. This is the only subsample of the census available for analysis.

Hukou or household registration system is a system under which each person got an identity according to his/her birthplace.[4] The very strict Hukou system separates people into two groups, those with urban Hukou identity and those with rural Hukou identity. Only people with rural Hukou have been assigned farmland. We separate people in each city into three groups: with local rural Hukou, with local urban Hukou and without local Hukou. In this paper, we want to focus on urban inequality and therefore exclude observations with local rural Hukou. One potential issue is that we may end up excluding individuals with local rural Hukou but living and working in an urban area. In our robustness check, we include both urban and rural residents in our analysis and the results are consistent. Moreover, for the whole analysis we focus on the observations older than 15 and younger than retiring ages (55 for women and 60 for men). In addition, we only consider individuals who had a job at the time when he/she was interviewed.

It should be noted that income information from the survey is monthly wage income. We use monthly wage divided by weekly working hours as the proxy for hourly wage. This is the best feasible measure since weekly income or monthly working hours are not available. Our measure is consistent with hourly wage when all workers worked approximately for the same number of hours each week, or if it was the average of weekly work hours reported. There are six education levels in the census: no education, primary school, middle school, high school, college and graduate school or above. College premium is calculated as the difference between the

[4] Please refer to Liu (2005), Chan and Buckingh (2008), Chan (2009), and Lu *et al*. (2013) for introduction of both the history and the reform of the Hukou system.

log of the average wage received by those with college education or above and the log of the average wage received by others.

Two sources of FDI information are explored in this paper: one is City Statistics Yearbooks and the other is the First National Economic Census in 2004. With both sources, we combine investment from foreign countries with investment from Hong Kong, Macao and Taiwan (HMT) and use the sum as our definition of overall FDI unless clearly specified otherwise. We examine these two types of FDI separately in the discussion of mechanisms. In City Statistics Yearbooks, there are three aspects of information on FDI penetration: the foreign/HMT FDI inflows, the number of foreign/HMT firms and the revenues from foreign/HMT firms. We use this information to construct two stock measures of FDI penetration: the share of the number of FDI firms and the share of FDI revenues in total output.

The First National Economic Census in 2004 was conducted by the National Bureau of Statistics (NBS) in China. We only have the access to data on manufacturing firms which account for about 80% of overall FDI in China. It includes all the state-owned enterprises (SOEs) and other enterprises with annual sales above RMB 5 million and covers 276,274 firms in total. Following Yu (2015), we exclude data with obvious measurement issues.[5] The data contain complete information on firms' accounting statements. Five categories of ownership capital are reported: national capital, collective capital, private capital, foreign capital and HMT capital. We aggregate firm capital up to city level and calculate the share of the foreign and

[5] See Yu (2015) for detailed information on the data.

HMT capital stock in total capital for each city. This ratio varies from less than 0.01% to 85% and has a mean of 13% (see Table A.1). We use this measure as the degree of FDI penetration in our main analysis and alternative measures in our robustness checks.

An alternative measure of FDI penetration constructed from this data set is the share of employment by FDI firms including foreign invested firms and HMT firms. A firm is defined as a foreign-invested firm if the share of foreign investment in total capital is higher than the share of HMT investment and the share of state-owned investment. Similarly, a firm is defined as a HMT-invested firm if the share of HMT investment in total capital is higher than the share of foreign investment and the share of state-owned investment.[6] According to this definition, foreign invested firms account for 10.1% and HMT firms account for 9.8%. The rest (80.1%) include state-owned firms (SOEs), collectively owned firms, private firms and others.[7] It can be seen from Table 1 that the share of FDI employment in manufacturing varies from less than 0.01% to 94% with the mean equal to 21% (see Table A.1). When we use alternative measures, we obtain results that are consistent with our initial findings.

3 FDI and urban inequality

3.1 Empirical specification and IV strategy

To analyze the relationship between the college premium and FDI penetration at the city level, we use the following model specification:

[6] It can be shown that our results are not sensitive to this definition of firm types.
[7] It should be noted that our definitions of foreign invested firms and HTM firms are broader than those in Chen, Ge and Lai (2010). That's why the share of FDI firms is a bit higher here.

$$college\ premium_c = a_0 + a_1 FDI\ penetratoin_c + a_2 X_c + R_{region} + \varepsilon_c$$

where *college premium* is the degree of income inequality in city *c*. FDI penetration is the degree of influence of overseas capital in the city's economy. X_c includes city-level control variables, such as city size, average income, exports and infrastructure. Finally, R_{region} represents regional fixed effects.[8]

Our goal is to identify the causal link between FDI penetration and the college premium. A key challenge in doing so is potential endogeneity. There are three potential reasons for endogeneity here: First, measurement errors in inequality that are correlated with city characteristics, such as city size and per capita income, can lead to endogeneity. Our measures of inequality are calculated from census data. As in any other census, there is an upper bound in income which could cause underestimation of inequality, and the magnitude of this error could be greater in larger or wealthier cities. Previous research has shown that market size is one of the main determinants of FDI location choice. This could lead to an overestimation of the effect of FDI on inequality. Second, FDI and inequality could be simultaneously determined by underlying city characteristics, such as geographic location, city size, human capital and so on. This could result in an overestimation of the FDI coefficient as well. Third, the college premium itself could affect FDI location since it can be an indication of local fairness and the quality of institutions. This raises concerns for potential reverse causality.

[8] If province fixed effects are controlled for, the sign pattern of the coefficients will not change but less significant.

We have tried to deal with the above issues in several ways. We first control for city characteristics that can determine FDI location choice. Cheng and Kwan (2000) study the location pattern of FDI firms in China and find that market size, infrastructure, wage cost and education are the main determinants of FDI inflows. Therefore, we control for city size, average income, infrastructure and educational composition at the city level. Furthermore, we also control for government policy, industry compositions and regional fixed effects. This will also help minimize the possibility that these characteristics can affect FDI and some other aspects of the economy at the same time and thus lead to a positive correlation between FDI and inequality. Also, FDI firms tend to be big exporters. In order to capture the effects of FDI but not exports, city-level export is also controlled for.

We also adopt an instrument-variable approach to further deal with the endogeneity issue caused by measurement errors and reversed causality. Our instrument variable is the historic degree of foreign culture influence. This is inspired by the literature on history and economic development as reviewed thoroughly by Nunn (2009). We use the share of primary students from missionary schools in the total population in the 1920s as the instrument variable for FDI penetration. The information is compiled from The Christian Occupation of China, which contains detail county-level data on the numbers of Protestant converts, missionaries, and churches in 1920s. We first aggregate the data to city level and then match it with current city-level data.

Figure 4 shows the geographic pattern of missionary school penetration. As

expected, the degree of Christian penetration is relatively high along the coastal regions since these areas were historically more open to foreigners due to treaty ports and occupation by foreign countries. However, some inland regions also experienced a very high level of Christian penetration as missionaries targeted certain regions to help local residents get through natural disasters, such as floods, draughts and pestilence. We believe that this pattern can make this variable valid as an instrument variable. Chen, Wang and Yan (2014) find that Christian historical activity has a significant effect on contemporary openness to foreign direct investment in China. In addition, the Christian distribution in the 1920s, which is more than half a century prior to the beginning of reform and openness, should not have any direct effects on the local income inequality in the 2000s. One concern on its validation as IV is that foreign culture influence can have long-run impacts on inequality through other aspects, such as institutions, human capital and international trade. However, we control for institutions, city size, average income, exports and human capital and believe that this issue is sufficiently dealt with when doing so. Results on the first-stage regression in Table A.2 further confirm the validation of our instrumental variable.

3.2 Baseline results

The baseline results are reported in Table 1. The dependent variable is the college premium as defined in section 3.1 and regional fixed effects are included in all regressions. Here, we use the share of foreign and HMT capital in total capital as the measure of FDI penetration. The first four columns show the OLS results. In column

(1), we see that correlation between FDI and inequality is positive and significant, with a coefficient of 0.49. This implies that, within a region, a 1% higher degree of FDI penetration is associated with a 0.49% higher college wage relative to non-college wage. When market size and average wage are controlled for in column (2), the coefficient on FDI penetration decreases by 25% but remains significant. This is consistent with the potential upward bias caused by missing variables. In column (3), FDI policy, infrastructures and industrial compositions are further controlled for. ETDZ is a dummy that is equal to one if the city has at least an economic and technological development zone in 2005. It can thus be seen as a proxy for FDI policy. Length of highways per squared kilometer and length of railroad per squared kilometer are used as proxies for infrastructure. Industrial composition is measured by the share of manufacturing outputs in GDP and used to control for spatial allocation of industries and its simultaneous influence on both FDI location and the college premium. The results show that FDI penetration is still significantly correlated with college premium, but the coefficient has decreased by another 22%. In column (4), after the share of college workers is controlled for, the coefficient decreases further to less than 40% of that in column (1) but still remains positive and significant. It should be noted that on the one hand the decrease in the size of the FDI coefficient after adding more control variables can be due to the upward bias from omitting variables. On the other hand, by controlling for factors that can affect FDI and inequality simultaneously, the total effect of FDI can be underestimated. This is because we shut down channels (e.g., education, market size and income) through which FDI can

affect inequality.

Column (5) in Table 1 reports the results from the IV regression. The coefficient for FDI is positive and significant which is consistent with the OLS results. This means that FDI penetration does contribute to a higher college premium in some cities. The first-stage F-statistics is 21.06, which indicates that weak instrument variable problem does not constitute an issue. In addition, the coefficients for city size and income are also in line with those from the earlier regressions. The college premium is higher in larger cities, a finding that is consistent with the results in the literature on city size and inequality (Baum-Snow and Pavan, 2013; Chen, Liu and Lu, 2016). Average income is not significantly associated with inequality after other factors are controlled for.

Next, we construct a panel data set and control for city fixed effects to avoid the potential issues of simultaneity and missing variables caused by city characteristics that do not change over time. We calculate the city-level college premium using information from urban household surveys for 16 provinces from 2000 to 2009. Due to a smaller sample size at city level, the number of cities in each years varies from 86 to 163. This implies that small cities are not included in this analysis. FDI penetration is measured by the share of revenues from FDI firms in GDP from City Statistic Year Books for the period 2000-2009. When we do this, we find that the effect of FDI penetration is still significant and positive, thereby further confirming our earlier findings.

In addition, Table 2 reports the results using three alternative measures of FDI penetration: share of FDI employment in total employment, share of FDI firms and share of FDI in total capital. The analysis in columns (4) and (5) of Table 1 is repeated using each of these measures. Both OLS and IV results are provided. As seen in the table, the results are consistent in terms of both sign and significance. Especially, the coefficients for FDI penetration are of similar magnitude. This implies that our instrument variable approach may also help to minimize the possible bias from measurement errors in FDI penetration.

Moreover, in order to further exclude the possibility that the above results are driven not only by FDI but by openness in general, we separate cities in coastal regions from non-coastal regions. If the results were indeed contaminated by trade or other benefit from openness, we expect the relationship to be stronger on the coastal regions. Table 3 reports the results, with the first two columns providing results for non-coastal regions and the last two columns for coastal regions. In fact, the connection between FDI and the college premium is much stronger in the non-coastal regions compared to the coastal regions. Furthermore, the F-statistics shows that the missionary school enrollment rate is much more significantly connected with FDI in the non-coastal regions. This further confirms that our instrumental variable mainly captures the variation in FDI penetration that is exogenous from other factors affecting the spatial sorting of industries and workers, including institutions, infrastructure and human capital.

So far, the analysis has shown that FDI penetration can lead to a higher skill premium within cities. This result is robust to various measures and specifications. Based on this finding, an interesting question to ask is whether the impact of FDI on inequality depends on the characteristics of FDI, including source and skill intensity.

3.3 Heterogeneous impact of FDI: source and skill intensity

In this subsection, we examine the heterogeneous impacts of overseas investments. Two types of heterogeneity are considered: source and skill intensity. We first separate foreign investment from HMT investment. Chen, Ge and Lai (2010) show that foreign-invested firms and HMT-invested firms can be very different in terms of capital intensity, relative employment of skilled labor and, as a result, the role on affecting local skill premium. The first three columns in Table 4 report the results. Here, foreign investment has a stronger and more significant impact on the college premium. Column (3) shows that if both types of investment are considered at the same time, foreign investment still remains significant but HMT investment does not. This is consistent with the facts that foreign invested firms are relatively more capital intensive, pay higher wages and employ relatively more skilled workers.

We next consider the difference in skill intensity of FDI firms. Two measures for skill intensity are constructed: one is a dummy variable equal to one if the share of skilled workers is higher in FDI firms than domestic firms; one is the share of skilled workers for FDI firms. Skilled workers are those with at least some form of college education. If FDI increases the relative demand of skilled labor and thus increases the

skill premium, we would expect that the effect of FDI penetration is stronger when FDI firms are more skill intensive. However, as seen in the last two columns of Table 4, the coefficient for the interaction term between FDI penetration and skill intensity measure is either negative or insignificant. There are two potential explanations for this. First, FDI may not increase the relative demand of skilled labor but just attract skilled labor from domestic firms. Second, the increase in relative demand of skilled labor from FDI firms could be offset by the increase in relative supply of skilled workers due to migration or college expansion. Unfortunately, we are not able to identify which of the two drive the result. However, the results at least imply that our baseline result is not mainly driven by the change in labor composition due to FDI. We come back to this in Section 4.4.

To sum up, we find that FDI penetration is positively associated with a local college premium. This result is robust to various specifications and measures. Our instrument variable approach further confirms the causality. In addition, the impact of foreign investment is found to be stronger than that of HMT investment. These findings suggest the value of a more detailed discussion on underlying mechanisms.

4 Discussion on Mechanisms

FDI can affect inequality through a variety of potential channels. In this section, we will focus on the following three aspects: (1) a composition effect: FDI can increase local skill premium by simply offering relatively more jobs for skilled workers and thus increase the relative demand for skilled workers; (2) a wage effect:

FDI firms themselves may offer relatively higher wages for skilled workers and by doing so may have an indirect wage effect for domestic firms; (3) agglomeration effect: skilled workers can benefit more from the spillover effects of FDI than unskilled workers. Below, we discuss each aspect in detail.

4.1 Composition Effect

FDI can change the skill compositions of local labor employment through two channels. First, FDI firms can employ relatively more skilled workers than the average domestic firms and thus increase the relatively demand of skilled labor (Feenstra and Hanson,1997); second, FDI firms can create an spillover effect on domestic firms and induce them to adopt better technology and, as a result, employ more skilled workers (Lu, Tao and Zhu, 2017).

First, we analyze differences in college ratio between FDI firms and domestic firms using firm level analysis. We use the following specification:

$$college\ ratio_f = \alpha_0 + \alpha_1 foreign\ firm_f + \alpha_2 HTM_f + \alpha_3 X_f + \omega_f$$

where $college\ ratio_f$ is the share of workers having college or above education in firm *f*. $foreign\ firm_f$ is a dummy variable equal to one if firm *f* is a foreign invested firm. HTM_f is an indicator equal to one if the firm is an HMT invested firm. X_f is a set of firm-level control variables related to firm employment composition, such as exported/output ratio, firm size, profit and capital per labor. In addition, industry

fixed effects and city fixed effects are also controlled for. The coefficients α_1 and α_2 capture the differences in college ratio between foreign-invested firms, HMT firms and domestic firms.

The first two columns in Table 5 report the main results. The first column shows that both foreign-invested firms and HMT firms are more skill intensive compared to domestic firms. The share of workers with some form of college education or above in foreign invested firms is 3.1% higher than that in domestic firms, while the difference for HMT firms is much smaller at 0.7%. This means that foreign-invested firms are the most skill-intensive among the three type of firms. In Column 2, firm size, age and capital are also controlled for. α_1 drops by almost a half but remains significant, while α_2 is no longer significant. This implies that the differences in labor composition to a significant extent can be explained by firm characteristics and not only firm ownership. In other words, the direct job creation effects of FDI can increase relative demand for skilled labor and this is mainly because FDI firms are different from domestic firms in size, age and capital intensity.

4.2 Wage Effect

Next, we investigate the wage effect of FDI penetration. The existing literature finds that FDI firms tend to pay higher wages than domestic firms (Lu, Tao and Zhu, 2017; Chen, Ge and Lai, 2011). This can be a potential reason for why FDI can widen the skill premium since foreign firms employ more high-skilled workers as shown above. Here, we focus on the within-firm skill premium of FDI firms. Although we do not have a direct measure of the within-firm skill premium in the data, we can use the

firm average wage to explore within-firm college premium by controlling for the college ratio. A similar approach is found in Chen, Yu and Yu (2016), who investigate within-firm inequality using the same type of information.

Our new model specification is as follows:

$$ln(average\ wage)_f = \beta_0 + \beta_1 college\ ratio_f + \beta_2 foreign_f + \beta_3 HTM_f + \beta_4 college\ ratio_f * foreign_f + \beta_5 college\ ratio_f * HTM_f + \beta_6 X_f + \upsilon_f$$

where $ln(average\ wage)_f$ is average wage paid by firm *f*. Other variables are defined as in Section 4.1. Industry and city fixed effects are also controlled for. Here, we are mostly interested in the coefficients for the interaction terms, β_4 and β_5. If foreign-invested firms and HMT firms pay a higher college premium than domestic firms, β_4 and β_5 are expected to be positive.

The results are reported in the last three columns in Table 4. Column (3) shows that both foreign-invested firms and HMT firms pay higher wages than domestic firms even after controlling for skill intensity. This implies that FDI firms pay higher average wages than domestic firms, a finding that is consistent with Chen, Ge and Lai (2011). Moreover, the coefficients for the interaction terms are both positive as shown in Column (4). This means that FDI firms pay a higher within-firm skill premium than domestic firms. In addition, foreign-invested firms pay a much higher within-firm skill premium compared to HMT firms.

The above findings have shown that that FDI penetration not only increases the

relative demand for skilled workers. FDI can also have wage effect at firm level by creating a wage premium between FDI firms and domestic firms and generating higher within-firm wage premia compared to domestic firms.

4.3 Spillover Effect

Finally, we discuss the spillover effects of FDI penetration on skilled workers and unskilled workers separately using individual-level information. Before examining the spillover effect of FDI, we first run an augmented Mincer regression to show that our baseline results hold when we use an individual-level approach:

$$ln(wage)_i = \gamma_0 + \gamma_1 college_i + \gamma_2 college_i * share\ of\ FDI_c + \gamma_3 X_i + \eta_{city} + \eta_{occup} + \eta_{ind} + \zeta_i$$

Here, $ln(wage)_i$ is the wage of individual *i*. $college_i$ is a dummy variable equal to one if the person received at least some college education and zero otherwise. $share\ of\ FDI_c$ is the degree of FDI penetration in city *c* where person *i* was working when surveyed. X_i is a set of individual characteristics, including gender, age and minority. η_{city}, η_{occup} and η_{ind} are city, occupation and industry fixed effects respectively. γ_2 captures how the college premium is associated with FDI penetration at the city level.

The results are reported in Table 6. The first column shows that the college premium is positively correlated with city FDI penetration when we use a simple Mincer regression. However, this simple correlation could be due to other city characteristics that are related to FDI penetration, such as city size and city income. In

column (2), city size and income are further controlled for. Industry and occupation are controlled for in Columns (3) The last column reports the results using instrument variables. The results are consistent with our baseline results which show that FDI can increase the average skill premium within a city.

Next, we investigate the spillover effect of FDI penetration on workers in domestic firms. In the census, there are six ownership categories for firms in which individuals worked at the time of the survey: government department, state-owned firm, collective firm, individual owned business, private firm and other types of firm. However, it is hard to tell whether an FDI firm is identified as a "private firm" or "other types of firm". We therefore focus on the spillover effect of FDI for state-owned and collective firms, respectively.

To investigate the spillover effect of FDI penetration on wage, we separate skilled worker from unskilled workers and consider the following augmented Mincer regression:

$$ln(wage)_i = \theta_0 + \theta_1 share\ of\ FDI_c + \theta_2 X_i + \theta_3 X_c + \phi_{occup} + \phi_{ind} + \phi_{province} + \vartheta_i$$

$ln(wage)_i$ is individual wage and $share\ of\ FDI_c$ is FDI penetration in city c as defined above. X_i includes individual characteristics such as education, age, gender and minority dummies. X_c is a vector capturing city-level features including city size, average income, government policy, road density and so on. ϕs are occupation, industry and province fixed effects respectively. The spillover effect of FDI

penetration is captured by θ_1. If $\theta_1 > 0$, it implies a higher average wage received by workers in state-owned and collective firms in a city with higher degree of FDI penetration.

We run the above regression for skilled workers and unskilled workers separately. The results are reported in the Table 7. Columns (1) and (3) report the results for skilled workers while Columns (2) and (4) presents the results for unskilled workers. The first two columns do not control for industry and occupation fixed effects while the last two columns include both. As seen in the table, while a spillover effect of FDI exists for both skilled workers and unskilled workers, the effect is much larger for skilled workers. This can be a natural result from the increase in relative demand for skilled workers due to FDI. The positive effect on unskilled workers can be a result of a complimentary relationship between skilled and unskilled workers.

In summary, we find various potential channels through which FDI can increase the local skill premium. First, FDI firms are relatively more skilled-worker intensive, which implies that FDI can increase the relative demand for skilled workers and thus widen the skill premium. We also find that FDI firms not only generates a higher between-firm wage difference but also a higher within-firm skill premium. Finally, we provide evidence on a spillover wage effect of FDI on SOE and collective firms. It should be noted that our discussion here does not exclude the possibilities of other channels.

5 Concluding remarks

FDI has been playing an important role in the process of globalization and has been accompanied by a widening skill premium in both developing and developed countries. In this paper, we investigate the impact of FDI on local income inequality at the city level in China. There are mainly three findings: first, the college premium is higher in the cities with higher degree of FDI penetration and we identify the causality by dealing with various sources of potential endogeneity issues. When we use historic Christian influence as an instrument variable for FDI penetration, the baseline results remain robust and consistent. Next, our firm-level analysis shows that FDI not only increases the relative demand for skilled workers, but also generates a strong wage effect. Especially, FDI firms both pay higher average wages and higher within-firm skill premia. Finally, FDI generates a positive spillover wage effect on both skilled worker and unskilled worker in state-owned and collective firms, but the magnitude is relative higher for skilled workers.

China and most other developing countries have been carrying out policies to attract more FDI inflows in order to promote growth (Hermes and Lensink, 2003, Markusen and Venables, 1999). It has been also widely documented that FDI plays a crucial role in technology and innovation (Fosfuri, et al., 2001; Girma, et al., 2008; Liu, 2008). The findings in this paper tell us that one potential consequence of FDI is that it can also exacerbate local inequality. Furthermore, we find that FDI can shift labor demand towards skilled workers and generate more between- and within-firm inequality. At the same time, it can create a positive spillover effect on wages received by both skilled and unskilled workers in domestic firms. This implies that although

inequality can be higher as FDI increases, everyone can benefit in terms of wage levels.

We are aware of two limitations of this research. One is that we do not include service industries in our analysis due to data limitation. As service FDI is becoming more and more important, it would be interesting to include it in future research when data are available. The other is that we mainly conduct cross-section analysis since nation-wide city inequality measures are available only for 2005. An important question would be how FDI contributes to the change in city inequality and therefore to overall inequality. We leave these questions for future research.

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Table 1: FDI and College Premium: Baseline

	(1)OLS	(2)OLS	(3)OLS	(4)OLS	(5)IV	(6)panel
Share of FDI	0.490***	0.365***	0.310***	0.219**	0.659**	0.402*
	[0.077]	[0.078]	[0.094]	[0.110]	[0.308]	[0.213]
Ln(population)		0.053***	0.045**	0.041**	0.045**	0.033
		[0.017]	[0.018]	[0.018]	[0.019]	[0.295]
Ln(wage)		0.062	0.026	0.075	0.059	-0.139
		[0.067]	[0.068]	[0.073]	[0.076]	[0.107]
ETDZ	No	No	Yes	Yes	Yes	Yes
Road	No	No	Yes	Yes	Yes	Yes
Industry	No	No	Yes	Yes	Yes	Yes
Exports	No	No	No	Yes	Yes	Yes
College ratio	No	No	No	Yes	Yes	Yes
region	Yes	Yes	Yes	Yes	Yes	-
First-stage F	-	-	-	-	21.06	-
city FE	-	-	-	-	-	Yes
R^2	0.35	0.40	0.43	0.44	0.38	0.12
N	251	251	251	251	251	903

Notes: * significant at 10% level; ** significant at 5% level; *** significant at 1% level; standard errors are in parentheses and clustered at province level. “Share of FDI” is the share of FDI in total capital. “ln(population)” is the log of total population in urban area. “ln(wage)” is the log of average individual income. “Road” includes highway density and railway density. ”Industry” includes the share of manufacturing and the share of service in GDP. “College ratio” is the share of people with at least some college education in total population. “ETDZ” is a dummy equal to one if the city has economic and technological development zone in 2005.

Table 2: FDI and College Premium: Alternative Measures

	(1)OLS	(2)IV	(3)OLS	(4)IV	(5)OLS	(6)IV
Share of FDI	0.147**	0.691**				
employment	[0.061]	[0.316]				
Share of FDI			0.137**	0.656**		
revenue			[0.065]	[0.285]		
Share of FDI firms					0.259**	0.627**
					[0.106]	[0.263]
Ln(population)	0.029	0.014	0.029	0.014	0.033*	0.032*
	[0.018]	[0.021]	[0.018]	[0.022]	[0.018]	[0.018]
Ln(wage)	0.117	-0.003	0.142**	0.113	0.126*	0.092
	[0.071]	[0.106]	[0.071]	[0.076]	[0.071]	[0.073]
ETDZ	Yes	Yes	Yes	Yes	Yes	Yes
Road	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Exports	Yes	Yes	Yes	Yes	Yes	Yes
College ratio	Yes	Yes	Yes	Yes	Yes	Yes
region	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F	-	10.37	-	15.04	-	25.60
R^2	0.54	0.36	0.54	0.38	0.55	0.51
N	251	251	251	251	251	251

Notes: * significant at 10% level; ** significant at 5% level; *** significant at 1% level; standard errors are in parentheses and clustered at province level. “share of FDI employment” is the share of workers of FDI firms in industrial firms. “share of FDI revenue” is the share of FDI revenues in GDP. “share of FDI firms” is the share of the number of FDI firms in total number of firms. “ln(population)” is the log of total population in urban area. “ln(wage)” is the log of average individual wage income. “Road” includes highway density and railway density. ”Industry” includes the share of manufacturing and the share of service in GDP. Education composition is college ratio in total population. ETDZ is a dummy equal to one if the city has economic and technological development zone.

Table 3: FDI and College Premium: Coastal v.s. Non-coastal Regions

	Non-coastal regions		Coastal regions	
	(1)OLS	(2)IV	(3)OLS	(4)IV
Share of FDI	0.412**	1.181***	-0.100	0.073
	[0.176]	[0.295]	[0.130]	[0.593]
Ln(population)	0.041	0.067**	0.016	0.011
	[0.025]	[0.030]	[0.028]	[0.030]
Ln(wage)	-0.061	-0.080	0.239*	0.250*
	[0.096]	[0.099]	[0.140]	[0.139]
ETDZ	Yes	Yes	Yes	Yes
Road	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Exports	Yes	Yes	Yes	Yes
College ratio	Yes	Yes	Yes	Yes
region	Yes	Yes	Yes	Yes
First-stage F	-	25.60	-	6.53
R^2	0.55	0.51	0.57	0.56
N	164	164	87	87

Notes: * significant at 10% level; ** significant at 5% level; *** significant at 1% level; standard errors are in parentheses and clustered at province level. “share of FDI employment” is the share of workers of FDI firms in industrial firms. “share of FDI revenue” is the share of FDI revenues in GDP. “share of FDI firms” is the share of the number of FDI firms in total number of firms. “ln(population)” is the log of total population in urban area. “ln(wage)” is the log of average individual wage income. “Road” includes highway density and railway density. ”Industry” includes the share of manufacturing and the share of service in GDP. Education composition is college ratio in total population. ETDZ is a dummy equal to one if the city has economic and technological development zone.

Table 4: FDI and College Premium: Heterogeneous Effects

	(1)	(2)	(3)	(4)	(5)
foreign FDI	0.291**		0.267*		
	[0.133]		[0.141]		
HMT FDI		0.163	0.093		
		[0.181]	[0.180]		
Share of FDI				0.442***	0.376**
				[0.102]	[0.176]
Share of FDI*				-0.270**	
FDI higher skill				[0.135]	
FDI higher skill				0.040*	
				[0.024]	
Share of FDI*					-0.665
FDI college share					[1.174]
FDI college share					0.022
					[0.144]
Ln(population)	0.032*	0.031*	0.031*	0.041**	0.037**
	[0.019]	[0.018]	[0.018]	[0.017]	[0.018]
Ln(wage)	0.148**	0.141*	0.143**	0.083	0.084
	[0.071]	[0.072]	[0.071]	[0.067]	[0.070]
R^2	0.54	0.53	0.54	0.51	0.50
N	225	225	225	225	223

Notes: * significant at 10% level; ** significant at 5% level; *** significant at 1% level; standard errors are in parentheses and clustered at province level. “foreign FDI” is the share of foreign capital in total capital. “HMT FDI” is the share of capital from Hong Kong, Macao or Taiwan in total capital. “share of FDI” is the share of oversea capital in total capital. “FDI higher skill” is a dummy equal to one if FDI firms are more skill intensive than local firms. “FDI college share” is the share of workers with some college education in total employment for FDI firms. Road, industry, ETDZ, exports and region fixed effects are all controlled for in all columns. College share is also controlled for in the first three columns.

Table 5: Composition Effect v.s. Wage Effect: Firm-level Analysis

	(1)	(2)	(3)	(4)	(5)
	Skill intensity	Skill intensity	Ln(wage)	Ln(wage)	Ln(wage)
Foreign firm	0.031***	0.017***	0.188***	0.131***	0.138***
	[0.005]	[0.004]	[0.017]	[0.013]	[0.014]
HMT firm	0.007**	-0.005	0.078***	0.049***	0.054***
	[0.003]	[0.003]	[0.014]	[0.015]	[0.016]
Firm size		-0.016***	-0.085***		0.002
		[0.002]	[0.004]		[0.003]
Capital		0.014***	0.086***		
		[0.001]	[0.004]		
Year		0.000***	-0.002***		-0.002***
		[0.000]	[0.000]		[0.000]
Skill intensity			1.251***	1.008***	0.404***
			[0.054]	[0.046]	[0.085]
Skill intensity				0.859***	0.724***
*foreign firm				[0.077]	[0.063]
Skill intensity				0.654***	0.589***
*HMT firm				[0.093]	[0.097]
Skill intensity					0.136***
*capital/labor					[0.016]
Capital/labor					0.081***
					[0.004]
Industry FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
R^2	0.17	0.22	0.30	0.30	0.31
N	265,933	264,337	263,825	263,825	263,825

Notes: The dependent variable in the first two columns is relative employment of skilled workers. A worker is identified as a skilled work if he/she received at least some college education. The dependent variable in the last three columns is the log of average wage paid by the firm. “foreign firm” and “HMT firm” are dummies indicating the firm is foreign-owned or HMT-owned. Firm size is measured by the log of total employment. “Year” is the year when the firm was established. Standard errors are clustered at city level.

Table 6: Individual-level Evidence

	(1)OLS	(2)OLS	(3)OLS	(4)IV
College dummy	0.522***	-0.726***	-0.896***	-0.935**
	[0.037]	[0.235]	[0.178]	[0.392]
College dummy	0.692***	0.457***	0.350***	0.882***
*share of FDI	[0.143]	[0.120]	[0.101]	[0.204]
College dummy		0.002	0.007	-0.038
*ln(population)		[0.038]	[0.031]	[0.030]
College dummy		0.424***	0.395***	0.494***
*ln(wage)		[0.156]	[0.124]	[0.178]
Individual	Yes	Yes	Yes	Yes
controls				
Industry FE	No	No	Yes	Yes
Occupation FE	No	No	Yes	Yes
City FE	Yes	Yes	Yes	Yes
_cons	3.160***	3.080***	3.375***	3.434***
	[0.037]	[0.041]	[0.052]	[0.077]
R^2	0.36	0.36	0.44	0.44
N	342,570	327,401	327,401	292,135

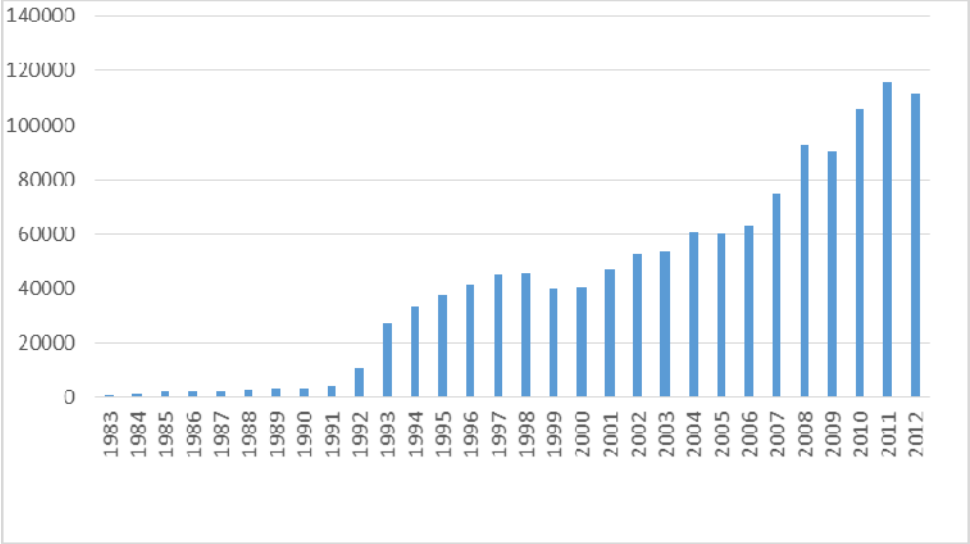
Note: The dependent variable is the log of hourly wage income for each individual. Columns (1) -(3) use OLS regression, and column (4) uses 2SLS. "College dummy" is equal to 1 if the person received at least some college education. "share of FDI", "ln(population)" and "ln(wage)" are city level variables defined as in the previous tables. Individual controls include age dummies and sex. Standard errors are clustered at city level. Please refer to the text for information on other control variables.

Table 7: Spillover Effects of FDI

	(1)	(2)	(3)	(4)
	Skilled workers	Unskilled workers	Skilled workers	Unskilled workers
Share of FDI	0.401***	-0.018	0.350***	0.097**
	[0.090]	[0.050]	[0.090]	[0.047]
Ln(population)	0.052***	-0.034***	0.065***	-0.006
	[0.017]	[0.012]	[0.016]	[0.012]
Ln(wage)	1.134***	1.196***	1.097***	1.092***
	[0.070]	[0.049]	[0.066]	[0.054]
Individual controls	Yes	Yes	Yes	Yes
Other city controls	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes
Occupation FE	No	No	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
constant	-0.781**	-0.433***	-0.447	-0.169
	[0.325]	[0.151]	[0.298]	[0.154]
R^2	0.38	0.19	0.44	0.30
N	23,011	61,606	23,011	61,606

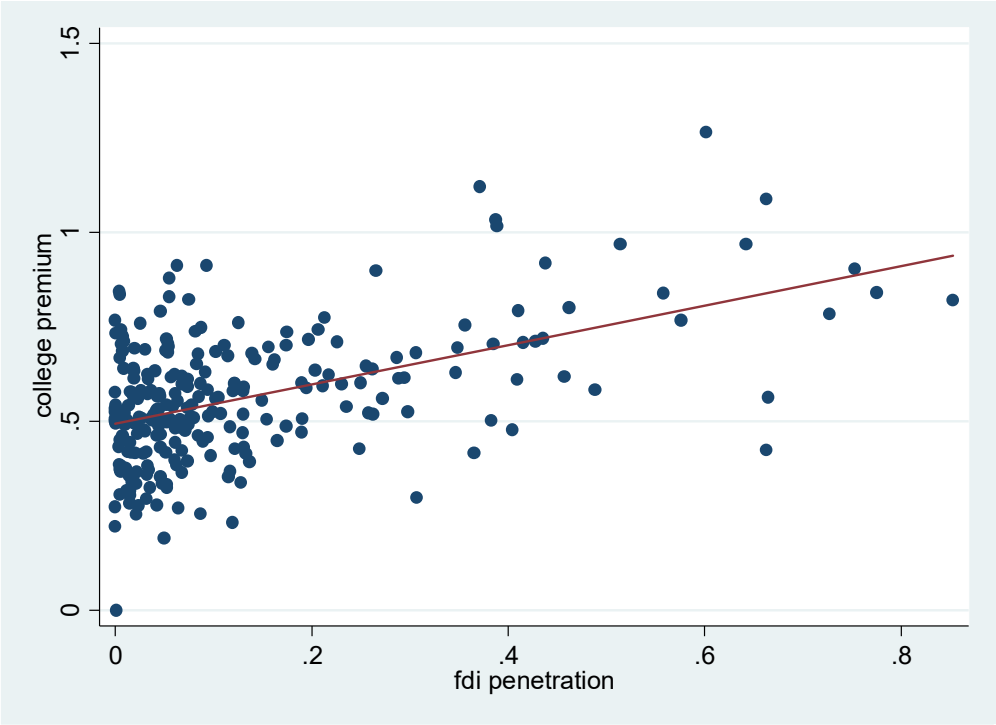
Note: We only include workers in SOEs or collective ownership firms. The dependent variable is the log of hourly wage income for each individual. Columns (1) and (3) consider skilled worker only, and columns (2) & (4) include unskilled workers only. A worker is identified as skilled worker if he received at least some college education. Otherwise, he/she is considered as an "unskilled worker". Individual controls include age dummies and sex. Standard errors are clustered at city level. Please refer to the text for information on other control variables.

Figure 1: Foreign Direct Investment in China, flows ($, million)



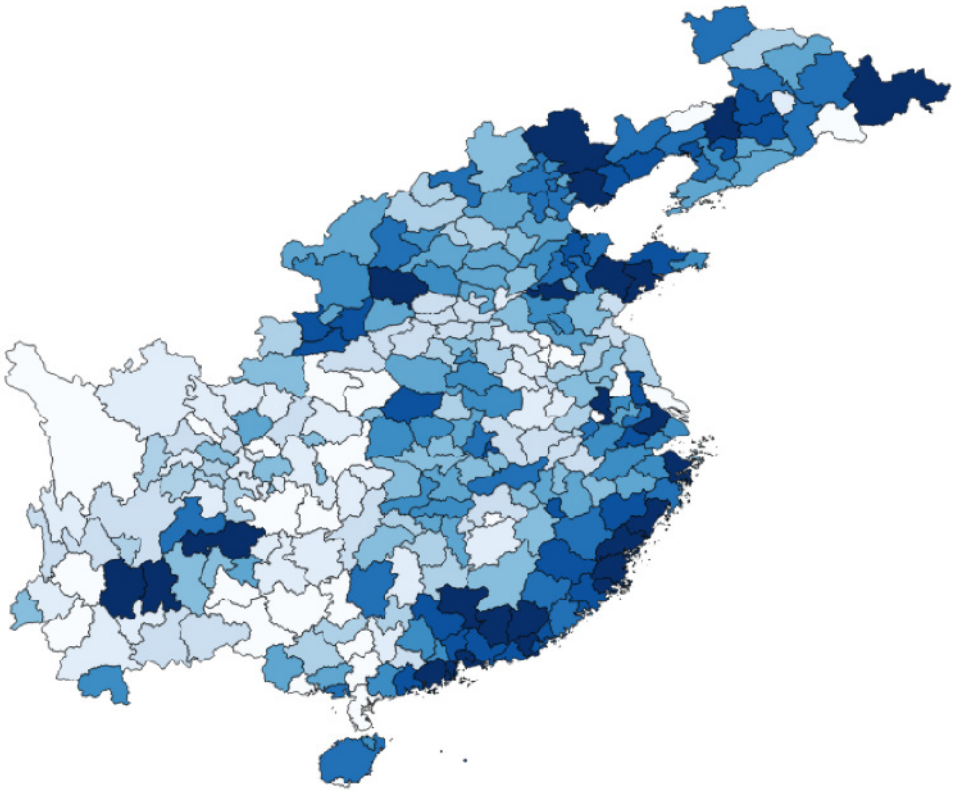
Source: China Statistical Yearbook (1984–2012), National Bureau of Statistics of China.

Figure 2: FDI Penetration and City Inequality



Note: Each dot represents a city. The vertical axis is college premium. The horizontal axis is the share of oversea capital in total capital of manufacturing.

Figure 3: The Spatial Pattern of Christian Influence



Note: we color all cities according to the value of ratio of converts all over china. The darker area represents higher ratio of convert numbers.

Appendixes

Table A.1: Summary Statistics for Main Variables

Variable	Obs	Mean	Std.Dev.	Min	Max
college premium	251	0.56	0.17	0.19	1.26
share of FDI	251	0.13	0.16	0.00	0.85
share of FDI revenue	225	0.21	0.20	0.01	0.91
share of FDI firms	225	0.15	0.14	0.01	0.78
share of FDI employment	251	0.21	0.20	0.00	0.94
college ratio	251	0.27	0.08	0.04	0.47
mean of ln(wage)	251	2.85	0.17	2.38	3.46
Ln(population)	251	7.58	0.75	6.68	11.12

Note: Share of FDI revenue and share of FDI firms are from City Statistics Yearbook in 2005; Share of FDI employment is constructed from Industrial Census in 2004; other variables are calculated based on individual level information from Census in 2005. College premium is in log points. Please refer to the text for details.

Table A.2: First-Stage Results of Instrumental Variable Estimation

	(1)	(2)	(3)
VARIABLES	OLS	OLS	OLS
ratio of students in missionary schools	0.0111***	0.0085***	0.0057***
	(0.00197)	(0.00173)	(0.00159)
ln(population)		0.118***	0.0710***
		(0.0182)	(0.019)
ln(wage)		0.083	0.140*
		(0.0852)	(0.0845)
ETDZ	No	No	Yes
Road	No	No	Yes
Industry	No	No	Yes
Exports	No	No	Yes
College ratio	No	No	Yes
Region	No	Yes	Yes
Constant	0.166***	-0.958***	-0.513**
	(0.0184)	(0.208)	(0.238)
Observation	225	225	225
R-squared	0.143	0.37	0.517

Note: * significant at 10% level; ** significant at 5% level; *** significant at 1% level; standard errors are in parentheses and clustered at province level. The dependent variable is the share of FDI in toral capital in manufacturing. Ratio of students is the ratio of students enrolled in mission primary schools. Ln (population) is the log of total population in urban area in 2005. ln (wage) is the log of average individual income. ETDZ dummy is whether it has economic and technological development zone. "Road" includes density of highways, density of railroads. "industry" represents the share of manufacturing in GDP. "region" represents regional fixed effects.