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## **Driving Factors of Rural-Urban Migration in China**

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## Abstract

This study employs panel data to analyze the economic factors that drive rural-urban migration and agricultural labor supply within China. The results indicate that higher wages in urban areas, especially in the construction sector, was associated with rural-urban migration and a decline in the agricultural labor supply. The rural-urban wage differential in construction reflects the housing boom in cities set off by rapid urbanization and government policies. Most importantly, our findings raise concerns about the negative impact of rural-urban migration on agriculture in China. Policies that impact labor supply, especially in times of rapid urban development and low diffusion of agricultural technology, are critical to Chinese economic development and stability.

Keywords: Internal migration, agricultural labor

JEL Classification: O15, R23, J43

## 1. Introduction

Population growth in Chinese metropolitan areas is partly attributed to massive migration from rural to urban areas. The number of urban residents increased by 14 million people, while the number of rural residents dropped by 7 million during the 2008-2014 period (National Bureau of Statistics of China 2014). In 2011, the Chinese urban population exceeded the rural population for the first time (World Bank 2012), perhaps as a result of rapid economic development that has encouraged rural residents to seek better employment opportunities in urban areas, particularly in coastal regions, where migration within provinces is more common (Zhang, and Shunfeng 2003). Historically, the labor mobilization allows temporary reallocation of workers, and is one of the main factors that have driven China to be more competitive. However, the massive inflow of rural workers to metropolitan areas raises a concern about the future of agricultural production and urbanization.

Different driving factors influence internal migration across China. Previous studies shown that employment opportunities and the rural-urban income gap are economic factors considered by Chinese workers when they migrate from the countryside to cities within or between provinces (Zhang and Shunfeng 2003; Zhu 2010). While previous work has analyzed the role of economic factors on rural-urban migration in general, the first objective of this study is to evaluate how economic factors related to other industries such as construction and manufacturing, two important sectors in the demand of migrant labor, affect rural-urban migration within provinces. In 2010, rural-urban migration within provinces account 37% of total migration, whereas in 1990 migrant workers who moved within their home provinces represented the majority (72%) of inter-county migrant workers (Chan 2013) . While there is a higher rate of interprovincial migration, the percentage increase of migration within provincial boundaries was larger than the percentage increase of interprovincial migration (6% vs. 3%) over the

period 2010-2011 (National Bureau of Statistics of China 2014). In addition, this growing trend of within-provinces migration might continue because geographic distance discourages migration between provinces. Chinese cities are predicted to face an influx of another 243 million migrants by 2025, taking the urban population up to nearly 1 billion people. Migrants will represent nearly 40% of the urban population in the next 10 years (Woetzel *et al.* 2009).

Due to China's status as a developing country and its severe shortage of arable land, farming in China has always been very labor-intensive. Since 2011, the workforce share in agriculture steadily decreased and the majority of China's labor force (36%) has been employed in the service sector (*Statista* 2016). The modernization of agriculture can be seen as a way to boost productivity and reduce the impact of a labor shortage in the agricultural sector. And so, China's government has started to increase government spending and encouraging investment in agriculture (Shangguan 2013), including increasing the supply of improved crop seeds and pesticides (Revill, and Spegele 2016). However, at the farm level, investment on labor-saving agricultural technology remains small (Wang *et al.* 2014), rising a concern about China's food security on the presence of labor migration out of agriculture. Understanding the economic drivers of agricultural labor supply is critical for decisions about internal migration policy that affects both urbanization and food production. Therefore, the second objective of this study is to assess how current economic factors affect the agricultural workforce.

Using 2008-2014 national data obtained from National Bureau Statistics of China, we estimate panel models 1) to evaluate the economic factors that stimulate rural-urban migration within provinces, and 2) to determine the economic factors that drive labor supply out of the agricultural sector at the provincial level. Overall, we explore how these economic conditions influence migration decisions and farm labor supply during a period of relative economic slowdown in China.

We found that the construction sector in urban areas played a key role in explaining changes in the rural-urban population and in the number of people employed in agriculture. Our results show that an increase of real wages in this sector decreased the ratio of rural to urban population and the number of people working in the primary sector.

This paper is organized as follows. In the next section, we provide a theoretical framework of rural-urban migration. Sections 3 and 4 discuss the economic factors related to rural-urban migration and agricultural workforce, and provide econometric models of rural-urban population ratio and agricultural labor. Section 5 describes the data used in the econometric analysis. Section 6 presents a discussion of the estimation results. Finally, we end with conclusions and policy implications in section

## 2. Theoretical Framework

### 2.1. Rural-Urban Migration

Economic and non-economic research agree that economic factors are important predictors of rural-urban migration, and particularly that high urban wages is the main pulling factor. Based on the theoretical model of Fields (1975), the amount of rural-urban migration can be denoted as follows

$$(1) \dot{L}_U = \varphi(E(W_U) - E(W_R))$$

where  $\varphi(\cdot)$  is the differential of wages between urban and rural areas  $E(W_U)$  and  $E(W_R)$ , respectively. Therefore, the equilibrium condition is

$$(2) E(W_U) = E(W_R).$$

We can also say that the expected income  $E(W_j)L_j$  in area  $j = U, R$  is equal to the wage  $W_j$  times the number of employment opportunities  $E_j$  and can be expressed as

$$(3) E(W_j)L_j = W_j E_j$$

Using equations 2 and 3 we can define the ratio of rural to urban population  $\frac{L_R}{L_U}$  as a function of wages  $W_j$  and employment  $E_j$  in area  $j = U, R$ .

$$(4) \frac{L_R}{L_U} = \frac{W_R}{W_U} \frac{E_R}{E_U}$$

Since total employment  $\bar{E}$  can be defined as  $E_R + E_U$ , we can write equation (4) as follows:

$$(5) \frac{L_R}{L_U} = \frac{W_R}{W_U} \frac{\bar{E} - E_U}{E_U} = \frac{W_R}{W_U} \left( \frac{\bar{E}}{E_U} - 1 \right)$$

We can infer that wages  $W_U$  and employment opportunities  $E_U$  in cities have a negative effect on the ratio of rural to urban population  $\frac{L_R}{L_U}$  from equation 5.

## 2.2. Agricultural Labor Supply

Using equation (4), we can say that the relationship between working in agriculture  $L_a$  versus working in non-agricultural jobs in urban areas  $L_U$  can be represented as

$$(6) \frac{L_a}{L_U} = \frac{W_a}{W_U} \frac{E_a}{E_U}$$

Therefore agricultural labor supply  $L_a$  can be expressed as follows:

$$(7) L_a = \frac{W_a}{W_U} \frac{E_a L_U}{E_U} = \frac{W_a}{W_U} E_a (U - 1)$$

where  $U$  is the unemployment rate in urban areas. Because an important proportion of the workforce in rural areas is employed in agriculture we can define total employment  $\bar{E}$  as  $E_a + E_U$ , and substitute  $E_a$  by  $\bar{E} - E_U$  in equation (7), therefore obtaining:

$$(8) L_a = \frac{W_a}{W_U} (\bar{E} - E_U)(U - 1)$$

In equation (8) we can deduce that work opportunities and high wages in urban jobs have a negative effect on farm labor force  $L_a$ . While, unemployment rate in cities  $U$  has positive effect on agricultural labor  $L_a$ .

### 3. Background of Rural-Urban Migration in China

In 2004, three out of four migrant workers were employed in manufacturing, construction, social services, hotels and restaurants, and commerce (Shi 2008). According to Wang (2008) manufacturing and construction employed over 67% of all migrant workers in 2005 (35% and 32%, respectively).

Although, in 2012 construction attracted just 10% of new-generation migrants compared to 28% of the previous generation of migrant workers, this economic sector remains as an important magnet for many rural-urban migrants. In fact, the most popular training schools migrants attend to improve their professional skills are for construction along with computer, technology, sewing, and beauticians (Hu 2012). Moreover, the current growth of migrants in the construction sector was steady even in face of the economic crisis in 2009, mainly due to government investments as a part of stimulus package to mitigate the effect of recession (Csanádi, Nie, and Li 2015).

For many years, cheap housing has been available for migrant workers in “urban villages”. However, these crowded neighborhoods are being cleared across China as part of an urbanization campaign announced by the government more than a decade ago. Policies that provide government-built housing

while removing these "villages within cities" result in a net loss of housing units, affecting the private rental market that for decades has enabled China's massive urban migration. Moreover, the removal of this urban village seems to result in at least 3% housing price appreciation (Zhang *et al.* 2016) . To assess the influence of these economic factors on rural-urban migration in China, we consider the following econometric model as our base line model to explain rural-urban migration:

$$(9) \log(rural/urban_{it}) = \mu + \log(urban\ wages_{it})' \gamma + \log(urban\ jobs_{it})' \alpha + z'_{it} \beta + a_t + a_i + v_{it}$$

where  $rural/urban_{it}$  is the ratio of rural to urban population in time  $t$  and province  $i$ . The variables of interest in this model are real wages of employed persons in urban areas in construction and manufacturing sectors represented by the vector  $urban\ wages_{it}$  and the number of workers employed in construction and manufacturing represented by the vector  $urban\ jobs_{it}$ <sup>1</sup>. The vector of control variables  $z_{it}$  includes unemployment rate in urban areas, natural growth rate, and Consumer Price Index (CPI) for rent as an indicator of rent inflation. The element  $a_t$  represents time fixed effects. The unexplained component of the regression is expressed in terms of  $a_i$  and  $v_{it}$  which correspond to the unobserved time-invariant province effect and error term, respectively.

Based on the baseline model in equation (9) we estimate a dynamic panel data model using Arellano-Bover/Blundell-Bond GMM estimator, which is the preferred specification in this study. The model and results are detailed in the results section.

#### 4. Agricultural Labor Supply

The growing urban population raises concern about the future of agricultural production and urbanization, because workers are leaving farms seeking better opportunities in cities and wealthier coastal regions (Knight, Deng, and Li 2011). However, there are arguments that the shortage of agricultural labor, if it happens, will not be permanent but circular because of the strict internal migration law, *hukou* system, established since the early 1960s that prevents rural workers from staying in the cities because the extension of urban social and economic benefits to migrants remains absent, even though physical controls on migration into cities have gradually been reduced (Chan, and Zhang 1999). Evidence, however, shows that the impact of rural-urban migration on the labor supply exists and differs across regions. During the 1990s, in the eastern developed regions of China, the percentage of agricultural workers in the workforce declined, while the workforce in the western undeveloped regions remained at a high level (Carter, and Estrin 2001). However, after 2005 the decline of agricultural workforce was also evident in western areas while in eastern developed regions this number has remained almost unchanged (National Bureau of Statistics of China 2014).

As urbanization draws more labor and land from agriculture and accelerates changes in food consumption, the government's ability to guarantee permanent farm labor is important to China's food sovereignty in the future. Today, China is considered the leading importer of soybeans and cotton and has recently emerged as an importer of other major commodities, including corn, pork, wheat, and rice. This trend reflects China's dependence on food imports, a scenario that could become critical if the labor supply in food production shrink because it could bring further demand for imports (Wang *et al.* 2013).

Research on Chinese internal migration has mainly focused on the socio-economic impact of migration in source and destination areas at household and aggregate level (Rozelle, Taylor, and

DeBrauw 1999; Taylor, Rozelle, and De Brauw 2003). Little work has been documented about the driving economic factors of labor supply in the agricultural sector, especially during a period of economic slowdown in China. Hu (2012) examined both economic and non-economic reasons for rural-urban migration using survey data. According to his study, among the factors that drive labor out of farming are high non-agricultural wages, lower wages for farm labor, and the increase in educational levels of the second generation of farmers. Similarly, Zhu (2010) found that the income gaps influence migration decisions in China. Similar results have been found when analyzing migration flows across countries. Hispanic migrants were mainly motivated by high wages and job opportunities when deciding to migrate and staying in the US (Melo, Colson, and Ramirez 2014). Rural workers that move to urban areas represent about 75% of total migrants, and about 60% come from: Sichuan, Anhui, Hunan, Jiangxi, Henan, and Hubei provinces (Migration News 2011). Three of these provinces, Henan, Sichuan, and Anhui, were among the top ten that generated most of the agricultural production in 2009 (USDA 2015).

Rural migrant workers received less access to public services and social benefits in urban areas compared to local workers. Yet, rural workers prefer to migrate and work under these “unfair” conditions in cities rather than remain in their towns and villages because better economic opportunities can be found in urban areas. The work compensation gap between urban and rural areas has increased. Therefore, although job opportunities in manufacturing and construction exist in towns and villages, higher wages in urban areas in these industries are more appealing to workers (Banister, and Cook 2011).

The *hukou* or household registration system has had an important impact on rural-urban migration in China. The *hukou* system, established in the 1950s, kept people tied to where they lived by making government services contingent on their occupation and place of residence. While agricultural laborers (rural *hukou* holders) received land, nonagricultural workers (urban *hukou* holders) received food rations

as well as public services such as employment opportunities, subsidized housing, free education, medical care, and old-age pensions (Cheng, and Selden 1994).

Under the current weakening of the *hukou* system that has shaped migration policies to “leave the land but not the villages”, workers have moved out of farming to rural industrial production (Au, and Henderson 2006). Because Chinese migration system still prevents migrant workers from residing permanently or receiving residency rights in the cities where they temporally work, the separation of family members is common. This forced separation exposes children to different hazards and may make marriages unstable (Zhao 1999). In addition, migrant workers struggle to acquired proper housing because of high rents and strict government policies in metropolitan areas (Davis 2013; Zhao 1999). Despite this situation, migrant workers account for 40 percent of the urban labor force in China (Scheineson 2009), while the lack of government protection and access to social services make migrant workers the most vulnerable group in the society.

Rozelle et al. (1999) found no evidence of a negative impact on farm output after migration because remittances sent home by migrants stimulate crop production by relaxing market constraints. This result supports the New Economics of Labor Migration proposition developed in 1980s which states that migration lessens production and investment constraints in imperfect markets (Taylor 1999).

Contrary to Rozelle, Taylor, and DeBrauw (1999), a later study suggested that labor-migrant households often under-cultivate or abandon their farmland as a consequence of household labor shortages (Qin 2010). The discrepancy of previous findings about the effect of rural-urban migration on the agricultural sector indicates that a potential danger for the future of agricultural production may exist, but more conclusive evidence is needed. Meanwhile, understanding the factors that drives farm workers

in and out of the agricultural sector is necessary for policy making. To analyze the impact of economic variables on agricultural labor supply, the baseline regression model is as follows:

$$(10) \quad \log(\text{agricultural labor}_{it}) = \mu + \log(\text{urban wages}_{it})' \gamma + \log(\text{urban jobs}_{it-1})' \alpha + z'_{it} \beta + a_t + a_i + v_{it}$$

where  $\text{agricultural labor}_{it}$  is the number of persons employed in the primary sector including agriculture, forestry, animal husbandry, and fishery in province  $i$  and year  $t$ . The vector of variables  $\text{urban wages}_{it}$  is defined as before as real wages in construction and manufacturing in urban areas. The vector  $\text{urban jobs}_{it-1}$  correspond to the lag of number of people employed in construction and manufacturing. The vector  $z_{it}$  contain the control variables defined in the model of rural-urban migration in equation (10) but it also includes real wages in agriculture. The element  $a_t$  represents time fixed effects. The unobserved time-invariant cross-unit effect is  $a_i$  and  $v_{it}$  is the error term.

Similar to the rural-urban population ratio model, we estimate a dynamic panel data model for agricultural labor based on the baseline specification in equation (10). The model and results obtained from using Arellano-Bover/Blundell-Bond GMM estimator are detailed in the results section.

## 5. Data

Socioeconomic and agricultural labor supply data from the National Bureau of Statistics of China (2014) during the period 2008-2014 was used to identify the economic factors that drives rural-urban migration and labor supply in the agricultural sector within provinces in China. Specifically, we use panel data analysis at the provincial-level 1) to analyze the economic factors that drive changes in rural-urban population, and 2) to determinate the economic factors associated with number of people employed in the primary sector in China.

Figure 1 indicates that for most of the Chinese regions, the ratio of rural to urban population has decreased between 2005 and 2014. The decline is steeper for those provinces located in the central region (Anhui and Henan) and western region (Sichuan, Yunnan, Guizhou, Gansu, and Tibet). Anhui, Sichuan, and Henan were among the provinces where most migrant workers come from (Migration News 2011). Similarly, figure 2 shows a reduction of Chinese workers employed in agriculture, forestry, animal husbandry and fishery (Primary Sector) in central and western regions for the same time period. The decline is more apparent in Anhui, Henan, and Sichuan, which are important provinces for agricultural production (USDA 2015). Guangxi is the only province where an increase of employment in the primary sector can be observed. This trend is not surprising given that foreign direct investment and efforts of local governments have supported agricultural development in this province in the last years (Ambler *et al.* 2008; Ye, Su, and Wei 2010).

Table 1 indicates that the ratio rural to urban population has decreased 0.34 points (from 1.3 to 0.9) during the period of 2008-2014, this change indicates that the urban population in China has increased at a faster rate than rural population for the study period. The changes in population ratio could be explained by the decrease in the unemployment rate (about 0.5 percentage points decline) and the increase of real wages in urban areas for the construction and manufacturing sectors.

In 2014 real wages in urban areas were about double what they were in 2008; interestingly, real wages in construction and manufacturing in urban areas increased by 119 percent between 2008 and 2014. Consequently, manufacturing companies started to move their production to other countries such as Vietnam where wages remain low (Chu 2013). While real wages in agriculture in urban areas also increased by 109 percent, the percentage increase of real wages in agriculture was 10 percentage points lower than compared to the percentage increase of real wages in construction and manufacturing. Agricultural wages in rural areas<sup>2</sup> are probably lower than agricultural wages in cities, increasing the

wage gap between rural and urban areas. This wage differential could be an important pulling factor that make agricultural workers to search non-farm jobs in cities.

Similar to the decline of rural-urban population ratio, there was a 3% decline of workers in the primary sector in China between 2008 to 2012. Part of this decline might be associated with the increase of employment experienced in the other industries, including manufacturing and construction by approximately 52% and 172%, respectively. The large increase in construction jobs resulted from an expansion of investment in urban construction projects during this period in China (Bai, Chen, and Shi 2011). It can also be as a result of an economic incentive implemented by the government similar to the huge stimulus package that Beijing implemented after the 2008 global financial crisis, which set off a building boom (Gough 2016). If China's property market remains saddled with a surplus of apartments in many cities, a crash in the housing market is possible according to some economists (Hewitt 2016).

China's manufacturing sector contracted at the end of 2013 because of a weakening in exports and government interest to promote domestic consumption even at the expense of investment and exports. This softening growth momentum for manufacturing sectors has weighed on employment growth (Reuters 2014). Therefore, it is not surprising to find that the increase of manufacturing jobs was modest and statistically insignificant compared to the increase in construction jobs during the 2008-2014 period. This modest increase in manufacturing probably reflects the fact that about 20 million migrant workers could not find work or had been dismissed during 2009 as a result of the slowdown in China's economy (LaFraniere 2009).

## 6. Results and Discussion

The results of two-way fixed effects FE<sup>3</sup> estimation using provincial-level data for the two models: rural-urban population ration and agricultural labor are presented in Tables 2 and 3, respectively. The small<sup>4</sup>

number of clusters (i.e., provinces) in our panel data might generate standard errors that are not correct when clustering panel data (Cameron, and Miller 2015). Therefore, we report unclustered standard errors.

The results of the two-way FE model for rural-urban population ratio in Table 2 (column 1) indicate that an increase in real wages earned by construction workers in the urban sector by 1 percent decreased the ratio of rural to urban population by 0.18 percent. Similarly, an increase in employment opportunities in the construction sector by 1 percent represented a decrease of rural-urban population ratio by 0.05 percent. In contrast, wages and job opportunities in the manufacturing sector were not associated with population ratio changes. These results indicate that employment opportunities along with real wages in the construction sector were the determinant factors that influenced changes in the population structure in China. Most importantly, high real wages in construction were more important than job opportunities in construction on influencing changes of the rural-urban population ratio. This result is in line with Banister, and Cook (2011), who found that wages are very important considerations for migrant workers. One of the reasons that can explain the relevance of construction wages is that the increase of real wages in this sector was considerably greater than the increase of real wages in manufacturing (170% vs. 53%, respectively) during the study period.

The results of two-way FE estimation model for agricultural employment in Table 3 (column 1) show that none of the variables of interest are related to employment in the primary sector including agriculture.

We employed a test of first-order correlation in the estimated models as described by Wooldridge (2010), which has been shown to present good statistical properties (Drukker 2003). The test results indicate that we can reject the hypothesis of no first-order correlation at 1% level for the baseline models presented in equations (9) and (10). Thus, we estimate these models allowing the error term to be first-

order autoregressive, specifically we fit the linear models of equations (9) and (10) with province fixed effects  $a_i$  and an autoregressive AR (1) disturbance as follows:

$$(11) \quad v_{it} = \rho v_{it} + \varepsilon_{it}, \text{ where } -1 < \rho < 1 \quad \text{and} \quad \varepsilon_{it} \sim N(0, \sigma^2)$$

The FE-AR(1) model was estimated first by transforming the data to remove the AR(1) error component following the estimation process by Baltagi (2009)

Results from the rural-urban population ratio model using FE-AR (1) estimation in table 2 (column 2), indicate that jobs and wages in the manufacturing sector are associated with changes in the population structure. We found that for every percentage increase in real wages in manufacturing, the rural-urban population ratio decreased by 0.3 percent, which is almost twice the decrease reported when construction wages increase in the two-way FE model (column 1). The results also show that a 0.06 percent decrease in rural-urban population ratio was associated with an increase in jobs in the manufacturing sector. This elasticity estimate is similar to the one for construction jobs in the two-way FE model. Surprisingly, an increase of CPI rentals decreased the rural-urban population ratio; however, its impact is not economically significant (-0.002).

Results for the model of primary sector labor using FE-AR (1) estimation in table 3 (column 2) indicate that construction wages had a negative impact on the number of people employed in agriculture (elasticity value -0.12). Surprisingly, an increase of jobs in construction in urban areas in year  $t-1$  had a positive association with agricultural employment in year  $t$  (elasticity value is 0.08). In addition, a one percentage point increase in the natural growth rate was associated to 0.02 percent increase in the amount of agricultural workers.

The positive and negative signs of the coefficients for construction jobs (in the agricultural labor model) and for CPI rentals (in the rural-urban population ratio model), respectively, might be a signal of model misspecification in these equations. Therefore, we checked stationarity of the variables in our

panel data analysis employing the Fisher-type test as proposed by (Choi 2001) . Because demeaning the data mitigates the impact of cross-sectional dependence on the test, we employ the test after subtracting the cross-sectional means from the series as suggested by Levin, Lin, and Chu (2002). While, nonstationary panel time series are common in the analysis of macro panels with large cross-units  $N$  and large time series  $T$  (Baltagi, and Kao 2000), the test results of our micro panel data with small  $T$  indicate that the dependent variables, rural-urban population ratio and employed persons in the primary sector, are non-stationary, including most of the explanatory variables. In addition, the test results show that the error term is  $I(1)^5$  for both regressions rural-urban ratio and agricultural labor, therefore we discard the possibility of cointegration.

Differencing is appropriate in nonstationary models in which all variables and error term are random walk  $I(1)^6$ . First differenced variables are stationary and the model parameters can be reliably estimated. In the presence of a mixed panel with  $I(0)$  and  $I(1)$  series, as in this case, other models are recommended. The Autoregressive Distributed Lag (ARDL) model is appropriate in large number of cross-sectional observations  $N$  and time series  $T$  panel data to address the latter problem (Blackburne, and Frank 2007). In small  $T$  panel estimation (i.e., micro panels), however, a combination of FE or RE estimator and instrumental variables estimator, such as the generalized method of moments GMM estimator in the context of dynamic panel data is recommendable (Arellano, and Bond 1991; Arellano, and Bover 1995; Blundell, and Bond 1998).

Another issue commonly found in panel data is that the model may contain a lagged dependent variable. Failing to include lagged-dependent variables that are related with the error term, will result in bias parameter estimates. Hence, we estimate an ARDL-type dynamic panel data (DPD) model which has been developed for small  $T$  data. We use Arellano-Bover/Blundell-Bond GMM system estimator which outperforms the Arellano-Bond GMM-IV. The problem with the latter estimator is that may suffer

of weak instruments (i.e., lagged-levels) if the autoregressive process is too persistent (Blundell, and Bond 1998). To deal with this problem, the former estimator uses lagged levels as well as lagged differences as instruments for first differenced variables. The DPD model equations based on the baseline equations (9) and (10) include the lag value of the dependent variable in the right hand side  $rural/urban_{it-1}$  in equation (11) and  $agricultural\ labor_{it-1}$  in equation (12) and they can be expressed as follow:

$$(12) \quad \log(rural/urban_{it}) = \mu + \delta \log(rural/urban_{it-1}) + \log(urban\ wages_{it})' \gamma + \log(urban\ jobs_{it})' \alpha + z'_{it} \beta + a_t + a_i + v_{it}$$

$$(13) \quad \log(agricultural\ labor_{it}) = \mu + \delta \log(agricultural\ labor_{it-1}) + \log(urban\ wages_{it})' \gamma + \log(urban\ jobs_{it-1})' \alpha + z'_{it} \beta + a_t + a_i + v_{it}$$

The results of DPD model related to construction wages for rural-urban population in table 2 (column 3) are similar to the results of the two-way FE model (column 1). We find that wages in the construction sector has a negative impact in the ratio rural-urban population. Specifically, an increase of 1 percent in real wages in the construction sector was associated with a 0.08 percent decrease in the ratio rural to urban population. As one would expect, the rural-urban ratio of year  $t-1$  has a contemporaneous positive effect on the rural-urban ratio of year  $t$ . Contrary to the previous model FE-AR (1) (column 2), CPI rentals is positive but not statistically significant in the DPD model (column 3).

The results of the DPD model for agricultural labor indicate that real wages in the manufacturing and construction sectors are important determinants of China's agricultural employment. The parameter estimate for manufacturing wages indicates that a decrease by 1 percent in real wages in this sector accounted for an increase in the number of employed people in agriculture by approximately 0.3 percent. Similarly, a decrease by 1 percent in construction wages was associated with an increase by 0.2 percent in the number of people employed in agriculture. As expected the lag value of number of people

employed in the primary sector is highly statistically significant and positive. A one percentage point increase in the natural growth rate will increase the amount of agricultural workers by 0.05 percent. This positive relationship between natural growth rate and labor force in agriculture predicted in the DPD and FE-AR (1) models, point out that the majority of agricultural workers are located in rural areas where the birth rate is higher due to stricter population control policies imposed in Chinese cities (Saltenyte 2013).

We conduct the Sargan test of over identifying restrictions. This test has an asymptotic Chi-squared distribution only for a homoscedastic error term (Arellano, and Bond 1991)<sup>7</sup>. The test results indicate that we cannot reject the null hypothesis that all instruments are uncorrelated with the error term at 1 percent level in both models. Also the Arellano–Bond tests for serial correlation in the first-differenced errors show that second order correlation of the errors is not a concern in our model.<sup>8</sup>

Comparing the elasticity estimates across model specifications, we can conclude that for the population ratio model, high real wages in construction is an important variable associated with a decrease of rural population, which is a consistent result in FE and DPD model specifications. Our results indicate that an increase in real wages in construction by 1 percent increased rural-urban mobilizations at least by 0.08 percent. More importantly, the estimation results from FE-AR (1) and DPD models point out that construction wages played an important role in agricultural labor supply. The elasticity estimate shows that an increase in real wages in this sector by 1 percent was associated with a decrease of agricultural jobs by at least 0.12 percent.

## 7. Conclusions and Implications

Overall, our results point out that urban areas are the main destinations for Chinese individuals who are looking for non-agricultural jobs and higher incomes to support their family and improve their living conditions, especially for those who live in rural areas where economic growth is slower. Urban

expansion along with government urbanization policies are some contributing factors to the growth in the construction sector which is reflected in high wages and jobs opportunities for migrant workers in this sector. In line with this, we found that higher wages in construction was associated with an increase of rural-urban migration and a decline of the agricultural labor supply.

Our results also point out that a downturn in these sectors, construction and manufacturing, will increase rural–urban population ratio, which might not be desirable if rural areas are not able to employ returned migrants. Now that China has entered a period of economic slowdown, it is critical to formulate policies to create rural employment opportunities for migrants returning from the cities in order to maintain socio-economic stability.

Understanding the role of economic factors on rural-urban migration and supply of farm labor is critical. Particularly, in the present scenario in which China is becoming more dependent on food imports and migration flows are expected to continue, possibly resulting in a large decrease of the amount of labor available for agricultural production. As a whole, our findings indicate that future policy oriented to provide economic incentives (i.e., higher wages) to rural workers to stay in agricultural jobs as well as to encourage the use of technology at farm level seem to be good alternatives in China.

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Table 1. Summary Statistics

Dependent Variables	2008	2014	P-value
Employed Persons in Agriculture, Forestry, Animal Husbandry and Fishery (Primary Sector)	914.95 (713.30)	673.88 <sup>a</sup> (673.90)	0.81
Rural-Urban Population Ratio	1.25 (0.68)	0.91 (0.50)	0.03**
Independent Variables			
Average Annual Real Wage of Employed Persons in Urban Units, Primary Sector (yuan)	15329.09 (5678.9)	32058.90 (11069.7)	0.00***
Average Annual Real Wage of Employed Persons in Urban Units, Manufacturing (yuan)	22552.52 (5097.0)	49450.79 (9359.0)	0.00***
Average Annual Real Wage of Employed Persons in Urban Units, Construction (yuan)	20531.93 (7974.7)	44868.43 (9306.5)	0.00***
Employed Persons in Urban Units, Manufacturing (10000)	110.78 (105.2)	169.13 (206.90)	0.17
Employed Persons in Urban Units, Construction (10000)	34.60 (28.52)	94.23 (96.67)	0.00***
Natural Growth Rate	5.46 (2.72)	5.52 (2.76)	0.93
Unemployment Rate in Urban Area (%)	3.75 (0.55)	3.28 (0.65)	0.00***
Consumer Price Indices (preceding year=100), Rentals	104.24 (3.46)	103.19 (1.49)	0.13

Notes: Standard Deviations in parenthesis. P-value corresponds to a paired t-test between 2008 and 2014 data. <sup>a</sup> Value that corresponds to 2012. Source: NBS, China (2008-2014),

Table 2. Rural-Urban Population Ratio

VARIABLES	(1) Two-Way FE	(2) FE-AR(1)	(3) DPD
Log(Average Annual Real Wage of Employed Persons in Urban Units, Manufacturing (yuan))	0.120* [0.065]	-0.295*** [0.045]	-0.023 [0.043]
Log(Average Annual Real Wage of Employed Persons in Urban Units, Construction (yuan))	-0.181*** [0.042]	-0.032 [0.035]	-0.081*** [0.031]
Log(Employed Persons in Urban Units, Construction (10000))	-0.049*** [0.015]	0.018 [0.016]	0.020 [0.015]
Log(Employed Persons in Urban Units, Manufacturing (10000))	-0.021 [0.030]	-0.060* [0.036]	-0.051 [0.032]
Natural Growth Rate	-0.013 [0.008]	-0.002 [0.006]	0.003 [0.007]
Unemployment Rate in Urban Area (%)	-0.005 [0.014]	0.020 [0.014]	0.021 [0.014]
Consumer Price Indices(preceding year=100), Rentals	-0.001 [0.001]	-0.002** [0.001]	0.001 [0.001]
Log(Rural-Urban population Ratio) Lag1			0.915*** [0.021]
Constant	1.413** [0.666]	3.614*** [0.143]	0.946* [0.548]
Year FE	Yes***		Yes***
Region FE	Yes***	Yes***	
Observations	216	185	186
Regions	31	31	31

Note: Robust standard errors in brackets except for FE-AR (1) \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Source: NBS, China (2008-2014)

Table 3. Employed Persons in the Primary Sector

VARIABLES	(1) Two-Way FE	(2) FE-AR(1)	(3) DPD
Log(Average Annual Real Wage of Employed Persons in Urban Units, Primary Sector (yuan))	-0.008 [0.028]	0.003 [0.055]	-0.005 [0.066]
Log(Average Annual Real Wage of Employed Persons in Urban Units, Manufacturing (yuan))	0.014 [0.120]	-0.011 [0.080]	-0.286** [0.132]
Log(Average Annual Real Wage of Employed Persons in Urban Units, Construction (yuan))	0.000 [0.096]	-0.123* [0.064]	-0.219** [0.102]
Natural Growth Rate	0.015 [0.014]	0.022* [0.012]	0.054*** [0.016]
Unemployment Rate in Urban Area (%)	-0.022 [0.023]	-0.019 [0.022]	-0.005 [0.024]
Consumer Price Indices(preceding year=100), Rentals	-0.001 [0.001]	0.001 [0.001]	-0.001 [0.001]
Log(Employed Persons in Primary Sector (10000)) Lag1			0.855*** [0.061]
Log(Employed Persons in Urban Units, Construction (10000)) Lag1	0.041 [0.055]	0.078** [0.037]	0.030 [0.032]
Log(Employed Persons in Urban Units, Construction (10000)) Lag2	-0.057 [0.070]	-0.048 [0.084]	0.030 [0.085]
Log(Employed Persons in Urban Units, Construction (10000)) Lag3			-0.037 [0.066]
Log(Employed Persons in Urban Units, Manufacturing (10000)) Lag1			0.007 [0.085]
Log(Employed Persons in Urban Units, Manufacturing (10000)) Lag2			-0.023 [0.159]
Log(Employed Persons in Urban Units, Manufacturing(10000)) Lag3			0.104 [0.138]
Constant	7.453*** [1.363]	7.528*** [0.462]	5.663*** [1.963]
Year FE	Yes***		Yes***
Regions FE	Yes***	Yes***	
Observations	124	93	62
Regions	31	31	31

Note: Robust standard errors in brackets except for FE-AR (1) \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Source: NBS, China (2008-2014)



Figure 2. Changes in Rural-Urban Population Ratio.

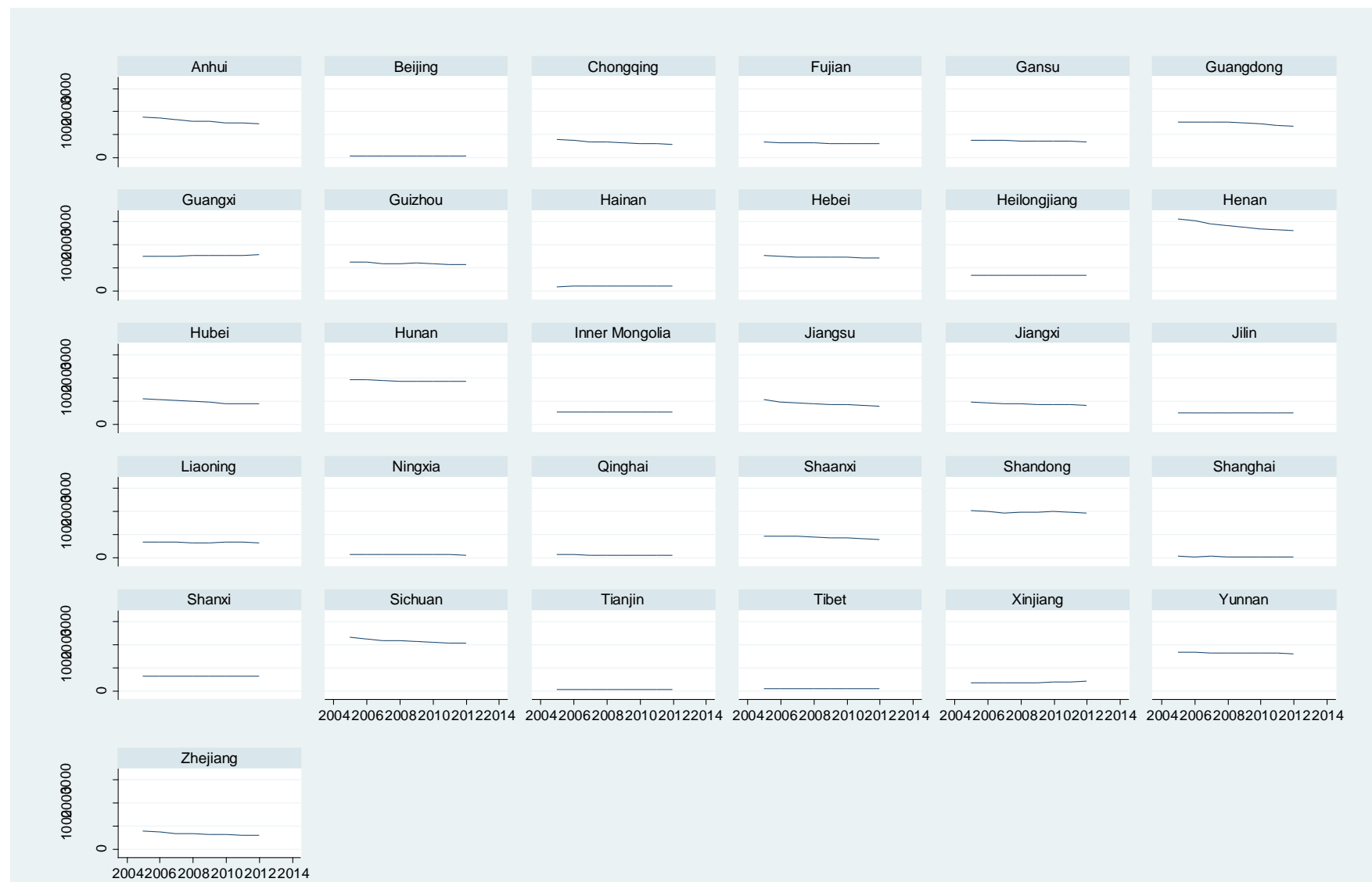


Figure 2. Changes in Number of Workers Employed in Primary Sector

<sup>1</sup> One might be concerned of collinearity issues in the rural-urban population ratio and the agricultural labor models, specifically correlation between wages and job opportunities. However, the Pearson correlation results show low correlations between wages and job opportunities for construction and manufacturing (0.24, 0.17, respectively).

<sup>2</sup> Agricultural wages in rural areas were not reported in National Bureau Statistics of China.

<sup>3</sup> Hausmann test rejected the null hypothesis that over identifying restriction of Random effects estimator hold for both models.

<sup>4</sup> There is no clear-cut definition of few, it may range from less than 20 to less than 50 clusters in the balanced case, and even more clusters in the unbalanced case (Cameron and Miller, 2015)

<sup>5</sup> We cannot reject the null hypothesis of unit root at 1 % level using the Dickey-Fuller test.

<sup>6</sup> If the residuals are stationary  $I(0)$ , then the variables are cointegrated and have a long run relationship. In this case, an error correction model or the Johansen procedure will generate accurate results.

<sup>7</sup> Arellano and Bond (1991) show that the one-step Sargan test tend to over reject in the presence of heteroscedasticity.

<sup>8</sup> First difference of white noise is necessarily autocorrelated, the concern is with second and higher autocorrelation.