The Proximate Determinants of Differences in GDP per Worker across Some Major Cities in China

ONLINE APPENDIX

Benjamin Shen[1] **Murat Üngör**[2]

16 June 2020

This is the Online Appendix for the paper, "The Proximate Determinants of Differences in GDP per Worker across Some Major Cities in China."
It is posted at (i) http://www.muratungor.com and (ii) https://benjaminshen.weebly.com.

[1] Department of Economics, University of Auckland, Auckland 1010, New Zealand. E-mail address: benjamin.shen@auckland.ac.nz
[2] Corresponding Author. Department of Economics, University of Otago, PO Box 56, Dunedin 9054, New Zealand. E-mail address: murat.ungor@otago.ac.nz

1. Household Registry System[3]

The *hu'kou* system began in August 1950 with a decree issued by the Ministry of Public Security.[4] Back then, the purpose of *hu'kou* is to restore social stability, and monitor, but not control, population movement. But as China prioritized heavy industry, and set up a planned economy based on the Soviet model, policymakers saw the need to finance the industrial projects, as well as the urgency to generate an agricultural surplus in order to support heavy industrial development. Policies shifted to preventing peasants from entering cities.

A landmark document is the *Decree on preventing rural population from blindly leaving*[5] issued on 18 December 1957. Less than a month later, on 9 January 1958, the National People's Congress passed a bill titled *Regulation on household registry of the P.R.C.*[6] This law became the basis of the *hu'kou* system. Article 10 of this legislation states that, when citizens relocate from rural to urban areas, they must carry a hiring contract for the work unit they are going to work in, or an offer of admission at a school, or a letter of approval by the urban household registry for them to move.

The rigidness of the *hu'kou* system is not relaxed until after 1978, when the market economy started to develop. In October 1984, the State Department issued a notice which allowed peasants to obtain non-agricultural *hu'kou* in counties and small towns.[7] In July 1985, the Ministry of Public Security issued a temporary regulation which allowed peasants who have migrated to cities to obtain temporary residence permits.[8] In a document released in May 1997, skilled peasants, peasants who have bought houses in cities, etc. were allowed to obtain non-agricultural *hu'kou*.[9] Nevertheless, "mechanical increases" in the population of big cities like Beijing, Tianjin, and Shanghai were strongly discouraged. The *hu'kou* system is further relaxed in a document issued by the State Department in July 1998 which allowed new-born infants to follow either parent's *hu'kou*, among other policy changes. But it still calls for strict control of the *hu'kou* of big cities like Beijing and Shanghai.[10] More recently, in a document issued in March 2001, peasants are allowed to obtain non-agricultural *hu'kou* in "small towns" which included county-level cities and other small urban centres.[11] Since then there have been more reforms of *hu'kou*, generally aimed at relaxing restrictions on rural-urban migration as well as eliminating the rural-urban divide. In some cities, it is now possible to migrate one's *hu'kou* under a point-based skilled migration system.[12] In July 2014, the State Department issued a decree which says China would gradually eliminate the agricultural and non-agricultural *hu'kou* divide.[13] Each province issued their own plans afterwards.

The *hu'kou* system has two fundamental features. First, it is compulsory. Second, it is dual-track: agricultural and non-agricultural. The law of January 1958 makes it clear that every

[3] All translations are done by the first author.
[4] 《关于特种人口管理的暂行办法（草案）》
[5] 《关于制止农村人口盲目外流的指示》
[6] 《中华人民共和国户口登记条例》
[7] 《国务院关于农民进入集镇落户问题的通知》
[8] 《公安部关于城镇暂住人口管理的暂行规定》
[9] 《国务院批转公安部小城镇户籍管理制度改革试点方案和关于完善农村户籍管理制度意见的通知》
[10] 《国务院批转公安部关于解决当前户口管理工作中几个突出问题意见的通知》
[11] 《国务院批转公安部关于推进小城镇户籍管理制度改革意见的通知》
[12] See, for example,《北京市积分落户管理办法（试行）》 for Beijing.
[13] 《关于进一步推进户籍制度改革的意见》

Chinese citizen must obtain *hu'kou*. Under the planned economy, *hu'kou* is almost the only form of ID that people had (the national ID system is approved in September 1985[14]). Up until the decree of July 1988, new-born infants generally followed the mother's *hu'kou*, which eliminates the incentive for women to marry into cities. The compulsory nature of *hu'kou*, combined with the fact that people need it to have access to food, housing, health care, education, jobs, superannuation, social welfare, etc. means that migration, rural-urban or between cities, is practically impossible in China under the planned economy. The reforms after 1978 essentially allowed rural residents to come to cities, live, and work, without granting them local, non-agricultural *hu'kou*. This has the effect of increasing the resident population of cities without catering to the new arrivals' social benefits such as their children's education, superannuation and health care, etc.

The other feature of *hu'kou* is its dual-track nature, which has persisted to the present day. *Hu'kou* is registered for a place of residence as well as status: agricultural and non-agricultural.[15] A non-agricultural *hu'kou* conveys huge advantages to its holder. In the planned economy, while almost every aspect of an urban resident's life is taken care of by the state, such as food, education, housing, health care, employment, superannuation, etc., rural residents do not enjoy any of these. Peasants work in collectives which have to fulfil food rations to the state.[16] Collectives have since disappeared.[17] Market economy has prospered in cities. But the dual-track nature of *hu'kou* has remained in most places.

Under the planned economy, the effect of *hu'kou* on migration is that it essentially eliminated it, whether rural-urban or urban-urban. In fact, China's urbanisation rate stagnated during the planned economy years.[18] After 1978, migration from rural to urban areas and between urban areas was relaxed, first into small towns, and then into bigger cities.[19] Wu and Treiman (2007) study the effect of *hu'kou* on intergenerational occupational mobility. They find that agricultural (rural) *hu'kou* blocks upward mobility for most workers. Furthermore, workers of rural origin, even though their parents do not work in agriculture, are vulnerable to downward mobility back into agriculture. Lu (2008) finds that the effect of *hu'kou* on social mobility has weakened as restrictions on *hu'kou* were relaxed over time. However, an urban *hu'kou* continues to benefit its holder in terms of career advancement. Using the 1998 Survey of Occupational Mobility and Migration (SOMM), and data from Beijing, Wuxi and Zhuhai, Zhang (2010) finds that temporary migrants (also known as the "floating population") have longer job durations as well as shorter unemployment durations when compared to locals and permanent migrants (those who have already obtained local *hu'kou* in cities). Zhang attributes this finding to the higher job-searching costs temporary migrants face, due to them not having local *hu'kou*.

Bosker et al. (2012) study the effects of a relaxation of *hu'kou* on China's economic geography. The authors survey 264 cities at prefecture-level and above, and find that relaxing *hu'kou* would lead to a more uneven distribution of city size in China. China's biggest cities, Beijing, Shanghai, Guangzhou, and Chongqing would grow bigger and carry more weight in the

[14] 《中华人民共和国居民身份证条例》
[15] Naughton (2007, p. 124).
[16] Ibid. pp. 114-115.
[17] Ibid. p. 89.
[18] Ibid. p. 126.
[19] See, for example, 《关于加强小城镇建设的若干意见》, 《小城镇综合改革试点指导意见》, 《关于加强城市建设工作的意见》, 《城市规划条例》

economy. This finding is in line with the opinion that China's megacities are undersized. Song (2014) finds that rural migrants face higher living costs and have less access to government services such as housing and public education for their children. As a result, although a strict prohibition on migration is a thing of the past, and workers nowadays can freely relocate to cities, *hu'kou* discourages migration by reducing expected payoffs. Chan (2013) documents the patterns of migration within China. He observes that the Pearl River Delta and the Yangtze River Delta have remained the most popular destinations for workers over time. He argues that hurdles imposed by the *hu'kou* system are a major obstacle China has to overcome in order to achieve sustained high growth.

2. Discussion of Alternative Employment Series

Li and Gibson (2015) compare the *City Statistical Yearbook* (CSY) and the *2010 Population Census*. They note that CSY only counts local *hu'kou* holders, omitting over 100 million urban residents with *hu'kou* registration from elsewhere and many private sector workers. Accordingly, Li and Gibson (2015) use data from the 2010 Population Census instead of CSY to get population and employment data. It is important to note that NBS defines urban areas in the 2010 census as areas located in or contiguous to the area where the local government is located.[20] Although the definition is a bit different from that used in the 2000 census, the difference is negligible (Chen and Song, 2014). As a result, a prefecture-level city may include both urban (*cheng'zhen*) and rural (*xiang'cun*) areas.

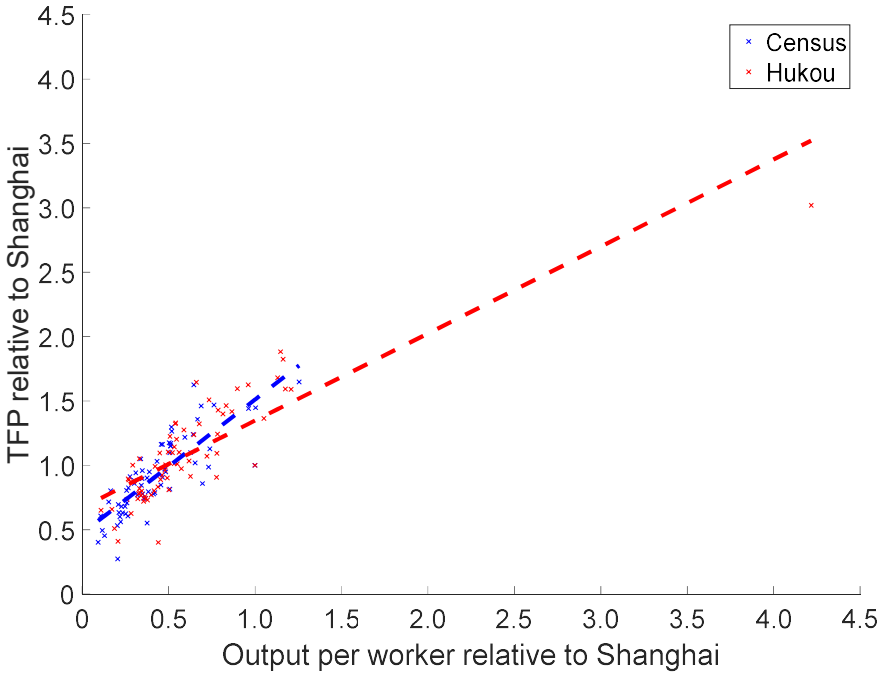
We estimate another set of employment data using urban population data found in the 2000 and 2010 *County-Level Population Census Reports*. Figure A1 plots relative TFP levels and output per worker for 69 cities in 2000 and 2010 using the alternative employment data. Data points are clustered together. In 2000, the correlation coefficient between relative TFP levels and relative output per worker is 0.81 using *Census* data, and 0.85 using *hu'kou* data. In 2010, the correlation coefficient is 0.91 using *Census* data, and 0.95 using *hu'kou* data. Therefore, the results do not change qualitatively. In order to maintain consistency, and also because *hu'kou* data are available for each year during 1994-2010 whereas Census data are only available for 2000 and 2010, we estimate employment series using *hu'kou* data.[21]

[20] Wang and Chanda (2018) note that due to administrative reforms between 2000 and 2010, the prefecture-level cities reported in the censuses of 2000 and 2010 are not identical.

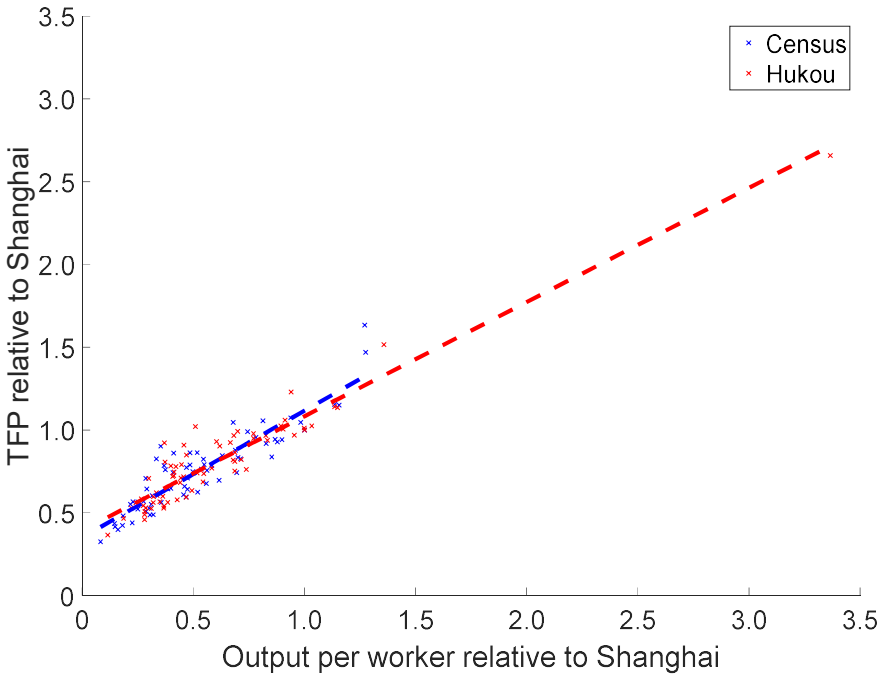
[21] Should readers be concerned with the accuracy of employment data for any particular city, one solution is to obtain statistical yearbooks published by the Bureau of Statistics of that particular city over the period. The drawbacks are that some cities do not publish their own statistical yearbooks, and data thus obtained are not as comparable as data reported in the *China City Statistical Yearbooks.* The first column in table 14-1 on page 348 of the *Statistical Yearbook of Shenzhen for 2017* reports employment for Shenzhen. The *Yearbook* is available on the website of the Statistics Bureau of Shenzhen, http://tjj.sz.gov.cn/. Note that the data are for "total city". Therefore, after taking away some workers who live in the countryside, these data correspond quite well with my *hu'kou* series.

Figure A1. Contrasting Hu'kou and Census data

(a): Comparisons for 2000



(b): Comparisons for 2010



3. Time-Varying Factor Income Shares and TFP Levels

Development accounting with Cobb-Douglas production function requires that α be constant across cities. Here we provide a simple proof. Let subscripts indicate different cities. Output per worker in each city can be expressed as follows:

$$y_1 = A_1 k_1^{\alpha} h_1^{1-\alpha}. \tag{A1}$$

$$y_2 = A_2 k_2^{\alpha} h_2^{1-\alpha}. \tag{A2}$$

Dividing (A1) over (A2) gives

$$\frac{y_1}{y_2} = \frac{A_1}{A_2}\left(\frac{k_1}{k_2}\right)^{\alpha}\left(\frac{h_1}{h_2}\right)^{1-\alpha}. \tag{A3}$$

Taking logarithms gives

$$\ln\left(\frac{y_1}{y_2}\right) = \ln\left(\frac{A_1}{A_2}\right) + \alpha \ln\left(\frac{k_1}{k_2}\right) + (1-\alpha)\ln\left(\frac{h_1}{h_2}\right). \tag{A4}$$

Note the absence of subscripts on α. It is this uniformity of α across cities which allows the capital endowments term to be raised to a common exponent. Development accounting with Cobb-Douglas production function is invalid without the assumption of the same factor shares across countries (see also Sturgill, 2014). One can develop a similar line of reasoning for the growth accounting exercises.

In a departure from the standard approach in the literature, we provide an exercise with a more flexible formulation that does not assume a common labour share across cities. Specifically, we use the Törnqvist quantity index to calculate TFP levels relative to Shanghai in order to investigate the effect of time-varying factor income shares. A second-order approximation to the production function is the Törnqvist quantity index of factor inputs Q^T, which can be used for comparing productivity levels between two cities *i* and *j* at a given time:

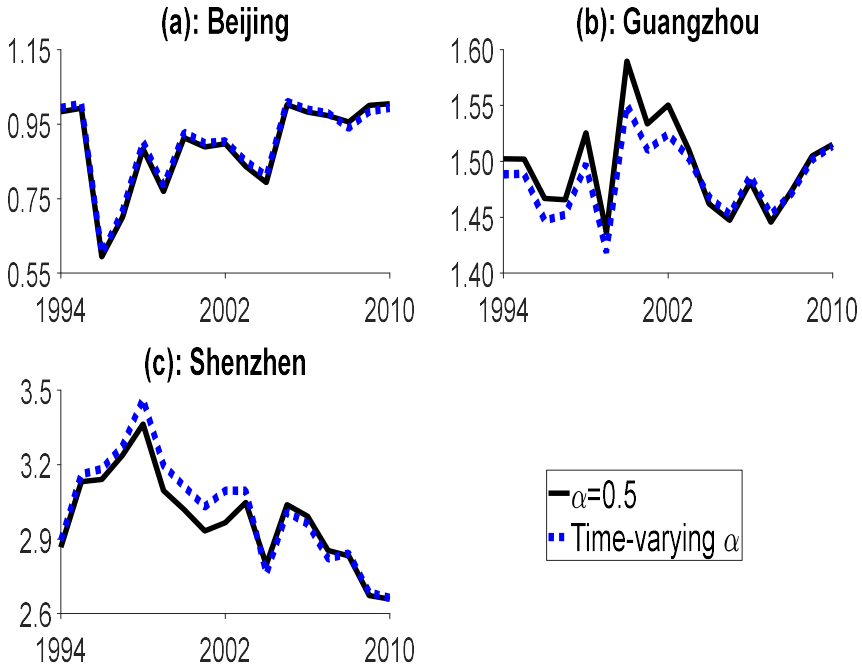
$$\ln\left(\mathrm{Q}^{\mathrm{T}}_{\mathrm{i,j,t}}\right) = \frac{1}{2}\left(\alpha_{\mathrm{i,t}} + \alpha_{\mathrm{j,t}}\right)\ln\left(\frac{K_{i,t}}{K_{j,t}}\right) + \left[1 - \frac{1}{2}\left(\alpha_{\mathrm{i,t}} + \alpha_{\mathrm{j,t}}\right)\right]\ln\left(\frac{h_{i,t}L_{i,t}}{h_{j,t}L_{j,t}}\right). \tag{A5}$$

In our empirical implementation, we use Shanghai as the base city, so all cities *i* are compared to *j=Shanghai.* We use the time series of the adjusted labour income shares. Relative TFP levels are calculated as:

$$TFP_{i,j,t} = \frac{Y_t^i / Y_t^j}{Q_{i,j,t}^T}. \quad \text{(A6)}$$

Figure A2 shows that allowing α to vary over time does not significantly alter relative TFP levels. Figure A2 only shows the analysis for the first-tier cities. We also observe similar behaviour for other cities. This is not surprising since α does not vary much during the sample period, fluctuating around 0.5 during the sample period.

Figure A2. TFP levels relative to Shanghai with time-varying factor income shares



4. Income Convergence among Cities

Two types of convergence are recognized in the literature: σ-convergence and β-convergence. At a most intuitive level, σ-convergence is where economies converge in income levels over time, and β-convergence is when economies which are poor at the beginning of the period have been growing faster than rich ones (Young et al., 2008). Panel (a) in Figure A3 shows evidence

of β-convergence. Poor cities have been growing faster than rich ones over the sample period. Panel (b) in Figure A3 shows that, when focusing on Tier 1 and 2 cities, that is, only 35 cities, the correlation gets slightly stronger. We test for unconditional β-convergence for 69-city and 35-city samples separately with the following two regressions:

$$\Delta \ln(Y/L)_i = \alpha_1 + \beta_1 \ln(Y/L)_i^{1994} + \epsilon_{1,i}, \qquad i=1,2,\ldots,69, \tag{A7}$$

$$\Delta \ln(Y/L)_i = \alpha_2 + \beta_2 \ln(Y/L)_i^{1994} + \epsilon_{2,i}, \qquad i=1,2,\ldots,35, \tag{A8}$$

where $\Delta ln(Y/L)_i$ is the average labor productivity growth rate in the 1994-2010 period, and $\ln(Y/L)_i^{1994}$ is the initial productivity for city *i*, and ϵ is a stochastic error term. Here β_1 and β_2 determine the relationship between initial labor productivities and subsequent growth rates. The results of regressing equations (A7) and (A8) are shown in Table A1. The estimated coefficients of β_1 and β_2 are negative. However, only β_1 is significant (and it is significant at the 10% level). The null hypothesis of no β-convergence cannot be rejected for the 35-city sample.

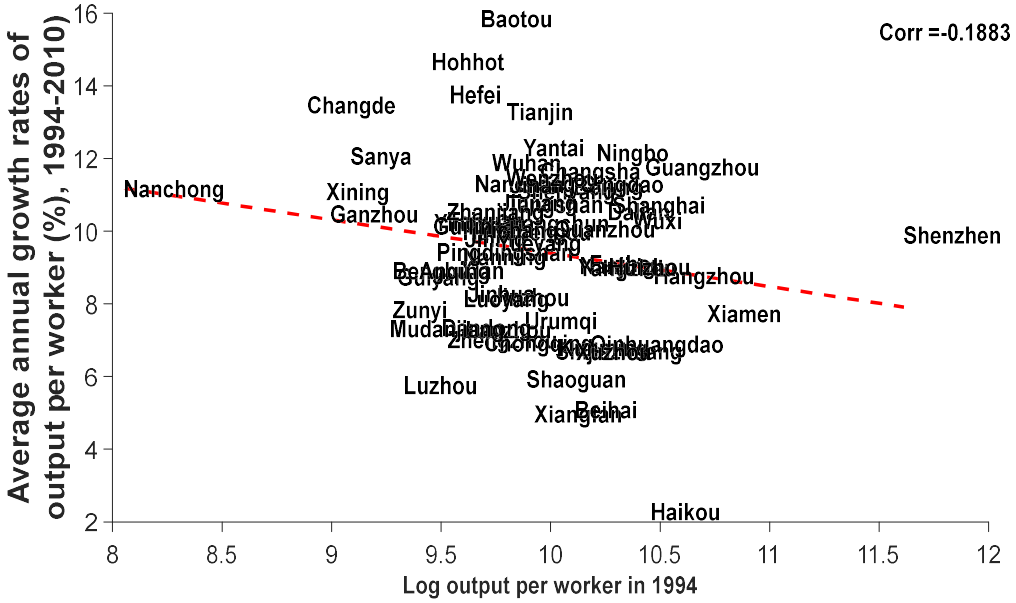
Table A1. Cross-section estimates of unconditional convergence

	$\Delta ln(Y/L)_i$		$\Delta ln(Y/L)_i$
α_1	18.58***	α_2	19.45***
	(5.612)		(8.056)
β_1	-0.919*	β_2	-0.966
	(0.532)		(0.818)
R^2	0.035	R^2	0.037

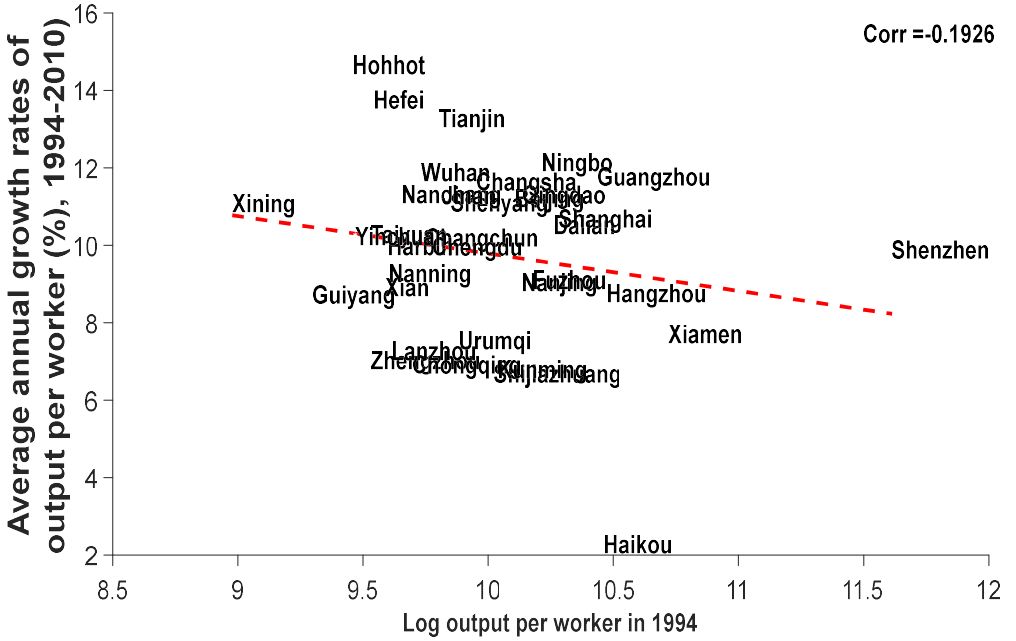
Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure A3. Income convergence among the Chinese cities, 1994-2010

(a): Sample of 69 cities



(b): Sample of 35 cities



References

Bosker, M., Brakman, S., Garretsen, H., Schramm, M. 2012. "Relaxing Hukou: Increased Labor Mobility and China's Economic Geography." Journal of Urban Economics, 72(2-3), 252-266.

Chan, K. W. 2013. "China: Internal Migration." The Encyclopaedia of Global Human Migration.

Chen, Q., Song, Z. 2014. "Accounting for China's Urbanization." China Economic Review, 30, 485-494.

Li, C., Gibson, J. 2015. "City Scale and Productivity in China." Economics Letters, 131, 86-90.

Lu, Y. 2008. "Does *Hukou* Still Matter? The Household Registration System and Its Impact on Social Stratification and Mobility in China." Social Sciences in China, 29(2), 56-75.

Naughton, B. 2007. "The Chinese Economy: Transitions and Growth." Cambridge, MA: MIT Press.

Shen, B. 2018. "Cities and Economic Development: The Chinese Experience." Unpublished Master Thesis. University of Otago.

Song, Y. 2014. "What Should Economists Know About the Current Chinese Hukou System?" China Economic Review, 29, 200-212.

Sturgill, B. 2014. "Back to Basics: Revisiting the Development Accounting Methodology." Journal of Macroeconomics, 42, 52-68.

Wang, T., Chanda, A. 2018. "Manufacturing Growth and Local Multipliers in China." Journal of Comparative Analysis, 46(2), 515-543.

Wu, X., Treiman, D. J. 2007. "Inequality and Equality under Chinese Socialism: The *Hukou* System and Intergenerational Occupational Mobility." American Journal of Sociology, 113(2), 415-445.

Young, A., Higgins, M., Levy, D. 2008. "Sigma Convergence versus Beta Convergence: Evidence from U.S. County-Level Data." Journal of Money, Credit and Banking, 40(5), 1083-1093.

Zhang, H. 2010. "The *Hukou* System's Constraints on Migrant Workers' Job Mobility in Chinese Cities." China Economic Review, 21(1), 51-64.

References (Chinese)

《关于特种人口管理的暂行办法（草案）》

《关于制止农村人口盲目外流的指示》

《中华人民共和国户口登记条例》

《国务院关于农民进入集镇落户问题的通知》

《公安部关于城镇暂住人口管理的暂行规定》

《国务院批转公安部小城镇户籍管理制度改革试点方案和关于完善农村户籍管理制度意见的通知》

《国务院批转公安部关于解决当前户口管理工作中几个突出问题意见的通知》

《国务院批转公安部关于推进小城镇户籍管理制度改革意见的通知》

《北京市积分落户管理办法（试行）》

《关于进一步推进户籍制度改革的意见》

《中华人民共和国居民身份证条例》

《关于加强小城镇建设的若干意见》

《小城镇综合改革试点指导意见》

《关于加强城市建设工作的意见》

《城市规划条例》