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Spatial Disequilibrium, Provincial Inequality and Individual Inequality in Urban China

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Abstract

This paper identifies substantial spatial disequilibrium in urban China in 1988, 1995, 2002, 2008 and 2013. It estimates that between 40% and 75% of urban Chinese workers could increase earnings by more than 50% through inter-provincial relocations. At least seven additional years of schooling would be required to produce equivalent earnings gains. These gains would reduce interpersonal inequality and eradicate inter-provincial inequality. A reference comparison for the urban U.S. in 1940 demonstrates that only 7.4% of workers predict relocation gains of more than 20%. These results imply that China has not achieved internal economic integration.

J.E.L. codes: J24, J31, J61, O15, P25, R12, R23

Keywords: China, regional inequality, human capital, law of one price, equality of opportunity

1. Introduction

Regional inequality in China is a subject of substantial scholarly and policy interest. Almost all of that interest is directed at comparisons of average income measures across provinces and regions. The extent to which these comparisons are insightful regarding regional components, if any, of differences in individual welfare is unknown.

This paper estimates these differences. It constructs measures of the extent to which earnings vary depending upon the province of residence for urban Chinese workers. These measures are based on estimates of potential earnings in multiple provinces. As workers reside in only one province, these estimates require the construction of counter-factual comparisons.

The counter-factual comparisons here are based on simple province-specific regressions of observed labor earnings on worker characteristics associated with human capital. These regressions predict earnings in every province for all workers, regardless of the province in which they actually reside. These predictions identify the province in which each worker would maximize predicted labor earnings.

The difference between predicted earnings in this province and in the province of residence is an indication of the earnings gains that might be available through increased economic mobility. Between 40% and 75% of non-migrant Chinese urban workers predict relocation gains of more than 50%. Average gains across all urban workers are equivalent to the earnings increases that would accrue from at least seven additional years of schooling. Potential gains of this magnitude indicate that there is substantial inequality in opportunity across provinces.

The 1988, 1995, 2002, 2008 and 2013 urban surveys of the China Household Income Project (CHIP) provide the data for these analyses. The first of these surveys took place when China was less developed, early in economic reform. The most recent took place when China had attained middle-income status, after 25 years of rapid growth. The evolution of potential gains from economic mobility over time illuminates the relationship between macroeconomic growth and inter-regional integration in China.

An additional counter-factual assesses whether the pattern of potential mobility gains in China is distinctive. The U.S. has a Constitutional commitment to inter-regional integration. Its experience provides an interesting standard to which that of China can be compared.

The analysis described above, applied to the urban U.S. in 1940, provides the appropriate reference.[1] This is the earliest year in which the U.S. Census recorded individual income. It is therefore the year in which observed individual income levels in the U.S. were most comparable to those of contemporary China. In that year, 92.6% of urban workers predict relocation gains of less than 20%. In other words, almost all of them were, roughly, in spatial equilibrium.

China's *hukou* restrictions on labor mobility (Chan, 2009) surely contribute to inter-provincial differences in the value of human capital. The legal obligation to reside in the province, the rural or urban sector and perhaps even the county of birth imposes substantial inequality of opportunity, ex ante, as well as inequality of realized earnings.

In response to these inequalities, workers increasingly disregarded formal restrictions and migrated to Chinese cities for which they did not have *hukous* during the period under study. These unprecedented increases in urban labor supply nevertheless failed to equilibrate earnings across regions. To the contrary, migrants have been segregated in dual labor markets in which they are complementary to, rather than competitive with, legal urban workers. Consequently, they have exacerbated spatial earnings disequilibria.

Equilibration has probably also been impeded by barriers to inter-provincial mobility of final goods (Tombe and Zhu, 2019). Moreover, Hsieh and Klenow (2009) and Brandt, Van Biesebroeck and Zhang (2012) demonstrate that there are large variations in productivity across Chinese employers. The new evidence of geographic variations in human capital valuations

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[1] The United States often serves as a standard of comparison in research that assesses the magnitudes of economic distortions (Banerjee and Duflo, 2005; Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009; Brandt, Van Biesebroeck and Zhang, 2012; Bartelsman, Haltiwanger and Scarpetta, 2013; Desmet and Rossi-Hansberg, 2013; Tombe and Zhu, 2019, as examples).

presented in this paper implies that variations in productivity probably also have a hitherto unexamined geographic component. More generally, the results here imply that there are important barriers to the diffusion of non-labor factors of production and of the most productive technologies, as well as of final goods, across provincial boundaries in China.

The partial equilibrium calculations here cannot account for all of the consequences that would ensue were these barriers to be removed. Nevertheless, the large estimates of personal income losses that they yield are of similar magnitude to general equilibrium estimates for China of productivity losses attributable to firm-level distortions (Hsieh and Klenow, 2009), welfare losses attributable to internal trade restrictions (Tombe and Zhu, 2019), and welfare losses attributable to interference with urban agglomeration economies and accessibility to amenities (Au and Henderson, 2006; Desmet and Rossi-Hansberg, 2013). This raises the possibility that, while these papers examine distinct issues, their results reflect, at least in part, a common set of substantial distortions at the core of the Chinese economy.

Section 2 of this paper summarizes the current understanding of inter-provincial inequality in China, the use of counter-factual simulations in the study of the Chinese economy and productivity variations across firms in China. Section 3 describes the theoretical motivation and estimation strategy.

Section 4 compares divisions of residence and of maximum predicted earnings for the urban U.S. in 1940 and analyzes actual and counter-factual individual and inter-regional inequality. Section 5 presents the analogous analysis for Chinese provinces in 1988. Section 6 summarizes the same analyses for 1995, 2002, 2008 and 2013. Section 7 discusses the evolution of these results over time and varying samples. Section 8 summarizes the contributions and discusses their implications for understanding the urban system, internal migration and internal integration in China. Extended discussions appear in Zax (2019).

2. The context

This paper engages three previously unrelated themes in the existing literature. The first examines inter-regional inequality in China, with largely informal attention to any sources in production functions and factor allocations. The second explores variations in the returns to human capital and develops counterfactuals in order to assess the effects of demographics and migration on inequality in China. The third examines inter-firm inequality in productivity in China, but ignores the within-country geographical distribution of productivity variations.

The coherence of its national economy is a central theme in the study of China (Goodman and Segal, 1995; Naughton and Yang, 2004). This engenders two subsidiary themes. The first assesses the degree of economic integration by comparing flows and prices of goods and non-labor factors to the standards implied by the Law of One Price, with inconclusive results (Zax and He, 2016). The second pursues a parallel inquiry, comparing proxies for average prices of labor across provinces.

The analysis here addresses the first sub-theme by explicitly exploring the extent to which labor compensation in China adheres to the Law of One Price. It derives its inspiration from the second sub-theme. It expands this literature by examining earnings variations and comparing them to the variations that might be expected in a relatively integrated labor market.

The voluminous literature addressing inter-regional inequality in China yields a rough chronological consensus.[2] There appears to have been no discernible change in inter-provincial inequality between 1952 and the mid-1960s. Inter-provincial inequality appears to have increased during the Cultural Revolution, from the mid-1960s through the mid-1970s. It then declined into either the early 1980s or even to 1990. It subsequently increased to as recently as 2000 and perhaps to 2005. However, it may have declined in 2005 and 2006.

The apparent increase in interprovincial inequality since at least 1990 appears to be

[2] This paragraph summarize results in Lyons (1991), Tsui (1991 and 1996), Chen and Fleisher (1996), Jian, Sachs and Warner (1996), Démurger (2001), Kanbur and Zhang (1999, 2005), Cai, Wang and Du (2002), Démurger, et al. (2002), Lu and Wang (2002), Pedroni and Yao (2006), Fan and Sun (2008), Lu (2008), and Lau (2010).

largely spurious. During most of this period, most official Chinese sub-national per capita statistics were based on registered population – those with *hukou* in the relevant jurisdiction – rather than resident population. These two counts were relatively similar in 1990 because migration was minimal. However, migration increased dramatically thereafter.[3]

As would be expected, migrants originated in low-income provinces and were attracted to high-income provinces. Consequently, official statistics understated actual per capita incomes in the former and overstated them in the latter. Inequality per resident capita appears to have increased slightly from 1990 through 1995. The change between 1995 and 2000 is ambiguous. Inequality in income per resident capita seems to have declined from 2000 to 2010.

The commitment to aggregate measurement, generally at the provincial level, presents another challenge to the assessment of regional inequality in China. This commitment arises from the macroeconomic tradition of convergence analysis (Baumol, 1986; Barro and Sala-I-Martin, 1991; Magrini, 2004) and from the Chinese government's preoccupation with the possibility that regional inequality will threaten social stability. Conceptual problems arise out of both the macroeconomic tradition and the political concern.

In general, the relationships between neo-classical growth theory and its empirical implementations in the study of convergence are problematic (Magrini, 2004). This theory provides little guidance regarding the region-specific characteristics that might affect output levels and growth paths. Consequently, most analyses of the Chinese economy employ limited, arbitrary and mutually inconsistent sets of explanatory variables.[4]

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[3] This and the next paragraph summarize results in Tsui (2007), Chan and Wang (2008), Yao (2009), Li and Gibson (2013), Jin et al. (2014), and Gibson and Li (2017).

[4] As extreme examples, Pedroni and Yao (2006) and Lau (2010) distinguish Chinese provinces solely by their time series of growth rates. This literature generally ignores potential simultaneity between dependent variables and contemporaneous regressors.

In particular, they typically omit measures of human capital accumulation.[5] If average levels of human capital differ across provinces, differences in average provincial incomes, and perhaps in growth rates, would be expected rather than exceptional.[6]

Aggregate-level analysis is consistent with the Chinese government's concern regarding inter-regional disparities (Ye, 1996, 83; Liu, 2006, 377; Chan and Wang, 2008, 21), as commonly acknowledged in the literature examining inter-regional inequality.[7] The Chinese government has addressed these concerns with policies that intend to direct development towards inland provinces.[8] Therefore, assessment at the regional and provincial levels may appear to be appropriate.

However, welfare concerns apply to individuals rather than to aggregates. Therefore, geographic areas are uncertain proxies for the individuals who are affected by these policies. From the perspective of individual welfare, the important question is not whether average incomes vary across regions in China, but whether individual incomes vary consistently with individual characteristics. A priori, this question cannot be answered affirmatively because of limitations on inter- and even intra-provincial mobility imposed by China's *hukou* system.

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[5] As examples, see Tsui (1991), Jian, Sachs and Warner (1996), Kanbur and Zhang (1999 and 2005), Yang (1999), Démurger (2001), and Démurger, et al. (2002). Combes, Duranton and Gobillon (2008, footnote 2) observe that analyses of regional wage differences largely ignore regional skill differences, regardless of the country under examination.

[6] Chen and Fleisher (19960, Fleisher and Chen (1997), Démurger (2001), Jones, Li and Owen (2003), Tsui (2007), Lu (2008). Fleisher, Li and Zhao (2010) and Lau (2010) are examples of the few papers that include measures of human capital as explanatory variables.

[7] As examples, Chen and Fleisher (1996, 1540), Jian, Sachs and Warner (1996, 2), Tsui (1996, 354), Fleisher and Chen (1997, 221), Wang and Hu (1999:201), Kanbur and Zhang (2005, 101), Tsui (2007, 60), Fan and Sun (2008, 1) and Andersson, Edgerton and Opper (2013, 239).

[8] The "Decision on Speeding up the Development of Rural Enterprises in Central and Western Regions" was issued in 1993 (Liu, 2006, 383). This was followed by the "Western Development Program" in 1999 (Naughton, 2004, 253; Yao, 2009, 231-2), the "Reviving the Northeast" program and the "Central Rising" program of 2006 (Yao, 2009, 232-234).

This paper addresses this question by measuring inequality across provinces in the potential earnings of individual urban Chinese workers. For this purpose, it engages two additional sub-themes among analyses of the Chinese economy: inter-provincial differences in returns to human capital and counterfactuals derived from regression-based simulations.

A small literature demonstrates inter-provincial differences in individual returns to education (as examples, Liu, 1998; Li, 2003; Zhang, et al., 2005). Whalley and Xing (2014) has the most in common with this paper. They estimate wide variation in province-specific returns to education, increasing over time, in the 1995, 2002 and 2007 CHIP urban surveys.

A smaller literature uses micro-data to simulate counter-factual earnings (Démurger, et al., 2009; Xing and Zhang, 2013; and Xing, 2014). These papers investigate the determinants and returns to migration within China. This paper also creates counter-factuals that are related to migration in China. However, they estimate earnings differences for all workers in multiple destinations, rather than assessing earnings gains for actual migrants.

Finally, Hsieh and Klenow (2009) and Brandt, Van Biesebroeck and Zhang (2012) demonstrate that total factor productivity (TFP) varies dramatically across Chinese firms. Hsieh and Klenow (2009) also estimate dramatic variations in firm-specific returns to capital and labor productivity. However, neither paper explores the geographic dimension of these variations, particularly in labor productivity. That is the subject of the rest of this paper.[9]

3. Theoretical motivation and estimation

The intent of this paper is to estimate and compare the potential value of each urban worker's human capital in each of China's surveyed provinces. This comparison informally tests the "null hypothesis", or presumption, that China is a competitive, integrated, internally open economy.

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[9] Brandt, Tombe and Zhu (2013) estimate large inter-provincial differences in total factor productivity. Within-country, inter-firm productivity variability is not exclusive to China among developing countries (Banerjee and Duflo, 2005).

If this were to be the case, expectations for this comparison would be straightforward. Factor mobility should equate the prices of all factors, including labor at each skill level, across provinces. Trade in final goods should reinforce the equality of province-specific factor returns, as predicted by the Factor Price Equalization Theorem (Samuelson, 1948; Ethier, 1984; Jones and Neary, 1984).

This null hypothesis also informs the structure of the comparison. First, its object should be the level of earnings rather than the more conventional natural log. The conventional specification estimates returns to investments in human capital. However, factor mobility and trade in goods should equalize compensation for given levels of human capital, rather than returns to the investments necessary to create those levels. Therefore, the interest here is in the contribution that differences in human capital characteristics make to differences in earnings.

Second, the comparison does not adjust earnings for differences in provincial "costs-of-living". Conventional cost-of-living measures vary across Chinese provinces (Brandt and Holz, 2006; Gong and Meng, 2008; Almås and Johnsen, 2012). However, these variations should be irrelevant to prices for traded final goods and factor prices in an open, competitive equilibrium.

Consumers are indifferent to the geographical origins of the goods that they purchase. Therefore, different producers of a good must adhere to the same final price for that good in order to be competitive, regardless of the characteristics of their production locations. Consequently, final good prices must be independent of costs-of-living at production locations.

This again implies, through the Factor Price Equalization Theorem, that factor prices will be the same regardless of where they are employed. Therefore, factor prices must also be independent of costs-of-living at the geographical location. In other words, trade in final goods should equalize the nominal rather than the real prices of both those goods and the factors that produce them.[10]

[10] Under the informal null hypothesis here, the incidence of any location-specific characteristic cannot be on mobile factors of production, or, for that matter, on mobile agents of consumption. If, with constant nominal wages,

Moretti (2011, 1249) acknowledges the relevance of nominal earnings: "(s)ince labor, capital and goods can move freely within a country, it is difficult for an economy in a long run equilibrium to maintain significant spatial differences in nominal labor costs in the absence of equally large productivity differences." Dauth, et al. (2019, 20) concur. Similarly, "wages unadjusted for cost of living differences across locations are most informative about workers' marginal productivities"(Baum-Snow and Pavan, 2012, 91).[11]

Accordingly, the investigation here assesses human capital valuations with province-specific human capital-style regressions that estimate the determinants of nominal earnings in the 1988, 1995, 2002, 2008 and 2013 urban CHIP surveys[12], and, for comparison, in the 1940 United States Integrated Public Use Microdata Sample (IPUMS).[13] These regressions take the simple form

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differences across regions in costs-of-living imply initial differences in utility across regions, labor will migrate so as to equate utility as well as nominal wages.

[11] The treatment of inter-regional price differences in the literature addressing regional inequality in China is haphazard. Liu (1998), Démurger (2001), Démurger, et al. (2002), Cai, Wang and Du (2002), Li (2003), Jones, Li and Owen (2003), Andersson, Edgerton and Opper (2013), Li and Gibson (2013) and Xing and Zhang (2013) do not discuss the issue. Yang (1999, 307), Fan and Sun (2008, 6), Zhang, Zhang and Zhang (2015, 176) deflate nominal values for intertemporal variation, but do not discuss cross-sectional variation. Tsui (1991, 5), Chen and Fleisher (1996, 146), Jian, Sachs and Warner (1996, 5), Fleisher and Chen (1997, 234), Kanbur and Zhang (1999, 689), Kanbur and Zhang (2005, 102), Pedroni and Yao (2006, 297), Tsui (2007, 71), Chan and Wang (2008, 26), Gustaffson, et al. (2008, 41), Lu (2008, 39), Lau (2010, 295), Whalley and Xing (2014, 402) and Xing (2014, 550) adjust for time-series price variation with province-specific price indices, which may also adjust for contemporaneous inter-province price variation. Tsui (1996), Zhang, et al. (2005) and Yao (2009) mention price adjustments, but do not specify the treatment of inter-provincial price differences. Only Fleisher, Li and Zhao (2010, 222) explicitly adjust for inter-temporal and inter-provincial differences in costs of living.

[12] These data are available at http://www.ciidbnu.org/chip/index.asp?lang=EN, accessed on 23 May 2016.

[13] These data are available at https://usa.ipums.org/usa/, accessed on 16 December 2015.

$$y_{ji} = \beta_{j0} + \sum_{s=1}^{S} \beta_{js} x_{jis} + \varepsilon_{ji}, \quad \textbf{(1)}$$

where *j* indexes province, *i* indexes individuals within province, *s* indexes individual characteristics and *S* represents the number of those characteristics. Earnings, y_{ji}, is the dependent variable. The explanatory variables x_{jis} include sex, education, age and age squared.[14] The idiosyncratic component of earnings is ε_{ij}.

Predicted earnings in the province of residence are

$$\hat{y}_{jji} = \hat{\beta}_{j0} + \sum_{s=1}^{S} \hat{\beta}_{js} x_{jis}. \quad \textbf{(2)}$$

Carets (^) represent estimates, the first subscript on ŷ represents the province of residence and the second represents the province within which earnings are predicted. Average predicted earnings in the province of residence are, therefore,

$$\bar{\hat{y}}_{jj} = \frac{\sum_{i=1}^{n_j} \hat{y}_{jji}}{n_j} = \bar{y}_j, \quad \textbf{(3)}$$

where n_j is the number of workers in province *j*.

Correspondingly, when province of residence is *j*, predicted earnings in province *k* are

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[14] Liu (1998), Li (2003) and Whalley and Xing (2014) include indicators for employer industry and ownership type as earnings determinants. In analyses for other countries, Combes, Duranton and Gobillon (2008), Ehrl (2017) and Gibbons, Overman and Pelkonen (2014) use industry, occupation controls or both. The specification here omits them because workers simultaneously choose industry, employer and earnings (Angrist and Pischke, 2015). Therefore, these variables are endogenous. Liu (1998), Li (2003), Zhang, et al. (2005) and Whalley and Xing (2014) use imputed experience, age minus six years, rather than age. This is econometrically equivalent to equation 1 because imputed experience is a linear transformation of age. The purpose of either variable is to serve as a proxy for unobserved work experience (Angrist and Pischke, 2015, 217). Estimated coefficients on either may be biased (Garvey and Reimers, 1980; Light and Ureta, 1995; Regan and Oaxaca, 2009). However, the predictions that are relevant here should not be. Liu (1998), Combes, Duranton and Gobillon (2008), Gibbons, Overman and Pelkonen (2014) and Ehrl (2017) include regional indicators in their specifications. Li (2003) and Zhang, et al. (2005) include provincial indicators in theirs. These are superseded here by province-specific regressions.

$$\hat{y}_{jki} = \hat{\beta}_{k0} + \sum_{s=1}^{S} \hat{\beta}_{ks} x_{jis}.$$

This calculation combines the characteristics of workers in province *j*, x_{jis}, with the estimated values of those characteristics in province *k*, $\hat{\beta}_{ks}$. Maximum predicted earnings across provinces *j*, *k* and *l* are

$$\hat{y}_{jm_i i} = \max\left(\hat{y}_{jji}, \hat{y}_{jki}, \hat{y}_{jli}\right). \quad \textbf{(4)}$$

The province of maximum predicted earnings for worker *i* resident in province *j* is $m_i \in (j,k,l)$.

This comparison relies on predicted rather than actual earnings in the home province for two reasons. Mechanically, actual earnings incorporate random components, ε_{ji}, that cannot be predicted for earnings in other provinces *k* and *l*. Economically, these idiosyncratic components can be taken as representing transitory earnings. From this perspective, $\hat{y}_{jji}$, $\hat{y}_{jki}$ and $\hat{y}_{jli}$ predict permanent earnings in provinces *j*, *k* and *l*, respectively. The comparisons between them capture the considerations relevant to locational decisions because transitory earnings should average to approximately zero over the time horizon associated with these decisions, regardless of location.

The difference across all workers resident in a province between average maximum predicted earnings across all provinces and average predicted earnings in the province of residence is of primary interest. The average of maximum predicted earnings for all workers resident in province *j* is

$$\bar{\hat{y}}_{jm} = \frac{\sum_{i=1}^{n_j} \hat{y}_{jm_i i}}{n_j}. \quad \textbf{(5)}$$

This difference, from equations 2, 3 and 5, is

$$\bar{\hat{y}}_{jm} - \bar{\hat{y}}_{jj} = \frac{\sum_{i=1}^{n_j} \left[\beta_{m_i 0} + \sum_{s=1}^{S} \beta_{m_i s} x_{jis}\right]}{n_j} - \left[\beta_{j0} + \sum_{i=1}^{S} \beta_{js} \bar{x}_{js}\right]. \quad \textbf{(6)}$$

If all workers in province *j* achieve their maximum predicted earnings in the same alternative province *k*, then m_i=*k* for all *i*. This difference simplifies to

$$\bar{\hat{y}}_{jm} - \bar{\hat{y}}_{jj} = \beta_{k0} - \beta_{j0} + \sum_{s=1}^{S}\left(\beta_{ks} - \beta_{js}\right)\bar{x}_{js}.$$

This is the Oaxaca-Blinder contribution of differences in treatments to differences in means. In general, equation 6 will not simplify in this way because maximum predicted earnings will not occur in the same province for all workers resident in the same province.

Three additional quantities are also of interest. The first represents inequality across workers within province in predicted earnings within that province, $\hat{y}_{jji}$, measured by the Gini coefficient. The second represents inequality across workers within province in predicted maximum earnings in any province, $\hat{y}_{jm_i i}$, again measured by the Gini coefficient. The third is the inequality across provinces of average maximum predicted earnings, $\bar{\hat{y}}_{jm}$, $\bar{\hat{y}}_{km}$, and $\bar{\hat{y}}_{lm}$.[15]

4. Earnings and regional inequality in the U.S., 1940

Analyses of inter-provincial inequality in China are motivated, in part, by concern that it may be exacerbated by impediments to goods and factor mobility across provinces. From this perspective, a comparable analysis in a context presumably less afflicted with impediments provides a useful standard of reference.

This section presents this analysis for the United States in 1940. By that time, its commerce had been governed for over 150 years by Article 1, Section 8, Clause 3 of its Constitution.

[15] The comparisons across these quantities are in the spirit of the literature on inequality of opportunity (Ferreira and Peragine, 2015; Roemer and Trannoy, 2015; Ramos and Van de gaer, 2016). However, that literature compares opportunities for different individuals in the same locations (as examples, World Bank, 2005; de Barros, et al., 2009; Carpantier and Sapata, 2013). These comparisons are problematic because they require distinctions between characteristics that are potentially compensable endowments and those that are presumably non-compensable consequences of individual choice (Roemer, 2008; Kanbur and Wagstaff, 2014). These problems are not relevant here where the comparisons are between predicted opportunities in multiple pro-vinces for the same individual. The relevant "endowment" is simply the province of residence.

This clause assigns to Congress the right "(t)o regulate commerce with foreign nations, and among the several states". This right has generally been interpreted as to restrict or prohibit state laws from interfering with interstate commerce.[16] In addition, Clause 1 states that "all Duties, Imposts and Excises shall be uniform throughout the United States". These clauses imply that inter-regional factor and goods flows in the U.S. might have been relatively unobstructed.

The comparison between the urban U.S. in 1940 and urban China in recent years is not entirely satisfactory because the former was already more developed than is the latter. Per capita annual earnings in the 1940 urban U.S. sample analyzed here were $18,678 in 2013 dollars. Per capita annual earnings in the 2013 Chinese survey were $7,002 in 2013 dollars according to official exchange rates and $11,537 in 2013 dollars adjusted for purchasing power parity. In the 1988 Chinese survey, these same values were $951 and $1,345.[17]

This analysis cannot be applied to U.S. experiences at stages of development that are more comparable to that of contemporary China because the U.S. Census did not record individual incomes prior to 1940. Consequently, comparisons between the results of this section and of the following two must acknowledge differences in levels of development as well as in institutional structure.

The sample analyzed here, described in Appendix A, consists of white urban workers with arguably full-time employment. Table 1 presents illustrative estimates of equation 1 for

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[16] "Despite some criticism, dormant Commerce Clause doctrine limits on state protec-tionism have a longstanding basis in constitutional law and continue to be widely understood as essential to American understandings of federalism." (Klass and Rossi, 2015, 155).

[17] The samples analyzed here yield average nominal incomes in current domestic currency units. Deflators implicit in the Bureau of Economic Analysis reports of nominal and real U.S. GDP (http://www.bea.gov/national/index.htm#gdp) convert dollar quantities into 2013 dollars . The World Bank's <u>World Development Indicators</u> provide official exchange rates and estimates of purchasing price parity conversions for private consumption. Purchasing price parity conversions begin in 1990. Calculations in the text employ the value for that year to convert 1988 urban Chinese incomes into dollars.

each of the nine Census divisions.

All coefficient estimates are statistically significant. In all divisions, women's monthly earnings were lower than men's by roughly $50, or approximately 40% of the $125 monthly earnings average in this sample. Monthly earnings increased by approximately $8 with each year of education. Earnings increased at a declining rate with age, with maximum predicted earnings occurring between 52 and 57 years of age.

These regressions are very similar. With the exception of the Pacific division, R^2 values are all between .30 and .34. The minimum absolute value for any coefficient is no less than approximately two-thirds of the maximum value. In all divisions, six or seven additional years of schooling were required to compensate for the female earnings reduction.

These comparisons suggest that the predicted incomes associated with combinations of individual characteristics may also have been similar across Census divisions. In order to maximize the accuracy of these predictions, the remainder of this section relies on regressions employing a more elaborate specification of equation 1. This specification replaces the

Table 1

Monthly earnings regressions by U.S. Census division, 1940

	Division								
Explanatory variables	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	East North Central	Mountain	Pacific
Intercept	**-98.4**	**-145.3**	**-139.1**	**-133.2**	**-130.5**	**-118.0**	**-151.0**	**-124.2**	**-140.1**
Female	**-44.2**	**-46.2**	**-53.7**	**-50.9**	**-43.8**	**-48.2**	**-51.2**	**-54.5**	**-49.7**
Years of school	**7.5**	**8.1**	**7.8**	**7.9**	**8.2**	**7.5**	**8.4**	**7.2**	**7.9**
Age	**6.6**	**9.2**	**9.0**	**7.9**	**7.6**	**7.2**	**8.6**	**8.0**	**9.0**
(Age/10) squared	**-5.8**	**-8.8**	**-8.5**	**-7.2**	**-6.8**	**-6.3**	**-8.0**	**-7.4**	**-8.6**
Observations	13,507	50,394	43,599	13,940	12,526	5,777	9,308	3,610	14,778
R-square	0.3175	0.3006	0.3151	0.3241	0.3368	0.3018	0.3163	0.3035	0.2713
Adjusted R-square	0.3173	0.3006	0.3150	0.3239	0.3366	0.3014	0.3160	0.3027	0.2711
F-statistic	**1570.5**	**5414.6**	**5013.5**	**1670.4**	**1589.6**	**623.9**	**1076.0**	**392.7**	**1375.3**
p-value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Age of maximum contribution	56.5	52.7	52.8	54.8	56.5	56.5	53.2	54.3	52.3

Note: Estimates in bold are significant with p-values of less than .0001.

Table 2

Potential gains from moving to another U.S. Census Division, 1940

Gains as % of predicted earnings in home Division	Workers	% of all workers
None - maximum predicted earnings are in home Division	39,258	23.4%
10% or less	79,341	47.4%
10%-20%	36,504	21.8%
20%-30%	8,702	5.2%
>30%	3,634	2.2%
Total	167,439	100.0%

continuous variable in education with complete interactions between the dummy variable for sex and categories for educational attainment. It replaces the variables for age and age squared with interactions between these two variables and the dummy variable for sex. This specification attains significantly higher explanatory power for each of the divisions, but retains the essential similarity of results across divisions.

Table 2 compares maximum predicted earnings from equation 4 to predicted earnings in the home division from equation 2 for each worker. It demonstrates, first, that many workers were located "optimally", at least with respect to earnings. Almost one quarter of all workers achieved their maximum predicted earnings in their home division.

This table also confirms that predicted incomes were similar across divisions. Among the 76.6% of workers who predicted maximum earnings in divisions other than that of their residence, nine-tenths predicted gains of no more than 20% compared to predicted earnings in the home division. "Losses" of these magnitudes may plausibly have been too small to motivate relocations, given the many considerations other than income that determine residential location (Marshall, 1891, 600; Kanbur, 2006, 371).

Only 7.4% of the sample predicted earnings in divisions other than the home division that exceeded predicted earnings in the home division by more than 20%. Some or even many of these individuals may have been in locational disequilibrium. However, they were not sufficiently numerous to challenge the general impression that worker characteristics were generally rewarded similarly in all parts of the United States of 1940. This suggests that the equilibrating mechanisms of mobility in labor, other factors of production and final goods were largely functional at that time.[18]

Table 3 demonstrates the implications of these predictions for earnings inequality. As given in the second column, inter-divisional inequality was minimal. Average earnings were very similar across divisions. The minimum, in the East South Central Division, was 82.7% of the maximum in the Pacific. The coefficient of variation for provincial average earnings was very small, at .0631.

Moreover, inter-worker inequality in the country as a whole was similar to inter-worker inequality within each division. In the third column of table 3, division-specific Gini coefficients for actual earnings varied only between .2844 and .3407. The national Gini for actual earnings was in the middle of this range, at .3081. Similarly, the range of Gini coefficients for predicted earnings in the fourth column of table 3 was only between .1681 and .2171. The national Gini coefficient was again in the middle of this range, at .1978.[19]

Conceptually, the reallocation of a worker to the division of maximum predicted

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[18] Maximum predicted earnings occurred in two divisions for 91.6% of the sample. Between 64.9% and 69.3% of workers in each of the divisions predicted their highest earnings in the Middle Atlantic Division. Between 20.5% and 26.2% predicted their highest earnings in the Pacific Division. To the extent that cost-of-living levels were roughly similar within division for workers at all income levels, they would have been captured in the intercepts of table 1. According to that table, the intercepts for these two divisions were negative and larger in magnitude than those for any other division except the East North Central. Higher predicted earnings in these divisions arose from higher valuations of individual characteristics rather than from higher compensation for division-specific effects, such as the local cost of living.

[19] If the specification of explanatory variables captured all of permanent income, these comparisons would suggest that inequality in permanent income was no more than two-thirds of inequality in observed income. To the extent that this specification is incomplete, these comparisons would set an approximate lower bound on the inequality in permanent income.

earnings constructs the counterfactual in which that worker were to migrate to the division

Table 3

Actual and predicted inequality, urban U.S., 1940

	Workers in home division				Workers in division of maximum predicted earnings			Workers in home division with maximum predicted earnings	
Home Census Division	Number of workers	Average earnings	Gini coefficient of actual earnings	Gini coefficient of predicted earnings	Number of workers	Average predicted earnings	Gini coefficient of predicted earnings	Average predicted earnings	Gini coefficient of predicted earnings
New England	13,507	114.8	0.2915	0.1931	2,022	90.0	0.2376	127.1	0.1936
Middle Atlantic	50,394	128.0	0.3103	0.1963	112,842	144.6	0.1531	128.8	0.1928
East North Central	43,599	129.4	0.2972	0.1897	8,206	151.3	0.1515	133.5	0.1792
West North Central	13,940	116.5	0.3153	0.2062				134.5	0.1830
South Atlantic	12,526	118.8	0.3224	0.2146	1,185	187.6	0.1165	131.4	0.2012
East South Central	5,777	112.3	0.3222	0.2077	1,119	117.4	0.2306	131.5	0.1883
West South Central	9,308	117.5	0.3407	0.2171				136.2	0.1891
Mountain	3,610	125.0	0.3102	0.1933	1,624	123.7	0.0838	139.9	0.1796
Pacific	14,778	135.8	0.2844	0.1681	40,441	95.5	0.1649	140.1	0.1724
Total	167,439	125.1	0.3081	0.1978	167,439	132.3	0.1873	132.3	0.1873

providing the technology and other factors of production that would allow the worker to achieve the highest level of productivity. Neither individual worker welfare nor inequality would have been substantially different in this counterfactual. Comparing the second to the sixth column of table 3, average monthly earnings would have increased only from $125 to $132, or by 5.7%. Comparing the fourth to the seventh columns, the Gini coefficient for predicted earnings would have declined only from .1978 to .1873.

An alternative counterfactual would, conceptually, allow technology to diffuse and other factors to migrate so as to allow the worker to achieve the maximum predicted earnings in the home division. In this counterfactual, each worker retains the actual division of residence, but is assigned the maximum earnings predicted for that worker across all divisions.

Neither inter- nor intra-divisional inequality would have been substantially different in this counterfactual, either. The eighth column of table 3 demonstrates that the distribution of average divisional earnings would have been compressed, but only slightly. The minimum divisional average predicted earnings would have been 90.1% of the maximum and the coefficient of variation for provincial averages of maximum predicted earnings would have been .0343. The ninth column demonstrates that the range of within-division Gini coefficients would also have been compressed, but again only slightly, from a minimum of .1724 to a maximum of .2012.

The distributional implications of the differences between predicted earnings in the home division and maximum predicted earnings were modest. At the divisional level, these differences were regressive. Divisions with lower average earnings predicted greater losses in comparison to average maximum predicted earnings in the third column. The correlation between average earnings and average losses by province was .8205.

However, the distributional consequences at the individual level were negligible. Within six of the nine divisions, the distribution of losses imposed as a consequence of predicted maximum earnings outside the home division was progressive. This counteracted the regressive across-division distribution. For the sample as a whole, the correlation was insubstantial, at .0830.

In sum, predicted earnings for individual urban workers in the U.S. of 1940 were roughly similar in all divisions. Almost all workers lived in divisions where their incomes were either maximized or close enough to their predicted maximums such that any differences were reasonably explicable by other location-specific preferences and moving costs. Regardless, these differences were small enough as to have negligible consequences for individual earnings, inter-personal inequality and inter-regional inequality. Therefore, the experience of workers in the urban U.S. of 1940 was broadly consistent with the informal null hypothesis of section 3.

5. Earnings and inter-provincial inequality in China, 1988

A priori, this hypothesis is a less plausible description of China in 1988. Tombe and Zhu (2019) estimate that trade and migration costs within China were large in 2000. They were probably larger in 1988. This section estimates the inter-provincial variation in human capital valuations in that year in order to assess the extent to which any such costs might have imposed distortions on the urban Chinese labor market.

The sample analyzed here, described in Appendix B.1, consists of non-migrant urban workers with arguably full-time employment. Each column of table 4 presents the regression of table 1 for one of the ten sampled provinces. These regressions share some common attributes. In all provinces, earnings were significantly lower for women. They increased with education.[20] They increased at declining rates with age, with peak earnings in the later work years.

At the same time, these regressions differ much more dramatically than do those for the U.S. in 1940. The smallest female effect, in Hubei, was barely one-fourth as large as the largest, in Guangdong. The smallest education effect, in Beijing, was less than half as large as the largest, in Gansu. Women required from approximately four additional years of school, in Hubei,

[20] The effects of education were small, typically around three yuan, or less than 2% of average earnings, per year of education. In contrast, according to table 1, one year of education was worth more than 6% of average earnings in the urban U.S. of 1940.

to 12 additional years in Guangdong to compensate for the negative female effect. The age of

Table 4

Monthly earnings regressions by Chinese province, 1988

	Provinces									
Explanatory variables	Beijing	Shanxi	Liaoning	Jiangsu	Anhui	Henan	Hubei	Guangdong	Yunnan	Gansu
Intercept	-41.47	-40.60	-12.09	-18.33	**-47.50**	-23.22	**-48.18**	**-123.00**	-26.47	**-93.80**
p-value	0.0954	0.1560	0.4372	0.3304	0.0402	0.0920	0.0047	0.0013	0.2585	0.0007
Female	**-25.97**	**-17.36**	**-15.19**	**-22.89**	**-22.22**	**-16.57**	**-10.73**	**-39.60**	**-22.44**	**-26.71**
p-value	<.0001	0.0004	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Years of school	**2.50**	**2.73**	**2.75**	**2.80**	**3.20**	**2.86**	**3.45**	**3.52**	**2.61**	**6.05**
p-value	0.0007	0.0017	<.0001	<.0001	<.0001	<.0001	<.0001	0.0011	<.0001	<.0001
Age	**9.21**	**6.86**	**5.84**	**7.57**	**7.67**	**5.54**	**7.63**	**16.79**	**7.86**	**7.99**
p-value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
(Age/10) squared	**-8.63**	**-5.95**	**-4.32**	**-7.27**	**-6.89**	**-4.54**	**-7.40**	**-18.67**	**-7.04**	**-6.05**
p-value	<.0001	0.0026	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.0162	0.0007
Observations	865	1,851	1,851	2,257	1,715	2,010	1,925	2,092	1,808	1,125
R-square	0.1993	0.0718	0.2407	0.1236	0.1294	0.2022	0.1499	0.0787	0.1439	0.2221
Adjusted R-square	0.1956	0.0698	0.2391	0.1221	0.1273	0.2006	0.1481	0.0769	0.1420	0.2193
F-statistic	**53.52**	**35.7**	**146.31**	**79.41**	**63.51**	**127.01**	**84.64**	**44.57**	**75.76**	**79.94**
p-value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Age of maximum age	53.4	57.6	67.6	52.0	55.7	61.1	51.5	45.0	55.8	66.0

Note: Estimates in bold are significant with p-values that are less than or equal to .05.

maximum earnings varied from 45.0 years in Guangdong to 67.6 years in Liaoning.

Incomes were more sensitive to individual attributes in Guangdong than in any the other province. Gansu was the only province in which the value of years of schooling was greater than in Guangdong. The linear effect for age in Guangdong was much larger than elsewhere. However, the quadratic effect for age, the female effect and the intercept were also largest in magnitude in Guangdong, and all negative. Therefore, while Guangdong appears distinctive, the consequences of that distinction are not apparent in table 4.

Comparisons across earnings predictions are necessary to make them so. As in section 4, the rest of this section relies on expanded versions of the regression models in table 4. These models replace the variable for years of school with dummy variables for levels of educational attainment. They interact these dummy variables and the variables for age and age squared with the female dummy variable. These regressions yield conclusions that are very similar to those that derive from the regressions of table 4, but with significantly improved precision.

As in table 2, table 5 compares predicted earnings in the home province with predicted maximum earnings. In urban China of 1988, the proportion of workers with maximum predicted earnings in their home province was barely more than one-tenth. The analogous proportion in the urban U.S. of 1940 was 2.5 times greater.

For 92.6% of urban U.S. workers in 1940, the difference between predicted maximum earnings and predicted earnings in their home division was 20% or less of the latter. For urban Chinese workers in 1988, this was true for only 14.9%. Only 2.1% of American workers predicted maximum earnings that would exceed predicted earnings in their home divisions by 30% or more. The corresponding proportion for Chinese urban workers in 1988 was 75.5%. More than 40% of all Chinese workers predicted earnings gains of more than 50% in some province other than that of their residence.

Table 6 reproduces table 3 for urban China in 1988. The second column presents average earnings in the province of residence. It demonstrates the fundamental fact that motivates the

Table 5

Potential gains from moving to another Chinese province, 1988

Gains as % of predicted earnings in home province	Workers	% of all workers
None - maximum predicted earnings are in home province	2,087	11.9%
10% or less	118	0.7%
10%-20%	405	2.3%
20%-30%	1,247	7.1%
30%-40%	2,455	14.0%
40%-50%	3,301	18.9%
50%-60%	2,912	16.6%
60%-70%	2,322	13.3%
70%-80%	1,432	8.2%
>80%	1,220	7.0%
Total	17,499	100.0%

literature of section 2. Average incomes varied dramatically across provinces, and by much more than across U.S. divisions in 1940. The lowest average, in Henan, was less than 60% of the highest, in Guangdong. The coefficient of variation for average home province predicted provincial earnings was almost three times as large as that for the urban U.S. in 1940, at .1683.

According to the fifth column, the regression for Guangdong predicted the highest earnings for 17,124, or 97.9% of the 17,499 workers in the sample. This represents much greater concentration than in the U.S. of 1940.[21] Taken literally, these results imply that if urban labor were freely mobile in China of 1988, nearly every worker would have migrated to Guangdong. Obviously, this scenario cannot be understood as a plausible “prediction”.

[21] As in footnote 18, this is a consequence of the returns to human capital characteristics in Guangdong rather than a cost-of-living effect. The intercept for the Guangdong regression is larger in magnitude than any other, and negative.

Table 6

Actual and predicted inequality, urban China 1988

	Workers in home province				Workers in province of maximum predicted earnings			Workers in home province with maximum predicted earnings	
Province	Number of workers	Average earnings	Gini coefficient of actual earnings	Gini coefficient of predicted earnings	Number of workers	Average predicted earnings	Gini coefficient of predicted earnings	Average predicted earnings	Gini coefficient of predicted earnings
Beijing	865	189.3	0.1899	0.1001	161	159.4	0.1666	244.2	0.0919
Shanxi	1,851	146.6	0.2366	0.1241	0			240.7	0.1032
Liaoning	1,851	162.4	0.1773	0.0995	34	196.0	0.0467	243.6	0.0972
Jiangsu	2,257	172.0	0.1799	0.0938	11	115.2	0.0064	240.6	0.1033
Anhui	1,715	154.8	0.2287	0.1251	0			237.7	0.1090
Henan	2,010	138.0	0.2053	0.1135	0			240.3	0.1050
Hubei	1,925	159.5	0.1780	0.0864	0			245.9	0.0965
Guangdong	2,092	240.9	0.2690	0.1027	17,124	242.9	0.0994	241.2	0.1021
Yunnan	1,808	179.6	0.2020	0.1009	100	235.8	0.0849	244.7	0.0965
Gansu	1,125	168.3	0.2468	0.1552	69	257.3	0.0425	242.5	0.1035
Total	17,499	171.0	0.2308	0.1419	17,499	242.0	0.1015	242.0	0.1015

First, residential location decisions respond to many location-specific attributes in addition to expected earnings. Second, this scenario relies on partial equilibrium predictions which assume that the values of human capital components would remain fixed within province. Those values would presumably change, perhaps radically, were the implied migrations to take place.[22] Therefore, this scenario is an "illustration" rather than a "prediction".

Within this illustration, the impediments that prevented equalization of human capital valuations across provinces were responsible for all of inter-provincial inequality. The eighth column of table 6 reports average earnings by province if workers resident in those provinces had earned the maximum earnings predicted for them in any province. Under this counterfactual, average earnings would have been nearly identical across all ten provinces. The coefficient of variation for average maximum predicted earnings would have been .0102, less than one-tenth of that for average home province predicted earnings.

Despite inter-provincial differences in average earnings, urban China in 1988 was relatively egalitarian among individuals. The aggregate Gini coefficient, in the last row of the third column of table 6, was relatively low, at .2308. Within-province inequality was less than in the aggregate, except in Shanxi and Gansu. The relatively larger magnitude of the aggregate Gini coefficient was attributable to differences across provinces in average earnings.[23]

As in table 3, the replacement of actual with predicted earnings in the home province, in the fourth column, reduced the aggregate Gini coefficient from .2308 to .1381, or by 40.2%. The analogous reductions were similar in each of the provinces. This implies that the permanent components of earnings may have been responsible for as little as 60% of observed inequality.

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[22] Human capital levels might also change. Education increases opportunities to migrate to urban areas Pan (2017). If those opportunities increase for other reasons, educational attainment of rural residents declines (de Brauw and Giles, 2017; Pan (2017).

[23] These calculations omit implicit subsidies associated with housing allocations. Zax (2015) demonstrates that they may have increased inequality by 15%.

The seventh column of table 6 presents the Gini coefficients for maximum predicted earnings. For the sample as a whole, this coefficient was .0961. This demonstrates that, if workers were located in the province that predicted their maximum earnings, the aggregate Gini coefficient for predicted earnings would have declined by 30.4%.

The ninth column presents the provincial Gini coefficients of maximum predicted earnings for each worker. These were typically smaller than those for predicted earnings. This demonstrates that the reduction in interpersonal inequality associated with maximum predicted earnings was composed of reductions in both inter- and intra-provincial inequality.

Finally, inter-provincial inequality was associated with substantial reductions in individual welfare. According to the sixth column, the average of maximum predicted earnings across all provinces was 242 yuan per month, 71 yuan per month greater than the average of predicted and actual earnings in home provinces. This represents a loss equal to 41.4% of actual average earnings.[24] According to the estimated effects of years of schooling in table 5, workers in Gansu would have required more than 12 additional years of schooling in order to equate their average earnings to their average maximum earnings. Those in Henan would have required nearly 36.

Within province, losses associated with location were progressive. Those with higher predicted earnings in the home province also predicted the largest losses in comparison to their maximum predicted earnings.

However, losses across provinces were strongly regressive. The correlation between average earnings and average location costs by province was 0.9963. Consequently, the aggregate correlation between predicted earnings in home provinces and losses across individuals was .4119. Workers who predicted lower incomes also predicted greater gains were they able to earn the maximum valuation of their human capital.

[24] Similarly, Hsieh and Klenow (2009) estimate that manufacturing TFP in China would increase by 30% to 50% if that variation were reduced to the level observed in the United States.

Implicit in tables 4 through 6 are estimates of the actual value of the right to live in Guangdong. This valuation was most straightforward for the 2,056 workers resident in that province whose highest predicted earnings were also there. Average predicted earnings in Guangdong for these workers were 242 yuan per month. On average, these exceeded the next highest predicted earnings for these workers by 52 yuan per month. This rent was equivalent, on average, to 21.6% of their predicted earnings in Guangdong, or to 27.5% of their greatest predicted earnings elsewhere. It would almost surely have dissipated if workers from other provinces had been able to migrate freely to Guangdong.

For the 15,068 workers resident in other provinces whose maximum predicted earnings occurred in Guangdong, average predicted earnings in the home province were 162 yuan per month. Had they earned the valuations available in Guangdong, their earnings would have increased by 81 yuan per month, or half of their predicted earnings in their home provinces.

For these workers, average earnings in the province other than Guangdong that offered the highest predicted earnings were 192 yuan per month. On average, their predicted earnings in Guangdong exceeded their maximum predicted earnings elsewhere by 51 yuan per month. This premium represented 26.8% of their greatest predicted earnings elsewhere.

Only 375 workers predicted maximum earnings in provinces other than Guangdong. They would have suffered small notional losses had they been forced to accept their predicted earnings in Guangdong. However, they were so few that, for the entire sample, the value of the Guandong *hukou* was approximately 50 yuan per month. This represented approximately one-fourth of alternative predicted earnings elsewhere.

In sum, this section demonstrates that, in urban China of 1988, substantial inter-provincial inequality coexisted with substantial inter-personal equality. However, disparities in human capital valuations across provinces were responsible for large reductions in individual welfare, 30% of inter-personal inequality and all of inter-provincial inequality.[25] These disparities are dramatically inconsistent with the informal null hypothesis of section 3. Urban China appears to have been in substantial spatial disequilibrium at this time.

6. Earnings and inter-provincial inequality in 1995, 2002, 2008 and 2013

The CHIP conducted additional urban surveys in 1995, 2002, 2008 and 2013. The surveyed provinces varied. Appendices B.2 and B.3 describe the compositions of the samples and the constructions of the earnings variables employed here.

Table 7 summarizes the regression of equation 1, applied to non-migrant full-time workers in each of the provinces in each of the survey years. Each of the first five rows reports the range of coefficient estimates for the corresponding explanatory variable across all of the surveyed provinces. The first column summarizes the regressions for 1988, from table 4.

Table 7 demonstrates that these regressions differ substantially across provinces in every survey year. In absolute value, the minimum female coefficient was never more than one-third of the maximum value. The maximum effect of years of schooling was at least twice as large as the minimum effect in every year. That of age was at least three times as large as its minimum effect With the exception of 2008, the age of maximum earnings varied across provinces by more than 20 years. The number of years of schooling necessary to compensate for the female earnings discount varied by at least a factor of two.

These differences suggest that, as in 1988, earnings predictions for a given worker might vary widely across provinces in all other survey years. The rest of this section relies on the expanded version of equation 1, with interactions between sex and levels of educational attainment and interactions between sex and age and age-squared, to examine these predictions.

[25] The 1990 urban cost-of-living was higher in Guangdong than in any other province (Brandt and Holz, 2006, table 5). This section suggests that, nevertheless, urban Guangdong was underpopulated relative to an equilibrium with free mobility. Consequently, the equilibrium Guangdong "cost-of-living" would likely have been higher, and perhaps greatly so.

This expanded model is statistically superior to the illustrative version of equation 1 in table 7 for all samples.

Table 8 adds results from 1995, 2002, 2008 and 2013 to those for 1988 in table 5. It confirms that workers predicted widely different earnings across provinces in all years. Inter-

Table 7

Summary of regression results, 1988, 1995, 2002, 2008 and 2013

	Ranges				
Explanatory variables	1988	1995	2002	2008	2013
Intercept	**-123.0** to -12.1	**-1111.4** to -144.0	**-2557.8** to -198.9	**-7632.7** to **-1465.6**	**-9609.7** to 213.7
Female	**-39.6** to **-10.7**	**-125.9** to **-23.8**	**-307.8** to **68.6**	**-1136.1** to **-379.4**	**-1612.9** to -215.3
Years of school	**2.5** to **6.1**	**16.2** to **53.7**	**53.2** to **130.2**	**121.4** to **443.6**	**120.6** to **593.0**
Age	**5.5** to **16.8**	**15.2** to **72.9**	2.8 to **136.1**	**88.5** to **352.9**	32.5 to **402.6**
(Age/10) squared	**-18.7** to **-4.3**	**-82.8** to **-9.3**	**-151.9** to 16.8	**-354.7** to **-93.8**	**-437.0** to **-23.4**
R-square	.0718 to .2407	.1214 to .3829	.0911 to .1976	.0394 to .2004	.0150 to .2197
Adjusted R-square	.0698 to .2391	.1172 to .3789	.0870 to .1934	.0320 to .1960	.0070 to .2159
Age of maximum age contribution	45.0 to 67.6	44.0 to 76.4	-8.4 to 144.6	41.1 to 48.0	41.9 to 69.3
Female discount in years of schooling	3.1 to 11.3	1.0 to 4.8	1.0 to 3.3	1.7 to 3.7	1.4 to 9.3
Number of provinces	10	11	12	9	14
Number of observations	17,499	11,393	9,357	6,116	8,825

Note: Estimates in bold are significant with p-values that are less than or equal to .05.

Table 8

Potential gains from moving to another province, 1988, 1995, 2002, 2008 and 2013

Gains as % of predicted earnings in home province	% of all workers 1988	1995	2002	2008	2013
None - maximum predicted earnings are in home province	11.9%	8.6%	9.4%	12.4%	7.8%
10% or less	0.7%	0.3%	3.5%	5.2%	7.3%
10%-20%	2.3%	0.6%	2.1%	5.3%	10.8%
20%-30%	7.1%	1.7%	2.0%	6.9%	11.1%
30%-40%	14.0%	2.6%	3.8%	6.1%	10.9%
40%-50%	18.9%	3.2%	4.2%	7.1%	9.6%
50%-60%	16.6%	4.1%	4.1%	5.8%	9.9%
60%-70%	13.3%	6.0%	6.8%	5.7%	8.3%
70%-80%	8.2%	6.8%	12.0%	8.0%	4.4%
80%-90%	4.6%	8.1%	11.0%	10.5%	4.5%
90%-100%	1.8%	8.5%	10.0%	8.1%	4.2%
>100%	0.6%	49.6%	31.1%	19.0%	11.1%
Number of workers	17,499	11,393	9,357	6,116	8,825

provincial imbalances worsened dramatically between 1988 and 1995. In the latter year, fewer than 10% of all workers had home province predicted earnings within 20% of their maximum predicted earnings. Almost half of all workers predicted maximum earnings that were more than twice their home province predicted earnings.

These imbalances subsided somewhat over the succeeding years. The proportions of workers predicting home province earnings within 20% of maximum predicted earnings increased to 15.0% in 2002, 22.9% in 2008 and 25.9% in 2013. Correspondingly, the proportions that predicted maximum earnings of more than twice their home province predicted earnings declined to 31.1% in 2002, 19.0% in 2008 and 11.1% in 2013.

Nevertheless, the distortions in 2013 were, substantively, at least as great as those in 1988. While many more workers predicted home province earnings that were reasonably close to maximum predicted earnings in 2013 than in 1988, many more also had maximum predicted

Table 9

Province of maximum predicted earnings, 1988, 1995, 2002, 2008 and 2013

Year		Province predicting maximum maximum earnings for: the most workers	the second most workers	the third most workers	Sum
1988	Province	Guangdong	Beijing	Yunnan	
	Proportion of workers	97.9%	0.9%	0.6%	99.3%
1995	Province	Guangdong	Beijing	Gansu	
	Proportion of workers	97.4%	2.3%	0.1%	99.9%
2002	Province	Guangdong	Beijing	Liaoning	
	Proportion of workers	72.9%	25.2%	0.9%	99.0%
2008	Province	Guangdong	Shanghai	Zhejiang	
	Proportion of workers	55.2%	21.7%	15.2%	92.1%
2013	Province	Guangdong	Jiangsu	Chongqing	
	Proportion of workers	52.9%	16.2%	11.7%	80.8%

earnings that were twice as large as home province predicted earnings, or more. In general, the 1988 distribution of predicted gains as a proportion of home province predicted earnings was highly concentrated in the range of 30% to 70%. The 2013 distribution was much more dispersed, with substantial proportions at either extreme.

Table 9 identifies the provinces that accounted for the three largest shares of workers by maximum predicted earnings in each survey year. Guangdong predicted maximum earnings for the largest number of workers in all five years. In 1995, as in 1988, almost all workers predicted their maximum earnings there. However, the share of workers predicting maximum earnings in Guangdong declined to only half over the final three surveys. The sharp decline between 2002 and 2008 was attributable, in part, to the one-time inclusion of Shanghai and Zhejiang. Nevertheless, it continued in 2013, when the sample was more similar to those of earlier years.

The concentration of maximum predicted earnings, as well as the dominance of

Table 10

Interprovincial inequality, 1988, 1995, 2002, 2008 and 2013

	1988	1995	2002	2008	2013
Herfindahl index for provincial sample shares	0.1055	0.0948	0.0873	0.1135	0.0754
Herfindahl index for provincial sample shares with assignment to province of maximum predicted earnings	0.9577	0.9499	0.5949	0.3773	0.3277
Coefficient of variation, average provincial earnings	0.1683	0.3130	0.2721	0.2392	0.1737
Coefficient of variation, average maximum earnings assigned to home province	0.0102	0.0285	0.0286	0.0365	0.0431

Guangdong, diminished over time. The three provinces assigned the largest shares of workers by maximum predicted earnings, together, accounted for more than 99% of all workers in 1988 and 1995. Their aggregate share declined to 80.8% by 2013. As urban China evolved, more provinces were able to offer at least some workers their best earnings opportunities.

The first two rows of table 10 demonstrate this conclusion more formally. They summarize the information in columns one and five of table 6 for all five samples. The first row measures the actual distribution of sample observations across provinces by the Herfindahl index of sample shares contributed by each province. It demonstrates that, as would be expected, sampling procedures in all five surveys distributed observations relatively equally across them.

The second row reports the Herfindahl index of sample shares, if all workers were reassigned to the province in which they predicted their highest maximum earnings. In 1988, the value of this index was close to the maximum of one, at .9577. In aggregate, worker residences would continue to be more concentrated if they were reassigned to their provinces of maximum predicted earnings in subsequent years. However, that concentration would diminish dramatically. The Herfindahl index for 2013 was .3277, barely one-third of its value for 1988.

The third and fourth rows of table 10 summarize the information in the second and eighth columns of table 6 for all five samples. The third row reports the coefficient of variation for average provincial incomes in each sample year. This measure of inter-provincial inequality nearly doubled between 1988 and 1995. As with the imbalances displayed in table 8, this measure then declined until, by 2013, it had essentially returned to the level of 25 years prior.

However, inter-provincial inequality would have notionally been much smaller in every year if workers were assigned their maximum predicted earnings without changing their province of residence. In this scenario, described in the fourth row of table 10, the coefficient of variation for average maximum earnings assigned to home provinces would have been less than one-tenth of the coefficient of variation for actual average provincial earnings in 1988, 1995 and 2002. It would have been proportionately greater in 2008 and 2013, but still no more than one-fourth of that for actual average provincial earnings.

Table 11 summarizes the information regarding inter-personal inequality in columns three, four and nine of table 6 for all five samples. The Gini coefficient for actual earnings increased steadily from 1988 through 2008, and then declined slightly to 2013.[26] The Gini coefficient for predicted earnings did the same, with a more marked decline in 2013. If the differences between the two are interpreted as the contributions of transitory income to inequality, those contributions were markedly greater in 2013 than in earlier years.

Inequality in maximum predicted earnings also increased regularly from 1988 to 2008, and at a faster rate than in predicted home province earnings. Consequently, the assignment of maximum predicted earnings to workers in their home provinces would have reduced interpersonal inequality by smaller amounts, both absolutely and relatively, in later years.

Moreover, the Gini coefficient for the maximum predicted earnings continued to increase between 2008 and 2013. Consequently, in 2013 the inequality in maximum predicted earnings was greater than that in predicted home province earnings. While, as demonstrated by table 8,

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[26] Kanbur, Wang and Zhang (2017) examine this decline in greater detail.

Table 11

Interpersonal inequality, 1988, 1995, 2002, 2008 and 2013

	1988	1995	2002	2008	2013
Gini coefficient of actual earnings	0.2308	0.2866	0.3361	0.3785	0.3511
Gini coefficient of predicted earnings, home province	0.1419	0.1866	0.2091	0.2432	0.1996
Gini coefficient of maximum predicted earnings assigned to home province	0.1055	0.1257	0.1497	0.2017	0.2178

differences between maximum and home province predicted earnings remained large in 2013, those differences were no longer equalizing.

Table 12 examines the distributional character of these differences in greater detail. The first column summarizes the results discussed at the end of section 5. The remaining columns present comparable results for later survey years. The evolution of these results demonstrates that losses associated with predicted home province earnings for the most part declined, in relative terms, after 1995. They also became markedly less regressive.

The first row reports that average monthly earnings grew in nominal terms over the period under study. According to the second row, average nominal differences between predicted monthly earnings and predicted maximum earnings, the losses associated with spatial misallocations, also grew. The third row demonstrates that these losses doubled as a proportion of average home province earnings between 1988 and 1995, to 83.1%. This proportion declined through the rest of the period, but was still at 51.4% in 2013. This pattern replicates the directions of change in inter-regional inequality as presented in the literature summarized in section 2, despite its inadequacies. However, the changes here are much more dramatic.

The fourth row of table 12 compares these losses to the earnings effects of an additional year of schooling. From this perspective, these losses declined from 1988 through 2008, but then increased. In 1988, nearly 24 additional years of schooling would have been necessary to increase average earnings to match average maximum predicted earnings. Less than a third as

Table 12

Interpersonal inequality, 1988, 1995, 2002, 2008 and 2013

	1988	1995	2002	2008	2013
Average predicted earnings	171.0	529.6	1,083.7	2,629.6	3,614.8
Average location cost: predicted earnings in home province minus maximum predicted earnings	-71.0	-439.9	-717.4	-1,406.3	-1,856.6
Average location cost as proportion of average earnings	-41.5%	-83.1%	-66.2%	-53.5%	-51.4%
Average years of school necessary to compensate for location costs	23.8	21.5	10.8	7.4	9.6
Correlation: location cost and predicted earnings in home province	0.4119	0.4257	0.2858	0.1698	-0.0747
Correlation: average earnings and average location costs within province	0.9963	0.9860	0.9849	0.9736	0.9291

many years, 7.4, would have been required to accomplish the same match in 2008. However,9.6 years would have been required in 2013. Consequently, the evolution of inter-regional inequality in individual opportunity differed from that of inter-regional inequality, as conventionally measured, at both the beginning and the end of this period.

According to the fifth row in table 12, the correlation between individual losses and individual home province predicted earnings in 1995 was almost the same, at about .4, as in 1988. This again implies that these losses were distributed regressively. They became less so in succeeding years. This correlation declined in value in 2002 and 2008. In 2013, it was slightly negative. By the end of this period the distribution of these losses was effectively neutral.

However, as reported by the last row of table 12, the distribution of average losses across provinces remained heavily regressive. Even in 2013, the correlation between average provincial earnings and average provincial losses was above .9. The evolution of the correlations between individual earnings and losses was driven by increasing progressivity of losses within province.

Although the patterns of regional imbalances in urban China changed between 1988 and 2013, they remained present and substantial. By the end of the period, labor markets in urban

China were no more consistent with the null hypothesis of section 3 than they had been at the beginning. During most of the interim, spatial disequilibrium appears to have been even worse.

7. Evolution of the Guangdong premium

The decline in the proportions of each successive sample predicting maximum earnings in Guangdong suggests that its valuations for human capital characteristics became more closely approximated by those in at least some other provinces. However, comparisons across the five sample years are complicated by variations in sampled provinces. The surveys of 1995, 2002 and 2013 all included the ten provinces of the 1988 survey. The analysis of these four surveys restricted to these ten provinces alone are readily comparable.

Table 13 presents this comparison. In 1988, all provinces predicted average earnings for the entire sample that were less than 80% of those predicted in Guangdong. The unweighted average of the proportions in the second column, omitting Guandong, was .67.

In 1995, these discrepancies actually increased. Only one province predicted average earnings for the entire sample that were even 70% of those predicted in Guangdong. The average province predicted earnings that were 50% of those in Guangdong.

However, between 1995 and 2013 nominal average predicted earnings in Guangdong grew more slowly than in the other provinces. Consequently, predicted average earnings in Beijing were more than 90% of those in Guangdong in 2002. The same was true for both Beijing and Jiangsu in 2013. In the latter year, the average province would have had average predicted earnings for the entire sample that were 74% of those in Guangdong.

In sum, average valuations of human capital characteristics in Beijing and Jiangsu converged to nearly those of Guangdong by the end of the period. Average valuations in Hubei grew quickly, but at the end of the period were still at the same level relative to those in Guangdong as had been true of Beijing and Jiangsu at the beginning. Average valuations in Anhui and Henan grew noticeably, but less quickly than those in Hubei. Average valuations in

Table 13

Average predicted earnings as proportion of average predicted earnings in Guangdong, consistent samples

	Year			
	1988	1995	2002	2013
Beijing	0.77	0.71	0.92	0.92
Shanxi	0.60	0.44	0.51	0.63
Liaoning	0.67	0.49	0.57	0.71
Jiangsu	0.72	0.60	0.68	0.94
Anhui	0.66	0.45	0.54	0.75
Henan	0.57	0.42	0.48	0.65
Hubei	0.65	0.50	0.53	0.77
Guangdong	1.00	1.00	1.00	1.00
Yunnan	0.73	0.50	0.58	0.67
Gansu	0.68	0.42	0.50	0.59
Observations	17,499	10,021	8,501	6,533

Shanxi and Liaoning converged only slightly to those in Guangdong. Average valuations in Yunnan and Gansu were actually smaller, relative to those in Guangdong, at the end of the period than they had been at the beginning.

These results demonstrate that, in the later reform period, average human capital valuations became more similar across provinces. Nevertheless, the previous sections have demonstrated that valuations for any specific worker continued to vary greatly across provinces. Moreover, most workers still lived in provinces where their predicted earnings were substantially below the maximum earnings predicted for them across all provinces.

8. Discussion and conclusion

Table 14 summarizes the results of sections 4, 5 and 6. Regional inequalities in the valuation of human capital characteristics were minimal in the urban United States of 1940. On average, maximum predicted earnings exceeded predicted earnings in home divisions by only about 6%. This deficit was less than the return on one year of schooling. Differences in human capital valuations had almost no effect on inter-divisional or inter-personal inequality. The production side of the United States economy appears to have been in at least rough spatial equilibrium.

In contrast, inequalities in the valuation of human capital characteristics were enormous in urban China of 1988, 1995, 2002, 2008 and 2013. On average, maximum predicted earnings exceeded predicted earnings in home provinces by more than 50% in the latter four, and by 42% in the first year.[27] The educational investments necessary to compensate for these disparities exceeded average educational levels in 1988 and 1995. In 2008 and 2013 they were equivalent to two degree levels or more. In all years, urban China was in substantial spatial disequilibrium.

These disparities were responsible for between 17% and 33% of inter-personal inequality in the first four years. Most strikingly, they were responsible for essentially all of inter-provincial inequality in all five years.

The implications of these results are also striking. Urban China continues to be characterized by dramatic inequality of opportunity. Residence appears to have substantial influence over economic well-being. This implies that, as a consequence of the *hukou* system, birthplace also has substantial influence. The extent of this influence indicates that deviations from the Law of One Price in China are also substantial. It suggests that mobility of other factors, and of final goods, as well as of labor, must be significantly impaired in order to sustain disparities of the magnitude demonstrated here.

This suggestion may seem incongruous because "China has experienced the largest migration flow in history" (Zheng and Yang, 2016, 223). Moreover, these flows have been consistent with economic incentives. Provincial migrant inflows reported by Chan (2012, 2013) were highly correlated with earnings as predicted in this paper. Guangdong, Shanghai and Beijing were among the provinces that received the largest net inflows during the period from 1990 to 2005. Anhui, Henan, Hubei and Sichuan experienced the largest net outflows.

However, the samples analyzed here exclude migrants. The labor markets in which

[27] Li, et al. (2017) recommend that China pursue conventional human capital polices in order to encourage growth. These disparities suggest that it would be much more effective to reduce earnings suppression.

Table 14

Summary of results

Country		U.S.	Urban China				
Year		1940	1988	1995	2002	2008	2013
Average earnings, domestic currency per month		118	171	530	1,084	2,630	3,615
Lost income attributable to local valuations	Value in domestic currency	7	71	440	717	1,390	1,857
	% of average	6%	42%	83%	66%	53%	51%
	In years of schooling	0.9	23.8	21.5	10.8	7.4	9.6
Share of inter-personal inequality attributable to local valuations		5%	28%	33%	28%	17%	-9%
Share of inter-provincial inequality attributable to local valuations		~0%	~100%	~100%	~100%	~100%	Nearly 100%

sample members participated probably excluded migrants, as well. “(D)iscrimination against rural migrant workers in urban areas is severe” (International Labour Organization, 2004, 5). At least some of this discrimination is legal (Deng and Li, 2010). Consequently, Chinese urban labor markets are segmented (Davin, 1999, chapter 6; Meng and Zhang, 2001). Longer-term migrants differed substantially in both industry and occupation from residents with urban *hukou* (Démurger, et al., 2009; Deng and Li, 2010).

The concentration of migrants in the informal sectors of dual urban labor markets prevents them from competing with residents for employment. Consequently, enormous earnings differentials persist across provinces despite huge migration flows.

Instead, it seems likely that migration in China has exacerbated provincial inequalities. Migrants were strong compliments with resident workers (Combes, Démurger and Li, 2015; Combes, et al., 2019). In order for migration to equalize earnings across provinces, migrants would instead have to be, on net, substitutes.

The failure to integrate urban migrants may be attributable, in part, to countervailing urban development policies intended to limit city size. According to Gu, Wu and Cook (2012, 111-2), State Council policy evolved from "controlling the size of big cities" in 1980 to "strictly controlling the size of large cities" in 1989. Only in the late 1990s did that relax to "moderately control the fast growth of population in big cities". Throughout this period, policy encouraged faster growth in smaller cities.[28]

These policies may have been effective. Au and Henderson (2006) and Desmet and Rossi-Hansberg (2013) construct counterfactual welfare measures for the Chinese urban system based on general equilibrium models of city-level activity. Both conclude that larger Chinese cities are smaller than optimal size. Chauvin, et al. (2017) agree, based on estimates of Zipf's Law. Au and Henderson (2006) and Desmet and Rossi-Hansberg (2013) conclude that substantial welfare gains would be available if distortions that limit growth were absent. Moreover, according to Desmet and Rossi-Hansberg (2013), these potential gains are much greater than they would be for the contemporary United States.

This paper, examining the microeconomics of labor market valuations rather than the general equilibria of urban systems, arrives at the same conclusions. Distortions to equilibrium in the national urban labor market impose substantial welfare costs. If they were removed, at least some of the largest Chinese cities would be even larger. Moreover, their costs-of-living, though perhaps already superficially "high", would be higher still.

Attempts to reduce these distortions would meet with substantial opposition because they would threaten the large rents enjoyed by those with *hukou* in the most productive cities. However, these rents impose dramatic reductions in welfare for all those without. They can only persist if there are substantial barriers to mobility of both factors and goods. These barriers indicate that China has failed to achieve internal economic integration.

[28] China's most recent guidelines regarding urban planning restate intentions to limit city growth (http://usa.chinadaily.com.cn/china/2016-02/22/content_23584448.htm). Governments in Beijing and Shanghai continue to actively oppose growth (The Economist, 2019).

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