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The dynamics of spatial agglomeration in China: an empirical assessment

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Abstract

In this paper, I complement the application of New Economic Geography –NEG– models for the explanation of wage disparities in China by estimating the Helpman Hason model, which focuses on the role of consumer markets as an attraction force and housing prices as a dispersion force for economic agglomeration. I estimate the structural parameters of the model for 2000 and 2005 and devote special attention to the multiple estimation problems of the Helpman-Hanson equation. I find that the market potential is slightly lower for 2005 than for 2000, as a direct product of a higher value of the elasticity of substitution for the last year. I also find that the share of income spent on manufactures increases between the two periods, and that transport costs decrease. I show how these effects may cause dispersion or agglomeration of economic activity according to the original Helpman (1998) model. An application of income shock experiments on different economic centers across China shows that spatial externalities are not homogeneous across prefectures, so that income shocks may have different effects across the country. Based on these results, I argue that the size of existent agglomerations will increase in the near future, but with marked differences across regions. As China moves to a market economy, prices should reflect more the forces pulling for dispersion, which not only include housing and land prices, but also congestion, pollution and many other problems that come along with urbanization.

1. Introduction

> *"Nearly one billion people will live in China's cities by 2025. The urban population will grow by some 350 million people-more than the population of the United States today. Some 240 million of China's city dwellers will be migrants. China will have 221 cities with more than one million inhabitants-compared with 35 in Europe. There will be eight megacities with populations of more than ten million".*
>
> *"Preparing for China's urban billion", McKinsey (2008)*

Due to labor mobility restrictions, the increasing demand for workers in urban coastal areas has led to labor shortages. As news report (Business Week, 2006; The Economist, 2008), enterprises have responded by raising wages and labor standards, and/or by moving production facilities to inland areas with cheaper labor costs. However, as recent research suggest (Chen et al, 2008), the location of business across China is not solely a matter of local costs, but is also a matter of *access*. Large cities offer greater demand markets, a more diverse pool of workers, intermediate goods and specialized services, but they are also likely to be more expensive. Small cities offer lower wages and rent prices, but they lack strong demand and cost linkages. With declining transport costs and vibrant emerging consumer markets, the trade-off between proximity to markets and costs has become increasingly relevant.

This work is concerned with the interaction between market size differences and distance, and their effect on wages. A relevant departure point is the work by Hearing and Poncet (2006) that finds that market access is a significant determinant of wage differentials within China. In this paper, I intend to complement the application of New Economic Geography models for the explanation of wage disparities in China. Using comprehensive city-level data, I estimate a model that focuses on the role of consumer markets as an attraction force and housing prices as a dispersion force for economic agglomeration. By means of estimating it, I try to assess the role of consumer markets, distance and scale economies in determining wage differentials in China.

After this introduction, this paper continues in section 2 with some stylized facts on employment density and wages that will motivate the empirical application. The theoretical framework on which the empirical application rests is introduced in section 3. An extensive appraisal of the application of NEG models for the case of China is presented in section 4, which includes facts and figures about labor mobility restrictions and migration, price and wage controls and the housing market. Section 5 presents the results of the empirical estimation, qualified by the choice of data and the estimation strategy in the face of the inherent econometric problems of the Helpman-Hanson equation. It also contains the results of a counterfactual experiment where the impact on wages of income shocks in different locations is assessed. Finally, in Section 6, I conclude and present some directions for future research.

2. Stylized facts

What is first noticeable when looking at the map[1] depicting the distribution of employment density at the prefecture-city level in China is that there is significant variation across and within provinces. Although every province has its own large agglomeration of workers, in the capital city, Henan, the most populous province of China, and the coastal provinces Shangdong, Jiansu, Zheijiang, Fujian and Guangdong have several prefectures-cities with high employment density. More remarkably, there is a "belt" of high-employment density cities starting from Shanghai, going down on south Zhejian, Fujian and finishing in the Pearl River Delta in Guangdong. It is worth noticing that there is a close match between employment density and the Special Economic Zones in the open coastal belt (Yangtze and Pearl River Delta). In the case of Guangdong, for example, several spots of large agglomeration of workers are situated next to each other along the Pearl River Delta in the Special Economic Zones (Shenzhen, Zhunhai and Shatou, for example). In this respect, the uneven distribution of employment is closely related to the geographical concentration of export and manufacturing industries.

[1] See Figure 1A in the Appendix for a reference map of China.

On the other hand, Jilin, Shanxi, Shaanxi, Sichuan, and Guizhou show a urban-rural pattern, where the capital city has the highest employment density. Fujian, Shandong, Liaodong, Hebei and Guangxi, provinces with Special Economic Zones show important agglomeration of workers in some coastal prefectures.

Figure 1: Employment density (10.000 employees per sq. km), 2005

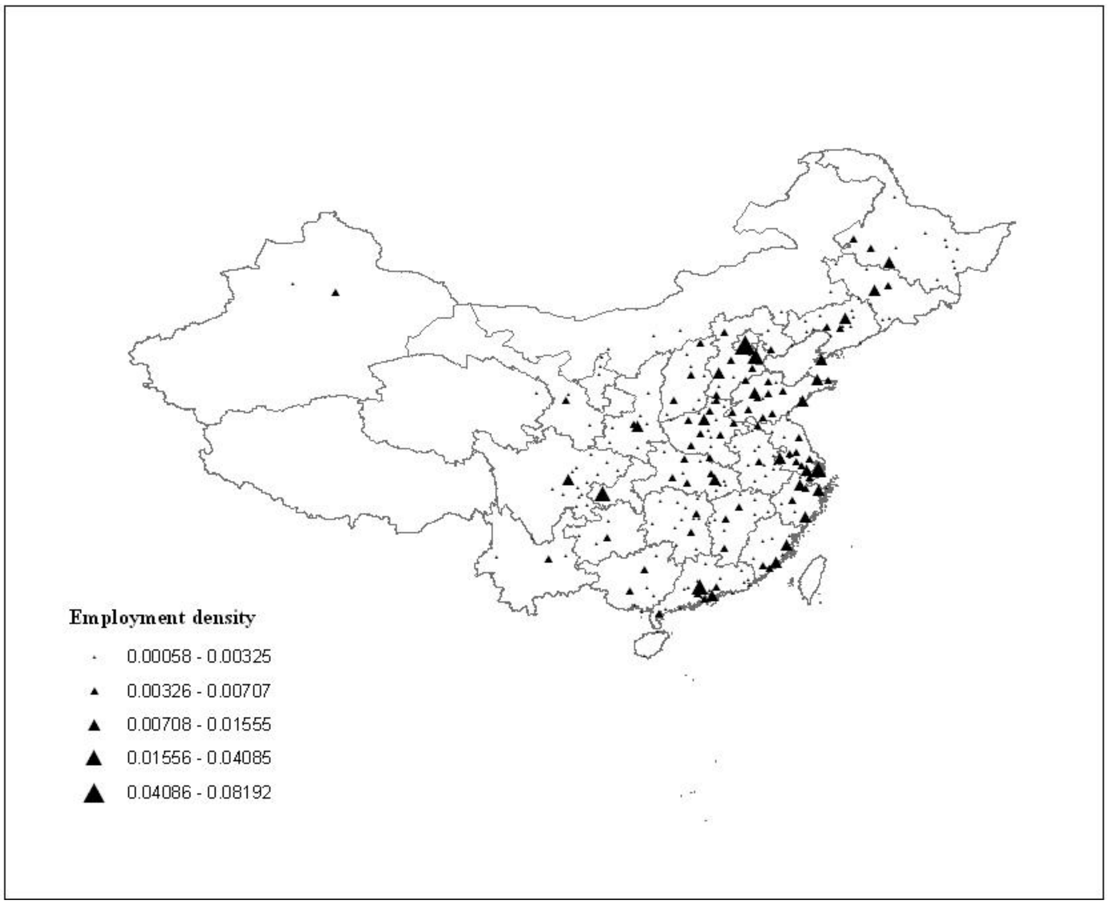
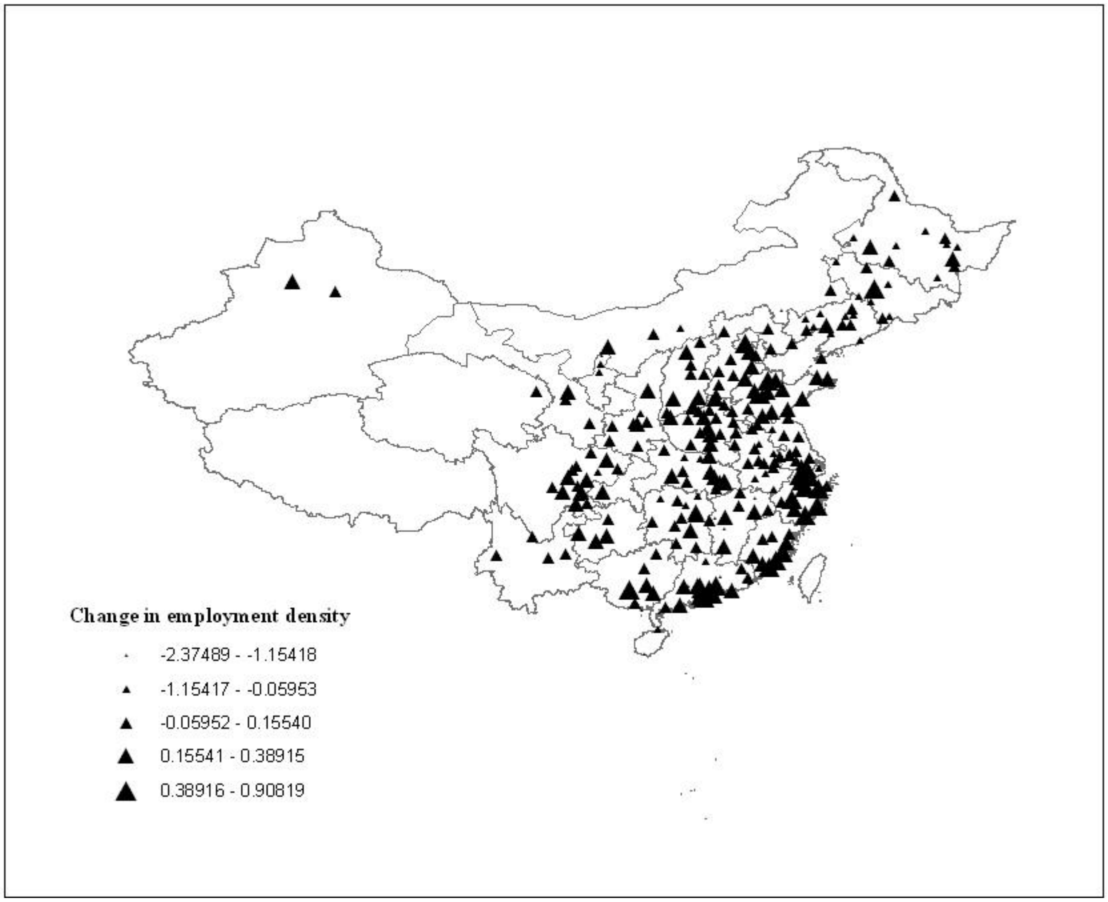


Figure 2: Log change in Employment density relative to national 2000-2005



Comparing the pictures of worker agglomerations in between five years time at a spatially disaggregated level reveals a great extent of mobility within and between provinces. Clearly, workers are attracted to urban centers, as one can interpret from the consistent increase in employment density in most capital cities, especially those located in coastal areas. This is evidence, if only indirect, of large internal labor mobility, as the economy experiences rapid economic growth.

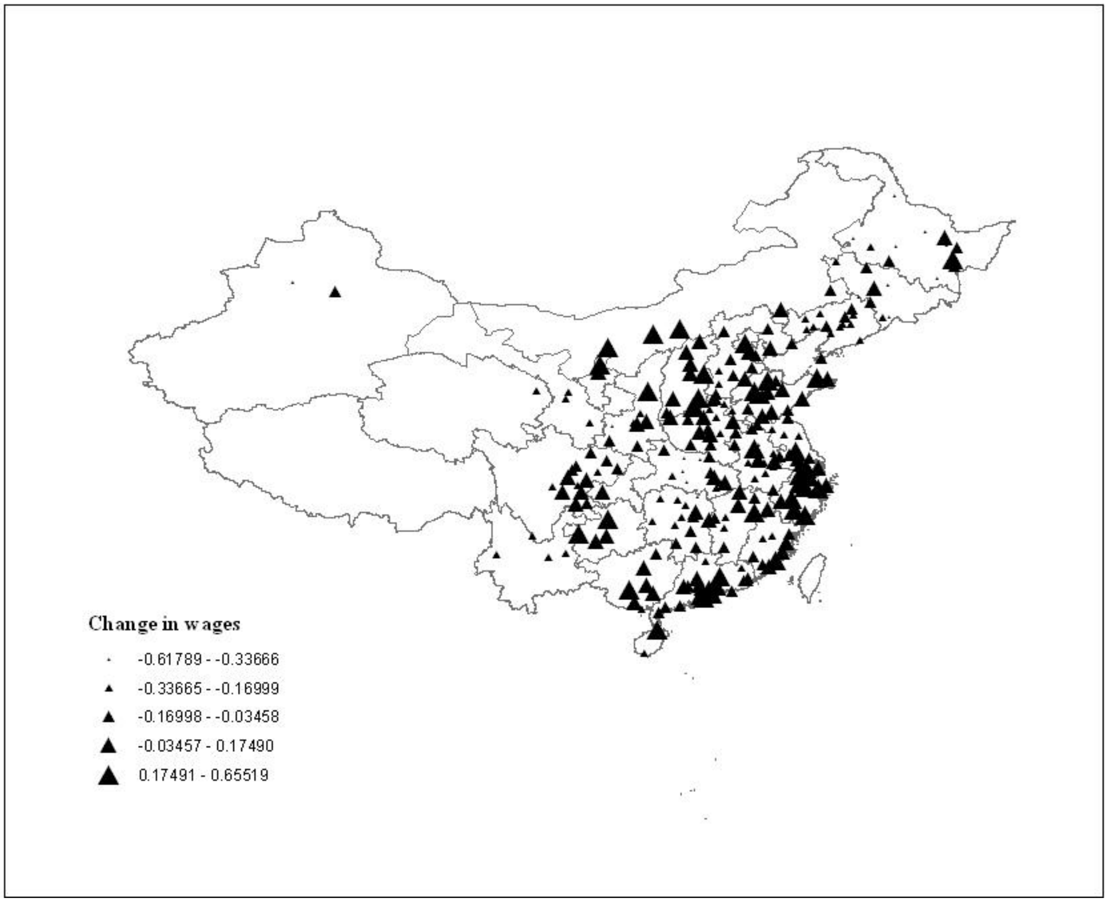
The change in employment density is not uniform even across traditional large worker agglomerations such as Beijing and Shanghai. Between 2000 and 2005, the former experienced an increased of more than 50% in its employment density, while the latter saw a reduction of 35% between the two years.

The fact that Shanghai, a traditional center of attraction for workers, experienced a fall in its employment density may be interpreted as evidence of dispersion forces at work, such as land prices and congestion. The improvements in the transportation network between Shanghai and surrounding cities in Jiangsu and Zhejiang may have reduced the time and costs of commuting, allowing Shanghai to lower its employment density.

Relative to the national average in 2005, Guangdong prefecture Shenzen had the highest employment density in China, accounting an impressive 27.2 times the national average after more than doubling its 2000 level (12.8). Shanghai follows Shenzen in the ranking of prefectures with the highest employment densities in 2005, although its 2005 level (21.3) is much lower than the correspondent level for 2000 (31.1). Just after the traditionally densely populated Beijing and Fujian coastal prefecture Xiamen, Guangdong prefectures Zhuhai and Guangzhou rank on the top of the highest employment densities relative to the national average. Although there is a clear concentration of employment in Guangdong province, not all of its prefectures have gained weight relative to the national level. As a matter of fact, Guangdong interior prefectures Zhajiang, Heyuan, Qingquan, Zhaoqing, Shantou and Jieyang are among the prefectures with larger drops in their relative employment densities between 2000 and 2005.

Another remarkable increase in the employment density relative to national between 2000 and 2005 occurred in Zhejiang coastal prefectures Jiaxing, Shaoxing and Wenzhou. In its neighboring province, Jiangxi, the two larger drops in relative employment density are found in Ji'an and Yichun prefectures, whose values dropped from 2.36 in 2005 to 0.27 in 2000 and 3.52 in 2005 to 0.42 in 2000, respectively. It is clear that the change in employment agglomeration within provinces is far from uniform, especially in "successful" provinces such as Guangdong and Zhejiang.

Figure 3: Log change in Total wage of employees relative to national 2000-2005



In a country with no restrictions to mobility, a large part of internal migration should be due to responses to wage changes. It is possible that the existence of the *Hukou* system has caused the geographic separation between labor supply and demand, because the excess of workers is located in inland, rural areas, while demand of workers is largely coming from urban prefectures, especially coastal ones. In spite of this, the pictures for the log change in the number of employees per sq. km relative to the national average and the log change in wages of employees relative to the national average between 2000 and 2005 match. Most of the prefectures with high growth rates in relative wages also show high increases in relative employment.

3. Theoretical framework

The Helpman-Hanson model merges the positive effect of consumer demand and the negative effect of housing prices in explaining agglomerations of economic activity. The next paragraphs focus on the intuition of the model starting with the description of the general theoretical Dixit-Stiglitz framework, as the formal derivation of the model has been extensively presented in the literature[2].

In an economy with R locations, there are two sectors, each of them producing one good. One of them is a tradable good (usually identified as manufactures), the other one is a homogeneous good that can be tradable or non-tradable across regions. The only input in the economy is labor[3]. There are positive costs for trading manufacture goods between locations. One way to model them is as “iceberg” transport costs, meaning that a part of the good “melts away” when transported, so only a fraction of the unit originally shipped arrives.

Consumers spend their income on both goods, and maximize their utility accordingly. The share of income that consumers spend on manufactures is denoted by δ. The manufacturing good can be thought of as an aggregate of differentiated varieties, and the consumption of each variety is determined by its price and by the consumer’s elasticity of substitution, denoted by ε.

On the production side, there is monopolistic competition on the manufacturing sector, where each firm produces under increasing returns to scale one variety of a product differentiated by secondary attributes. For a sufficient large number of firms, one can assume that each firm has no influence on prices and therefore, faces a downward sloping demand curve. Given that the elasticity of substitution is constant, a measure of scale economies can be derived by taking the ratio between the average cost and the marginal

[2]See for example Brakman et al (2001), Kiso (2005) and Neary (2001) for the description of the theoretical model.

[3] Other versions of the model also include intermediate inputs, see for example Krugman and Venables (1995).

cost, so that the larger the elasticity of substitution, the lower the mark-up a firm can charge on consumers and the lower the scale economies.

Krugman (1991) assumes that the second good, associated with an agricultural good, is homogeneous, produced under constant returns to scale, freely tradable across regions and not subject to transport costs. There are two types of agents: fully mobile workers and owners of the homogeneous good that do not move across regions.

For the case of two regions and an equal distribution of workers, if transport costs are nil, prices and wages are equal in the two regions and the distribution of the population is even. Introducing positive but low transport costs does not cause an incentive to migrate *per se* but one can assume that for reason or another, a fraction of workers from region 2 decides to migrate to region 1. In doing so, they expand the market in region 1, creating a demand or backward linkage. Enterprises may raise their profitability, because they can settle in region 1 to provide the larger market and still supply region 2 at low transport costs.

But this possibility depends on three aspects. First, profits of entrants will be higher the larger the share of income spent on manufactures (parameter δ). Second, when enterprises enter, the general price index lowers as does the demand facing each existing firm in the market. This effect lowers the profitability of the entrants and existing firms in region 1. Third, if one defines real wages as nominal wages deflated by the price index, the lower price index also acts in favor of enterprises in region 1, because it means higher real wages. This cost or backward linkage has a positive effect on profitability.

Assuming that the positive effects dominate, the entry of firms in region 1 increases the number of available manufacture varieties. Together with higher real wages, it triggers more migration from region 2 to region 1. In the meantime, the local demand of landowners in region 2 is not sufficient to raise real wages. Given lower wages and fewer varieties to choose from, workers have an incentive to migrate to region 1, causing a cumulative process of migration. Thus, in the Krugman (1991) model, small transport costs encourage agglomeration.

As noted by Helpman (1998), in the Krugman (1991) model the centrifugal force is the local demand from landowners, so the dispersion is driven by region-specific demands. However, Brakman et al (2001) stress that in the Krugman (1991) model the forces for agglomeration are disproportionably larger than the forces for dispersion, for which the model tends to reproduce too few agglomerations compared to what is observed in reality. This makes the empirical validation of the Krugman (1991) model cumbersome. Helpman (1998) introduced a model with housing prices as an additional dispersion force, yielding to more agglomerations in the long-run[4].

Helpman (1998) assumes that the second good, associated with housing services, is not tradable across regions. There is a fixed stock of housing in each region, so housing prices differ across locations and depend on the population in each region. As the ownership of the housing stock is assumed to be equally owned by workers, there are no regional specific-demands acting as a spreading force. Thus, in the model all agents are fully mobile[5].

For nil transport costs and different stocks of housing across regions, a stable equilibrium is found in a distribution of the population proportional to the housing stock. For the case of two asymmetrical regions, Helpman (1998) shows that for any given level of transport costs, if the elasticity of substitution and the share of income spent on housing (i.e., $(1-\delta)$) are high, workers are not attracted to the large region because they do not value variety in manufactures as much as they value lower housing prices in the smaller region. This creates a pressure for occupying all available (fixed) housing stocks, until the population is proportionally distributed with respect to the housing stock. The result is that whenever $\varepsilon(1-\delta) > 1$, the level of agglomeration does *not* depend on transport costs. For a low

[4] The Helpman (1998) model, unlike the Krugman (1991) model, also has the convenient feature of not displaying full agglomeration in one region at any level of transport costs.

[5] An alternative assumption that leads to the same results is to assume that there are two groups of people: i) workers that are mobile across locations; ii) owners of housing in a region that live and consume on the same region.

elasticity of substitution and a small share of income spent on housing, workers will want to migrate to the larger market, because their benefit from more varieties compensates for higher housing prices. In this sense, whenever $\varepsilon(1-\delta) < 1$ the level of agglomeration depends on transport costs. This condition is known as the "no-black hole" condition. Helpman (1998) shows that low transport costs lead to dispersion, while high transport costs lead to agglomeration.

Hanson (2005) derived a reduced-equation of the Helpman (1998) model suitable for empirical testing. He first noticed that for deriving an explicit measure of the price index, one option is to assume that free mobility equalizes real wages across locations in the long run. In this sense, he is assuming *a priori* the unknown long-run equilibrium of wages, in order to derive measure for the structural parameters δ, ε and T.

Using the equilibrium conditions of the formal model and assuming real wage equalization in the long-run leads to the following wage equation:

$$\log(W_r) = \kappa_0 + \varepsilon^{-1} \log\left[\sum_{s=1}^{R} Y_s^{\frac{1-\varepsilon(1-\delta)}{\delta}} P_{Hs}^{\frac{(1-\delta)(\varepsilon-1)}{\delta}} W_s^{\frac{(\varepsilon-1)}{\delta}} T_{rs}^{(\varepsilon-1)}\right] \quad (1)$$

Equation (1) is the base equation for empirical testing. W_r measures wage in location r, Y_s measures income level in location s, P_{Hs} is the price of housing services in region s, T_{rs} is a function decreasing in distance or transport costs between locations and κ_0 is a constant. Its interpretation is that "firms desire to be in a region with high employment to serve a large local consumer market at low transport costs without duplicating fixed production costs. The costs of being in a large market are higher wages, resulting from high housing costs associated with local congestion" (Hanson, 2005, p. 5).

4. Appraisal: which NEG model is suitable for the case of China?

At first, the Krugman (1991) model seems appealing for the case of China, because agriculture still has a considerable share of GDP and because due to restrictions to mobility, some demand is actually tied to local markets in rural areas. However, as mentioned in the previous section, the Krugman (1991) is unable to reproduce multiple agglomerations and it is therefore difficult to implement empirically.

As the Helpman-Hanson model assumes perfect mobility of labor, the spatial adjustments are made through movements of workers and firms. In reality, changes in prices (wages), migration and delocalization of firms occur simultaneously in response to better wages, variety and profitability. Krugman and Venables (1995) introduced a model where the spatial adjustments occur only through changes in wages, because labor is assumed to be fully immobile between regions. The Krugman-Venables model could be suitable for China given labor mobility restrictions. As a matter of fact, Hearing and Poncet (2006) estimate a version of the Redding-Venables empirical application for the case of China. Their basic argument is that in China, changes in demand are met by changes in wages, not in employment levels, as they consider labor migration restrictions to be tight enough for the "price" effect to prevail over the "quantity" effect. The authors estimate the Redding-Venables model using survey data for 10000 workers from 56 cities in 11 provinces for 1995. They find that wage disparities within provinces are due to cities' market access, so that differences in trade costs or market size have positive impact on wage disparities.

The Helpman-Hanson model may be more appropriate for analyses at more spatially disaggregated levels, because the Krugman-Venables model requires detailed information on inter-regional trade flows and this information is not available at higher levels of disaggregation. However, on the estimable version proposed by Hanson (2005), it is assumed that free mobility equalizes real wages across locations in the long run. But in China there are considerable restrictions to labor mobility under the *Hukou* system. Furthermore, there are price and wage controls, and the housing market is not fully free. Understanding the effect of these institutional restrictions and (its effects on) the current trend of migration is highly important for the purpose of choosing a model that can describe the Chinese case. I devote the next subsections to present some facts and figures on them.

4.1. Labor mobility restrictions

Labor mobility restrictions in China have evolved with economic growth and the transition to a market economy. While workers in China have more freedom of choice regarding employment than ever before due to increasing marketization of the economy, many are still unable to migrate to other locations permanently. The *Hukou* system consists on a series of regulations that restrict labor mobility within China. In its present form, it refers to a location-related legal status. Each Chinese citizen must register in one and only one location of permanent residence. As a system of control over migration, it has existed as early as 1951, but its character and orientation have been shaped according to the national development goals. To understand its present meaning, it is worthwhile to describe its evolution.

Initially, during the establishment of the People's Republic and the difficult years of food shortages during the 60s that followed the Great Leap Forward, the *Hukou* system was a *de facto* mechanism to secure the provision of agricultural products, as it tightly restricted the rural population to their lands. In addition to the location-related status, there was an economic activity-related *Hukou* type, which could be "agricultural" or "non-agricultural", through which the entitlements of state benefits, such as subsidized food grain, were regulated. The benefits of the latter were clearly greater than those of the former (Chan and Buckingham, 2008). At that time, a peasant in China willing to migrate had to be ready to give up all his rights as a citizen, which included access to housing, schooling, health care and even participation in collective farming. The only type of migration that occurred at that time was centrally decided. This situation partly changed in 1978 with the excess of rural labor that followed the introduction of the Household

Responsibility System (HRS) as a national policy, under which individual or collective households assumed the task of production (Zhao, 2004).

After the crisis years and the ongoing urbanization process, the tight controls over rural population were not sustainable or desirable, so the government "relaxed" the controls over migration in 1984. The changes introduced in the *Hukou* system were directed only to a segment of the rural population. Farmers were allowed to enter urban areas only if they could demonstrate permanent accommodation in the cities, capacity to engage in their own business or if they had a permanent contract with an urban enterprise (Qian, 1996). A "temporary residence permit" category was created so that entering a city did not automatically imply urban residency status (change in *Hukou*) and/or access to the benefits that came with it, such as subsidized education and housing.

In the late 80s and early 90s, it was evident that such a strict system of regulations was not at odds with the market-oriented reforms. Critical reforms were introduced to the *Hukou* system between 1992 and 1993. As noted by Chan and Buckingham (2008), the *nongzhuanfei* reform is fundamental in understanding the evolution and present state of the *Hukou* system in China. After 1992, the authority for deciding the size of local *Hukou* population and admission requirements was decentralized. At the same time, and given the changes in urban areas, a number of cities eliminated the distinction between agricultural and non-agricultural *Hukou within* each individual city (including some or all of its suburban county-units). While seemingly unclear, the abolition of the activity-related *Hukou* distinction has no direct meaning for rural-urban migrants, since the policy applies mainly to agricultural *Hukou* holders that already live in urban areas.

The existence of the "temporary migrant" status in combination with the decentralized character of residency decisions provided the grounds for selective migration. Cities and towns are allowed to give local *Hukou* to investors (or rich people, for that matter) or people with high occupational skills. Rural migrants offer the low-skilled job force needed in certain activities in the city, but they certainly do not offer sufficient tax contributions to the local government. It then occurs naturally that the "urban workforce" protectionism is largest the larger the city, making it virtually impossible for rural migrants to obtain local residency in metropolis such as Beijing or Shanghai. Of course, people may also migrate illegally, or stay under the temporary migrant status in a city for a long time.

Recent policies (issued in 1997 and 2001) that aim to ease *Hukou* transfers to small towns are consistent with these tendencies, because in small urban centers there is no pressure of the local urban population or significant congestion costs. Even so, a rural migrant willing to move to a small urban center has to be ready to give up his entitlement to land in his home village.

In summation, the present state of the migratory regulations in China is characterized by great variability across cities and towns, ranging from small cities offering "free" local *Hukou* to large cities imposing prohibitive costs. The possibility for a Chinese person to migrate is heavily dependant on their economic and educational status. It is relatively easy for rich or highly educated people to migrate permanently and virtually impossible for poor and uneducated peasants.

4.2 Migration

Table 1 shows two series of migration data in China between 1982 and 2006, obtained from Chan (2008). The first column contains the flow of migrants who legally changed their residence place, i.e., those who were granted a local *Hukou*. The second column contains stock migration figures on *de jure* and *de facto* migrants with a minimum length of stay of 6 months. Column 3 contains rural-migrant labor estimates based on MOA surveys at the township level, and defines a "rural migrants" as person regularly engaged in work outside townships.

Between 1982 and 2006, the annual volume of *Hukou* migrants remained between 17 and 20 million. The effects of the labor mobility restrictions are then most evident on the strikingly stability of this volume of "*Hukou*" migrants. From this figures one can deduce that neither the abolition of the activity-related status under the *nongzhuanfei* reform nor the decentralization of residency decisions had a substantial impact on the flow of permanent, legal migrants to the cities.

Table 1: Migration figures, 1982-2006, in millions of people

Year	*Hukou* Migrant Series (Flow)	*Hukou* + Temporary Migrant Series (Stock)	Rural Migrant Labor (Stock)
1982	17.3		
1985	19.69		
1987	19.73		
1988	19.92		
1989	16.87		
1990	19.24		
1991			
1992	18.7		52.8
1993	18.19		
1994	19.49		
1995	18.46	49.7	69
1996	17.51	60	
1997	17.85	61.8	
1998	17.13	62.4	79.8
1999	16.87	63.7	
2000	19.08	144.4	
2001	17.01	NA	
2002	17.22	108	
2003	17.26	105.9	98.2
2004	19.49	103	102.6
2005	19.33	153.1	108.2
2006		121.6	114.9

Source: Chan (2008)

In sharp contrast, there is a rising tendency of temporary (non-*Hukou*) migration since the early 80s (Ping and Pieke, 2003; Chan, 2008; Fan, 2008). Because of the outline of the *Hukou* restrictions explained above, the majority of the floating or temporary population can be characterized as rural migrant population. According to Chan (2008), "the floating population started to grow rapidly in the mid-1980s to about 70 million in 1988, then dropped somewhat in 1989-1991 due to an economic austerity programme, but regained momentum around 1992 through probably 1997, reaching 100 million then. The current figure is probably very close to 200 million". Although some differences in the figures in column 2 may be due to the accuracy of the sample used[6], a general tendency can be induced: the variation on migration figures that account for temporary migration is by far larger than the variation of the figures for permanent migration.

Given these tendencies, can labor in China be described as *im*mobile? Certainly not. The continuous and increasing flow of temporary migrants implies a *de facto* increase in urban population, even if statistics fail to account for it. Consider the case of a rural migrant in a city to whom a citizenship status is denied. He will return to his village, sooner or later. But as far as he works in the city, he is a *de facto* urban resident. As the flow of rural migrants is continuous, by the time of his departure many more rural migrants had arrived to the city and many more will come after him. They will take his place as *de facto* urban residents. This is why labor mobility restrictions in China should not be compared to international labor mobility restrictions. Near 200 million people mobilized internally in China in 2006. The biggest human movement in history is certainly not observable under immobility of labor conditions. Classifying labor as immobile in China is more accurate for the 50s and 60s, but not for the present.

4.2. Price and wage controls

Agglomeration shows up in the form of higher wages and migration. If migration is restricted, then the largest effect is on wages. But if there are controls on wages, the excess-supply is not cleared and agglomeration is likely to magnify existent regional disparities (Mion, 2004). Especially for the public sector, wages are set nationally in most countries, so that one expects some rigidity but an overall response of wages to market forces. For the case of China, the concern is that wages and prices may be controlled even

[6] Figures are drawn from a 1 per 1000 sample, except for 2005, where figures are drawn from a 1 per cent sample and 2000, where figures are drawn from a full census.

in the private sector, in which case it would be difficult to state a case in favor of the Helpman-Hanson model.

A big part of the story of China's transition to a market economy is the liberalization of prices and wages. The pressure for liberalization was particularly evident in 2001 when China joined the WTO. In China, as in any transitional economy, economic dualism is prevalent, where firms operating under market forces coexist with firms operating under the centrally planned economy. In this scenario, labor markets are segmented, as the wage-setting behavior is different for the two sectors; the first one responding more to supply-demand rules and the second one to lobbies and trade union pressures. Thus, our case for market responses to prices boils down to argue that in China, the extent of firms operating under market forces has been increasing. According to Dong and Bowles (2002), this has been the case since the mid-1990s, as the share of State-Owned Enterprises (SOE) in industrial output has been decreasing at an increasing pace, while township and village enterprises (TVEs), join ventures (JVs), foreign-invested firms (FIFs) and other private firms have increased their participation. In 2006 the share of SOE, TVEs and other forms on joint ownership, domestic private enterprises and foreign funded enterprises on industrial output was 14.6, 21.2, 37.7 and 20.9% respectively[7].

The TVEs, although responding more to local employment maximization objectives, are more market oriented than SOEs (Dong and Bowles, 2002). The JVs and FIFs sectors are concentrated in export-oriented industries. As such, theses sectors are subject to very intense competition and thus, cannot bear wage controls, as wage flexibility is one of the key elements in their competitiveness. It is therefore the case that, at least in the JV, FIFs and private sector, wages respond to supply-demand pressures, as it is evident from the large migration flows to areas where these enterprises are prevalent.

[7] Source: China Statistical Yearbook, 2007.

4.3. Is there a housing market in China?

In China, land is owned by the state. This does not mean, however, that the real estate market is non-existent in China, or put in another way, that housing prices do not respond to market forces at all. As a matter of fact, in 1999 the government launched its policy for secondary housing market and encouraged urban residents to exchange houses. As anecdotal evidence, according to Yen (2008), "since 1996, there have been 67,333 residential properties being put for sales on the market in Shanghai, accounting for about 5% of the total sold properties there in the same period. In 2000 alone, about 7.5 million square meters (80.73 million square feet) existing houses were sold in Shanghai. The total transaction amount was valued at RMB 65.6 billion (about U.S. $8 billion). There are over 5,000 foreign funded real estate companies, including China-foreign joint ventures (JVs) or cooperative enterprises, and over 1,000 wholly foreign-owned companies currently operating in China".

It is rather difficult to argue that housing prices in China perfectly respond to market forces. As stated by Zhou and Logan (2002, p. 149), with reforms, "housing has gradually been changed from a public good to something approaching a commodity. The life-long welfare right to housing has been replaced by one-time purchase subsidies. Housing can be bought and sold in a controlled real state market. (…) Housing investment is no longer constrained by rigid state budget allocations. Municipal governments, work units, and individuals are allowed to raise housing funds through different sources to build new housing. A more open market on the supply side of the system has begun to take form". With these considerations in mind, I now turn to the empirical testing of the Helpman-Hanson model. Given the caveats described above, I also estimate an alternative wage equation proposed by Brakman et al (2004) that does not require real wage equalization nor explicitly uses housing prices.

5. Empirical testing

5.1 Data description

The People's Republic of China administers 33 province-level divisions (see Table A1 in the Appendix for details), including 22 provinces, five autonomous regions (Guangxi, Inner Mongolia, Ningxia, Xinjiang and Tibet), four municipalities (Beijing, Tianjin, Chongqing and Shanghai) and two special administrative regions (Hong Kong and Macau, not included in this paper). The prefecture level is the second level in the administrative hierarchy of the People's Republic of China. This structure consists of 333 divisions composed of 283 prefecture-level cities, 17 prefectures, 30 autonomous prefectures and 3 leagues. For empirically testing the market potential function and the Helpman-Hanson equation for China, I use data at the prefecture-city level, which is generally composed of an urban center and surrounding rural areas.

The source of all data is the China City Statistical Indicators 1996-2005 database provided by the China Data Center of the University of Michigan. The original data are reported by the National Bureau of Statistics, which is collected from local statistical bureaus in all counties and cities in China. The data is comprehensive for all prefecture-cities in 2005, but not for the remaining years, in which the number of prefectures with available data varies between 215 and 256 prefecture-level cities[8]. As a measure of market size, I use Gross Domestic Product measured in thousands of current Yuan. For wages, I use two alternative measures: average wage of staff and workers and average wage of employees in current Yuan. In the literature, housing services are measured in two different ways: as price of housing services and as housing stock. As those measures are not available in the China City Statistical Indicators database, I use investment in real estate development in thousands of current Yuan scaled by area as a proxy for housing services. I measure distance between every pair of locations using the great distance circle formula and proxy internal distance by $2/3\sqrt{area/\pi}$ (Brakman et al, 2006).

5.2 Empirical testing of the Helpman-Hanson model

[8] The aggregate data for GDP and population accounts for roughly 80% of the national figures.

5.2.1. Estimation issues

By estimating equation 1 one can obtain the values of the share of income spent on manufactures (δ), the elasticity of substitution between manufacture varieties (ε) and the level of transport costs (T). From the theoretical model, $0 < \delta < 1$ and $\varepsilon > 1$ are expected. The estimated value of the parameter T depends on the specific distance measure used.

Equation (1) suffers from possible biases, because there might be a two-sided causality between GDP and wages, and even between wages and investment in real estate development. I take several strategies to tackle this problem. First of all, I remove the prefecture's own wage from Right Hand Side (RHS). Second, I make a robustness check and use population instead of GDP as proxy for income. I also try to estimate equation 1 using Instrumental Variables.

Directly estimating equation (1) may lead to overestimation of the parameters because difference in market sizes is not the only determinant of wage differentials across locations. The characteristics of workers can vary from location to location. For instance, if a place offers more and better education, it will probably have, on average, more workers with higher skills, in which case the wage differential relative to other locations is determined not only by market size but also by the skill level of workers. Therefore, in order to assess the importance of market size and proximity in the determination of wages, one should take a homogeneous measure for wages across locations and assume that the factors determining the differences are relatively constant over time. This idea can be expressed in a more formal way, as in Hanson (2005). Let $\overline{W}_{rt}$ be a homogeneous wage rate. Country average wages may vary because $\overline{W}_{rt}$ is varying across regions and over time (this change being associated with the effect of market size) or because worker characteristics are varying across regions. In terms of measurement errors, this can be expressed as

$$\log(W_{rt}) - \log(\overline{W}_{rt}) = \varphi_r + \eta_{rt}$$

Where φ_r captures all the fixed (time-invariant) differences across locations that in one way or another affect workers skills, such as the presence of educational centers, general infrastructure and so on. The term η_{rt} is a white noise term capturing random variations across regions and over time. So if there are location-specific fixed characteristics that attract more workers and raise their skill level, estimating (1) directly would be capturing not only the effect of market size differentials, but also the existence of these factors.

An alternative strategy is to control explicitly for the fixed factors that, in theory, affect the change in wages, and also for other time-variant determinants. As noted by Overman et al (2001, p. 17) regarding Hanson (2005) estimation for the United States, "the time-differenced specification controls for unobserved heterogeneity across counties in the level of manufacturing wages. However, it could be that wages have risen faster in counties with favourable exogenous amenities (e.g. weather or natural geography) or that have accumulated human capital (both through the private rate of return to human capital acquisition and through any externalities) and that these omitted variables are correlated with changes in market access. Since human capital accumulation may, in part, be determined by economic geography, it is not clear that one wants to exclude this component of the change in wages from the analysis."

One of the most salient determinants of wage differences is skill differences. It has been repeatedly pointed out in the literature (Poncet and Hearing, 2006; Mion, 2004) that not controlling for differences in skills when estimating a wage equation leads to considerable biases, because one might be attributing differences in wages to spatial externalities when in reality they are due to skill differences. To tackle this issue I follow a strategy proposed by Kiso (2005) and use wages for a "homogeneous" category of labor, that is, I use average wage of employees as a measure of wages.

Another time-variant factor that might determine wages are human and population density externalities (Ciccone and Peri, 2006). To control for them, I include control variables for student enrollment scaled by area, employment density and the prefecture's percentage of urban population. I also control for "first nature" or geographical explanations (Bao et al, 2002) by including a dummy variable that takes the value of one if the prefecture has access to the sea and zero otherwise, and I also include elevation above the sea level and average temperature. I include other infrastructure variables such as number of local telephone users, area of paved roads per capita and number of beds in hospitals[9].

Another way of expressing equation 1 is:

$$\log(W_r) = \alpha_0 + \alpha_1 \log\left[\sum_{s=1}^{R} Y_s^{\alpha_2} P_{Hs}^{\alpha_3} W_s^{\alpha_4} f(d_{rs})\right], \ f(d_{rs}) = T^{(1-\varepsilon)d_{rs}} \qquad (1')$$

5.2.2. Estimation results

I estimate equation 1 and derive the implicit values for α_1, α_2, α_3 and α_4 in equation 1'. Table 2 summarizes the results for 2000 and 2005.

Table 2: Estimation of the Helpman-Hanson model for 2000 and 2005

[9] All control variables enter the equation in logarithms unless they are dummies or percentages.

Dependent variable: Log of average wages of employees in current yuan

Structural Parameters		No controls		NLS - Controls		NLS - Sel. Controls	
		2000	2005	2000	2005	2000	2005
ε	Elasticity of substitution between manufacturing varieties	9.027**	14.785**	6.130**	7.754**	7.434**	7.748**
		3.294	*6.594*	*1.823*	*1.575*	*2.149*	*1.560*
δ	Share of income spent on manufactures	0.886**	0.926**	0.875**	0.913**	0.869**	0.916**
		0.021	*0.014*	*0.029*	*0.015*	*0.024*	*0.014*
T	Distance	1.002**	1.002**	1.004**	1.002**	1.003**	1.002**
		0.001	*0.000*	*0.001*	*0.000*	*0.001*	*0.000*
Controls							
c1	Student enrollment higher education/area			0.06*	0.073**	0.081**	0.08**
				0.026	*0.013*	*0.021*	*0.013*
c2	Urban population as percentage of prefecture population			0.003	0.003**		0.003**
				0.002	*0.001*		*0.001*
c3	Elevation			0.028	0.024*		0.02*
				0.019	*0.010*		*0.010*
c4	Area of paved roads per capita			0.19**	0.063	0.179**	
				0.065	*0.035*	*0.065*	
c5	Access to coast			0.039	0.152**		0.152**
				0.095	*0.046*		*0.046*
Implied values							
Log T	Transport costs	0.0009	0.0009	0.0017	0.0009	0.0013	0.0009
α1	Market potential	0.111	0.068	0.163	0.129	0.135	0.129
α2	Income	-0.032	-0.101	0.269	0.359	0.028	0.359
α3	Housing services	-1.032	-1.101	-0.731	-0.641	-0.972	-0.641
α4	Wages	9.059	14.886	5.861	7.395	7.405	7.395
ε/(ε-1)	Scale economies	1.125	1.073	1.195	1.148	1.155	1.148
ε(1-δ)	"No balck-hole" condition	1.028	1.093	0.765	0.672	0.975	0.672
Adj. R-squared		0.013	0.106	0.191	0.381	0.180	0.377
Number of Observations		240	240	213	231	214	232

White Heteroskedasticity-Consistent Standard Errors in italics
**Significant at the 1% level
*Significant at the 5% level

I included the results for the estimation with no controls for reference. I also included the estimation results for several controls, presented those which were significant for a given year in column 2, and excluded those that turned out to be significant at the 5% level of confidence in order to obtain the final specification contained in column 3, "NLS Selected controls". I will interpret these estimates given that the IV strategy (results not reported here) did not yield satisfactory results[10], but it should be kept in mind that there

[10] I tried (a set of) the following instruments: prefecture population in 1996, prefecture population density in 1996, prefecture area, lags of wages, the aggregate of GDP and wages per province (Hanson, 2002) and distance to the economic centre (Brakman et al, 2006).

might be a bias in the standard errors due to possible endogeneity of the regressors. In this section I focus on the specification that controls for fixed factors explicitly[11].

In the preferred specification - NLS with selected controls (column 3) - for both years the three structural parameters of interest have the correct sign and are precisely estimated[12]. The estimated values for the elasticity of substitution of the NLS estimation for 1995 and 2005 are within the range suggested in the literature[13] and are, for both years, close to the NLS estimate of 6.56 found by Hanson (2005) for the United States in the period 1980-1990.

In the context of a Dixit-Stiglitz monopolistic competition model, a measure of scale economies or price-marginal cost ratio is given by $\varepsilon/(\varepsilon-1)$.Under perfect competition and constant returns to scale, price equals marginal cost, in which case $\varepsilon/(\varepsilon-1)$ equals 1. A value of $\varepsilon/(\varepsilon-1)$ higher than 1 indicates the presence of scale economies in the production of manufactures (or traded goods in a more general sense)[14]. For China I find price-marginal costs ratios of 1.155 for 2000 and 1.148 for 2005, implying profit margins of around 15%. Scale economies are present for both periods and the price-margin ratio is higher for the first period, indicating a decrease in the price-marginal cost ratio. Hanson (2005) finds a price-marginal cost ratio of 1.15 for the United States for 1970-1980 and 1.18 for.1980-1990 and Brakman et al (2004) find values between 1.3 and 1.4 for Germany.

[11] The estimation results of the specification in first differences are given in Table 2A in the appendix. The parameters are precisely estimated but their values differ greatly from those obtained in the estimation of the equation in levels and those obtained elsewhere in the literature. It could be the case that the estimation in first differences is finding a different local minimum, in which case the results are not comparable with those obtained by estimating the equation in levels.

[12] The estimations using population instead of GDP yielded very similar results and thus, are not reported here.

[13] Feenstra (1994) suggested that an appropriate interval should be between 4 and 9; see also Hanson (2005); Eaton and Kortum (1998) and Head and Reis (2001).

[14] It is important to note that this measure of scale economies should be taken as reference for comparison with other studies, since it is oversimplified, as it depends only on a demand side parameter.

The estimates for the structural parameter δ indicate that the share of income spent on tradable goods is 87% for 1996 and 92% in 2005, implying that the share of income spent on non-tradable goods (housing services) decrease form 13% in 2000 to 8% in 2005.

The transport cost parameter is very precisely estimated. I find a lower value for 2005 than for 2000, confirming the increasing importance of proximity to markets. The value is lower compared to the values found by Brakman et al (2004) for Germany, but it is worth noticing that the transport cost parameter is affected by the way distance is measured and the relative size of the country.

Because in the Helpman-Hanson model the measure of the impact of market potential on wages depends only (and inversely) on the elasticity of substitution, I find that this effect is slightly larger for 2000 (0.135) than 2005 (0.129). The values are close to the 0.16 estimate for China found by Au and Henderson (2006b) using a different methodology, and the range of values found by Hanson (2005) for the US (0.132-0.203). Also using a different estimation strategy, Poncet and Hearing (2006) find in their preferred specification a value of 0.06 for the elasticity of wages to market potential for China.

Finally, the "no black hole" condition ($\varepsilon(1- \delta)<0$) is used to check if the transport costs are relevant for the distribution of economic activity across space. The condition is met for 2000 and 2005, as revealed by the implied values reported in Table 2.

Coming back to the original interpretation of Helpman (1998) can be fruitful to shed light on the effect of changes in parameter values on agglomeration. First of all, a higher value of the share of income spent on manufacturing implies that people spend a smaller share of their income on housing, for which they are attracted to larger cities and thus, there is a push for agglomeration. Second of all, a higher value of ε, the elasticity of substitution between manufacturing varieties, implies that people are satisfied with local varieties and are not attracted to large cities that offer more diversity. This effect leads to dispersion. A higher value of ε also implies that firms can exploit less their market power, which in turn means that the economies of scale effect is not so prevalent, leading to dispersion. And lastly, a lower value of transport costs means that imported varieties are cheaper and consumers can access them from "home", leading to dispersion. However, it also means that firms can export from one location, which leads to the self-enforcing process of agglomeration of firms, higher wages, migration of workers and increasing agglomeration. Nonetheless, this effect depends on the initial value of the transport cost, which is unknown.

In order to better grasp these ideas, I conduct a counterfactual experiment. I simulate a shock in income in Beijing and Shenzhen in 2000 and 2005, following Brakman et al (2004). Figures 4 to 7 summarize the results (see also Tables A2.1 and A2.2 in the Appendix).

Figure 4: Experiment: Increasing the income of Beijing by 10%, 2000

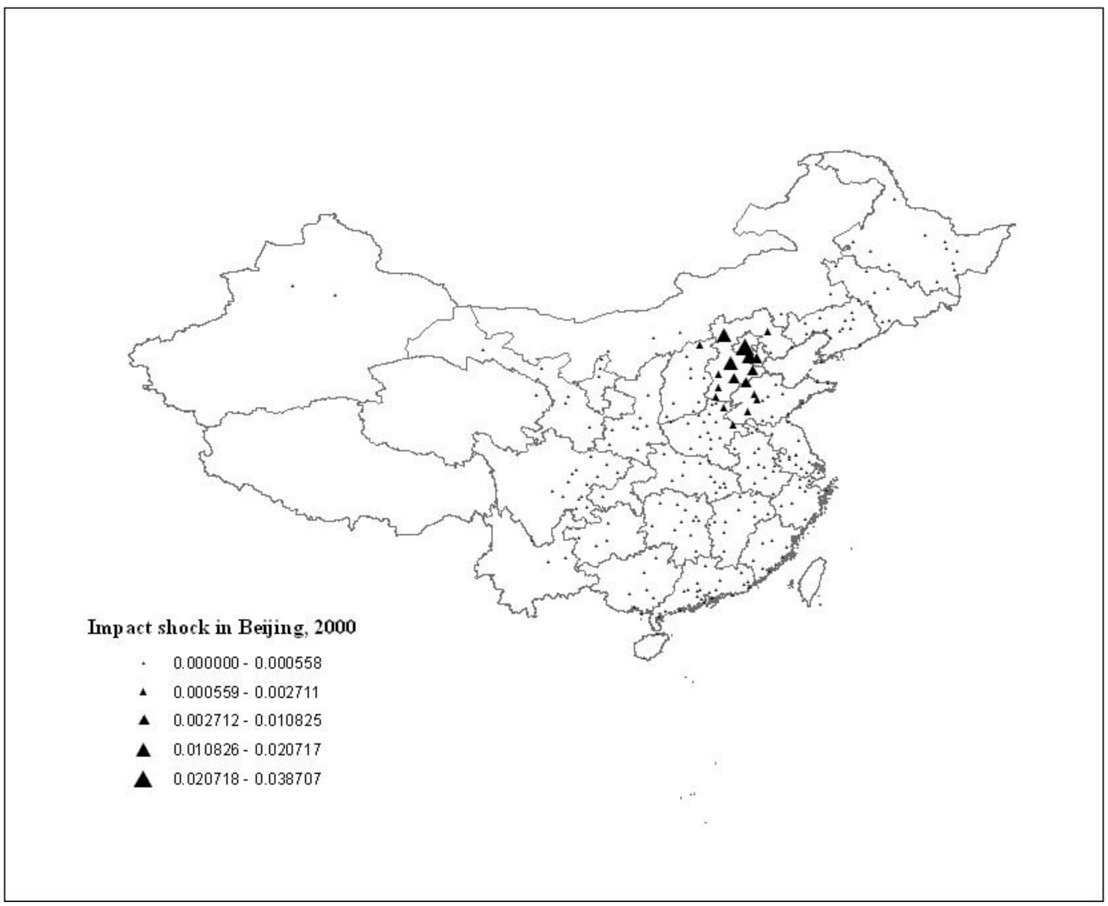


Figure 5: Experiment: Increasing the income of Beijing by 10%, 2005

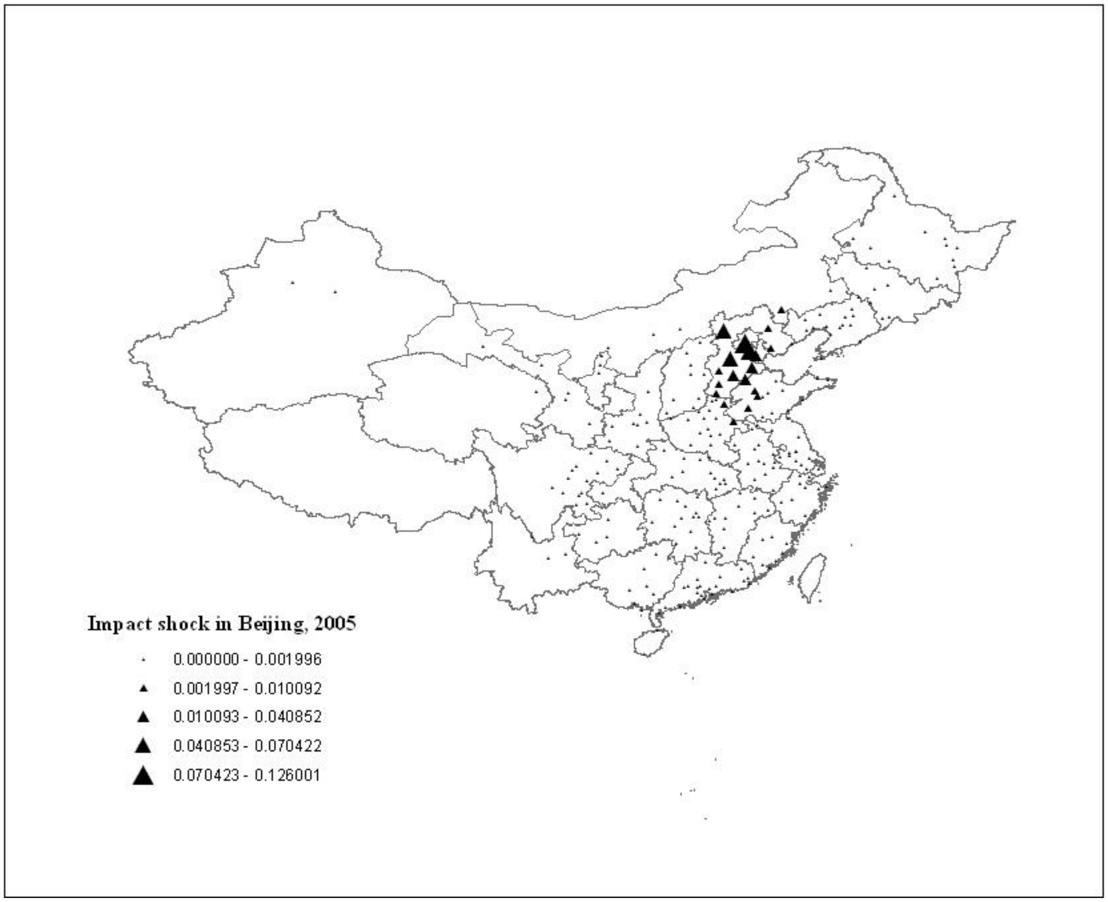


Figure 6: Experiment: Increasing the income of Shenzhen by 10%, 2000

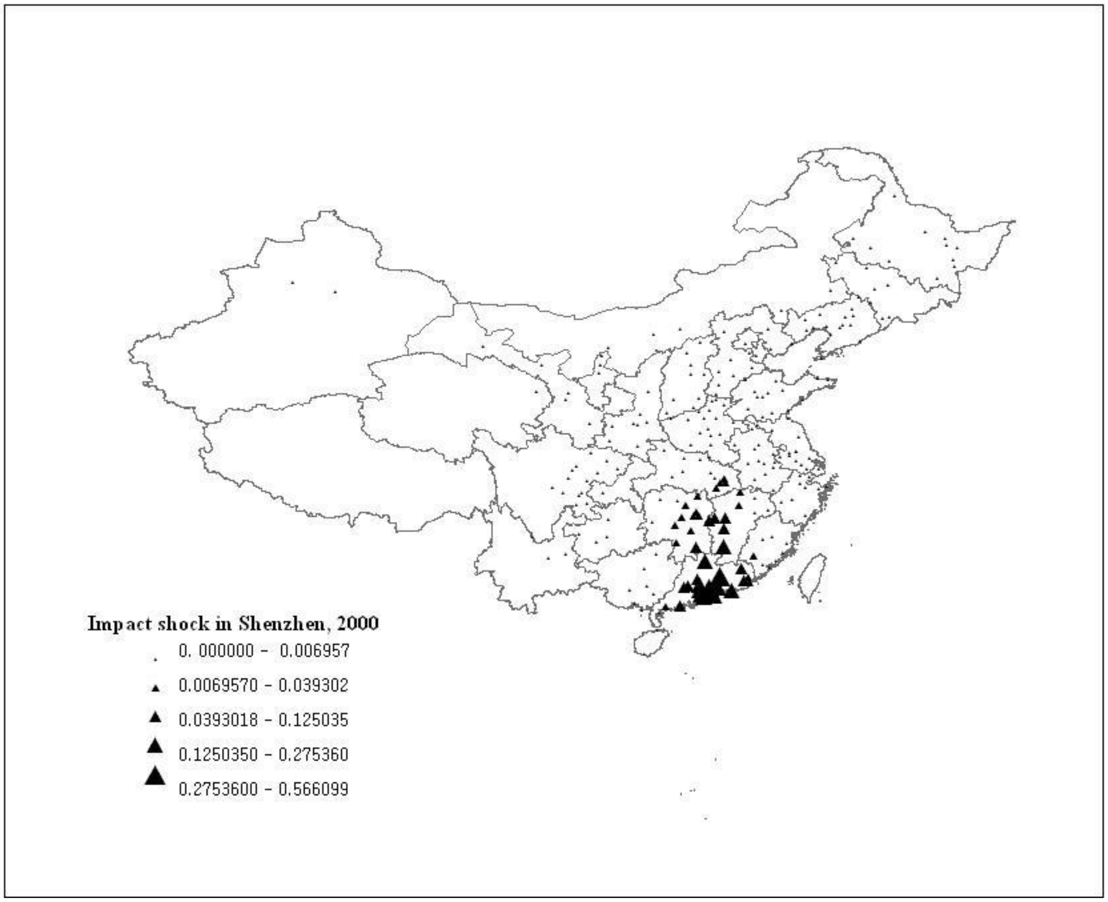
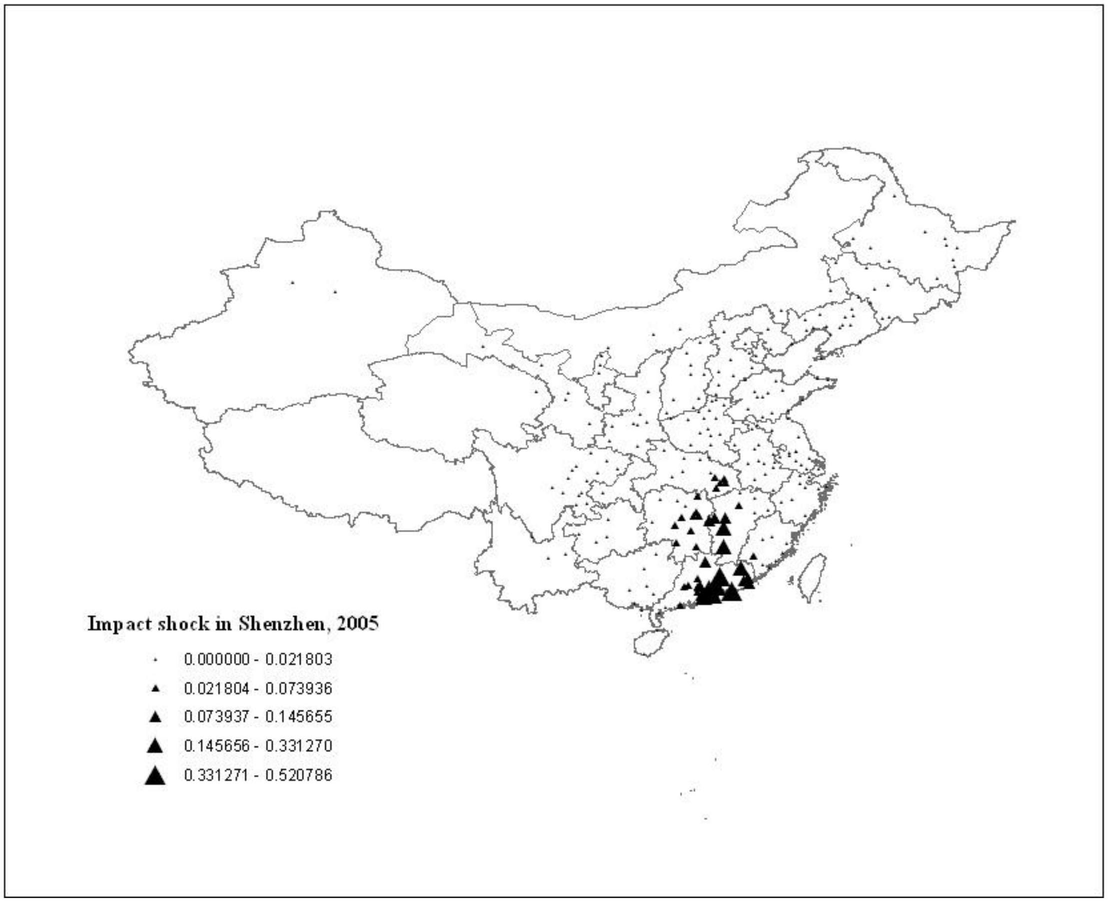


Figure 7: Experiment: Increasing the income of Shenzhen by 10%, 2005



Ceteris paribus, increasing the income of Beijing by 10% causes an increase in the wages of Beijing of 0.04% in 2000 and 0.12% in 2005. For both years, the change also has small but positive effects on prefectures located in the nearby provinces of Hebei, Shandong and Tianjin. The effect of the shock decreases non-monotonically with distance, and its impact is already very small for prefectures located in Shanxi, Anhui and Inner Mongolia. The effects of a shock are less localized in 2005 compared to 2000, so that they fade slower in distance (see Table 3A.1 in the Appendix). This can be observed in Figure 8 that plots distance against the relative change in wages.

Interestingly, a similar experiment for another economic center gives different results. A change of 10% in the income of Shenzhen (Guangdong) causes an increase in wages of 0.57% in the same prefecture in 2000, followed by a change of 0.54% in the wages of

Huizhou (Guangdong), a neighboring prefecture located at 42 km from Shenzhen (see Table 3A.2 in the Appendix). Significant effects of the income shock in Shenzhen are felt within Guangdong, and less prominently in Jianzi prefecture. As the effect of the shock decreases with distance, the effects on prefectures located in the provinces of Fujian, Hubei and Hunan are relatively very small (see Figure 9). Unlike the case of Beijing, the impact in the own region is smaller for 2005 but decreases less rapidly with distance.

It might seem that the effects of spatial externalities are negligible because the absolute effects of income shocks on wages described here are very small. This observation needs two qualifications. First of all, China is a vast country. Comparing the effects of income shocks of Beijing and Shenzhen is interesting, because in the Pearl River Delta area where Shenzhen is located, cities are more "proximate" (the distance between them is smaller) than in the case of Beijing. This might be the reason why the absolute value of an income shock in Shenzhen is higher than an income shock in Beijing. Although it is not possible to test it here, another relevant explanation could be that the relative importance of the industrial sector is larger in Shenzhen than in Beijing. In any case, what can be grasped from this comparison is that spatial externalities are not homogeneous across prefectures, so that income shocks may have different effects across the country, and that they depend on how proximate cities are. Second of all, the effects described here depend critically on the functional form chosen to describe transport costs, so that the results should be taken as reference and not as a description of real effects, because these may change radically by just choosing a different functional form[15].

[15] For example, Mion (2004) describes how Hanson (2005) finds that the effects of a shock decay very rapidly in distance just because an exponential functional form is chosen for the transport costs.

Figure 8: Distance versus relative change in wages, Beijing

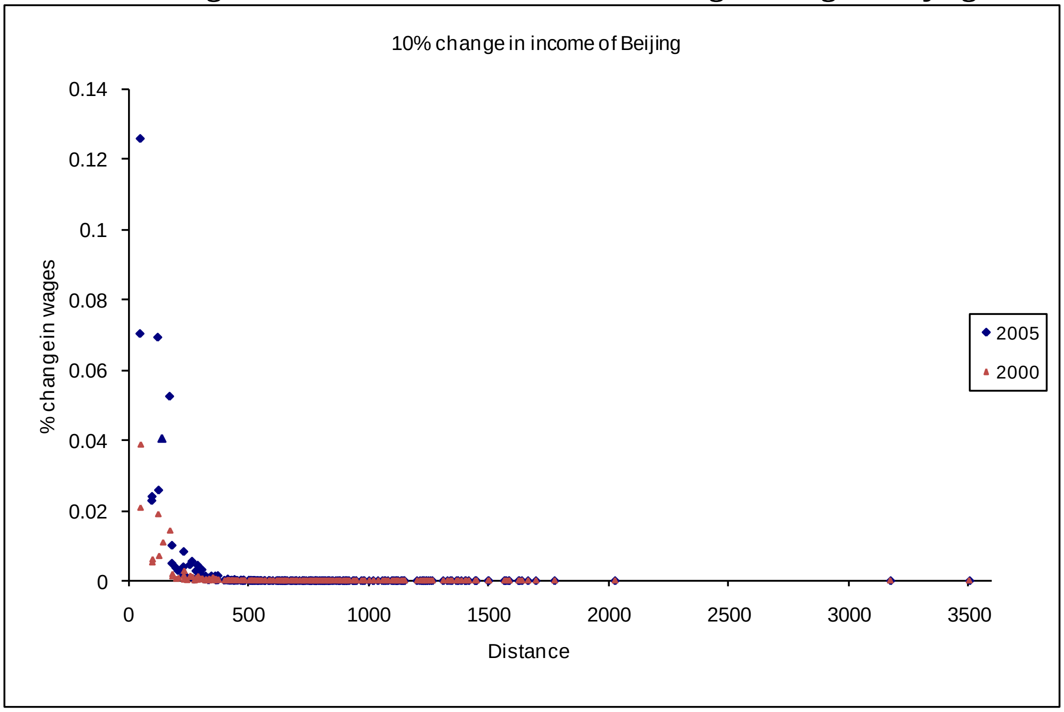
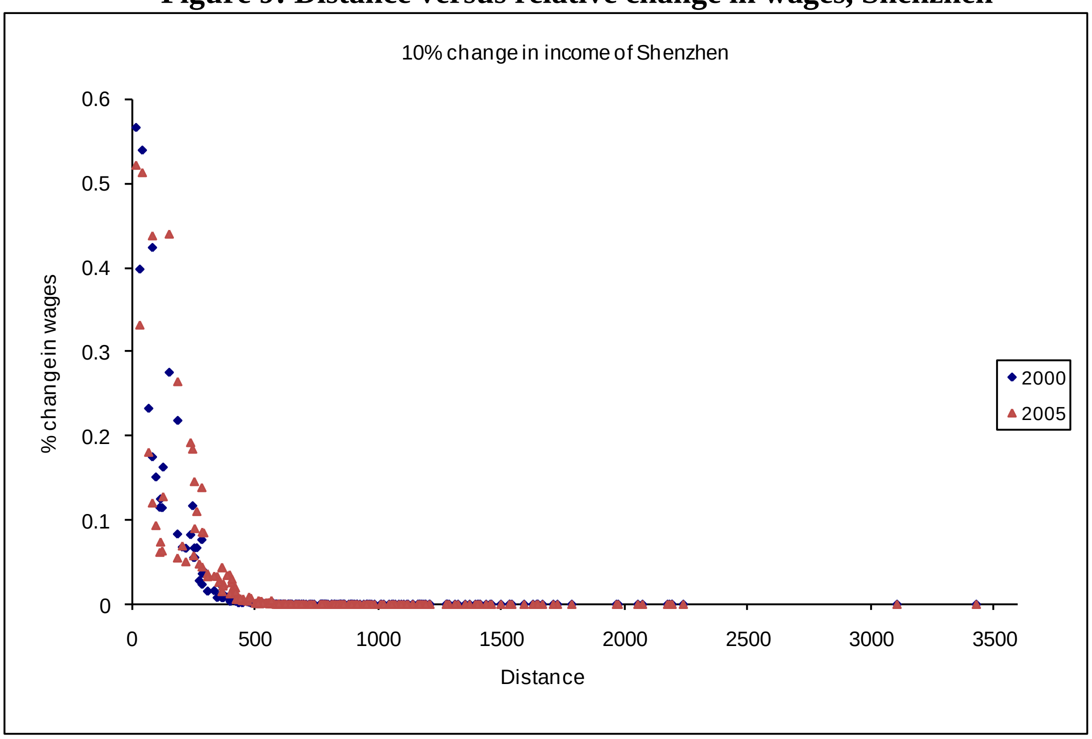


Figure 9: Distance versus relative change in wages, Shenzhen



6. Conclusions

Throughout this paper I assessed the existence of spatial externalities as one of the possible causes of wage differences across locations in China. NEG models focus on the role of consumer markets and distance in generating economic agglomerations. For the case of China, Hearing and Poncet (2006) analyzed the impact of market access on wages using a version of the Redding-Venables model that stresses the importance of internal and foreign markets in determining economic agglomeration. I have complemented the application of NEG models for the case of China by estimating the Helpman-Hanson model.

At first, the application of a model based on fully-fledged free market conditions seemed dubious for the case of China, where restrictions to labor mobility, controls on wages, prices and the housing market still exist. However, in the last two decades there have been significant changes that have caused an increasing response of agents to market opportunities. In this sense, labor mobility is a salient phenomenon, even though there are still labor mobility restrictions, because workers are responding to differences in wages, especially between coastal and rural areas. Wages are more flexible than before because of the intense competition in the private and semi-private sectors and the housing market is increasingly reflecting supply and demand conditions.

Using one of the strategies for empirical estimation, I was able to estimate the structural of the Helpman-Hanson model. The results are in line with what has been found in the literature for other countries. Comparing two years, 2000 and 2005, proved useful in understanding the type of changes that the interaction between the size of markets, the behavior of consumers and distance can cause. In this respect, I find that the market potential (depending only and inversely on the elasticity of substitution) is larger for 2005 than for 2000. I also found that the share of income spent on manufactures increased between the two periods, and that the transport costs decreased. I showed how this effect may cause dispersion or agglomeration of economic activity according to the original Helpman (1998) model, and concluded from shocks experiments on two economic centers that the impact of a change in income in one economic center "fades out" less rapidly in 2005, compared to 2000. More importantly, I found that shocks affect locations across China differently, depending on how clustered cities are and how different wages and incomes are within these (possible) clusters.

A different estimation strategy for future work is to estimate a linearized version of the Helpman-Hanson equation using Arellano-Bond panel data techniques. According to Mion (2004), this strategy corrects for the endogeneity problems inherent to the Helpman-Hanson equation that were not fully solve in this work due to the instability of IV techniques on a non-linear setting.

It is also important to find better measures for transport costs (such as travel time). Constructing a measure of migration costs based on value of destination fees and hometown taxes seems appealing for incorporating explicitly labor mobility restrictions in the model. Extending NEG models to explicitly incorporate imperfect rural-urban migration and the role of temporary migration seems plausible and desirable.

I opened this paper with a quote from the McKinsey report on urbanization in China that showed impressive figures for the future of urbanization in China. An influential strand of literature has argued that the size of economic agglomerations (cities) in China is suboptimal (Au and Henderson, 2006a and 2006b; McKinsey, 2008). From what has been found in this work I can hypothesize that the tendencies for migration to cities and the enlargement of existent agglomerations will continue, specially because is a process that was somehow "repressed" before the economic reforms of Deng Xiaoping. As China moves to a market economy, prices should better reflect the forces pulling for dispersion, which in a broader sense not only include housing and land prices, but also congestion, pollution and many other problems that come along with urbanization. What remains debatable is if the cost paid in a "suboptimal" distribution of cities is larger than the benefits of a more spatially balanced growth, which could be directed with the maintenance of labor mobility restrictions. In this respect, only history has the last word.

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Appendices

Figure 1A: Map of China

Table 1A: Composition of Provinces, Autonomous Regions and Municipalities in China

Provinces, Autonomous Regions and Municipalities	#Regions at Prefecture Level	# Cities at Prefecture Level	# Regions at County Level	# Cities at County Level	#Districts under the Jurisdiction of Cities	#Regions at Townships Level	#Towns
National Total	**333**	**282**	**2861**	**374**	**845**	**44067**	**20226**
Beijing			18		16	318	142
Tianjin			18		15	241	120
Hebei	11	11	172	22	36	2207	937
Shanxi	11	11	119	11	23	1386	564
Inner Mongolia	12	9	101	11	21	1431	527
Liaoning	14	14	100	17	56	1532	614
Jilin	9	8	60	20	19	1011	456
Heilongjiang	13	12	130	19	64	1314	475
Shanghai			19		18	221	118
Jiangsu	13	13	106	27	53	1518	1117
Zhejiang	11	11	90	22	32	1598	783
Anhui	17	17	105	5	44	1936	997
Fujian	9	9	85	14	26	1111	608
Jiangxi	11	11	99	10	19	1548	770
Shandong	17	17	139	31	48	1928	1237
Henan	17	17	158	21	48	2440	866
Hubei	13	12	102	24	38	1234	737
Hunan	14	13	122	16	34	2587	1098
Guangdong	21	21	122	23	54	1710	1318
Guangxi	14	14	109	7	33	1396	748
Hainan	2	2	20	6	4	218	181
Chongqing			40	4	15	1259	648
Sichuan	21	18	181	14	43	5144	1934
Guizhou	9	4	88	9	10	1539	693
Yunnan	16	8	129	9	12	1574	580
Tibet	7	1	73	1	1	692	140
Shaanxi	10	10	107	3	24	1744	919
Gansu	14	11	86	4	16	1569	463
Qinghai	8	1	43	2	4	429	115
Ningxia	5	5	21	2	8	227	92
Xinjiang	14	2	99	20	11	1005	229

Source: *China Statistical Yearbook*, 2004.

Table 2A: Estimation results of the Helpman-Hanson model in first differences

Dependent variable: Change in Log of average wages in current Yuan 2000-2005

Sturctural Parameters		2000-2005
ε	Elasticity of substitution between manufacturing varieties	2.048
		0.730
δ	Share of income spent on manufactures	0.963
		0.117
T	Distance	1.019
		0.015
Implied values		
α1	Market potential	0.488
α2	Income	0.959
α3	Housing services	-0.041
α4	Wages	1.089
ε/(ε-1)	Scale economies	1.954
ε(1-δ)	Stability condition	0.077
Adj. R-squared		0.046
Number of Observations		240

White Heteroskedasticity-Consistent Standard Errors in italics

**Significant at the 1% level

*Significant at the 5% level

Table 3A.1: Simulation of a 10% change in market potential index of Beijing using the Helpman-Hanson equation

10% change in income of Beijing

2000				2005			
Prefecture	**Province**	**% change in wages**	**Distance (Km)**	**Prefecture**	**Province**	**% change in wages**	**Distance (Km)**
Beijing	Beijing	0.039	48	Beijing	Beijing	0.126	48
Langfang	Hebei	0.021	47	Langfang	Hebei	0.070	47
Baoding	Hebei	0.019	121	Baoding	Hebei	0.069	121
Zhangjiakou	Hebei	0.014	171	Zhangjiakou	Hebei	0.053	171
Hengshui	Hebei	0.011	141	Hengshui	Hebei	0.041	141
Dezhou	Shandong	0.007	125	Dezhou	Shandong	0.026	125
Cangzhou	Hebei	0.006	97	Cangzhou	Hebei	0.024	97
Tianjin	Tianjin	0.005	96	Tianjin	Tianjin	0.023	96
Shijiazhuang	Hebei	0.003	229	Chengde	Hebei	0.010	181
Chengde	Hebei	0.002	181	Shijiazhuang	Hebei	0.008	229
Jining	Shandong	0.001	228	Puyang	Henan	0.006	264
Xingtai	Hebei	0.001	255	Ji'nan	Shandong	0.005	180
Shangqiu	Henan	0.001	288	Xingtai	Hebei	0.005	255
Ji'nan	Shandong	0.001	180	Shangqiu	Henan	0.004	288
Puyang	Henan	0.001	264	Jining	Shandong	0.004	228
Datong	Shanxi	0.001	350	Tangshan	Hebei	0.004	197
Handan	Hebei	0.001	281	Chifeng	InnerMong	0.003	305
Taian	Shandong	0.001	206	Taian	Shandong	0.003	206
Chifeng	InnerMong	0.001	305	Handan	Hebei	0.003	281
Anyang	Henan	0.001	300	Anyang	Henan	0.002	300
Yangquan	Shanxi	0.000	334	Laiwu	Shandong	0.002	229
Fuyang	Anhui	0.000	361	Zhoukou	Henan	0.001	372
Tangshan	Hebei	0.000	197	Fuyang	Anhui	0.001	361
Huaibei	Anhui	0.000	301	Kaifeng	Henan	0.001	345
Hebi	Henan	0.000	321	Hebi	Henan	0.001	321
Kaifeng	Henan	0.000	345	Zibo	Shandong	0.001	242
Xuzhou	Jiangsu	0.000	298	Datong	Shanxi	0.001	350
Zhoukou	Henan	0.000	372	Huaibei	Anhui	0.001	301
Laiwu	Shandong	0.000	229	Zaozhuang	Shandong	0.001	285
Xinxiang	Henan	0.000	363	Yangquan	Shanxi	0.001	334

Table 3A.2: Simulation of a 10% change in market potential index of Shenzhen using the Helpman-Hanson equation

10% change in income of Shenzhen

2000				2005			
Prefecture	Province	% change in wages	Distance (Km)	Prefecture	Province	% change in wages	Distance (Km)
Shenzhen	Guangdong	0.566	17	Shenzhen	Guangdong	0.521	17
Huizhou	Guangdong	0.539	42	Huizhou	Guangdong	0.512	42
Heyuan	Guangdong	0.424	83	Shanwei	Guangdong	0.439	151
Dongguan	Guangdong	0.398	32	Heyuan	Guangdong	0.437	83
Shanwei	Guangdong	0.275	151	Dongguan	Guangdong	0.331	32
Zhuhai	Guangdong	0.233	68	Ganzhou	Jiangxi	0.264	186
Ganzhou	Jiangxi	0.218	186	Meizhou	Guangdong	0.192	238
Zhongshan	Guangdong	0.175	83	Ji'an	Jiangxi	0.184	246
Shaoguan	Guangdong	0.163	127	Zhuhai	Guangdong	0.180	68
Guangzhou		0.151	97	Jieyang	Guangdong	0.146	253
Jiangmen	Guangdong	0.125	116	Xinyu	Jiangxi	0.139	284
Ji'an	Jiangxi	0.117	246	Shaoguan	Guangdong	0.128	127
Foshan	Guangdong	0.115	113	Zhongshan	Guangdong	0.120	83
Qingyuan	Guangdong	0.115	123	Yichun	Jiangxi	0.110	263
Zhaoqing	Guangdong	0.083	185	Guangzhou		0.094	97
Meizhou	Guangdong	0.083	238	Pingxiang	Jiangxi	0.090	255
Xinyu	Jiangxi	0.077	284	Chaozhou	Guangdong	0.086	286
Chenzhou	Hunan	0.068	205	Shantou	Guangdong	0.085	291
Yichun	Jiangxi	0.067	263	Jiangmen	Guangdong	0.074	116
Jieyang	Guangdong	0.067	253	Chenzhou	Hunan	0.069	205
Yunfu	Guangdong	0.066	219	Qingyuan	Guangdong	0.063	123
Pingxiang	Jiangxi	0.056	255	Foshan	Guangdong	0.062	113
Yangjiang	Guangdong	0.055	251	Yangjiang	Guangdong	0.058	251
Shantou	Guangdong	0.039	291	Zhaoqing	Guangdong	0.055	185
Chaozhou	Guangdong	0.036	286	Yunfu	Guangdong	0.051	219
Hengyang	Hunan	0.028	273	Hengyang	Hunan	0.048	273
Zhuzhou	Hunan	0.024	285	Zhuzhou	Hunan	0.044	285
Nanchang	Jiangxi	0.022	366	Nanchang	Jiangxi	0.044	366
Yongzhou	Hunan	0.016	334	Xianning	Hubei	0.043	366
Xiangtan	Hunan	0.016	308	Changsha	Hunan	0.036	307