THE POLITICAL ECONOMY OF MIGRATION IN CHINA*

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Abstract

Large differences in hourly compensation exist between the natives (urban hukou holders) and rural to urban migrants of the Chinese cities, a third of which cannot be explained by any variation in observable characteristics. This paper attempts to explain the differences using a Tiebout-esque political economy model of migration in which rents are appropriated from the migrants by the rent-seeking bureaucrats and redistributed among the politically influential groups- the urban hukou holders. We derive conditions under which the competition between regions for rents tend to lead to a bias against migrants and those that induce better treatment than their urban counterparts with the same characteristics.

Keywords: migration, discrimination, rent seeking, tax competition.

JEL classification: J15, J61, J71, O15, O53.

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1 Introduction

After the end of the Chinese civil war in 1949, the Chinese Communist Party institutionalised the household registration system (also referred to as 'hukou' or internal passport of China), in an attempt to control the "blind flow" of people rushing into the cities in search of employment and better standard of living. Inter-regional labour mobility was non-existent and the rural people were excluded from working in the cities. The hukou system, however, heavily subsidised housing, medical expenses, and secured a constant supply of food grain needed for industrialization in the urban sector. This dichotomy reflected the beginning of the imbalances in the Chinese government's treatment of the individuals registered with the cities and the rural areas.

It was only after the success of the agricultural reforms under Deng Xiaoping and the introduction of the 'household responsibility system' in 1978 that the controls restricting the migration of the rural citizens to the urban centers were relaxed. With the development of institutions (Dennis T. Yanng, 1997; Zhao, 1999) and social networks (Meng, 1996; Wu and Li, 1997) more and more migrants have crossed the provincial borders to reach farther destinations. In the absence of controls to restrict migration, the share of urban population has risen from 18 percent in 1978 to 50 percent in 2010. By the end of 2010, there was a total of 155 million rural-urban migrants[1] in the Chinese cities (Cai, et al, 2011, p.18).

Although the restrictions on migration have been relaxed, the government appears to favour the interests of those who had city household registration (Chan,1994; Knight and Song, 1999) and had denied the migrants 'access to institutions that provide capacities and resources' thereby treating them like second class citizens within their own country and creating an "invisible wall" in China (Chan, 1994; Solinger, 1999 p4). Large differences in hourly compensation exist between urban hukou holders and rural to urban migrants both within and across cities, a third of which cannot be explained by any variation in individual or household observable characteristics and reflect ineffective enforcement of labour market regulations (Frijters.et.al, 2009; Pakrashi and Frijters, 2012). What appears to be more interesting is that in certain cities like Wuxi and Bengbu, migrant workers are actually treated 20% better than their equivalent urban counterparts in the labour market (Frijters.et.al,2009). This apparent co-existence of extreme differences in compensation between the two groups across regions with open borders and labour mobility motivates a discussion of the biased incentive system that promotes the protectionist behaviour of local governments and officials towards it's local hukou holders.

[1] Rural to urban migration in China has often been classified into two distinct groups: Migration with a change in the local hukou status (bendi hukou) and non-hukou migration. Unfortunately in China only hukou migration has been considered as qianyi ("migration") while the latter is merely referred to as "floating population" or temporary migrants, however the dominant form of migration since mid 1980s has been the spontaneous or unofficial migration which is not associated with any change in hukou registration.

Since 1980 there has been a number of interesting changes to the management of the hukou system- while private goods have largely been unlinked from the provisions of the hukou, local governments continue to play a prominent role in the allocation of public goods and services. The influence of local governments and officials over local issues has increased with the devolution of fiscal and administrative powers from the central government, allowing them more control on decisions regarding both hukou and non-hukou based migration (O'Brien and Li 1999). Decentralization also provided regional governments the right to derive profits from state enterprises under their jurisdiction (Wong 1992; Wong, Heady and Woo 1995; Oi 1999). Critics have often argued that the decentralization of power from the central to the local authorities has far perpetuated hukou based barriers rather than attenuating them (Litao and Li, 2006).

Fiscal constraints of the local governments (Whiting 2001), coupled with the perception that local revenues should be used only by the local hukou holders who have contributed to the development of the local economy for longer periods than the migrants play a significant role in explaining why regional governments favour local interests. The cadre performance evaluation system has been arguably the most important factor affecting local officials' attitude towards the migrants (Whiting 2004, p.104). Local officials are evaluated and rewarded on the basis of the performance of the local community on a range of criterias. This performance based evaluation system invariably defined on the progress of the local hukou holders, provides sufficient incentives to the regional governments to exclude the nonhukou holders while delivering public goods and services (Litao and Li, 2006).

This paper develops a Tiebout-esque political economy model of migration in China in which rents are appropriated from the rural to urban migrants by the bureaucrats of the local government and redistributed among the politically influential groups - the urban hukou holders. The rent expropriated from the productive agents of the economy (Murphy et al. 1993; Robinson 1994; and Acemoglu 1995) is then used by the beneficiaries to finance goods and services, which were previously provided by the central government. The present paper studies the basic dynamics that lies underneath the cross border mobility of the migrants and analyzes the competition among the regional governments that triggers the "race to the top" phenomenon in terms of fairer treatment of the outsiders.

The hourly wage differential that exists between urban hukou holders and migrants can be explained by the political strategy of the local officials discussed in our migration model. We derive conditions under which competition between regions for rents tend to lead to a bias against migrants and those which induce better treatment than their urban counterparts with the same characteristics. We also show that the form of bias which ultimately arises in equilibrium depends extensively on the initial state of the regions.

The paper proceeds as follows. Section 2 introduces the basic model. This is followed by characterization of the cross border migration decision in section 3. It explores the mechanisms by which regional characteristics affect the choice of destination associated with the decision to migrate. The equilibrium solutions for this model is presented in section 4 followed by a few extensions in the appendix. The theoretical model presented in this paper is calibrated in section 5 to best fit the data from the Chinese cities. Section 6 examines the effects of exogenous changes in the parameters of the model on the equilibrium solutions using a numerical example and establishes the paper's main results . A brief conclusion is provided in section 7.

2 Theoretical Model

Since the formalization of the first two sector models of rural urban migration (Lewis,1954; Ranis and Fei,1961; Todaro,1969 and Harris and Todaro, 1970) most of the literature have found significant effects of individual, household and community characteristics upon the migration decision of individuals from the rural to the urban regions (Dennis Hare and Shukai Zhao, 1999; Hein Mallee, 1999; Xing Meng, 1999; Zhao, 1999). Most of the existing empirical studies have focused on the decision to migrate to the urban cities from the rural countryside and the choice of the destination city (Meng, 1996; Wu and Li, 1997; Poncet, 2006; Bao et al. 2009; Zhang and Zhao, 2011) while a few have examined the role that institutional constraints play in the migration decision (Dennis T. Yang, 1997; Zhao, 1999). There has been limited effort to understand the wide variations in compensation between the urban hukou holders and the migrants across regions and to examine the recent "race to the top" phenomenon observed among the Chinese cities in terms of favourable treatment of the migrants.

This paper employs a simple theoretical model of cross border labour mobility to the cities from the rural subsistence sector. Once the decision to migrate has been made the rural to urban migrants choose a city from a set of potential destinations so as to maximize their utility (Tiebout, 1956). Once in the cities the urban hukou holders and migrants compete in the same labour market for jobs but the Chinese government's strategy of political favouritism towards its politically influential population causes the imbalance in the compensation received by the two groups of urban residents. The enforcement of the household registration system has been relaxed but the urban residents still receive generous subsidies and benefits that are not available to the migrants. We discuss the model with respect to three key players: the individual firms, the Chinese citizens-both urban hukou holders and rural to urban migrants and the regional governments composed of self serving bureaucrats who themselves are part of the urban hukou holder population. The urban hukou holders are the pressure groups in the model who exploit

their influence to enhance the welfare of their group (Becker,1983;Tideman and Tullock,1976) and the local officials and bureaucrats are assumed to mainly transmit the pressures of the active group. The migrant population of the model on the other hand plays a politically insignificant role, thereby falling prey to rent seeking activities and discrimination.

2.1 Residents of the cities

This section develops a simplified political economy model of migration in China model where all the residents are rational[2] individuals with perfect information and are not subject to money illusion. The migration decision is treated as an investment decision such that rural to urban migrants "vote with their feet" and relocate to the city whose local government policies are most compatible with their preferences (Tiebout, 1956; Tullock, 1971; Banzhaf and Walsh, 2008). They also take into account geographic living-cost differences in their cost-benefit analysis, thereby making locational decisions on the basis of real variables rather than nominal variables. Geographic living cost differentials can be enormous as cities like Guangzhou, Dongguan, Shenzhen, Shanghai and Hangzhou which were paying the highest nominal hourly earnings and compensation were also found to have high cost of living. Cost of living therefore should logically be included in a model designed to explain the pattern of human migration (Cebula, 1972-3; Cebula, 1978; Liu, 1975). Prospective migrants will thus prefer cities with higher real income and lower real tax burdens as lower taxes will invariably increase their disposable income, thereby letting them attain the highest possible utility.

The K cities which are potential migration destinations in this model are situated at a distance from each other and is surrounded by the non-overlapping sending regions[3]. Individuals in each of the K cities can be broadly classified as: urban hukou holders, the insiders in this model and the rural to urban migrants who have migrated from the countryside in search of jobs and better standard of living. Each city differs in their initial endowment of urban hukou holders and the residents of a city are identical in all respect except for their region of registration. Regional or local governments often appear to favour the interests of those who are registered with the region offering them generous subsidies and benefits that are not available to the migrants.

We assume that there is no labour-leisure trade-off in this model and each individual invests one unit

[2]The assumption of rationality is an important assumption as it rules out the possibility of a "money illusion" in this model. I define money illusion as the "tendency to think in terms of nominal rather than real monetary values," following Shafir, Diamond and Tversky (1997). This is important as the concept of money illusion violates the basic assumption of rationality. According to Tobin (1972) "An economic theorist can, of course, commit no greater crime than to assume money illusion".

[3] There is no common or overlapping region between the rural areas of both the cities. All the K cities are mutually exclusive and governed by K different authorities. This is an important assumption as without this, individual migrants residing in the intersection of the two suburbs will be able to migrate to any of the two cities at zero cost.

of labour in equilibrium. Non-farm work is available only through wage employment in the urban regions and there exists no segregation in the labour market. Wages are set in the competitive labour market of the cities with each of the individuals employed receiving the same wage rate in equilibrium. Migrants and urban hukou holders are considered perfect substitutes in the labour market and earn the same wage in equilibrium but are discriminated by the rent seeking activities of the regional authorities who favour local interests. Even though individuals are perfectly mobile across regions, the assumption that all urban benefits received by the hukou holders are tied to their city of registration eliminate their incentives to migrate and establishes migrants as the only residents undertaking cross border mobility in this model.

For the sake of simplicity we normalize the pool of potential migrants in the rural region of each city to one. Prospective rural to urban migrants compare the compensation schedule offered by each of the K potential destinations and chooses the migration destination that helps them attain the highest possible welfare. The utility function of individual j in each of the k cities is assumed to be symmetrically distributed over all the n goods using the standard Dixit and Stiglitz type utility function. We use the constant elasticity of substitution utility function in our model as it will help us in deriving closed form solutions for the model.

$$U_{jk} = \sum_{i=1}^{n} u(c_{ijk}); \quad \forall k = 1.....K \tag{1}$$

Consumers in our model love variety and consume each of the n products produced by the firms in the city. c_{ijk} is the amount of the i^{th} good consumed by the j^{th} individual (which includes both the urban residents and rural urban migrants) in city k. Due to the symmetrical nature of the utility function each of the L individuals in the k^{th} city irrespective of their region of registration will consume the same amount of all the n goods; consumption of individual j in city k will however vary with the type of registration.

2.2 Firms and goods

Each of the n goods in the economy is produced by a privately owned firm which is monopolistic in nature and produces a single differentiated product which differs from the good produced by the other firms to some extent. The treatment of monopolistic competition that we adopt in this paper is a slight modification of Dixit and Stiglitz (1977) and Krugman (1979). This section develops the basic model of monopolistic competition with a single factor of production, labour. Labour in this model is mobile both within and between regions but there is a cost associated with migration which we will discuss in detail in the next section. The number of firms in each city is exogenously given and entry is restricted by the licensing requirements of the urban local governments which create substantial difficulties, sufficient

enough to discourage entry. Each of the n goods in the k cities is assumed to be produced with the same Cobb Douglas type production function using the same level of technology.

The production function that we have assumed in this paper is

$$x_{ik} = A l_{ik}^{\alpha}\,;\, \alpha > 1 \tag{2}$$

where α is the output elasticity of labour, $l_{ik}$is the amount of labour employed in the production of the i^{th} good in the k^{th} city , and x_{ik} is the output of the good produced in the city. The above mentioned production function exhibits scale economies which are internal to the firms and hence both the average (AC) and marginal cost (MC) curves will be falling over the entire range of production with the MC curve lying below the AC curve. Production of each of the n goods must equal the sum of their individual consumptions as all the goods are unique and non-substitutable to some extent. Total production of each good can also be represented by the product of the consumption of an average individual times the labour force.

$$x_{ik} = \sum_{j=1}^{L} c_{ijk} = L_k \bar{c_{ik}} \tag{3}$$

The profit maximization problem of an individual firm i in city k can be defined as

$$\pi_{ik} = p_{ik} x_{ik} - w_{ik} l_{ik} \tag{4}$$

The firms maximize its individual profit function and sets its output and prices according to the first order condition, where marginal revenue is equal to the marginal cost. The non-substituability of the goods allow the firms to charge a price over and above their marginal cost, depending on the elasticity of demand.

2.3 Political Strategy

In our set up regional bureaucrats favour the city's local urban holders by offering them higher private consumption opportunities through benefits and subsidies that are not available to their migrant counterparts. As the rational individuals only care about their real income, the rent-maximizing political strategy involve maximizing the (real) revenues collected by the local officials by taxing the city's mobile tax base. High rent seeking activities will "crowd out" migrants from the city and so the local authorities need to strike a balance between rents and migrant labour shortages. Rents are collected from the migrants in the cities and redistributed to the hukou holders in the form of subsidies, thereby creating a wedge in the

hourly compensations received by the two groups. Each urban hukou holder in city k receive some (real) benefits b_k and their hourly (real) compensation increases to $W_k + b_k$ which is above the market clearing (real) wage W_k, while the rural to urban migrants receive just $W_k(1-\tau_k)$, where τ_k is the rent collected by the regional authorities in equilibrium. Otherwise identical to the other urban hukou holders, migrants are thus discriminated[4](Becker, 1971) against and treated as second class citizens owing to their lack of city registration or urban hukou.

The rent seeking activities of the regional governments take place in two stages. In the first stage, the K cities compete against each other for a larger share of the rent under tax base mobility. The local authorities of the regions also derive the residual income from the enterprises under their jurisdiction using a tax rate appropriate to confiscate all of their profits. Competition between the K cities in the absence of a pre-assigned division rule determine the rent collected in the first round. In the second stage, the rents and the profits collected from the firms through an appropriate profit tax is redistributed as benefits to the urban residents with local hukou, subject to the city's balanced budget condition. The rent in this contest thus exhibits the characteristics of a public good in the first round, and a private good in the second (Katz and Tokatlidu, 1996). The lump sum benefits, b that each urban hukou holder receive in equilibrium is determined by the balanced budget condition of the city:

$$b_k L'_k = L_k^M W_k \tau_k + \sum_{i=1}^{n} \Pi_{ik} \tag{5}$$

where $\Pi_{ik} = \frac{\pi_{ik}}{p_{ik}}$ represent the real profits earned by firm i in city k, which eventually gets taxed away by the local authorities. $L^M W\tau$ is the rent or revenue collected by taxing the migrants at the rate τ while bL' is the lump sum benefits distributed equally among all the urban hukou holders of the city, each receiving a subsidy of b in equilibrium. There are no savings or investment decision that needs to be made in this model and so there is no leakage of funds from the total tax revenue. We neglect the possibility of any trade in final goods between cities to maintain the simplicity of the model. Trade between cities can be incorporated in this migration model with a few modifications but is beyond the scope of this present paper.

2.4 The Symmetry of the problem

The symmetry of the utility functions and the firms in this model will ensure that all the goods will be produced in the same quantity and all the firms in the city will eventually charge the same price

[4]Gary Becker (1971) defines discrimination as unequal treatment between equivalent people solely based on race or gender. In other words when otherwise similar and equally productive individuals with the same level of human capital and other productivity-related characteristics are treated differently just because of their complexion, race, gender, caste or in the case of China-entitlement to hukou, it is termed as discrimination.

in equilibrium. Each individual will also consume equal amount of all the goods in equilibrium as the goods enter symmetrically in the utility function of the individuals. Production, consumption, wages and prices may however vary across regions in equilibrium depending on the initial endowment of urban hukou holders in the cities. We will hereafter assume away the subscript k as the below mentioned conditions will hold for all of the k cities in the economy in equilibrium.

$$c_j = \begin{cases} c & if \ \ urban \ hukou \ holder \\ c' & if \ \ migrant \ workers \end{cases} \tag{6}$$

where $c' \leq c$ depending on the equilibrium value of the urban benefits, b.

Instead of trying to develop a general model, this paper will assume particular functional forms for the utility and the cost functions to simplify the model and provide closed form solutions for better understanding and to ease the calibration and simulation procedure that follows. We assume constant elasticity of substitution type utility functions for the individual residents of the model

$$U = \sum_{i=1}^{n} u(c_i); \qquad u' > 0, u" < 0 \tag{7}$$

where u(c) = $\frac{c^{1-\sigma}}{1-\sigma}$;$\sigma > 0$, where the elasticity of demand facing an individual producer is constant $\varepsilon = \frac{-u'}{u"c} = \frac{1}{\sigma}$, inverse of the substitution parameter σ that determines the value of the constant elasticity of substitution.

3 Voting with their feet or Choice of Destination

In this section we model the geographical aspect of the migration decision in which identical prospective migrants from the rural regions choose their potential destination from a set of destination cities so as to maximize their individual utility. For the sake of brevity (to keep the mathematical calculations as straightforward as possible and to be able to derive closed form solutions) we assume that $K = 2$ i.e. there are only two cities in the whole economy-city A and city B. Similarity of the migration decision of the residents of the rural regions of the two cities ensures the existence of a "symmetric" equilibrium in which the equilibrium conditions of the two cities are symmetric. As individual migrants in this model are not subject to money illusion, they will be responsive to the geographic living cost differences and in-migration in a city will be an increasing function of income and a decreasing function of the cost of living at the city. Given that individuals have no control over the local government's policies, migrants will move to the cities which offer the best basket of real wages and taxes rates, thereby maximizing their

personal utility. We thus explicitly introduce the idea that the pattern of human migration is affected by the differential local tax systems (Tullock, 1971) and the bundles of services and taxes offered by the local governments (Tiebout, 1956).

Migration to the cities in the search of better opportunities and higher earnings is common among rural residents but migration to regions closer to the region of origin is much more common than longer-distance migration. Rural-urban migrants prefer shorter-distances as migration do not come without a cost. Migration to the city though beneficial is associated with emotional, physical, and psychological costs, sometimes requiring social networks in the city and financial support from the rural communities to get settled (Zhang and Zhao, 2011). We assume the migration cost function to be symmetric across the cities. There are two costs associated with the decision to migrate, a fixed cost F and a variable cost that depends on the total migrants migrating to the city in question at a given time from the migrant's region of origin. The cost of migration[5] includes the psychological cost of moving from the vicinity of the family and social circle and the cost of transportation, cost of job search, establishment cost, and the high fees that the township or village authorities charge to provide the necessary documents required for migration, etc. Each individual migrant weighs the real benefits against the cost of moving to each of the cities and then decides on the destination city. (Schwartz , 1973; Robinson and Tomes, 1982)

Net real compensation earned by each migrant in each of the k cities will be $W_k(1-\tau_k)$ - ϕ, where $\phi = F + aL^M$ is the cost associated with the migration decision, where a is the marginal cost of migration. An additional assumption here is that ϕ is equal to zero if an individual moves to the city that is closest to it, so that he can work from home and this decision cost him nothing as there is no migration away from home in the real sense. However if he decides to go to the other city he incurs a cost of $\phi > 0$ which is independent of the direction of the resulting migration as the cities are equidistant from the other city's countryside. This assumption captures the income-distance tradeoff implicit in the search for the potential destination. The individuals compare the expected income from each of the potential destinations and moves to the city that helps him attain the highest utility.

If faced with the same net migrant compensation at both the destinations the migrant breaks the tie by moving to the city closest to his place of registration thereby demonstrating his bias for shorter distances. Individual j from the rural neighbourhood of city A will choose to migrate to city A over city B iff

[5] We assume that the individuals who decide to migrate have zero opportunity costs in the rural subsistence sector (a simplifying assumption). Here, the opportunity costs of migrants back home is taken to be zero, which means that these are surplus labourers in the rural areas with zero marginal product of labour and they represent the open unemployed.

$$W_A(1-\tau_A) \geq W_B(1-\tau_B) - \phi \tag{8}$$

when this condition holds with equality the potential migrant is indifferent between the outcomes from the two cities and decide to commute from home to the nearest city at no cost.

On the other hand individual j will migrate to city B iff

$$W_A(1-\tau_A) < W_B(1-\tau_B) - \phi \tag{9}$$

holds. Similar conditions are true for the individuals of the rural neighbourhood of city B as well due to the symmetric nature of the decision of the potential migrants in both the cities, only the subscripts change from A to B and vice versa. Individuals migrate to city B as long as condition 9 holds. Cross border mobility from one region to the other will tend to equalize the net migrant compensation in both the cities. In equilibrium

$$W_A(1-\tau_A) = W_B(1-\tau_B) - \phi \tag{10}$$

holds and no one moves from city A's suburbs to city B. As $\phi = F + aL^M$ by definition, substituting for ϕ in the equilibrium condition in equation 10 yields,

$$W_A(1-\tau_A) = W_B(1-\tau_B) - F - aL_B^M \tag{11}$$

where L_B^M is the out migration from the rural outskirts of city A to city B. In equilibrium migration will be positive as long as $F/a < 0$. Here we will assume that $F < 0$ and $a > 0$ so that a stable equilibrium exists and out migration is positive in equilibrium even when the real migrant compensation in both the cities is same. F can be defined as the fixed negative cost or an initial level of fixed benefits associated with migration, this could be the benefits from social capital or other government privileges which benefits the rural to urban migrants at the time of migration and is assumed to be the same for all individuals. However, a the marginal cost of migration is positive and includes variable costs like transportation, establishment, accommodation, etc. So, there are some initial negative costs or benefits available for potential migrants but the added advantage disappears as more and more migrants move in from the rural areas, competing for jobs, and cheap accommodation, etc.

Rearranging the equilibrium condition derived from the migration decision of rural residents migrating from the countryside of city A to city B we get

$$L_B^M = \mu W_B(1-\tau_B) - \mu W_A(1-\tau_A) - \mu F \tag{12}$$

L_B^M is thus the number of migrant labourers that city B will receive from city A's countryside in equilibrium where $\mu = \frac{1}{a}$, the inverse of the marginal cost of migration in the model. Here, μ is the number of migrants that can migrate from the countryside with a unit cost. The lower the marginal cost of migration, the higher is the number of migrants that can migrate with one unit of cost. The assumption that $a > 0$ ensures that the immigration of migrants into city B will be positive in equilibrium. By symmetry, we find the out migration from city B's outskirts to city A and denote it by L_A^M.

$$L_A^M = \mu W_A(1 - \tau_A) - \mu W_B(1 - \tau_B) - \mu F \tag{13}$$

As we have normalized the total migrants that initially decided to migrate from the rural regions of both the cities to one, the total migrants that immigrate to city A can be denoted by L_A^{MT}

$$L_A^{MT} = 1 - L_B^M + L_A^M \tag{14}$$

the summation of migrants that relocate from city A's outskirts to city A and those that move from city B's outskirts to city A.

Due to symmetry between the two cities the total migrant labour supply in city B in equilibrium will be

$$L_B^{MT} = 1 - L_A^M + L_B^M \tag{15}$$

In equilibrium anyone who had decided to migrate initially actually migrate either to destination A or B receiving a real compensation of $W_A(1 - \tau_A)$ from their employment in city A or $W_B(1 - \tau_B)$ from city B post migration. The schematic representation of the inter-regional labour migration, in post-reform China with open borders and a relaxed hukou is presented in figure 1.

Substituting for $L_A^M$and L_B^M, the total migrant labour supply of city A and city B in equation 14 and 15 can be rewritten as

$$L_A^{MT} = 1 + 2\mu W_A(1 - \tau_A) - 2\mu W_B(1 - \tau_B) \tag{16}$$

$$L_B^{MT} = 1 + 2\mu W_B(1 - \tau_B) - 2\mu W_A(1 - \tau_A) \tag{17}$$

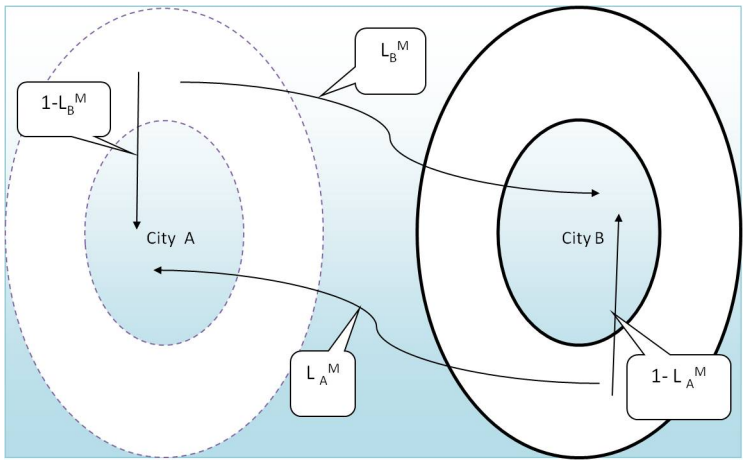

Figure 1: Schematic representation of the inter-regional labour migration in the model, post-reform China

4 The nature of equilibrium under decentralization

The demand for labour is derived from the profit maximization problem of the individual monopolistic firms. The assumption of a single factor of production ensures that the market demand curve for the factor is a simple horizontal summation of the individual demand curves of all the firms. The market labour supply on the other hand is not affected by the fact that firms have monopolistic power in the product market instead it is determined by the summation of the region's urban hukou holders and the migrants moving into the city at the offered wage. Equilibrium wages are determined by the intersection of the market labour demand and supply curves.

Proposition 1. The vector of equilibrium real wages in the cities is a linear combination of the city's initial endowment of urban hukou holders ($L_A^{'}$, $L_B^{'}$).

$$W_A^* = x(1 + L_A^{'}) + y(1 + L_B^{'}) \tag{18}$$

$$W_B^* = x(1 + L_B^{'}) + y(1 + L_A^{'}) \tag{19}$$

Proof. Follows directly from the equilibrium in the labour market. See the appendix.□□

Proposition 2. The cross effect dominates the own effect and a unique and stable equilibrium exists for the model if the condition $4\mu A(1-\sigma) > 3n$ holds.

Proof. See the appendix. □□

The parameter x in this model is defined as the own effect. i.e the effect of the city's own initial endowment of urban hukou holders on its equilibrium real wage while y on the other hand is the cross

effect . With a higher endowment of initial hukou holders, each city's labour demand will be higher and the equilibrium real wage in the city will also be high, so the own effect is always positive. On the other hand when the other city has a larger initial endowment of urban hukou holders, the equilibrium real wage in that city will be higher due to the positive own effect. With higher equilibrium real wages in the other city, less and less migrants will have an incentive to move to this city, total labour supply will fall and equilibrium wages will be higher in equilibrium in here. From the equilibrium in the labour market and the stability conditions, we can derive the signs for both the own and the cross effect and the cross effect always dominates the own effect.

As the city government's only concern is the welfare maximization of it's urban citizens, the balanced budget condition of the regional governments derived in equation 5 reduces the benefit maximization problem of the local authority to a rent maximization problem. Given the profits of the firms in the city, the welfare maximization problem and the revenue maximization problem is like two sides of the same coin. The rent-seeking regional government of city A thus can maximize the real revenue or rents accrued from the taxation of it's migrants by choosing a suitable tax rate τ_A given the tax rate of the other city. The revenue maximization problem of the local government of city A is thus

$$\underset{\tau_A}{max} \;\; RE_A = L_A^{MT} W_A \tau_A \tag{20}$$

The regional authorities of both the cities in this model face a similar revenue-immigration trade-off in their attempt to maximizing rents due to their strategic interdependence. If the tax rate is zero total tax revenues collected by the city will be zero, thereafter increasing with an increase in the migrant tax rates until the rent seeking activities are carried too far to eliminate the incentives to migrate to this city, thereby reducing immigration and tax revenues. Migrant tax revenue thus is highest at the point where the laffer curve reaches its maximum, at the optimum tax rate τ^*, and any point to the left and to the right is suboptimal and tax revenue can be enhanced by altering the tax rates. Due to our assumption that once migrants relocate they choose to provide one unit of labour, i.e. there is no labour-leisure choice the shape of the Laffer curve in our analysis is determined solely based on changes in the direction of the migration[6].

The interdependent migrant labour supply of the cities permit a translation of the optimality conditions derived from the revenue maximization problem of the regional authorities into best response functions. If any city increases (decreases) its tax rate the optimal strategy for the other city will be to follow suit and increase (decrease) its tax rate. Each individual city's attempt to maximize the migrant tax revenue

[6]It is not based on any income and substitution effects like the standard public finance Laffer curve which works through the relative strengths of these effects

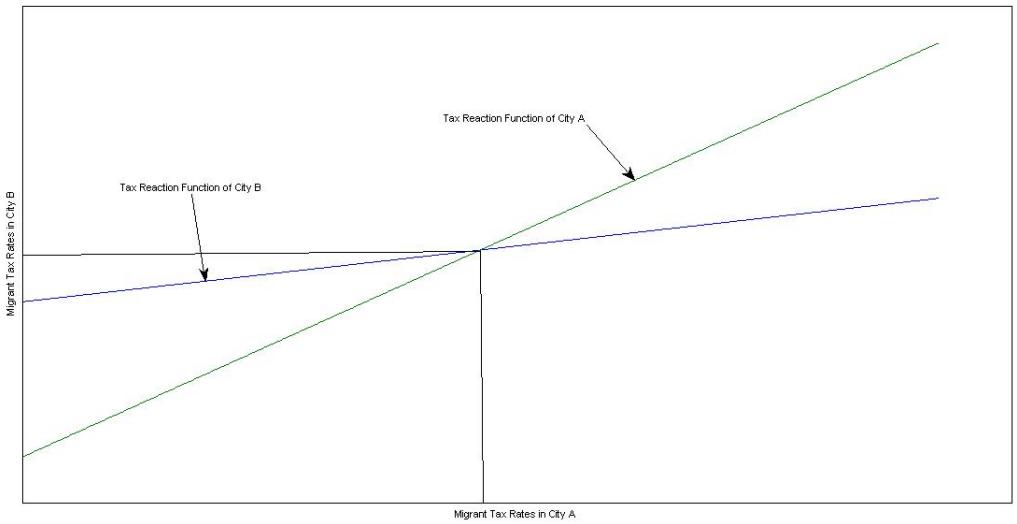

Figure 2: Determination of Equilibrium Migrant Taxes

for it's urban hukou holders will result in the cities engaging in wasteful competition undercutting each other to obtain a larger share of the pool of migrants until they reach the equilibrium.

In this model, the strategies available to each city government is the different tax rates that it can impose on its rural to urban migrants. Simultaneously solving the two migrant tax reaction functions (as in figure 2) derived from the revenue maximization problem of the local governments we get the equilibrium migrant tax rates in both the cities, which is also the unique Nash Equilibrium of the model. In this two city game, the strategy pair (τ_A^*, τ_B^*) is a Nash Equilibrium as for each local authority k, $RE_k(\tau_k^*, \tau_{k'}^*) \geq RE_k(\tau_k, \tau_{k'}^*)$ and at this equilibrium there is no incentive for any of the regional authorities to deviate. The tax function $G: R^2 \longmapsto R^2$ is defined by equations 21 and 22. The domain of G being the first quadrant, i.e.R_+^2, as negative wages are economically meaningless and the target space of G is R^2, the image of G is the set of negative and non-negative numbers as we do not strike out negative migrant tax rates in our model, which can be a possible outcome of our model and will be discussed next. We will assume that tax rates are continuously divisible so that each city's strategy space can be represented as $S_i = (-\hat{t},1)$, the balanced budget condition of the government determining the level of $\hat{t}$ in equilibrium. Both negative and positive values of taxes are thus possible, with the payoff being the tax revenue that the city collects.

Proposition 3. The vector of equilibrium migrant tax rates in the cities is a non-linear function of the equilibrium wage rates

$$\tau_A^* = (3 + 2\mu W_A^* - 2\mu W_B^*)/(6\mu W_A^*) \tag{21}$$

$$\tau_B^* = (3 + 2\mu W_B^* - 2\mu W_A^*)/(6\mu W_B^*) \tag{22}$$

Proof. Follows directly from simultaneously solving the two best response functions. See appendix. □□

The migrant tax rate pair (τ_A^*, τ_B^*) is a Nash Equilibrium for each city k, the tax rate τ chosen by the city government maximizing the revenue generated, given the other city's migrant tax rate. Models of competition among groups resulting in Cournot-Nash equilibrium has also been used by Brock and Magee (1975, 1978), Stigler (1975), Findlay and Wellisz (1981) and Becker (1983).

The rent collected by the regional governments in the first stage of this two stage game is distributed among the identical urban hukou holders according to a preset distribution rule. The rent displays characteristics of a public good in the first stage but a private good in the second stage, with rent dissipation depending on the relative size of the group and the distribution.

Proposition 4. Competition between regional governments under decentralization leads to welfare enhancing outcomes for the city's migrants compared to a coordinated approach .

Proof. See the appendix for the detailed discussion.□□

Cross border mobility of the tax base coupled with tax competition among the regions thus lead to welfare-enhancing outcomes for the migrants compared to the situation/s where migration is non-existent or the cities face a coordinated rent seeking approach of the central government. Tax competition under decentralization will force the local governments to undercut each others tax rates in an attempt to attract a larger pool of the mobile tax base, thereby reducing rents and discrimination[7] against migrants (Oates, 1972; Zodrow and Mieszkowski, 1986; Wilson, 1986; Wildasin, 1989 and Janeba and Peters, 1999).

As a representative individual maximizes his own utility function subject to his budget constraint. The first order condition from the utility maximization problem is given as $u'(\bar{c}) = \lambda p$ where λ is the shadow price on the budget constraint, which can also be interpreted as the marginal utility of income.. If the number of goods produced is sufficiently large, then each firm's pricing policy will have a negligible effect on the marginal utility of income, and λ can be taken to be a constant. Summing the demand curves over all the individuals in the city the market demand facing an individual firm in the city can be represented by $p = \lambda^{-1}u'(x/L)$ following Krugman (1979). The first order condition of the profit maximization problem of the firms, $MR = MC$ can be rewritten as $p = p(W)$ and the labour market

[7] Discrimination against the migrants or the wage gap in this paper is denoted as Δ and is defined as the difference between the compensation received by the urban hukou holders and the migrants. So, discrimination (in real terms) in city k will be $\Delta = W_k + b_k - W_k(1-\tau_k) = b_k + W_k\tau_k$. Narrowing of the earning gap and reduction in discrimination can be used interchangeably, as they refer to the same thing.

equilibrium real wages in equations 18 and 19 can be rewritten as $W = \frac{w}{p}$. Prices and nominal wages can then be determined by simultaneously solving the labour and product market equilibrium of the model.

The migrants thus receive a (nominal) wage of w^* in equilibrium, pay a tax of $w^*\tau^*$ to the local authorities as part of their individual tax liabilities, thereby having a take home nominal income of $w^*(1-\tau^*)$, the nominal migrant compensation. The urban hukou holders however receive a benefit or subsidy in equilibrium from the regional government which pushes their take-off income or urban nominal compensation to $(w+b')^*$ where b'^* is the nominal value of b^*. Discrimination measured as the difference between hourly urban and migrant compensation,$\triangle$ will be $(w+b')^* - w^*(1-\tau^*) = b'^* + w^*\tau^*$ in equilibrium.

4.1 Symmetric and Assymmetric Equilibrium

In this subsection we compare the asymmetric equilibrium with the symmetric equilibrium of the model set up so far. We define the symmetric equilibrium as the case where both the cities have similar endowment of urban local residents, $L_A^{'} = L_B^{'}$ while under the asymmetric equilibrium we report the equilibria in which the initial level of urban hukou holders differ across the cities. From the simulations of the model presented in this paper, we will see that asymmetry in the size of cities can have significant effect on the rent seeking behaviour of the regional governments and the discrimination observed against the migrants.

The equilibrium wages of the two cities as given in equations 18 and 19 is derived from the intersection of the market labour demand and supply curves and is a linear combination of the city's initial endowment of urban hukou holders. Substituting the equilibrium wages back in equations 21 and 22 we get the equilibrium migrant tax rates of both the cities. So, both the equilibrium wages and tax rates in the cities will be a function of the initial urban hukou holders in both the cities, and the parameters n, A, n and μ.

If both the cities start off with identical endowment of hukou holders, they will have the same equilibrium wages, taxes, urban subsidies and also face same level of immigration in equilibrium. Each city in equilibrium will receive only it's own migrants from it's rural countryside and none from the other city's suburbs as faced with the same migrant compensation in both cities, the migrants can always save on the cost of migration by relocating to the nearest city. However, when each city starts off with a different initial endowment of urban labourers they will in equilibrium have different labour demand and supply functions, and wages, migrant tax rates and all other variables may vary across the cities.

Table 1: Mean Hourly Earning and Compensation (Nominal) in different cities in 2008

City of Residence	Hourly Earnings			Hourly Compensation		
	Total Residents	Hukou Holders	Migrants	Total Residents	Hukou Holders	Migrants
Guangzhou	12.74	20.4	7.32	15.38	25.63	8.12
Dongguan	9.36	15.02	5.61	10.84	17.75	6.25
Shenzen	13.16	19.6	7.46	15.1	23.12	8
Zhengzhou	6.99	10.44	4.66	8	12.8	4.76
Luoyang	6.63	9.09	4.66	7.65	11.36	4.68
Hefei	8.82	11.4	5.79	10.28	14.02	5.88
Bengbu	5.92	6.74	5.27	6.54	8.04	5.33
Chongqing	6.71	9.52	4.69	7.72	11.65	4.89
Shanghai	12.35	17.73	7.65	15	23.27	7.79
Nanjing	9.97	13.52	7.03	11.8	17.08	7.42
Wuxi	9.47	11.13	8.22	11.58	13.84	9.88
Hangzhou	12.01	17.5	7.51	14.03	21.17	8.2
Ningbo	10.67	15.39	6.41	12.95	19.68	6.85
Wuhan	8.71	12.6	5.86	9.96	15.19	6.12
Chengdu	7.15	9.63	5.78	7.9	11.57	5.87

5 Parametrization

The empirical study discussed in this section is based on the data collected by the Rural Urban Migration in China and Indonesia (generally referred to as RUMiCI) project established in 2006 to conduct a five-year longitudinal survey in China and Indonesia. Three independent surveys were conducted to investigate the impacts of internal migration within China and Indonesia, however, for the purpose of this paper we will focus mainly on the Urban Household and Migrant Survey for the first two years from China. The Urban Household Survey covers 5000 households in 19 cities whereas the Urban Migrant Survey spans a total of 5000 households from 15 cities.

Employers in the Chinese cities are required by law to contribute a certain proportion of their employees annual wage bill into the "Five Insurances, One Fund" to be paid out later to the employees in the form of insurance payments. In our analysis, we consider six types of insurance payments to arrive at the annual compensation of the urban residents[8].Hourly earnings and compensation is calculated by deflating the

[8] As a rule of thumb, employers are required by law to pay 20% of the worker's wages towards pension, 1% for work injuries, 8% for medical insurance, 2% for unemployment insurance, and 5% for housing fund and less than 1% for maternity insurance; however insurance payments in the cities differ widely due to the lack of enforcements. In our analysis, we consider six types of insurance payments to arrive at the total insurance payments made by the individual employer which are then added to the annual wage earnings to arrive at the annual compensation of the urban dwellers. The employer contribution has been valued equally with actual wages on the assumption that the cost of insurance to employers translates into an equivalent expected benefits to employees following Frijters et al. (2008).

Table 2: Percentage of urban hukou holders and migrants insured in different cities of China in 2008

City of Residence	Percentage of Individuals with Employer provided Insurance			
	Unemployment Insurance		Pension Insurance	
	Urban Hukou Holders	Migrant Wage Earners	Urban Hukou Holders	Migrant Wage Earners
Guangzhou	56.38	25	66.94	29.33
Dongguan	40.39	29.68	60.78	39.58
Shenzhen	42.5	5.55	58.18	29.62
Zhengzhou	48.47	2.06	64.74	3.44
Luoyang	53.96	1.19	65.34	1.58
Hefei	54.48	3.77	67.94	5.03
Bengbu	48.9	4.82	51.64	6.14
Chongqing	46	5.68	60.75	14.49
Shanghai	83.8	3.27	87.9	4.52
Nanjing	66.41	13.23	73.18	16.8
Wuxi	69.71	50.18	76.92	51.26
Hangzhou	64.87	11.32	74.7	25.71
Ningbo	70.48	14.34	78.41	19.12
Wuhan	49.57	8.52	62.25	14.13
Chengdu	43.91	2.88	61.25	3.71

total annual variables using the hours worked in a year. We choose hourly variables for our comparison because annual or monthly variables are highly sensitive to the hours worked in a day. Migrants were found to work 42% more on average than the urban residents and this could result in a downward bias in the wage gap if hourly variables are not considered. Hourly earnings for urban hukou holders are more than twice of that of the migrants during both the waves, whereas the urban hourly compensation was found to be as much as three times the migrant hourly compensation. Hourly wages and compensation not only varied within cities between the two groups of residents, but large differences were also found across cities a quarter of which could not be explained by individual or household characteristics (Frijters.et.al, 2009; Pakrashi and Frijters, 2012). Discrimination measured as the difference between urban and migrant compensation was found to be as high as 17.51 and 15.48 yuans in Guagzhou and Shanghai respectively. This is in sharp contrast to cities like Wuxi and Bengbu, where migrant workers were actually treated 20% better than their equivalent urban counterparts in the labour market (Frijters.et.al,2009).

Not only the wages but also the insurance payments varied widely across regions as most of the regional governments failed to enforce the labour market regulations regarding insurance payments. There is a large variation across cities in the percentage of people with access to employer provided insurance benefits. Whereas 69% of the urban hukou holders had access to pension insurance in 2008, it was just about 18%

Table 3: Parameters of the Model

Calibrated values for Parameters					
A	μ	n	σ	λ	α
9.9990	3.9563	10.0003	0.7607	1.4028	2

Derived values* for Parameters					
a	ξ	γ	$\xi^2 - \gamma^2$	x	y
0.2528	-0.5478	2.6375	-6.6563	0.0823	0.3962

for the migrants. Similarly, 58% of the urban hukou holders had unemployment insurance compared to just 12% for the migrants, working longer hours under harsher conditions. About 84% of urban hukou holders in Shanghai were found to have access to employer provided unemployment insurance compared to only 3% of the migrants. Wuxi however seem to treat their migrants better than the other cities with about 50.18% and 51.26% of the migrants being covered under employer provided unemployment and pension insurance respectively.

Urban population data from the World Urbanization Prospects: The 2007 Revision Population Database has been used in the simulations of the model. Population (in thousands) for all the Chinese cities for the year 2005 is taken from the database and extrapolated forward for the years 2008 and 2009 using the average urban growth rate of 2.7% for the period 2005-2010. The sample proportion of individuals with local urban hukou holders in the RUMIC data set is then used to estimate the population of urban hukou holders in these Chinese cities.

The variables of interest in this paper are hourly wage earnings, urban and migrant compensation. Discrimination, urban benefits and migrant taxes are estimated from the observed values using the specifications of our model. Once we have the data we need for the purpose of our analysis, we calibrated the model to the data set using the lsqnonlin[9] command in MATLAB. It is important to note over here that Guangzhou has been used as the benchmark region for the calibration technique, i.e. all the variables are calculated relative to the observations for Guangzhou. The parameter values for $\{n, A, \mu, \sigma, \lambda, \alpha\}$ obtained from the calibration methodology are presented in table 3.

The results of the calibrated model along with the observed and estimated variables from the data are presented in table 4 together with the goodness of fit measures. We have provided four different indicators to prove the hypothesis that the model fits the data quite well, each of which seem to provide support to

[9]The lsqnonlin command that we used in this paper fits the data to the model and generates the set of parameters that minimizes the sum of squares of difference between the (real) observed or estimated observations and the expected outcome from the model. We obtain the real variables used for the calibration of this model by deflating the nominal variables with a suitable cost of living index (Cebula, 1978), thereby controlling for any geographical differences in cost of living. The cost of living index is constructed from the RUMIC data set to compare the cost of maintaining a certain standard of living in different geographical areas of China based on the monthly household expenditure required to buy a basket of goods and services consisting of food, clothing and housing.

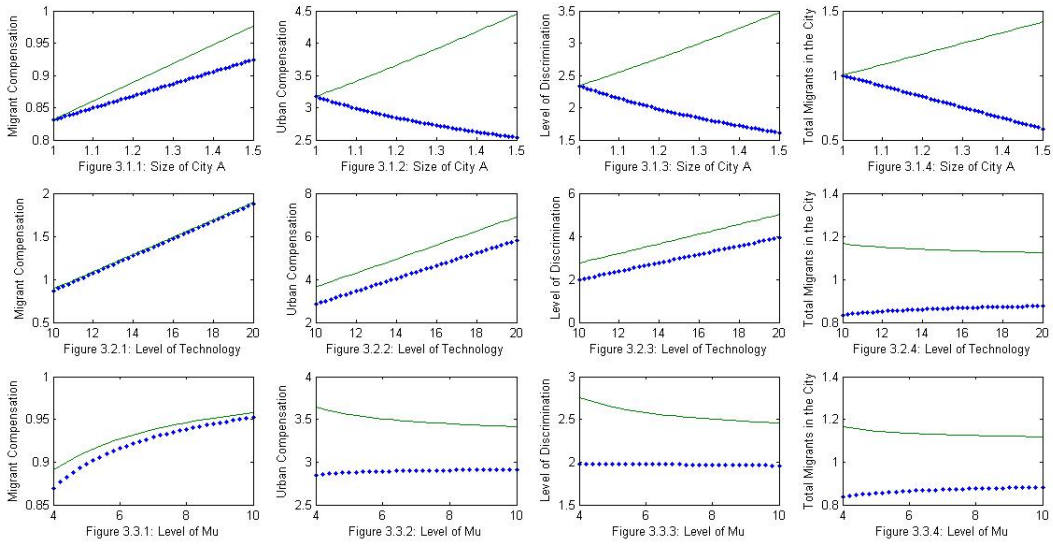

Figure 3: Simulations of the model (Real variables).

our claim.

Using the calibrated version of the model as the starting point we now consider departures away from the base case to understand the effect of changes in the parameters on the equilibrium values of the model.

6 A Numerical Example

While we were able to find the equilibrium wages, taxes, benefits, compensation and total migrants, we were unable to sign the direct and indirect effects of the changes in the various parameters on the equilibrium outcomes. The significance of these effects are thus explored with numerical examples below. The variables of interest considered for comparative statics in our model are the equilibrium real wages, migrant and urban compensation, and total immigration into the city. As a benchmark, we choose $\{n = 10.0003,\ A = 9.9990,\ \mu = 3.9563,\ \sigma = 0.7607,\ \lambda = 1.4028,\ \alpha = 2\ \}$. Here we assume a special case of the generalized model, with $\alpha = 2$ to arrive at nice closed form solutions.

Beginning from the first principles of this paper the comparative static properties of a selected endogenous outcomes in equilibrium will be derived graphically. Unless specified otherwise city A over here is the large city with an initial endowment of $L_A^{'} = 1.2$ while city B is the small city with $L_B^{'} = 1$ and the selected endogenous outcomes reported in figure 3 are represented with a dotted line for city A and with a continuous line for city B .

Table 4: Observed and Predicted Hourly (Real) variables for the year 2008

City of Residence	Wage Earning		Migrant Compensation		Urban Compensation		Discrimination		Urban Benefits		Migrant Tax Rates	
	Observed	Predicted	Observed	Predicted	Observed	Predicted	Estimated	Predicted	Estimated	Predicted	Estimated	Predicted
Guangzhou	12.74	12.19	8.12	8.36	25.63	25.39	17.51	17.03	12.89	13.20	0.36	0.31
Dongguan	11.37	11.66	7.59	8.30	21.56	20.81	13.97	12.50	10.19	9.15	0.33	0.29
Shenzen	13.37	12.31	8.13	8.37	23.49	23.29	15.36	14.92	10.12	10.99	0.39	0.32
Zhengzhou	12.39	11.50	8.43	8.29	22.68	22.84	14.25	14.55	10.30	11.34	0.32	0.28
Luoyang	11.97	11.39	8.45	8.27	20.51	20.67	12.06	12.39	8.54	9.27	0.29	0.27
Hefei	12.07	11.50	8.05	8.29	19.19	19.05	11.14	10.77	7.12	7.55	0.33	0.28
Bengbu	9.55	11.28	8.60	8.26	12.97	13.27	4.37	5.01	3.42	2.00	0.10	0.27
Chongqing	8.85	12.07	6.45	8.35	15.37	13.54	8.92	5.20	6.52	1.48	0.27	0.31
Shanghai	12.86	13.46	8.11	8.49	24.23	23.92	16.12	15.43	11.37	10.45	0.37	0.37
Nanjing	12.19	11.69	9.07	8.31	20.88	21.53	11.81	13.22	8.69	9.84	0.26	0.29
Wuxi	11.50	11.35	12.00	8.27	16.81	20.33	4.81	12.06	5.31	8.98	-0.04	0.27
Hangzhou	13.75	11.58	9.39	8.29	24.23	25.17	14.85	16.88	10.48	13.59	0.32	0.28
Ningbo	12.80	11.44	8.21	8.28	23.60	23.55	15.39	15.27	10.80	12.11	0.36	0.28
Wuhan	13.47	12.17	9.46	8.36	23.49	24.55	14.03	16.20	10.02	12.38	0.30	0.31
Chengdu	9.39	11.64	7.71	8.30	15.19	14.43	7.48	6.13	5.80	2.79	0.18	0.29
Mean test	-0.0264		0.5797		-0.8213		-0.6960		-0.3424		-0.9587	
Goodness of Fit (χ^2)	6.7422		4.7855		1.6589		13.3925		38.616		0.9839	
Pearson Correlation	(0.6106)*		0.2737		(0.9770)*		(0.8876)*		(0.8930)*		(0.5286)*	
Spearman Correlation	(0.5915)*		0.1982		(0.9666)*		(0.8968)*		(0.8950)*		(0.5795)*	

Source: RUMiCI dataset.

Footnote: Discrimination is defined as the difference between urban compensation and migrant compensation. Discrimination (Δ) is $b + W\tau$.

The Null hypothesis for the Mean test is equality of two means. The t values are provided. Critical value is 2.05 with 29 d.f at 5% level. Fail to reject null hypothesis.

The Pearsonian Chi-square tests if the data is in agreement with the model predictions. The critical value of the $\chi^2$is 45.72 with 29 d.f at 5% level. We fail to reject null of good fit.

Null hypothesis for correlation is independence between the observed and the predicted. Correlations are given in brackets. * is significant at 1% level. Reject null of no association.

The estimated values are author's calculations from the observed values based on the model presented in this paper.

6.1 The Impact of Exogenous changes

6.1.1 Changes in the Size of the City

We begin the comparative statics by studying the effect of changes in the size of the city or the initial endowment of hukou holders on the variables of interest of this model. We set the initial size of both the cities at 1 (the case of symmetry) and then allow the size of city A to increase slowly relative to that of city B (asymmetric case) from 1 to 1.5. As discussed earlier we have normalized the pool of potential migrants in each city to one so that the total migrant labour supply that the cities receive in equilibrium always adds up to a total of 2, with each receiving a share of the total.

At ceteris paribus a relative increase in the size of city A (relative to that of city B) causes i) an increase in migrant compensation, ii) lowers urban compensation, iii) reduces the level of discrimination, and iv) decreases the total migrants in city A. The results will however be quite different in city B in equilibrium, while migrant compensation increases in city B as well, urban compensation, level of discrimination and total migrant supply will increase in city B, the relatively smaller city. So, there will be a redistribution of migrant labourers from region A to region B in equilibrium.

Corollary 1. Under specific conditions, competition between rent-seeking regional governments may lead to negative taxes in equilibrium for the migrants, which will result in benefits for the migrants similar to the urban counterparts with the same characteristics.

Proof. The proof follows directly from Proposition 3. See appendix. □□

The presence of a very small city (relative to the size of the other city) may lead to significant decline in discrimination against the migrants in the larger city, with the possibility of even negative migrant taxes under the conditions specified in the proof of corollary 1. If city B is relatively very small compared to city A, for example if $L_B^{'} = 0.2$ and $L_A^{'} = 1.6$ then fierce competition between rent seeking local governments may force the large city to charge a negative tax to it's migrants to induce migration into the city, thus eliminating any trace of discrimination faced by the migrants.

6.1.2 Technological Innovations

In this subsection discuss the effects that technology will have on the equilibrium values of the endogenous variables. There is an increase in the level of technology, A from 10 to 20 in both the cities over here compared to the benchmark model. It is important to note over here that the two cities only differ in the initial endowment of urban hukou holders with city A being the larger city with $L_A^{'} = 1.2$ and city B the smaller one.

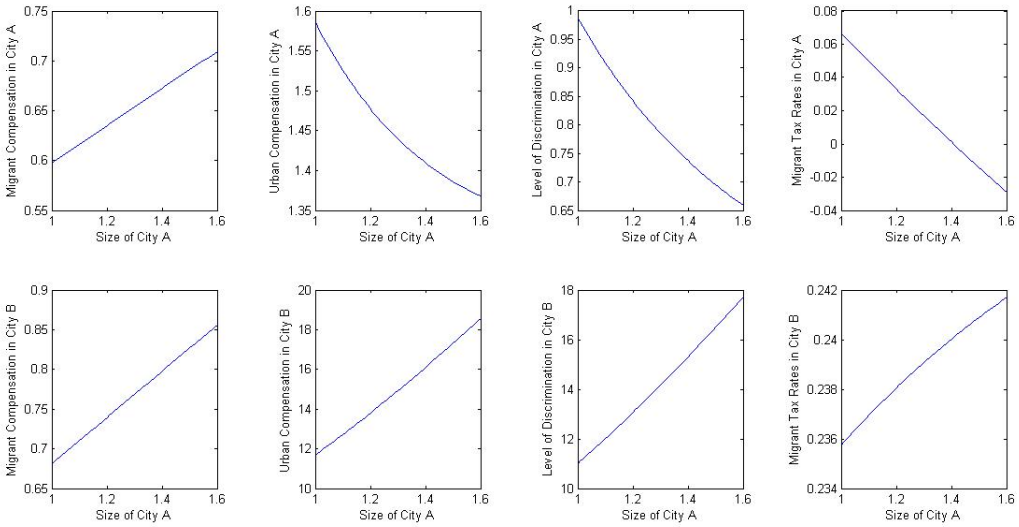

Figure 4: Special case of Negative Migrant Taxes (Real variables)

An increase in the level of technology at ceteris paribus has a positive effect on migrant and urban compensation, and also increases the level of discrimination in both the cities. Innovation however has an opposite effect on immigration in both the cities. Migrants prefer the larger city as migrant compensation is comparatively higher over here, thereby leading to a marginal redistribution of migrants in equilibrium. Continued innovation seems to be a matter of great concern as it significantly increases discrimination in both the cities.

6.1.3 Falling Marginal Cost of Migration

Urbanization and economic development has almost always been associated with an increase in investment in the development of infrastructure, resulting in significant decline in the cost of migration. We try to model such a change in this framework by considering the effect of a declining marginal cost of migration on the endogenous outcomes[10].

Here μ, the number of migrants that can migrate with a unit cost increases from 4 to 10 and so a , the marginal cost of migration falls from 0.25 to 0.1. An increase in μ or a decline in the marginal cost of migration between both the cities at ceteris paribus, has interestingly opposite effect in both the cities. It increases the migrant compensation in both cities, but leads to a marginal decline in urban compensation and the level of discrimination in the larger city. However, the decline in urban compensation and the level

[10]We have assumed cost of transportation,and establishment under costs of migration to observe the effect of changes in the marginal cost of migration on the endogenous variables. As $\mu = 1/a$, increases in μ is the same as declining marginal cost of migration between cities.

of discrimination is significantly higher in the smaller city. Migrant labour supply marginally increases in the larger city but falls in the smaller one due to the presence of comparatively higher levels of migrant compensation in the larger city.

7 Conclusion

We set up a political economy model of migration in China where prospective migrants from the rural countryside "vote with their feet", moving to the city that maximizes their utility. The formal link established in this paper between the migrant labour supply functions of the two cities is able to explain the large differences in hourly compensation and the changing attitudes towards the migrants. Quite contrary to popular belief that decentralization of power from the central to the local authorities has far perpetuated hukou based barriers rather than attenuating them (Litao and Li, 2006), we find that devolution of fiscal and administrative powers allowing considerable control to the local authorities regarding both hukou and non-hukou based migration can under certain conditions succeed in eliminating all discrimination against the migrants, by encouraging tax competition among rent seeking regional governments.

The essence of the model is that it is able to explain the large variations in compensation across regions and the "race to the top" phenomenon with only differences in the initial size of the cities defined in terms of the level of urban hukou holders. This paper suggests that there is, in fact, a strategic solution to the problem of discrimination embedded in the critical role that city size and marginal cost of migration play. While technological innovation poses a threat of higher discrimination in the cities, creation of smaller autonomous cities along with investments in infrastructure development that will eventually ease migration can be successfully used as tools to combat discrimination under decentralization.

We argue that the "race to the top" phenomenon observed among the cities is driven undoubtedly by the tax competition between rent-seeking regional authorities whose only objective has been welfare maximization of their local urban hukou holders. Altruism towards the migrant workers of the cities does not seem to play an important role in this context. The main contribution of the paper was infact derived under the assumption that migrants are still being treated as second class citizens and their welfare is not being directly considered in the utility maximization problem of the city governments.

Though based on the political economy of migration in China, this model of cross-border mobility of rural to urban migrants can also be applied to understand the dynamics of international migration where immigrants are often treated differently from the citizens. Our model of migration justifies the importance of fairer treatment of migrants in the wake of volatile migration and the increasing global demand for

skilled labour.

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8 Appendix

8.1 Generalization

The equilibrium wages that was derived in Proposition 1 is a special case of the generalization which makes no qualitative impact on the results but provides simple closed form solutions to the model. So far we have discussed the product market and how product prices are determined under conditions of imperfect condition from the profit maximizing conditions of the firms. Now we need to focus on the factor market with a Cobb Douglas type production function which exhibits increasing returns to scale or decreasing average cost with a single factor of production, labour.

To analyze the hiring decision of an individual representative firm we use the assumption that optimal choice of labour is determined from the first order condition of the profit maximization problem of the firm. As we have assumed that each firm has monopolistic power in the commodity market, with perfect competition existing in the labour market, the representative firm employ labour upto the point that the marginal revenue product of labour is equal to the wage rate. Marginal revenue product of labour is the product of marginal revenue and the marginal product of labour. Summing up the labour demanded by each of the n firms, and equating it to the total labour supply, we find the interdependent labour market equilibrium in both the cities. Simultaneously solving the labour market equilibrium conditions of both the cities we derive the equilibrium real wages in the two cities A and B as a function of the initial endowments of urban hukou holders in them.

Given that the firms produce using a Cobb Douglas type production function with increasing returns to scale, we have

$$x = Al^{\alpha}; \quad \alpha > 1$$

where l is the amount of labour employed by the firm to produce the final product x.

The firm's profit function will then be given by

$$\pi = px - wl$$

where p is the price at which the firm can sell each unit of its product and profits are defined as the difference between total revenue and the total cost of production. Let $x = f(l)$ be the production function

and $p(x)$ the inverse demand function. The revenue function of the firm can then be expressed as

$$R(l) = px = p(f(l))f(l)$$

Thus to maximize profits the firm will have to employ labour upto the point where marginal revenue product of labour is equal to the wage rate, the price of labour. So, the demand curve of a single firm will be identical to the marginal revenue product[11] curve of labour. The first order condition derived from the profit maximization problem of the representative firm is

$$f_l' \left[\frac{\partial p}{\partial x} x + p \right] = MRP_l = w$$

$$p(1-\sigma) \left[A\alpha l^{\alpha-1} \right] = w$$

Rearranging the first order condition from the labour market, we can write the total labour demanded by a single firm as

$$l_A^D = \left[\frac{W_A}{A\alpha(1-\sigma)} \right]^{\frac{1}{\alpha-1}}$$

As labour is the only factor of production in our analysis we can derive the market demand curve for labour in city A by horizontally summing all the individual firms demand curve for labour. So, the market labour demand can be represented by

$$L_A^D = n \left[\frac{W_A}{A\alpha(1-\sigma)} \right]^{\frac{1}{\alpha-1}}$$

The migrant labour supply to city A is,

$$L_A^{MT} = 1 + 2\mu W_A(1-\tau_A) - 2\mu W_B(1-\tau_B)$$

Combining it with the total urban hukou holders of the city, we can denote the total labour supply in city A as

$$L_A^s = 1 + L_A' + 2\mu W_A(1-\tau_A) - 2\mu W_B(1-\tau_B)$$

[11] VMP is the value of the marginal product of labour, price multiplied by marginal product of labour. Under imperfect competition as $MR < p$ it follows that $MRP_l < VMP_l$, the MRP of labour therefore lies below the VMP. As $w = MRP < VMP$, each factor will receive a price less than the value of its marginal product of labour and this difference is called monopolistic exploitation of labour.

We know that equilibrium in the labour market is determined by the equality between the market labour demand and the labour supply curves. Under the full employment condition, the labour market should clear at the equilibrium wage. So in equilibrium

$$L_A^d = L_A^s = 1 + L'_A + 2\mu W_A(1-\tau_A) - 2\mu W_B(1-\tau_B)$$

Substituting for the labour demand function we can rewrite the labour market equilibrium of city A as

$$W_A = A\alpha(1-\sigma)\left[\frac{3+3L'_A+2\mu W_A - 2\mu W_B}{3n}\right]^{\alpha-1}$$

Rewriting this we get,

$$2\mu W_B + 3n\left[\frac{W_A}{A\alpha(1-\sigma)}\right]^{\frac{1}{\alpha-1}} - 2\mu W_A = 3(1+L_A^{'})$$

We derive the General case over here $\forall\alpha$

By Taylor's expansion we get

$$2\mu W_B + 3n\left[\frac{W_A}{A\alpha(1-\sigma)}\right]^{\frac{1}{\alpha-1}} - 2\mu W_A - 3(1+L_A^{'}) \simeq 2\mu W_B + 3n\left[\frac{1}{A\alpha(1-\sigma)}\right]^{\frac{1}{\alpha-1}}\left(\frac{\alpha-2}{\alpha-1}\right) + 3n\left[\frac{1}{A\alpha(1-\sigma)}\right]^{\frac{1}{\alpha-1}}\frac{W_A}{\alpha-1} - 2\mu W_A - 3(1+L_A^{'})$$

Rearranging the above expanded labour market equilibrium we get

$$2\mu W_B + zW_A = 3(1+L_A^{'}) - m$$

Similarly the other equation derived from linearizing the labour market equilibrium condition in city B we get

$$2\mu W_A + zW_B = 3(1+L_B^{'}) - m$$

where

$$z = 3k - 2\mu;$$

$$m = 3k\,(\alpha - 2)\,;$$

$$k = \frac{n}{\alpha - 1}\left[\frac{1}{A\alpha(1-\sigma)}\right]^{\frac{1}{\alpha-1}}$$

The interdependence of the migrant labour supply functions result in the interdependence in the labour market equilibrium conditions of the two cities. Simultaneously solving both the equilibrium conditions we get the equilibrium wages in both the cities,

$$W_A^* = \left[\frac{3z}{z^2 - 4\mu^2}\right](1 + L_A^{'}) - \left[\frac{6\mu}{z^2 - 4\mu^2}\right](1 + L_B^{'}) + \left[\frac{2\mu - z}{z^2 - 4\mu^2}\right] m$$

and

$$W_B^* = \left[\frac{3z}{z^2 - 4\mu^2}\right](1 + L_B^{'}) - \left[\frac{6\mu}{z^2 - 4\mu^2}\right](1 + L_A^{'}) + \left[\frac{2\mu - z}{z^2 - 4\mu^2}\right] m$$

We can rewrite the equilibrium wages in cities as

$$W_A^* = x'(1 + L_A^{'}) + y'(1 + L_B^{'}) - m(z + 2\mu)^{-1}$$

$$W_B^* = x'(1 + L_B^{'}) + y'(1 + L_A^{'}) - m(z + 2\mu)^{-1}$$

where

$$x' = \left[\frac{3z}{z^2 - 4\mu^2}\right] = \left[\frac{9k - 6\mu}{9k^2 - 12\mu k}\right]$$

$$y' = \left[\frac{-6\mu}{z^2 - 4\mu^2}\right] = \left[\frac{-6\mu}{9k^2 - 12\mu k}\right]$$

where $x^{'}$ is the own effect and $y^{'}$ is the cross effect of the general model.

8.2 Results and Proofs

8.2.1 Proof of Proposition 1:

The labour market equilibrium conditions of the two cities derived in the generalization subsection are

,

$$2\mu W_B + 3n\left[\frac{W_A}{A\alpha(1-\sigma)}\right]^{\frac{1}{\alpha-1}} - 2\mu W_A = 3(1+L_A^{'})$$

$$2\mu W_A + 3n\left[\frac{W_B}{A\alpha(1-\sigma)}\right]^{\frac{1}{\alpha-1}} - 2\mu W_B = 3(1+L_B^{'})$$

This is the general labour market condition which does not assume any specific value for α, the economies of scale or the elasticity of output to labour. As a system of simultaneous linear equations is not only easy to work with and apprehend but also easy to derive closed form solutions to the model we assume a specific case $\alpha = 2$ and rewrite the equilibrium conditions as

$$\left[\frac{3n-4\mu A(1-\sigma)}{6A(1-\sigma)}\right]W_A + \left[\frac{2\mu}{3}\right]W_B = 1 + L_A^{'}$$

$$\left[\frac{3n-4\mu A(1-\sigma)}{6A(1-\sigma)}\right]W_B + \left[\frac{2\mu}{3}\right]W_A = 1 + L_B^{'}$$

which can also be rewritten as

$$\xi W_A + \gamma W_B = 1 + L_A^{'}$$

$$\xi W_B + \gamma W_A = 1 + L_B^{'}$$

Each city in our model has a specific set of parameters and these parameters are assumed to be identical across cities as this model is structured to be driven entirely by differences in each city's initial endowment of urban hukou holders.

Solving these labour market equilibrium conditions simultaneously we obtain the equilibrium wages in the two cities A and B as a function of the initial endowments of urban hukou holders in the two cities.

$$W_A^* = x(1+L_A^{'}) + y(1+L_B^{'})$$

$$W_B^* = x(1+L_B^{'}) + y(1+L_A^{'})$$

This follows directly from the existence (unique) and stability conditions of the equilibrium real wage.□□

8.2.2 Proof of Proposition 2:

The upward rising market labour demand curve in our model for the cities requires that both the existence and the stability conditions are satisfied for the existence of a stable equilibrium wage in this model. The labour market is said to be in a stable equilibrium position if any deviation from the equilibrium creates market forces such that the previous equilibrium is restored again. We will now consider the conditions that must be satisfied to have a stable equilibrium for this model economy.

The equilibrium will be stable in the Walrasian sense[12] iff

$$\left|\frac{\partial L_A^S}{\partial W_A}\right| > \left|\frac{\partial L_A^D}{\partial W_A}\right|$$

is satisfied. So, the equilibrium will be stable if the absolute value of the slope of the demand curve is lower than the absolute value of the slope of the labour supply curve.i.e. the supply curve should be steeper than the demand curve. So, the labour market equilibrium under the general case is stable in the Walrasian sense when

$$\left[\frac{2\mu}{3} > \frac{n}{(\alpha-1)}\left[\frac{1}{A\alpha(1-\sigma)}\right]^{\frac{1}{\alpha-1}} W^{\frac{2-\alpha}{\alpha-1}}\right]$$

In the special case when $\alpha = 2$ the stability condition is expressed as

$$\left[\frac{2\mu}{3}\right] > n\left[2A(1-\sigma)\right]^{-1}$$

Rearranging this condition we get,

---

[12] The labour demand curve for city A is

$$L_A^D = n\left[\frac{W_A}{A\alpha(1-\sigma)}\right]^{\frac{1}{\alpha-1}}$$

whereas the labour supply curve is given as

$$L_A^s = 1 + L_A' + 2\mu W_A(1-\tau_A) - 2\mu W_B(1-\tau_B)$$

Substituting for the equilibrium values of the migrant taxes in the labour supply function we get

$$L_A^S = \left[\frac{3 + 3L_A' + 2\mu W_A - 2\mu W_B}{3}\right]$$

Differentiating both the labour supply and demand equation in city A with respect to its wages we get,

$$\left|\frac{\partial L_A^D}{\partial W_A}\right| = \frac{n}{(\alpha-1)}\left[A\alpha(1-\sigma)\right]^{\frac{-1}{\alpha-1}} W_A^{\left[\frac{2-\alpha}{\alpha-1}\right]} > 0$$

$$\left|\frac{\partial L_A^S}{\partial W_A}\right| = \left[\frac{2\mu}{3}\right] > 0$$

$$4\mu A(1-\sigma) > 3n$$

This is the required stability condition. So, the labour market equilibrium will be stable as long as this stability condition holds. Now we can directly derive the signs of different parameters of the model when the stability conditions in the labour market are satisfied. Given the signs of the parameters in our model we can sign the derived parameters of the model as well.

$$\xi = \left[\frac{3n - 4\mu A(1-\sigma)}{6A(1-\sigma)}\right] < 0$$

$$\gamma = \left[\frac{2\mu}{3}\right] > 0$$

$$\xi^2 - \gamma^2 = \left[\frac{9n^2 - 24\mu An(1-\sigma)}{36A^2(1-\sigma)^2}\right] < 0$$

If $\mu A(1-\sigma) > \left[\frac{3n}{4}\right]$, and $\frac{3n}{4} > \frac{3n}{8}$ then by transitivity $\mu A(1-\sigma) > \left[\frac{3n}{8}\right]$. Combining these two conditions we can derive the signs for x and y. The own effect and cross effect of the model is thus

$$x = \left[\frac{\xi}{\xi^2 - \gamma^2}\right] = \left[\frac{6nA(1-\sigma) - 8\mu A^2(1-\sigma)^2}{3n^2 - 8\mu An(1-\sigma)}\right] > 0$$

and

$$y = \frac{-\gamma}{\xi^2 - \gamma^2} = \left[\frac{-8\mu A^2(1-\sigma)^2}{3n^2 - 8\mu An(1-\sigma)}\right] > 0$$

Both the own and cross effect of the model thus turns out to be positive. It is important to note that the model is discontinuous when $8\mu A(1-\sigma) = 3n$ as both x and y have $3n - 8\mu A(1-\sigma)$ as its denominator. So, whenever $8\mu A(1-\sigma) = 3n$ the denominator turns zero, and the equilibrium wages and taxes is undefined. From the derived parameters of the model can will be able to show that

$$y - x = \frac{-6nA(1-\sigma)}{3n^2 - 8\mu An(1-\sigma)} > 0$$

So, $y > x$, and the cross effect always dominates the own effect. The model will provide stable and valid equilibrium solution when the stability condition $4\mu A(1-\sigma) > 3n$ holds and the stability condition also provides the necessary signs on both the own and the cross effect. The parameters of the model μ, A, σ and n must be so chosen such that this condition binds at all time.□□

8.2.3 Proof of Proposition 3:

The rent maximizing local government of City A maximizes the migrant tax revenue function given by

$$RE_A = (1 - L_B^M + L_A{}^M)W_A\tau_A$$

substituting for $L_A^M$and L_B^M from equations 12 and 13 in the above mentioned migrant tax revenue function of city A we can rewrite it as

$$RE_A = [1 + 2\mu W_A(1 - \tau_A) - 2\mu W_B(1 - \tau_B)]W_A\tau_A$$

Maximizing $RE_A$with respect to τ_A we derive the best response function of city A to city B's taxation strategy and is given by

$$R_A(\tau_B) = (1 + 2\mu W_A - 2\mu W_B + 2\mu W_B\tau_B)/(4\mu W_A)$$

Analogous reasoning leads to city B's best response function to city A's migrant tax rate. City B's best response function can then be represented by

$$R_B(\tau_A) = (1 + 2\mu W_B - 2\mu W_A + 2\mu W_A\tau_A)/(4\mu W_B)$$

The intuition behind this interdependence is simple. Each city in isolation would like to impose a very high tax rate on it's migrants to extract most of the migrant's wages, the only constraint being that net benefit in equilibrium should be positive in each city otherwise migration will be adversely affected and migrants will not move to the cities. City A's best response function can be rewritten as

$$\tau_B = 1 - \frac{1}{z} - \frac{1}{2\mu W_B} + \frac{z}{2}\tau_A$$

where the slope of this reaction function is $\frac{\partial\tau_A}{\partial\tau_B} = \frac{z}{2}$. Similarly, city B's best response function can be written as

$$\tau_B = \frac{1}{2} - \frac{1}{2z} + \frac{1}{4\mu W_B} + \frac{\tau_A}{2z}$$

and the slope of this reaction function is $\frac{\partial\tau_A}{\partial\tau_B} = \frac{1}{2z}$ where $z = \frac{W_B}{W_A}$ is defined as the ratio of the two real wages. As both the tax reaction functions are strictly increasing there will be an unique set of equilibrium

migrant tax rate in this model. The tax reaction function of the two cities are then simultaneously solved to get the equilibrium migrant taxes of the two regions.

$$\tau_A = (3 + 2\mu W_A - 2\mu W_B)/(6\mu W_A)$$

$$\tau_B = (3 + 2\mu W_B - 2\mu W_A)/(6\mu W_B)$$

This equilibrium migrant taxes chosen by the two cities are Nash Equilibrium of the model as at this point no one will have any incentive to deviate and are a non-linear combination of the equilibrium wages in the two cities. □□

8.2.4 Proof of Proposition 4:

In this section we will discuss the equilibrium under a central urban planner or the Chinese central government (whose objective is joint benefit maximization of all the urban hukou holders) which decides on the unique migrant tax rate that gets uniformly applied to all the cities' migrants irrespective of the region of residence. The social planner thus maximizes joint migrant tax revenue $RE = RE_A + RE_B$ with respect to a single migrant tax rate, $\tau_A = \tau_B = \tau^S$.

$$RE = RE_A + RE_B$$

Substituting for $RE_A$and RE_B in the joint revenue maximization problem of the central planner we get

$$RE = [1 - 2\mu W_B(1 - \tau_B) + 2\mu W_A(1 - \tau_A)]W_A\tau_A + [1 - 2\mu W_A(1 - \tau_A) + 2\mu W_B(1 - \tau_B)]W_B\tau_B$$

As the social planner's aim is to set the same tax rate for both the cities in such a way that joint migrant tax revenue is maximized, the tendency of the regional governments to undercut each other will be eliminated.

Maximizing RE with respect to τ we get,

$$\tau^S = (W_A + W_B + 2\mu[W_A - W_B]^2)/(4\mu[W_A - W_B]^2) \tag{23}$$

The social planner's equilibrium migrant tax rate is denoted by τ^S. The Nash Equilibrium or the non-collusive equilibrium obtained from the model when the cities competed with one another is denoted

by τ_k^* for k =A, B. The migrant tax rate (non-collusive equilibrium) for city B is given by

$$\tau_B^* = (3 + 2\mu W_B - 2\mu W_A)/(6\mu W_B)$$

Comparing the equilibrium under the central planner with the one under city competition we get that $\tau^s > \tau_B^*$ and due to symmetry we get $\tau^s > \tau_A^*$. If the two cities collude the central planner internalizes the interdependence that exists between the cities' migrant labour supply and chooses a higher migrant tax rate for both the cities. Under the social planner problem, cities abstain from undercutting each other and the revenue collected is thus higher. So, even though higher tax rate is preferred by each city, competition among them for a larger pool of migrant labour forces them to undercut each other. This is the well known "race to the top" phenomenon displayed by the city governments where they undercut each other thereby leading to welfare enhancing outcomes for the migrants.□□

8.2.5 Proof of Corollary 1:

The proof of this proposition follows directly from the equilibrium migrant tax rate condition of city A. From the formalization of the model, a negative migrant tax rate is reflective of the migrants receiving the same treatment as the city's urban hukou holders or at least facing no discrimination in the cities.

$$\tau_A < 0$$

Substituting for the equilibrium value of $\tau_A$we get that a negative migrant tax rate in equilibrium in city A will be possible if and only if

$$[W_B - W_A] > \left[\frac{3}{2\mu}\right]$$

Substituting for the equilibrium level of wages, this reduces to a condition related to the difference between the size of the two cities. Negative equilibrium migrant taxes will be possible if the differences in size of the two cities exceeds a certain critical level.

$$\left[L_A^{'} - L_B^{'}\right] > \left[\frac{3}{2\mu(y-x)}\right]$$

If the wages of the city B is sufficiently higher than the wages in city A, then city B will be a better choice for migrants for a given marginal cost of migration. If the wage gap between the two cities is already too high then the only instrument that city A which has comparatively lower wages or lower migrant compensation will have left at its disposal is to lure the migrants with lower tax rates, and city

A may even be forced to lower it to negative levels. To put in words the city may be forced to provide benefits to it's migrants alongside the native hukou holders. The same may also hold if μ is very high or if a is very low then there will be a mass migration towards B instead of A.□□