ASSESSING THE EFFECTS OF RESTRICTIONS ON MIGRATION:

WHAT CAN WE LEARN FROM CHINA?*

by

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ABSTRACT

Unlike most countries, China regulates internal migration. Since the 1950s public benefits, access to good quality housing, schools, health care, and attractive employment opportunities in the state sector have been available only to those who have local registration (*Hukou*). The ease of obtaining local Hukou has typically differed across China's provinces. Coincident with the deepening of economic reforms, Hukou has gradually been relaxed since the 1980s, with some provinces relaxing restrictions more than others. China has experienced a tremendous surge in rural-to-urban migration over the last 30 years, which may partly be due to the gradual deregulation of Hukou. In the migration literature, very little is known theoretically and empirically about how restrictions affect the scale and structure of migration. China is a very convenient natural experiment for studying this problem because Hukou is effectively an internal passport system where restrictions vary across provinces and time. In this study, we exploit this experiment by asking: To what extent has Hukou influenced the scale and structure of interprovincial migration? A modified gravity model of migration rates, carefully nuanced to fit the case of a developing economy in transition from central planning to marketized, is estimated using three waves of data from the semi-decennial China census – 1985-90, 1995-2000, and 2000-05. Two alternative measures of Hukou restrictions are used -- the unregistered migrant's perceived probability of securing: (i) local registration; and (ii) employment available only to those with Hukou. It is found that migration is generally very sensitive to Hukou, with the greatest sensitivity occurring during the middle period. Implications for a more global study of immigration restrictions are discussed.

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I. INTRODUCTION

Since Adam Smith's *The Wealth of Nations*, economists and policymakers have understood that barriers to the mobility of goods or factors will preclude buyers and sellers from fully exploiting gains to exchange. In the literature on the Economics of Immigration, most of the debate on the effects of immigration restrictions has focused on the extent to which restrictions help or harm the labor market outcomes of native-born workers in the destination country. For example, there is a very large literature since the 1970s on the estimated effects of exogenous immigration on the wages and employment propensities of native-born workers. While this literature generally does not directly examine the effects of changes in restrictions on native-born labor market outcomes, the estimates provided have important implications for the effects of restrictions on native-born labor market outcomes.[1]

In the ongoing academic and policy debates over the effects of immigration restrictions, one topic that has received very little attention is: What are the estimated effects of restrictions on the scale and structure of migration? While everyone understands that reduced barriers stimulate migration, the literature is devoid of empirical estimates of migration's sensitivity to restrictions. The only very recent study to provide this type of information is Clark, Hatton and Williamson's (2007) analysis of U.S. immigration during 1971-98. They estimated a modified gravity model of U.S.

[1] For example, a common finding in these studies is that exogenous immigration tends to have a relatively benign effect on native-born wages. This would imply that changes in immigration quotas may have a much less adverse effect on native-born labor market outcomes than many people believe. For a very recent comprehensive review and assessment of literature in this area, including references to other expository surveys of the literature, see Chapters 5-7 in Bodvarsson and Van den Berg (2009).

immigration rates that includes quantitative measures of various immigration quotas.[2] While their study produces very useful and reliable information regarding the effects of changes in restrictions on the scale of migration, it is only for one destination country. The literature lacks a worldwide study of the effects of restrictions on immigration rates primarily because of: (i) lack of adequate data on most countries; (ii) considerable variation in the quality of data; and (iii) substantial differences in types of policies used. Because different countries write very different policies and many lack the resources to gather good quality data on immigration, an international study of immigration restrictions is extremely difficult.

In this study, a prominent case of *internal* migration is suggested as a laboratory for studying the effects of restrictions on external migration: China. Unlike most countries, China regulates internal migration through its "Household Registration System," or *Hukou*. Since 1958, each province requires persons seeking a change in residence to obtain permission from the public security bureau. If one wants to move from a rural to urban area, for example, he (or she) must convert his (or her) local registration status from "agricultural" to "non-agricultural," an approval that is usually very difficult.[3] Likewise, if one wants to move from a small to a large city, it is also very difficult. Being

[2] They found that an increase of 10% in the family quota (the number of immigrants admitted for the purpose of uniting with family members already in the U.S.) raises immigration by 0.3%, a 10% increase in employment visas raises immigration by 1.5%, and a 10% increase in the refugee allowance raises immigration by 0.5%.

[3] Historically, it has been very difficult to change one's local registration and even today, there are considerable barriers to obtaining local registration in an urban area. One way of surmounting these barriers is through education. If a person is able to gain admission to college and complete his degree, then there is a strong chance of being hired into an urban job with local registration. The government has sometimes permitted factories in urban areas to hire permanent workers from rural areas, permitted family members in rural areas to join other members in cities, or permitted migration from rural areas to nearby small cities. Other ways of gaining urban Hukou include military recruitment or having membership in communes whose land is requisitioned for urban purposes. In addition to the costs of overcoming barriers to access, conversion to urban Hukou imposes high opportunity costs. For example, permanently leaving one's village forces a migrant to abandon claims to ownership of land without compensation, land that may have been in the family for decades, as well as to profits of local rural industries.

registered in a large city can bring substantial benefits, e.g. permanent (and better-paying) jobs in the state sector, the right to own a home, and access to food, public schooling, and health care.[4] Hukou is effectively an internal passport system that makes the process of moving between or within provinces analogous to the process of moving between countries. For researchers interested in the study of how restrictions affect the scale and structure of migration, China is thus a tremendously valuable natural experiment.

The Chinese test case is important not only for the study of restrictions on immigration, but for the testing of economic models of migration rates in general. Consider these factors:

(a) since 1990, when the semi-decennial census first included questions on mobility, data on inter- (as well as intra-) provincial migration in China have been available[5]. Because the census is a national survey using the same methodologies, at comparable levels of accuracy, and measuring the same variables for all provinces, the currently insurmountable data problems that preclude an international test of restrictions are avoided ;

[4] Until the early 1990s, urban Hukou also entitled a person to "grain rations" – rations of necessities such as grain products and kerosene.

[5] The first national survey that included questions about migration was the 1987 1% population survey and 1990 was the first year in which the government collected data on migration in the population census. The 1990 census asked questions about both inter- and intra-provincial migration for the period 1985-90 and the 2000 (2005) census included questions about migration during 1995-2000 (2000-05). There have also been a number of household surveys in very specific areas of the country, which have included questions about migration.

(b) there are non-trivial interprovincial differences in the extent of Hukou restrictions, allowing for a meaningful test of the effects of *ceteris paribus* variation in restrictions on the variation in migration rates;

(c) Hukou has undergone an incremental dismantling over the last three decades. The deregulation of migration in China may be broken down into three periods – the 1980s, 1990s and post-2000 period. Up to the late 1980s, anyone wishing to travel within China had to show an official "permission" letter from his/her local government. Beginning in the late 1980s, identity cards replaced permission letters, making it much easier to travel. During the early 1990s, grain rationing coupons were abolished. These coupons had been the means by which people obtained food rations and they could only be used in the place of residence. In 2001, residency in small towns and townships was opened to all rural workers who were legally employed and had a place to live. At roughly the same time, medium-sized cities and some provincial capitals eliminated ceilings on the number of rural workers who could apply for permanent residence status. Some very large cities such as Shanghai and Beijing concurrently eased restrictions on the in-migration of rural workers.[6] It follows that a test of the effects of deregulation on migration is quite feasible

[6] Coincident with the easing of Hukou restrictions was the introduction of various market-oriented reforms. The first reform was the decollectivization of agriculture (also known as the inception of the *household responsibility system*) in rural areas. The most important aspect of this reform is that it freed workers to choose how they wanted to allocate their labor supplies. This encouraged many workers to leave the agricultural sector and seek employment in other sectors, most notably enterprises in urban areas. The second consisted of a set of market-oriented reforms in the urban areas during the late 1980s. The government, in an effort to attract foreign direct investment, created favorable provisions, e.g. tax concessions and attractive terms for leasing land, to many coastal cities so they could establish economic development areas and high technology development zones. In the 1990s, the government gave special tax and regulatory treatment to certain areas (called "special economic zones"), which generated large amounts of FDI in those areas. These economic reforms had the effect of creating large real income differentials between the Eastern provinces and the rest of China, encouraging Eastward migration. These reforms very likely helped to contribute to the rural-to-urban migration surge beginning in the 1980s. Other reasons

because one can exploit the gradual nationwide loosening of Hukou over time. To quote Fang and Dewen (2003), "While China has many similarities with other developing countries as far as the determination of migration is concerned, its feature of being in transition to a market economy makes it a case which stands out in the process of labour mobility from rural to urban areas" (page 78);

(d) Despite the high costs of changing one's local registration, there continues to be a very high level of undocumented migration in China. There is a huge "floating population" comprising persons with no local household registration who have concentrated primarily in large coastal cities.[7] The floating population has grown because as China's transition to a market-based economy has intensified, regional income differences (which have favored Eastern coastal cities) have widened. Analogous to the large population of undocumented U.S. immigrants from Mexico and Central America, China's floating population is testimony to the power of spatial differences in income as a motive for migration.[8] It follows that despite the history of central planning in China,

include global prosperity, which helped fuel tremendous growth in China's export markets, the growth of migrant networks, and cultural changes making migration more acceptable and appealing.

[7] The floating population comprises the bulk of the extraordinary surge in internal migration that has taken place since the 1980s. Based on the 1% population sample survey of 1987, for example, it is estimated that over 30 million Chinese relocated either within or between provinces during 1982-87. Using data from the 2000 Chinese Census, researchers have estimated that intra- and interprovincial migration during 1995-2000 totaled over 121 million persons. According to the 2005 Census, the level of migration during 2000-05 is estimated to have risen even further, to nearly 195 million persons. Much of the surge since the mid 1990s has involved rural residents moving to urban areas without obtaining local registration, particularly the metropolitan coastal cities and Beijing. See Seeborg, Jun and Zhu (2000) and Goodkind and West (2002) for a discussion of some of the most important reasons for the emergence of the floating population. In addition, the government's Xibu Da Kaifa ("Go West") policy, enacted in 1999, which encouraged Westward migration, has been a recent contribution to China's migration surge.

[8] For a more detailed history and explanation of the Hukou system, see Chan (1994), Chan and Zhang (1999), Cheng and Selden (1994), Day and Xia (1994), Goldstein (1990), Goldstein and Goldstein (1990), Wang (1997), Davin (1999), and Liang (2001)

traditional Western models of migration, which emphasize the influence of spatial differences in labor markets, should be quite applicable to the Chinese case.

There are two very small, emerging strands of literature on migration in China that help frame this study. First, there are two very recent theoretical studies that use numerical analysis to examine the effects of the lessening of Hukou restrictions on the scale of labor mobility. Drawing on the much earlier work of Hamilton and Whalley (1984), which uses numerical analysis to calculate the efficiency losses that result from global restrictions on labor mobility, Whalley and Zhang (2007) apply numerical analysis to a general equilibrium model in which there are barriers to rural-to-urban mobility. Their model depicts a country with homogeneous labor in which wage differentials across various geographical divides is supported by quantity based restrictions. Using very reasonable numerical parameters for production, labor force composition and industrial structure, Whalley and Zhang find that the loosening of Hukou restrictions can significantly reduce both income inequality and increase rural-to-urban labor mobility. Ito (2008) applies a similar production function and general equilibrium approach as do Whalley and Zhang to perform numerical analysis of the effects of Hukou loosening on rural-to-urban wage differentials, as well as parts of the economy not examined by Whalley and Zhang. Ito's simulation results indicate that removing Hukou would stimulate massive migration to urban areas and that rural industry labor forces would deplete more rapidly than agricultural labor forces. Ito also shows that urban unemployment in China will be worsened if off-farm employment opportunities in urban areas for rural migrants are rationed.

While the two simulation studies cited above have the strength of a solid theoretical model, there are two limitations. First, their models lack a unique Hukou variable or parameter, i.e. there is no stand alone theoretical counterpart for migration restrictions. Instead, the approach taken is to simply assert that when there are no restrictions on migration, spatial differences in marginal product vanish, regional labor markets clear, and there is a common wage. A theoretical analysis of Hukou would be strengthened if the model were to contain a separate variable or parameter representing migration restrictions. Second, neither of these studies include any econometric estimates of Hukou's effects using real world data.

The second strand of literature examines the extent to which migration flows are driven by regional differences in labor markets.[9] These studies mostly comprise tests of a Western style modified gravity model of migration, occasionally nuanced to fit the Chinese case. While most of these studies generally acknowledge the important role of Hukou in Chinese migration patterns, none of them include any empirical measure of Hukou.[10] In fact, no study presents a theoretical model with a measure of Hukou

[9] The literature can be conveniently divided into studies utilizing micro-data obtained from special household surveys (see, for example, Liang (2001), Liang and White (1996,1997), Zhao (1997,1999a, 1999b, 2002, 2003) and a few studies utilizing province-level aggregate data provided by the central government (see, for example, Fan (2005), Lin, Wang and Zhao (2004), Poncet (2006) and Bao, Hou and Shi (2006)), Bao, Bodvarsson, Hou and Zhao (2008, 2009)). We should also point out that in 2002, an entire issue of the journal *Urban Studies* was devoted to empirical papers on China's growing migration and urbanization. We particularly wish to highlight the studies of Chen and Coulson (2002) on the determinants of urban migration, Liang, Chen and Gu (2002) on the effects of rural industrialization on internal migration, Li and Zahniser (2002) on the determinants of temporary rural-to-urban immigration, and the Goodkind and West (2002) study on the floating population.

[10] We should point out that several relatively recent studies examine other effects of Hukou. Au and Henderson (2006) develop a theoretical model and test to demonstrate that Hukou has led to undersized cities (they call this "insufficient agglomeration") and losses in GDP. Whalley and Zhang (2004) use a simulation model to show that in the absence of restrictions on migration, interregional income inequality in China would have been substantially smaller. There is also a study by Wu and Treiman (2004), which seeks to identify those factors which are most important in influencing the odds of converting from rural to urban registration. They find that education and membership in the Chinese Communist Party are the most important sources of influence.

restrictions and carries it over to a regression equation that includes an empirical counterpart for Hukou.[11] One exception is Poncet's (2006) study of the lessening of Hukou during 1985-95. Poncet argued that as deregulation intensified, migration should have become more responsive to economic factors. She estimated a modified gravity model for the 1985-90 and 1990-95 periods, finding that intra- and interprovincial migration rates were indeed more responsive to spatial income and unemployment rate differences in the later period. However, Poncet's theoretical and empirical models did not include a Hukou variable, nor did her data set include a measure of the intensity of Hukou restrictions. Furthermore, her coefficient estimates are likely to suffer from omitted variables bias because her regression equations lacked a number of important controls, including migrant stocks in the destination, foreign and domestic investments, industrial structure, demographic characteristics, climate, and human capital endowments. We should emphasize, though, most other empirical studies of Chinese migration lack some or many of these controls.

This study has three goals. First, we seek to estimate the strength of the Hukou system's influence on the scale of migration in China. We accomplish this by extending the modified gravity model to include a Hukou variable and then carrying it over to an empirical specification that is estimated using good quality data on a Hukou measure . We use data from the semi-decennial China census to study migration during three key periods -- 1985-90, 1995-2000 and 2000-05 migration periods. Panel estimation is

[11] Economists studying migration have generally paid very little attention to the modeling of and testing for the effects of restrictions on migration propensities. Because most countries don't have restrictions on within-country mobility and most internal migration studies have been for those countries, researchers have seen no need to modify their models to account for restrictions. It is surprising, though, that the literature on international migration has generally avoided theoretical or empirical analyses of restrictions, especially since most countries do have immigration restrictions. For a very recent appraisal of the status of theoretical and empirical work on the determinants of migration, see Chapters 2 and 3 in Bodvarsson and Van den Berg (2009).

performed in order to guage the extent to which the sensitivity of migration to Hukou has changed over time. Such an analysis helps us better understand how the structure of migration has changed as deregulation of migration and other market reforms have deepened. Second, we test our hypotheses using a much more comprehensive model of migration than will be found in earlier studies. The Chinese test case is unique because it involves an economy in transition from central planning to a market-based system, where there have been large infusions of FDI and domestic fixed asset investments, considerable social and cultural changes, and significant growth in communications, transportation infrastructure, and migrant communities. Earlier studies have not adequately included controls for all these factors. We believe our test provides the most complete and accurate picture to date of the scale and structure of migration in China. Third, we seek implications from the China case for the study of worldwide restrictions on immigration.

The remainder of this paper is organized as follows. Below we present a theoretical model of interprovincial migration flows, which includes parameters describing restrictions on internal migration, followed by empirical specifications that include Hukou measures. We then describe our data set, followed by a presentation of the empirical results. The paper concludes with a discussion of the implications of our findings for future Western research on immigration restrictions.

II. A THEORETICAL MODEL OF MIGRATION

Our theoretical model of internal migration incorporates elements of models due to Poncet (2006), Crozet (2004) and Tabuchi and Thisse (2002). For simplicity, we assume

just one potential destination. Worker k from province j needs to decide whether to relocate to province i or stay home. Her objective is to choose the location for which the perceived quality of life, adjusting for all relocation costs, is higher. The perceived quality of life in a province is assumed to depend upon earnings opportunities available to the worker, the probability of finding a job, and the availability of various amenities and non-tradeable goods. Amenities and non-tradeable goods may include climate, the availability of ethnic goods and services, the quality of schools and public services, etc. Furthermore, the perceived quality of life will depend upon the size and proximity of the migrant's community of family and friends from the home province.

The migration decision will also depend upon migration costs, which are assumed to vary directly with distance. In the more general case where there are R destination provinces (including j), the migrant's objective function is

$$(1)\Phi_{ji}^{k} = W_{ji}^{k} + \eta_{i}^{k} = \ln[\pi_i Y_i (d_{ij})^{-\psi}] + \eta_{i}^{k} \qquad i \in [1, R],$$

where π_i is the probability of securing employment in province i, Y_i is real income in i, d_{ij} is the geographic distance between home and host provinces, and η_i^k is a stochastic term capturing all the other factors influencing the migrant's perceptions of the quality of life available in province i. Migration costs will rise proportionately with distance because as distance rises, typically the physical costs of moving, the costs of acquiring information about labor market opportunities in the province, and the psychic costs of migration will be higher. In our simplified (one-destination case), though, the decision boils down to comparing the two equations below and choosing the option associated with the higher-value equation:

$$(2)\ \Phi_{i}^{k} = W_{i}^{k} + \eta_{i}^{k} = \ln[\pi_i Y_i (d_{ij})^{-\psi}] + \eta_{i}^{k}$$

(3) $\Phi_j^k = W_j^k + \eta_j^k = \ln[\pi_j Y_j] + \eta_j^k$

Since there are no migration costs associated with the "stay home" option (equation (3)), then real income, the probability of securing employment and/or the migrant's perceptions of provincial characteristics in i, must be higher to overcome any explicit or implicit costs of moving there.

The migrant's comparison of the values of equations (2) and (3) is equivalent to her calculating the expected net benefits of migration, $\Phi_i^k - \Phi_j^k$, and choosing to relocate only if those net benefits are positive. Taking the difference between equations (2) and (3) and then taking logs, the expected net benefits to migration are

(4) $\Phi_i^k - \Phi_j^k = [\ln(\pi_i) - \ln(\pi_j)] + [\ln(Y_i) - \ln(Y_j)] - \psi \ln(d_{ij}) + [\eta_i^k - \eta_j^k]$.

Equation (4) implies that the likelihood of migration will be higher the higher are expected relative income and the relative probability of securing employment in i, the higher is the perceived relative favorability of other characteristics of i, and the lower is distance. These are standard predictions implied by the economic theory of internal migration due originally to Sjaastad (1962) and Greenwood (1969).

In the home province, where the prospective migrant is assumed to have local Hukou, the probability of securing employment depends upon general labor market conditions, which are reflected in the provincial unemployment rate. Specifically, we posit that $\pi_j = g(u_j)$, where u_j is the unemployment rate in the home province. In provinces where labor demand is relatively weak, the unemployment rate will be higher and it will be more difficult for anyone to find employment. With subscripts as derivatives, this implies that $g_1 < 0$.

In the destination province, the unregistered migrant can be hampered in finding a good job by two factors – general labor market conditions and the lack of household registration. Therefore, the probability of securing employment depends upon both the unemployment rate and the likelihood of obtaining Hukou:

(5) $\pi_i = f[u_i, pr\{H_i\}]$,

where u_i is the unemployment rate in province i and $pr\{H_i\}$ is the probability of obtaining Hukou. It is assumed that $f_1 < 0$ and $f_2 > 0$. The reason for $f_2 > 0$ is that if a person lacks local Hukou, she will be shut out of certain parts of the labor market, e.g. jobs in state enterprises and more high-skill and better-paying jobs. Having local Hukou not only provides one access to coveted jobs, but access to a greater variety of jobs. Even if the migrant doesn't care about securing Hukou, she may view the probability of securing Hukou as an indicator of the openness of the province, e.g. provinces where it is harder to obtain local registration could be provinces that generally impose higher barriers to entry for outsiders. It is also possible that there could be an interaction effect between the unemployment rate and the likelihood of securing local Hukou ($f_{12} \neq 0$). For example, suppose an export boom affecting all industries strengthens labor demand and lowers the unemployment rate. While all workers will experience a higher likelihood of securing employment, those with local Hukou may experience an even bigger increase in the odds of landing a job ($f_{12} < 0$) because they have access to a greater variety of job opportunities.

Incorporating $\pi_j = g(u_j)$ and equation (5) into equation (4), the expected net benefits to migration are now

$$(6)\ \Phi_i^k - \Phi_j^k = [\ln(\pi_i(u_i, \Pr\{H_i\}) - \ln(\pi_j(u_j)] + [\ln(Y_i) - \ln(Y_j)] - \psi \ln(d_{ij}) + [\eta_i^k - \eta_j^k].$$

Equation (6) implies that the probability of migration is higher: (a) the higher is the unemployment rate in the home province; (b) the lower is the unemployment rate in the destination province; and (c) the higher is the perceived probability of obtaining local Hukou in the destination. In the section below, we work with several empirical specifications implied by equation (6).

III. EMPIRICAL SPECIFICATIONS

The theoretical model above implies a double-log empirical specification where the dependent variable is the log of the migration rate ($\ln(M_{ij})$), defined as the number of persons moving from province j to province i as a percentage of all persons moving out of province j.[12] In using this specification for the case of China, we include explanatory variables from an assortment of studies, including Lin, Wang and Zhao (2004), Bao, Hou and Shi (2006) and Poncet (2006). However, our empirical model extends previous research in several other important ways. First, we add controls for the regulation of migration, which is very important for China because of its history of restrictions on migration. Second, we add other measures which are important for the study of the Chinese test case. Furthermore, in contrast to most previous studies of China, ours is a panel study spanning three important periods of migration.

We estimate three specifications implied by the theoretical model. The first is a panel version of a basic specification due originally to Greenwood (1969, 1997) and applied to the Chinese test case by Lin, Wang and Zhao (2004). This specification is described by the following double-log equation for the interprovincial migration rate:

[12] This specification, widely used in the literature, is due originally to Greenwood (1969).

$$(7)\ \mathrm{Ln}(M_{ijt}) = \alpha_0 + \alpha_1 Ln(Y_{jit}) + \alpha_2 D_{ij} + \alpha_3 Ln(\pi_{it}) + \alpha_4 Ln(\pi_{jt}) + \sum_{x=1}^{q} \beta_x Ln(Z_{xt}) + \sum_{t=1}^{T-1} \lambda_t \mathrm{Period}_t + \sum_{p=1}^{Z-1} \theta_p \mathrm{Province}_p + \varepsilon_{ijt},$$

where:

Y_{jit} = the ratio of destination province to origin province income in period t;

D_{ij} = Geographic distance between provinces;

π_{it} (π_{jt}) = the probability of securing employment in the destination (origin) province in period t;

Z_{xt} = other controls for perceived quality of provincial life, in period t;

Period_t = time period during which migration occurred, where there are T periods;

$\mathrm{Province}_p$ = origin province fixed effect, where there are Z provinces;

ε_{ijt} = random error term;

and the α, β, λ, and θ parameters are coefficients to be estimated. We hypothesize that $\alpha_1 > 0$, $\alpha_2 < 0$, $\alpha_3 > 0$ and $\alpha_4 < 0$.

The next two empirical specifications are extensions of equation (7). Where they differ is in how Hukou restrictions are measured. Before describing each equation, it is important to note that in China unemployment rates are estimated using data only on locally registered persons, i.e. members of the "floating population" are not part of the sample. Therefore, the official provincial unemployment rate measures unemployment risk for a registered person only. Define u_{it} (u_{jt}) as the reported unemployment rate in the destination (origin) province. It follows that $(1 - u_{it})$ are the odds of securing employment in the destination province when a person is registered there and $(1 - u_{jt})$ are the odds of securing employment in the origin province.

The first equation measures Hukou as the odds of securing local registration in the destination:

$$(8)\ \mathrm{Ln}(\mathrm{M_{ijt}}) = \alpha_0 + \alpha_1 Ln(Y_{jit}) + \alpha_2 D_{ij} + \alpha_3 Ln(1-u_{it}) + \alpha_4 Ln(\mathrm{Hukpercent}_{it}) + \alpha_5 Ln(1-u_{jt}) + \sum_{x=1}^{q} \beta_x Ln(Z_{xt}) + \sum_{t=1}^{T-1} [(\lambda_t \mathrm{Period}_t) + \chi_t((\mathrm{Period}_t) Ln(\mathrm{Hukpercent}_{it}))] + \sum_{p=1}^{Z-1} \theta_p \mathrm{Province}_p + \varepsilon_{ijt},$$

where "Hukpercent" is the probability of securing local Hukou. Given available data, we measure Hukpercent as the *lagged relative frequency of registered households*. It is assumed that prospective migrants know the historical relative frequencies of registered households in destination provinces and have adaptive expectations about barriers to entry. We hypothesize that $\alpha_4 > 0$, implying that when the likelihood of securing Hukou rises, the perceived benefits to migration and the migration rate will rise. The second equation measures Hukou as the joint probability of an unregistered migrant securing a job and Hukou in the destination. This measure equals *one minus the unemployment rate in the destination times the historical relative frequency of registered households:*

$$(9)\ \mathrm{Ln}(\mathrm{M_{ijt}}) = \alpha_0 + \alpha_1 Ln(Y_{jit}) + \alpha_2 D_{ij} + \alpha_3 [Ln(1-u_{it}) Ln(\mathrm{Hukpercent}_{it})] + \alpha_5 Ln(1-u_{jt}) + \sum_{x=1}^{q} \beta_x Ln(Z_{xt}) + \sum_{t=1}^{T-1} [\lambda_t \mathrm{Period}_t + \chi_t((\mathrm{Period}_t)(Ln(1-u_{it}) Ln(\mathrm{Hukpercent}_{it}))] + \sum_{p=1}^{Z-1} \theta_p \mathrm{Province}_p + \varepsilon_{ijt},$$

While one minus the unemployment rate measures the likelihood of a registered migrant securing a job, weighting that likelihood by the likelihood of securing Hukou accounts for the fact that unregistered migrants find it more difficult to secure employment in the destination than those who are registered, all other things equal. It is hypothesized that α_3 in equation (9) is positive.

Another way of looking at the difference between equations (8) and (9) is that in (9), Hukou is relevant to the migrant only if it impacts the odds of securing employment in the destination. In contrast, equation (8) includes a more expansive measure of Hukou, reflecting the notion that the benefit of local Hukou goes beyond getting a good job;

Being registered means having access to other kinds of benefits in the destination, e.g. access to public benefits, better quality housing or job security.

The interactions between the time period dummies and the relative frequency of registered households ($(Period_t)(Ln(Hukpercent_{it}))$ describe the time-varying effects of Hukou on the incentive to migrate. If the odds of obtaining local Hukou affect the incentive to migrate differently for different periods, this will be reflected in positive or negative values of the χ_t coefficients in equations (8) and (9). The Hukou system across China has gradually been relaxed over the last quarter century, with some provinces reducing barriers to local registration more than others. Greater deregulation may, for example, lower the perceived relevance of securing Hukou to the migration decision and cause the migration rate to be less sensitive to the odds of securing Hukou. In that case, λ_t will be negative. On the other hand, if greater ease of transportation and communication reduce migration costs and macroeconomic reforms, combined with growing prosperity, substantially stimulate migration flows, then having local registration may be more important than before. In that case, λ_t will be positive.

The other controls (the x's) included for each period in the empirical specifications are the following (where appropriate, hypothesized signs are in parentheses):

(i) log size of the migrant community residing in the destination province that previously migrated from the origin province, as a percent of the destination's population (> 0);

(ii) log ratio of real FDI per capita in the destination province to real FDI per capita in the origin province (>0);

(iii) log ratio of real domestic fixed asset investment (FAI) per capita in the destination province to real domestic FAI in the origin province (>0);

(iv) log percentages of adult population enrolled in the origin province's universities and the destination province's universities;

(v) log ratio of the share of manufacturing employment in the destination to the share of manufacturing employment in the origin (> 0)

(vi) log ratio of the urban share of the destination province's population to the urban share of the origin province's population (> 0)

(vii) log ratio of the destination province's minority population share to the origin province's minority population share;

(viii) log ratio of mean yearly temperature in the capital city of the destination province to mean yearly temperature in the capital city of the origin province (> 0);

(ix) log share of real FAI in the origin province devoted to transportation infrastructure (< 0);

(x) dummy equaling 1 if the migrant flow is between two provinces that are adjacent and equaling 0 if not (> 0);

(xi) interaction of the log of the FDI ratio (item (ii) above) and the log of the FAI ratio;

(xii) interaction of the log of real FAI in the origin and real per capita GDP in the origin (> 0);

(xiii) interaction of the log of relative past migration flows (item (i) above) and log of distance (> 0).

Below are explanations for hypothesized signs on selected items above:

1. The migration rate is hypothesized to be positively related to both the destination/origin real FDI and FAI ratios. Higher investment, such as new commercial or residential construction in the destination area, will generate higher demand for labor from other provinces, higher wage rates, and thus an increase in "demand-pull" migration. Higher investment in the origin province will diminish the incentive to migrate due to more attractive labor market opportunities there. An interaction term between the real FDI and FAI ratios is included to control for the possibility that higher levels of one investment type may influence the marginal effect

of the other investment type on the migration rate. Foreign firms investing in a province tend to compete for the same pool of workers as do domestic firms making fixed-asset investments (which tend to be state and collective enterprises). Suppose, for example, there is higher FDI in the destination province which results in a greater inflow of workers who obtain employment in FDI-financed firms. Now the pool of migrants available for jobs in FAI-financed firms will be lower, implying that the amount of immigration induced by higher FAI will be lower. In that case, the hypothesized coefficient on the interaction term is negative;

2. The ratio of the share of manufacturing employment in the destination province to the origin province's share is included as a control for industrial composition. Manufacturing jobs are generally higher-skilled and higher-paying compared to, for example, jobs in the agricultural sector. Therefore, provinces with relatively larger manufacturing sectors should attract relatively more migrants, all other things equal, especially from provinces that have large agricultural sectors;

3. The ratio of destination urban population share to origin urban population share controls for relative population density in the destination province. Provinces that are relatively more urbanized tend to have different amenities, types of employment opportunities, standards of living, etc., which could influence the rate of immigration. For example, the proportion of skilled positions in more urban provinces is typically higher and may encourage more immigration;

4. Following Bao, Hou and Shi (2006, pp. 335), we include a control for the relative proportion of the destination's population that is minority.[13] We include this variable for several reasons and postulate that its effect on migration could be positive or negative. First, this variable may proxy general political conditions in the province, e.g. provinces with larger minority population shares may have more political divisiveness than other provinces, which may influence immigration rates. Second, as Bao, Hou and Shi (2006) point out, provinces with relatively large minority population shares tend to lack many basic service industries, hence entrepreneurial migrants seeking to start service businesses may find these provinces profitable places to establish businesses. On the other hand, professionals seeking salaried positions may be less interested in migrating to provinces with higher minority shares because they may perceive such provinces to have limited high-skill employment opportunities;

5. The migration rate is hypothesized to be positively related to the level of educational attainment, measured as the proportion of the adult population enrolled in universities,[14] in the destination because a better-educated labor force there is likely to mean on average higher quality employment opportunities.[15] However, using the same

[13] The proportion of a province's population that is minority was computed in the following way: $\text{minority share} = (\frac{\text{total population - Han population}}{\text{total population}}) x100.$

[14] A better measure of educational attainment is the percentage of the population that is college-educated, however that sort of data are not available for individual provinces.

[15] Another reason is that more educated provinces may have higher levels of particular amenities that migrants value, e.g. a lower crime rate, higher quality public goods, more arts, etc. On the other hand, in better educated provinces, there may be fewer low-skill employment opportunities, which could create a disincentive for low-skill workers to migrate there.

type of argument, greater educational attainment in the origin is hypothesized to be inversely related to the migration rate[16];

6. In a province where the share of real FAI allocated to transportation infrastructure rises, e.g. there are greater investments to expand and upgrade railroads, airports and highways, the costs of relocating will fall. We would thus expect to see a higher out-migration rate from the province;

7. The interaction between FAI per capita and real GDP per capita in the origin province is included to account for the possibility that emigration from poorer provinces, in response to changes in domestic investment spending, may behave differently than emigration from richer provinces. An increase in FAI in the origin province would be expected to reduce out-migration from that province. In poorer provinces, where state-sponsored investment spending is usually much lower to begin with, the marginal productivity of new investment and the resulting increase in labor demand may be much higher. Consequently, the out-migration rate may fall relatively more in poorer provinces than in richer provinces. In other words, the higher is GDP per capita in the origin province, the lower will be the marginal effect of FAI on the rate of migration from the province. In that case, the hypothesized sign on the interaction term is negative;

[16] One can make an argument for an opposite sign; Better educated persons may have greater proclivities to migrate.

8. The interaction between past migration flows and distance incorporates the idea that when the destination and origin provinces are far apart, the marginal value of having friends and family already in the destination will be very high, hence the marginal effect of past migration flows on the incentive to migrate will be very strong. For a long distance move, the migrant will likely be much more reliant on a migrant network for information and assistance with relocation, as well as relief from psychic costs. In contrast, when the provinces are very close to one another, the destination province will be familiar territory and one is likely to be less reliant on a pre-existing network. Therefore, we hypothesize a positive sign on this interaction;

9. The border dummy variable is an additional control for migration costs. A move between two adjacent provinces is presumed to be less costly, both in terms of direct and indirect costs, *ceteris paribus*, then a move between two distant provinces. Aside from the lower distance between the two, adjacent provinces tend to be culturally and socioeconomically more alike, hence perceived assimilation costs are likely to be lower. Furthermore, the expected costs of acquiring information about job market, housing, and other opportunities, are expected on average to be lower when a move is contemplated between two provinces sharing a common border.

IV. DISCUSSION OF DATA

Our data are drawn from two major sources. For the 1985-90 and 1995-2000 periods, we expand the data set used by Lin, Wang and Zhao (2004) in their study of

interprovincial migration.[17] Their data set is expanded because it doesn't include some provincial measures discussed earlier. Data for 2000-05 plus data for the additional provincial measures are taken from University of Michigan's *China Data Online* website (http://www.chinadataonline.org/), where data on that website are extracted from China's National Bureau of Statistics. For all regressions we omitted observations for which the migration rate was zero, and for those regressions where past migration was included as a control observations with past migration = 0 were eliminated. Like Lin, Wang and Zhao (2004) and other researchers, we exclude Tibet because of data gaps and treat Chongqing as part of Sichuan. Our sample thus includes 29 provinces, each a prospective destination and prospective point of origin.

A major drawback of the 1985-90 period is that information about past migration is not available for that period because the 1990 semi-decennial census was the first to include questions about change in residence. However, information about past migration is available when estimating migration rates for 1990 and beyond. Consequently, we produced two sets of estimates: (1) estimates for the full panel (all three periods) with no control for past migration; and (2) estimates for a smaller panel comprising the later two periods only (which includes a control for past migration). Data used for the full panel estimates are absent observations for which migration rates are zero, resulting in 2,385 usable observations. Of these 2,385 observations, 765 came from the first period and 790 from the each of the latter two periods. For the smaller panel (last two periods only), data used are absent observations where migration rates and past migration are zero. This

[17] Note that we replaced Lin, Wang and Zhao's (2004) calculations of the dependent variable with our own calculations. The reason is that there are some inaccuracies in the series used by Lin, Wang and Zhao, which they acknowledged in communications with us.

resulted in a total of 1,535 observations – 765 from the first period, 784 from the second, and 751 from the third.

Tables 1 - 3 show summary statistics for all variables used in our regressions for each of the three migration periods. Table 1 excludes zero migration rates only, whereas Tables 2 and 3 exclude zero values for both migration rates and past migration. Starting from the top of each table, we describe the variable, the data source from which the variable was taken, and trends apparent in the data:

(i) Gross interprovincial migration rate. For the 1985-90, 1995-2000 and 2000-05 periods, respectively, migration rates are calculated from samples comprising 1% of the 1990 population census, 0.95% of the 2000 census,[18] and 1% of the 2005 census. In the 1990 (2000, 2005) census, respondents were asked to report on migration activities during 1985-90 (1995-2000, 2000-05, respectively). Consequently, migration rates during each decade were calculated for only the second half of each decade. The mean volume of emigration from a province surged from over 355,000 persons during 1985-90 to over 1,075,000 during 1995-2000 and over 2,200,000 during 2000-05.[19] Note that mean provincial population rose by 9.44% between 1990 and 2000 and by 5.86% between 2000

[18] As pointed out by Lin, Wang and Zhao (2004), there is a small difference between the 1990 and 2000 censuses with respect to how migration is defined. If a person is observed to change residence *and* to change their household registration (a situation officially called "Hukou migration"), then this movement is officially classified as "migration" in both censuses. If, however, the person is observed to change residence without changing registration ("non-Hukou migration"), then the movement is classified as "migration" only if the migrant has been away from the place of registration for a minimum period of time. In the 2000 census, this period is 6 months, but in the 1990 census it is one year. To account for this change in classification between the two periods, the migration numbers in both periods were standardized by discounting the 2000 numbers by a small amount, approximately 5%. For further details, see Lin, Wang and Zhao (2004, page 593).

[19] There are likely to be discrepancies in the calculations of these numbers between decades, for the reasons discussed in the preceding footnote.

and 2005. For the first two periods, Sichuan province experienced the highest volume of interprovincial emigration (approximately 1,457,000 persons during 1985-90 and 4,375,000 during 1995-2000), while Ningxia province had the lowest (approximately 54,500 persons during 1985-90 and 94,750 during 1995-2000). During 1985-90, the highest interprovincial migration rate was 79.34% (Guangxi to Guangdong) and the lowest was 0.02% (a tie between Jiangxi to Qinghai and Jiangxi to Ningxia). During 1995-2000, the highest reported migration rate was 87.32% (Guangxi to Guangdong) and the lowest was 0.14% (Jiangxi to Qinghai). For 2000-05, the highest in-migration rate was 36.53% (Guangdong) and the lowest was 0.19% (Qinghai); The highest out-migration rate was 20.54% (Gansu) and the lowest was 0% (Xinjiang);

(ii) *The historical relative frequency of persons with local Hukou*. This is the ratio of the registered population to total (registered + unregistered) population at year's end. For the 1985-90 (1995-2000, 2000-05) period, we use the mean annual proportion of persons with Hukou during 1980-84 (1990-94, 1995-99, respectively). There are two reasons for using the lagged proportion of persons with Hukou. First, this measure is consistent with its theoretical counterpart, the lagged relative frequency of persons with Hukou. Second, there is very likely to be two-way causality between the migration rate and the contemporaneous proportion of registered persons in the destination. By using the lagged proportion of persons with Hukou we avoid potential problems with simultaneous equations bias.

Tables 1-3 indicate some very interesting patterns over time with respect to the proportion of registered persons in each province. First, note that despite Hukou

undergoing gradual relaxation, the proportion of persons with local Hukou fell from an average of approximately 98% during the early 1980s to an average of approximately 88.5% during the late 1990s. This is probably because the floating population grew faster than the number of registered households. Second, note that the variance of the proportion of persons with Hukou across the provinces rose appreciably over these three decades. The spread between the minimum and maximum percentages during 1980-84 was 4.79%, but soared to 21.04% during 1990-94 and 28.85% during 1995-99. This means that differences across provinces with respect to the ease of obtaining Hukou rose significantly. Some provinces, for example, reduced entry barriers substantially, which would have greatly increased the incentive to migrate to those particular provinces.

(iii) Size of the community of migrants from the origin who reside in the destination. An ideal measure of the size of the migrant community is the current stock of migrants from the origin who reside in the destination, as a percentage of current population in the destination. Unfortunately, unlike data sets in the USA and many European countries, such a migrant stock measure is unavailable for China. Therefore, we used past *flows*. In our regression analyses for the 1995-2000 and 2000-05 sub-samples, relative migrant flows during the half-decade five years prior to the start of the migration period were used to proxy the relative size of the migrant network. For the 1995-2000 (2000-05) period, the relative size of the migrant community was calculated by the ratio of total flows from origin to destination during 1985-95 (1990-95) to the destination's population in 2000 (2005). There are several reasons for this approach. First, it is presumed that the stock of previous migrants is proportional to the size of the previous flow of migrants.

Second, by lagging past flows by 5 years, we hopefully reduce the risk of serial correlation. As Tables 2 and 3 show, the estimated provincial migrant stock averaged approximately 1.35 million persons for the 1995-2000 migration period and approximately 1.22 million persons for the 2000-05 period. The reduction in migrant stock could be due to return migration.

(iv) Real annual FDI and FAI per capita. For each period, we used mean annual real FDI (FAI) per capita during 1980-84 when regressing 1985-90 migration flows, 1990-94 mean annual real FDI (FAI) per capita when regressing 1995-2000 migration flows and 1995-99 mean real FDI (FAI) per capita when regressing 2000-05 migration flows. We lagged investment spending because it typically takes time for migration to respond to changes in spending on investment projects. Furthermore, since there is very likely to be two-way causality between investment and migration, by regressing migration rates on lagged investments we avoid potential problems with simultaneous equations bias. We adjusted the investment series for cost of living differences between the two decades, as well as across provinces within each decade, using national government measures of provincial CPI and calculating both series at 1985 price levels. For most of the provinces, FDI numbers were available for each year, but for some there were missing years. For several provinces, no investment data were available for 1980-84, so we used the earliest year available as a proxy for that period. Therefore, our coefficient estimates for the early period may be influenced by measurement error in some parts of the investment series. Note that the FDI series is in USA dollars, whereas the fixed asset investment series is in Chinese Yuan.

Comparing Tables 1-3, there was a dramatic increase in FDI, reflecting a surge in interest by international investors in the Chinese economy. The areas receiving the highest levels of FDI tended to be the main cities in China and those receiving the lowest amounts tended to be rural provinces. Tables 1-3 also indicate that China experienced a dramatic increase in FAI across decades, reflecting a boom in mostly state-sponsored residential and commercial construction. There is great disparity across provinces with respect to the level of construction spending, with the largest cities receiving the most investment and rural provinces the least;

(v) The share of manufacturing employment. Manufacturing is classified in China as a "Secondary" industry and construction is one of its components. There is considerable variation across the country with respect to the dominance of manufacturing in the provincial labor market. For all three periods, Shanghai had the highest share of manufacturing employment and Hainan the lowest;

(vi) The share of the province's population that is minority. This is the percentage of population that is not Han. Because data on Han population shares for 1990 are not available, we used 2000 data to proxy minority population shares for the first two migration periods. For the most recent migration period, we used information on Han population shares from the 2005 census;

(vii) Mean real per capita income. Due to lack of available data for consecutive years during the 1980s and 1990s, income data only for 1989 (1999) were used to measure average

annual income for the 1985-90 (1995-2000) periods. For the 2000-05 migration period, though, we use the average of yearly incomes for the period. All income data are adjusted for cost of living differences across provinces and over time using provincial CPI measures;

(viii) Mean level of educational attainment. Educational attainment was measured as the percentage of the population aged 22-60 enrolled in colleges and universities in 1990 (for the 1985-90 period), in 2000 (for the 1995-2000 period), and in 2005 (for the latest period. For all three periods, a large majority of a typical province's adult population was not enrolled in colleges or universities, reflecting substantial barriers to access to post-secondary education in China. However, as reforms deepened and barriers to access fell, the percentage of the population enrolled at colleges and universities rose at an increasing rate, from over 3% in 1990 to nearly 9% in 2005. Note also that the variance of enrollment rose at an increasing rate, a likely explanation for rising income inequality in China.

Data on the remaining variables are from Lin, Wang and Zhao (2004). Please refer to their paper for details on data sources and measurement of these variables.

V. COEFFICIENT ESTIMATES

Tables 4 and 5 provide results from OLS estimation of equations (7), (8) and (9). Table 4 presents results for the full panel, whereas Table 5 presents results for the smaller panel comprising the last two migration periods only. The important difference between

the two tables is that in Table 4, our proxy for the size of the destination province's migrant community is not included as an explanatory variable. The obvious disadvantage of working with the full panel is the absence of this variable, which does place the coefficient estimates at risk of omitted variables bias. The advantage is that we can include the 1985-90 period, hence we can study the effects of changing reforms over a twenty-year period instead of a ten-year one.

The discussion of specific results is organized as follows. First, we examine estimates of a "basic" equation of the migration rate, a specification found in most other internal migration studies. Second, we examine estimates of this specification with Hukou restrictions added. Third, we add our other explanatory variables, partly to check on robustness of the coefficient estimates for Hukou, and also to see how important the additional controls are. Altogether, 11 estimated equations are examined – 5 for the full panel and 6 for the panel comprising the last two periods only.

Before discussing specific results, we must emphasize that interpretation of the numerical coefficients in Tables 4 and 5 requires some care due to the double-log functional form for the regression equations and because some of the independent variables are ratios. Each coefficient is technically an elasticity, the estimated percentage change in the *percentage* of persons moving from province j to province i (out of all persons moving from j). Furthermore, some coefficients will be estimates of the percentage change in the migration rate when there is a one percentage change in a ratio. For example, the coefficient on the destination/origin income ratio measures the estimated percentage change in the migration rate when relative destination income

changes by 1%. Note that all estimated equations in both tables include origin province fixed effects and time period controls, and are also corrected for heteroskedasticity. Finally, as all the tables indicate, data on some percentage variables were multiplied by 100 to allow for greater ease in interpretation of coefficients.

Estimates of the basic modified gravity model

Column I in each table shows estimates of a basic specification, due originally to Greenwood (1969). This specification includes distance, past migration (Table 5 only), regional differences in income, urban population shares and climate, as well as education levels and employment rates[20] in both places, as explanatory variables. The results generally confirm some predictions of a Western theory of internal migration, namely that migration rates are inversely related to geographic distance, and positively related to relative income in the destination, the likelihood of obtaining employment in the destination, and how much warmer the destination is relative to the origin.

According to column in Table 4 (5), a one percent increase in distance is estimated to reduce the migration rate by 1.29% (1.19%); a one percent increase in the destination/origin income ratio is estimated to raise the migration rate by 1.82% (1.76%); a one percent increase in the probability of employment in the destination is predicted to raise the migration rate by 6.44% (10.28%); and a one percent increase in the ratio of destination to origin Celsius temperature is predicted to increase the migration between

[20] Customarily, researchers use unemployment rates, but we use employment risks (probabilities of being gainfully employed) instead.

0.45% and 0.5%. Results for the origin province employment probability are mixed. For the full panel, the hypothesized negative sign is confirmed and it is estimated that a one percentage point increase in the likelihood of employment in the home province will reduce the migration rate by a little under 6%. Table 5 shows a positive but insignificant relationship, however. Finally, there are mixed results for the education and urban population share ratio. The results in Table 4 indicate that when the origin (destination) province is better educated out- (in-) migration falls (rises). However, Table 5 indicates that educational attainment in either province has no effect on migration patterns. The degree of urbanization appears to have no effect on migration. While these results for China are not as strong as the types of results commonly seen in applications of this empirical specification to other developing , as well as developed, countries, they generally suggest that the basic Western model of internal migration is appropriate for China.

Table 5 shows what happens to coefficient estimates for the basic migration equation when the migrant stock variable is added. With the addition of the migrant stock (see column II), it is found that: (a) adjusted R-square rises from approximately 59% to 68%; and (b) the majority of coefficients drop in absolute value, e.g. the distance elasticity falls from just under 1.2% to about 98%. The increase in goodness-of-fit and the attenuation of marginal effects of the other explanatory variables confirm the important role of past migration as a control. The addition of migrant stock improves the Western model's ability to account for Chinese migration patterns during the post-reform era.

The influence of migration restrictions

The next step was to take the basic modified gravity equation and add the Hukou control and the time period x Hukou interactions. Column II in Table 4 and column III in Table 5 show coefficient estimates when Hukou is measured by the lagged relative frequency of registered households. Hukou's effect is very strong and highly significant (this is called measure A). Column II in Table 4 predicts that a one-percentage point increase in the perceived probability of securing Hukou, e.g. perceived odds rise by one unit from 88.5 to 89.5 percentage points, will *ceteris paribus* induce an increase (decrease) in the migration rate of approximately 6%. Column III in Table 5 predicts that the migration rate will rise by 9.85%, all other things equal. Column III in Table 4 and Column IV in Table 5 show estimates when Hukou is measured as the joint probability of an unregistered migrant securing a job and Hukou (called measure B). From Table 4, when the odds of securing Hukou rise by a percentage point, the migration rate rises by 3.81%. From Table 5, a one percentage point increase in the odds of an unregistered migrant securing a job and Hukou will induce an increase in the migration rate of 7.39%. Note that Hukou's marginal effects are generally greater in Table 5 than Table 4, indicating that the structure of migration was different during the latter two periods compared to the first period.

How do the new explanatory variables influence migration?

The last two columns in Tables IV and V show coefficient estimates when all explanatory variables are included. Column IV (V) in Table 4 (5) shows estimates for the full equation when Hukou measure A is used; Column V (VI) in Table 4 (5) use Hukou measure B. Two important trends emerge. First, the coefficient estimates for Hukou are

relatively robust to expansion of the migration equation. Columns IV and V in Table 4 indicate that, depending upon which measure of Hukou is used, the elasticity of migration with respect to Hukou varies between about 4.97% and 5.37%. These coefficients are relatively little changed from the equations that didn't contain all the additional explanatory variables. Columns V and VI in Table 5 indicate that, again depending upon which measure of Hukou is used, the elasticity varies between 6.51% and just under 15%. No matter which permutation of the migration equation is used, Hukou restrictions exert a significant and robust influence on migration in China.

The second important trend relates to the migrant stock variable. Across all specifications in Table 5, past migration is found to exert the hypothesized effect on migration rates. The elasticity coefficients are remarkably uniform and all predict that a 1 percentage point increase in migrant stock will induce an increase in the migration rate of 0.001%. While this is a small effect, it is extremely robust and significant. Referring to the distance x past migration interaction, we find evidence confirming the hypothesis that when the home and destination provinces are farther apart, the marginal effect of past migration will be higher.

There are other results to note. While the relative size of the manufacturing labor force in the destination province does not appear to influence migration, there is some evidence suggesting that there is an inverse relationship between the relative minority population share in the destination and migration to that province. Contrary to what Bao, Hou and Shi (2006) would argue, a province with a smaller fraction of Han population is a less attractive province for migrants.

The results for the investment variables are mixed. In Table 4, our hypothesis that more investment in the destination, relative to the origin, will in general stimulate in-migration is strongly confirmed. Fixed asset investment (FAI) appears to have a stronger effect on migration than foreign direct investment (FDI). Furthermore, the coefficient on the FAI x FDI interaction indicates that the two types of investment complement one another in stimulating flows of persons from other provinces. In contrast, there is no support in Table 5 for the hypothesis that relative investment in the destination influences in-migration. Table 4 suggests that the marginal effect of FAI on out-migration is greater in wealthier provinces (higher per capita GDP), but the opposite is predicted in Table 5. Table 5 indicates that out-migration is smaller in provinces where a greater share of FDI is allocated to transportation infrastructure. This may be due to greater employment opportunities in the home province's transportation industry.

Finally, migration rates are found to be higher, all other things equal, when flows are between two adjacent provinces. All these and other results suggest that the basic modified gravity model (equations I in Table 4 and equations I and II in Table 5) are incomplete and that it is important to extend the specification to include other controls unique to the Chinese case.

A difference-in-differences test on the effects of Hukou

Our results show that the sensitivity of migration to restrictions varies substantially across periods. In Table 4, the default period is 1995-2000, so the coefficients on the interactions between the period dummies and Hukou (rows 3-4, columns II - V) are estimates of the difference between the elasticity of migration with respect to Hukou

restrictions in one period relative to the middle period. The following discussion pertains to equations IV and V. Using Hukou measure A, the estimated migration elasticity is 19% lower in 1985-90 than in 1995-2000, but only 3.77% lower in 2000-05 than in 1995-2000. This implies that the sensitivity of migration to Hukou rose between the 1980s and 1990s, fell between the 1990s and 2000s, but the fall was less in absolute value than the rise. This means that migration on balance is more sensitive to Hukou now than back in the 1980s. The same type of result emerges from measure B for Hukou; The Hukou elasticity was 9.48% lower in 1985-90 than in 1995-2000, but 2.04% lower in 2005-05 than in 1995-2000. These results suggest an inverse U-shaped pattern over time for the elasticity of migration with respect to Hukou. As the reforms deepened and Hukou was gradually dismantled, migrant responsiveness to the dismantling initially rose, peaked out, then fell. Thus the structure of migration, specifically with respect to migration restrictions, has changed as reforms have deepened.

In Table 5, the default period is 1995-2000. The following discussion pertains to columns V and VI in the table. Consider first measure A for Hukou. According to column V, row 3, the elasticity of migration with respect to the odds of securing Hukou was 13.58% higher in 1995-2000 than in 1995-2000. According to column VI, row 5, the elasticity with respect to the odds of an unregistered migrant securing a job and Hukou was approximately 4.62% higher in 1995-2000. While there are only two time periods analyzed here, these results are compatible with what was found in Table 4.

One can formally test for the inverse U-shaped relationship discussed above through a difference-in-differences test. Table 6 shows calculations from such a test on the

coefficients from columns IV and V in Table 4.[21] Note again that the default period is 1995-2000. The numbers in the second and third columns from the left are the same as those found in Table 4. The number in the last column is a difference-in-differences calculation. It is the estimated difference between (i) the 1985-90 and 1995-2000 difference in the elasticity; and (ii) the 2000-05 and 1995-2000 difference in the elasticity. The difference in differences calculation is 15.22% and tells us that while the Hukou elasticity was lower in both 1985-90 and 2000-05 than it was in 1995-2000, the 2000-05 number was much closer to the middle period number. This finding is significant at 1%. Row 4 shows the same type of information now using the joint odds of an unregistered migrant securing a job and local registration. While that elasticity was lower in the first and third periods, the third period elasticity was considerably closer to the middle period elasticity than the first period was. The difference-in-differences calculation is 7.45% and significant at 1%.

The difference-in-differences tests above suggest that between the 1980s and 1990s, migration's sensitivity to Hukou apparently rose, which may be a result of the deepening of economic reforms and deregulation of migration. Following the arrival of the new millennium, sensitivity fell, perhaps because the above-normal returns to migration had by then dissipated for most prospective migrants.[22] However, the sensitivity of migration to Hukou was still higher in the 2000s compared to the 1980s, consistent with our general hypothesis that China's move towards a market-based system heightened incentives to migrate.

[21] In the interest of space, we show only the results for the full sample and the migration equations with all controls included. Other results are available from the author upon request.
[22] We thank T.N. Srinivasan for pointing this out to us.

VI. CONCLUDING REMARKS

We view this study as making two important contributions to the literature on immigration. First, very little is known in the general immigration literature about the effects of restrictions on the scale and structure of migration. Due to lack of theoretical work, lack of data in many countries, and often vast differences in the types and qualities of available data across countries, the literature lacks answers to these questions: (i) How elastic are migration rates with respect to a change in quantitative restrictions; (ii) Does migration become more or less sensitive to restrictions as they ease over time; and (iii) Do restrictions influence the effects of other determinants on migration? We seized upon a very convenient natural experiment – post-reform China – a country with an internal passport system that has been undergoing incremental deregulation – for answers to these questions. For a cross-section study of the effects of immigration restrictions, China is a beautiful case of "borders within a border," allowing a researcher to test for the effects of restrictions across spatial units without having to use different data sets for different countries or having to control for country-specific influences such as type of political system, labor market structure, regulations, and educational system. Furthermore, China offers the researcher the opportunity to study the effects of restrictions in a transition economy, one that has been experiencing dramatic changes in the structure of its markets.

What we learn from our examination of the Chinese test case is that migration can be significantly responsive to a loosening of restrictions. We find that even a modest reduction in restrictions can greatly strengthen the incentive to migrate. We find strong evidence that the sensitivity of migration to Hukou restrictions has on balance risen over the last 30 years, with the greatest increase occurring during the 1990s. We also find that

adding migration restrictions to an empirical specification can influence considerably the effects that other determinants of migration have on migration. Therefore, restrictions change not only the scale of migration, but its *structure*. This inspires a question for future research: Are these results for post-reform China generalizable to an international study?

Our second contribution is to further clarify what drives migration in post-reform China. We see our study as generating two specific benefits in this regard. First, we show that Hukou's influence can be substantial, implying that if the goal of deregulation is to encourage more labor mobility, then further deregulation is clearly warranted. This confirms the findings of numerical simulations produced by Whalley and Zhang (2007) and Ito (2008). Second, the empirical literature on Chinese migration is still very small, comprising studies that estimate relatively parsimonious equations of migration rates. Most of these studies lack controls for migrant communities in the destination, indicators of a spatial unit's economic and demographic structures, FDI and domestic investments, export market dependency, and other influences. We add migrant networks, FDI and domestic fixed asset investments, industry and ethnic mix, climate, origin fixed effects, and more, to the modified gravity model of Chinese migration. We find these additional controls can contribute significantly to accounting for migration patterns across spatial units and time, hence failure to include them can result in substantial omitted variables bias. Finally, ours is the first comprehensive panel study of migration in China.

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TABLE 1
Summary Statistics for 1985-90 period
765 observations

Variable	Mean	Standard Deviation	Maximum	Minimum
Migration rate x 100[i]	3.775%	6.982%	79.336%	0.018%
Mean annual percentage of households with *Hukou* status during 1980-84 x 100	98.40%	1.412%	99.73%	94.94%
Percentage of migrants moving between adjacent provinces x 100	15.82%	36.51%		
Real Mean Annual FDI Per Capita during 1980-84[ii]	$US 1.544	$US 5.947	$US 31.75	$US 0.0038
Real Mean Annual Fixed Asset Investment (FAI) Per Capita during 1980-84[ii]	163.77 Yuan	132.84 Yuan	518.71 Yuan	40.888 Yuan
Percentage of provincial FAI attributable to transportation infrastructure x 100	3.67%	1.85%	8.82%	1.07%
Railway distance between capital cities	1,630.76 Kilometers	1.87 Kilometers	6,313.21 Kilometers	137 Kilometers
Real annual per capita income[iii]	510.95 Yuan	183.11 Yuan	1084.5 Yuan	340.53 Yuan
Percentage of adult population enrolled in universities x 100	3.05%	3.01%	1.02%	16.29%
Unemployment rate x 100	1.178%	0.705%	4.11%	0.28%
Manufacturing share of employment x 100	23.44%	12.10%	59.3%	9.47%
Urban share of population x 100	31.03%	16.17%	73.44%	14.87%
Mean yearly temperature	14.113 C	5.176 C	24.517 C	4.608 C
Minority population share	12.28%	16.06%	59.43%	0.31%

[i] In the 1990 Census, a migrant is defined as someone who has moved from other towns or townships and has lived in this place for more than one year but less than five years.
[ii] Computed using average annual CPI for 1980-84
[iii] Computed using income and average annual CPI for 1989 only

TABLE 2
Summary Statistics for 1995-2000 period
784 observations

Variable	Mean	Standard Deviation	Maximum	Minimum
Migration rate x 100[i]	3.589%	7.230%	87.317%	0.014%
Mean annual percentage of households with *Hukou* status during 1990-94 x 100	90.38%	5.443%	96.01%	74.97%
Percentage of persons moving between adjacent provinces x 100	15.43%	36.15%		
Past migration flows (1985-90)	1,351,400	3,439,300	44,320,000	10,000
Real Mean Annual FDI Per Capita during 1990-94[ii]	$US 16.14	$US 24.25	$US 92.73	$US 0.58
Real Mean Annual Fixed Asset Investment (FAI) Per Capita during 1990-94[ii]	871.66 Yuan	717.63 Yuan	3393.2 Yuan	229.7 Yuan
Percentage of provincial FAI attributable to transportation infrastructure x 100	5.48%	2.04%	11.07%	2.81%
Real annual per capita income[iii]	1,069 Yuan	442.2 Yuan	2,451.5 Yuan	605.26 Yuan
Percentage of adult population enrolled in universities x 100	5.92%	3.58%	3.13%	20.5%
Unemployment rate x 100	4.40%	2.41%	9.64%	1.36%
Manufacturing share of employment x 100	22.83%	9.82%	49.25%	9.17%
Mean yearly temperature	14.113C	5.176C	24.517C	4.608C
Urban share of population x 100	40.20%	18.56%	90.67%	18.63%
Minority population share x 100	12.28%	16.06%	59.43%	0.31%

[i] In the 2000 Census, a migrant is defined as someone who has moved from other towns or townships and has lived in this place for more than one year but less than five years.
[ii] Computed using average annual CPI for 1990-94
[iii] Computed using income and average annual CPI for 1999 only

TABLE 3
Summary Statistics for 2000-05 period
751 observations

Variable	Mean	Standard Deviation	Maximum	Minimum
Migration rate x 100[i]	3.655%	7.387%	87.32%	0.01%
Mean annual percentage of households with *Hukou* status during 1995-99 x 100	88.57%	6.726%	95.85%	67%
Percentage of persons moving between adjacent provinces x 100	16.11%	36.79%		
Past migration flows (1995-2000)	1,218,100	3,531,800	45,360,000	10,000
Real Mean Annual FDI Per Capita during 1995-99[ii]	$US 44.64	$US 66.57	$US 253.05	$US 1.15
Real Mean Annual Fixed Asset Investment (FAI) Per Capita during 1995-99[ii]	2,452.8 Yuan	2,441.5 Yuan	12,705 Yuan	646.5 Yuan
Percentage of provincial FAI attributable to transportation infrastructure x 100	9.2%	3.06%	17.19%	3.98%
Real annual per capita income[iii]	5,122.3 Yuan	2,632.7 Yuan	13,484 Yuan	2,614.6 Yuan
Percentage of adult population enrolled in universities x 100	8.69%	4.92%	4.03%	28.05%
Unemployment rate x 100	3.14%	1.50%	7.17%	1.21%
Manufacturing share of employment x 100	22.83%	9.82%	49.25%	9.17%
Mean yearly temperature	14.27C	5.24C	25.1C	4.70C
Urban share of population x 100	40.20%	18.56%	90.67%	18.63%
Minority population share x 100	12.83%	16.47%	60.13%	0.31%

[i] In the 2005 Census, a migrant is defined as someone who has moved from other towns or townships and has lived in this place for more than one year but less than five years.
[ii] Computed using average annual CPI for 1995-99
[iii] Computed using average annual income and average annual CPI for 2000-05

TABLE 4
OLS Results for Full Sample (1985-90, 1995-2000 and 2000-05 migration periods)
Dependent variable = log gross interprovincial migration rate
(Standard Errors in Parentheses; ** denotes significant at 1%, * significant at 5%)

REGRESSOR	I	II	III	IV	V
Log (odds of Hukou in dest. x 100) (Measure A)		5.999** (2.96)		5.367** (3.015)	
A x early dummy		-21.638* (4.229)		-18.995** (4.210)	
A x late dummy		-3.911** (2.685)		-3.773 (2.693)	
Log (odds of migrant securing a job with Hukou x 100) (Measure B)			3.810** (1.151)		4.970** (1.244)
B x early dummy			-13.282** (3.285)		-9.482** (3.213)
B x late dummy			-1.262 (1.098)		-2.037 (1.126)
Log distance	-1.286** (0.039)	-1.302** (0.039)	-1.314 (0.040)	-0.954** (0.059)	-0.961** (0.059)
Dummy = 1 if flow is between two adjacent provinces				0.823** (0.089)	0.819** (0.089)
Log (dest./origin income ratio)	1.824** (0.090)	1.882** (0.098)	1.902** (0.093)	1.733** (0.128)	1.805** (0.122)
Log (university enrollment in origin x 100)	-0.073 (0.142)	-0.065 (0.141)	-0.070 (0.142)	0.086 (0.140)	0.073 (0.141)
Log (university enrollment in destination x 100)	-0.182** (0.080)	-0.209** (0.086)	-0.205** (0.083)	-0.387** (0.103)	-0.297** (0.098)
Log (1- unemp. rate in origin)	-5.896** (2.163)	-6.081** (2.148)	-6.187** (2.159)	-4.267** (2.156)	-4.575** (2.165)
Log (1- unemp. rate in destination)	6.440** (1.518)	3.553** (1.663)		6.701** (1.735)	
Log (ratio of dest. to origin urban population shares)	-0.085 (0.126)	-0.144 (0.127)	-0.178 (0.115)	-0.077 (0.125)	-0.181 (0.114)
Log (ratio of dest. to origin temperatures)	0.478** (0.062)	0.458** (0.062)	0.476** (0.062)	0.364** (0.070)	0.404** (0.069)
Log (ratio of dest. to origin manufacturing employment shares)				-0.002 (0.090)	-0.012 (0.091)
Log(ratio of dest. to origin minority population shares)				-0.006 (0.017)	-0.013 (0.17)
Log (ratio of dest. to origin per capita FAI)				0.133** (0.053)	0.098** (0.051)

Log (ratio of destination to origin per capita FDI)				0.059** (0.018)	0.053** (0.018)
Log FAI ratio x Log FDI ratio				0.027** (0.007)	0.023** (0.006)
Log(transportation share of fixed asset investment in origin x 100)				-0.081 (0.083)	-0.093 (0.084)
Log (origin per capita GDP) x Log (origin per capita FAI)				0.034** (0.010)	0.032** (0.011)
Early period dummy	-0.152 (0.235)	99.467** (19.47)	122.06** (30.17)	87.728** (19.38)	87.675** (29.52)
Late period dummy	-0.033 (0.090)	18.02 (12.34)	11.634 (10.04)	16.825 (12.37)	18.233 (10.29)
Constant	8.467 (12.87)	-4.949 (16.78)	4.517 (15.43)	-29.524 (17.21)	-18.489 (15.71)
Adjusted R-squared	0.5479	0.5529	0.5499	0.5791	0.5744
SSE	2487.5	2457.2	2474.5	2305.4	2332.1
Sample size	2,385	2,385	2,385	2,385	2,385

TABLE 5
OLS Results for later two periods
Dependent variable = log gross interprovincial migration rate
(Standard Errors in Parentheses; ** denotes significant at 1%, * significant at 5%)

REGRESSOR	I	I I	III	IV	IV	V
Log (odds of Hukou x 100) (Measure A)			9.850** (3.06)		14.989** (2.859)	
A x 2000-05 dummy			-6.748** (2.483)		-13.578** (2.334)	
Log (odds of migrant securing job in dest. with Hukou x 100) (Measure B)				7.390** (1.317)		6.507** (1.293)
B x 2000-05 dummy				-2.953** (1.00)		-4.618** (0.913)
Log (relative size of migrant network)		0.001** (0.0002)	0.001** (0.0002)	0.001** (0.0002)	0.0008** (0.0001)	0.0008** (0.133)
Log distance	-1.186** (0.046)	-0.978** (0.045)	-0.981** (0.044)	-0.988** (0.045)	0.003 (0.051)	0.004 (0.063)
Log distance x Log network					0.062** (0.003)	0.061** (0.003)
Dummy = 1 if adjacent borders					0.193** (0.069)	0.205** (0.069)
Log (ratio of dest. to origin incomes)	1.756** (0.095)	1.508** (0.087)	1.590** (0.095)	1.631** (0.092)	1.114** (0.107)	1.141** (0.102)
Log (university enrollment in origin x 100)	0.024 (0.221)	0.060 (0.208)	0.056 (0.209)	0.058** (0.210)	0.264 (0.177)	0.278 (0.178)
Log (university enrollment in dest. x 100)	-0.182 (0.122)	-0.203* (0.105)	-0.016 (0.130)	-0.016 (0.116)	-0.769** (0.114)	-0.848** (0.107)
Log (1 - unemp. rate in origin)	1.337 (3.553)	1.756 (3.181)	1.758 (3.175)	1.695 (3.182)	4.478 (2.812)	4.253 (2.823)
Log (1 – unemp. rate in dest.)	10.279** (1.818)	9.434** (1.586)	8.107** (1.603)		5.029** (1.647)	
Log (ratio of dest. to origin urban shares)	0.148 (0.156)	0.161 (0.135)	0.102 (0.136)	0.004 (0.124)	0.516** (0.111)	0.500** (0.104)
Log (ratio of dest. to origin temperatures)	0.448** (6.073)	0.437** (0.066)	0.505** (0.068)	0.486** (0.067)	0.641** (0.073)	0.632** (0.073)
Log (ratio of dest. to origin manufacturing employment shares)					-0.051 (0.083)	-0.028 (0.081)

Log (ratio of dest. to origin minority population shares)					-0.032** (0.015)	-0.034** (0.015)
Log (ratio of dest. to origin real per capita FAI)					-0.060 (0.053)	-0.038 (0.051)
Log (ratio of dest. to origin real per capita FDI)					0.041 (0.029)	0.011 (0.028)
Log FAI ratio x Log FDI ratio					0.005 (0.005)	0.004 (0.005)
Log (transportation share of fixed asset investment in origin x 100)					-0.318** (0.126)	-0.316** (0.127)
Log (origin per capita GDP) x Log (origin per capita FAI)					-0.032** (0.013)	-0.031** (0.012)
2000-05 period	-0.289** (0.127)	-0.265** (0.116)	30.738** (11.40)	26.844** (9.144)	63.081** (10.74)	43.018** (8.361)
Constant	-42.967** (18.23)	-42.759** (16.25)	-82.319** (20.76)	-67.415** (18.91)	-107.01** (19.27)	-73.683** (17.7)
Adjusted R-squared	0.5894	0.679	0.6811	0.6796	0.7826	0.7797
SSE	1362.7	1063.6	1056.1	1061.9	715.71	725.8
Sample size	1,535	1,535	1,535	1,535	1,535	1,535

TABLE 6
Difference-in-Differences Tests of the Hukou Elasticity Over Time[1/]
(Standard Errors in Parentheses; ** denotes significant at 1%, * significant at 5%)

	1985-90 and 1995-2000 difference	2000-05 and 1995-2000 difference	Difference-in-Differences
Marginal effect relative to 1995-2000 period of:			
Log (odds of securing Hukou x 100), (measure A)	-18.995** (4.210)	-3.773** (2.693)	15.222** (3.419)
Log (odds of a migrant securing a job with Hukou x 100), (measure B)	-9.482** (2.951)	-2.037 (1.126)	7.445** (3.222)

[1/]Coefficients are taken from estimates of equations (IV) and (V) in Table 4 only. Other results are available from the author upon request