Modeling Interprovincial Migration in China, 1985–2000

C. Cindy Fan[1]

Abstract: Using data from China's 1990 and 2000 censuses, this paper examines interprovincial migration by describing its spatial patterns and estimating models based on the gravity approach. Between the censuses, interprovincial migration increased considerably in size and became more unidirectional and concentrated. Modeling results highlight the role of regional economic disparity and migration stock, as well as the gravity variables of population and distance, in explaining migration flows. Over time, the effect of regional disparity has increased, while that of distance decreased. Findings suggest that models based on experiences of countries lacking migration control are increasingly relevant for China. *Journal of Economic Literature*, Classification Numbers: C10, O15, O18. 3 figures, 3 tables, 45 references. Key words: internal migration, China, regional disparity, social networks, gravity model, migration stock.

INTRODUCTION

The rapid surge of migration has been one of the most profound changes in China over the past two decades. Despite the proliferation of research on this phenomenon, most studies use a descriptive approach and as such are limited in their theoretical contribution. In addition, relatively few efforts have been made to use a modeling approach to examine migration in China. Because of the dominance of government-sponsored migration and the prevalence of migration control during the pre-reform period, it is questionable if conventional migration models, such as the gravity model, are relevant for China. Changes since the reforms, however, have brought about new circumstances for population movements. Specifically, self-initiated migration has increased and the regional gap in development has widened. In this paper, using data from China's 1990 and 2000 censuses, I examine interprovincial migration and attempt to show that the logic of the gravity model as well as regional disparity and migration stock are important explanations for population flows in China.

In the next section, I briefly describe the gravity approach and its relevance for China. This is followed by an account of the recent changes in China and their implications for population movements, the role of migration networks, and a short review of recent studies that use modeling to examine migration in China. The next two sections deal with, respectively, the census data and the spatial patterns of interprovincial migration based on these data. The

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second half of the empirical analysis focuses on estimating models of interprovincial migration. I conclude by summarizing the findings and their theoretical and methodological implications.

GRAVITY MODELS OF MIGRATION

The most popular models to predict migration flows are based on the gravity approach. Also referred to as spatial interaction models, this family of models relates migration to the origin's population, the destination's population, and the distance between the origin and destination, based on the principle that the frequency and interaction between two places are akin to the gravitational attraction between two masses (Zipf, 1946). The gravity approach has provided a good fit to migration flows in many empirical cases. Numerous modified versions of the gravity model, via for example adding single or double constraints, have improved even more the accuracy of the models (Haynes and Fotheringham, 1984, p. 92; Isard, 1998).

Although widely agreed to be a good descriptive device, the gravity models have been criticized for not addressing the causes of migration and the many considerations in the decision-making process of migrants (Clark, 1986, p. 57). This weakness is in large part due to the models' focus on macro-level forces rather than micro-level reasoning. Efforts to correct this weakness include adding variables that represent the socioeconomic conditions of the origin and the destination, such as income, employment, education, and age structure (Lowry, 1966; Greenwood, 1969; Kau and Sirmans, 1979; Fotheringham and O'Kelly, 1989, pp. 98-102). By doing so, researchers seek to emphasize the relationship between migration and regional economic development, one that is consistent with Ravenstein's (1889) observation that humans migrate primarily to improve their economic well being. To be sure, the relationship is reciprocal rather than unilateral (Richardson, 1978, pp. 108-109; Greenwood, 1981, pp. 143-168), but economic development is undoubtedly an important determinant of why, and to and from where, one moves. Research has also linked present patterns of migration to past migration, in order to make the models more dynamic. A popular approach is to include a migration stock variable, which is usually defined as the number or proportion of migrants from the origin to the destination (Kau and Sirmans, 1979; Haynes and Fotheringham, 1984, p. 93). Greenwood (1969) shows that the failure to include a stock variable would overestimate and obscure the true direct effect of other variables in the model.

Studies that use the gravity approach to examine migration in China are relatively scarce.[2] This is partly due to data constraints, as this modeling approach requires detailed data on not only migration volume but migration flows. But perhaps a more important reason is the relatively low mobility and the dominance of government-sponsored migration in China until recent decades. Under these circumstances, it is questionable if the gravity family of models, which is primarily based on empirical experiences where mobility control is largely absent, are relevant. On the other hand, the Chinese economy is undergoing major structural change. Like other transitional economies, constraints and opportunities for migration, and thus considerations in the decision-making process, are also changing. Recent changes in policy have made it possible for massive number of Chinese to look for jobs across the country. The regional gap in development has widened, hinting at increasingly strong push and pull forces on migration. By estimating migration models using the gravity approach, I seek to assess if widely accepted notions about migration—those having to do

[2]For a brief review, see the following section.

with the gravity principles, regional economic development, and migration stock—are relevant for understanding the Chinese empirical case. I now turn to a description of recent changes in China related to migration and a brief review of selected studies on modeling migration in China.

MODELING MIGRATION IN CHINA

Two major and recent changes are especially relevant for the analysis of migration in China. The first change is concerned with migration control. Between 1949 and the late 1970s, central planning was key to understanding flows of resources, including human ones, in China. The state considered migration an instrument for ideologically driven development programs. For example, urban youths were "rusticated" to the countryside and to remote regions during the Cultural Revolution. Under the Third Front program between the mid-1960s and early 1970s, labor was transferred to the relatively poor and remote provinces in central and western China. Government-sponsored migration, therefore, took place from more developed regions to less developed regions. Between the late 1950s and the early 1980s, self-initiated migration was largely confined to rural destinations (Yang, 1994, p. 188). The state controlled self-initiated migration to urban areas via a *hukou* (household registration) system that was formally implemented during the late 1950s.[3] Suffice it to say that, prior to the 1980s, rural Chinese were blocked from moving to urban areas because they did not have access to housing, food, and jobs there—resources that were tied to the *hukou*. In much of pre-reform China, not only was rural-urban migration strictly controlled, the overall level of mobility was low (Yang, 1994, p. 116; Cai, 2001, pp. 44-48).

Under the above circumstances, gravity models are not effective in describing population movements in China. Rather than moving to destinations with large population, migrants were rusticated to small and remote places. The effect of distance, likewise, was not as one expected, as labor was moved to locations far from developed regions. In addition, the *hukou* system deterred self-initiated migration to cities, so that individuals who desired to move to places with better economic opportunities were prevented from moving. The relationship between regional economic development and migration was, therefore, different from that expected in societies where migration is generally free.

Since the 1980s, however, relaxation of migration control in China has brought about new circumstances that are more similar to those assumed by gravity models. Specifically, the state has introduced a series of additions and revisions to the *hukou* system, so that rural Chinese are permitted to work in urban areas as temporary migrants (Goldstein and Goldstein, 1991). Although most rural migrants are still denied urban *hukou*, they now have access to the goods and services necessary for their survival in urban markets. I have argued elsewhere that by relaxing migration control and continuing to deny migrants urban *hukou*, the state has sought to foster a migrant labor regime in order to accelerate industrialization at low cost (Fan, 2004b). This new policy has unleashed massive migration. Between the 1990 and 2000 censuses, intercounty migration more than doubled in size and interprovincial migration almost tripled (Liang and Ma, 2004; Fan, 2005). Such a rapid increase in mobility was largely attributable to temporary migrants—migrants who do not have local *hukou* (Yan, 1998; Liang, 2001). According to the 2000 census, the floating population, or persons whose residence is different from the *hukou* location, amounted to 144 million (NBS, 2002a, p. 14).

[3]Details of the *hukou* system have been extensively reviewed elsewhere (e.g., Cheng and Selden, 1994; Chan and Zhang, 1999; Yu, 2002; Wu and Treiman, 2004) and are not repeated here.

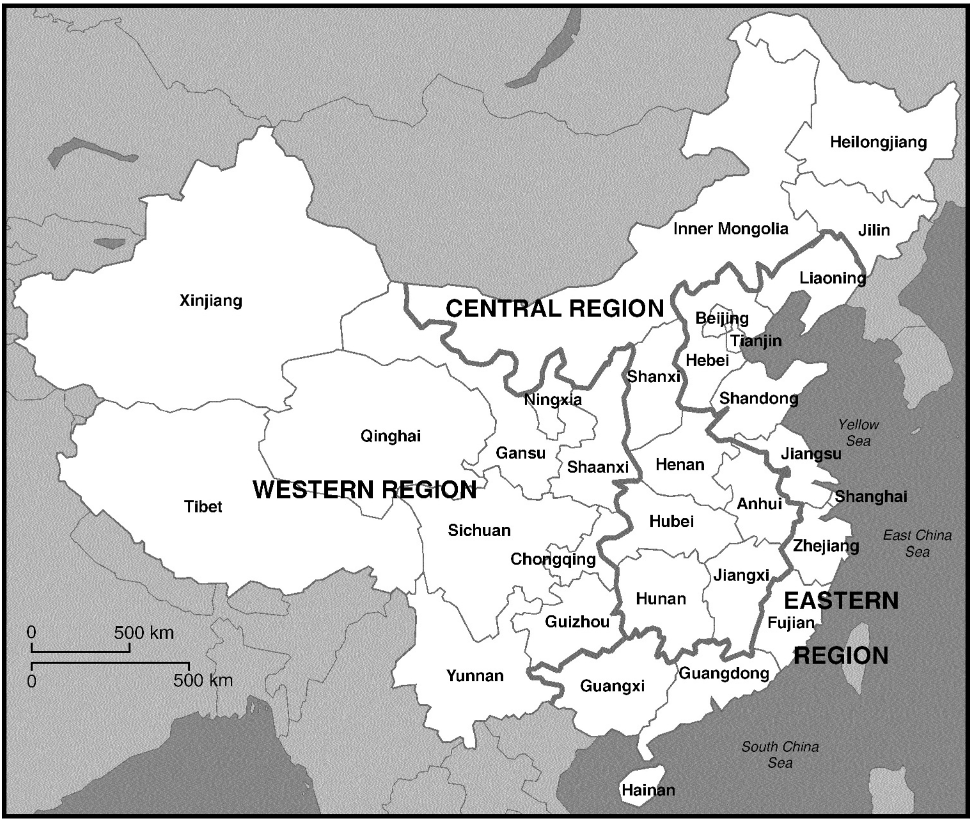

Fig. 1. Provincial-level units in China.

Most temporary migrants are not sponsored by the government but are self-initiated migrants. They are predominantly from rural areas and their migration is in response to economic opportunities, especially those found in large urban areas. Furthermore, their selection of migration destination is sensitive to distance, as long-distance travel is costly and information about distant places is relatively scarce. All of this suggests that migration models that emphasize the effects of population, distance, and economic development may be increasingly useful for China.

A second major change in the reform period involves an increase in regional disparity. By taking on a developmentalist role to accelerate economic growth, the Chinese state has prioritized the eastern region as the first to benefit from economic reforms (see Fig. 1). Deng's famous quote—"let some people and some regions get rich first; the others will follow"—succinctly summarizes this new development philosophy. Thus, state investment was pumped into the eastern region, along with preferential policies that made the region attractive to foreign investment. Many studies have shown that the development gap between the eastern region and the rest of China has widened over time (e.g., Fan, 1995; Wei, 2000). In 1985, the GDP per capita for the eastern region was 1.45 times that of the central region and 1.70 times that of the western region; these ratios increased to, respectively, 1.94 and 2.47 in 2003 (Fan, 2005; see also Table 2). Increased regional disparity provides impetus to migration. Expansion of employment and economic opportunities in the eastern region is a profound contrast to rural poverty and stagnant growth in many inland provinces. Facing a large development gap, and having greater autonomy to move (despite continued restrictions on *hukou*), the Chinese respond enthusiastically by moving in large numbers from less developed regions to the more developed ones. Thus, migration models that address regional economic disparity are likely to be increasingly relevant in describing population movements in China.

Despite the changes described above, China continues to set itself apart from Western capitalist economies by its rapid changes and by its simultaneous adoption of market and central planning mechanisms. The dramatic increase of migration volume, for example, suggests that models that deal with only one point in time are inadequate. In addition, remnants of the socialist period, such as the *hukou* system, continue to shape the patterns of migration. Specifically, rural migrants are institutionally inferior and have little access to state-sponsored resources, including information about jobs (Solinger, 1999). Thus, most peasants rely on social networks, via fellow villagers, friends, relatives, and family members, as the primary source of information about prospective migration destination and job opportunities (Cai, 2001, pp. 198-215; Fan, 2002; Lou et al., 2004). These networks often explain how migration takes place and determine where migrants move to. For example, after the Spring Festival (when rural migrants customarily return to the home village), it is very common for new migrants to follow their more experienced counterparts to desirable destinations, sometimes even to be hired by the same employers (Fan, 2004a). Migration streams from specific origins to specific destinations reflect not only migration stock as a lagged variable but the role of social networks. The importance of social networks is not unique to China, but the institutional inferiority of rural migrants is an additional reason for them to rely heavily on social networks. A migration stock variable is, therefore, critical for a migration model for China.

The body of research using modeling to examine migration in China is small but growing. Partly because of data constraints, most studies focus on migration volume and rate at the origin or destination rather than origin-destination flows. Liang and White (1997) estimated models that predict provincial in-migration and out-migration propensities, based on data from a national survey conducted in 1988. Census-type data, on the other hand, enable direct modeling of migration flows. Using data from the 1990 census, Wang (1993) included GDP and per capita income of the destination into a gravity-type model to predict migration rate from a specific province to all provinces. He found that the signs of the economic and distance coefficients are as expected. Also using the 1990 census and focusing on interprovincial migration, Chan et al. (1999) defined the migration rate between pairs of origin and destination provinces as the dependent variable and linked it to gravity, economic, and demographic variables. Moreover, they included a stock variable, defined as the ratio of in-migrants to the destination's population in a previous period (1982–1986), which was found to be significant for temporary migrants and points to the importance of migration networks. Shen (1999) used the migration flow between pairs of provinces as the dependent variable and determined that it is strongly influenced by the destination's economic growth and level of industrialization.

Also using interprovincial migration flow as the dependent variable, Yan (1998) examined data from the 1995 One-Percent Population Sample Survey and focused on the eight largest origin provinces. His independent variables include distance, ratio of GDP per capita between the destination and the origin, ratio of growth rate of GDP between the destination and the origin, and a migration stock variable. Yan defined migration stock as the proportion of out-migrants from an origin to a destination to all out-migrants from that origin in a previous period (the 1990 census). This variable assesses the propensity of migrants from a specific origin to go to a specific destination. Migration propensity is a more desirable form of the stock variable than migration flow, as the latter is likely to result in model circularity and to be highly correlated with other independent variables (Haynes and Fotheringham, 1984, p. 92). The analysis in this paper employs Yan's definition of the stock variable. His paper shows that an economic gap is important but migration stock is even more important, which again highlights networks as a determining factor of the spatial pattern of migration.

Informed by the studies reviewed above, this paper seeks to estimate models for interprovincial migration that are relatively simple but that include the most prominent factors of migration in China and use the most widely accepted forms of the variables. Inasmuch as intraprovincial migration is important, interprovincial migration is a more prominent factor of population redistribution and economic development at the national and regional levels (Ma, 1996). As described earlier and suggested by the literature, interprovincial migration is strongly influenced by economic disparity between regions and by migration networks. Thus, I include all the fundamental elements of the gravity approach—population and distance—and add to them economic variables representing the origin and the destination, as well as a stock variable. This approach facilitates straightforward interpretation and, most importantly, allows all theoretically driven variables to be kept in the model (and not be dropped because of multicollinearity, as is the case of some existing studies), thus enabling comparison and theoretical analysis. Unlike most studies, this paper employs data from two censuses, thus making it possible to examine how prominent factors of migration have changed over time.

DATA FOR THE EMPIRICAL ANALYSIS

Systematic and national-level data on migration in China did not exist until the 1980s, which was a major constraint on modeling and quantitative analysis. The 1990 census was the first Chinese census that included specific questions about migration, and the 2000 census had even more detailed information about migration. Taken together, these two enumerations are widely considered the authoritative sources for examining changes in migration since the 1980s.[4] The empirical analysis in this paper employs data from both censuses.

Not unlike enumerations in other countries, the Chinese census uses a spatial criterion to define migration. A migrant is a person five years of age or older whose usual place of residence five years ago was different from that on the census day. In addition, a second, temporal, criterion tied to the *hukou* system is used, in order to exclude transients and short-term migrants. In the 1990 census, in addition to satisfying the spatial criterion, an individual must (1) have moved his/her *hukou* to the place of enumeration or (2) have physically stayed in the place of enumeration or have left the *hukou* location for more than one year, in order to be defined as a migrant.[5] The first condition defines permanent migrants (i.e., those who possess local *hukou*), and the second condition defines temporary migrants (those who do not have local *hukou*). The 2000 census revised the temporal criterion of temporary migrants from one year to six months. It is difficult to assess the effect of this change, but recent

[4]Although the 1995 One Percent Population Sample Survey is also a popular source of migration data, scholars have noted that the survey had seriously underestimated the actual migration volume (Chan and Hu, 2003; Liang and Ma, 2004).

[5]Persons who have stayed in the place of enumeration or have left the *hukou* location for less than one year are included in the place of registration (*hukou* location) and are not reflected as migrants (Cao, 1995).

Table 1. Volume of Interprovincial Migration in China[a]

	1985-1990 (1990 census)	1995-2000 (2000 census)
Volume (million)	10.76	31.81
Rate (% of 5+ population in 1990/2000)	1.06	2.72

[a]Tibet is omitted and Sichuan is combined with Chongqing.
Sources: Compiled by the author from State Statistical Bureau, 1992, pp. 20 and 126-139, and National Bureau of Statistics, 2002a, p. 570; 2002b, pp. 1813-1817.

studies suggest that the surge in migration between the two censuses reflects an actual and significant increase in mobility rather than a change in definition (Yan, 1998; Liang and Ma, 2004). At the time of this paper's writing, the National Statistical Bureau has not made publicly available data from the 2000 census that specify the *hukou* status of migrants. Without such data, it is impossible to separately examine permanent migrants and temporary migrants. Thus, the empirical analysis here includes all migrants, regardless of their *hukou* statuses. As the volume of temporary migrants increased considerably between the two censuses, more so than that of permanent migrants (Liang and Ma, 2004), this paper's findings likely reflect the contribution of temporary migrants more than that of permanent migrants.

China's provincial-level units[6] (Fig. 1) include regular provinces such as Guangdong, autonomous regions such as Xinjiang, and centrally administered municipalities such as Beijing. Between the two censuses, the number of provincial-level units increased from 30 to 31, because in 1996 Chongqing was "upgraded" from a city in Sichuan into a centrally administered municipality. For the sake of simplicity, I use the term "province" to refer to all types of provincial-level units; accordingly, interprovincial migration refers to migration that takes place from one provincial-level unit to another.

In the empirical analysis, I omit Tibet because its in-migration data are absent in the 1990 census. In addition, I combine Chongqing with Sichuan in order to facilitate comparison between the two censuses. These two adjustments result in a data set consisting of 29 provinces. The 1990 census recorded a total of 10.76 million migrants between the 29 provinces, accounting for 1.06 percent of the 5+ population (Table 1). The 2000 census documented a surge of interprovincial migration to 31.81 million, or 2.72 percent of the 5+ population. Although the level of mobility is still low compared with that in Western countries,[7] the rate at which mobility has increased in China is remarkable. The average of the 812 flows between pairs of the 29 provinces is, respectively, 13,302 and 39,178 for the 1985–1990 and 1995–2000 periods.

SPATIAL PATTERNS OF INTERPROVINCIAL MIGRATION

Table 2 shows the population of each of the provinces, as well as GDP per capita and volumes of in-migration, out-migration, and net migration. Data on population and GDP per capita for 1988 and 1998 depict the provinces' situations near the mid-points of the two

[6]Hong Kong and Macao, which are Special Administrative Areas (SAR), are not included in the empirical analysis.

[7]For example, the inter-state migration rate in the U.S. was respectively 9.37 and 8.42 percent in the 1990 and 2000 censuses.

Table 2. Population, GDP per Capita, and Interprovincial Migration in China[a]

Province	Population (million)			GDP per capita (1998 constant yuan)			GDP per capita annual growth		Interprovincial migration ('000) (thous.) 1985-1990			1995-2000		
	1988	1998	2003	1988	1998	2003	1988-1998 pct.	1998-2003 pct.	In	Out	Net	In	Out	Net
Eastern	450	507	535	3,785	9,483	14,277	9.2	8.2	6,129	4,174	1,955	24,945	7,807	17,138
Pct. of nation	41.4	41.2	40.9	—	—	—	—	—	57.0	38.8	—	78.4	24.5	—
Beijing	11	12	15	9,244	16,142	23,469	5.6	7.5	663	123	539	1,888	174	1,714
Tianjin	8	10	10	6,405	13,964	21,754	7.8	8.9	312	86	225	491	104	387
Hebei	58	66	68	2,554	6,479	10,086	9.3	8.9	468	665	-197	769	872	-103
Shandong	81	88	91	2,924	8,104	12,911	10.2	9.3	609	523	86	903	878	26
Liaoning	38	42	42	4,772	9,338	12,909	6.7	6.5	517	272	245	754	380	375
Shanghai	13	15	17	11,536	25,193	33,028	7.8	5.4	655	150	505	2,167	163	2,004
Jiangsu	64	72	74	4,178	10,025	15,610	8.8	8.9	837	588	248	1,907	1,240	667
Zhejiang	42	45	47	4,076	11,193	18,730	10.1	10.3	321	626	-305	2,714	968	1,746
Fujian	28	33	35	2,853	10,095	13,663	12.6	6.1	294	228	67	1,346	624	722
Guangdong	59	71	80	3,838	11,087	16,093	10.6	7.5	1,162	250	911	11,500	438	11,062
Hainan	6	8	8	2,930	5,829	7,714	6.9	5.6	133	112	22	218	130	88
Guangxi	41	47	49	1,719	4,071	5,188	8.6	4.9	157	549	-391	287	1,838	-1,551

Central	388	440	452	2,483	5,249	7,369	7.5	6.8	2,814	3,690	-876	3,246	15,590	-12,344
Pct.of nation	35.7	35.8	34.5	—	—	—	—	—	26.1	34.3	—	10.2	49.0	—
Anhui	54	62	64	2,243	4,537	5,871	7.0	5.2	343	538	-195	313	2,892	-2,579
Shanxi	28	32	33	2,696	5,048	6,824	6.3	6.0	269	227	42	382	333	49
Inner Mongolia	21	23	24	2,850	5,084	8,639	5.8	10.6	239	278	-39	325	441	-116
Jiangxi	36	42	43	1,980	4,419	6,261	8.0	7.0	226	277	-52	235	2,680	-2,445
Jilin	24	26	27	3,399	5,892	8,879	5.5	8.2	254	346	-92	254	529	-275
Heilongjiang	35	38	38	3,697	7,508	10,761	7.1	7.2	332	594	-262	301	940	-639
Henan	81	93	97	1,830	4,677	6,929	9.4	7.9	493	578	-85	468	2,306	-1,838
Hubei	52	59	60	2,837	6,271	8,220	7.9	5.4	411	348	62	605	2,209	-1,604
Hunan	59	65	67	2,285	4,939	6,652	7.7	6.0	248	504	-256	362	3,260	-2,898
Western	249	283	322	2,162	4,056	5,785	6.3	7.1	1,818	2,897	-1,078	3,621	8,415	-4,794
Pct. of nation	22.9	23.0	24.6	—	—	—	—	—	16.9	26.9	—	11.4	26.5	—
Sichuan	106	116	146	2,097	4,336	6,212	7.3	7.2	410	1,287	-877	660	5,091	-4,432
Guizhou	31	37	39	1,555	2,301	3,260	3.9	7.0	198	309	-111	261	1,231	-971
Yunnan	36	41	44	1,996	4,329	5,213	7.7	3.7	232	272	-40	731	397	334
Shaanxi	31	36	37	2,438	3,842	6,117	4.5	9.3	301	332	-31	420	716	-296
Gansu	21	25	26	2,076	3,453	4,765	5.1	6.4	159	269	-110	203	555	-353
Qinghai	4	5	5	3,135	4,377	7,129	3.3	9.8	104	98	5	76	120	-44
Ningxia	4	5	6	2,602	4,228	6,225	4.9	7.7	78	56	22	129	87	41
Xinjiang	14	17	19	3,480	6,392	9,142	6.1	7.2	336	273	63	1,142	216	926
China	1,087	1,230	1,309	2,948	6,317	9,802	6.3	7.1	10,761	10,761	0	31,813	31,813	0

[a]Tibet is omitted and Sichuan is combined with Chongqing.

Sources: Compiled by author from Hsueh et al., 1993; State Statistical Bureau, 1992, pp. 126-139; National Bureau of Statistics, 2002b, pp. 1813-1817; and China Statistical Yearbooks.

migration periods, while data for 2003 are the most recent available. The migration data once again indicate a considerable increase in mobility between the 1985–1990 and 1995–2000 periods. Among the "three economic belts" (eastern, central, and western), the eastern region accounted for about 41 percent of China's population but respectively 57 percent and 78 percent of interprovincial in-migration in the two periods. This region has been, no doubt, a gainer in migration, as further evidenced by its highly positive net migration figures. Conversely, the central and western regions as a whole lost population due to migration; hence, their net migration figures were negative in both periods. Moreover, the discrepancy in net migration between the eastern region on one hand and the central and western regions on the other has increased, as did the discrepancy between the major donor provinces and receiving provinces, between the two censuses. This shows that gainers are gaining more and losers are losing more, and that interprovincial migration is playing an increasingly important role in redistributing population between provinces, an observation described in detail elsewhere (Fan, 2005).

The data in Table 2 illustrate further the importance of population size and level of economic development as factors of interprovincial migration. Most of the leading donor provinces (as indicated by large volumes of out-migration) have a large population. For example, Sichuan was the largest donor of interprovincial migration in both periods as well as the most populous province in China. Other major donor provinces with large population include Henan, Hebei, Hunan, and Anhui. Among prominent receiving provinces (as indicated by large volumes of in-migration), Shandong, Guangdong, and Jiangsu are respectively the third, fourth, and fifth most populous provinces of China. There are, nevertheless, important exceptions to the relationship between population size and in-migration. Specifically, Beijing, Tianjin, and Shanghai, which have relatively small populations, are among the leading receiving provinces, which reflects the attraction to migrants of not only the eastern region but also the large cities in that region.

Using GDP per capita as an indicator of level of economic development, the data in Table 2 show that the eastern region is the most developed, followed by the central and the western region, in that order. Moreover, the eastern region grew at higher rates—9.2 and 8.2 percent annually in 1988–1998 and 1998–2003, respectively, compared with rates on the order of 6 percent and 7 percent in the central and western regions—the net effect of which is a widening gap between it and the other two regions. The disparity in economic development among the three regions and at the provincial level appears to correlate with the spatial patterns of interprovincial migration (see also Fan, 2005). Provinces with the largest in-migration, including Guangdong, Zhejiang, Shanghai, and Beijing, also are among the top in GDP per capita. Conversely, provinces with the largest out-migration, such as Sichuan, Hunan, Anhui, Jiangxi, and Henan, have relatively low GDP per capita. This observation further supports the notion that a satisfactory model of migration for China must consider regional disparity in economic development.

The above data, while giving an overall picture of interprovincial migration, do not reveal the detailed patterns of migration flows. Figures 2 and 3 illustrate the 30 largest interprovincial migration flows, which accounted for, respectively, 31.46 percent and 56.60 percent of the total interprovincial migration in the 1985–1990 and 1995–2000 periods. Although the figures do not show the rest of the 812 interprovincial flows, many of which are small in volume, they do depict the most prominent patterns of interprovincial migration and their changes between the two censuses.

First, Figures 2 and 3 support the observation that migration is related to the population size of origin and destination provinces. Sichuan as a leading origin province and

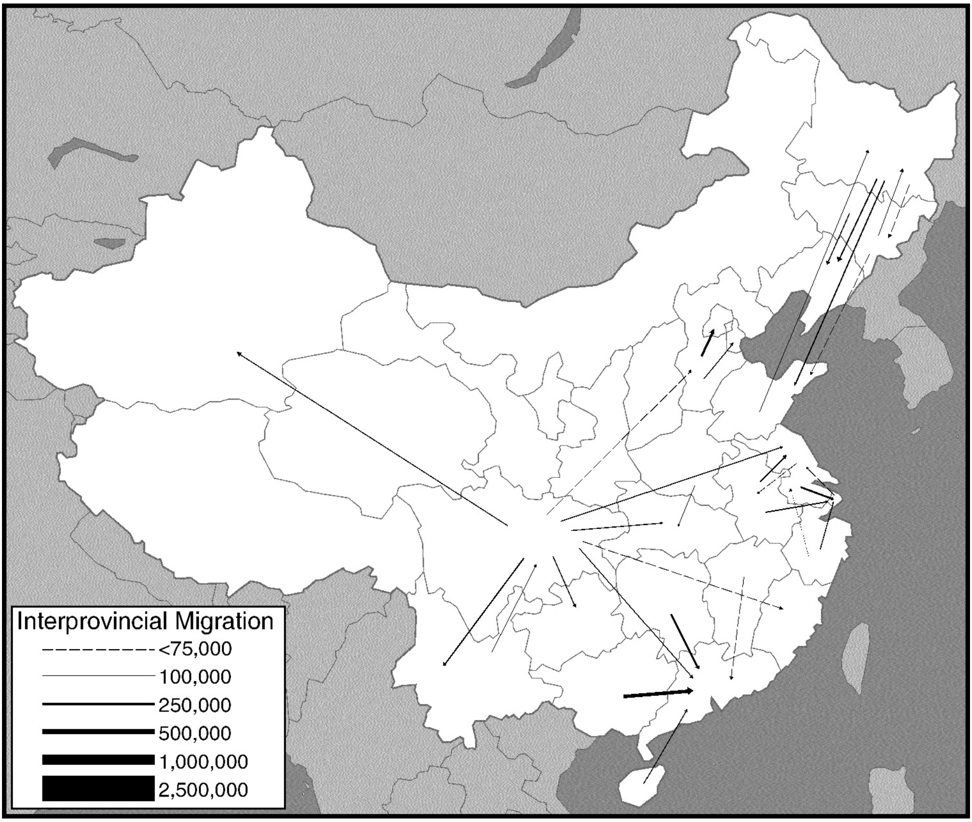

Fig. 2. The 30 largest interprovincial migration flows in China, 1985–1990. *Source*: Based on State Statistical Bureau (1992).

Guangdong as a leading destination province are most prominently illustrated. Second, the figures show that migration flows are a function of distance. Although long-distance moves such as those from Sichuan to Xinjiang and from Heilongjiang to Shandong are among the 30 largest flows, migration between adjacent provinces is more numerous and voluminous. In fact, several clusters of proximate provinces with large migration flows among them resemble regional migration fields (He and Pooler, 2002). At least four clusters can be identified for the 1985–1990 period: among the northeastern provinces of Heilongjiang, Jilin, and Liaoning and between them and Shandong; among Jiangsu, Shanghai, Zhejiang, and Anhui; from Jiangxi, Hunan, Guangxi, and Hainan to Guangdong; from Sichuan to Hubei and Guizhou and between Sichuan and Yunnan. Some of the migration fields are attributable to past migration patterns. The flows between Heilongjiang and Shandong, for example, reflect in part interactions that began during the pre-reform rustication programs and the return of migrants from frontier regions to their coastal origins (Chan et al., 1999). Most of the migration fields persisted in the 1995–2000 period, depicting the continued negative effect of distance. However, the relative prominence of some long-distance migration flows, such as that from Henan to Xinjiang, and the strong pull of Guangdong to migrants from a large number of provinces, adjacent or otherwise, suggest that the friction of distance might have declined over time.

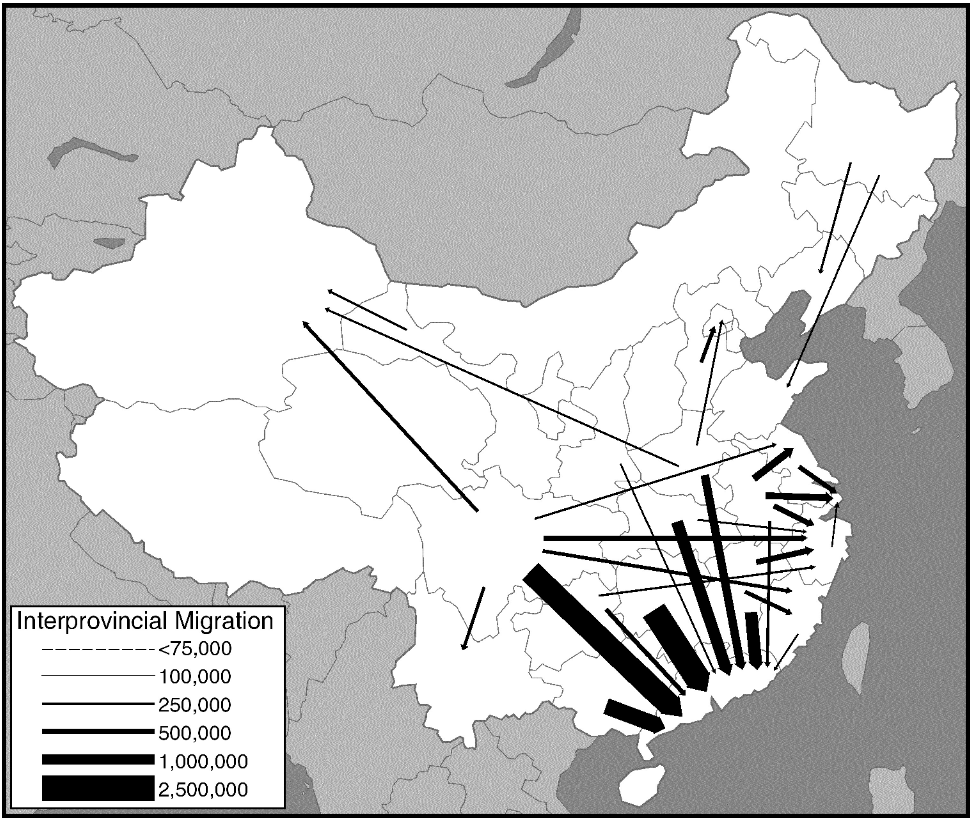

Fig. 3. The 30 largest interprovincial migration flows in China, 1995–2000. *Source*: Based on National Bureau of Statistics (2002b).

Third, the spatial patterns clearly point to the effect of uneven regional development. Most of the prominent origin provinces are relatively poor, and the most prominent destination provinces are economically more developed. The largest migration flows are toward the eastern region. The only noticeable exception is Xinjiang, which has enjoyed near-average rates of economic growth as a result of its cotton industry and cross-border trade with the Central Asian Republics (Pannell and Ma, 1997; Loughlin and Pannell, 2001; Liang and Ma, 2004). A basic gravity model approach, which considers only the effects of population and distance, would have missed the impacts of regional economic disparity.

Changes between the two periods further reinforce the notion that economic development is an increasingly important factor of migration. Figure 2 shows that in the 1985–1990 period, a number of migration streams were accompanied by counterstreams, including those between Heilongjiang and Jilin, Heilongjiang and Shandong, Jiangsu and Shanghai, Jiangsu and Anhui, and Sichuan and Yunnan. By contrast, in the 1995–2000 period, all the 30 largest migration flows were unidirectional. In other words, counterstreams were considerably smaller in volume and are thus not shown in the figure. This suggests that over time interprovincial migration had become more concentrated and more "efficient" in redistributing population (He and Pooler, 2002; Fan, 2005). In addition, the 30 largest flows accounted for a significantly greater proportion of the total migration volume in the 1995–2000 period, as described earlier. Thus, over time interprovincial migration became more efficient, more unidirectional, and more concentrated. The eastern coastal provinces of Jiangsu, Shanghai, Zhejiang, Fujian, and Guangdong, in particular, had clearly become the most dominant destinations. The pull of Guangdong was especially profound, attracting migrants from both nearby and distant provinces. In the 1995–2000 period, migration to Guangdong alone (11.5 million) accounted for 36 percent of all interprovincial migration in China. The changes between the two periods suggest that the most developed parts of the country are increasingly attractive to migrants and that economic development has become an increasingly powerful predictor of migration flows.

Despite changes between the two periods, the largest migration flows did display a high degree of consistency. Evidence includes the persistence of regional migration fields, as described above. In addition, half of the 30 largest flows in the 1985–1990 period remained among the 30 largest in the 1995–2000 period. Some of the migration streams persisted and gained magnitude over time. They include, for example, those from Sichuan to Guangdong, Fujian, Jiangsu, Xinjiang, and Yunnan; from Anhui to Jiangsu and Shanghai; from Guangxi, Hunan, and Jiangxi to Guangdong; and from Hebei to Beijing. While these flows are attributable in part to the effects of population size, distance, and economic development, their persistence and increased magnitude over time suggest that present migration streams are influenced by past migration streams. The persistence of migration streams reflects the role of networks, which facilitate migration and channel migrants from specific origins to specific destinations.

MODELING INTERPROVINCIAL MIGRATION

Using the above descriptive information as a guide and the gravity approach as a framework, I now turn to models of interprovincial migration and estimation of these models. Unlike Figures 2 and 3, the analysis below includes all 812 flows in the two periods.

The formulation of the basic gravity model is

$$M_{ij} = k \frac{P_i^{a_1} P_j^{a_2}}{d_{ij}^{\,c}},$$

where P_i and P_j are respectively the masses of the two objects i and j, d_{ij} is the distance between them, and k is a constant. When applied to predicting migration flows, P_i and P_j are usually represented by population; that is, migration flow is directly proportional to the population of the origin and destination. When i and j are areal units rather than nodes, d_{ij} can be defined as the distance between representative point locations within them. In the empirical analysis, I select provincial capitals as representative point locations for the provinces. In most Chinese provinces, the capital is also the city with the largest population and is therefore an appropriate representative location. The variable d_{ij} is customarily evaluated by Cartesian distance or transportation distance. In China, the railroad remains the predominant means of long-distance passenger travel and is especially relevant for migrants, because air travel is costly. I have used both Cartesian distance and railroad distance in the model estimations. Because the differences of the results are minimal and as railroad distance reflects better the distance of actual travel, I shall describe below only the results using railroad distance (Harbin Map Publishing Company, 1998, p. 2).

The basic gravity model can be linearized as

$$\ln M_{ij} = a_0 + a_1 \ln P_i + a_2 \ln P_j + a_3 \ln d_{ij} , \qquad \text{(Model A)}$$

where P_i is the origin province's population, P_j is the destination province's population, d_{ij} is the railroad distance between the capital of i and the capital of j, $a_0 = \ln k$, and $a_3 = -c$. The expected signs are positive for a_1 and a_2 and negative for a_3.

Model A is estimated for the 1985–1990 and 1995–2000 periods using the 812 migration flows. The variables P_i and P_j are evaluated near the middle of the respective periods, namely, 1988 and 1998 (see Table 2). For both periods, all three coefficients of Model A have the expected signs and are significant (Table 3). The standardized regression coefficients indicate that distance is the most important variable for the 1985–1990 period, suggesting that the friction of distance—such as the cost of traveling and the uncertainty about distant destinations—is a major deterrent to migration. Origin population has the second largest standardized regression coefficient, and destination population has the smallest. Indeed, as described earlier, some of the most popular migration destinations—such as Beijing and Shanghai—have a relatively small population. This finding is consistent with some researchers' observation that origin population is a more powerful predictor than destination population of migration flows (Chan et al., 1999; Shen, 1999). For the 1995–2000 period, origin population replaces distance as the most important variable. The importance of the distance variable has somewhat declined, suggesting that migrants' ability to mitigate the friction of distance has improved. This could be a result of improved transportation, better sources of information, as well as increased motivation for long-distance migration as a result of the widening gap in regional development (Liang and Ma, 2004; Fan, 2005). The average distance of interprovincial migration increased from 1,347 km in the 1985–1990 period to 1,390 in 1995–2000, further supporting the notion that the friction of distance has declined.[8]

The basic gravity model (A), however, does not address directly the effect of uneven regional development. As discussed earlier, regional disparity in economic development is a major factor of migration, especially in the reform period. Using GDP per capita as an indicator of the level of economic development, the following model improves upon the basic gravity model by including the effect of uneven regional development:

$$\ln M_{ij} = a_0 + a_1 \ln P_i + a_2 \ln P_j + a_3 \ln d_{ij} + a_4 \ln G_i + a_5 \ln G_j , \qquad \text{(Model B)}$$

where G_i is the origin province's GDP per capita and G_j is the destination province's GDP per capita.

If migrants are predominantly moving from the less developed to more developed provinces, then a_4 and a_5 are expected to be, respectively, negative and positive. Like P_i and P_j, the two variables G_i and G_j are evaluated for 1988 and 1998 (Table 2). Adding these variables results in an increase in the adjusted R^2 from 0.54 to 0.62 in the 1985–1990 period and from 0.53 to 0.68 in 1995–2000 period. For 1985–1990, destination GDP per capita has a positive and significant coefficient, whereas the coefficient for origin GDP per capita is not significant. This suggests that from a regional development perspective, the destination

[8]I computed the average distance of interprovincial migration as the average distance between the 812 pairs of provinces weighted by the migration flow.

Table 3. Modeling Interprovincial Migration in China

Variable/indicator[a]	Model A						Model B						Model C		
	1985-1990			1995-2000			1985-1990			1995-2000			1995-2000		
	B[b]	Beta[c]	t[d]	B[b]	Beta[c]	t[d]	B[b]	Beta[c]	t[d]	B[b]	Beta[c]	t[d]	B[b]	Beta[c]	t[d]
Constant	-6.3180		-4.59**	-7.7127		-5.45**	-20.3335		-10.00**	-18.5232		-11.64**	-11.5560		-9.86**
Origin population	0.8319	0.4134	17.25**	0.9414	0.4598	19.00**	0.8420	0.4184	17.55**	0.9308	0.4547	22.34**	0.9063	0.4427	30.26**
Destination population	0.5804	0.2885	12.04**	0.5335	0.2606	10.77**	0.8205	0.4078	17.10**	0.6367	0.3110	15.29**	0.1776	0.0867	5.18**
Railroad distance	-1.2772	-0.4665	-19.33**	-1.1793	-0.4333	-17.78**	-1.1753	-0.4293	-19.12**	-1.0870	-0.3994	-19.44**	-0.2133	-0.0784	-4.16**
Origin GDP per capita							0.0021	0.0006	0.02	-0.2515	-0.0766	-3.78**	-0.2511	-0.0764	-5.25**
Destination GDP per capita							1.1153	0.3007	12.68**	1.2247	0.3729	18.39**	0.6062	0.1846	11.46**
Migration stock[e]													0.7133	0.6033	27.48**
R^2		0.5440			0.5349			0.6204			0.6785			0.8341	
Adjusted R^2		0.5430			0.5332			0.6180			0.6765			0.8329	

[a]Dependent variable = natural log of interprovincial migration. All independent variables are in natural log.
[b]B = Regression coefficient.
[c]Beta = Standardized regression coefficient.
[d]** Significance level = 0.01 or less.
[e]Migration stock = natural log of the percent of interprovincial migration between an origin-destination pair to the total out-migration from the origin, 1985-1990.

exerts a strong pull to migrants but the push from the origin is relatively weak. For the 1995–2000 period, destination GDP per capita again has a positive and significant coefficient. Moreover, it replaces distance as the third most important variable, after origin population and distance. Unlike the previous period, however, the coefficient for origin GDP per capita is negative and significant. Although the size of the standardized regression coefficient is small, the result does suggest that push forces have increased in importance. Put together, the GDP per capita variables show that migration is increasingly responsive to uneven economic development between provinces, as evidenced by the more powerful presence of both push and pull forces in the 1995–2000 period than in the previous one. In short, regional economic disparity is a key reason why migrants leave specific origins and why they go to specific destinations. Moreover, the effect of regional disparity has increased over time. Without this component, the model would have missed a compelling reason and motivation for migration.

Like the basic gravity model, however, Model B has two drawbacks. First, it is static and assumes that current migration flows have nothing to do with past flows. In reality, past migration patterns are an important determinant of present migration flows. Second, Model B relies solely on provincial characteristics, such as population and level of economic development, and ignores the ways in which individuals embark on the process of migration. The existence and persistence of specific migration streams reflect the role of migration networks. In other words, origin-destination networks of migrants foster continued migration from the same origin to the same destination. To assess the effect of past migration flows, a migration stock variable is added to the model:

$$\ln M_{ij} = a_0 + a_1 \ln P_i + a_2 \ln P_j + a_3 \ln d_{ij} + a_4 \ln G_i + a_5 \ln G_j + a_6 \ln S_{ij}\ , \quad \text{(Model C)}$$

where S_{ij} is the proportion of migration from i and j to the total out-migration from i ($M_{ij}/\Sigma_j M_{ij}$) in the previous period. S_{ij} evaluates, from the point of view of the origin, the propensity of migrants to go to specific destinations, and is the same as the migration stock variable used by Yan (1998).

Using M_{ij} and $\Sigma_j M_{ij}$ from the 1985–1990 period to evaluate S_{ij}, Model C is estimated for the 1995–2000 period (Table 3). The adjusted R^2 increases from 0.68 to 0.83, strongly supporting the migration stock explanation. Moreover, the standardized regression coefficient of the migration stock variable is positive and is the biggest in the equation; thus, it becomes the most important predictor of migration flows. The order of importance of the other variables remains largely the same. Origin population is the second most important variable, followed by destination GDP per capita, destination population, distance, and origin GDP per capita. Destination population replaces distance as the fourth most important variable. All coefficients are significant and have the expected sign. However, the coefficients for destination population and distance have changed considerably in value, depicting some degree of multicollinearity. The effect of the migration stock variable is, in fact, similar to that observed by Greenwood (1969) in a study of interstate migration in the United States: namely, it results in large alterations in the parameter estimates of other variables. He points out that this is because these variables entered into the determination of past migration. The propensity of migrants to go to specific destinations—measured by migration stock—is indeed expected to be negatively correlated with distance. It is also expected to be positively correlated with destination population. The correlation coefficients between migration stock on one hand and destination population and distance are, respectively, 0.40 and -0.61. However, as the mean and maximum of the variance inflation factors—a statistic that detects multicollinearity[9]—are, respectively, only 1.46 and 2.34, the problem is not serious and the modeling results are acceptable. This is especially the case since omitting the stock variable would have overestimated the direct effect of other variables and resulted in a mis-specified model (Greenwood, 1969).

SUMMARY AND CONCLUSION

Using data from China's 1990 and 2000 censuses and simple models based on the gravity approach, I have described and explained the patterns and changes of interprovincial migration in China. Between the two censuses, interprovincial migration almost tripled in volume and became more concentrated and unidirectional, but the main directions continued to be from inland to eastern regions and prominent migration streams persisted. The spatial patterns of interprovincial migration suggest that gravity variables such as population and distance are important; they also reflect the roles of regional economic disparity and migration stock. These observations are confirmed when models that build on the gravity principles are estimated.

The models satisfactorily predict interprovincial migration flows and all the variables have the expected sign. Migration stock is the most important determinant, which explains the persistence of migration streams and which underscores the role of social networks in explaining how, and from and to where, migration takes place. Origin population is the second most important determinant, indicating that populous provinces are more likely than smaller provinces to be donors of migrants. The third most important determinant is destination GDP per capita, which supports the notion that migrants strongly prefer destinations with high levels of economic development. Moreover, over time this variable increased in importance, hinting at increased responsiveness of migrants to economic opportunities at the destination.

Distance and destination population are the next most important independent variables. As expected, distance is negatively related to migration flows, but its importance has declined over time, indicating that the friction of distance has weakened. This is consistent with the finding that average migration distance has increased and the general observation that long-distance migration is increasingly prevalent. Destination population is not as powerful a determinant as origin population, as migrants are attracted to not only populous provinces but municipalities such as Beijing that promise economic opportunities. Finally, origin GDP per capita is the least important determinant. Although the coefficient's negative sign is as expected, it is not significant in the 1985–1990 model, suggesting that interprovincial migration was predominantly in response to pull rather than push forces. In the 1995–2000 models, however, the coefficient for origin GDP per capita is both negative and significant. Thus, over time, the push force has increased, although it is still weaker compared with the pull from attractive destinations. Once again, this finding supports the notion that regional disparity in development is an increasingly important factor of interprovincial migration in China.

This paper's empirical analysis has demonstrated that gravity-type models are indeed relevant and effective tools for describing and explaining migration flows in China. By including variables that represent regional economic disparity and migration stock, not only

[9]When the largest variance inflation factor is in excess of 10 or when the mean of the variance inflation factor is considerably larger than one, multicollinearity may be unduly influencing the regression coefficients.

are the models descriptive tools but they facilitate explanations of why migrants are from specific origins and why they move to specific destinations. This information enhances the theoretical understanding of the decision-making process of migration. In the Chinese empirical case, interprovincial migration is clearly in response to the widening regional gap in development. Unlike the pre-reform period, when government-sponsored migration moved down the gradient of development, migration in the reform period is primarily from the less developed to more developed provinces. The prominence of migration stock as an explanatory variable reflects the important role of social networks, an observation not unique to China. Unlike most other countries, however, the institutional inferiority of rural migrants in China is one of the main reasons why they overwhelmingly rely on social networks for undertaking migration and for choosing specific destinations.

In short, this paper has shown that models based on the gravity approach are useful, in both theoretical and methodological terms, for enhancing our understanding of interprovincial migration in China. This yields additional evidence for the notion that existing migration theories and experiences from other countries are increasingly relevant for conceptualizing population movements in China (Roberts, 1997; Fan, 2005). This is not to say, however, that the patterns and decision-making process of migration in China are no different from those in Western capitalist economies. Rather, the analysis highlights the roles of regional disparity and social networks, determinants that must be interpreted and understood in relation to the economic transitions that have taken place in China.

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