Journal of Development Studies,
Vol. 42, No. 6, 1023–1055, August 2006

Routledge
Taylor & Francis Group

Climbing the Development Ladder: Economic Development and the Evolution of Occupations in Rural China

SANDEEP MOHAPATRA*, SCOTT ROZELLE*, &
JIKUN HUANG**
*University of California, Davis, USA, **Chinese Academy of Sciences, Beijing, China

Final version received July 2005

ABSTRACT *We study how occupations evolve across space and time during the development of an economy. Using a data set on more than 200 villages from 8 provinces in China, we examine the main occupations that have characterised China's labour markets since the economic reforms. Our findings reveal a systematic evolutionary pattern of occupational emergence: the evolution of occupations proceeds from traditional and fairly simple forms of subsistence agriculture to modern, more complex manufacturing and service firms. Our findings suggest that rural development in China is being built by a process that can be described by the climbing of a development ladder with each step up the ladder denoting the economy's transition into a more complex occupational regime.*

I. Introduction

In the wake of China's rural reforms, an explosion of new livelihood strategies (or occupations) have arisen across China's rural areas. For instance, migration emerged as the dominant strategy in poorer, more rural provinces such as Sichuan, Anhui, Hunan and Guangxi (Chan, 1999; Fan, 1999). In contrast local rural industries appeared along the rapidly developing eastern coast (Jin and Qian, 1998). China's economy also has produced a new class of 'petty capitalists', individuals who own and operate micro-enterprises. Studies have documented the dominance micro-enterprises in the nation's middle to upper middle income regions (Entwisle et al., 1995; Liu and Chan, 1999). At the same time, subsistence farming still dominates the economic landscape in China's mountainous southwest and dry northwest, areas that are remote and relatively unintegrated with the rest of the nation (World Bank, 2001a).

Correspondence Address: Sandeep Mohapatra, Post Doctoral Researcher and Instructor, Department of Agricultural and Resource Economics, University of California, Davis, CA 95616.
Email: sandeep@primal.ucdavis.edu

ISSN 0022-0388 Print/1743-9140 Online/06/061023-33 © 2006 Taylor & Francis
DOI: 10.1080/00220380600774988

The geographic specificity of the emergence of these occupations does not mean that the structure of China's economy has been stagnant; a series of authors have shown that occupational choices also have evolved over time. Migration has accelerated greatly in the 1990s (Chan and Yang, 2000; de Brauw et al., 2002a). Rural industries have begun to concentrate themselves in the richest areas of the richest provinces (Otsuka, 2001). Most of China's rural industrial growth has come from a limited number of areas in the Guandong, Fujian, Zhejiang and Southern Jiangsu provinces. Since the beginning of the reforms, micro-enterprises also have grown very fast. In fact, according to one survey, between 1988 and 1995, the micro-enterprise sector was the fastest growing off-farm sector in rural China (Rozelle et al., 1999b). Finally, throughout the 1990s, there has been a large decline in households dependent upon subsistence agriculture, although many villages in the poor regions of the country have not experienced this decline (World Bank, 1997).

Although the growing literature on China's economy documents the emergence of new occupations in certain areas and their evolution over time, a set of key questions regarding their significance and their role in rural development remains unanswered. Is there a systematic pattern to the emergence of different occupations over space, over time, or both? Can this pattern be identified with the process of economic development? More specifically, is there a correspondence between the stages of economic development and the occupations that emerge in China's rural economies? Finally, what are the factors that determine the emergence and disappearance of different occupations?

Unfortunately, the development literature offers no clear answers to these questions and there is still a sense among those working in the field that more needs to be done to better capture the processes that underlie the emergence of different off-farm occupations. Lanjouw and Lanjouw (1995) believe that the rural non-farm sector in general is poorly understood and that relatively little is known about how the opening up of different mixes of occupational choices affects the broader development process. The gap is due to the sector's wide heterogeneity and the lack of empirical and theoretical focus. Others believe that the understanding of the non-farm sector in developing countries is so poor that policy-makers charged with the formulation of policies to guide economic development make blind decisions since they have such a weak empirical basis on which they can design their plans (Chuta and Liedholm, 1990). Previous work has demonstrated that the literature on China's rural economy has failed to answer basic questions about the patterns of emerging occupations and their determinants because of its reliance on small samples, the focus on different segments of the labour market, and the failure of some authors to use clearly defined analytical frameworks (Rozelle et al., 1999b).

The overall goal of this paper is to understand the role that the emergence and evolution of occupations have in the process of economic development. In one sense, this can be thought of as an empirically-oriented paper. We seek to organise the facts and assess what variables are correlated with the rise of certain occupations at a certain time, in a certain place. Our work in a larger sense, however, is an attempt to understand the process of development that is going on in rural China. We are interested in this because such an understanding will help identify what policies are needed to facilitate growth in different regions of the country and also will help assess the regional impacts of macroeconomic policies and events. It also will help

policy makers identify which areas are poor and why they have not integrated themselves into the rest of the economy. At the other extreme, understanding how the economy evolves over time will help those interested in development to better understand why some regions have developed so fast, the sources of that development, and the policies that may have facilitated it.

To meet this overall goal, we have four specific objectives. First, we describe the different occupations that are found in China's rural economy and their changes over time (1988 to 1995), using employment data from a nationally representative sample of over 200 villages drawn from eight provinces in rural China. Second, we demonstrate how different occupations have emerged in distinct patterns across space, patterns that suggest that different regions characterised by high and low income levels and regions that are close and far from major metropolitan regions are more likely to be dominated by specific types of occupations. Third, we seek to identify how the different occupations evolve over time. We demonstrate how over time, as the economy develops, some occupations disappear and others emerge to take their place. The sequence, taken as a whole, across a region over a several decade period, can be thought of as a development ladder, with each step up the ladder denoting the economy's transition into a different activity regime. Rural development, we hope to show, can be portrayed in part as the process of climbing the development ladder. Finally, we will try to explain the determinants of these patterns of development.

To meet the overall goal and specific objectives of this paper, it is organised as follows. Section II discusses how occupational choices can be used to characterise the broader development process. Section III describes the data. In Section IV we use descriptive analysis to demonstrate the how dominant occupational choices of rural residents characterise rural development in China, focusing on the relationship of the choices with the wealth and geography of different regions. In this section, we also use Markov chain analysis to examine the evolution of occupational patterns for villages over time, paying special attention to the interrelationships and linkages among them. In Section V we develop two representative household models to examine part of the microeconomic foundations that could be underlying these processes. In Section VI we econometrically examine the determinants behind the emergence of different occupations using a version of the multinomial logit model that allows for estimation when the dependent variable is measured as proportions. In addition, we test the hypotheses that occupations evolve according to the wealth and location characteristics of regions. The final section concludes.

II. Occupations, Wealth and Geography

The evolution of an economy's occupations can be used to characterise its economic development. Economic development is the process of transformation of an economy's institutions (Stiglitz, 1988; Townsend, 1988; Khan, 1989). The most significant element of institutional transformation in an economy is the evolution in its main economic activities (Banerjee and Newman, 1993). Hence, economic development can be regarded as the process of transformation in the occupational choices that people make.

At both the macro and micro level, previous studies that examine changes in people's livelihood choices have used shifts in employment shares in their analyses (Fisher, 1935; Clark, 1940; Fei and Ranis, 1997). For example, studies have analysed employment shares of agricultural and industrial sectors of countries using aggregate cross-section or time series data to understand the structural transformations that occur during economic development (see Chenery and Taylor, 1968; Gemmel, 1982; Lee, 1992). Others have used disaggregated data on labour allocation and occupational choice to study how they change during the development process (Nee and Keister, 2000). Many writers also have used their understanding of the shift of employment from agriculture to other occupations to illuminate the process of economic development (Nurkse, 1959; Fei and Ranis, 1997; Rostow, 1990).

Two of the most regular empirical results from this literature have been from studies of the close association between occupational choices, and the level of wealth and location of an economy (Chenery, 1960; Chenery and Taylor, 1968). For example, Fuchs (1968) tested the hypothesis that sector shares of employment are linear functions of the reciprocal of per capita income and found highly significant regression coefficients for the aggregate sectors of agriculture, industry and services. The results of other studies, such as those by Gemmel (1982), Chenery and Taylor (1968), and Chenery and Syrquin (1975), also indicate that per capita income is an important determinant of people's occupational choices. Their findings show that agricultural employment falls rapidly in the early stages of development, at low levels of income, giving rise to rapid increases in the share of industry in total employment.[1]

Researchers also have emphasised the importance of the locational characteristics of a region as a determinant of a region's occupational structure. For example, transport access to urban centers has been shown to facilitate the emergence of more complex activities, such as local rural industry (see Radelet and Sachs, 1998). Locational characteristics, such as proximity to urban centers, also increase the efficiency of certain activities leading to advances in economic development (Gallup et al., 1998). The importance of location also has been supported empirically. Economists have found that characteristics associated with the location of a region, such as its infrastructure, the ease of communications, and the density of its network of roads, railway, waterways, and telephones have an effect on the patterns of economic development (Démurger et al., 2001).[2]

Hypothesis and Assumptions

In the light of the above discussion, several hypotheses can be drawn regarding the evolution of occupations across space and over time. First, we expect that across diverse geographical regions, we will observe the dominance of certain occupations in certain places. In the least developed regions, the least complex occupations should dominate the local economy. In the more developed regions, the most commonly observed occupation should evolve into more complex ones. Likewise, *within a particular area*, as the level of development rises, occupations should evolve to become more complex.

In this paper, we assume that the evolutionary path of an economy will involve four occupations. The least complex occupation, traditional agriculture, relies on

little physical capital and can be produced in subsistence, relatively isolated economies by producers that have little capital. That is not to say that at some point of time farming itself cannot begin to use higher levels of physical and human capital and be integrated into the rest of the economy. But traditional agriculture is a form of production that is carried out with few inputs from the economy as a whole and much of its output is typically directly consumed.

The other three occupations are more complex than subsistence agriculture. While migration is a fairly rudimentary economic activity, it usually depends on a minimum level of investment and successful migration is linked with higher levels of education, and experience and access to information (Stark, 1991). As such, we would not expect to observe migration to begin until an area has reached a certain level of development. In other words, we would expect to see migration in poor, remote areas; but not in the poorest of the poor or the most remote regions. As the economy develops further, however, we expect to observe the emergence of enterprises, simple at first, such as individually owned and operated micro-enterprises, and then more complex manufacturing and service production firms.[3]

Increases in the level of development, following the literature, will be measured by increases in the level of wealth (per capita income) and improvements in locational characteristics of a region. We will be examining two hypotheses using two different approaches. First, when looking at a cross section of regions at any point of time, we expect to find the least complex occupations in the poorest areas and increasingly complex occupations in wealthier ones. Second, we expect to find the least complex occupations in the isolated and remote areas, and increasingly complex occupations in more developed ones. Additionally, the link between the evolution of the occupation and development also may be tested by examining that if within a given region, occupations become more complex during a time when the region's economy is developing (or growing in wealth).

III. Data

China's economy provides a unique opportunity to study changes in occupations over space and over time. The rapid economic growth in China in the past two decades and its regional heterogeneity has created a series of natural experiments that are more easily measured than in other countries where growth has occurred more slowly. The inequality among China's rural areas and the heterogeneous nature of China's provinces at least partially segments one area from another. These features will enhance the analysis and help identify the patterns in which occupations evolve as development occurs.

To study occupations in China, we use a unique set of data drawn from a nationally representative sample of over 200 villages from eight provinces in China with information on off-farm labour force activity in 1988 and 1995. In each village enumerators asked a series of questions to three leaders – the party secretary, the village head, and the accountant – during five to eight hour interview sessions spanning one to two days. The community-level data on the size of the labour force and occupational choice was obtained from a section of the survey that was responded to by the village accountant. In China's villages, the accountant is responsible for keeping detailed information on many aspects of village life.

While the accountant may not have known the work history of every single family (on average, there are about 200 households per village), certainly he had a good idea of the household's economic activities. In filling out the form, an enumerator went through the village roster on a family-by-family basis and created a tally of the employment profile of the village. Certainly, if the levels were not exactly right, the trends reflect the shifts in employment structure over time.

Village accountants provided information on different aspects of the village economy: off farm labour decisions by the villagers, credit and banking institutions, land institutions, market participation, the organisation of village run enterprises and questions about village income, infrastructure, location, and the level of economic development. After being asked about markets and activities in 1995, accountants were also asked to approximate the changes since 1988, a year chosen for its comparability since both periods had high grain prices and followed several years of robust economic growth.

In answering questions regarding off farm employment patterns in the village, leaders classified those working in the off farm sector into three, non-over-lapping categories: migrants, self-employed and local rural industry workers.[4] A migrant is defined as a person that leaves the village for at least one month per year for a job and that retains direct ties with the village by actions such as returning for spring festival or for annual farm operations. A person is classified as self-employed if he works for himself or starts up a micro enterprise. Local rural industry workers are those who earn a job working either in village- or team-run firms run by cadres and their hired managers, or in private firms run by entrepreneurs. Based on the total labour force estimates reported in the survey, we were able to calculate the number of workers engaged in agriculture. We computed the number of agricultural workers as the total labour force less the number of migrants, micro-enterprise workers and local rural industry workers.[5] The characteristics of the labour force, such as the average age and level of education of workers in each category, were enumerated at the same time. On average the size of the labour force is about 500 workers in our sample villages.

The survey also includes detailed information on other characteristics of the sample villages. In particular, it provides information on the wealth of the village measured in terms of per capita income and its location in relation to urban centers. Enumerators also asked questions about the human capital characteristics of village leaders.

IV. Occupations in Rural China

To examine the data for support of our hypotheses, in this section we have four specific objectives. We will first document the main occupations that have emerged in rural China and their evolution over the 1988 to 1995 period. Second, we will try to find descriptive support for our hypothesis that across regions – *at a particular point of time* – the least complex occupations are found in the poorest areas and increasingly complex occupations in wealthier ones. Third, we will try to find support for the hypothesis that across regions – *at a particular point of time* – the least complex occupations are found in isolated and remote areas and increasingly complex occupations in developed urban ones. Finally, we will use Markov chain

analysis to study whether *over time* – within a given region – the dominant occupation has become more complex. The evidence that we gather regarding these hypotheses will enable us to establish the pattern in which occupations evolve during economic development.

To meet the first objective of this section, we identify the main occupations that have emerged in China's rural economy and track how the importance of different occupations, (in terms of their labour force shares) has changed over time. We also decompose the aggregate change in an occupational share into a component that is due to the reallocation of labour within villages, and a component that is due to change in the labour force size of villages. Such a decomposition will help illuminate some of the underlying mechanics governing the aggregate evolution of occupational shares. Is it that all villages are evolving in similar ways? Or is it that while within some villages the occupational structure of the labour force is changing rapidly, in others the structure is stagnant or changing less rapidly.

In order to compute the aggregate change in occupational shares and to decompose the change into its components we use the following approach: Consider a sample of $v = 1, \ldots V$ villages. For each village we have information on the fraction of the labour force that derives its livelihood from each of four activities: subsistence agriculture, migration, self-employment and employment in large enterprises. Let ω_{ivt} denote the share of the labour force in village v at time t whose main source of income is activity i. These *occupational shares* are observed for each village in each of the two years, 1988 and 1995. Let L_{vt} denote the size of the labour force in village v at year t and let:

$$\phi_{vt} = \frac{L_{vt}}{\sum_v L_{vt}} \tag{1}$$

denote the share of the overall labour force (or *labour force share*) that comes from village v. The aggregate change in occupational shares across the 1988 to 1995 time period can be written as a weighted average:

$$\Omega_{it} = \sum\nolimits_v \phi_{vt}\omega_{ivt} \tag{2}$$

The change in aggregate occupational shares for each activity can be written as:

$$\begin{aligned}\Omega_{i95} - \Omega_{i88} &= \sum\nolimits_v \phi_{v95}\omega_{iv95} - \sum\nolimits_v \phi_{v88}\omega_{iv88} \\ &= \sum\nolimits_v \phi_{v88}[\omega_{iv95} - \omega_{iv88}] + \sum\nolimits_v [\phi_{v95} - \phi_{v88}]\omega_{iv95}\end{aligned} \tag{3}$$

The first term in the expression above is the weighted average of the change in an occupational share, the weights being the initial-period labour force share of each village. It captures the component of the aggregate change in the occupational share that is due to the sectoral reallocation of labour within villages (reallocation effect). The second term is the weighted average of the change in labour force share across villages, the weights being the share of the occupation for each village. The second term, therefore, captures the component of change in the occupational share that is due to the change in the labour force size of villages (labour force size effect).

Our survey results, like the rest of the literature on China's economic growth (see Jin and Qian, 1998), illustrate the structure of employment during the late 1980s and

the evolving nature of the four occupations during the 1990s (Table 1, Columns 1 and 2). Unsurprisingly, given the legacy of Mao's agriculture-first development strategy, even in 1988, nearly 10 years after the onset of the reforms, the share of agriculture stood at about 79 per cent. Nonetheless, some rural residents found work out of agriculture during this period. For example, migration had a share of about 4 per cent in 1988. Those working in micro-enterprises and local rural industries accounted for 6 per cent and 10 per cent of employment.

While agriculture still accounted for most of the employment in rural China during the entire study period, the mix changed sharply during the 1990s (Table 1). Most prominently, the share of agriculture fell from 79 per cent in 1988 to 60 per cent in 1995. In contrast, the off-farm sectors all rose. The share of migration increased from 4 per cent to 10 per cent. The share of micro-enterprises also increased from 6 per cent to 11 per cent in 1995. Local rural industry, which was one of the most prominent features of China's development during the 1980s and 1990s (Byrd and Lin, 1990; Nyberg and Rozelle, 1999), increased its share from 10 per cent to 18 per cent. To the extent that China is growing rapidly over time (an average GDP growth of over 10 per cent annually (World Bank, 2001a), the increase in employment proportions in migration, micro-enterprises and manufacturing is consistent with the hypothesis that as an economy develops, its occupations become more complex.

While the aggregate changes demonstrate the changing occupational structure for the rural economy as a whole, it is unclear if this process is at work within individual villages or concentrated in certain villages in which the labour force is growing more rapidly. Our decomposition results help address this issue (Table 1, Columns 3 and 4). We find that the aggregate change in an occupational share is primarily due to the reallocation of labour among different occupational sectors within villages, with only a minimal amount of the aggregate change being attributable to the growth in the size of the labour force of villages. For instance, between 1988 and 1995, on average the share of agriculture in a village fell by 19 per cent (Row 1, Column 1 and 2). Decomposition of this change reveals that holding the labour force size constant there was a reduction in the share of agriculture by about 21 per cent due to the movement of labour from farming to non-farming sectors within individual villages (Row 1, Column 3). Only a small proportion (an increase of 2 per cent, Row 1,

Table 1. Occupational shares: aggregate and decomposed changes over time

	Aggregate change in occupational shares		Decomposition of aggregate change, 1995–1988	
Occupation	Occupational share, 1988 $\Omega_{i,1988}$	Occupational share, 1995 $\Omega_{i,1995}$	Labor reallocation effect (1988–1995) $\sum_v \phi_{v88}[\omega_{iv95} - \omega_{iv88}]$	Labor force size effect (1988–1995) $\sum_v [\phi_{v95} - \phi_{v88}]\omega_{iv95}$
Agriculture	0.79	0.60	−0.21	0.02
Migration	0.04	0.10	0.07	−0.01
Micro enterprises	0.06	0.11	0.06	0.00
Local rural industry	0.10	0.17	0.08	−0.01

Column 4) of the aggregate change in the share of agriculture was due to an increase in the size of the labour force in the sample villages.[6]

The above findings suggests that the pattern of change in occupational structure observed in our data is more consistent with an evolutionary principle according to which labour is being reallocated from simple to more complex occupations. Only a small portion of the change is attributable to shifts in occupational structure due to changes in the size of the labour force. Our findings imply that the changes in occupational shares, that is, the fall of agriculture and the rise of migration, micro-enterprises and manufacturing, are happening within individual villages (albeit at different rates during different time periods) and not concentrated in few pockets of the rural economy. To the extent that the structure of employment within individual villages is changing from agriculture to industry it is reasonable to believe that all villages are participating in the evolution of the labour force.

Occupations in China and Wealth

Stronger support for the hypotheses can be gained by more directly linking a region's wealth (per capita income) with its dominant occupation. To do so, we group the villages in the sample in order of increasing wealth and observe how occupations change across the groups in the 1995 time period: bottom 10 per cent (which corresponds to per capita incomes less than 203 Yuan); low-middle income (with per capita incomes in the range 206 to 449 Yuan), high-middle income (with per capita incomes in the range 456 to 909 Yuan), top 10 per cent (916 to 1366 Yuan). A Kernel density estimate of the per capita income distribution reveals that the distribution of income is only moderately (right) skewed and close to the normal distribution (Figure A1, Appendix). Based on the empirical distribution of income and the values of income levels that categorise the sample into four mutually exclusive categories we expect that, in absolute terms, the evolutionary changes in occupational patterns are being triggered by reasonably large differences in incomes.

While our main interest is in uncovering the pattern in which occupations evolve across varying levels of wealth using the data from 1995, it may well be that an important part of the story is the way in which the link between per-capita income and occupational shares itself has evolved over time. To evaluate whether or not the relationship between per-capita income and occupational shares has changed over time we first examine the data for 1988. Figure 1, Panels I to IV, depict the relationships among occupations and wealth for the 1988 time period.

Despite the dominance of agriculture the evolution in occupational structure was starting to become evident even in 1988: agriculture was declining in the richer villages; migration was starting to be initiated in the poorer regions; micro-enterprises were starting to grow in the lower-middle income villages and large enterprises were being concentrated in the richest regions. The share of agriculture declined from 80 per cent in the poorest regions to about 65 per cent in the richest regions (Panel I). Migration started to appear in the poorer regions, although migration accounted for only a small fraction of the labour force (Panel II). Micro-enterprises were most prevalent in the higher middle income regions, with a share of around 20 per cent (Panel III). In the richest villages, local rural industries had started to emerge and accounted for about 28 per cent of employment of the labour

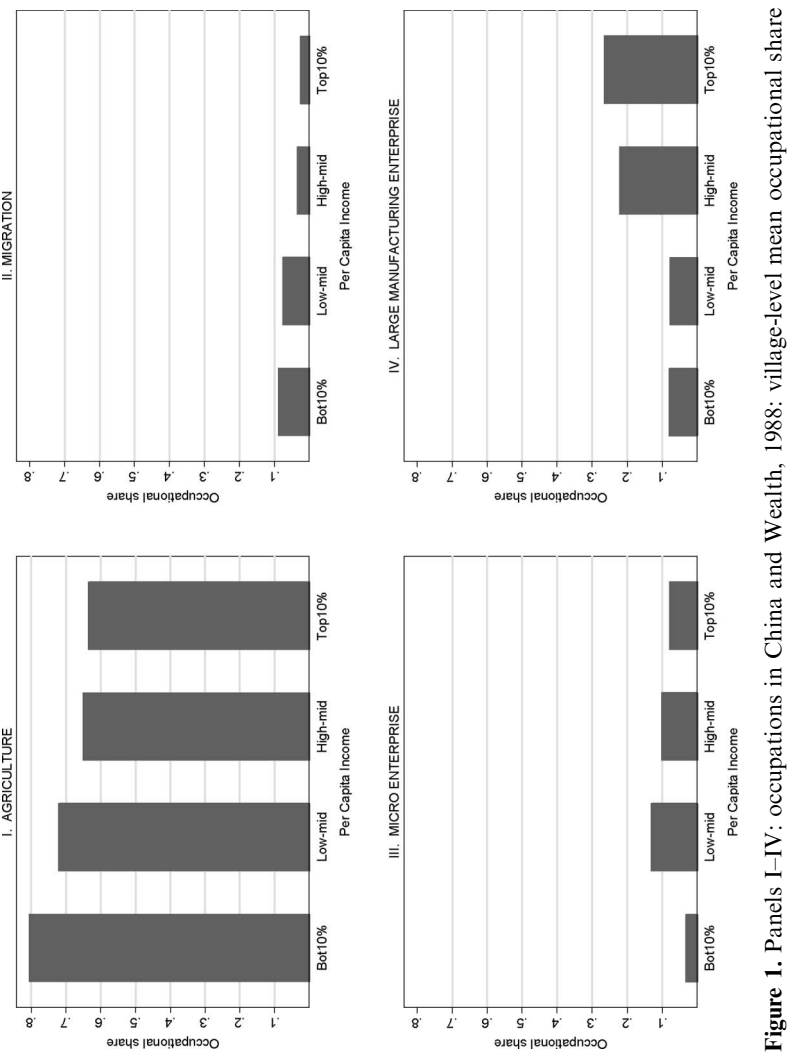

Figure 1. Panels I–IV: occupations in China and Wealth, 1988: village-level mean occupational share

force (Panel IV). While the rates of change and the magnitudes of the new off-farm occupations are small, the pattern of occupational change observed in 1988 foretells a more distinct evolutionary pattern that would appear in later years.

Some of the most robust evidence is found by examining the role of farming in villages when the villages are ranked from poorest to richest using the observations from 1995 (Figure 2, Panels I to IV). Agriculture dominates in the poorest regions where it has a share of almost 60 per cent (Panel I). However, as wealth increases, agriculture declines and in the richest regions the share of agriculture is only about 10 per cent. This pattern provides strong support for our hypotheses that as wealth increases the less complex occupations decline.

In contrast, the data show that migration dominates in the lower-middle income regions (Panel II). The share of migration increases from about 12 per cent in the poorest villages to about 22 per cent in the lower-middle income villages. With further increases in wealth, however, migration declines and is only about 6 per cent in the richest regions. Thus, we observe a switch in the dominant occupation from agriculture to migration in the lower middle income villages. This finding provides the initial support for the hypothesis that as wealth increases more complex occupations replace simpler ones. The predominance of migrants from the poor, but not the poorest, regions in our data is consistent with the work of World Bank (2001b).

Unlike in the case of migration in our sample communities, micro-enterprises dominate in the higher middle income villages (Panel III). The share of micro-enterprises grows from about 7 per cent in the poorest villages to about 22 per cent in the higher-middle income villages. In contrast, in the richest villages the share of micro-enterprises declines to about 16 per cent. Thus, once again we see an evolution in the dominant occupation, from migration to micro-enterprises, with the switch occurring in this case in the higher middle income villages.

In the richest regions local rural industry is the dominant occupation (Panel IV). The share of local rural industry grows monotonically from under 10 per cent in the poorest villages to over 60 per cent in the richest villages. Thus, in the richest villages we see the final stage of the evolutionary hypothesis, as local rural industry, the most complex occupation, becomes dominant. The villages are taking on characteristics of urban economies. In fact, almost 30 per cent of all rural industrial employment occurs in the top 10 per cent of the wealthiest villages alone. In contrast, only 2 per cent of all industrial employment occurs in the bottom 10 per cent of the income distribution. These patterns also are apparent where we plot all observations in the village-level data underlying the above patterns rather than the means level of occupational shares (Figure A2, Appendix).[7]

Occupations in China and Geography

In his seminal work Skinner (1977) demonstrated that there is a critical spatial dimension to the processes of China's economic and social change. Transportation systems, the location of cities and certain aspects of physical geography play key roles in regional development. In order to demonstrate these roles, Skinner divided rural China into nine macro-regions, each comprising 'core' and 'periphery' zones. Each macro region is specified based on a set of criteria that indicated a level of

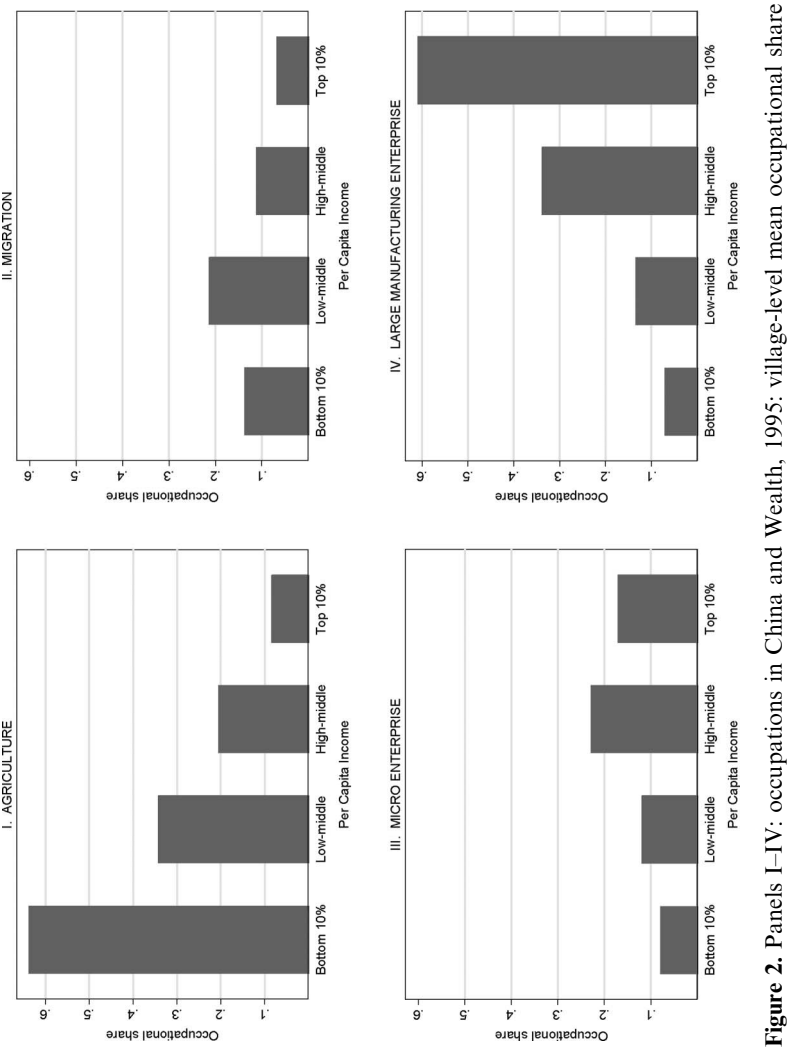

Figure 2. Panels I–IV: occupations in China and Wealth, 1995: village-level mean occupational share

development. The most developed areas are in the core and the least are in the periphery.

Skinner's spatial division of China's rural economy takes advantage of the fact that most economic, social, and demographic variables are spatially correlated and co-vary systematically through regional space (Henderson, 2001). The core-periphery zones (CPZ) make explicit these spatial relationships and a CPZ measure is assigned to each county using a macro-regional index of highly correlated variables, such as transportation networks, electricity use, and age and education structure of the population. Using GIS files of county boundaries and transportation networks, all pairs of contiguous counties are tested based on this criterion till each county is assigned to a core-periphery zone, from the highly urbanised inner core to the remote rural periphery. Skinner's work demonstrates that many social and economic phenomena in China vary in space according to relative location within these macro-regions.

We use this concept of Skinner in this analysis to examine the second hypothesis concerning the effects of spatial organisation on the evolution of occupations by assigning a CPZ index to each village. This index represents the core-periphery zone in which the home-county of the village is located. We are assuming that the CPZ index captures the characteristics of geographic location, including such elements as the transaction costs of exchange, local demand conditions and access to technology. In other words, in villages in the core regions villagers that wish to start a business or manufacturing firm, have more opportunities to do so. In contrast, those in the periphery, are faced with high transaction costs of exchange, insufficient access to marketing channels and inefficient production technologies.

As was the case with income, we also find four distinct spatial patterns in which production modes evolve across the periphery-core continuum of the sample (Figure 3, Panel I to IV). Agriculture is most prevalent in the far periphery, areas that are remote and isolated, and is declining towards the core. In contrast, migration is a phenomenon of the more developed regions of the periphery, although it also declines towards the core. Micro-enterprises have the highest share in the outer edge of the urban core. Local rural industry, unsurprisingly, is highest in the urban core and declining rapidly towards villages at the periphery. One explanation of these contours is that there exists mechanisms through which economic development processes that characterise core-periphery regions shape the structure of occupations in a local economy.

In summary, the above findings support the hypotheses that least complex occupations are dominant in the poorest and most remote regions and increasingly complex occupations in wealthier and more developed ones. On the basis of these observations there is a fairly distinct development ladder pattern that is observed spatially.

Occupations in China Over Time: A Markov Transition Analysis

In this section we seek to find support for the hypothesis that occupational structure of villages evolve and become more complex over time. To examine this, we use a Markov chain model that can estimate the parameters in a transition matrix that represent the probabilities that occupations in an economy (in this case a village) will

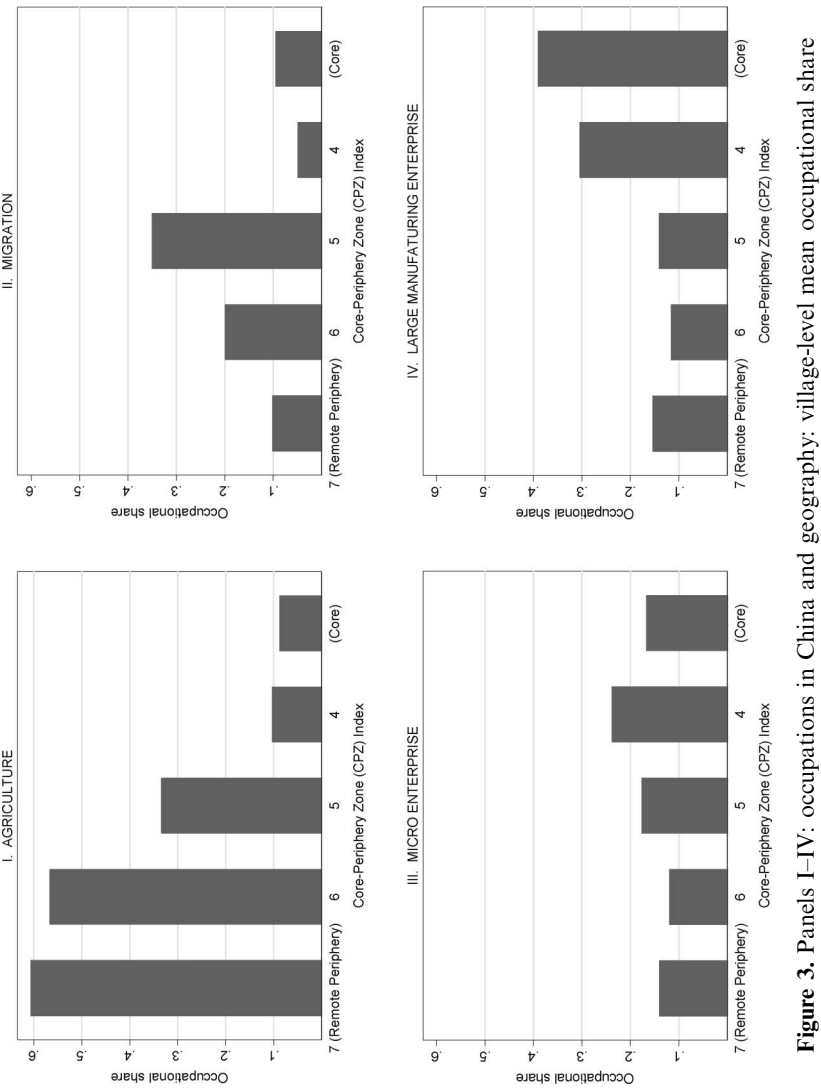

Figure 3. Panels I–IV: occupations in China and geography: village-level mean occupational share

shift (in this case from 1988 to 1995) from one type to another (e.g., from migration to micro-enterprise ownership). If occupations are evolving to more complex states over time, we should see positive transition parameters that represent shifts between agriculture and migration, migration and micro-enterprises, and micro-enterprises and large scale manufacturing enterprises.[8]

We follow Lee (1992) in our approach for estimating the transition parameters from aggregate occupational shares. We also use similar interpretations. We have 210 village-level occupational shares for the time periods 1988 and 1995. Given the Markov assumptions, we specify the occupational shares observed in 1995 as a function (through the transition probabilities) of the occupational shares observed in 1988 in the 210 villages. Specifically, using the village level occupational shares (ω_{ivt}) the empirical model we consider is:

$$\boldsymbol{\omega}_t = \boldsymbol{\omega}_{t-1}\mathbf{p} \tag{4}$$

where $\boldsymbol{\omega}_t$ is a $(1 \times \mathrm{I})$ vector of true village level occupational shares observed at time t, $\boldsymbol{\omega}_{t-1}$ is a $(1 \times I)$ vector of observed shares in time t-1, and $\mathbf{p}$ is $(I \times I)$ matrix of transition probabilities between the I occupations with the property: $0 \leq P_{ji} \leq 1$. We estimate the transition matrix using a mathematical programming approach which minimises the sum of squared errors between the calculated occupational share for each village (from Equation 4) and the observed share in the village (Bhat, 1985; Beasley, 1990). Although we use a programming approach to estimate the model and make no distributional assumptions, our approach is similar to a simultaneous equation regression model with constraints on the parameters. The parameters provide a forecast of how occupations evolve over time and also allow adjusting the transition probabilities to reflect changing policies.

The transition matrix estimates for the 1988 to 1995 period provide strong support for the hypothesis that pattern of the community occupations are evolving over time (Table 2). In particular, the analysis illustrates the shift away from agriculture. For example, the probability of workers in a community staying in agriculture is only 0.71 (Row 1). The probabilities associated with the workers in a community moving from agriculture to migration, micro-enterprises and large enterprise also are each positive (0.10, 0.09 and 0.10, respectively). In contrast, the transition probabilities from the more complex occupations back to agriculture are all 0.00 (Column 1,

Table 2. Transition probability matrix for agriculture, migration, micro-enterprise and large enterprise occupations

		To (1995)			
		Agriculture (A)	Migration (O)	Micro-enterprise (M)	Large enterprise (K)
From (1988)	A	0.71	0.10	0.09	0.10
	O	0.00	0.67	0.33	0.00
	M	0.00	0.08	0.53	0.40
	K	0.00	0.07	0.11	0.83

Rows 2 to 4). This one-way, shifting relationship is consistent with the findings of a time series analysis of China's economy by Yau (2000).

The results also suggest that the other occupations have also undergone substantial change. The probability of workers in a village remaining in the migrant labour force was only 0.67 (Row 2). The largest transition probability associated with migration is into the micro-enterprise sector (with a transition probability of 0.33). As seen in de Brauw et al. (2002b), this result is consistent with a finding that migration is being used as a strategy to help households accumulate wealth and experience so they are able to make additional investments when they return to the village after working outside of the household. The results, however, do not necessarily mean that migration is falling. As some migrants from some communities shift to become micro-enterprise managers, those in other communities are entering the migrant sector. The transition probabilities out of other sectors into the migrant sector are all positive (Column 2, Rows 3, 4 and 5) with the highest transition probability being associated with the transition out of agriculture into migration.

The final step in the evolutionary process is seen by examining the micro-enterprise sector (Row 3). The probability of workers in a community staying in the micro-enterprise sector is estimated to be 0.53. The largest transition probability associated with the micro-enterprise sector is the transition probability from the micro-enterprise sector to the large enterprise sector (0.40).

Simulating into the future with this one set of transition matrix coefficients clearly demonstrates the evolutionary shift from agriculture to off-farm sectors and from less complex occupations to more complex ones (Figure 4). While in Time Period 1, agriculture has the largest share relative to the off-farm occupations, over time it would shrink to the smallest sector. At the same time, migration, micro-enterprises and large enterprises expand their share. By Time Period 9, if the transition relationships were to remain constant, a clear order of dominance would appear: large enterprise would provide a majority of the employment, followed by micro-enterprises and migration. From the context of this study, these results provide strong support for the hypotheses and reveal the rural development ladder pattern over time.

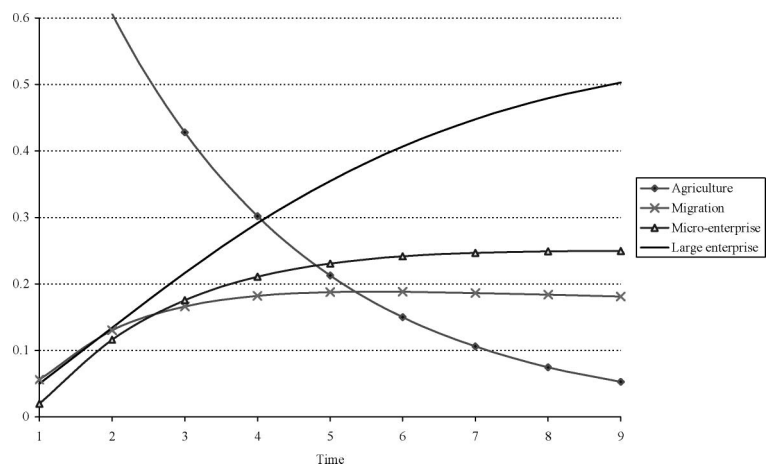

Figure 4. Evolution of occupations during development: Markov Simulation

V. Explaining the Evolution: Two Conceptual Models

In this section we seek to explain the evolution of occupations observed in rural China. To do so, we are going to use two stylised theoretical models of micro-behaviour that seek to explain why an individual might remain in a less complex (less profitable) occupation and what factors could facilitate a shift to a more complex one. We will be examining two simple, representative agent models. We are not saying that one or the other (or even both) is causing all of the observed changes. Instead, we seek to illustrate two important elements that may be part of the force driving the evolution of China's rural economy. The patterns we observe at the village- or 'macro-level' are obviously driven by underlying micro-level behaviour in the rural economy. There is a large literature on micro-level occupational strategies in rural China—for example: Stark (1991), Zhao (1999), Chang (1993), Rozelle et al. (1999b), de Brauw et al. (2002b). Therefore, we wish to integrate the micro-level factors, often studied separately by these papers, into a single framework and show how they may lead to the evolutionary pattern we observe at the macro-level. We do not try to formally aggregate the results to the economy level, and so in this sense, we are following the lead of previous studies that infer changes to the entire economy on the basis of the decisions of representative agents (Eswaran and Kotwal, 1986).

We consider two types of changes in the local economy that may be important in shaping the emergence of occupations. First, we create a model that shows that, under certain assumptions, increases in wealth can overcome capital constraints that are keeping agents in less complex occupations. Second, we build a model that shows that as the local environment (including the local infrastructure; the demand for a firm's output; etc) becomes more conducive to fostering the emergence of enterprises and other more complex occupations, they begin to appear and the occupations are transformed into more complex ones. We model the impact of these two types of changes (that is, increases in wealth and improved infrastructure) on the household's activity participation decisions that endogenously determine the occupations that emerge. The construction of the models are given in the appendix.

A Model of Rising Wealth

Given its endowments of time and wealth we assume that the household maximises income from agricultural production, migration and enterprise production. Agricultural production primarily uses the household's own labour time on a fixed amount of land to produce agricultural output.[9] Alternatively, the household may devote its own time into migration that yields an income through migration remittances.[10] The household also may own and operate a household business as a micro-enterprise using its own labour time. It may also expand the business into a large enterprise by hiring labour and capital from the market. The output of the household business is assumed to be stochastic, necessitating the supervision of hired labour for effort extraction.

Maximisation of household income from these three activities is subject to three constraints. First, the household faces a financial constraint when deciding whether or not to enter the migrant labour market since migration is costly for the household. Conceptually, the household either uses its own funds or obtains them through informal borrowings from friends and relatives. The amount of such borrowings

available to the household is proportional to its wealth endowment, which represents its ability to repay the loan and serves as an implicit collateral. Second, the household faces a similar working capital constraint when expanding the household business through the purchase of hired labour and capital inputs. In the case of the working capital constraint, the household obtains working capital from its own endowment, borrowings from friends and relatives, and from its earnings from migration. Finally, the household faces a time constraint: the allocation of the household's time into agricultural production, migration, enterprise production and hired-labour supervision cannot exceed its total time endowment.

The above model highlights several key features of developing agrarian economies in general and China's rural economy in particular. For example, costs of entry into the migrant labour market are thought to be an important factor, and they have been extensively discussed in the literature as an important determinant of the decision to migrate inside and outside of China (Stark, 1991; Zhao, 1999). In some parts of China the inability to finance migration was identified as such a constraint to poverty alleviation that the World Bank provided loans as a key part of a poverty alleviation loan package in some of the poorest parts of the country (World Bank, 2001b).

Equally prominent in the literature is the importance of working capital constraints faced by rural entrepreneurs as they attempt to finance purchased inputs for enterprise production and how they overcome them (Eswaran and Kotwal, 1984; Carter and Zimmerman, 1998). In China capital constrained farm households almost exclusively have to use their own funds to operate new industrial enterprises themselves (Chang, 1993; Ho, 1995). Moreover, one of the most effective ways to accumulate such funds has been by using off-farm labour market earnings (Rozelle et al., 1999a; deBrauw et al., 2002b).

Simulating the Wealth-Induced Evolution of Occupations

The focus of the modeling effort here will be on how output supply and input demand varies with wealth. In order to test whether or not the modeling framework described above is useful for explaining the dynamics in modern rural China, we must evaluate if changes in wealth cause occupations to evolve and, if they do, whether the evolutionary pattern can be identified with the one observed in our data. To do so, we parameterise the model using reasonable values for the price of the agricultural output, the price of the manufactured good, labour wages, efficiencies of household production in the three activities, and the exogenously given cost of sending migrants out of the household. Under these assumptions, we can simulate the model, letting wealth change, and look for the effects of rising wealth on household employment decisions and the associated changes in the occupations.

The simulations reveal four distinct occupations that emerge in four critical intervals of wealth (Figure 5, Panels I to IV). In the initial stages, at low levels of wealth, entry into the migrant labour market is difficult for households due to their inabililty to finance the costs of migration (Panel I). In the absence of a large wealth endowment or substantial migration earnings the household can only purchase a small amount of capital for the enterprise. The consequent low marginal productivity of labour in the enterprise, and the lack of finance for entering the migrant labour market make it optimal for the household to put the major portion

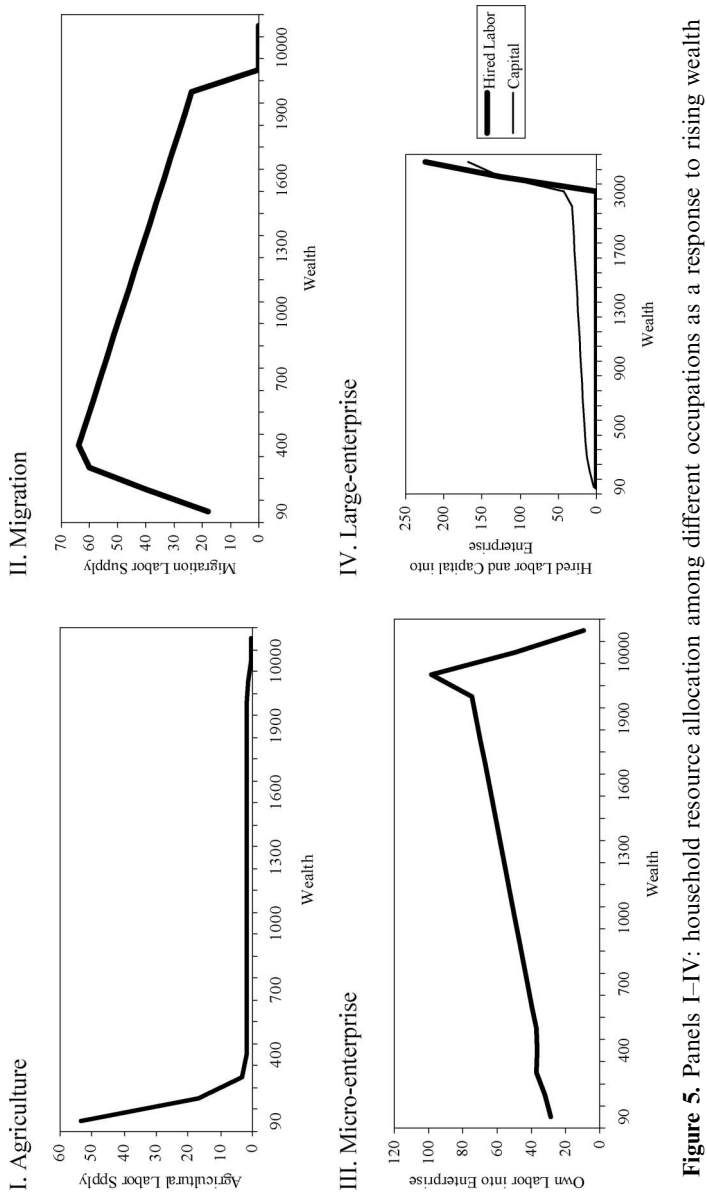

Figure 5. Panels I–IV: household resource allocation among different occupations as a response to rising wealth

of its time into subsistent agricultural production. Thus, in this stage agriculture dominates, migration is limited and the household runs the enterprise as a small household business without any hired labour or capital.

As income increases, the share of agriculture starts to fall (Panel II). The household is now able to finance migration, which, in turn, helps relax the working capital constraints of the household business. Marginal productivity of labour in the household business starts to rise drawing more of the household's own time into it. Thus, in this stage, migration dominates and the small business starts to expand, primarily through the greater use of household labour and small increases in capital inputs.

At even higher levels of wealth, the working capital constraint on financing enterprise inputs relaxes further (Panel III). Therefore, the need for migration declines. The household starts to allocate the majority of its time into the household business, which also employs a modest amount of capital. This stage marks the dominance of micro enterprises.

As income increases further, the working capital constraint on the household business is not binding (Panel IV). With sufficient finance to purchase inputs, the small household business is transformed into a large enterprise. The greater availability of capital also allows the firm to hire labour. Most of the household's own time in this stage is spent on managing and supervising workers. Although the modeling environment in not rich enough to show the effect, as large enterprises rise and become more complex, the firms demand more technically trained workers, middle level managers and other more highly trained and experienced employees. Hence, while not all workers in wealthier areas will start a business, it may be that their rising wealth is accompanied (or caused) by a movement into more demanding and high-paying jobs.

Despite some of the shortcomings of the model to handle all of the direct and indirect effects of rising wealth, it does provide a simple illustration of the evolution of the occupations that are observed in contemporary rural China. The model of rising wealth clearly suggests a micro-level evolution of the dominant occupation, from least complex to more complicated ones. These micro-economic responses, when aggregated together, provide one explanation for the observed patterns of evolution in our data, in particular the patterns found in Figure 2.

A Model of Rising Efficiency

In this section we use a framework similar to the previous model to analyse the effects of increasing efficiency on the emergence of different occupations. We consider, as before, a household that seeks to maximise income from agricultural production, migration and enterprise production.[11] However, in this section's model we assume that the household's ability to migrate and its efficiency at operating the enterprise is constrained by a lack of access to technology and information, not wealth differentials. In the modeling effort, we assume that these constraints relax as the local economy develops. Localities create linkages (physical, electronic, and networking) that gradually connect villages with urban centers. Improving infrastructure and better communications facilitate easier access to information and technology required for both migration and efficient enterprise production. One part of the improving communication networks could rely on the information and skills brought home by migrants to run the enterprise more efficiently.

It is in this way that a village located right next to a major metropolitan region will find that it can efficiently manufacture and sell the goods and services from its factory. Thought about this way, efficiency can also be thought of in terms of the amount of demand that there is for a village's production, including the demand for the household's labour. We simulate the effects of rising efficiency and evaluate how occupations change on the efficiency continuum.

Simulating the Efficiency-Induced Evolution of Occupations

The pattern of evolution of occupations that is suggested by this model is similar to the pattern suggested by the model of rising wealth (Figure 6, Panels I to IV). Occupations evolve and become more complex in regions with better information and technology relative to isolated regions. In the most isolated regions with poor technologies of enterprise production and lack of information for migration, agriculture dominates (Panel I). With increases in local development migration starts to occur as information regarding outside opportunities increase (Panel II). As this process continues the efficiency of enterprise production increases, both due to the better enterprise production technologies that are available and also due to the new skills acquired by migrants. In the villages that are in the most efficient locations, enterprises can manufacture goods and services and expand their size from micro- to large-scale firms (Panels III and IV). In this way, these results provide an alternative (or complementary) explanation for the evolution of occupations observed in our sample of villages. These results also reproduce the patterns found in Figure 3.

VI. Econometric Analysis

In this section we use our empirical data to econometrically test the hypotheses of evolving occupations in rural China. We use a proportions-multinomial logit model to analyse the factors that induce villages to specialise in certain occupations. The standard multinomial logit framework applies when the dependent variable is in the form of proportions rather than being binary, Greene (1990).[12] The model is:

$$\text{Prob}(y_i = m) = \exp\left(\frac{\exp(\boldsymbol{\beta}_m \mathbf{X}_i)}{\sum_m^M \exp(\boldsymbol{\beta}_m \mathbf{X}_i)}\right), m = 0, 1, \ldots, M. \quad (5)$$

where y_i, the dependent variable, are a set of proportions representing the shares of different occupations in the labour force, X represents a set of village characteristics that affect the shares of different occupations.

To capture how wealth affects the village's occupational structure, we create four dummy variables indicating four critical wealth intervals: low income, low middle income, high middle income and high income. In the first model we will examine how wealth alone affects the village's occupations, which conceptually is a replication of Figure 2. Similarly, we also use four dummy variables to indicate different levels of the CPZ index, a measure of the level of development of the region, which decreases as one moves from the core to the periphery. These CPZ dummy variables locate a village within four categories: far periphery, inner periphery, outer core and core. In model two, we will examine the independent affect of the CPZ variables on

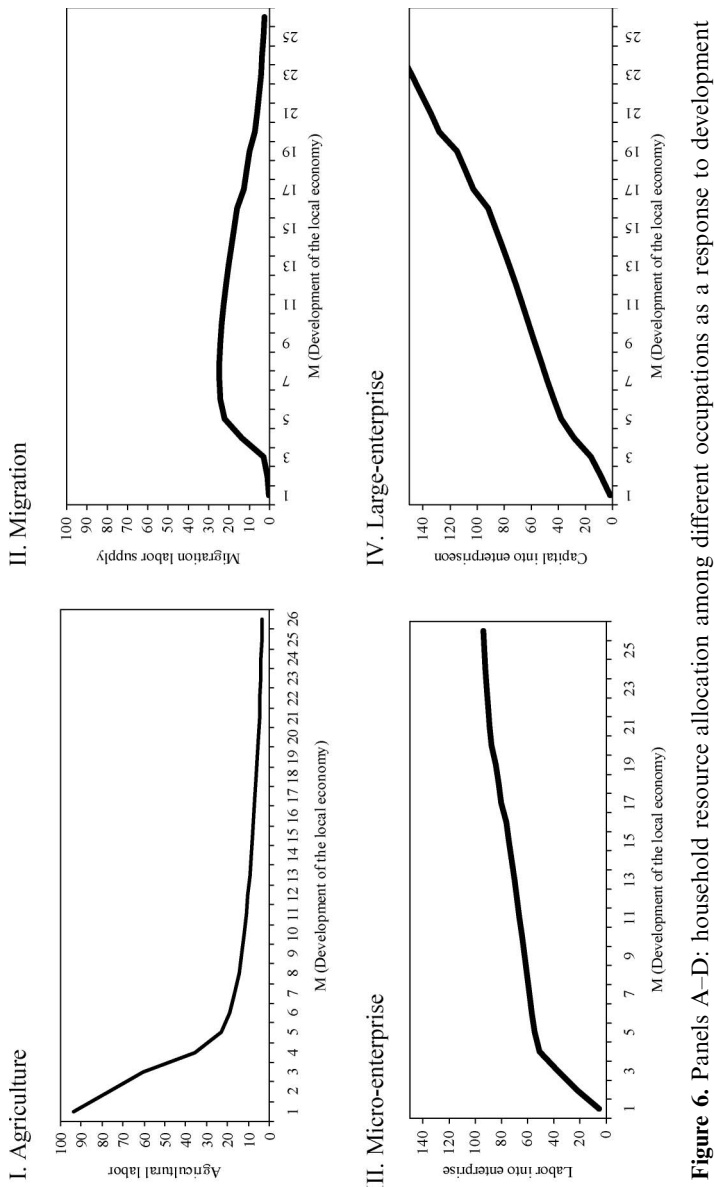

Figure 6. Panels A–D: household resource allocation among different occupations as a response to development

occupations. In the final model, we include both wealth and the CPZ variables and also control for the influence of other village characteristics that may affect the emergence of different occupations, such as the human capital of the village leader, average level of educational attainment of village labour force and village land per capita.

The econometric estimates of the effects of wealth on production modes are consistent with the earlier findings (Table 3). Relative to the base low income category, the proportion of migrants is higher in the lower middle income group. In fact, the share of migration is found to be the highest in the low middle income wealth interval and decreasing rapidly in the high middle income and high income villages. In contrast, as we move to the high income villages, the positive effects of rising wealth are increasing in terms of a rise in the share of micro-enterprises, and even more so for large manufacturing firms. These findings are consistent with the patterns in Figure 2.

Using the second multinomial regression model we estimated the independent effects of the CPZ variables on the different occupations (Table 4). These estimates also support the earlier descriptive findings in Figure 3. Relative to the far periphery, migration increases in the inner periphery. However, the marginal effects on migration of moving to the inner core are negative. The estimates in Table 4 also support the hypothesis regarding the shifts in the shares of micro-enterprises and large enterprises along the periphery-core continuum.

The results of the combined specification also yield estimates that are qualitatively equivalent to the earlier econometric findings: rising wealth and increasing levels of development (measured by the CPZ index) encourage the proliferation of more complex occupations (Table 5). The share of migration is about 3.4 per cent higher in the lower middle income villages relative to the base, low income category of villages. Further increases in wealth have negative effects on the share of migration. In contrast, increases in wealth have positive effects on the shares of micro-enterprises and even larger positive effects on the share of large enterprises, revealing the dominance of large enterprises in richer villages.[13] The coefficient estimates of the CPZ variables reveal a similar pattern. The marginal effect of moving from the far periphery to the inner periphery on the share of migration is an increase of 1.2 per cent. Further movements away from the periphery cause migration to fall. The share

Table 3. The marginal effects of wealth on off-farm occupations: proportions-multinomial logit model

	Migration		Micro enterprise		Large enterprise	
Independent variable	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
Low middle income	0.0294*	0.0029	0.0202*	0.0037	0.0781*	0.0055
High middle income	−0.0249*	0.0030	0.0602*	0.0037	0.1833*	0.0060
High income	−0.0842*	0.0055	0.0856*	0.0044	0.3330*	0.0072

Notes: *indicates significance at the 5 per cent level. [b]The low-income group are left out as the base category.

Table 4. The marginal effects of location on off-farm occupations: proportions-multinomial logit model

	Migration		Micro enterprise		Large enterprise	
Independent variable	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
Inner periphery	0.0324*	0.0022	0.0377*	0.0027	0.0296*	0.0042
Outer core	−0.1398*	0.0055	0.0526*	0.0027	0.0908*	0.0040
Core	−0.0454*	0.0020	−0.0171*	0.0021	0.1540*	0.0033

Notes: *indicates significance at the 5 per cent level. [b]The far periphery group are left out as the base category.

Table 5. The combined effects of wealth and location proportions-multinomial logit model

	Migration		Micro-enterprise		Large enterprise	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Low middle-income	0.0343*	0.0030	0.0281*	0.0039	0.0504*	0.0057
High middle income	−0.0013	0.0034	0.0719*	0.0043	0.1200*	0.0062
High-income	−0.0916*	0.0058	0.1016*	0.0051	0.1998*	0.0070
Inner periphery	0.0122*	0.0023	0.0394*	0.0029	0.0152*	0.0041
Outer core	−0.1232*	0.0055	0.0342*	0.0028	0.0650*	0.0040
Core	−0.0342*	0.0022	−0.0554*	0.0026	0.0597*	0.0030
Village education	0.0009*	0.0010	0.0010*	0.0001	0.0017*	0.0002
Land per capita	−0.0300*	0.0014	0.0123*	0.0012	−0.0443*	0.0019
Leader education	0.0011*	0.0003	−0.0024*	0.0004	0.0017*	0.0005

Notes: *indicates significance at the 5 per cent level. [b]The low income group and the far periphery group are left out as the base category.

of micro-enterprises also increases as we move away from the far periphery; however at the core, the share of micro enterprises decreases by over 5 per cent.

As we move from the far periphery towards the core, the share of large enterprises also increases at a rapid rate. In fact, relative to the far periphery, the share of large enterprises is about 6 per cent higher at the core. In addition to the findings regarding the effects of wealth and CPZ variables, the estimates of the coefficients on other village characteristics are of the expected signs. Overall, the results of the combined specification show that increases in village wealth and development, measured by the CPZ variables, cause occupations to evolve, and that this observation is robust even in the presence of other variables that may affect the evolution.

VII. Conclusions

This paper studies how occupations emerge across space and over time during the development of China's rural economy. Using our data set on rural China we

examine four main occupations that have emerged in rural China since the onset of economic reforms: subsistence agriculture, migration, micro-enterprises and large enterprises. The findings reveal that there is a systematic pattern to the emergence of different occupations across space and over time.

Among the most striking results of this study is the discovery of an evolutionary pattern according to which occupations emerge in rural China. There is clear evidence that during economic development occupations evolve and become more complex. Specifically, we find that the lowest income and most remote regions at the periphery are predominantly subsistence agriculture. However, in the more developed regions the main occupation changes into more complex forms. In the lower middle income and slightly more developed areas, migration replaces agriculture as the main occupation. In the higher middle income and more developed regions, micro-enterprises replace migration as the dominant occupation. In the richest and most developed villages near the core, large-scale manufacturing dominates. The results also indicate this evolution of occupations is also happening within a particular region, over time. These findings suggest that rural development in China is comparable to a process of climbing the development ladder with each step up the ladder denoting the rural economy's transition into a more complex occupation.

If the current evolution continues we should see the convergence of economic growth happening in different regions of rural China and a reversal of the strong trends of inequality that have worried policymakers in the past. However, insights from the conceptual model suggest that the removal of barriers to a rational allocation of resources is key to the continued evolution of occupations into more advanced forms. In China's post-reform rural economy, policymakers have sought to relax constraints on the growth of industrial occupations allowing all areas to grow, however, these efforts have varied across regions. While the coastal provinces have been granted favorable access to key goods and capital, and have experienced rapid development of land, labour and credit markets, many regions in inland China still rely on individual endowments for the growth of their most profitable occupations. Removal of the barriers that constrain the rural farmer's decision to participate in different off-farm occupations is, hence, key to raising rural incomes and, over time, in bringing about equitable growth in rural China.

Acknowledgements

The authors would like to thank two anonymous referees for their comments and James Eaves, Arizona State University, for his encouragement and helpful suggestions.

Notes

1. Although there are several reasons why wealth is important to the emergence of different occupations, the one most pertinent to developing countries is that in poor areas innovators of new productive activities face restricted access to capital (Eswaran and Kotwal, 1986). Low income regions are characterised by poorly developed financial markets and credit is invariably rationed according to the ability to offer collateral (Pische et al., 1983; Rudra, 1983). High factor costs such as that for capital which arise in poor areas due to the small size of markets, are an important determinant of the of

occupations that emerge in the economy (Chenery, 1960; Kuznets 1966; Chenery and Taylor, 1968). Wealthier regions with better access to capital and credit, will therefore, experience faster expansion of their off-farm occupations than poorer regions; especially in the occupations such as large scale entrepreneurship, that are more capital intensive and bound by working capital and credit constraints

2. Areas that are closer to the urban centers have a larger demand for goods and services and better access to information, modern technology, markets, infrastructure and lower transaction costs. Therefore, occupations such as large-scale industries that require access to information and technology in order to operate efficiently, are more likely to develop more rapidly in rural areas that are closer to urban areas than in more isolated regions.
3. Micro-enterprises are believed to develop by taking advantage of market niches and isolated locations in which they do not have to face competition from larger firms but where they have sufficient access to small venture capital (Sherer, 1970; Pryor, 1972; Fafchamps, 1994). The literature on the location of large scale manufacturing emphasises the importance of attributes that are linked to urbanisation and affluence of a region; the location decision seeks to minimise costs of marketing and distribution, procuring material inputs, transportation and infrastructure and access to capital in the region.
4. While it is somewhat unusual for village leaders to be able to provide employment data for their villages, in China it is possible and we believe that the data are fairly accurate. To make the estimates, what is needed is an estimate of the size of the labour force (the denominator) and a count of the number of individuals that are participating in each type of occupation (the numerator). Information on the size of the village labour force is relatively straightforward, since it is a figure that villages are required to report on year-end statistical forms to township officials. In other words the denominator is a figure that is updated by the village accountant each year as a standard part of his job. To get the counts of individuals in each village that are in each occupation, during the survey, the village leader and accountant used a comprehensive list of all of the village's households. They then went down the list household-by-household and created running tallies of the number of individuals that they believed were involved in each occupation category. We have used this procedure many times and because of the intense interaction between village leaders and households (leaders are responsible for many village activities: they distribute land to farmers; collect taxes; implement family planning; oversee irrigation; co-ordinate health care; and many other activities. When going through the list of households it is clear from their interactions with each other that local leaders know each household and have a reasonably good idea of what members of each are doing.
5. Local rural industry workers include in-migrants, commuters and local wage earners. Among these, in-migrants are those who come from other villages in search of wage earning jobs. Commuters include those workers who come into the village from a nearby area for wage jobs and those, from within the village, who commute daily to work in a factory in a nearby area. Local wage earners, as explained before, comprise of people from within the village working in a local factory.
6. We would like to thank an anonymous referee for suggesting the decomposition in occupation shares.
7. Relative to Figure 2 which depicts the village means of occupational shares, in Figure A2 we present a vertical collection of dots for each income category, with each dot representing a village in that category. Note that the mean level of employment shares in each income group are indicated by a horizontal line of pluses, and solid lines indicate the mean plus or minus the standard deviation of each group. This provides a sense of the extent of dispersion in occupational shares within each of the income categories.
8. It is important to note that we are dealing with village-level not individual-level data. Therefore the transition parameters refer to the aggregate shift of communities across occupational categories which characterises the observed occupational evolution and not to the probability of any one individual worker transitioning from one occupation to another.
9. We treat land as a fixed factor in production due to the administrative restrictions on land use in rural China. The absence of hired labour in the agricultural production function also reflects another feature of China's rural economy; thin on-farm labour markets (see Brandt et al., 2001).
10. We assume that migration earnings are realised within the production period, at the end of which the agricultural and enterprise output is realised and factor costs are paid.
11. We assume for simplicity that the household uses its own labour and capital purchased from the market as inputs into the enterprise.
12. The underlying model of occupational choices in a village is discrete but the observed dependent variable is a proportion (of people making a particular discrete choice).

13. In the high income villages the share of micro enterprises increases by 10 per cent while the share of large enterprises increases by almost 20 per cent.
14. We treat land as a fixed factor in production due to the administrative restrictions on land use in rural China. The absence of hired labour in the agricultural production function also reflects another feature of China's rural economy; thin on-farm labour markets (see Brandt et al., 2001).
15. We assume that migration earnings are realised within the production period, at the end of which the agricultural and enterprise output is realised and factor costs are paid.
16. We assume for simplicity that the household uses its own labour and capital purchased from the market as inputs into the enterprise.

References

Banerjee, V. A. and Newman. A. F. (1993) Occupational choice and the process of development, *Journal of Political Economy*, 101(2), pp. 274–98.

Bhat, N. (1985) *Elements of Applied Stochastic Processes* (New York: Wiley).

Beasley, J. E. (1990) OR-library: distributing test problems by electronic mail, *Journal of the Operational Research Society*, 41(11), pp. 1069–72.

Brandt, L., Huang, J., Li, G. and Rozelle, S. (2000) Land rights in China: facts, fictions, and issues, Working Paper, Department of Agricultural and Resource Economics, University of California, Davis.

Byrd, W. A. and Lin, W. (1990) *China's Rural Industry* (Oxford: Oxford University Press).

Carter, M. and Zimmerman, F. (1998) The dynamic costs and persistence of asset inequality in an agrarian economy, U.W. Agricultural and Applied Economics Staff Paper 416.

Chan, K. W. (1999) Internal migration in China: a dualistic approach, in H. Mallee and F. Pieke (eds), *Internal and International Migration: Chinese Perspectives* (Richmond: Curzon Press).

Chan, K. W. and Yang, Y. (2000) Interprovincial migration in China in the post-1949 era: types, spatial patterns and comparisons, Seattle Population Research Center, Working Paper.

Chang, K. S. (1993) The peasant family in transition from Maoist to Lewisian rural industrialization, *Journal of Development Studies*, 29(2), pp. 220–44.

Chenery, H. B. (1960) Patterns of industrial growth, *American Economic Review*, 50(1), pp. 624–54.

Chenery, H. B. and Syrquin, M. (1975) *Patterns of Development 1950–1970* (London: Oxford University Press).

Chenery, H. B. and Taylor, L. (1968) Development patterns: among countries and over time, *The Review of Economics and Statistics*, 1(4), pp. 391–416.

Chuta, E. and Liedholm, C. (1990) Rural small-scale industry: empirical evidence and policy issues, in C. Eicher and J. M. Steatz (Ed.) *Agricultural Development In The Third World* (Baltimore: Johns Hopkins University Press).

Clark, C. (1940) *The Conditions of Economic Progress* (London: Macmillan).

DeBrauw, A., Zhang, L., Huang, J. and Zhang, Y. (2002a) The evolution of labour markets during the reforms, *Journal of Comparative Economics*, 30(2), pp. 329–53.

DeBrauw, A., Rozelle, S. and Taylor, E. (2002b) Migration and incomes in source communities: a new economics of migration perspective from China, Working paper, Agriculture and Resource Economics Department, University of California Davis.

Démurger, S., Sachs, J. D., Woo, W. T. and Bao, S. (2001) Geography, economic policy and regional development in China, paper prepared for the *Third International Conference on the Chinese Economy*, CERDI, Clermont-Ferrand, France.

Entwisle, B., Henderson, G. E., Short, S., Bouma, J. and Zhai, F. (1995) Gender and family businesses in rural China, *American Sociological Review*, 60(1), pp. 36–57.

Eswaran, M. and Kotwal, A. (1986) Access to capital and agrarian production organization, *Economic Journal*, 96(1), pp. 482–98.

Fafchamps, M. (1994) Industrial structure and micro-enterprises in Africa, *Journal of Developing Areas*, 29(1), pp. 1–30.

Fan, C. C. (1999) Migration in a socialist transitional economy: heterogeneity, socioeconomic and spatial characteristics of migrants in China and Guangdong province, *International Migration Review*, 33(4), pp. 954–74.

Fei, C. H. J. and Ranis, G. (1997) *Growth And Development From An Evolutionary Perspective* (Massachusetts: M. A Blackwell).

Fisher, A. G. B. (1935) *The Clash of Progress and Security* (London: Macmillan).
Fuchs, V. (1968) *The Service Economy* (New York: NBER).
Gemmel, N. (1982) Economic development and structural change: the role of the service sector, *The Journal of Development Studies*, 19(1), pp. 37–66.
Gallup J., Sachs, J. D. and Mellinger, D. (1998) Geography and economic development, NBER Working Paper 6849.
Greene, W. H. (1999) *Econometric Analysis* (New York: Macmillan).
Henderson, M. (2001) GIS techniques for cross-time analysis of China county data, paper presented at the International Workshop on Historical GIS, Fudan University, Shanghai, August 23–25.
Ho, S. P. (1995) Rural non-agricultural development in post-reform China: growth, development patterns and issues, *Pacific Affairs*, 68(3), pp. 360–391.
Jin, H. and Qian, Y. (1998) Public versus private ownership of firms: evidence from rural China, *Quarterly Journal of Economics*, 113(3), pp. 773–808.
Khan, M. A. (1989) *In Praise Of Development Economics* (Baltimore: John Hopkins University).
Kuznets, S. (1966) *Modern Economic Growth; Rate, Structure and Spread* (New Haven: Yale University Press).
Lanjouw, J. O. and Lanjouw, P. (1994) Rural non-farm employment: a survey, Policy Research Working Paper 1463, World Bank, Washington, DC.
Lee, T. C. (1992) Changes of employment among sectors of the fast growing economy in Taiwan: a Markov chain analysis, in W. Griffiths, H. Lutkepohl and M. E. Bock (eds), *Readings In Econometric Theory and Practice* (London: Elsevier Science Publishers).
Liu, Q. and Chan, K. W. (1999) Rural–urban labour migration process in China: Job search, wage determinants and occupational attainment, University of Washington, mimeo.
Nee, V. and Keister, L. A. (2000) Institutional change, path dependence and emergent social order: the rational peasant in China, Working Paper, Cornell University.
Nyberg, A. and Rozelle, S. (1999) *Accelerating China's Rural Transformation* (Washington, DC: World Bank).
Nurkse, R. (1959) *Patterns of Trade and Development* (Stockholm: Almqvist and Wiksell).
Otsuka, K. (2001) Strategy for industrial development in the western region, unpublished work.
Pryor, F. L. (1972) The size of production establishments in manufacturing, *Economic Journal*, 82(1), pp. 547–66.
Radelet, S. and Sachs, J. (1998) Shipping costs, manufactured exports and economic growth, paper presented at American Economic Association annual meeting, Chicago, January 1998.
Rostow, W. W. (1990) *The Stages of Economic Growth* (Cambridge: Cambridge University Press).
Rozelle, S., Taylor, E. and deBrauw, A. (1999) Migration, remittances, and agricultural productivity in China, *American Economic Review*, 89(2), pp. 287–91.
Rozelle, S., Guo, L. and Minggao, S. (1999) Leaving China's farms: survey results of new paths and remaining hurdles to rural migration, *The China Quarterly*, 158(1), pp. 367–93.
Rudra, A. (1983) Indian agricultural economics, in J. von Psichke, D. Adams and G. Donals (eds), *Rural Financial Markets in Developing Countries* (Baltimore: John Hopkins University Press).
Sherer, F. M. (1970) *Industrial Market Structure and Economic Performance* (Chicago, IL: Rand McNally).
Skinner, G. W. (1977) Regional development in nineteenth century China, in G. W. Skinner (ed.), *The City in Late Imperial China* (Stanford, CA: Stanford University Press).
Stark, O. (1991) *The Migration of Labour* (Cambridge: Basil Blackwell).
Stiglitz, J. E. (1988) Economic organization, information and development, in H. Chenery and T. N Srinivasan (eds.), *Handbook of Development Economics* (New York: North-Holland).
Townsend, R. M. (1988) Models as economics, *Economic Journal*, supplement.
World Bank (1997) *China 2020: Development Challenges in the New Century* (Washington: World Bank).
World Bank (2001a) *The Alleviation of Poverty in China, World Bank Report* (Washington: World Bank).
World Bank (2001b) *China: Overcoming Rural Poverty, World Bank Report* (Washington: World Bank).
Yau, S. (2000) Agriculture's role in economic development: the case of China, in S. Cook, S. Yao and J. Zhuang (eds), *The Chinese Economy in Transition* (New York: St Martin's Press).
Zhao, Y. (1999) Labour migration and earnings differences: the case of rural China, *Economic Development and Cultural Change*, 47(4), pp. 767–82.

Appendix

A Model of Rising Wealth

Given its endowments of time ($\overline{L}$) and wealth ($\overline{I}$) we assume that the household maximizes income from agricultural production, migration and enterprise production:

$$\Pi = P_a Q_a + (W - c)Q_o + \{P_b Q_b - rk_b - WL_b\} \tag{1}$$

In this formulation the first term denotes the household's revenues from subsistent agricultural production, the second term denotes net migration earnings and the third term denotes net revenues from a household business enterprise. The household can hire labour (L_b) and capital (k_b) inputs for expanding enterprise production, at exogenously given prices W and r respectively.

Agricultural production and migration produce income with technologies that primarily rely on the household's own labour. Agricultural output is produced using the technology:

$$Q_a = \tau_a f(l_a|D) \tag{2}$$

where τ_a is an index of the household's efficiency in agricultural production and l_a measures the amount of the household's own time that is devoted to on-farm agricultural production on a fixed amount of land (D).[14] Alternatively, the household may also devote its own time into migration according to the process:

$$Q_o = \tau_o g_0(l_o) \tag{3}$$

where τ_o is the household's efficiency in migration. This occupation uses the household's own time l_o and yields a gross income, Q_o, from working outside of the village.[15] Migration, however, is not costless; we assume that there is an exogenously-determined cost of migration, c, that varies with the number of migrants that leave the home.

The household also may own and operate a household business as a micro-enterprise or expand the business into a large enterprise. Its technology in enterprise production is given by

$$Q_b = \tau_b h_b(k_b, l_b, L_b) \tag{4}$$

where τ_b is the household's efficiency in operating an enterprise, k_b denotes capital inputs that are provided from the individual's own wealth (or borrowed using the entrepreneur's own wealth as collateral), l_b denotes the household's own time used in enterprise production and L_b denotes labour hired for enterprise production. The output of the household business is assumed to be stochastic necessitating the supervision of hired labour for effort extraction. Hence, the household may also spend $l_s(L_b)$ amount of its time in monitoring the hired labour. Capital is used at an exogenously-determined opportunity cost, r.

Constraints on Household Behaviour

Maximization of household income (1) is subject to three constraints. First, the household faces a financial constraint when deciding whether or not to enter the migrant labour market:

$$cg_0(l_o) \leq i(\overline{I}). \tag{5}$$

Equation (5) states that the household needs to have access to sufficient funds, *i(we)*, for financing an economic activity, in this case, migration. Conceptually, the household either uses its own funds or obtains them through informal borrowings from friends and relatives. The amount of such borrowings available to the household is proportional to its wealth endowment, which represents its ability to repay the loan and serves as an implicit collateral. The household faces a similar working capital constraint when purchasing inputs for production in the micro- or large enterprise,

$$\overline{I} + wg_0(l_o) \geq rk_b + wL_b \tag{6}$$

In the case of the working capital constraint, the household obtains working capital from its own endowment, borrowings from friends and relatives, and from its earnings from migration. This assumption relies on the observations spelled out in Rozelle, Taylor, and deBrauw, 1999.

Finally, the household faces a time constraint:

$$l_a + l_o + l_b + l_s(L_b) \leq \overline{L} \tag{7}$$

which simply states that the allocation of the household's time into agricultural production, migration, enterprise production and hired-labour supervision cannot exceed its total time endowment.

Assuming that the household's technologies (equations 3, 4 and 5) are concave and twice-differentiable in each of their arguments and that the household's supervision technology is convex, its problem is to maximize (1) subject to (2) to (7). The solution to this problem yields an optimum value function $\Pi(\overline{I}, \tau; \overline{L}, P_a, P_b, r, w, c)$, which is consistent with a system of output supply equations for the different occupations $Q(\overline{I}, \tau; \overline{L}, P_a, P_b, r, w, c)$ and a corresponding system of input demand equations $q(\overline{I}, \tau; \overline{L}, P_a, P_b, r, w, c)$ for household labour, hired labour and capital. The focus of the modelling effort here will be on how output supply and input demand varies with wealth ($\overline{I}$).

A Model of Rising Efficiency

In this section we use a framework similar to the previous model to analyze the effects of increasing efficiency (τ) on the emergence of different occupations. We consider, as before, a household that seeks to maximize income from agricultural production, migration and enterprise production.[16] However, in the current model

we assume that the household's ability to migrate and its efficiency at operating the enterprise is constrained by a lack of access to technology and information, not wealth differentials. In the modeling effort, we assume that these constraints relax as the local economy develops. Localities create linkages (physical, electronic, and networking) connections with urban centers. Improving infrastructure and better communications facilitate easier access to information and technology required for both migration and efficient enterprise production. One part of the improving communication networks could rely on the information and skills brought home by migrants to run the enterprise more efficiently.

Taking into account the above scenario, the household's problem is to maximize income (Equation 8) subject to its technology, a time constraint (Equation 9), and two efficiency constraints on migration and on operating the enterprise (Equations 10 and 11):

$$Max\ P_a\tau_a f_a(l_a) + (w-c)\tau_o g_0(l_o) + P_b\tau_b h_b(k_b, l_b) - rk_b \tag{8}$$

$$s.t \qquad l_a + l_o + l_b \leq \overline{L} \tag{9}$$

$$\tau_o = \overline{\tau_o} + t_o(M) \tag{10}$$

$$\tau_b = \overline{\tau_b} + t_b(M, l_o) \tag{11}$$

where the marginal revenues and costs of different occupations are defined as before. The efficiency parameters in Equation 8 associated with the household's agriculture, migration and enterprise production (τ_a, τ_o, and τ_b, respectively) are assumed to have two components. The first is the base level of the household's efficiency ($\overline{\tau}$) that is conditioned on fixed household characteristics such as education. The second component, t_o, is a function of other characteristics outside of the household, a component which may change over time due to factors such as the closeness

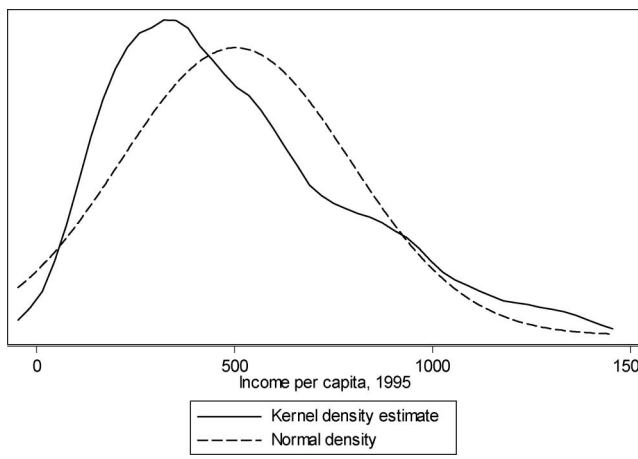

Figure A1. The distribution of per capita income, rural China

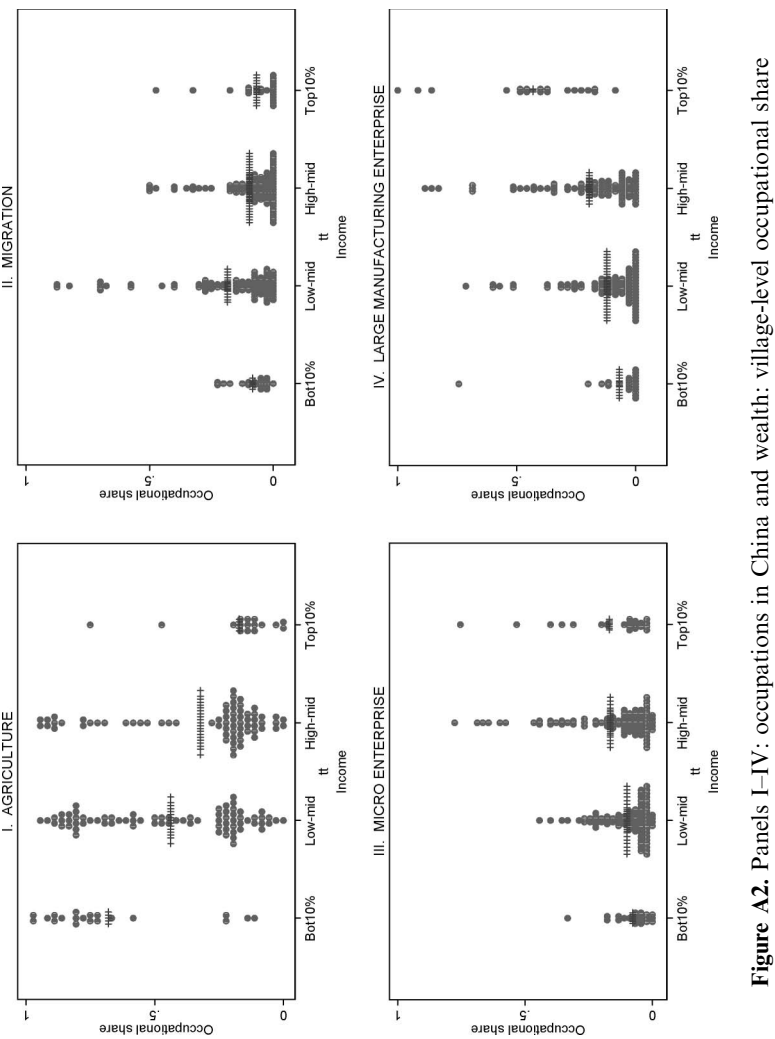

Figure A2. Panels I–IV: occupations in China and wealth: village-level occupational share

(which, for example, could be measured in time) of a locality to urban centers. In order to capture the impact of this effect on the choice of occupations, we define a variable, M, which is a metric of how close a village is to a major demand center for its goods and services. It is in this way that a village located right next to a major metropolitan region will find that it can relatively efficiently manufacture and sell the goods and services from its factory. Thought about this way, efficiency can also be thought of in terms of the amount of demand that there is for a given village's production, including the demand for the household's labour. We simulate the effects of rising efficiency through increases in the M variable and evaluate how occupations change on the efficiency continuum.