RURAL INDUSTRY AND LABOR MARKET INTEGRATION IN EASTERN CHINA

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This paper tests the competitiveness of the labor market in a semi-industrialized county located in eastern China. Labor market segmentation is linked to the degree of government interventions and the management structures of the local enterprises, and two forms of rationing labeled entrance and time rationing are identified. A test based on income maximizing behavior is developed to find the form of rationing that is consistent with the data. The results show that the labor market is not competitive and time rationing prevails in the county. In addition, industrial wages are not responsive to experience and education, but strongly biased against women and varying to government interventions.

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Rural Industry and Labor Market Integration in Eastern China

1. Introduction

Starting in the early 1980's, China has led a road to industrialization in its rural areas by the establishment of numerous small indigenous enterprises at the township and village level (subsequently, we will call them township and village enterprises, or TVEs). In the fifteen years between 1980 and 1994, the number of rural enterprises had grown 16.5 times and reached 8.75 millions by the end of 1994. In that year, rural enterprises employed 120 million workers, or 64.6% of the national industrial workforce, and contributed to 55.4% of the national industrial output.[1] This drastic development of rural industry has brought tremendous changes to the Chinese rural society. One of those changes is that rural residents for the first time have the opportunity to take industrial jobs which were the privilege reserved mostly for urban people some 20 years ago.[2] The indigenous nature of the TVEs gives hope that the agricultural-industrial dual structure of the Chinese labor market, at least at the local level, would have been weakened or even eliminated as industry is being integrated into the local economy. Nevertheless, some studies also point out the possibility that the rural labor market may not have become as competitive as one might have thought. This has much to do with the local governments' intensive interventions and the TVEs' own management structures. As the review of the recent literature in the next section will show, the TVEs may be caught up in the dilemma of employment creation imposed by the local authorities and the protection of insider interests imposed by their employees. This mixture of

[1] The above quoted figures all come from China Statistical Yearbook: 1995.

management structures complicates the performance of the local labor market and distorts the wage determination in the TVEs.

Studying a set of survey data of Ninxian county in eastern China's Zhejiang province that is under rapid localized industrialization, this paper tests whether a competitive labor market exists in the county and studies the wage determination in its TVEs. Two forms of non-price rationing of industrial jobs are identified. One is what we call entrance rationing under which some people are completely rationed out of the industrial sector while people already admitted can choose to work as many days as they wish; the other is what we call time rationing under which people's industrial working days are being limited although the entry to the industrial sector is not blocked. The first form of rationing is likely to be caused by the pressure from inside the firm to protect the interests of the current employees. The second is likely to be caused by the pressure from the local authorities to maximize employment. The unique feature of this form of rationing is job sharing among people in the same local community, a phenomenon that is widely observed in Chinese state-owned enterprises. When industrial jobs are limited, this form of rationing could be an effective way to balance income distribution in a community.

A two sector model is developed to study whether the labor market in Ninxian is competitive and if it is not, what form the rationing is. The model is based on Roy (1951)'s income maximization model, but is extended to handle the case of simultaneous employment across sectors and the unobservability of wages in the agricultural sector. The joint employment across sectors is utilized to estimate a structural industrial labor supply equation by which the parameters in the agricultural sector can be inferred. Parameter identification is handled by utilizing the

[2] This is not to say that there was no rural industry in the collective era. In some areas, commune and village owned rural enterprises were established and even flourished in that time period (Putterman, 1997). But the distribution of these enterprises was concentrated in several relatively developed areas such as the Yangtze delta.

different structural restrictions put on the competitive model, entrance rationing, and time rationing. A test strategy based on the identification routes is proposed to first test the competitive model against the alternative of either kind of rationing, and then, if the competitive model is rejected, to test each type of rationing alone against the alternative of either kind of rationing.

Our tests show that the competitive model is rejected by a large margin, and time rationing is the prevailing form of rationing in the county. In addition, we find that the only factors that strongly differentiate industrial wages are gender and government interventions. It is shown that women are paid 41% less than men, and a worker in a village with direct government control of employment and wage determination earns 29% higher than a worker in another village. In contrast, education and experience are shown to have insignificant effects on a person's wage. This finding is contrasted with the findings on other developing countries where 10 - 15% return rates have been found, but is consistent with other findings on Chinese rural firms.

The paper is organized as follows. Section 2 identifies the causes and types of rationing in Chinese rural industry by synthesizing the results emerging from the recent studies on the TVEs. Section 3 constructs three models corresponding to the competitive labor market, entrance rationing, and time rationing, respectively, and presents a test strategy to determine which model conforms with the data. Section 4 presents and discusses the empirical results. Section 5 concludes the paper by a short discussion of possible future research that could be developed starting with the results found in this paper.

2. The nature of the TVEs and labor market segmentation in rural China

In the literature, there are a number of theories suggesting the potential causes for labor market segmentation.[3] In rural China, labor market segmentation is likely to be related to the nature of the TVEs as well as the causes raised in the literature. In the study of the TVEs, two non-exclusive spectra of views are frequently found regarding their nature. The first spectrum of views postulates that the TVEs' management is a combination of local government interventions and manager scrutiny. Chang and Wang (1994) rationalized this arrangement as the combination of manager's individual entrepreneurship and the government's access to scarce resources such as bank loans. Thus, the firm's concession to the government's interventions could be seen as its complements to the government's contribution to its operations. Their claim was supported by several empirical studies. Li (1996) found in Shanxi province in northern China that private firms deliberately put themselves under government supervision in the hope of getting access to various conveniences. In a World Bank project that covered the rural enterprises (including both public and private enterprises) in four counties with different characteristics, it was found that 83.3% of the managers of the surveyed TVEs were appointed by the local governments (Song, 1990); 46% of the workers were assigned by the local governments, and in Wuxi county where collective economy was the strongest among the four counties, the percentage reached 59% (Gelb, 1990). Complementary to job assignment, wages in the TVEs were also controlled by the local governments. For example, Meng (1990) found that the wages for new workers in 31.3% of the enterprises in Wuxi county were directly decided by the local governments, and another 34.4% reported that they had to get approval from the local governments.

One implication of this spectrum of views is that profit may not be the only objective pursued by the TVEs; rather, they may have to assume some of the government responsibilities such as maintaining maximum employment in the community. In the World Bank project mentioned above, Svejnar (1990) estimated the weights the TVEs put on profit, employment, and wages in their objective functions, and found that they put significant weights on generating employment as well as on profits in their early years of development. This kind of behavior is consistent with our definition of time rationing. That is, people's entry to the industrial sector is made relatively easy, but their working days in that sector are rationed in order to allow more people to get a wage job. From the standpoint of the firm, its total hired days may still be optimal, but the number of workers is higher than what it wants to retain. In other words, job sharing may be used to accommodate the extra workers who could increase the operational costs of the firm. For public firms, the costs may be offset by the increase of the total welfare in the community; for private firms, the costs can be viewed as an exchange for the conveniences they could get from the local government.

On the other hand, the second spectrum of views maintains that the TVEs operate like labor managed firms. While it acknowledges the local governments' interventions into the firms, this spectrum of views emphasizes the labor management aspect of the TVEs. From a theoretical point of view, a labor managed firm tends to employ a less than profit maximizing workforce and maintain higher than market clearing wages (Bonin and Putterman, 1987). In a comparative study, Gelb and Svejnar (1990) found a wide range of similarities between the Chinese TVEs and the labor managed firms in Eastern Europe, especially those in the former Yugoslavia. Using a panel dataset of 200 rural firms in the time period of 1984 to 1989, Pitt and Putterman (forthcoming) found that the actual average employment size of these firms was lower than the estimated profit

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[3] For example, Lewis (1954)'s dual structure model, Shapiro and Stiglitz (1985)'s monitoring model, and Akerlof

maximization level. They also found that public firms paid higher wages than private firms did. This second finding was also confirmed by Gelb (1990). Complementary to these findings, Xu (1991), using a set of provincial level data in the time period of 1982 to 1987, found that the average wage in his sample was much lower than the estimated marginal labor product.

If the TVEs indeed behaved like labor managed firms so that inside interests were likely to be protected, we would observe another type of rationing in the rural labor market: Some people are excluded from the industrial sector completely while people already in the sector can choose a flexible working schedule. This is what we call entrance rationing. The efficiency implications of labor managed firms are well documented in the literature. From the narrow perspective of employment alone, however, entrance rationing may not entail much efficiency losses as workers can increase their working hours to compensate for a smaller workforce.[4] This is especially pertinent in the case we are studying in which industrial labor supply is elastic because of part-time employment.

To summarize, the existence of rationing in Chinese rural labor market is very much related to the outside and inside pressures the TVEs are facing. While we do not attempt to determine the nature of the TVEs, we will test the competitiveness of the labor market in a semi-industrialized county, Ninxian in eastern China's Zhejiang province. In addition, we will identify the type(s) of rationing if the labor market is proved not to be competitive. We would like to emphasize here that the proof of the existence of one kind of rationing does not necessarily provide sufficient evidence supporting one view of the nature of the TVEs over the other. As Weitzman and Xu (1994) argued, the TVEs may be vaguely defined cooperatives that are between labor managed and

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and Yellen (1987)'s efficiency wage model. For a survey on this subject, see Stanley (1996).

[4] This remark shows that the studies quoted above might have measurement problem. If they had measured labor force in terms of working days or hours instead of the number of workers, their results could have been changed.

government controlled firms. The above quoted evidence also showed that the TVEs share the properties of both kinds of firms. A labor managed firm is not necessarily totally free of government interventions and may restrict all of its employees' working hours when a negative shock happens in the market, so its behavior may reflect the properties of time rationing. Conversely, government control does not prevent a firm to protect the interests of its employees, so the properties of entrance rationing may be found in its behavior. The finding of one kind of rationing, therefore, may only indicate that the TVEs have more of the properties of one kind of the firms, and less of the other.

3. The econometric model

In this section, we will first discuss the uniqueness of the problem studied, then develop three models to account for competition, entrance rationing, and time rationing, respectively. Identification between these three models will be carefully studied, and a test strategy will be proposed in the end.

Test methods of labor market segmentation have been studied intensively in the labor economics literature (see, for example, Dickens and Lang, 1985; Heckman and Hotz, 1986; Magnac, 1991; and Stanley, 1996). The central element of these tests is the Dickens and Lang (1985) model. In their model, Dickens and Lang assume a two sector economy with each sector having a distinct wage payment equation that rewards certain kinds of human capital such as education and experience differently. The criterion for the existence of labor market segmentation is that the allocation of people's employment is not consistent with people's self-selection based on the reward differences between the two sectors.

Two differences exist between the assumptions of the existing test methods and the reality considered in this paper. The first is related to the wage rates in the sectors under consideration. The conventional test methods assume that standard wages exist in all the sectors under consideration. This assumption, however, may not apply to the agricultural sector where self-employment is prevailing. Comparing the average hourly or daily income in agriculture and the standard wage rate (presumably, paid by marginal product of labor) in the industrial sector may not be a valid approach because of the existence of diminishing marginal return to labor in the former sector. The second difference is that the existing methods assume that a person only works in one sector while in China's semi-industrialized areas, many people work in both rural industry and self-employed agriculture. This distinction is important in terms of the test of labor market segmentation. The existing tests only consider corner solutions to people's sectoral choices. Employment across sectors introduces interior solutions for both sectors and therefore needs new techniques for the study of labor market segmentation.

Based on the Dickens and Lang model, our test method to be developed in this section incorporates the two considerations discussed above. Interestingly, by incorporating the second consideration, i.e., part-time employment in both sectors, we are able to solve the first problem in a natural way. This is because, by taking into account of the interior solutions of employment in both sectors for the part-time workers, we are able to establish a structural industrial labor supply equation for the competitive model. When interior solutions exist, a person's marginal agricultural product is equal to his industrial wage. As the former depends on his working hours in agriculture, or conversely, on his working hours in industry, we can first set the marginal agricultural product equal to the observed industrial wage, then obtain the industrial labor supply by inverting the equation. In this industrial labor supply equation, the observed wages summarize all the information of the industrial sector, so a factor's effect in the agricultural sector can be isolated. This property has an added advantage for parameter identification, that is, it does not require cross-equation variable exclusion to identify the parameters that are not identifiable in a model of dichotomous employment choice. In what follows we will first present the competitive model, then discuss the two rationing models and come up with a test strategy that will be used to identify the type(s) of rationing existing in the labor market.

3.1. The competitive model

We start our discussion by defining two sectors in the economy, the industrial sector where standard wages are paid to workers, and the agricultural sector where people are engaged in self-employment and no explicit wages are paid. In the industrial sector, wages are paid deterministically according to the workers' qualifications and the characteristics of the TVEs that are observable to both the employer and the workers themselves. Consistent with the human capital literature, we assume that a worker's wage takes the following logarithm form

$$\ln(w_{ni}) = X_{0i}\gamma_{01} + X_{ni}\gamma_{n} + \varepsilon_{ni} . \qquad (1)$$

In the equation, w_{ni} is the ith worker's wage rate, X_{0i} is a set of personal characteristics indicating his qualifications, X_{ni} is a set of village variables describing the industrial sector in the village, and ε_{ni} is a zero-mean random variable that is unknown to the researcher but known to both the employer and the worker. We distinguish two sets of variables X_{0i} and X_{ni} in notation because they will play different roles in our estimation and tests. As one will see shortly, the former will be assumed to affect both industrial wages and agricultural productivity while the latter only affects industrial wages. The latter set of variables, X_{ni} describe the conditions of the local TVEs, for example, the competition among the firms and the degree of government interventions into TVE wage determination. The random variable may be thought as picking up the effects of unmeasured worker and village attributes. Its properties will be discussed later.

In the agricultural sector, a person possesses a concave production function which he can use to engage in agricultural production. We adopt the Roy (1951) model to assume that a person maximizes his income by allocating his time between the industrial and agricultural sector.[5] Formally, he solves the following problem, assuming that he does not hire labor for agricultural production

$$\max_{x_i, L_{ai}, L_{ni}} f(x_i, L_{ai}; Z_i) - r' x_i + w_n L_{ni} \quad \text{s.t.} \quad L_{ai} + L_{ni} = L^0 \tag{2}$$

in which $f(.)$ is a concave agricultural production function, L_{ai} and L_{ni} are his agricultural and industrial working days, respectively, x_i is a set of inputs other than labor, r is a vector of factor prices (in terms of output price), Z_i is a set of family and personal variables that may influence his production efficiency, and lastly, L^0 is his time endowment. We can divide his decision into two steps. In the first step, he solves his profit maximization problem in agriculture conditional on a certain amount of industrial labor supply L_{ni}. This problem is

$$\max_{x_i} \pi_{ai}(L_{ni}, r, Z_i) = f(x_i, L^0 - L_{ni}; Z_i) - r' x_i \tag{3}$$

In this way, he obtains his conditional factor demands in agriculture that are functions of L_{ni}, r, and Z_i. It is noteworthy that the conditional agricultural profit function $\pi_{ai}(L_{ni}, r, Z_i)$ is decreasing and

[5] As shown by the literature of household models (see, for example, Carter and Yao, 1997), the assumption of income maximization instead of utility maximization is not crucial in the absence of risk if job itself does not generate utility and there is a parametrically given wage in the labor market. In our case, the industrial wage is parametrically given as the reference for labor allocation.

concave in L_{ni}. This is because the objective function in (3) is a concave function of L_{ni}, but the value function is concave in a parameter if the objective function itself is (Cornes, 1992).

In the second step, substituting the conditional factor demands back into problem (2), the person determines L_{ni} by comparing his marginal product of labor in the agricultural sector, MP_{ai}, say, and his potential wage in the industrial sector, w_{ni}. It is evident that MP_{ai} is a function of L_{ni}, r, and Z_i, too

$$MP_{ai} = MP(L_{ni}, r, Z_i). \tag{4}$$

As the data we will use in the empirical test is from a one time survey on a county which has been well integrated into the regional markets, the variation in the factor prices r is small. Therefore, we will drop it in our specification of MP_{ai}. In addition, to simplify the analysis and be consistent with the industrial wage equation, we assume that the logarithm of MP_{ai} takes a linear form in its arguments,

$$\ln(MP_{ai}) = X_{0i}\gamma_{02} + X_{ai}\gamma_a + \beta L_{ni} + \varepsilon_{ai}, \tag{5}$$

where X_{0i} and X_{ai} are the two components of Z_i, with the former defined as in the industrial wage equation (1), and the latter a set of family variables that only affects the person's marginal agricultural product but not his industrial wage potential, and ε_{ai} is a zero-mean random variable whose properties will be discussed later. The separation of Z_i into two parts, as in the case of the industrial wage equation, is introduced because the two components play different roles in our estimation and tests.

It is easy to show that with the specification in (5), the conditional profit function $\pi_{ai}(L_{ni}, Z_i)$ is indeed, as the above discussion of problem (3) showed, decreasing and concave in L_{ni}. From another perspective, $\pi_{ai}(L_{ni}, Z_i)$ is an increasing and concave function of L_{ai}, so an interior solution to L_{ai} is guaranteed for a proper w_{ni}.

The linearity specification in (5), although it captures some important properties such as the one discussed above, also has several limitations. After all, it is not a flexible representation of the true functional form of the conditional marginal agricultural product, therefore it can not identify all the possible features the true functional form possesses. For example, it does not allow for interactions between one's industrial labor supply and his personal or family characteristics. This may not be a plausible restriction. For instance, higher educational achievement may compensate for the profit loss due to incremental reduction of labor days in agriculture. In other words, there may be a positive complementarity between education and industrial working days. However, this kind of effects is of secondary significance in our study which does not study income determination *per se*. In addition, taking into account of the interaction effects will unnecessarily complicate our model, or even make our tests impossible. We emphasize here that the linear specification is not uncommon in labor economics literature. For example, Heckman (1974) used the same specification to characterize women's shadow wage equation.

After the industrial wage equation and the marginal agricultural product equation are defined, we turn to the properties of the two error terms ε_{ni} and ε_{ai}. We assume that they are i.i.d. and mean-independent of the exogenous variables. However, this assumption may not be satisfied. In the case of ε_{ni}, it may be heteroskedastic because of systematic unobserved variations. For example, preferences over non-wage attributes of an industrial job may induce a person to take the job that pays his skills lower. We will discuss this issue in detail later in this section. More importantly, the assumption of mean-independence may also be questioned because ε_{ni} may include the effects of some omitted variables that are correlated with X_{0i} or X_{ni}. For example, we do not have information to control for one's position in a factory which may be correlated with one's educational attainment and experience and serve as one of the factors that determine one's wage. However, this kind of correlation can be controlled for by the exogenous variables. Let W_i be the set of omitted variables that are correlated with X_{0i} and X_{ni}. Then, we can use $E(W_i|X_{0i}, X_{ni})$ to control for the correlation. Then, ε_{ni} can be viewed as only capturing the researcher's ignorance that is uncorrelated with the exogenous variables. Of course, the coefficients of the exogenous variables now include the effects of W_i and should be taken into account of when they are interpreted.

In the case of ε_{ai}, heterogeneous preferences are also a problem. In addition, agricultural production is organized at the family level, so one's marginal productivity is related to other family members' employment whose influences are summarized in ε_{ai}. Worse than that, our sample includes people from same households, raising a legitimate concern of the existence of serial correlation caused by household specific effects. However, to incorporate these personal and household heterogeneity may make our model, which is complicated, unmanageable in terms of empirical implementation. With the family variables X_{ai}, though, we hope that the correlation and part of the heterogeneity in equation (5) will be controlled for.

Maintaining the i.i.d. and mean-independence assumptions, we assume further that ε_{ni} and ε_{ai} jointly have a bivariate normal distribution with zero means, standard deviations σ_n and σ_a, and correlation coefficient ρ. It is widely acknowledged that normality in this type of self-selection models is not an innocent assumption. For example, Lee (1984) tested the bivariate normality assumption for a tobit type self-selection model in one of his earlier papers, and found that the assumption was rejected by a large margin. In addition, Magnac (1991) tested the normality assumption for his bivariate probit model and also rejected the assumption. However, there has been also evidence showing that log-normality in wage equations is not too far away from the true distribution. Heckman and Sedlacek (1985) transformed wages (or equivalently, tasks, in their specification) by the Box-Cox transformation in their study of job allocation between manufacturing and non-manufacturing sectors in the United States. They found that the transformation parameters for the two wage equations, although significantly different from zero, were very small numbers, being 0.08 and -0.06, respectively. That is to say, the distributions were close enough to log-normal. Indeed, their plotting of the two distributions showed that log-normality was only significantly different from the true distribution at the tails. In a related paper, Heckman and Sedlacek (1990) compared the performance of a log-normal income maximization two sector Roy model with a non-normal utility maximization three sector model and found that the abandonment of the log-normality assumption was not crucial in differentiating the two models.[6] Perhaps, the rejection of normality based on the test of moments (as used by both Lee (1984) and Magnac (1991)) is too strong as lower order moments may not significantly deviate from the true distribution parameters even when a joint test of all the moments rejects the normality hypothesis. In addition, the rejection of normality so far does not provide us with a good alternative to model the distributions in a complicated self-selection model. Normality is still the most convenient assumption to make such a model econometrically tractable.

With the assumptions on the error terms, we can continue to study a person's decision of industrial labor supply. We also divide this decision into two stages. In the first stage, he decides whether to work in the industrial sector. This is done by comparing $\ln(w_{ni})$ and $\ln(MP_{ai})$ evaluated at $L_{ni} = 0$. If the former is greater than the latter, he will enter the industrial sector; otherwise, he will stay full-time in the agricultural sector. Therefore, his decision of entry can be characterized by

[6] The three sector model added a self-employment sector to the two sector model. Heckman and Sedlacek showed

$$P_{ni} = \ln(w_{ni}) - \ln(MP_{ai}|_{L_{ni}=0})$$
$$= 1\,\{X_{0i}\gamma_0^* + X_{ni}\gamma_n^* + X_{ai}\gamma_a^* + e_i^* > 0\}. \qquad (6)$$

In the equation,

$$\gamma_0^* = \gamma_{01} - \gamma_{02}, \qquad (7a)$$

$$\gamma_n^* = \gamma_n, \qquad (7b)$$

$$\gamma_a^* = -\gamma_a; \qquad (7c)$$

and

$$e_i^* = \varepsilon_{ni} - \varepsilon_{ai}$$

is a random variable that also has a normal distribution with zero mean, variance of

$$\sigma_e^2 = \sigma_n^2 + \sigma_a^2 - 2\rho\sigma_n\sigma_a, \qquad (8a)$$

and correlation coefficients with the two other error terms ε_{ni} and ε_{ai}, respectively,

$$\rho_{ne} = (\sigma_n - \rho\sigma_a)/\sigma_e, \qquad \rho_{ae} = (\rho\sigma_n - \sigma_a)/\sigma_e. \qquad (8b)$$

Equation (6) provides the sorting criterion that a person uses to decide whether to enter the industrial sector or to stay in the agricultural sector full-time. Subsequently, we will call this equation the sorting equation.

Conditional on entry, a person's second stage decision is to decide how many days he would like to work for in the industrial sector. There are two cases that we need to consider. In the first case, the person works part-time in both the industrial and agricultural sectors. That is, we have an interior solution for L_{ni} so that L_{ni} is determined by equating the right hand side of equation (5) and the logarithm of the observed industrial wage

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that the adding of this self-employment sector was crucial to make the two models differ.

$$L_{ni} = \frac{1}{\beta}[\ln(w_{ni}) - X_{0i}\gamma_{02} - X_{ai}\gamma_a - \varepsilon_{ai}]. \quad (9)$$

This industrial labor supply equation is the unique feature of our model. With this additional equation, we are able to identify the parameters γ_{02} and γ_a in the marginal agricultural product equation that are crucial for our tests. This capacity is made possible by the joint employment we consider in our problem. In a conventional model of dichotomous choice of employment, this equation can only be regarded as describing the relationship between one's shadow wage and desired working days in one sector, and its parameters are not identifiable (Magnac, 1991).

In the second case, the person works full-time in the industrial sector so we have P_{ni} = 1 and L_{ni} = L^0. That is, the person's industrial labor supply as defined in equation (9) is upper-censored at L^0.

In Dickens and Lang (1985), the characterization of a competitive market is that people's sectoral allocation is governed by self-selection based on the differences of the two sectors in the compensation to different personal skills. In the model presented above, this is equivalent to requiring that, as shown by the constraints in (7), the coefficient of a variable in the sorting equation (6) ought to be proportional to the difference between the coefficients of the same variable in the two wage equations if that variable appears in both wage equations, and to be proportional to the coefficient of the same variable in either wage equation if that variable only appears in that wage equation. This proportionality condition was criticized by Heckman and Hotz (1986) based on the argument that the variables in the wage equations may well pick up people's preferences over non-wage attributes of the two sectors, that is, a person may prefer working in a certain sector not only based on the differences of the compensation to certain attributes of his human capital, but also based on his subjective job preferences that are correlated with those attributes. Correlation between non-wage preferences and skill attributes is crucial in Heckman and Kotz criticism. If non-wage preferences do not vary systematically with skill attributes but are randomly distributed in the population, the proportionality condition will still hold and the effects of non-wage preferences will only be reflected as heteroscedastic disturbances in the error terms. Empirically, one would wonder if non-wage preferences matter significantly for people's job choices in semi-developed regions such as Ninxian county where the pursuit of income is likely to dominate people's job choices. While we realize the impacts of non-wage preferences, we maintain that they do not apply to the mean-level parameters in our model. This assumption is consistent with other recent studies on labor market segmentation such as Magnac (1991) and Stanley (1996). It also conforms with the assumption made by studies on the Chinese rural labor market. For example, in recent studies of family labor allocation and migration, Yang (1997) and Zhao (forthcoming) implicitly made the same assumption as ours.

Maintaining our assumption of income maximization, the proportionality condition under the competitive model implies that the constraints in (7) hold for the mean-level parameters. For a pure income maximization model, the second-order constraints in (8) put on the distribution parameters also hold. However, the imposition of the second-order constraints may be too stringent as the disturbances contain measurement errors as well as unobserved factors. In the subsequent discussion and implementation of our tests, we will ignore these constraints. For computation's sake, we will also ignore the heterogeneity that could be caused by systematic differences among individual preferences. This is not to say that this problem is not important, it is just because incorporating heterogeneity will make our already complicated model more complicated and even unmanageable. The likelihood functions for the entire competitive model are provided in Section A1 in the Appendix.

As we discussed in the last section, there may exist two kinds of rationing, entrance and time rationing. In the next several subsections, we will first explore the conditions under which each of them can be distinguished from the competitive model, and then develop a test strategy that leads us to find out which form of rationing is consistent with the reality as manifested by the data. For the first task, we start with the discussion of entrance rationing.

3.2. Entrance rationing

Following Roy (1951) and Magnac (1991), we assume that entrance rationing takes the form of the imposition of a one time entry cost on a person for the whole year.[7] This fixed cost changes a person's decision of whether to enter the industrial sector. Instead of comparing marginal agricultural product with potential industrial wage, a person now compares his total income of staying full-time in agriculture and the optimal income of entering the industrial sector lest of the entry cost. By the assumption of the marginal agricultural product in (5), the income of full-time farming is

$$\pi_i^0 = \frac{1}{\beta}(e^{A_i+\beta L^0} - e^{A_i}), \qquad (10)$$

where A_i summarizes all the right hand terms (including the random variable) except βL_{ni} in equation (5). Then, the income of obtaining optimal employment L_{ni}^* in the industrial sector with an entry cost of C_i is

$$\pi_i^* = w_{ni} L_{ni}^* + \frac{1}{\beta}(e^{A_i+\beta L^0} - e^{A_i+L_n^*}) - C_i \,. \qquad (11)$$

[7] It may be more proper to think of entry costs as applied to the life time of a person who wants to take an industrial job. Our assumption is made to conform with our sample which only shows one year data.

If π_i^* is greater than π_i^0, the person will enter the industrial sector; otherwise, he will stay in agriculture full-time. It is evident that this rule is equivalent to comparing the logarithm of the industrial wage w_{ni} with the logarithm of the average opportunity cost

$$c_i = \frac{1}{L_{ni}^*}\left[\frac{1}{\beta}(e^{A_i+\beta L_{ni}^*} - e^{A_i}) + C_i\right], \tag{12}$$

Which is a function of A_i, C_i, and L_{ni}^*. In a comparable way by which we defined $\ln(MP_{ai})$, we assume that $\ln(c_i)$ is a linear function of the three arguments

$$\ln(c_i) = A_i + (X_{0i}\alpha_{01} + X_{ni}\alpha_{n1} + X_{ai}\alpha_{a1} + \eta_{1i}), \tag{13}$$

in which the terms in the parenthesis represent C_i and L_{ni}^*, and η_{1i} is a random variable that captures the researcher's ignorance. It should be kept in mind that the linear assumption in (13) shares the same limitations of equation (5). Substituting the definition of $\ln w_{ni}$ in equation (1) and the definition of A_i in equation (5), the entry decision under entrance rationing can be characterized by

$$P_{ni}' = 1\{X_{0i}\gamma_0^{*\prime} + X_{ni}\gamma_n^{*\prime} + X_{ai}\gamma_a^{*\prime} + e_i^{*\prime} > 0\}, \tag{14}$$

where

$$\gamma_0^{*\prime} = \gamma_{01} - \gamma_{02} - \alpha_{01}, \qquad \gamma_n^{*\prime} = \gamma_n - \alpha_{n1}, \qquad \gamma_a^{*\prime} = -\gamma_a^* - \alpha_{a1}, \tag{15}$$

and

$$e_i^* = \varepsilon_{ni} - \varepsilon_{ai} - \eta_{1i}.$$

Equation (14) is the new sorting equation under entrance rationing. After a person enters the industrial sector, however, he can work as long as he wishes. So the industrial labor supply equation (9) is still valid. Therefore, the difference between the competitive model and entrance rationing rests in the contrast between the constraints in (7) and those in (15) (with the second-order constraints ignored). The problem of concern, in terms of identifiable parameters, is whether the parameters defining the noise, α_{01}, α_{n1}, and α_{a1} are zero. A test of the competitive model against entrance rationing, assuming that it is the only kind of rationing, therefore, is equivalent to testing whether the three sets of constraints in (7), that is, the proportionality property, hold in a model consisting of the industrial wage equation (1), the sorting equation (14), and the industrial labor supply equation (9). We can identify γ_{01} and γ_n in the industrial wage equation (1), γ_{02} and γ_a in the industrial labor supply equation (9), and $\gamma_0^{*\prime}$, $\gamma_n^{*\prime}$, and $\gamma_a^{*\prime}$ in the sorting equation (14). It is noteworthy that we do not need cross-equation variable exclusion to carry out the above identification, especially that on γ_a. This is made possible by the introduction of the simultaneity of working days and log-wages: Log-wages summarize the information in the industrial sector, so the effects of X_{ai}, even if it appears in the industrial wage equation, are isolated in the agricultural sector. We will see that cross-equation variable exclusion is only important when we try to distinguish different kinds of rationing.

3.3. Time rationing

The virtue of time rationing is that people are allowed to enter the industrial sector freely, but their working days are rationed.[8] Because of free entry, the sorting equation in (6) and the constraints in (7) still hold. Now, the industrial labor supply equation (9) has to be changed. Time rationing is best modeled as a variable discount put on a person's daily wage rate conditional on that he is already in the industrial sector. Let t_i denote the discount factor. We assume that $\ln(t_i)$ also has a linear representation

$$\ln(t_i) = X_{0i}\alpha_{02} + X_{ni}\alpha_{n2} + X_{ai}\alpha_{a2} + \eta_{2i}, \tag{16}$$

where η_{2i} has the same properties of η_{1i}. The new industrial labor supply L_{ni}' is now obtained by equating $\ln(MP_{ai})$ with $\ln(w_{ni})$ - $\ln(t_i)$

$$L_{ni}' = \frac{1}{\beta}\left[\ln(w_{ni}) - X_{0i}\gamma_{02}' - X_{ni}\alpha_{n2} - X_{ai}\gamma_a' - (\varepsilon_{ai} + \eta_{2i})\right], \tag{17}$$

where

$$\gamma_{02}' = \gamma_{02} + \alpha_{02}, \qquad \gamma_a' = \gamma_a + \alpha_{a2}. \tag{18}$$

Obviously, the difference between equation (17) and equation (9) is that the parameters in the variable cost function (16) enters the former. The test of the competitive model against time rationing is one that tests whether the three sets of discount parameters α_{02}, α_{n2}, and α_{a2} are zero. To identify these parameters, we first get $\gamma_{02} = \gamma_{01} - \gamma_0^*$ and $\gamma_a = -\gamma_a^*$ from (7a) and (7c), then plug them into (18), together with (7b), to obtain the conditions that are satisfied under time rationing

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[8] We think of time rationing as one that is applied to a worker's working days in a year. This is an assumption rather than a description of the reality. The survey our data are drawn from only provides data on standard working days (defined as 8 hours of work time) in a year, and does not tell us their distribution. Lack of the information on the distribution may make our tests lose some valuable aspects of people's employment patterns. For example, if industrial jobs are seasonal, part-time employment in industry may be efficient (I thank an anonymous referee for pointing out this point). With the limitation of the data, however, our assumption is the best we can make.

$$\gamma_0{}^* = \gamma_{01} - \gamma_{02}{}' + \alpha_{02}, \qquad \gamma_n{}^* = \gamma_n, \qquad \gamma_a{}^* = -\gamma_a{}' + \alpha_{a2}, \qquad \alpha_{n2} \neq 0. \tag{19}$$

Now, the identifiable parameters are γ_{01} and γ_n in the industrial wage equation (1), $\gamma_{02}{}'$ and $\gamma_a{}'$ in the new industrial labor supply equation (17), and $\gamma_0{}^*$, $\gamma_n{}^*$, and $\gamma_a{}^*$ in the sorting equation (6). So α_{02} and α_{a2} can also be identified through the constraints in (19). In addition, α_{n2} can be identified in equation (17) directly. Here again, cross-equation variable exclusion is not essential for the identification. A test of the competitive model against time rationing, assuming that it is the only kind of rationing, is equivalent to testing whether the following proportionality constraints hold in a model consisting of the industrial wage equation (1), the sorting equation (6), and the industrial labor supply equation (17)

$$\gamma_0{}^* = \gamma_{01} - \gamma_{02}{}', \qquad \gamma_n{}^* = \gamma_n, \qquad \gamma_a{}^* = -\gamma_a{}', \qquad \alpha_{n2} = 0. \tag{20}$$

Note that in terms of identifiable parameters, these constraints are the same as those to be tested for entrance rationing as $\alpha_{n2} = 0$ is automatically imposed by using the industrial labor supply equation (9) in the latter case.

3.4. Both kinds of rationing

In the discussion of entrance rationing, we used the fact that the industrial labor supply was characterized by the untainted equation (9); and, in the case of time rationing, we used the fact that the sorting equation was still (6) describing the competitive behavior. When both entrance and time rationing exist, the sorting and industrial labor supply equations are (14) and (17) which are contaminated by the entry and variable costs, respectively. The technique of cross identification used before no longer applies. Nevertheless, we are still able to find the conditions that enable us to separate rationing from competition. To combine both kinds of rationing, we substitute γ_{02} and

γ_{a2} in (15) characterizing entrance rationing with the corresponding identifiable parameters γ_{02}' and γ_{a2}' defined in (18) to get the conditions that should be satisfied when both kinds of rationing exist

$$\begin{aligned} &\gamma_0^{*}{}' = \gamma_{01} - \gamma_{02}{}' - (\alpha_{01} - \alpha_{02}), \qquad &&\gamma_n^{*}{}' = \gamma_n - \alpha_{n1}, \\ &\gamma_a^{*}{}' = -\gamma_a{}' - (\alpha_{a1} - \alpha_{a2}), &&\alpha_{n2} \neq 0. \end{aligned} \tag{21}$$

Now the identifiable parameters are α_{01} - α_{02}, α_{a1} - α_{a2}, α_{n1}, and α_{n2}. Under the null of the competitive model, the parameters in the two cost functions are all zero so that the constraints in (21) degenerate to those in (20). Therefore, a test of the existence of the null of the competitive model against both kinds of rationing is still to test whether the proportionality property holds for the identifiable parameters in a model consisting of the industrial wage equation (1), the sorting equation (14), and the industrial labor supply equation (17). However, a problem rises when $\alpha_{01} = \alpha_{02} \neq 0$ or $\alpha_{a1} = \alpha_{a2} \neq 0$ holds. In either case, there is a risk that the competitive model is accepted when the labor market is actually segmented. As the parameters involved can not be identified separately, we can not detect if that really happens. Therefore, when the competitive model is accepted in the test, one should be careful in interpreting the result. Perhaps, a way to double check the validity of the result is to test whether the constraints put on α_{n1} and α_{n2} are accepted alone. However, when the competitive model is rejected, we are sure that there exists at least one kind of rationing.

3.5. Test strategy

The first step of our test is to test the existence of either kind of rationing against the competitive model. To proceed, we define model (U) as the one that consists of the industrial wage equation (1), the sorting equation (14), and the industrial labor supply equation (17). This model is the most unrestricted model that characterizes rationing in general. The competitive model (C) can be defined as this model with some structural constraints imposed. It turns out that in terms of identifiable parameters, these constraints are exactly those proportionality conditions in (20). This is evident when we recall that the tests of the competitive model against the three rationing models are eventually testing whether the same set of constraints, those in (20), are satisfied. Therefore, we define model (C) as model (U) with the constraints in (20) imposed. A likelihood-ratio (LR) test that compares the log-likelihood values of model (U) and model (C) can be performed. Let k_0, k_n, and k_a be the numbers of variables in X_{0i}, X_{ni}, and X_{ai}, respectively. Then the degree of freedom of the test statistic is $k_0 + 2k_n + k_a$. Details of the construction of the test is presented in Section A2 in the Appendix.

If the above test shows that the competitive model is rejected, the second step is to determine which kind of rationing exists in the labor market. This task can be accomplished by two tests. First, we test the null of the existence of only entrance rationing against the alternative of the existence of either kind of rationing. As the unique feature of entrance rationing relative to model (U) is that the industrial labor supply equation is (9) instead of (17), entrance rationing is unambiguously distinguished from model (U) by $\alpha_{n2} = 0$. It is here that cross-equation variable exclusion becomes important: It is crucial to have at least one variable appearing in the variable cost function (16) that does not appear in the equation of marginal agricultural labor product in order to distinguish entrance rationing from either kind of rationing. An LR test can be performed by comparing model (U) and model (E) defined as model (U) with $\alpha_{n2} = 0$ imposed. If the constraint is accepted, then the form of rationing must be entrance rationing. If it is rejected, we then test the null of the existence of only time rationing against the alternative that either kind of rationing exists. Now, the unique feature of time rationing is $\gamma_n^* = \gamma_n$ relative to model (U) in terms of identifiable parameters. Therefore, the corresponding LR test can be performed by comparing model (U) and model (T) defined as model (U) with $\gamma_n^* = \gamma_n$ imposed. Now, in order to conduct the test, we require that there is at least one variable that appears in the industrial wage equation but does not appear in the marginal agricultural product equation. If the constraint is accepted, it must be the case that the form of rationing is only time rationing; otherwise, there exist both kinds of rationing.

4. Empirical estimation

In this section, we present the empirical results of our tests. Before getting into the tests, though, we first give a description of our data, some preliminary statistics of the labor market in our sample villages, and an account of the variables that will be used in our regressions.

4.1. Descriptions of Data

The data used in this paper come from two sources. One is a household survey of 100 households in Ninxian county of Zhejiang province in the spring of 1994 as a part of a large survey.[9] The survey asked a variety of questions concerning household characteristics and their

[9] The survey was jointly designed by the Land Tenure Center, University of Wisconsin-Madison and the Development Research Center, the State Council of China, and carried out by the State Statistical Bureau of China in eight counties in Zhejiang, Jiangxi, Henan, and Jilin provinces.

production and labor allocation in the 1993 calendar year. The other source is a village survey later administered on cadres in the ten villages covered by the early household survey. It provided information on village governance and rural industry. The reason that we use only the data on Ninxian county is that only this county reported industrial wages.

Zhejiang province is located in China's eastern coast, adjacent to Shanghai. It has been one of the several most developed provinces in both historical and contemporary China. In the last twenty years, it has been one of the leading coastal provinces that have experienced fast development of rural industry. Located at a sea port in southeastern Zhejiang, Ninxian has kept the pace of development of the rest of the province. In the ten years between 1983 to 1993, the average number of firms per village in the ten villages covered by the survey was increased from 3 to 8, and the average fixed capital stock, industrial output, and employment per village was increased by 1.4 times, 6.4 times, and 1.8 times, respectively. In the same period of time, the average real per capita net income was increased by 66% and reached 1649 yuan (in 1993 yuan) in 1993, 79% higher than the national average, but below the Zhejiang average 1746 yuan.[10] Among the 1649 yuan net income, 59% came from non-farm employment, a figure that was relatively low in the coastal part of Zhejiang.[11] Like most of the counties in Zhejiang province, publicly owned TVEs dominated Ninxian's industrial sector. Although the number of private firms has been increasing, their average percentage in the ten villages only reached 36% in 1993. We include both public and private firms in our study because, as pointed out in Section 2, both of them may be subjected to

[10] The average official exchange rate was 5.73 yuan to one dollar in 1993. The income growth rate in the villages covered by the survey was much lower than the Zhejiang average. In the period of 1980 to 1993, real income in Zhejiang was increased by 2.4 times (China Statistical Yearbook, 1994). From a top county in the early 1980s, Ninxian became a below average county in Zhejiang in the early 1990s in terms of real income.

[11] For instance, the two other counties, Shaoxin and Yueqin covered in the same household survey had an average of 71%.

the same outside and inside pressures that cause rationing to happen. This approach is also consistent with the World Bank and other studies (such as Xu, 1991) quoted in Section 2.

The household survey covered 367 persons of 100 households in ten villages. In this paper, we exclude those who were not in the labor force, that is, those who did not work in either agriculture or industry in 1993. This leaves us with 234 persons in our study. Of these 234 persons, there were each 77 (32.9%) people working full-time (working days were at least 300) and part-time in the industrial sector, respectively, and 80 (34.2%) people working full-time in the agricultural sector.[12] Among those working in industry, 36% worked in private firms. Table 1 presents the demographic and family characteristics of the three groups of people.

There were considerable differences between full-time farmers and people who worked in the industrial sector. Full-time farmers were older, more likely to be married, less educated, and with more land and grain quotas than those working in the industrial sector. These statistics seem to show that the pattern of sectoral allocation is consistent with self-selection behavior. Inside the industrial sector, however, the trace of self-selection becomes weaker. The differences between full-time and part-time industrial workers were much smaller except the latter group of people bore much more grain quotas. The average wage for industrial workers was 10.2 yuan, but part-timers earned slightly higher, indicating that the length of industrial employment did not respond to wage payments. In addition, wages seemed not to be significantly differentiated, if not declining, along with the amount of education. When workers are divided into high education and low education groups by using the average schooling years as the cutting point, the average wage of the high education group (with an average of 8.4 schooling years) is 10.2 yuan/day, and that of the

[12] This categorization is solely based on a person's working days in the industrial sector, and a working day is standardized to be 8 working hours as reported by the correspondents. Therefore, it is possible that a full-time

low education group (with an average of 4.9 schooling years) is 10.4 yuan/day. In contrast, wages were significantly differentiated by gender. On average, men earned 12.4 yuan/day while women earned 8.4 yuan/day. This large difference was not likely to be caused by educational difference between men and women as the average schooling years were 6.9 and 6.5 for the two group of workers, respectively. To summarize, it seems that there is a dissonance between people's sectoral allocation and their choices in the industrial sector. Our empirical tests based on the econometric model proposed in the last section will provide a clearer picture to us.

4.2. Variables

In the industrial wage equation, wages are daily earnings reported by the correspondents and measured in 1993 yuan. Six personal and four village variables are used as its explanatory variables. The personal variables are experience (EXP, equals age -15), experience squared (EXP2), a dummy indicating household head (HEAD), gender (GENDER, female = 1), marital status (MARRIED, married = 1), and formal schooling years (EDU). The village variables are the number of firms per 100 villagers (NUM_FIRMS), the ratio of private firms (PRIV_FIRMS),[13] profit per worker (PROFIT, 10,000 yuan), and a decision dummy (DECISION) indicating whether the village cadre controlled the decision of employment and wages in the village TVEs. A constant term is also added. The personal variables were obtained in the 1994 household survey, and the village variables were obtained in the village survey. While the meanings of other personal variables are straightforward, the household head dummy and experience need more explanations.

industrial worker also worked some days in agriculture. However, a full-time agricultural worker did not work in industry at all.

[13] One would think that the equation should include a dummy indicating the ownership of the firm a person worked for. However, adding such a variable will make the sorting equation unestimable as the one's of the dummy are all associated with the cases that have observed industrial wages.

The household head dummy enters the wage equation because a household head's productivity may be different from that of other family members. There may be three possibilities. One is that a household head is more productive than other family members in both agriculture and industry because he may have more experience and thus higher ability. The other is that a household head plays the role of an organizer in agriculture and other home production, so he is relatively more productive in these activities. But being an organizer means that he has less time to accumulate human capital in wage earning capacities, so he may be relatively less productive in industry. The last possibility is just the opposite: The task of agricultural production is assumed by other family members, noticeably by elders and wives, and the household head plays the role of a wage earner, so his agricultural productivity may be less than other family members because he is likely to accumulate his human capital in wage earning activities. As the head dummy will also enter the marginal agricultural product equation, our empirical estimation will tell us which possibility is real in our sample.

We use age minus 15 to approximate one's experience because by 15 years old, most people in the area we study have finished junior high school and are about to enter the labor force. However, this measurement of experience by no means captures the real time length that a person stayed in the industry or agriculture. Rather, it tells us the experience, both social and economic and not necessarily specific to a single sector, that a person should have gained after he entered the labor force. Defined in this way, it does not discriminate between two persons with different abilities of learning. Therefore, one should be careful when drawing inferences from its estimates.

The village variables also need some explanations. The number of enterprises in a village (normalized by village population) enters the wage equation to capture the effect of competition in the village. More enterprises mean more competition to bid for workers so that wage rates in the village may be driven up. In addition, if public TVEs pay higher wages to their employees than private firms do, as revealed by some studies quoted in Section 2, more private firms in a village may drive its wage rates down. Profit per worker is added to explore the possibility of profit sharing in the TVEs. There has been evidence in the literature showing that TVEs' wages are weakly correlated to their profitability (Svejnar, 1990). Our data do not allow us to relate individual workers' wages to their employers because a worker is not matched with the firm he worked for. The average profit in a village is more likely to measure inter-village profit variations that are accumulated in the history of village development. Finally, the decision dummy is constructed by a close-end question about the right village cadres own to interfere with village enterprises' internal decisions such as employment and wage rates (see Section 2 for examples).

There is a probability that the village variables are endogenous, probably correlated with the error terms in the marginal agricultural product as well as in the industrial wage equation. However, this problem may be undermined by the following facts. First, all the village variables are measures of the effects that had been accumulated in the history before the two random terms were realized. Second, our data consist of only a sample of about 30 persons of ten households in a village, so the village variables are likely to be predetermined relative to individual wages and marginal agricultural product. Of course, the possibility of the endogeneity of the village variables still exists because they may carry some time persistent and unmeasured village variations, such as political structure and institutional setting, that could affect both themselves and individual wages and productivity. We do not treat the endogeneity problem because we do not have adequate instruments for the above mentioned variations, and, if we had, the treatment itself would be computationally costly in our model.

We make one final remark on the industrial wage equation before we turn to the agricultural product equation. As we pointed out in the last section, variables in the wage equation may include the effects of the omitted factors (such as job position) that are likely to be correlated with these variables. One concern may be raised regarding to the validity of our tests of proportionality as the estimates are contaminated. However, if we interpret the estimates carefully, this concern can be arranged. Take the example of education. It is quite possible that education is correlated with job position whose effects are captured by the error term in the industrial wage equation. As a result, the estimate of education may be biased. However, from the standpoint of the choice between industrial and agricultural employment, this bias should be anticipated by a person making the choice. Put differently, this means that this bias is incorporated in a person's decision that is accounted for by our tests.

In the marginal agricultural product equation, working days were reported by correspondents as standard days each consisting of 8 working hours.[14] Exogenous variables include all the personal variables in the industrial wage equation and two family variables, household land per capita (LANDPOP, mu/capita with one mu equaling to one fifteenth of a hectare), and household grain quota per capita (QUOTAPOP, ton/capita). Land is a complementary input to labor in agricultural production, more land thus means higher labor product. Grain quota is the amount of grain that is required to be sold to the state stock for a lower than market price. It is an in-kind tax and reduces the return to labor. The two family variables also serve the purpose of controlling for household specific heterogeneity arising from joint home production.[15]

[14] The questionnaire asked the correspondent to convert his working hours, regardless whether he worked part-time or full-time, into standard working days with 8 hours each. For example, a person who worked four hours for two days was coded as working for one standard day.

[15] The practice of land distribution in most parts of rural China is to divide a family's land into the so called food land and responsibility land. The distribution methods of the two kinds of land are usually different. Food land is

Finally, the right hand sides of the two cost functions include all the exogenous variables appearing in both the industrial wage and marginal agricultural product equations. Therefore, the four village variables appearing only in the industrial wage equation are crucial for our identification of the type(s) of rationing.

4.3. Test results

The first model we estimate is model (U) defined in the last section, that is, the model consisting of the industrial wage equation (1), the sorting equation (14), and the industrial labor supply equation (17). In the estimation, we classify those whose working days were at least 300 as full-time industrial workers. To accommodate individual heterogeneity, however, the full-time cutting point L^0 is set to be individual working days of those full-timers rather than fixed at 300 days. To ensure easy convergence, the inverse of the two standard deviations s_n and s_a rather than themselves are estimated. In addition, the parameters in the industrial and agricultural equations are divided by s_n and s_a, separately. The standard deviation of the sorting equation s_e can not be identified. Following standard practice, we assume it to be one.

The results of this model are presented in the first three columns of Table 2. The estimates reported under the industrial wage and labor supply equations are converted back by multiplying them by s_n and s_a, respectively. Their standard errors are calculated by assuming that s_n and s_a are constants. We will save our discussion of the estimates to the point after our tests are conducted and the model consistent with the data is determined. Here we just give a discussion of the general properties of the model. The estimates of s_n^{-1} and s_a^{-1} are 3.20 and 2.99, which means

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distributed by family population, and responsibility land by family labor. Although the two kinds of land are not necessarily physically separable, grain quota is usually levied on only responsibility land. Therefore, we do not expect that the two variables LANDPOP and QUOTAPOP are collinear to each other.

that σ_n and σ_a are 0.31 and 0.33, respectively. Judging by the fact that the natural logarithm of the average industrial wage (10.2 yuan/day) is 2.32, one realizes that the estimated industrial wage and agricultural product equation account for most of the variations in the data. The estimates for ρ, ρ_{ne}, and ρ_{ae} are 0.54, -0.24 and 0.35, respectively, and ρ and ρ_{ae} are significant. It has been checked that the correlation matrix is positive definite. A positive ρ shows that unobserved personal, family, or village characteristics tend to affect a person's industrial wage potential and marginal agricultural product in the same direction, a result that is intuitively understandable. In contrast, the interpretation of the negative ρ_{ne} and positive ρ_{ae} needs to be careful. On the one hand, they could be taken as manifesting the existence of rationing as higher wage or productivity in one sector does not induce one more likely to choose that sector. One the other hand, they are also consistent with competitive behavior: A person with higher unmeasured productivity in both sectors (as shown by the positive ρ) may have relatively higher reward in the agricultural sector, so he will choose the agricultural sector as his unmeasured productivity is increased.[16]

Our first task, then, is to test the null hypothesis that the labor market is competitive. For that purpose, we estimate model (C) which is model (U) with the constraints in (20) imposed. Its results are presented in the first two columns under Model (C) in Table 2. This time, the marginal agricultural product equation rather than industrial labor supply equation is reported because the parameters in the former equation are identifiable. The third column under model (C) reports the parameters in the sorting equation (6) as calculated according to the constraints in (7). The estimates of the standard deviations and correlation coefficients are comparable with those estimated in model (U). The log-likelihood function values of model (U) and model (C) are -29.3

[16] I thank an anonymous referee for pointing out this possibility to me.

and -106.9, respectively, so the LR statistic is 155.2, far greater than the 1% critical value of $\chi^2(17)$ ($k_0 = 7$, $k_n = 4$, $k_a = 2$, and the degree of freedom is $k_0 + 2k_n + k_a$) which is 33.4. Therefore, the competitive model is rejected by a large margin, and we can be assured that there exists at least one form of rationing in the labor market of Ninxian county.

Our next step is to determine what form(s) of rationing exists in the market. By our test strategy proposed in the last section, we first test the null of the existence of only entrance rationing against the alternative that there is either form of rationing. As we concluded in the last section, this requires us to test model (E) against model (U), that is, to test whether $\alpha_{n2} = 0$ holds in model (U). The LR statistic for this test is 54.4, far above the 1% critical value of $\chi^2(4)$ 13.3. Therefore, we conclude that entrance rationing is not the only form of rationing in our sample. Now, turning to the next test of the existence of only time rationing against the alternative of either kind of rationing, we estimate model (T) that is constructed by imposing the constraint $\gamma_n^* = \gamma_n$ on model (U). The LR statistic for the constraint is 4.8, less that the 10% critical value of $\chi^2(4)$ 7.78. Therefore, the null of the existence of only time rationing is accepted.

The acceptance of time rationing shows that the TVEs in Ninxian county were subjected to considerable government interventions. As noted at the end of Section 2, however, this finding does not necessarily provide evidence to support one view of the nature of the TVEs over the other. What it does show is that the outside pressure of employment creation out-weighted the inside pressure of protecting the current employees' interests in Ninxian's TVEs. Eastern Zhejiang and southern Jiangsu province are renowned for their strong collective economy at the village level. Our finding is consistent with the evidence quoted earlier on Wuxi county which is located in southern Jiangsu province. Although private elements in our sample were considerable, they were not strong enough to break the local governments' interventions into the industrial employment.

Or, as we pointed out at one point in Section 2, the private firms themselves might take the interventions as an exchange for the conveniences they got from the local governments.

4.4. Calibration of the estimates

As time rationing is found to be the only form of rationing in Ninxian county, we present the results of model (T) in Table 3 and will concentrate our discussion on the results of this model, referring occasionally to the results of models (U) and (C).

Let us first study the industrial wage equation. Our prior concern is whether human capital is properly compensated. The effect of experience is shown to have a usual inverse U-shape whose curvature is shown to be significant. The peak of the curve is at 24 years of experience, or 39 years old, the average age of our sample. The highest rate of return to experience is 2%, but not statistically significant. This is contrasted with what commonly found in other countries where 3% to 4% return rates prevail (Heckman and Kotz, 1986). The effect of education is even more disappointing. None of the three sets of results show that education contributes significantly to individual wages in both statistical and economic senses. This is sharply contrasted to the finding that the average rate of return to education is 12.8% for other Asian developing countries and 14.4% for all the developing economies that have been studied (Heckman and Hotz, 1986). However, our finding is supported by Gelb (1990) who found in the World Bank study that education was either insignificant or significantly negative in his various specifications of the industrial wage equation even when occupation attributes were controlled. One explanation for the low return to experience and education is that the work in the TVEs is simple and does not require much education and training. This explanation is not convincing because even for very simple tasks, more education and experience help one manage the tasks better and quicker, and thus are likely to be rewarded should there be an adequate promoting system. Another explanation is that the TVEs have non-economic considerations when they make their decisions of employment and wage payments. Some case studies support this explanation. For example, Wang et al. (1996) found in villages with strong collective economies, high-pay positions were always filled by those who had good ties to village cadres who usually were also in the management of the village firms.

Among the four village variables, all but DECISION are shown by all of the three sets of results to be highly insignificant. In contrast, DECISION is shown to be significant in all the three models. While model (C) shows that this variable has a negative effect on individual wages, the other two models show the opposite. According to model (T) that is consistent with our data, in villages where the village governments control the employment and wages of the village TVEs, workers are paid 29% higher than those in other villages. Although we do not have information about their modes, it can be inferred from the estimate that direct government interventions prevented wages to be adjusted downward. This behavior seems to be inconsistent with time rationing: A local government aiming at creating more employment should lower the wages in the village. One possible explanation is that the variable DECISION carries more information than just control of employment. For example, a village with a strong village government may be good at promoting productivity of its enterprises. Precise explanations, however, require decomposition of the effects represented by this variable.

As for the intrinsic personal characteristics, we find that only gender has a significant effect on individual wages. In fact, gender by far makes the largest contribution to individual wage differences. By model (T), a woman was paid 41% less than a man with the same qualifications. This large difference may be attributed to the lower positions women took in the factories. Li (1993) observed in a study of a northern village that most women working in the village factories were unmarried young girls who had not begun to assume household duties. They stopped working as soon as they had saved enough money for bridal and were ready to marry. Because of the tentativeness of their employment, the types of jobs they took were simple and seldom involved managerial tasks, so their wages were understandably lower than men's. This explanation may also apply to our case. Yet, other explanations are possible.

For example, paying women less may have productive implications. As shown by model (C) in which the parameters of the marginal agricultural product is directly estimated, women are 33% less productive than men in the agricultural sector. Although model (C) is rejected, this estimate is consistent with the finding by Benjamin and Brandt (1995) in a study of women's contribution in agriculture in the Japanese-occupied Manchuria in the thirties. In their study, Benjamin and Brandt found that women's direct contribution to crop output was 55% less than men's in their whole sample. It is interesting to see that after more than half a century, the productive gap between men and women still exists. Judging against this observation, it would be regarded as productively fair to pay women less in the industrial sector as women may be intrinsically less productive than men. However, the large gender difference in the industrial wage payment is still hard to be ignored. Gelb (1990) showed that women were paid 14% lower than men even when their occupations were controlled for, indicating that some form of discrimination against women might exist. Further studies are needed to determine whether gender discrimination exists in our case.

Turning to the sorting equation, we find that none of the directly estimated parameters except per capita land is significant. It is shown that more land hinders one to get an industrial job, which is intuitively understandable. In addition, direct government interventions significantly increase a person's chance of getting an industrial job (the coefficient for DECISION is obtained from the estimation of the industrial wage equation by imposing the constraints in (19)), which is consistent with time rationing under which entry to industry is made free. It is noteworthy that all the parameters estimated directly in the sorting equation may be contaminated by their corresponding parameters in the variable cost function (16). Therefore, the insignificance of most of them can not be taken as evidence of weak self-selection in sectoral allocation.

Lastly, we turn to the discussion of the industrial labor supply equation. Most of the coefficients are shown to be statistically significant in this equation. In particular, all the four village variables are significant, so the rejection of entrance rationing is natural. Among the variables with positive effects, there are gender, education, number of firms, profitability, and grain quota; and among the variables with negative effects, household head, ratio of private firms, government intervention, and the amount of land. It is intuitive to understand the positive effects possessed by the factors other than gender. While women are not significantly more likely to enter the industrial sector, they do work significantly longer than men do at the same wage rate: They work about 100 more days in a year (calculated by dividing the point estimate 0.44 by the estimate of b which is 0.0043) than men do. One explanation to this contrast is that women have relatively lower opportunity costs in agriculture where they are less productive than men. Another explanation is that women are used by the TVEs as cheaper labor for all year round routine production, and men are used to assume more technical but more intensive, and probably seasonal jobs. Among the variables with negative effects, that of land endowment is the easiest to understand from both individual and local government standpoints: From the individual standpoint, more land increases one's marginal product and his comparative advantage in agriculture; from the government standpoint, a person from a land-richer family should work less in industry in order to balance income in the village. The negative effect of being a household head, though, needs more explanations. The difference between a household head and a non-head worker is considerable, the former works 49 days less than latter. This finding could be taken as the evidence showing that a household head possesses comparative advantage in non-industrial activities, consistent with one of the three conjectures we gave earlier. However, as the parameters in the industrial labor supply equation are contaminated by those in the variable cost function, one needs to be careful in interpreting them as revealing individual productivity differences in the agricultural sector. Therefore, the difference between a household head and a non-head could be caused by the TVEs' deliberate selection as well as by individual productivity disparities. The negative effect of private firms may be caused by their small sizes. In our sample, private firms on average hired 20.5% of the village labor force, short of the average percentage of their numbers in village totals, which was 36%. Most interestingly, government interventions are shown to significantly reduce individual working days in the industrial sector: Workers in an intervened village work 167 days less than those living in a freer village. This is sharply contrasted with the easier entry made by the interventions we found in the sorting equation, and provides another piece of evidence to support our test result of the existence of time rationing.

The last estimate we want to discuss is that of b. It is significantly positive in all the three models. By the estimate obtained in model (T), one yuan increase over the average daily wage rate of 10.2 yuan will induce a person to work 22.8 more days in a year. On the other hand, the elasticity of industrial labor supply evaluated at the average working days of those already working in the sector, 265 days, is 0.88. The estimate of model (U) is similar while that of model (C) gives highly unrealistic result by which the effect of wage is far too strong. This contrast is consistent with our test result that the unrestricted industrial labor supply equation provides the right description of the data.

5. Concluding remarks

Our finding of the existence of time rationing in Ninxian county shows that the rapid growth of rural industry in the county has by far not brought about an integrated local labor market. Time rationing may be a phenomenon pertinent to the relatively early stage of industrialization in Ninxian county where industrial jobs are limited and have to be shared among villagers. There is evidence showing that the form of rationing may turn from time rationing to some forms of entrance rationing as the local economy develops into certain stage and intra-village job sharing becomes unnecessary. Wang et al. (1996) found that in relatively developed villages, the role village authorities played was turned into protecting the village resources from being shared by outsiders. Labor market segmentation might be even worse in highly developed villages that had a strong collective economy and attracted many outside workers whose number was several times as high as that of the village residents. In these villages, local people were assigned by the village to occupy almost all the management jobs in the village factories although their educational levels and managerial skills were below many of the outsiders. This employment segmentation of local and outside people may possess profound economic and social implications to local communities. It seems that strong social and political changes have to be carried out in order to revert the trend. Viable studies could be developed along this line.

The weak link between wage payments and human capital variables is related to, and may even be a consequence of labor market segmentation as people are not assigned to their jobs in a competitive fashion. This conclusion is reinforced by our finding that individual wages are highly correlated with the degree of local government interventions. The large gap between the earnings of men and women is also alarming. Although more careful studies are needed to determine this result's empirical contents, we could infer from our estimation that there are some forms of social or economic impediments that prevent women from gaining necessary skills to increase their productivity and wage potentials in both farming and industrial jobs. In the collective era, women were explicitly paid lower than men, yet they were forced to work in the field with men. After the restoration of family farming in the early 80s, women began to return to their houses in accordance with the traditional labor division in a household. The diminishing role played by women as an outside income earner raises the issue of intra-household inequality as well as women's social status as a whole in the society. Economic and sociological research in this filed could generate fruitful results.

Appendix

A1. Likelihood functions for the competitive model

A1.1. Full-time farmers

The likelihood function for full-time farmers is

$$f_1 = \Pr(P_{ni} = 0 \mid X_i) = \Phi(-c_i^* / \sigma_e), \tag{A1}$$

where $X_i = (X_{0i}, X_{ni}, X_{ai})$, $c_i^* = X_{0i}\gamma_0^* + X_{ni}\gamma_n^* + X_{ai}\gamma_a^*$, and Φ stands for the cdf of the standard normal distribution.

A1.2. Part-time workers

For those who work in the industrial sector, we transform the labor supply equation into an inverse supply equation

$$\ln(w_{ni}) = X_{0i}g_{02} + X_{ai}g_s + b\,L_{ni} + e_{ai}\,. \tag{A2}$$

The likelihood function for the part-timer is

$$f_2(\ln(w_{ni}), L_{ni}, P_{ni} = 1 \mid X_i) = \int_0^{\infty} j\;(\ln(w_{ni}), L_{ni}, L_{ni}^{\,*})dL_{ni}^{\,*},$$

where $L_{ni}^{\,*}$ stands for the latent decision variable in equation (6), and j stands for the distribution of $\ln(w_{ni})$, L_{ni}, and L_{ni}*. It can be shown that this likelihood function takes the following form

$$f_2(\ln(w_{ni}), L_{ni}, P_{ni} = 1 \mid X_i)$$
$$= |\beta| \frac{1}{\sigma_n \sigma_a} \phi\left[\frac{\ln(w_{ni}) - c_{ni}}{\sigma_n}, \frac{\ln(w_{ni}) - c_{ai}}{\sigma_a}, \rho\right] \tag{A3}$$
$$\Phi\left\{-\frac{-c_i * /\sigma_e - \eta_1[\ln(w_{ni}) - c_{ni}]/\sigma_n - \eta_2[\ln(w_{ni}) - c_{ai}]/\sigma_a}{(1-\eta_3{}^2)^{1/2}}\right\},$$

where $c_{ni} = X_{0i}g_{01} + X_{ni}g_n$, $c_{ai} = X_{0i}g_{02} + X_{ai}g_a + bL_{ni}$, f stands for the pdf of the standard bivariate distribution with correlation coefficient r , |b| is the Jacobian term of the transformation from the distribution of e_{ni}, e_{ai} and e_i* to that of $\ln(w_{ni})$, L_{ni}, and L_{ni}*, and

$$\eta_1 = \frac{\rho_{ne} - \rho\rho_{se}}{1-\rho^2}, \quad \eta_2 = \frac{\rho_{se} - \rho\rho_{ne}}{1-\rho^2}$$
$$\eta_3 = (\eta_1{}^2 + 2\rho\eta_1\eta_2 + \eta_2{}^2)^{\frac{1}{2}}$$

The likelihood function in (A3) can be derived by the following procedure. Using the Bayesian rule, $f_2(.)$ can be written as

$$f_2(\ln(w_{ni}), L_{ni}, P_{ni} = 1 | X_i)$$
$$= j_{12}(\ln(w_{ni}), L_{ni}) \int_0^{\infty} j_3(L_{ni}^{\,*} | \ln(w_{ni}), L_{ni}) dL_{ni}^{\,*},$$

where φ_{12} and φ_3 are the marginal distribution of w_{ni} and L_{ni}, and that of L_{ni}* conditional on w_{ni} and L_{ni}, respectively. Specifically, φ_3 can be derived by the following procedure. We start by deriving the distribution of e_i* conditional on ε_{ni} and ε_{ai} which is normal. Let μ_e^c and σ_e^c denote its conditional mean and standard deviation. Then (Goldberger, 1991)

$$\mu_e^c = -b'\begin{pmatrix}\varepsilon_{ni}\\ \varepsilon_{ai}\end{pmatrix} = -b'\begin{pmatrix}\ln(w_{ni}) - c_{ni}\\ \ln(w_{ni}) - c_{ai}\end{pmatrix}, \qquad \sigma_e^c = (\sigma_e^2 - b'\Sigma_{na} b)^{\frac{1}{2}},$$

$$\Sigma_{na} = \begin{pmatrix}\sigma_n^2 & \sigma_{na}\\ \sigma_{na} & \sigma_a^2\end{pmatrix}, \quad b = \Sigma_{na}^{-1}\begin{pmatrix}\sigma_{ne}\\ \sigma_{ae}\end{pmatrix},$$

where σ_{ij} denotes the covariance between the corresponding pair of error terms. Using the fact

$$\Sigma_{na}^{-1} = \frac{1}{\sigma_n^2\sigma_a^2(1-\rho^2)}\begin{pmatrix}\sigma_a^2 & -\sigma_{na}\\ -\sigma_{na} & \sigma_n^2\end{pmatrix},$$

we can rewrite b, μ_e^c, and σ_e^c as

$$b = \frac{\sigma_e}{1-\rho^2}\begin{pmatrix}(\rho_{ne} - \rho\rho_{ae})/\sigma_n\\ (\rho_{ae} - \rho\rho_{ne})/\sigma_a\end{pmatrix} = \sigma_e\begin{pmatrix}\eta_1/\sigma_n\\ \eta_2/\sigma_a\end{pmatrix},$$

$$\mu_e^c = \sigma_e\left\{\eta_1[\ln(w_{ni}) - c_{ni}]/\sigma_n + \eta_2[\ln(w_{ni}) - c_{ai}]/\sigma_a\right\},$$

$$\sigma_e^c = \sigma_e\left[1 - (\eta_1^2 + 2\rho\eta_1\eta_2 + \eta_2^2)\right]^{\frac{1}{2}} = \sigma_e(1-\eta_3^2)^{\frac{1}{2}}.$$

The conditional distribution of (e_i* - μ_e^c)/σ_e^c|ε_{ni}, ε_{ai} is standard normal, which means that (L_{ni}* - c_i* - μ_e^c)/σ_e^c | ln(w_{ni}), L_{ni} also has standard normal distribution. This leads to the cumulative part of equation (A3). By transforming φ_{12}(w_{ni}, L_{ni}) into standard normal distribution, plus the absolute value of the Jacobian for ln(w_{ni}) and L_{ni} which is |b|, we then get the density part of equation (A3).

A1.3. Full-time workers

By similar method, we can derive the likelihood function for full-time workers. While most parts of the derivation are analogous to those presented above, one caveat is that $L_{ni} \geq L^0$ is equivalent to $\ln(w_{ni}) - c_{ai} \geq \varepsilon_{ai}$, where now $c_{ai} = X_{0i}\gamma_{02} + X_{ai}\gamma_a + \beta L^0$. Therefore,

$$f(\ln(w_{ni}), L_{ni} \geq L^0, P_{ni} = 1 \mid X_i)$$

$$= \int_{L^0}^{\infty}\int_{0}^{\infty} \varphi(\ln(w_{ni}), L_{ni}, L_{ni}^*)dL_{ni}dL_{ni}^*$$

$$= \int_{-\infty}^{\ln(w_{ni})-c_{nii}} \int_{-c_{ni}}^{\infty} |\beta|\varphi'(\varepsilon_{ni}, \varepsilon_{ai}, e_i^*)d\varepsilon_{ai}de_i^*,$$

where φ' is the joint normal distribution for the three error terms. The likelihood function thus is

$$f_3(\ln(w_{ni}), L_{ni} \geq L^0, L_{ni}^* > 0 \mid X_i)$$

$$= |\beta|\frac{1}{\sigma_n}\phi\left[\frac{\ln(w_{ni}) - c_{ni}}{\sigma_n}\right] \qquad \text{(A4)}$$

$$\Phi\left\{\frac{[\ln(w_{ni}) - c_{ai}]/\sigma_a - \rho\,[\ln(w_{ni}) - c_{ni}]/\sigma_n}{(1-\rho^2)^{1/2}}, -\frac{-c_i^*/\sigma_e - \rho_{ne}[\ln(w_{ni}) - c_{ni}]/\sigma_n}{(1-\rho_{ne}^2)^{1/2}}, -\rho_{ae}^c\right\},$$

where here ϕ stands for the pdf of the standard normal distribution, Φ stands for the cdf of the standard bivariate normal distribution, and ρ_{ae}^c is the correlation coefficient for the joint normal distribution of ε_{ai} and e_i^* conditional on ε_{ni} which is equal to $(\rho_{ae} - \rho_{ne}\rho)$.

A2. Reparametrization and the test of segmentation

It can be seen that σ_e is associated with c_i^* whenever it appears. Therefore, it can not be estimated in the unconstrained model, which in turn means that the constraint put on σ_e in (8a) is redundant. Thus, when estimating the constrained model, we can simply omit σ_e that is associated with c_i^* in equations (A1), (A3), and (A4).

To ensure convergence, the following reparametrization is made

$$t_n = \frac{1}{s_n}, \quad d_{01} = \frac{g_{01}}{s_n}, \quad d_n = \frac{g_n}{s_n}, \quad t_a = \frac{1}{s_a}, \quad d_{02} = \frac{g_{02}}{s_a}, \quad d_a = \frac{g_a}{s_a}. \tag{A5}$$

Therefore, the first order constraints for the competitive model become

$$g_0 * = \frac{d_{01}}{t_n} - \frac{d_{02}}{t_a}, \quad g_n * = \frac{d_n}{t_n}, \quad g_{\mathrm{a}} * = -\frac{d_a}{t_a}. \tag{A6}$$

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Table 1. Demographic characteristics of the three employment groups

	Agricultural sector	Industrial sector			Whole sample	
		Part-timers	Full-timers	Subtotal	Mean	Std. dev.
Num. of people	80	77	77	154		
Age	45.4	35.6	35.4	35.5	38.8	27.8
Perc. of married	88.7	68.8	66.2	67.5	74.8	43.5
Perc. of female	48.7	48.1	51.9	50.0	49.6	50.1
Education (yrs)	5.1	6.4	7.1	6.7	6.2	2.1
Perc. of family head	37.5	33.8	24.7	29.2	32.1	46.8
Land/capita (mu)	3.5	1.4	1.1	1.2	2.0	2.5
Quota/capita (kg)	556	136	94	115	266	690
Ind. Wage (yuan)		10.8	9.7	10.2		

Table 2. Estimation results: model (U) and model (C)[a]

Parameters	Model (U) Sorting eq. (16)	Model (U) Ind. wage eq. (1)[b]	Model (U) Labor supply eq. (19)[b,c]	Model (C) Ind. wage eq. (1)[b]	Model (C) Marg. Agr. Prod. eq. (5)[b]	Model (C) Sorting eq. (4)[d]
CONSTANT	1.56* (0.83)	2.31** (0.25)	-1.86** (0.31)	2.41** (0.30)	2.09** (0.29)	0.32
EXP	-0.05 (0.05)	0.02 (0.02)	0.02 (0.02)	0.004 (0.02)	-0.01 (0.01)	0.014
EXP2	-0.28×10^{-3} (0.86×10^{-3})	-0.44×10^{-3} * (0.26×10^{-3})	-0.15×10^{-3} (0.30×10^{-3})	-0.31×10^{-3} (0.29×10^{-3})	-0.09×10^{-3} (0.24×10^{-3})	-0.22×10^{-3}
HEAD	0.06 (0.39)	0.06 (0.10)	-0.23** (0.11)	0.14 (0.10)	.24** (0.08)	-0.10
GENDER	0.09 (0.50)	-0.41** (0.08)	0.42** (0.09)	-0.38** (0.09)	-0.33** (0.07)	-0.05
MARRIED	0.45 (0.61)	0.10 (0.11)	-0.30** (0.13)	0.24** (0.12)	0.16 (0.11)	0.08
EDU	0.12 (0.09)	0.02 (0.16)	0.33* (0.20)	-0.07 (0.15)	-0.04** (0.02)	-0.03
NUM_FIRMS	-0.11 (0.56)	-0.23 (0.21)	1.01** (0.26)	0.16 (0.15)		0.16
PRIV_FIRMS	0.36 (0.75)	0.11 (0.13)	-0.23 (0.16)	-0.08 (0.11)		-0.08
PROFIT	0.02 (0.33)	0.04 (0.18)	0.48** (0.22)	0.10 (0.12)		0.10
DECISION	0.69 (0.46)	0.28** (0.08)	-0.69** (0.10)	-0.13* (0.07)		-0.13
LANDPOP	-0.46** (0.10)		-0.13 (0.14)		-0.03 (0.02)	0.03
QUOTAPOP	0.01 (0.38)		0.31** (0.14)		-0.16** (0.08)	0.16
β			0.40×10^{-2}** (0.03×10^{-2})		0.25×10^{-2} ** (0.04×10^{-2})	
$\sigma_n^{-1}/\sigma_a^{-1}$		3.20** (0.18)	2.99** (0.22)	3.20** (0.29)	3.10** (0.26)	
ρ		0.54** (0.06)			0.72** (0.09)	
ρ_{ne}		-0.24 (0.17)			-0.21 (0.46)	
ρ_{ae}		0.35** (0.15)			0.30 (0.43)	

a. The number of cases is 234. Standard errors reported in the parentheses are calculated from the variance-covariance matrices computed from the inverse of the Hessian. The values of the log-likelihood functions for model (U) and (C) are - 29.3 and -106.9, respectively.
b. Standard errors are calculated assuming σ_n and σ_a to be constant.
c. Estimates include the signs adjacent to the parameters in equation (17).
d. Figures are calculated by using the constraints in (7a), (7b) and (7c).
* Significant at the 10% significance level. ** Significant at the 5% significance level.

Table 3. Estimation results: model (T)[a]

Parameters	Sorting eq.[b]	Ind. wage eq. (1)[c]	Labor supply eq. (19)[c,d]
CONSTANT	1.74** (0.73)	2.30** (0.24)	-1.87** (0.31)
EXP	-0.05 (0.05)	0.02 (0.02)	0.02 (0.02)
EXP2	-0.26×10^{-3} (0.85×10^{-3})	-0.42×10^{-3} * (0.25×10^{-3})	-0.14×10^{-3} (0.31×10^{-3})
HEAD	0.02 (0.24)	0.08 (0.10)	-0.21* (0.12)
GENDER	0.23 (0.48)	-0.41** (0.08)	0.44** (0.10)
MARRIED	0.62 (0.60)	0.10 (0.11)	-0.30 (0.30)
EDU	0.59 (0.62)	0.00 (0.02)	0.038* (0.02)
NUM_FIRMS	-0.22	-0.22 (0.19)	1.07** (0.26)
PRIV_FIRMS	0.12	0.12 (0.12)	-0.22** (0.16)
PROFIT	0.05	0.05 (0.15)	0.52** (0.22)
DECISION	0.29	0.29** (0.08)	-0.71** (0.10)
LANDPOP	-0.47** (0.10)		-0.13** (0.04)
QUOTAPOP	-0.18 (0.38)		0.34* (0.15)
b			0.43×10^{-2} ** (0.03×10^{-2})
s_n^{-1}/s_a^{-1}		3.22** (0.18)	2.91** (0.21)
r		0.51** (0.07)	
r_{ne}		-0.21 (0.17)	
r_{ae}		0.37** (0.15)	

a. The number of cases is 234. The variance-covariance matrix is computed from the inverse of the Hessian. The value of the log-likelihood function is - 31.7.

b. The estimates for the four village variables are the same as their counterparts in the wage equation because of the imposition of the constraints in (19).

c. Standard errors in the parentheses are calculated assuming s_n and s_a to be constant.

d. Estimates include the signs adjacent to the parameters in equation (17).

* Significant at the 10% significance level. ** Significant at the 5% significance level. 0