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The Role of Attitude to Risk in the Migration Decision-Making

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In this article I suggest theoretical model which explains the intensity and the structure of rural-to-urban migration. The key feature of my analysis as opposed to existing literature is that agents differ with respect to risk aversion. My model demonstrates that people with different attitude to risk choose to work in different regions even though they face the same employment alternatives. This variation comes from the fact that workers with different attitude to risk differently evaluate the same uncertainty of future employment. The model sheds the light on empirically observed structure of rural-to-urban migration. I also provide evidences that assumptions and predictions of my model are supported by the empirical research in this field.

Key words: rural-to-urban migration, degree of risk aversion, attitude to risk, urban formal sector, urban informal sector, rural region, expected utility, human capital, uncertainty, risk, mean earnings.

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В этой статье я рассматриваю теоретическую модель, которая помогает объяснить интенсивность и структуру миграции рабочей силы из села в город. Ключевым элементом моего анализа, отличающим её от существующих работ, является предпосылка о том, что агенты по-разному относятся к риску. В своей модели я показываю, что люди с разным отношением к риску выбирают работу в разных регионах, несмотря на то, что сталкиваются с одинаковыми альтернативами занятости. Это различие возникает из-за того, что рабочие с разным отношением к риску по-разному оценивают одну и ту же степень неопределённости своей будущей занятости. Модель проливает свет на эмпирически наблюдаемые потоки мигрантов между селом и городом и их структуру. Я так же подкрепляю предпосылки и результаты моей модели эмпирическими исследованиями в этой области.

Ключевые слова: миграция из села в город, степень отвращения к риску, отношение к риску, городской формальный сектор, городской неформальный сектор, сельский регион, ожидаемая полезность, человеческий капитал, неопределённость, риск, средний доход.

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1. Introduction

Problems of migration in general and rural-to-urban migration in particular were extensively studied by economists for many years. One of the seminal papers on this topic was written by Todaro (1969). It was argued there that the main driving force for migration is the urban-rural difference in expected earnings. Since then many authors have extended and modified different aspects of that model. For my paper one of the most important extensions is the introduction of urban informal sector. This sector is characterized by low barriers to employment and low income. In the models of Hart (1973) and Fields (1975) employment in the informal sector is considered as a transitional phase, providing an alternative to unemployment while waiting for a job in urban formal sector. However, surveys in the late '70s have found out significant structural changes in the rural-to-urban migration which questioned the transitional role of urban informal sector. Mexican census has revealed that the bulk of migration into the Metroplex comes from the most rural and relatively poor states where levels of education are absolutely and relatively low. It means that those people have no prospects to be employed in the urban formal sector, which has formal minimum education requirements, and move to the city with the expectations of finding long-term employment in urban informal sector. To the same results came Biswajit Banerjee (1983). He found out that a substantial proportion of informal sector entrants were attracted to Delhi by opportunities in urban informal sector and only two-fifths of informal sector entrants continued to search for alternative employment. This discrepancy of theory and real data induced a wave of theoretical works which tried to propose reasons for migrants to relocate with the intention of finding jobs in urban informal sector. For example, Cole and Sanders (1985), suggest that earnings and employment in urban informal sector are intimately tied to developments in other sectors (urban formal and rural). The purpose of my paper is to develop a model of self-selection in which people with identical initial conditions but various attitudes to risk choose different labor markets. Based on the results of the model I will try to predict what types of people prefer to work in urban informal, urban formal and rural sectors, and what factors may be responsible for the growth of urban informal sector.

The plan of the paper is as follows. The next section provides an overview of papers which mainly influenced my work. Section 3 outlines the basic setup and suggests first preliminary predictions of the model. Section 4 discusses the most important results of the model. Section 5 concludes.

2. Literature Overview

One of the seminal works on rural-to-urban migration was written by Michael Todaro in 1969. The distinguishing feature of his model is that, instead of assuming that migration is caused by actual income differences, migration takes place in response to expected income gaps which are adjusted for the probability that workers will obtain urban jobs. In urban sector the wage rate is fixed at a politically determined, exogenous level which is higher than the competitive wage in rural sector which ensures full employment. When a rational worker decides where to work he compares the expected income in two sectors. Although in the urban sector wage rate is more attractive than in the rural sector, the number of jobs there is fixed and not everyone can find one. The probability of finding a job in the city is equal to the ratio of working places to the total number of workers in the urban sector. It follows that workers will migrate from one sector to

another until their expected income is the same in both sectors. As the minimum wage in the city is higher than the competitive one in the rural sector, in equilibrium, to get an equal expected income, there has to be unemployment in the urban sector. So this model explains why despite a high level of unemployment in urban areas, large volumes of migration to urban areas prevail.

In his model Todaro assumes that workers are identical in their abilities, skills and the amount of human capital. However, in the reality it is not so. The probability of employment and the quality of a new job in the city depends on many factors which are not identical among the agents. It implies that although in the work of Todaro people were equally driven by the expected income differential, in the reality those who migrate and those who stay are different in their abilities to find a new job and that is why they have different aspirations for migration. So Todaro's model does not help us to understand in what way migrants differ from non-migrants because the place of work is a matter of luck and does not depend on individual characteristics.

One of the works which introduces heterogeneity in individual characteristics is the paper of Stark (2003). In the attempt to explore whether non-migrants can become better off under migration Stark assumes that there are two types of workers: low-ability and high-ability. Both types can acquire human capital to increase their productivity (earnings), but it is more costly to acquire human capital for low-ability workers than for those of high-ability. All agents are risk neutral and they choose the amount of human capital to maximize their expected income. In the case when migration is not allowed workers with different abilities face identical domestic production function which positively depends on the amount of both individual and average level of human capital. However, cost functions are different and high-ability workers prefer to acquire more human capital than those with low-ability as they suffer less from the process of education. Before we proceed to the case where migration is allowed it is worth noting that, since positive externalities from the economy-wide average level of human capital are not internalized by the individual worker, the level of acquired human capital is not socially optimal.

Migration opens the opportunity to earn higher earnings abroad and in principle all workers want to migrate. However, only workers with a reasonably high level of human capital are allowed to migrate because migration requires a minimum level of human capital. Stark further assumes that this minimum level is too high for low-ability workers and they find it more profitable to stay home. High-ability workers, however, prefer to acquire a higher than under non-migration times level of human capital and migrate. It was shown that under some reasonable restrictions and low probability of migration non-migrants (both low- and high-ability) gain from migration opportunity because of a higher average human capital.

Although the above model was built to analyze the welfare effect of migration opportunity on non-migrants, in my model I will use the idea that agents with different individual characteristics acquire different levels of human capital and this choice may influence their decision to migrate.

It follows from the model that a worker's desire to migrate depends entirely on his abilities but in the reality people even with similar abilities, skills and background behave differently. It appears that internal attitude toward different life events is also very important in the decision-making process. And one of the possible factors which can explain the difference in individuals' behavior is interpersonal difference in risk

aversion. Migration, for example, is concerned with the risk of unemployment or possibility of getting a low-paid job and the individual's attitude to risk can be one of the factors which determine the decision to migrate. That is why in my model I will explore how the "degree" of risk aversion alone affects individuals' choice about migration.

Another shortcoming of Todaro's migration model was revealed by Cole and Sanders (1985). First of all they divide urban region into formal and informal sectors and define their characteristics in the following way. The informal sector involves such occupations as domestic service, petty tradesmen, handicrafts, repair manual labor services, and the like. It has very low capital-labor ratios and almost no formal human capital requirements. So there are no barriers to join this sector. The urban formal sector jobs, on the contrary, carry education requirements that effectively exclude people who have acquired little or no formal education.

Then they argue that nowadays the bulk of migration in the developing countries comes from the most rural and relatively poor states where levels of education are absolutely and relatively low. Surveys confirm that the majority of migrants have minimal education attainments and as a result the mean level of education of urban immigrants regressed toward the rural mean. It appears that all these low-educated people move to the city with the expectation of finding long-term employment in the informal sector. However, these empirical results contradict to the predictions of the expected income hypothesis.

Todaro's model claims that urban migrants are attracted by expectations of employment in urban formal sector where earnings are higher than in the rural region. Indeed, people migrating in the face of zero probability of employment in the urban formal sector must be seen as irrational by Todaro's model. So it cannot explain rapid growth of urban informal sector which attracts low-educated people.

Whereas the Todaro model explains why, in spite of the unemployment, those who possess human capital do migrate; Cole and Sanders (1985) try to explain why masses of unschooled and relatively unskilled persons also join the trek to the city. They suggest two explanations of the burgeoning growth of urban informal sector: the growth of the rural population, and the rapid growth of the urban formal sector. The growth of the rural population keeps the downward pressure on the rural earnings and increases the flow of migrants to the urban informal sector. The growth of the urban formal sector, through the growth of demand for services from the informal sector, pushes earnings in the informal sector up and also attracts new workers.

In my work I will develop a model of self-selection in which people with identical initial conditions but various attitudes to risk acquire different amounts of human capital and choose employment in different labor markets. Based on the results of the model I will try to predict what types of people prefer to work in urban informal, urban formal and rural sectors, and what factors may be responsible for the growth of urban informal sector.

3. The Basic Model

In my model individuals migrate from rural to urban region in response to a differential in expected utility rather than in expected income, thereby highlighting the role of risk-aversion in individual migration

decisions. One would expect the degree to which an individual is risk averse to have a large effect on the individual's decisions, in particular, decisions to migrate.

Consider a static economy consisting of a continuum of risk-averse agents. The emphasis in my model is placed on the heterogeneity in personal risk aversion that results in heterogeneity in human capital investments. Their preferences admit an expected utility representation $\left(U(F) = \int u(x)dF(x)\right)$ with Bernoulli utility function of a CARA type

$$u(x) = 1 - \exp(-\lambda x), \lambda > 0. \quad (1)$$

I choose this form of the Bernoulli utility function as I want to study the effect of different "degrees" of risk aversion on the individuals' decision-making and one of the approaches to measure this "degree" is to calculate the Arrow-Pratt coefficient of absolute risk aversion. For CARA functions this coefficient by definition is constant and in my case equals to lambda for any *x*. It means that to find out which worker is more risk-averse I just need to compare lambdas.

Agents can work in any of two regions: rural and urban. The urban region in its turn is divided into formal and informal sectors. Employment in urban informal sector, as in rural region, has no human capital requirements and any worker can freely enter these labor markets. On the other hand, to get a job in urban formal sector workers have to acquire some minimum level of human capital. This assumption corresponds with the reality as an entry into a higher level job is often restricted to some credentials. A credential required by an employer could be a degree, a minimum class rank or average grade point, graduation from a college of at least some minimum quality, or a combination of these.

Each agent before he starts working determines the level of human capital investments. Under human capital I do not imply just the number of years in the institute but the quality of education which in addition to many other factors depends on the level of efforts. It implies that the amount of human capital is not discrete and agents can acquire any level of human capital. As workers have to exert efforts and spend their time to acquire human capital they bear some costs of forming human capital. For simplicity I assume that all workers face identical cost function because the purpose of my paper is to explore the effect of interpersonal differences in risk aversion on the individual's decisions to migrate. So all workers acquire human capital with costs, $c(\theta)$, which positively depend on the amount of human capital, θ. I also assume that marginal costs of acquiring human capital decrease because accumulated human capital helps to acquire an additional one less costly.

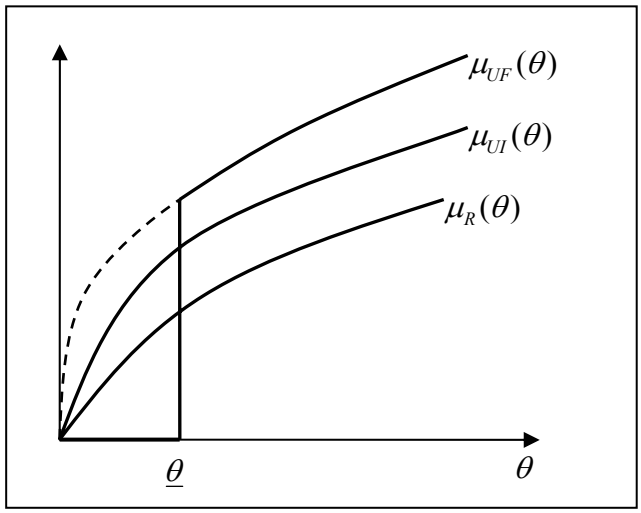
Although the amount of human capital is determined by individual's choice and is 100% certain it does not mean that the returns to this investing are also certain. In fact the future pay-offs depend not only on the level of education but also on unknown personal abilities, skills, working environment and many other factors which are uncertain. It implies that future earnings, although depend, are not completely determined by the level of human capital and are random with some distribution function.

I assume that earning in each region, conditional on acquired human capital, are normally distributed with some mean and variance. Mean earnings and variance both positively depend on the amount of acquired human capital. Positive influence of education on mean earnings is intuitively clear and was more than once

empirically confirmed. Positive correlation between human capital and earnings dispersion is less obvious but I assume that the more human capital one forms, the broader is his potential pool of jobs and, consequently, the higher is the variance of his earnings distribution. Another way to see the positive correlation between human capital and earnings dispersion is to consider earnings as a long-term stream of future wages which may change over time. A person with good education even if he starts from a low position has, ceteris paribus, better career perspectives than a person with worse education but actual career growth depends on many other unknown factors and can be very low. It means that human capital broadens the potential range of future earnings.

I assume that each sector has its own functional dependence of mean earnings and variance on human capital. In rural region and urban informal sector mean earnings are, correspondingly, equal to $\mu_R(\theta)$ and $\mu_{UI}(\theta)$, for $\theta > 0$. In urban formal sector mean earnings are equal to $\mu_{UF}(\theta)$, for $\theta > \underline{\theta}$, where $\underline{\theta}$ is the minimum level of human capital which is required by an employer. Mean earnings is a concave function of human capital. It means that an additional amount of human capital on average increases the earnings of the workers, however further improvement in earnings requires more and more efforts.

Figure 1. Mean Earnings

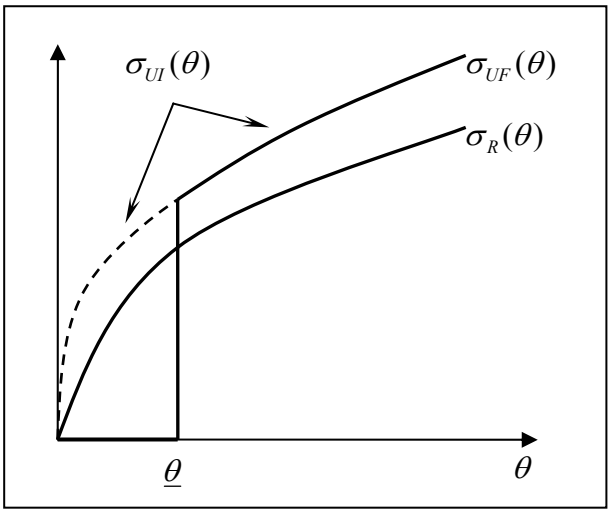


I also assume that given some fixed amount of human capital employment in the urban formal sector is on average the most profitable and employment in the rural region is the least profitable. Higher labor productivity and higher earnings in the city can be explained by higher capital-labor ratio which increases the marginal product of labor. So if we assume that all three labor markets are competitive then greater marginal product of labor simultaneously leads to greater wages. It may seem that in the case of no migration costs all workers want to migrate to the region with the highest earning, however, here only mean earnings were discussed but agents in my model are risk-averse and they also care about risk of employment.

Although urban labor market is more profitable than the rural one it is more risky. It means that given some fixed amount of human capital employment in the urban region is more uncertain than employment in the rural region. It follows from the fact that in the city people face a greater variety of working opportunities than in the country and that is why their future earnings are less certain. One can argue that formal and informal labor markets also should have different variance of earnings because urban formal sector

compared with the urban informal one offers social security, conclude labor contracts and negotiate with trade unions which make employment there more secured. In response to this I can say that although labor market in urban informal sector is less secured it imposes no formal restrictions on employees and one can relatively easy find a new job with similar characteristics in terms of occupation and earnings. Moreover, the assumption that formal and informal sectors are equally risky is not crucial for my analysis because individuals' choice between two urban sectors is to a greater extent determined by the level of minimum formal human capital requirements.

Figure 2. Variance of Earning



The variance in earnings is represented by the increasing functions, $\sigma_i^2(\theta)$, where $i = \{UF, UI, R\}$ for urban formal sector, urban informal sector and rural region correspondingly.

Each agent faces three different distribution functions of earnings which correspond to each of three labor markets.

$$f_i(W) = \frac{1}{\sigma_i(\theta)\sqrt{2\pi}} \exp\left(-\frac{(W - \mu_i(\theta))^2}{2\sigma_i^2(\theta)} \right), \text{ where } i = \{UF, UI, R\}. \quad (2)$$

All agents choose the optimal amount of human capital in order to maximize their expected utility functions.

$$U(F_i) = \int_{-\infty}^{\infty} \left(1 - \exp[-\lambda(W - c(\theta))]\right) f_i(W) dW . \quad (3)$$

For each labor market agents determine the optimal amount of human capital according to their attitude to risk. I think that now it is intuitively clear that the degree to which an individual is risk averse has a large effect on the individual's decisions to invest in risky human capital. Then agents compare optimal values of expected utilities for all three labor markets and migrate to the sector with the highest expected utility level.

In short my model can be presented in the following way:

$u(x) = 1 - \exp(-\lambda x), \lambda > 0.\ \lambda - degree\ of\ risk\ aversion.$

$c(\theta)$ – costs of human capital formation.

Two Regions

Rural

Urban

	Formal Sector	*Informal Sector*
Rural region has no human capital requirements. Earnings are normally distributed according to *p.d.f.,* $f_R(W)$. With mean $\mu_R(\theta)$ and variance $\sigma_R^2(\theta)$.	Formal sector requires minimum level of human capital ($\theta > \underline{\theta}$). Earnings are normally distributed according to *p.d.f.,* $f_{UF}(W)$. With mean $\mu_{UF}(\theta)$ and variance $\sigma_{UF}^2(\theta)$.	Informal sector has no human capital requirements. Earnings are normally distributed according to *p.d.f.,* $f_{UI}(W)$. With mean $\mu_{UI}(\theta)$ and variance $\sigma_{UI}^2(\theta)$.

Rural Labor Market:

$$\max_{\theta} \int_{-\infty}^{\infty} \left(1 - \exp\{-\lambda(W - c(\theta))\}\right) f_R(W) dW \rightarrow \theta = \theta_R^*(\lambda)\ and\ U(\theta_R^*).$$

Urban Formal Labor Market:

$$\max_{\theta} \int_{-\infty}^{\infty} \left(1 - \exp\{-\lambda(W - c(\theta))\}\right) f_{UF}(W) dW,\ s.t.\ \theta > \underline{\theta} \rightarrow \theta = \theta_{UF}^*(\lambda)\ \ and\ U(\theta_{UF}^*).$$

Urban Informal Labor Market:

$$\max_{\theta} \int_{-\infty}^{\infty} \left(1 - \exp\{-\lambda(W - c(\theta))\}\right) f_{UI}(W) dW \rightarrow \theta = \theta_{UI}^*(\lambda)\ \ and\ U(\theta_{UI}^*).$$

Agents in my model are assumed to be absolutely identical except for the "degree" of risk aversion. That is why lambda is the key parameter which drives all the results. Workers can freely migrate to any of three destinations which differ in their profitability and risk. They choose the most attractive option based on the maximization of their expected utility function and this choice depends on the "degree" of risk aversion.

My first predictions about the model's results are as follows: those who try hard to avoid risk (high lambda) will work in rural sector as it is less risky. Work in urban formal sector, though highly paid, requires relatively high level of human capital which in its turn makes this job rather risky. In the light of this it seems reasonable to predict that only those who can bear risk (low lambda) will work in urban formal sector. And those who are in the middle, in terms of risk aversion, will work in urban informal sector.

4. The Basic Results.

4.1. Analytical solution.

The expression for the expected utility (3) is rather complicated for the analysis but it can be simplified to the following expression:

$$U(F_i) = 1 - e^{\lambda\left(c(\theta) - \mu_i(\theta) + 0.5\lambda\sigma_i^2(\theta)\right)},\ i = \{UF, UI, R\}.^{1} \tag{4}$$

However, in the general case the analysis of the individual's behavior is still impossible. That is why I suggest certain functional forms for mean earnings, variance of earnings and cost function.

The worker's cost function of forming human capital is

$$c(\theta) = \delta \ln(1+\theta). \tag{5}$$

The mean earnings are

$$\mu_i(\theta) = \alpha_i \ln(1+\theta). \tag{6}$$

$i = \{UF, UI, R\}$, where $\alpha_{UF} > \alpha_{UI} > \alpha_R$.

The variance of earnings takes the following form:

$$\sigma_i^2(\theta) = \beta_i \theta. \tag{7}$$

$i = \{UF, UI, R\}$, where $\beta_{UF} = \beta_{UI} > \beta_R$.

Under these assumptions the expected utility function can be rewritten in the following way:

$$U(F_i) = 1 - e^{\lambda\left[(\delta - \alpha_i)\ln(\theta+1) + 0.5\lambda\beta_i\theta\right]}. \tag{8}$$

It means that each agent chooses the level of human capital so as to minimize the power of the exponent given his personal risk aversion, λ:

$$\min_{\theta}\left\{0.5\lambda\beta_i\theta + (\delta - \alpha_i)\ln(\theta+1)\right\}.$$

$$F.O.C.: 0.5\lambda\beta_i = \frac{\alpha_i - \delta}{\theta_i^* + 1} \Rightarrow$$

$$\theta_i^* = \begin{cases} \dfrac{\alpha_i - \delta}{0.5\lambda\beta_i} - 1, & if\ \dfrac{\alpha_i - \delta}{0.5\lambda\beta_i} > 1. \\ 0, & o/w. \end{cases} \quad for\ i = \{UI, R\}. \tag{9}$$

$$\theta_{UF}^* = \begin{cases} \dfrac{\alpha_{UF} - \delta}{0.5\lambda\beta_{UF}} - 1, & if\ \dfrac{\alpha_{UF} - \delta}{0.5\lambda\beta_{UF}} > 1 + \underline{\theta}. \\ \underline{\theta}, & if\ \dfrac{\alpha_{UF} - \delta}{0.5\lambda\beta_{UF}} < 1 + \underline{\theta}\ and\ U(\underline{\theta}) > 0. \\ 0, & o/w. \end{cases} \tag{10}$$

[1] Derivation can be found in Appendix

$$\frac{\partial \theta^*}{\partial \lambda} \le 0, \frac{\partial \theta^*}{\partial \beta} \le 0, \frac{\partial \theta^*}{\partial \alpha} \ge 0, \frac{\partial \theta^*}{\partial \delta} \le 0. \quad (11)$$

In other words inequalities in (11) imply that risk-averse individuals (high lambdas) will invest less in risky human capital. In addition, the greater the uncertainty surrounding the returns to these investments the more the risk-averse individuals will avoid them. As beta rises, investments in human capital fall, unless the person is compensated by a higher expected return, alpha.

To understand which workers prefer urban informal to rural region we should compare corresponding expected utilities. An individual prefers urban informal sector if

$$U^*(F_{UI}) = 1 - e^{\lambda\left[(\delta-\alpha_{UI})\ln\left(\theta^*_{UI}+1\right)+0.5\lambda\beta_{UI}\theta^*_{UI}\right]} > U^*(F_R) = 1 - e^{\lambda\left[(\delta-\alpha_R)\ln\left(\theta^*_R+1\right)+0.5\lambda\beta_R\theta^*_R\right]}$$

$$\text{or if } C_1 \ln\lambda - C_2\lambda + C_3 < 0, \text{ where} \quad (12)$$

$$C_1 = (\alpha_{UI} - \alpha_R); \quad C_2 = 0.5(\beta_{UI} - \beta_R);$$

$$C_3 = \left[(\alpha_{UI} - \delta)\left(\ln\frac{0.5\beta_{UI}}{\alpha_{UI}-\delta}+1\right) - (\alpha_R - \delta)\left(\ln\frac{0.5\beta_R}{\alpha_R-\delta}+1\right)\right];^{2}$$

If we keep initial assumptions that $\alpha_{UI} > \alpha_R$ and $\beta_{UI} > \beta_R$ we get that C_1 and C_2 are both positive and our expression graphically has inverse-U shape with maximum at $\lambda = \frac{C_1}{C_2}$. Figure 3[3] provides visual illustration.

We see that as $C_1 > 0$, for individuals with small lambdas urban informal sector is more attractive than rural region, however after some critical value of lambda ($\tilde{\lambda}$) individuals' preferences reverse and the rural region is more attractive for all $\lambda > \tilde{\lambda}$. Indeed, one can argue that for large enough lambdas our expression becomes negative again and workers prefer urban informal sector. Point is that the optimal amount of human capital which maximizes utility functions is negative for all lambdas where optimal utility function increases again. This is illustrated in Figure 4[3].

However, negative human capital is impossible and it was reflected in the analytical expressions. It implies that the right picture which includes all the restrictions should not have part with negative thetas and final part with increasing utility, Figure 5[3]. So we get that if theta can be only positive we at best can get only one reversal of preferences, which occurs when $C_1 \ln\tilde{\lambda} - C_2\tilde{\lambda} + C_3 = 0$ for the *first* time.

The key moment here is that expression $C_1 \ln\lambda - C_2\lambda + C_3$ can have maximum two roots and the second one violates assumption about positive values of human capital. So we have only one reversal of preferences from urban informal sector to rural region as lambda (degree of risk aversion) grows.

[2] Derivation can be found in Appendix
[3] Figure 3, 4, 5 are attached to Appendix.

When we compare urban informal and urban formal sectors we get similar expressions but analysis is more sophisticated. When formal human capital requirements are not binding individuals choose their *optimal* level of theta and work in urban formal sector if

$$\text{if } C_4 \ln\lambda - C_5\lambda + C_6 < 0 \text{, where} \tag{13}$$

$$C_4 = (\alpha_{UF} - \alpha_{UI}); \quad C_5 = 0.5(\beta_{UF} - \beta_{UI});$$

$$C_6 = \left[(\alpha_{UF} - \delta)\left(\ln\frac{0.5\beta_{UF}}{\alpha_{UF} - \delta} + 1 \right) - (\alpha_{UI} - \delta)\left(\ln\frac{0.5\beta_{UI}}{\alpha_{UI} - \delta} + 1 \right) \right];$$

This expression is complete analog of the previous one and there is nothing new. However, formal human capital requirements are not binding only for those who have low lambdas

$$\lambda < \frac{2(\alpha_{UF} - \delta)}{\beta_{UF} + \beta_{UF}\underline{\theta}} = \breve{\lambda} \tag{14}$$

Otherwise, we cannot apply optimal choice of human capital and have to put $\underline{\theta}$. In this case individuals prefer urban formal sector if

$$-C_7 \ln\lambda + C_8\lambda - C_9 < 0 \text{, where} \tag{15}$$

$$C_7 = (\alpha_{UI} - \delta); \quad C_8 = 0.5(\beta_{UF}\underline{\theta} + \beta_{UI});$$

$$C_9 = \left[(\alpha_{UI} - \delta)\left(\ln\frac{0.5\beta_{UI}}{\alpha_{UI} - \delta} + 1 \right) + (\alpha_{UF} - \delta)\ln(\underline{\theta} + 1) \right];^{4}$$

Here I want to draw your attention to the signs before coefficients in two inequalities. In these expressions coefficients have opposite signs. It was done to get uniform sign of inequalities (less than zero). So to compare urban informal and urban formal sectors we have to apply different inequalities for different levels of lambda (degree of risk aversion). Visual illustration of equations (13) and (15) can be found in Appendix.

Here we should not check whether theta is positive or not because it is not less than $\underline{\theta}$. So the critical value of lambda ($\hat{\lambda}$) after which workers prefer urban informal sector to urban formal is such that $C_7 \ln\hat{\lambda} - C_8\hat{\lambda} + C_9 = 0$ for the *second* time.

We then have

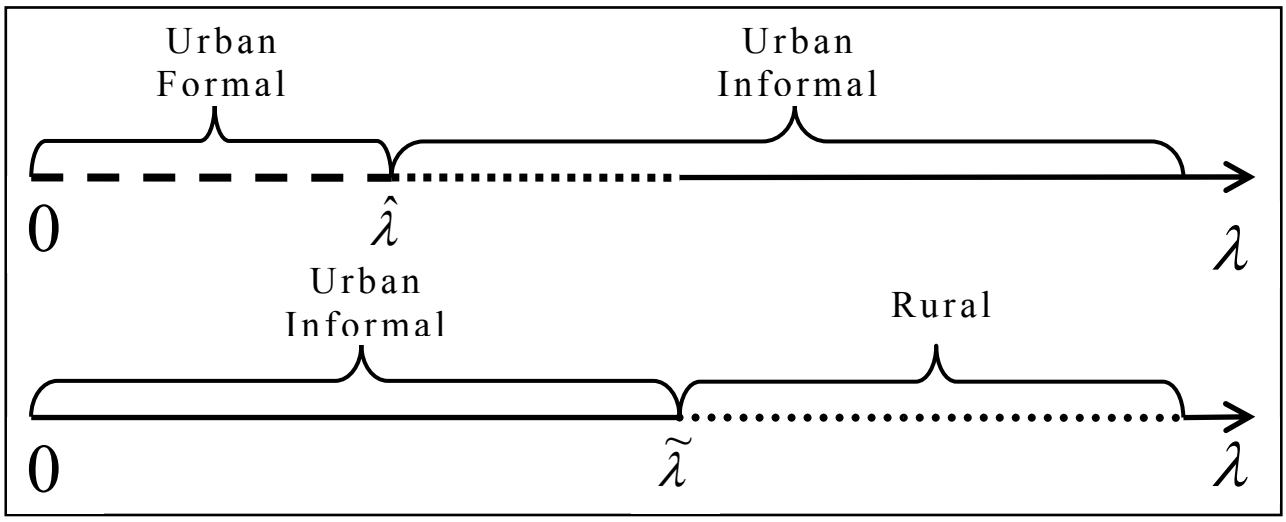
Proposition 1. Suppose that assumptions about functional forms 5-7 hold. If human capital can be only positive, then urban informal sector is more attractive than rural region for small values of lambda, $\lambda < \tilde{\lambda}$, and is less attractive for all lambdas greater than $\tilde{\lambda}$. Urban formal sector is more attractive than urban informal sector for small values of lambda, $\lambda < \hat{\lambda}$, and is less attractive for all lambdas greater than $\hat{\lambda}$.

[4] Derivation can be found in Appendix

Where $\tilde{\lambda}$ is the smallest root of equation $C_1 \ln \lambda_{1,2} - C_2 \lambda_{1,2} + C_3$, and $\hat{\lambda}$ is the greatest root of equation $C_7 \ln \hat{\lambda} - C_8 \hat{\lambda} + C_9$.

Proposition 1 is illustrated in Figure 8.

Figure 8



From Figure 8 we can see that individuals with the lowest degree of risk aversion prefer urban formal sector as it is the most productive, $\alpha_{UF} > \alpha_{UI} > \alpha_R$. Rural region is attractive only for those who avoid risk a lot. And those who are in the middle in terms of risk aversion prefer employment in urban informal sector.

4.2. Simulations.

Although, I have got analytical expressions for the optimal amount of human capital and equations for critical values of lambdas it is impossible to solve them analytically. That is why to get quantitative results I have written a program in GAUSS which for each labor market calculates the optimal values of expected utilities for different lambdas.

Concrete numerical results of my model depend on the values of eight parameters: three alphas, three betas, delta and minimum level of human capital requirements. It means that by taking various combinations of these parameters we can get almost any values of optimal human capital investments and corresponding expected utility functions. However, before we move to the comparative static I want to demonstrate a concrete simulation which is presented in Table 1.

Under well-selected values of parameters which ensures employment in all three sectors we get the following picture: workers with low lambdas (almost risk neutral) prefer employment in urban formal sector, workers with higher values of lambdas prefer urban informal sector and workers with even higher lambdas find it more profitable to work in the rural region.

Although all agents when they choose optimal amount of human capital face identical trade-off between risk and earnings they have different attitude to risk. This heterogeneity in personal risk aversion results in heterogeneity in human capital investments. From Table 1 we see that individuals with greater lambdas are

less likely to undertake risky human capital investments. This negative correlation between risk aversion and education demonstrates the decreasing willingness to bear risk by risk-averse individuals.

Table 1. $\underline{\theta} = 20, \delta = 1, \alpha_R = 3, \alpha_{UI} = 6.5, \alpha_{UF} = 10, \beta_R = 2, \beta_{UI} = 8, \beta_{UF} = 8.$

Lambda	Optimal Theta in the Urban Formal Sector	Optimal Theta in the Urban Informal Sector	Optimal Theta in the Rural Region	Max Utility in the Urban Formal Sector	Max Utility in the Urban Informal Sector	Max Utility in the Rural Region
0.1	21.500	12.750	19.000	**0.857**	0.606	0.336
0.2	20.000	5.875	9.000	**0.898**	0.693	0.429
0.3	20.000	3.583	5.667	0.639	**0.705**	0.466
0.4	0.000	2.438	4.000	0.000	**0.685**	0.477
0.5	0.000	1.750	3.000	0.000	**0.644**	0.471
0.6	0.000	1.292	2.333	0.000	**0.584**	0.454
0.7	0.000	***0.964***	1.857	0.000	**0.508**	0.429
0.8	0.000	***0.719***	1.500	0.000	**0.419**	0.397
0.9	0.000	0.528	***1.222***	0.000	0.322	**0.361**
1.0	0.000	0.375	***1.000***	0.000	0.222	**0.320**
1.1	0.000	0.250	*0.818*	0.000	0.131	**0.278**
1.2	0.000	0.146	0.667	0.000	0.057	**0.234**
1.3	0.000	0.058	0.538	0.000	0.011	**0.189**
1.4	0.000	0.000	0.429	0.000	0.000	**0.147**
1.5	0.000	0.000	0.333	0.000	0.000	**0.107**
1.6	0.000	0.000	0.250	0.000	0.000	**0.071**

From Table 1 we can also see that not only optimal investments in human capital change with lambda but also the preferences about place of work shift from one labor market to another. Risk-neutral individuals care only about mean earnings and do not suffer from any risk. It implies that individuals with very small lambdas always choose the most productive labor market, in my case urban formal, in spite of any risk. It follows that they acquire very high levels of education which are higher than $\underline{\theta}$. In fact theta runs to infinity as lambda approaches to zero.

However, as lambda grows agents in the attempt to decrease uncertainty of future employment acquire less human capital, notwithstanding the fact that it simultaneously decreases mean earnings. Unfortunately employment in urban formal sector requires minimum level of education. It implies that from some moment agents have to bear excessive risk which is greater than the optimal one. For greater lambdas this burden becomes too severe and agents prefer urban informal or rural labor markets which, on the one hand, are less productive but, on the other hand, allow to work with any positive amount of human capital. So agents become better off because the freedom in choosing allows them to decrease risk significantly and this reduction in uncertainty compensates them lower productivity.

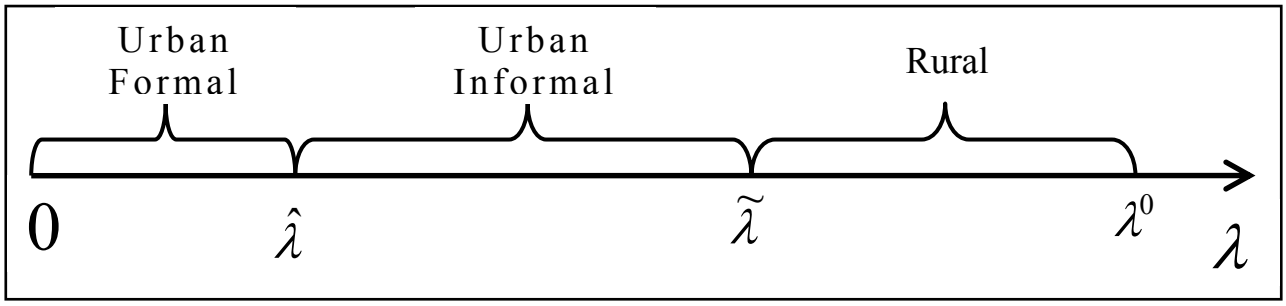
It is clear that for small lambdas urban formal sector is the best option as it is the most productive. However, for more risk-averse individuals urban formal sector is too risky and they choose between urban informal sector and rural region. Agents prefer urban informal sector if its greater productivity compensates its greater risk and makes this labor market more attractive than the one in the rural region. However, it is not always the case, and under certain parameters when the difference in mean earnings is rather small

($\alpha_{UI} - \alpha_R < \Delta$) but the difference in uncertainty is huge ($\beta_{UI} >> \beta_R$) nobody would prefer urban informal sector to rural region after urban formal sector. So the existence of employment in urban informal sector requires "adequate"[5] compensation in terms of greater productivity for greater risk.

4.3. Comparative static.

By now I have demonstrated that the differences in the migration behavior can be described just by the heterogeneity in personal risk aversion but nothing was yet said about the factors which may be responsible for the growth of urban informal sector. To understand the possible reasons of the change in the structure of rural-to-urban migration I want to turn to the discussion of comparative static.

In the most general case there is employment in all three labor markets. For some small values of lambda urban formal sector is the most attractive option, as it is the most productive. The most risk-averse individuals prefer rural region which is the most safe. And those who are in the middle in terms of risk aversion work in the urban informal sector. The width of these intervals depends on the values of eight parameters.



If lambda is greater than λ^0 then the optimal human capital investments are zero and there is no sense to analyze differences between labor markets as the individuals' behavior is identical in all regions.

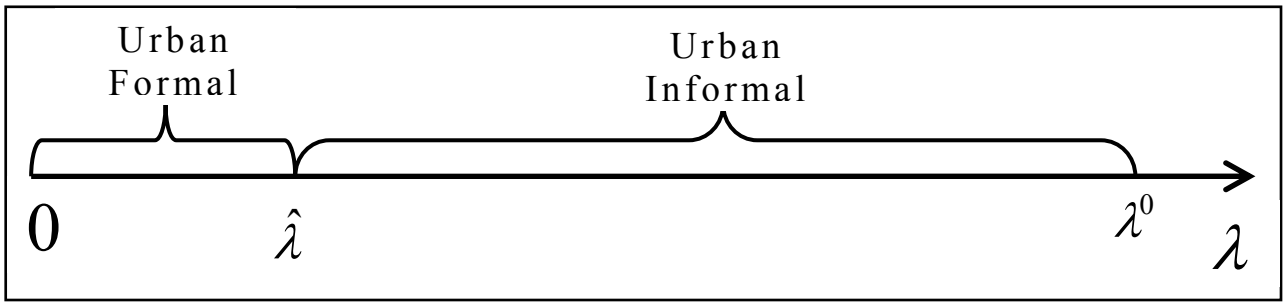
Unfortunately analytically we can derive only expression for λ^0.

$$\lambda^0 = \frac{\alpha_R - \delta}{0.5\beta_R}. \qquad (16)$$

The rest two critical values are determined by simulations. For the initial values of parameters ($\underline{\theta} = 20, \delta = 1, \alpha_R = 3, \alpha_{UI} = 6.5, \alpha_{UF} = 10, \beta_R = 2, \beta_{UI} = \beta_{UF} = 8.$) $\lambda^0 = \frac{3-1}{0.5 \cdot 2} = 2$, $\hat{\lambda} = 0.29$ and $\tilde{\lambda} = 0.837$.

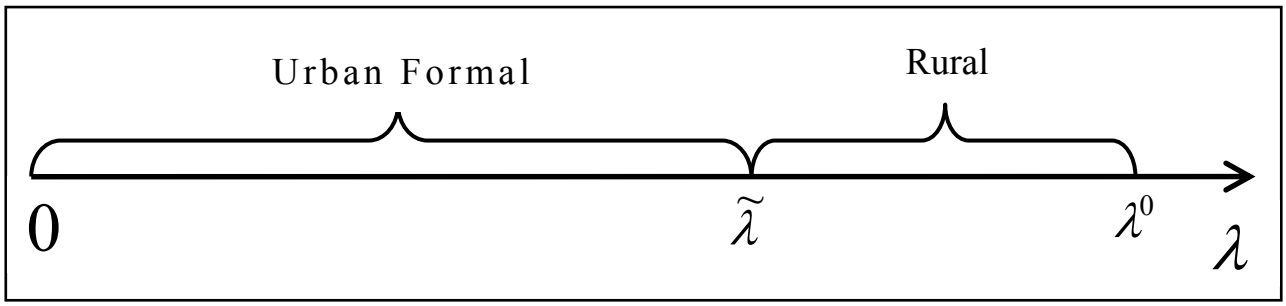
If we increase α_{UI} and β_R or decrease α_R and β_{UI} we make urban informal sector attractive for more people and it shifts $\tilde{\lambda}$ to the right. In fact if we change these parameters far enough we get the situation where there is no employment in the rural region.

[5] The word "adequate" would be clarified later.



In that case $\frac{\alpha_{UI}-\delta}{0.5\beta_{UI}} > \frac{\alpha_R-\delta}{0.5\beta_R}$ and $\tilde{\lambda} = \lambda^0 = \frac{\alpha_{UI}-\delta}{0.5\beta_{UI}}$. So when in the analysis above I mentioned that the existence of employment in all labor markets requires "adequate" ranges of parameters I implied that $\frac{\alpha_{UI}-\delta}{0.5\beta_{UI}} < \frac{\alpha_R-\delta}{0.5\beta_R}$.

If we increase α_{UF} and β_{UI} or decrease α_{UI}, β_{UF} and $\underline{\theta}$ we make urban formal sector attractive for more people and it shifts $\hat{\lambda}$ to the right. As in the previous case large changes of these parameters may lead to employment in just two or even one sector.



On the figure right above $\tilde{\lambda} = \hat{\lambda}$ and there is no employment in urban informal sector. If we continue increase α_{UF} and β_R or decrease α_R, β_{UF} and $\underline{\theta}$ we can end up with just urban formal sector $\left(\tilde{\lambda} = \hat{\lambda} = \lambda^0 = \frac{\alpha_{UF}-\delta}{0.5\beta_{UF}}\right)$.

The influence of the cost function on the critical values of lambda is not so obvious because δ affects human capital acquisition in all labor markets. However, the simulations have shown that if we increase delta we shifts $\hat{\lambda}$ to the left and $\tilde{\lambda}$ to the right. In other words we make urban informal sector attractive for more people. For example, if we increase delta to 1.5 we get that $\hat{\lambda} = 0.279$ and $\tilde{\lambda} = 1.016$, but if we decrease delta to 0.5 we get that $\hat{\lambda} = 0.302$ and $\tilde{\lambda} = 0.696$ (when $\delta = 1$ then $\hat{\lambda} = 0.29$ and $\tilde{\lambda} = 0.837$).

For small changes of parameters the above analysis can be summarized in the following table (initial values of parameters ensure employment in all labor markets: $0 < \hat{\lambda} < \tilde{\lambda} < \lambda^0$).

Table 2

	α_{UF}	β_{UF}	α_{UI}	β_{UI}	α_R	β_R	δ	$\underline{\theta}$
$\hat{\lambda}$	+	-	-	+	0	0	-	-
$\tilde{\lambda}$	0	0	+	-	-	+	+	0
λ^0	0	0	0	0	+	-	-	0

We have already seen that under certain parameters we can get almost any values for critical lambdas, however, it is very important to mention that $\hat{\lambda} \le \tilde{\lambda} \le \lambda^0$. It means that there are no parameters which reverse these inequalities. In other words if the agent with some $\bar{\lambda}$ prefers urban formal sector then all agents with $\lambda < \bar{\lambda}$ also prefer it. If the agent with some $\bar{\lambda}$ prefers rural region then all agents with $\lambda > \bar{\lambda}$ also prefer it. So in fact there are only four possible combinations: *1) UF-UI-R; 2) UF-UI; 3) UF-R; 4) UF*. Labor markets are ordered according to their appearance on the lambda-axis (e.g. *UF-R-UI* is impossible). In all four cases there exists at least some employment in urban formal sector because as lambda approaches to zero the importance of risk vanishes and only greater productivity matters.

So let us summarize what kind of changes can lead to the growth of urban informal sector. There is a number of obvious parameters, such as $\alpha_R, \alpha_{UI}, \alpha_{UF}, \beta_R, \beta_{UI}, \beta_{UF}$, the growth or decline of which make urban informal sector relatively more attractive. However, here I want to discuss in more details the role of cost function of human capital formation. As we have seen the growth of delta makes urban informal sector relatively more attractive. It implies that if, for example, we introduce higher fees for education we can expect a greater flow of *low-educated* people to urban informal sector, as greater delta also decreases the optimal amount of human capital $\left(\frac{\partial \theta^*}{\partial \delta} \le 0\right)$. This can be one of the possible explanations of empirically observed growth of urban informal sector which is caused by the massive flow of low-educated persons. And this prediction rather well corresponds with the reality because professional education becomes more commercial and requires more and more investments (coaches and so on). We can also think about the costs of education not in absolute but in relative terms. With the growth of knowledge, availability of primary education and modern teaching methods people on average become smarter from decade to decade. It means that it is more and more difficult to be in the top quintile of human capital distribution which gets access to the formal urban labor market and more people just do not consider education as a worthy activity and prefer employment in urban informal sector.

4.4. Predictions of the model.

After the discussion of theoretical results of the model I would like to analyze whether its predictions correspond with empirically observed structure of rural-to-urban migration. As I have already mentioned in Section 2 there is some gap between existing theoretical literature and empirical research about migration. Namely, the traditional models of migration which consider that difference in expected earnings is the main

driving force of migration cannot explain the rapid growth of urban informal sector which is caused by the massive flow of unschooled and relatively unskilled persons from rural regions. To see whether this empirically observed behavior corresponds with the predictions of my model I suggest to return to Table 1.

From columns 3 and 4 which represent optimal investments in human capital in urban informal sector and rural region correspondingly, one can see that there are individuals who prefer employment in urban informal sector and acquire less human capital than some individuals who work in the rural region. It happens because these two regions have different risks of future employment. Risk-averse individuals who work in the rural region face lower risk than those who work in urban informal sector for any given level of human capital. It implies that for some range of lambda (more than $\tilde{\lambda}$ but close to it) agents in the rural region acquire more human capital than their colleagues in urban informal sector because the trade-off between risk and profitability for them is less severe. It follows that the introduction of the uncertainty of future unemployment and interpersonal differences in risk aversion into the model provides possible theoretical explanation of the current flow of relatively low-educated individuals to the urban informal sector.

Another "empirical paradox" was revealed by Katz and Stark (1986). In that paper the authors argue that in some cases migrants move to the cities even if urban expected income is not larger than the expected income in the rural area. Even though my model assumes that urban informal sector is more productive than rural region for any given level of human capital it still provides theoretical explanation of this, at first glance, irrational behavior. One can see this from Table 3.

Table 3. Mean Earnings and Variance in Different Sectors

$\underline{\theta} = 20, \delta = 1, \alpha_R = 3, \alpha_{UI} = 6.5, \alpha_{UF} = 10, \beta_R = 2, \beta_{UI} = 8, \beta_{UF} = 8.$

Lambda	Mean Earnings in Informal Sector	Mean Earnings in Rural Region	Variance in Informal Sector	Variance in Rural Region	$\theta_R^*(\lambda) - \theta_{UI}^*(\lambda)$	$\frac{\theta_R^*(\lambda)}{\theta_{UI}^*(\lambda)}$
0.1	17.037	8.987	102.000	38.000	6.25	1.49
0.2	12.531	6.908	47.000	18.000	3.125	1.531
0.3	9.895	5.692	28.664	11.334	2.084	1.581
0.4	8.027	4.828	19.504	8.000	1.562	1.64
0.5	6.575	4.159	14.000	6.000	1.25	1.714
0.6	5.391	3.612	10.336	4.666	1.041	1.805
0.7	4.387	3.149	7.712	3.714	0.893	1.926
0.8	3.521	2.749	5.752	3.000	0.781	2.086
0.9	***2.756***	***2.395***	4.224	2.444	0.694	2.314
1.0	2.070	2.079	3.000	2.000	0.625	2.666
1.1	1.450	1.793	2.000	1.636	0.568	3.272
1.2	0.886	1.533	1.168	1.334	0.521	4.568
1.3	0.366	1.291	0.464	1.076	0.48	9.275

It is true that all agents have their own fixed "degree" of risk aversion, but it does not mean that their optimal values of human capital investment in different labor markets are identical. In fact the difference between optimal amounts of human capital in rural region and urban informal sector is positive and

decreases with lambda. However, their ratio $\left(\frac{\theta_R^*(\lambda)}{\theta_{UI}^*(\lambda)}\right)$ increases with lambda in the exponential manner. As the result mean earning between urban informal sector and rural region converges and from some moment (in current specification from lambda equals to one) they start to diverge but mean earnings in rural region this time are greater. The illustration of this story can be seen in Table 3. However, I want to draw your special attention to the values of mean earnings for lambdas around 0.9. For these values of risk aversion mean earnings in urban informal sector are still greater than in the rural region but individuals already prefer employment in the rural region. So we observe situation when agents move to the region with lower expected income. From the point of view of the expected income hypothesis this situation is impossible as agents are risk-neutral. However, in my model agents are risk-averse and although mean earnings are important they do not entirely determine individual's behavior. If we look on columns 4 and 5 in Table 3 we will see that variance of earnings in urban informal sector is almost two times greater than in rural region. It implies that modest advantage of urban informal sector in terms of mean earnings does not compensate significant disadvantage in terms of risk and risk-averse individuals prefer rural labor market. It follows that the introduction of risk-averse individuals into the model helps to explain why some individuals move to the regions with lower expected earnings.

Finally, I want to analyze how the existence of migration opportunity influences mean earnings in rural region. For that I again suggest to return to Table 1. Let us consider a situation when migration is completely prohibited and all people are in the rural region. From the forth column with optimal values of human capital in rural region we can, once again, notice that individuals with low values of lambda acquire more human capital than those who are more risk averse. Imagine that now we remove all barriers and everybody can freely migrate to any region. It implies that agents who previously acquired the greatest amount of human capital migrate to the city and only those who are very risk-averse and relatively low-educated stay. It follows that the average level of human capital in the rural region after the outflow of most educated workers decreases. If we accept that the presence of more skillful colleagues exerts positive externality on the others through the spill over effect, we can conclude that opportunity of migration is likely to make non-migrants worse-off as it decreases the average "quality" of workers in rural region.

5. Conclusion.

A lot of works about migration are based on the idea of expected income differential between the regions but not many of them study why one person migrates and another one does not, even if they face the same perspectives.

In my work as opposed to existing literature it was shown that even if agents have identical abilities and there are no barriers for migration individuals move to different regions simply because of the interpersonal differences in risk aversion. In other words, we can expect that the most conservative and prudent people prefer employment in the rural region. Active people, who want to try something new and ready to take the risk, migrate to urban region in spite of the higher uncertainty about their future perspectives. Moreover only the most confident in their success people decide to work in urban formal sector because employment there,

in addition to greater risk, requires high irrevocable investments in human capital which frightens off a lot of potential workers.

The introduction of interpersonal differences in risk aversion and the uncertainty of future unemployment into the model also provide possible explanation of the rapid inflow of relatively low-educated individuals to the urban informal sector and help to explain why some individuals move to the regions with lower expected earnings.

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Appendix

A1. Expected utility simplification.

$$E_W\left(1-e^{-\lambda(W-c(\theta))}\right)=1-e^{\lambda c(\theta)}\cdot E_W\left(e^{-\lambda W}\right)=$$

$$=1-\frac{e^{\lambda c(\theta)}}{\sigma_i(\theta)\sqrt{2\pi}}\int_{\infty}^{-\infty}e^{-\lambda W}e^{-\frac{(W-\mu_i(\theta))^2}{2\sigma_i^2(\theta)}}dW=$$

$$=1-\frac{e^{\lambda c(\theta)}}{\sigma_i(\theta)\sqrt{2\pi}}\int_{\infty}^{-\infty}e^{-\frac{W^2-2W\mu_i(\theta)+\mu_i^2(\theta)+2\sigma_i^2(\theta)\lambda W}{2\sigma_i^2(\theta)}}dW=$$

$$=1-\frac{e^{\left(2\lambda c(\theta)\sigma_i^2(\theta)-\mu_i^2(\theta)\right)/2\sigma_i^2(\theta)}}{\sigma_i(\theta)\sqrt{2\pi}}\int_{\infty}^{-\infty}e^{-\frac{W^2-2W\left(\mu_i(\theta)-\sigma_i^2(\theta)\lambda\right)}{2\sigma_i^2(\theta)}}dW=$$

$$=1-\frac{e^{\left(2\lambda c(\theta)\sigma_i^2(\theta)-\mu_i^2(\theta)\right)/2\sigma_i^2(\theta)}}{\sigma_i(\theta)\sqrt{2\pi}}\int_{\infty}^{-\infty}e^{-\frac{\left(W-\left(\mu_i(\theta)-\sigma_i^2(\theta)\lambda\right)\right)^2-\left(\mu_i(\theta)-\sigma_i^2(\theta)\lambda\right)^2}{2\sigma_i^2(\theta)}}dW=$$

$$=1-\frac{e^{\left(2\lambda c(\theta)\sigma_i^2(\theta)-\mu_i^2(\theta)+\left(\mu_i(\theta)-\sigma_i^2(\theta)\lambda\right)^2\right)/2\sigma_i^2(\theta)}}{\sigma_i(\theta)\sqrt{2\pi}}\int_{\infty}^{-\infty}e^{-\frac{\left(W-\left(\mu_i(\theta)-\sigma_i^2(\theta)\lambda\right)\right)^2}{2\sigma_i^2(\theta)}}dW=$$

$$=1-e^{\left(2\lambda c(\theta)\sigma_i^2(\theta)-\mu_i^2(\theta)+\mu_i^2(\theta)-2\mu_i(\theta)\sigma_i^2(\theta)\lambda+\sigma_i^4(\theta)\lambda^2\right)/2\sigma_i^2(\theta)}=$$

$$=1-e^{\lambda\left(c(\theta)-\mu_i(\theta)+0.5\lambda\sigma_i^2(\theta)\right)},$$

A2. Expected utilities comparison.

a) Urban Informal vs. Rural

$$\theta_i^* = \frac{\alpha_i - \delta}{0.5\lambda\beta_i} - 1 \Rightarrow$$

$$U^*(F_i) = 1 - \exp\left(\lambda\left[(\delta - \alpha_i)\ln\left(\theta_i^* + 1\right) + 0.5\lambda\beta_i\theta_i^*\right]\right) =$$

$$= 1 - \exp\left(\lambda\left[(\delta - \alpha_i)\ln\left(\frac{\alpha_i - \delta}{0.5\lambda\beta_i}\right) - 0.5\lambda\beta_i + \alpha_i - \delta\right]\right) =$$

$$= 1 - \exp\left(\lambda\left[(\alpha_i - \delta)\left(\ln\lambda + \ln\frac{0.5\beta_i}{\alpha_i - \delta}\right) - 0.5\lambda\beta_i + (\alpha_i - \delta)\right]\right) =$$

$$= 1 - \exp\left(\lambda\left[(\alpha_i - \delta)\left(\ln\lambda + \ln\frac{0.5\beta_i}{\alpha_i - \delta} + 1\right) - 0.5\lambda\beta_i\right]\right);$$

$\underline{U^*(F_{UI}) > U^*(F_R)}$ *if*

$$(\alpha_{UI} - \delta)\ln\lambda - 0.5\beta_{UI}\lambda + (\alpha_{UI} - \delta)\left(\ln\frac{0.5\beta_{UI}}{\alpha_{UI} - \delta} + 1\right) <$$

$$(\alpha_R - \delta)\ln\lambda - 0.5\beta_R\lambda + (\alpha_R - \delta)\left(\ln\frac{0.5\beta_R}{\alpha_R - \delta} + 1\right) \quad \textit{or if}$$

$$(\alpha_{UI} - \alpha_R)\ln\lambda - \lambda\cdot 0.5(\beta_{UI} - \beta_R) +$$

$$+\left[(\alpha_{UI} - \delta)\left(\ln\frac{0.5\beta_{UI}}{\alpha_{UI} - \delta} + 1\right) - (\alpha_R - \delta)\left(\ln\frac{0.5\beta_R}{\alpha_R - \delta} + 1\right)\right] < 0;$$

b) Urban Informal vs. Urban Formal

$$\lambda > \frac{2(\alpha_{UF} - \delta)}{\beta_{UF} + \beta_{UF}\underline{\theta}} \quad \Rightarrow \quad \theta_{UF} = \underline{\theta};$$

$$\underline{U^*(F_{UF}) > U^*(F_{UI})} \quad \textit{if}$$

$$0.5\lambda\beta_{UF}\underline{\theta} - (\alpha_{UF} - \delta)\ln(\underline{\theta} + 1) <$$
$$(\alpha_{UI} - \delta)\ln\lambda - 0.5\beta_{UI}\lambda + (\alpha_{UI} - \delta)\left(\ln\frac{0.5\beta_{UI}}{\alpha_{UI} - \delta} + 1\right) \quad \textit{or if}$$

$$(\alpha_{UI} - \delta)\ln\lambda - 0.5\cdot(\beta_{UI} + \beta_{UF}\underline{\theta})\lambda +$$
$$+\left[(\alpha_{UI} - \delta)\left(\ln\frac{0.5\beta_{UI}}{\alpha_{UI} - \delta} + 1\right) + (\alpha_{UF} - \delta)\ln(\underline{\theta} + 1)\right] > 0;$$

A3. Figures.

Figure 3. Optimal Utilities of Informal Sector and Rural Region

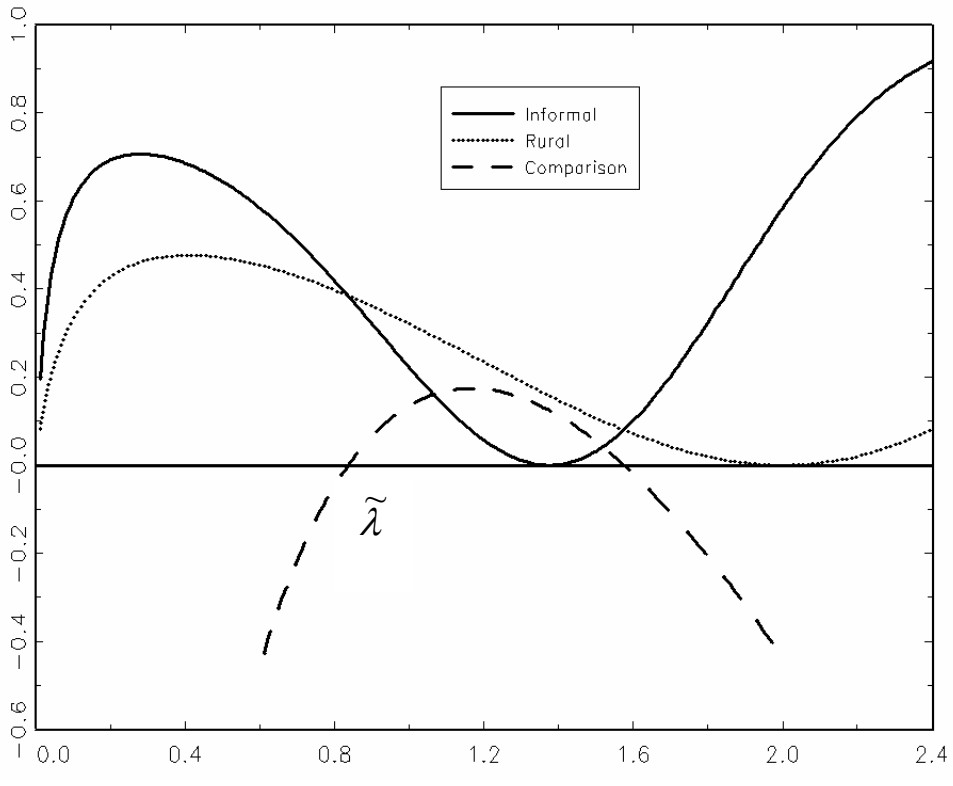

Figure 4. Optimal Human Capital when it can be Negative

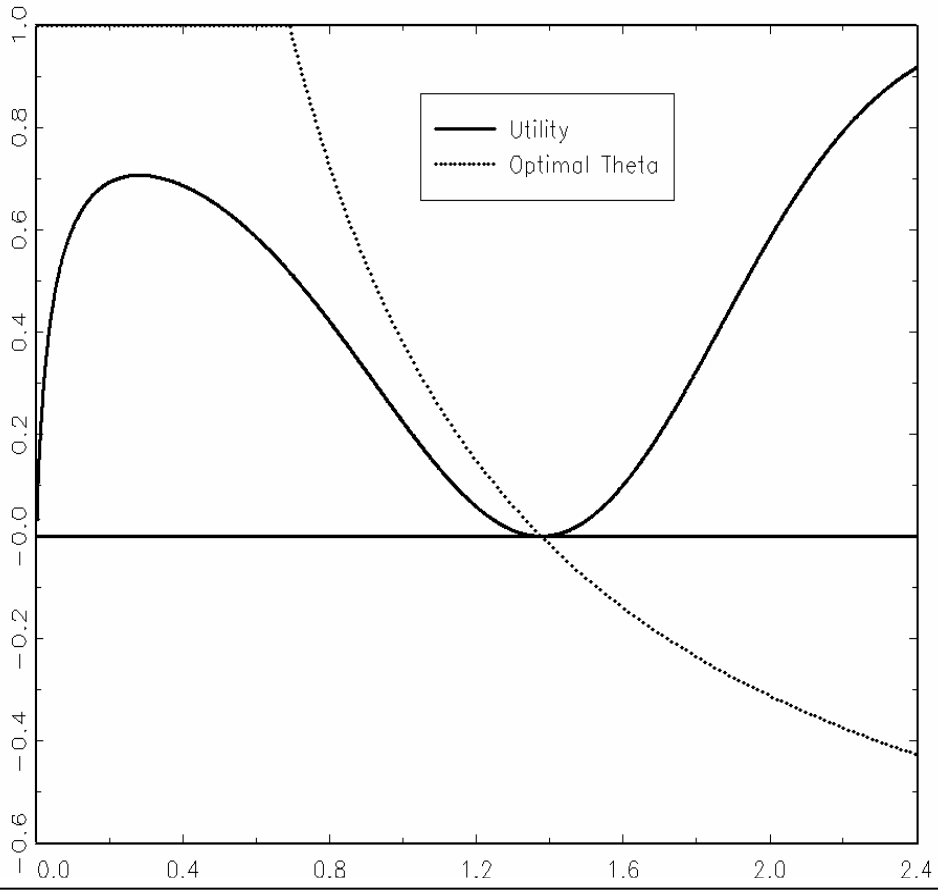

Figure 5. Optimal Utilities and Human Capital when the later have to be positive

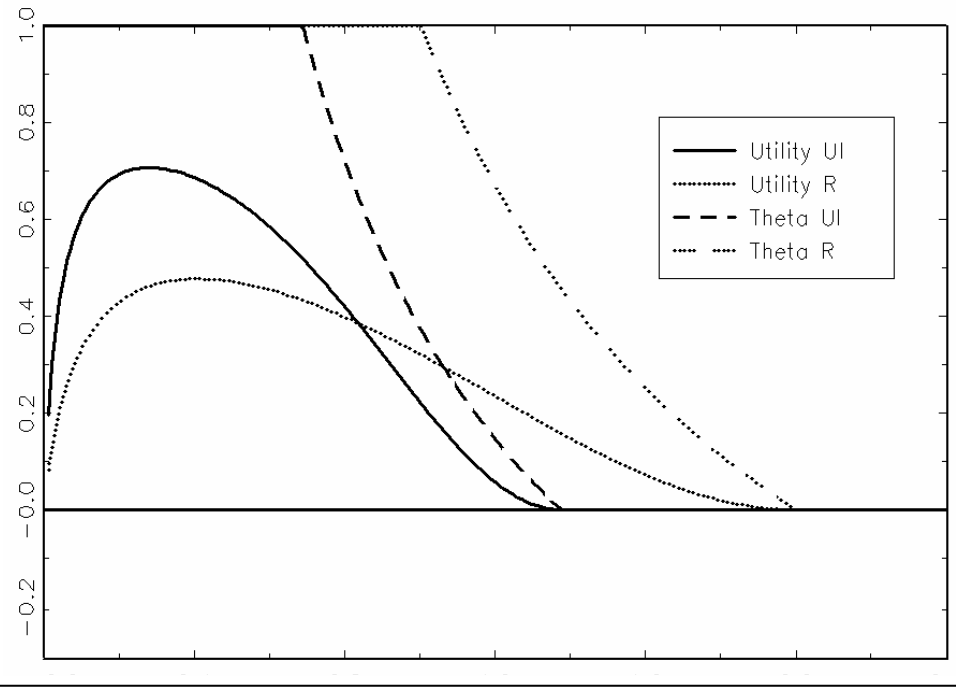

Figure 6. Optimal Utilities for Formal and Informal Sectors

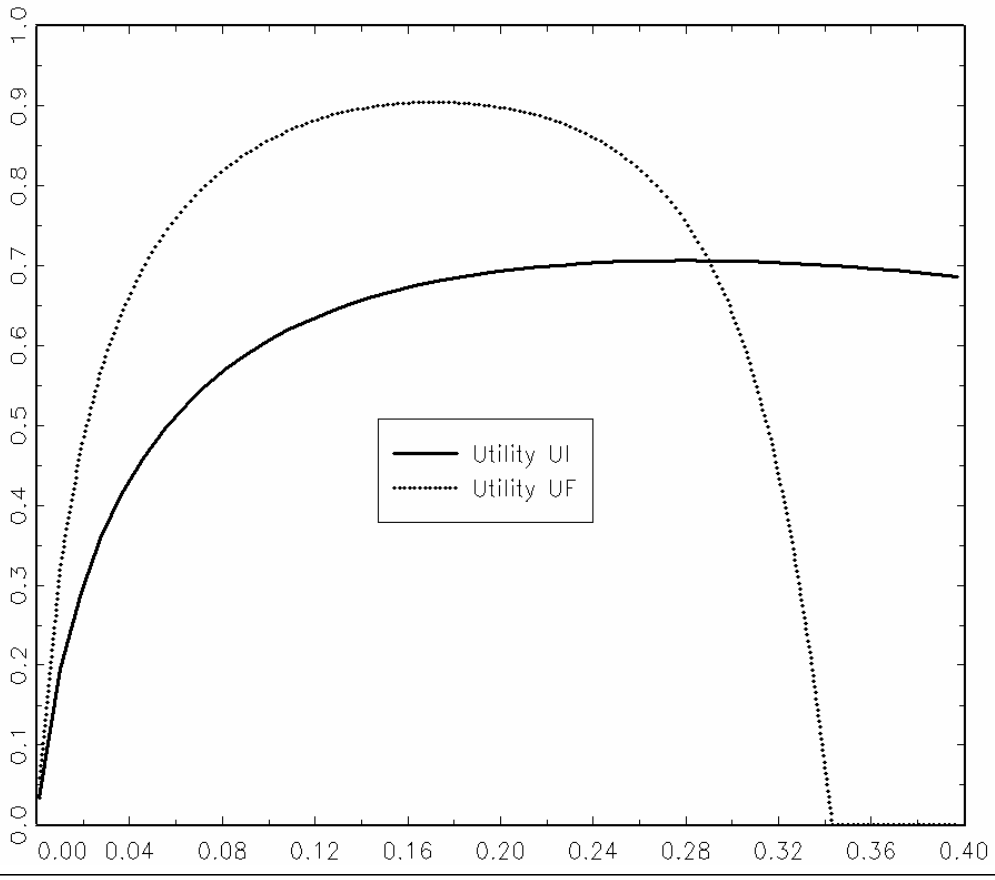

Figure 7. Comparison of Formal and Informal Sectors