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Wage Disparities and Internal Migration Patterns*

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I investigate how the choice of migration pattern is associated with wage disparities. Wage disparities have negative as well as positive effects on human capital formation under parental migration, whereas they have positive effects under family migration. It is possible that parental migration is more likely preferred to family migration with decreases in wage disparities, whereas family migration is more likely preferred to parental migration with increases in wage disparities. My results suggest that not only do wage disparities cause internal migration but also affect the choice of the internal migration pattern and that they may facilitate human capital formation.

JEL Classification: J24, J61, O15, P25, R23
Keywords: wage disparity, migration cost, parental migration, family migration, human capital

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1. INTRODUCTION

In this paper, I deal with wage disparities between rural and urban areas and choice of internal migration pattern. In particular, I attempt to clarify how wage disparities affect the choice of internal migration pattern and human capital formation.

In China, the number of people who migrate internally has increased very rapidly despite the presence of various barriers.[1)] Chan (2008) estimates that rural migrant labourers numbered 79.8 million in 1998, 98.2 million in 2003, 102.6 million in 2004, 108.2 million in 2005 and 114.9 million in 2006. This growth is mainly due to growing income differences between the rural and urban areas (Zhang and Song, 2003) or wage disparities between them (Chan, 2008).[2)] According to the China Development Research Foundation (2013), the urban-rural income ratio has increased from 2.78 in 2000 to 3.23 in 2003 and 3.32 in 2007, although it has dropped consistently from 2010, decreasing to 3.13 in 2011.

Internal migration can be broadly divided into two types, i.e., parental migration and family migration (Shimada, 2014).[3)]

In general, not only school education but also home education is imperative in building human capital (Glomm and Kaganovich, 2003; Casarico and Sommacal, 2012). The quality and quantity of children's education at school and home are different under parental migration and family migration. Accordingly, human capital will be formed differently across these two migration patterns. Clearly, human capital determines workers' earnings, suggesting that migration pattern can be an important factor in determining future income differences.

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1) Obstacles to labour mobility include the household registration (hukou) system, local protectionism in the destination, lack of a well-developed social safety net for rural migrants in the destination and discrimination against migrants (Zhang and Zou, 2012).

2) Reform of the household registration system might have also encouraged internal migration. However, Melander and Pelikanova (2013) and Chan (2010) argue that concrete proposals for such reform are scarce and the core of the dualistic structure supported by the system has not changed much.

3) Another classification of internal migration will be hukou migration and non-hukou migration.

As mentioned earlier, previous studies have revealed that people in rural areas move to urban areas due to the existence of large income differences or wage disparities. In addition, there have been controversies on whether internal migration will help reduce income differences or wage disparities (Keidel, 2009; Lu, 2009).

However, previous studies have not placed sufficient emphasis on the effects of income differences or wage disparities on choice of internal migration pattern. Which pattern people choose given the income difference or the wage disparity has not been fully understood, despite the fact that migration patterns have significant implications for the future course of the economy via education and human capital.

Therefore, I attempt to identify which pattern of migration people in rural areas utilise under different wage disparities when moving to urban areas. In particular, I reveal how migration pattern choice is associated with wage disparities.

I obtain the following results: Wage disparities increase parent's utility under both parental migration and family migration. However, such disparities lower as well as raise human capital under parental migration but raise human capital under family migration.

As for the choice of internal migration pattern, if wage disparities are sufficiently large, the optimal internal migration pattern is determined only by differences in migration cost. Otherwise, the migration pattern is determined by wage disparities as well as migration cost difference. In particular, if wage disparities are neither large nor small and the cost does not differ significantly, then parental migration is more likely to be selected with decreases in the wage disparity, whereas family migration is more likely with increases in the wage disparity.

My results suggest that wage disparities affect the choice of the internal migration pattern and human capital formation in addition to the fact that they cause internal migration. They further suggest that present wage disparities might reduce future wages differences between the rural and urban areas.

The remainder of this paper is organised as follows: section 2 models parental migration and family migration and formulates the maximisation problem for each migration pattern. Section 3 solves the maximisation problem for parental migration and determines how migration duration, human capital and parent's utility are associated with wage disparities. Section 4 solves the maximisation problem for family migration and determines how human capital and parent's utility are associated with wage disparities. Section 5 compares parent's utility between the two migration patterns and determines how wage disparities affect migration pattern choice. Section 5 provides concluding remarks.

2. MODEL

I assume an overlapping-generations economy. The economy is comprised of the rural and urban areas. The rural area is connected to the urban area through labour emigration. The rural and urban areas differ in that wages are higher in the urban area than in the rural area. This stems from an implicit assumption that physical capital is more abundant in the urban area than in the rural area.

In general, wages differ between the rural and urban areas not only because physical capital differs in these areas but also because human capital differs. Accordingly, even if physical capital is abundant in the urban area, wages can be higher in the rural area in case human capital is much higher in the rural area. However, I assume that initially differences in physical capital dominate those in human capital and that wages in the urban area are higher than in the rural area. Wage disparities in this paper refer to differences in wage arising from large differences in physical capital.[4)]

I focus on a representative household in the rural area consisting of a parent and a child. Each agent is assumed to live for two periods, childhood

[4)] This paper focuses on the worker's decision. The production side of the economy is not considered explicitly.

and parenthood. Households in the rural area are homogenous.[5] As a child, he goes to school and receives school education. He also receives parental care, i.e., home education while his parent resides with him. Unlike previous studies, such as Vidal (1998) and Docquier *et al*. (2008), I explicitly assume that human capital is formed not only by school education but also home education.[6]

Utilising human capital accumulated in childhood, an agent provides labour in parenthood. The parent may migrate to the urban area alone or with a child and stay there for part or all of the period to work. As he is altruistic towards the child, he derives utility not only from consumption in the present period but also from human capital in the next period. Although the parent shares consumption with the child, this is not because he is altruistic towards the child but to satisfy the child's survival needs.

2.1. Parental Migration

The parent resides in the urban area to work for either part or all of the parenthood period.[7] The migration duration in period t is $0 \le l_t^* \le 1$. The parent manipulates the migration duration to maximise his utility.

The parent earns wages in period t by w_t in the rural area and w_t^* in the urban area. Wages are the product of human capital measured in terms of efficiency units of labour and wages per efficiency. Wages per efficiency in the rural area are denoted as w, and those in the urban area are w^*. Due to the difference in the availability of physical capital, a disparity in wages per efficiency exists by $\alpha^* > 0$ between the rural and urban areas and w^* is equal

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[5] The referee suggested making households in the rural area heterogeneous so that a selection device works. In such a case, some people migrate and other people do not migrate due to, for example, the differences in innate ability.

[6] According to Jingzhong and Lu (2011), lack of parental disciplining due to parental absence has negative effects on children's school performance. Accordingly, not only does home education play a separate role but it also complements school education.

[7] If the parent has migrated to the urban area, it appears that the child is left alone. However, in the actual economy grandparents or other relatives usually take care of such a child. Not to complicate the analysis, I did not include the household members like grandparents who do not work.

to $(1+\alpha^*)w$. Larger values of α^* mean larger disparities in wages per efficiency.[8)]

Under these assumptions, parent's income in period t is $(1-l_t^*)w_t + l_t^* w_t^* = (1+\alpha^* l_t^*)wh_t$, where h_t is human capital in period t measured in efficiency units of labour under parental migration.

The parent spends $1-\theta_t$, where $0<\theta_t<1$, of his income on consumption and θ_t on child's school education in period t. The parent manipulates this ratio to maximise his utility.

Measuring the amount of school education by money expended on it and denoting the amount of home education by $2-l_t^*$, where 2 (two) is assumed to be the maximum amount of home education, human capital available in period $t+1$, h_{t+1} is built according to the following human capital formation equation under parental migration:

$$h_{t+1} = \{\theta_t(1+\alpha^* l_t^*)wh_t\}^s (2-l_t^*)^p,\ s, p>0,\ s+p<1,$$

where s, which equals $\partial \ln h_{t+1} / \partial \ln\{\theta_t(1+\alpha^* l_t^*)wh_t\}$ (the elasticity of human capital with respect to school education), measures the effectiveness of school education and p measures the effectiveness of home education (the elasticity of human capital with respect to home education).[9)] The human capital formation function exhibits decreasing returns to scale.[10)]

[8)] In this paper, wage disparities are given exogenously. However, they are endogenous in general. See the last section of the paper for the endogenous nature of wage disparities.

[9)] $2-i$ is an approximation of the amount of home education. When the child is with the parent, the child can receive the maximum amount of parent's disciplining. Of course, this does not mean that the parent disciplines the child all the time when they live together. If the maximum amount of home education were 1 (one), which is equal to the length of the period, then given the amount of home education, the contribution of home education to human capital formation (and also to parent's utility defined by equation 1), $\ln(1-l_t^*)^p$, would be smaller with higher effectiveness of home education, i.e., larger values of p.

[10)] In this paper, I assume that money expanded by the parent on child's school education surely raises child's human capital. However, spending money on school education does not guarantee the opportunity to receive education and enhance human capital when the competition for entry into education prevails. I disregard such a possibility assumed by Kim and Choi (2010). This will take on a reality in the case where provision of higher education is severely limited.

The human capital formation equation under parental migration is endowed with the property wherein human capital in period t affects human capital in period t+1 through wages in period t Intergenerational externality is operative in the same manner as in Galor and Stark (1994).

The parent derives utility in period t from consumption in period t and the amount of human capital available to his child in period $t+1$. Since the parent is altruistic towards the child, higher child wages, which do not matter to the parent directly, nevertheless also raise the parent's utility.

Thus, parent's utility before deducting parental migration costs, u_t^{PM}, is

$$u_t^{PM} = \ln(1-\theta_t)(1+\alpha^* l_t^*)wh_t + \varepsilon \ln \rho\{\theta_t(1+\alpha^* l_t^*)wh_t\}^s(2-l_t^*)^p, \qquad (1)$$

where $0<\varepsilon<1$ is the parent's degree of altruism towards the child and $0<\rho<1$ measures the subjective time rate of the discount (I assume that the present value of parent's utility derived from child's human capital in the next period is smaller than its next period's value by the fixed mount). I represent the costs for parental migration, $\bar{c}^{PM}>0$, by negative utility since they include non-pecuniary elements such as those arising from family disintegration as well as pecuniary ones. Costs are given exogenously.[11)]

The parent's maximisation problem under parental migration is summarised as follows:

$$\max_{\theta_t, l_t^*} u_t^{PM} \text{ subject to } 0 \le l_t^* \le 1,\ 0<\theta_t<1.$$

2.2. Family Migration

Under family migration, the parent and the child move to the urban area together, and the migration duration is always equal to 1 (one) since he does not have to return to his home to provide home education. However, they

11) It is often assumed that migration costs are determined by the level of human capital. However, they depend on other factors as well. We cannot specify the factors that determine the costs definitely.

return to the rural area at the end of the period and go again to the urban area at the beginning of the next period since they are not permanent residents of the urban area and the rural area is his home town.

Accordingly, the parent provides labour in the urban area for all of the period, giving rise to an income of $(1+\alpha^*)w\tilde{h}_t (= w^*\tilde{h}_t)$, where $\tilde{h}_t$ is human capital in period t measured in efficiency units of labour under family migration. The child receives home education fully, i.e., by 2 (two). Denoting the ratio of parent's income spent on consumption by $1-\tilde{\theta}_t$, where $0<\tilde{\theta}_t<1$, and the ratio spent on child's school education by $\tilde{\theta}_t$, then human capital in period $t+1$, denoted by $\tilde{h}_{t+1}$, is built according to

$$\tilde{h}_{t+1} = \{\tilde{\theta}_t(1+\alpha^*)w\tilde{h}_t\}^s 2^p.$$

The effectiveness of both school education and home education are assumed to be the same as those under parental migration. This is, of course, to simplify the analysis. In general we cannot determine whether or not the effectiveness of school education is identical under parental migration and family migration, as this is the product of the school education's quality and the school's accessibility. The quality of school education is higher in the urban area.[12] However, migrant children's accessibility to local schools in the urban area is strictly limited if the migrant is non-hukou. On the other hand, the quality of school education is lower but accessibility is high in the rural area.

I represent parent's utility derived from consumption and human capital in a similar manner as in parental migration.

$$\ln(1-\tilde{\theta}_t)(1+\alpha^*)w\tilde{h}_t + \varepsilon \ln \rho\{\tilde{\theta}_t(1+\alpha^*)w\tilde{h}_t\}^s 2^p.$$

To compare parent's utility between the two migration patterns, I deduct the difference in costs between two migration patterns from above utility.

[12] Wang and Li (2009) find a large discrepancy between urban and rural education quality and infer the causes.

Parent's utility under family migration excluding the cost difference is represented as follows:

$$u_t^{FM} = \ln(1-\tilde{\theta}_t)(1+\alpha^*)w\tilde{h}_t + \varepsilon \ln \rho\{\tilde{\theta}_t(1+\alpha^*)w\tilde{h}_t\}^s 2^p - \bar{c}, \qquad (2)$$

where $\bar{c}$ is the difference of migration costs, i.e., $\bar{c}^{FM} - \bar{c}^{PM}$, where $\bar{u}^{FM} > 0$ is the costs for family migration. As with the costs for parental migration, the costs for family migration are given exogenously and include both pecuniary and non-pecuniary elements. We cannot determine a priori which migration pattern incurs larger costs. In other words, $\bar{c}$ can be negative, zero, or positive.

The parent's maximisation problem under family migration is summarised as follows:

$$\max_{\tilde{\theta}_t} \; u_t^{FM} \text{ subject to } 0 < \tilde{\theta}_t < 1.$$

3. PARENTAL MIGRATION UNDER DIFFRENET WAGE DISPARIES

In this section, I solve the maximisation problem for parental migration and determine migration duration, human capital, and parent's utility.

3.1. Migration Duration under Parental Migration

Differentiating equation (1) with respect to θ_t, the optimal ratio of parent's income spent on the child's school education, θ_t^*, is determined as follows:

$$\theta_t^* = \varepsilon s/(1+\varepsilon s). \qquad (3)$$

Equation (3) suggests that as the parent cares more about the child or as

school education is more effective, the parent spends a larger fraction of income on the child's school education ($\partial\theta_t^*/\partial\varepsilon,\ \partial\theta_t^*/\partial s>0$). The optimal ratio does not depend on the level of human capital and remains unchanged over time.

I differentiate equation (1) with respect to l_t^* and find

$$2\alpha^*(1+\varepsilon s)-\varepsilon p-\alpha^*(1+\varepsilon s+\varepsilon p)l_t^* \gtreqless 0.$$

When $l_t^*=0$, the left-hand side of the above equation is positive if $\alpha^*>\varepsilon p/2(1+\varepsilon s)$ and negative if $\alpha^*<\varepsilon p/2(1+\varepsilon s)$. On the other hand, when $l_t^*=1$, the left-hand side is positive if $\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)$ and negative $\alpha^*<\varepsilon p/(1+\varepsilon s-\varepsilon p)$. Clearly, $\varepsilon p/2(1+\varepsilon s)<\varepsilon p/(1+\varepsilon s-\varepsilon p)$. Moreover, the left-hand side decreases with l_t^*. These facts suggest that

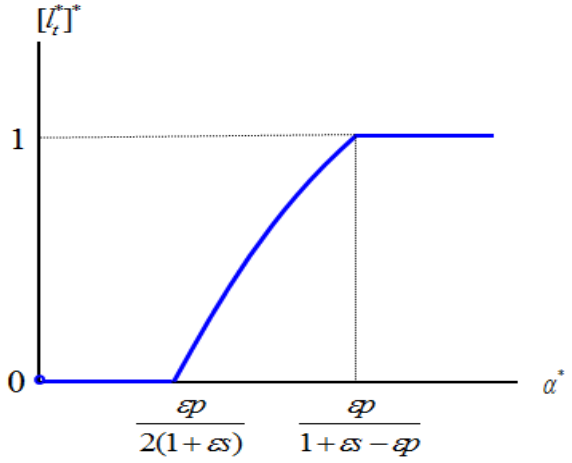
$\partial u_t^{PM}/\partial l_t^*<0$ if $\alpha^*<\varepsilon p/2(1+\varepsilon s)$, hereafter called *Case A*,
$\partial u_t^{PM}/\partial l_t^* \gtreqless 0$ if $\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)$, hereafter called *Case B*,
$\partial u_t^{PM}/\partial l_t^*>0$ if $\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)$, hereafter called *Case C*.

Therefore, the optimal migration duration, $[l_t^*]^*$, differs across different wage disparities.

$$\begin{aligned}
[l_t^*]^* &= 0\left(\equiv [l_t^*]^*\big|_{\alpha^*<\varepsilon p/2(1+\varepsilon s)}\right),\\
[l_t^*]^* &= \frac{2\alpha^*(1+\varepsilon s)-\varepsilon p}{\alpha^*(1+\varepsilon s+\varepsilon p)}\left(\equiv [l_t^*]^*\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}\right), \qquad (4)\\
[l_t^*]^* &= 1\left(\equiv [l_t^*]^*\big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)}\right).
\end{aligned}$$

In *Case A*, that is, when the wage disparity is small, the parent does not migrate but rather stays in the rural area. The interior solution obtained in *Case B* $[l_t^*]^*\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ increases with α^*, starting from $[l_t^*]^*\big|_{\alpha^*=\varepsilon p/2(1+\varepsilon s)}$

Figure 1 Migration Duration under Parental Migration



=0 and ending with $[l_t^*]^*\big|_{\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)}=1$. In *Case C*, that is, when the wage disparity is large, the parent stays in the urban area all the period. Accordingly, equations (4) show that the migration duration increases with the wage disparity (see figure 1).

From this we have the following proposition:

Proposition 1 *Under parental migration, the parent does not migrate if the wage disparity is small. Otherwise, he migrates and its duration monotonically increases with the wage disparity.*

By staying longer in the urban area, the parent earns a larger income, enabling more money to be spent on consumption and the child's school education. However, home education decreases. If the wage disparity is small, the latter negative effects on home education and thereby on parent's utility are larger than the former positive effects, dissuading the parent from migration. As the wage disparity increases further, the positive effects come to outweigh the negative effects, thus motivating the parent to stay longer in the urban area.

3.2. Human Capital under Parental Migration

In *Case A*, that is, when the wage disparity is small, human capital in period $t+1$, $h_{t+1}\big|_{\alpha^*<\varepsilon p/2(1+\varepsilon s)}$, for given h_t, is

$$h_{t+1}\big|_{\alpha^*<\varepsilon p/2(1+\varepsilon s)}=[\{\varepsilon s/(1+\varepsilon s)\}wh_t]^s 2^p, \tag{5}$$

and its steady state, $h^*\big|_{\alpha^*<\varepsilon p/2(1+\varepsilon s)}$, is

$$h^*\big|_{\alpha^*<\varepsilon p/2(1+\varepsilon s)}=[\{\varepsilon s/(1+\varepsilon s)\}w]^{s/(1-s)}2^{p/(1-s)}. \tag{6}$$

The steady state is stable.

In *Case B*, that is, when the wage disparity is neither small nor large, human capital in period $t+1$, $h_{t+1}\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$, for given h_t, is

$$\begin{aligned}&h_{t+1}\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}\\&=[\{\varepsilon s/(1+\varepsilon s)\}\{(1+2\alpha^*)(1+\varepsilon s)/(1+\varepsilon s+\varepsilon p)\}wh_t]^s\\&\quad\times\{(1+2\alpha^*)\varepsilon p/(1+\varepsilon s+\varepsilon p)\alpha^*\}^p,\end{aligned} \tag{7}$$

and its steady state, $h^*\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$, is

$$\begin{aligned}&h^*\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}\\&=[\{\varepsilon s/(1+\varepsilon s)\}\{(1+2\alpha^*)(1+\varepsilon s)/(1+\varepsilon s+\varepsilon p)\}w]^{s/(1-s)}\\&\quad\times\{(1+2\alpha^*)\varepsilon p/(1+\varepsilon s+\varepsilon p)\alpha^*\}^{p/(1-s)}.\end{aligned} \tag{8}$$

The steady state is stable.

In *Case C*, that is, when the wage disparity is large, human capital in period

$t+1$, $h_{t+1}\big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)}$, for given h_t, is

$$h_{t+1}\big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)}=[\{\varepsilon s/(1+\varepsilon s)\}(1+\alpha^*)wh_t]^s, \tag{9}$$

and its steady state, $h^*\big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)}$, is

$$h^*\big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)}=[\{\varepsilon s/(1+\varepsilon s)\}(1+\alpha^*)w]^{s/(1-s)}. \tag{10}$$

The steady state is stable.

If the wage disparity is smallest in *Case B*, i.e., $\alpha^*=\varepsilon p/2(1+\varepsilon s)$, then from equations (7) and (8), human capital in the short run $h_{t+1}\big|_{\alpha^*=\varepsilon p/2(1+\varepsilon s)}$ is $[\{\varepsilon s/(1+\varepsilon s)\}wh_t]^s 2^p$ and human capital in steady state $h^*\big|_{\alpha^*=\varepsilon p/2(1+\varepsilon s)}$ is $[\{\varepsilon s/(1+\varepsilon s)\}w]^{s/(1-s)}2^{p/(1-s)}$. These are the same values as those obtained when α^* approaches to $\varepsilon p/2(1+\varepsilon s)$ in equations (5) and (6). Similarly, if the wage disparity is largest in *Case B*, i.e., $\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)$, then from equations (7) and (8), human capital in the short run $h_{t+1}\big|_{\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ is $[\{\varepsilon s/(1+\varepsilon s)\}\{(1+\varepsilon)/(1+\varepsilon s+\varepsilon p)\}wh_t]^s$ and human capital in steady state $h^*\big|_{\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ is $[\{\varepsilon s/(1+\varepsilon s)\}\{(1+\varepsilon)/(1+\varepsilon s+\varepsilon p)\}w]^{s/(1-s)}$. These are the same values as those obtained when α^* approaches to $\varepsilon p/(1+\varepsilon s-\varepsilon p)$ in equations (9) and (10). Moreover, $h_{t+1}\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ for the given h_t and $h^*\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ decrease with α^*.[13)]

Therefore, human capital in both the short run (h_{t+1} for the given h_t) and the steady state ($h_{t+1}=h_t\equiv h^*$) remain unchanged or decrease with the wage disparity ($dh_{t+1}/d\alpha^*,\ dh^*/d\alpha^*\le 0$) until $\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)$.

[13)] Signs of $dh_{t+1}/d\alpha^*$ and $dh^*/d\alpha^*$ in *Case B* are determined by the sign of $-(p/2s-\alpha^*)$ and by the fact that $p/2s>\varepsilon/(1+\varepsilon s-\varepsilon p)$. In addition, in *Case B*, $\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)$. Accordingly, $p/2s-\alpha^*>p/2s-\varepsilon p/(1+\varepsilon s-\varepsilon p)>0$. This suggests that $dh_{t+1}/d\alpha^*$ and $dh^*/d\alpha^*$ are negative.

Figure 2a Human Capital in the Short Run under Parental Migration

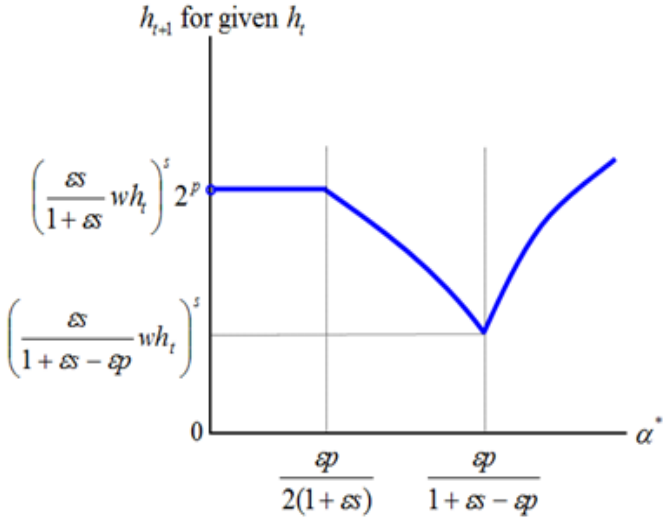
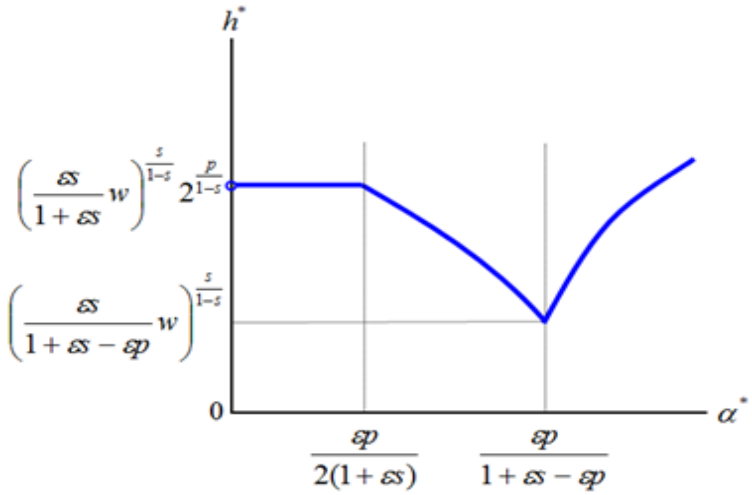


Figure 2b Human Capital in Steady State under Parental Migration



However after α^* has exceeded $\varepsilon p/(1+\varepsilon s-\varepsilon p)$, human capital in the short run and in steady state increases with the wage disparity, as clear from equations (9) and (10) (see figures 2a and 2b).

I summarise these results by the following proposition:

Proposition 2 *Under parental migration, initially, human capital monotonically decreases with the wage disparity. After the parent has decided to stay in the urban area all the period, human capital increases with the wage disparity.*

As the wage disparity increases, the migration duration increases. As the parent's absence is longer, the negative effects on human capital formation via the smaller amount of home education outweigh the positive effects via the larger amount of school education. Accordingly, the wage disparity hinders human capital formation. However, after the parent has decided to stay in the urban area all the period, even without home education, larger income due to larger wage disparities enhances school education. Accordingly, the wage disparity raises human capital.

3.3. Parent's Utility under Parental Migration

In *Case A*, the parent's utility in period t, $u_t^{PM}\big|_{\alpha^* < \varepsilon p/2(1+\varepsilon s)}$, for the given h_t, is

$$\begin{aligned} u_t^{PM}\big|_{\alpha^* < \varepsilon p/2(1+\varepsilon s)} &= \ln\{1/(1+\varepsilon s)\} w h_t + \varepsilon \ln \rho [\{\varepsilon s/(1+\varepsilon s)\} w h_t]^s + \varepsilon p \ln 2 \\ &= v(h_t) + \varepsilon p \ln 2, \end{aligned} \tag{11}$$

where $v(h_t) \equiv \ln\{1/(1+\varepsilon s)\} w h_t + \varepsilon \ln \rho [\{\varepsilon s/(1+\varepsilon s)\} w h_t]^s)$. As clear from equation (11), parent's utility is unaffected by wage disparities.

In *Case B*, the parent's utility in period t, $u_t^{PM}\big|_{\varepsilon p/2(1+\varepsilon s) \le \alpha^* \le \varepsilon p/(1+\varepsilon s-\varepsilon p)}$, for the given h_t, is

$$
\begin{aligned}
& u_t^{PM}\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)} \\
&= v(h_t)+(1+\varepsilon s)\ln\{(1+2\alpha^*)(1+\varepsilon s)/(1+\varepsilon s+\varepsilon p)\} \\
&\quad +\varepsilon p\ln\{(1+2\alpha^*)\varepsilon p/(1+\varepsilon s+\varepsilon p)\alpha^*\}.
\end{aligned} \tag{12}
$$

In *Case C*, parent's utility in period t, $u_t^{PM}\Big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)}$, for the given h_t, is

$$
u_t^{PM}\Big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)} = v(h_t)+(1+\varepsilon s)\ln(1+\alpha^*). \tag{13}
$$

In equation (12), $u_t^{PM}\Big|_{\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)} = v(h_t)+(1+\varepsilon s)\ln\{(1+\varepsilon s)/(1+\varepsilon s-\varepsilon p)\}$, and in equation (13), $\lim_{\alpha^*\to\varepsilon p/(1+\varepsilon s-\varepsilon p)} u_t^{PM}\Big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)} = v(h_t)+(1+\varepsilon s)\ln\{(1+\varepsilon s)/(1+\varepsilon s-\varepsilon p)\}$.

Parent's utility increases with wage disparities in both *Case B* and *Case C* ($du_t^{PM}\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}/d\alpha^*>0$, $du_t^{PM}\Big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)}/d\alpha^*>0$).[14]

This provides us with the following proposition:

Proposition 3 *Under parental migration, parent's utility increases with the wage disparity if the parent decides to migrate*.

As proposition 1 states, wage disparities make the parent stay longer in the urban area. By earning a larger income, the parent spends more money on consumption and child's education. These positive effects dominate the negative effects arising from the smaller amount of home education that were alluded by proposition 2. As a result, the parent's utility rises.

To summarise the results in this section, it was found that under parental migration, a wage disparity makes the parent stay longer in the urban area

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[14] $du_t^{PM}\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}/d\alpha^* = \{1/(1+2\alpha^*)\alpha^*\}\{2(1+\varepsilon s)\alpha^*-\varepsilon p\}$. $du_t^{PM}\Big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)}/d\alpha^* = (1+\varepsilon s)/(1+\alpha^*)$.

and raises his utility. However, human capital decreases as well as increases as the wage disparity widens.

4. FAMILY MIGRATION UNDER DIFFERENT WAGE DISPARITIES

In this section, I solve the maximisation problem for family migration and determine human capital and parent's utility.

4.1. Human Capital under Family Migration

I differentiate equation (2) with respect to $\tilde{\theta}_t$ to find

$$\tilde{\theta}_t^* = \varepsilon s/(1+\varepsilon s). \tag{14}$$

The optimal ratio of parent's income spent on the child's school education is the same as under parental migration (see equation 3).

Substituting equation (14) into the human capital formation equation under family migration, human capital in period $t+1$, $\tilde{h}_{t+1}$, for the given $\tilde{h}_t$, is

$$\tilde{h}_{t+1} = [\{\varepsilon s/(1+\varepsilon s)\}(1+\alpha^*)w\tilde{h}_t]^s 2^p, \tag{15}$$

and its steady state, $\tilde{h}^*$, is

$$\tilde{h}^* = [\{\varepsilon s/(1+\varepsilon s)\}(1+\alpha^*)w]^{s/(1-s)} 2^{p/(1-s)}. \tag{16}$$

Equations (15) and (16) suggest that human capital in the short run ($\tilde{h}_{t+1}$ for the given $\tilde{h}_t$) and in steady state ($\tilde{h}_{t+1} = \tilde{h}_t \equiv \tilde{h}^*$) increase with the wage disparity ($\partial\tilde{h}_{t+1}/\partial\alpha^*$, $\partial\tilde{h}^*/\partial\alpha^* > 0$) (see figures 3a and 3b).

Figure 3a Human Capital in the Short Run under Family Migration

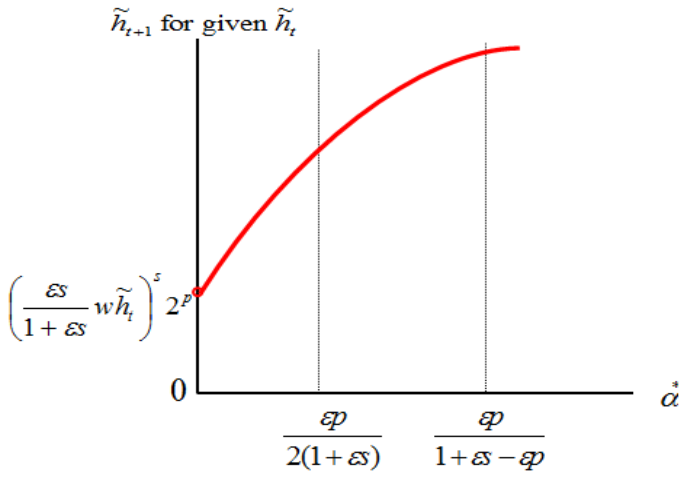
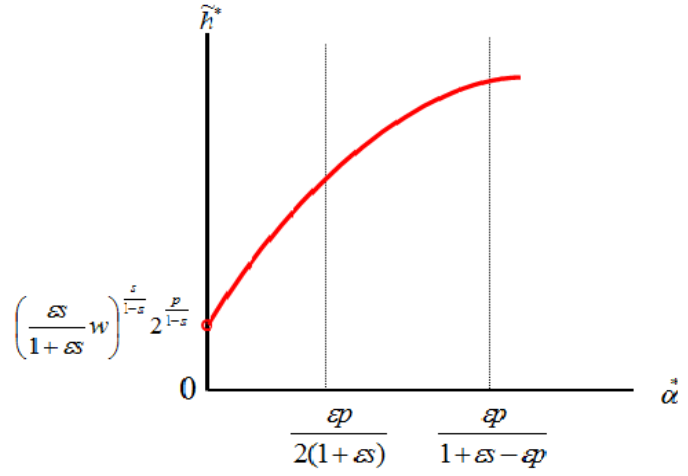


Figure 3b Human Capital in Steady State under Family Migration



I summarise this property by the following proposition:

Proposition 4 *Under family migration, human capital monotonically increases with the wage disparity*.

The larger wage disparity enables the parent to earn larger income, and the larger amount of money can be spent on child's school education. Unlike under parental migration, the amount of home education remains unchanged under family migration. As a result, the wage disparity has only positive effects on human capital formation.

4.2. Parent's Utility under Family Migration

By substituting equation (14) into equation (2), we have

$$u_t^{FM} = v(h_t) + (1+\varepsilon s)\ln(1+\alpha^*) + \varepsilon p \ln 2 - \bar{c}. \tag{17}$$

Equation (17) suggests that parent's utility increases with the wage disparity.

I summarise this property as follows:

Proposition 5 *Under family migration, the parent's utility monotonically increases with the wage disparity*.

Under family migration, both consumption and human capital are larger with larger wage disparities. Accordingly, parent's utility is also larger.

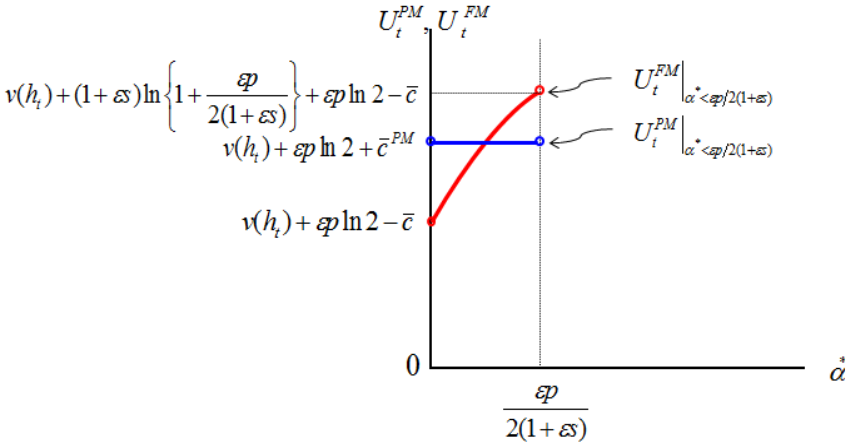
To summarise the results in this section, it was found that under family migration, a wage disparity increases both human capital and parent's utility.

5. CHOICE OF THE INTERNAL MIGRATION ON PATTERN UNDER DIFFERNET WAGE DISPARITIES

I am now in a position to examine how the choice of internal migration pattern is associated with wage disparities.

When the wage disparity is small, i.e., $\alpha^* < \varepsilon p/2(1+\varepsilon s)$ as in *Case A*, the

Figure 4a Parent's Utility when $\alpha^* < \varepsilon p/2(1+\varepsilon s)$ and $(1+\varepsilon s)\ln[1+\{\varepsilon p/2(1+\varepsilon s)\}]-\bar{c}^{FM} > 0$



difference of parent's utility is, from equations (17) and (11)

$$u_t^{FM}\big|_{\alpha^*<\varepsilon p/2(1+\varepsilon s)} - u_t^{PM}\big|_{\alpha^*<\varepsilon p/2(1+\varepsilon s)} = (1+\varepsilon s)\ln(1+\alpha^*) - \bar{c}^{FM}. \quad (18)^{15)}$$

According to equation (18), if the wage disparity is sufficiently small, i.e., α^* is sufficiently near to 0 (zero), parental migration provides higher utility. Accordingly, the parent decides not to migrate in such a case.

If $(1+\varepsilon s)\ln[1+\{\varepsilon p/2(1+\varepsilon s)\}]-\bar{c}^{FM} > 0$, the difference in parent's utility is positive for a value of α^* sufficiently near to $\varepsilon p/2(1+\varepsilon s)$. In this case, there is a level of wage disparity at which two migration patterns produce the same parent's utility. If wage disparities are higher than that level, the parent chooses family migration. On the other hand, if wage disparities are lower than that level, he chooses parental migration although in this case he decides not to migrate (see figure 4a).

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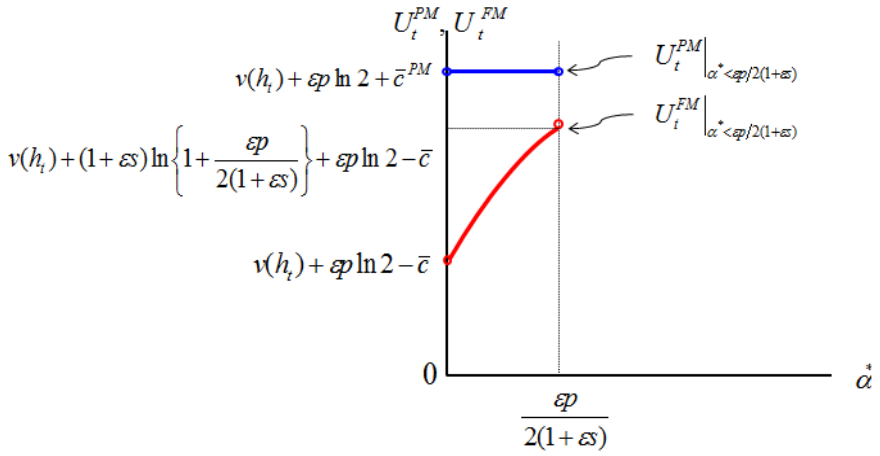
15) It should be noted that in *Case A*, the parent does not migrate so that no migration costs are incurred. However, parent's utility under family migration (equation 2) is defined as to include parental migration costs. Accordingly, for the comparison with family migration to make sense, I added the costs for parental migration to parent's utility when calculating the difference.

Figure 4b Parent's Utility when $\alpha^* < \varepsilon p/2(1+\varepsilon s)$ and $(1+\varepsilon s)\ln[1+\{\varepsilon p/2(1+\varepsilon s)\}]-\bar{c}^{FM} < 0$.



On the other hand, if $(1+\varepsilon s)\ln[1+\{\varepsilon p/2(1+\varepsilon s)\}]-\bar{c}^{FM} < 0$, then the parent always chooses parental migration and stays in the rural area (see figure 4b).

These results can be summed up by the following proposition:

Proposition 6 *When the wage disparity is small, the optimal internal migration pattern is determined by both migration costs and wage disparities. In particular, if family migration costs are sufficiently small, then for smaller wage disparities, parental migration is more likely preferred whereas for larger wage disparities, family migration is more likely preferred. Otherwise, the parent always chooses parental migration and stays in the rural area*.

I move on to *Case B*, where the wage disparity is neither small nor large, i.e., $\varepsilon p/2(1+\varepsilon s) \le \alpha^* \le \varepsilon p/(1+\varepsilon s-\varepsilon p)$.

When α^* is smallest, i.e., $\alpha^* = \varepsilon p/2(1+\varepsilon s)$, $u_t^{FM} = v(h_t)+(1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\}+\varepsilon p\ln 2-\bar{c}$ and from $(1+2\alpha^*)(1+\varepsilon s)/(1+\varepsilon s+\varepsilon p)=1$ and $(1+2\alpha^*)\varepsilon p/(1+\varepsilon s+\varepsilon p)\alpha^* = 2$, $u_t^{PM} = v(h_t)+\varepsilon p\ln 2$.

$$u_t^{FM}\Big|_{\alpha^*=\varepsilon p/2(1+\varepsilon s)} - u_t^{PM}\Big|_{\alpha^*=\varepsilon p/2(1+\varepsilon s)} = (1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\} - \bar{c}. \quad (19)$$

When α^* is largest, i.e., $\alpha^* = \varepsilon p/(1+\varepsilon s-\varepsilon p)$, from $1+\alpha^* = (1+\varepsilon s)/(1+\varepsilon s-\varepsilon p)$, $(1+2\alpha^*)(1+\varepsilon s)/(1+\varepsilon s+\varepsilon p) = (1+\varepsilon s)/(1+\varepsilon s-\varepsilon p)$, and $(1+2\alpha^*)\varepsilon p/(1+\varepsilon s+\varepsilon p)\alpha^* = 1$, $u_t^{FM} = v(h_t) + (1+\varepsilon s)\ln\{(1+\varepsilon s)/(1+\varepsilon s - -\varepsilon p)\} + \varepsilon p\ln 2 - \bar{c}$ and $u_t^{PM} = v(h_t) + (1+\varepsilon s)\ln\{(1+\varepsilon s)/(1+\varepsilon s-\varepsilon p)\}$.

$$u_t^{FM}\Big|_{\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)} - u_t^{PM}\Big|_{\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)} = \varepsilon p\ln 2 - \bar{c}. \quad (20)$$

If the cost difference is larger than $\varepsilon p\ln 2$, then from equation (19) $u_t^{FM}\Big|_{\alpha^*=\varepsilon p/2(1+\varepsilon s)} - u_t^{PM}\Big|_{\alpha^*=\varepsilon p/2(1+\varepsilon s)} < (1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\} - \varepsilon p\ln 2.$

Since the right-hand side of the above equation is negative, parental migration produces higher parent's utility at $\alpha^* = \varepsilon p/2(1+\varepsilon s)$. From equation (20), parental migration produces higher parent's utility at $\alpha^* = \varepsilon p/(1+\varepsilon s-\varepsilon p)$ as well. Moreover, with increases in the wage disparity, not only does the parent's utility increase under both migration patterns but parent's utility also increases more under family migration than under parental migration, i.e., $\partial u_t^{FM}/\partial\alpha^*\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)} > \partial u_t^{PM}/\partial\alpha^*\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)} > 0$. These facts suggest that the curves for $u_t^{FM}\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ and $u_t^{PM}\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ do not intersect and that the curve for $u_t^{PM}\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ lies above the curve for $u_t^{FM}\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$. Therefore, parental migration always provides higher utility for the parent if $\bar{c} > \varepsilon p\ln 2$, i.e., $u_t^{FM}\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)} < u_t^{PM}\Big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ if $\bar{c} > \varepsilon p\ln 2$. This is illustrated by figure 5a.

If the cost difference is smaller than $(1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\}$, then from equation (19), family migration produces higher parent's utility at $\alpha^* = \varepsilon p/2(1+\varepsilon s)$. From equation (20), family migration produces higher parent's utility at $\alpha^* = \varepsilon p/(1+\varepsilon s-\varepsilon p)$ as well. These facts suggest that the

Figure 5a **Parent's Utility when $\varepsilon p/2(1+\varepsilon s) \le \alpha^* \le \varepsilon p/(1+\varepsilon s-\varepsilon p)$ and $\bar{c} > \varepsilon p \ln 2$**

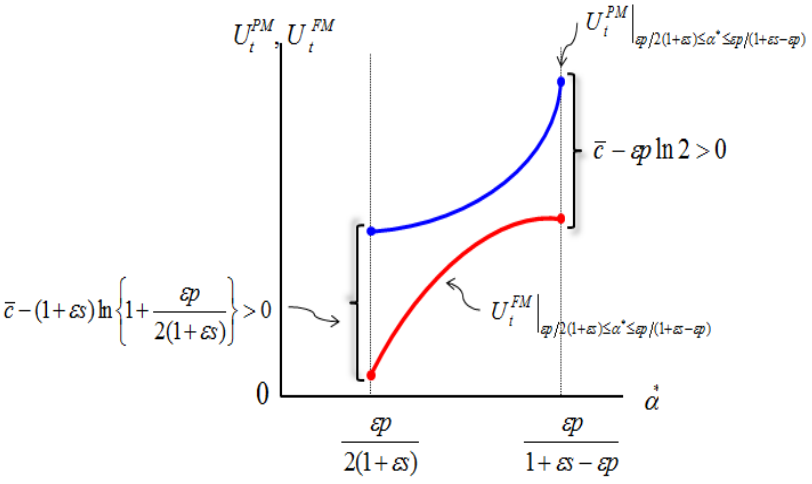
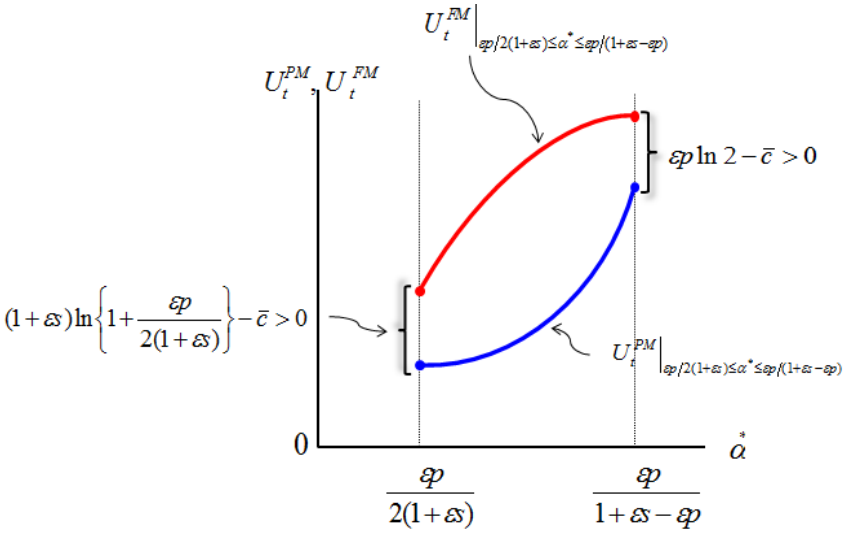


Figure 5b **Parent's Utility when $\varepsilon p/2(1+\varepsilon s) \le \alpha^* \le \varepsilon p/(1+\varepsilon s-\varepsilon p)$ and $\bar{c} < (1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\}$**



curve for $u_t^{FM}\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ lies above the curve for $u_t^{PM}\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$. Therefore, family migration always provides higher utility for the parent if $\bar{c}<(1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\}$, i.e., $u_t^{FM}\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}>u_t^{PM}\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ if $\bar{c}<(1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\}$. This is illustrated by figure 5b.

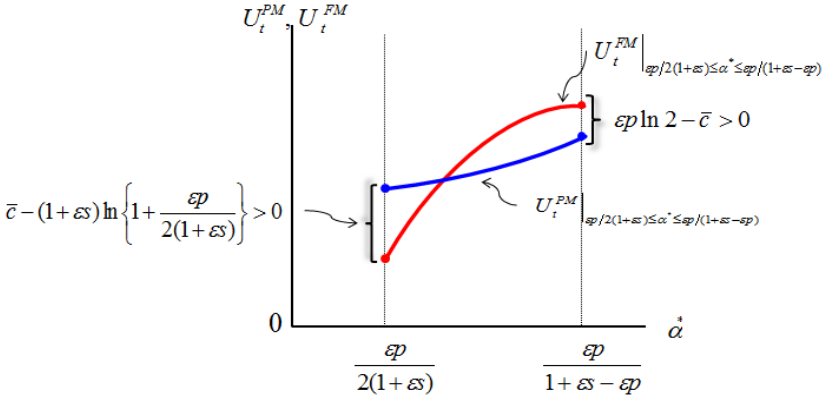
So far in *Case B*, I have found parental migration is chosen when the cost difference is sufficiently large but family migration is chosen when the cost difference is sufficiently small. Accordingly, in such cases, the choice of the migration pattern is determined by the cost difference.

However, when the cost difference is not significant, i.e., $(1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\}\le\bar{c}\le\varepsilon p\ln 2$, parental migration and family migration can provide the same utility. In particular, the parent derives the same utility at $\alpha^*=\varepsilon p/2(1+\varepsilon s)$ if $\bar{c}=(1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\}$ (see equation 19) and at $\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)$ if $\bar{c}=\varepsilon p\ln 2$ (see equation 20). At these wage disparities, the parent is indifferent between the two migration patterns.

In addition, the parent derives the same utility at a certain wage disparity between $\varepsilon p/2(1+\varepsilon s)$ and $\varepsilon p/(1+\varepsilon s-\varepsilon p)$ if $(1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s)\}<\bar{c}<\varepsilon p\ln 2$. In this case, we have $u_t^{FM}\big|_{\alpha^*=\varepsilon p/2(1+\varepsilon s)}<u_t^{PM}\big|_{\alpha^*=\varepsilon p/2(1+\varepsilon s)}$ and $u_t^{FM}\big|_{\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)}>u_t^{PM}\big|_{\alpha^*=\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ from equations (19) and (20), and the curve for $u_t^{PM}\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ and the curve $u_t^{FM}\big|_{\varepsilon p/2(1+\varepsilon s)\le\alpha^*\le\varepsilon p/(1+\varepsilon s-\varepsilon p)}$ intersect only once. Accordingly, parental migration produces higher utility before the wage disparity reaches a certain level at which $u_t^{PM}=u_t^{FM}$, and beyond that level of wage disparity, family migration produces higher utility. This is illustrated by figure 5c.

Therefore, in the case where the cost difference is not significant, the wage disparity determines the migration pattern choice. For smaller wage disparities, parental migration is more likely chosen, whereas for the larger wage disparity, family migration is more likely chosen.

Figure 5c Parent's Utility when $\varepsilon p/2(1+\varepsilon s) \le \alpha^* \le \varepsilon p/(1+\varepsilon s-\varepsilon p)$ $(1+\varepsilon s)\ln\{1+\varepsilon p/2(1+\varepsilon s) < \bar{c} < \varepsilon p \ln 2$



Summarising the results yields the following proposition:

Proposition 7 *If the wage disparity is neither small nor large and the cost does not differ significantly between parental migration and family migration, then the optimal internal migration pattern is determined by the wage disparity. In particular, for smaller wage disparities, parental migration is more likely preferred whereas for larger wage disparities, family migration is more likely preferred.*

According to proposition 7, when the migration cost difference is not significant, human capital likely increases with the wage disparity since family migration is more likely preferred with the wage disparity and, as derived in proposition 4, family migration raises human capital with the wage disparity.

We infer from this that present wage disparity might lower future wage differences due to sufficient human capital formation by people in the rural area.

Now I look at *Case C*, the case wherein the wage disparity is large, i.e., $\alpha^* > \varepsilon p/(1+\varepsilon s-\varepsilon p)$. The difference in the parent's utility is, from equations (17) and (13)

$$u_t^{FM}\Big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)} - u_t^{PM}\Big|_{\alpha^*>\varepsilon p/(1+\varepsilon s-\varepsilon p)} = \varepsilon p \ln 2 - \bar{c}. \qquad (21)$$

Equation (21) suggests that the outcome of which internal migration pattern produces higher parent's utility does not depend on the wage disparity. Instead, the choice of migration pattern is determined solely by the cost difference.

Figure 6a Parent's Utility $\alpha^* > \varepsilon p/(1+\varepsilon s-\varepsilon p)$ and $\varepsilon p \ln 2 > \bar{c}$

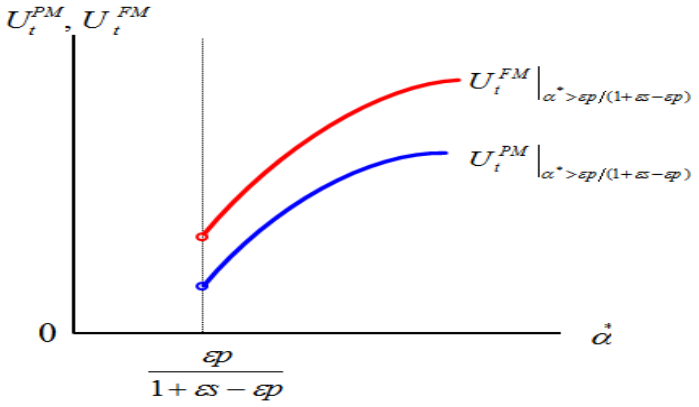
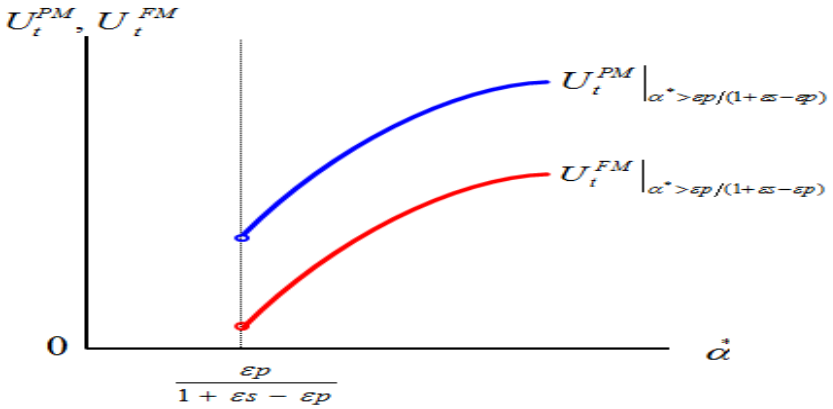


Figure 6b Parent's Utility $\alpha^* > \varepsilon p/(1+\varepsilon s-\varepsilon p)$ and $\bar{c} > \varepsilon p \ln 2$



In particular, if the cost does not differ or is larger for parental migration than for family migration, i.e., $\bar{c}^{PM} \geq \bar{c}^{FM}$, or if the cost for family migration is larger than the cost for parental migration but by less than $\varepsilon p \ln 2$, i.e., $\varepsilon p \ln 2 > \bar{c}^{FM} - \bar{c}^{PM} > 0$, then family migration is seen as the optimal pattern (see figure 6a).

On the other hand, if family migration incurs larger costs than parental migration by more than $ep \ln 2$, then parental migration is chosen (see figure 6b).

I summarise this result by the following proposition:

Proposition 8 *If the wage disparity is large, then the internal migration pattern is determined solely by the migration cost. Internal migration with smaller costs is likely preferred as an optimal pattern*.

From propositions 2, 4, and 8, we find that regardless of the migration cost difference, the wage disparity always raises human capital when the wage disparity is sufficiently large.

To summarise the results in this section, I found that in general the wage disparity as well as the cost difference determines the choice of migration pattern.

6. CONCLUDING REMARKS

In developing countries, large income differences or wage disparities between the rural and urban areas tend to motivate people in the rural areas to attempt to move to and work in urban areas. In China, even with various migration prevention measures in place, a growing number of people from rural areas have attempted to migrate to urban areas. In undertaking the migration process, people choose different internal migration patterns that bring about different levels of human capital.

I attempted to determine whether and how people's choice of internal

migration pattern is associated with wage disparities, and showed that the wage disparity affects the choice of migration pattern when the migration cost does not differ significantly across two patterns and the wage disparity is not so large.

I infer from these results that the present wage disparities might affect the future wage differences between the rural and urban areas. In particular, when the choice of the migration pattern is made solely by the wage disparity, people become likely to choose the family migration with increases in the wage disparity, and human capital increases with the wage disparity under this migration pattern. Since human capital is passed on to the future generations, people in the rural area will have larger human capital in future. Accordingly, even if the physical capital is not so abundant initially in the rural area as in the urban area, wages in the rural area will not be so significantly lower than those in the urban area due to human capital formation, and future wage differences might be smaller.

In the analysis, I gave the wage disparity, i.e., the disparity in wages per efficiency exogenously. Given such a wage disparity, people choose a migration pattern. A certain migration pattern produces a certain level of human capital. However, since human capital affects wages, the wage disparity in the general sense will change and this might affect the choice of the migration pattern. If this is the case, the choice of migration pattern might change over time. My analysis will be more general if the wage disparity is determined endogenously.

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