Human capital, migration and remittance in developing countries: a general equilibrium approach

Abstract:

The paper develops a three-sector model with Harris–Todaro type unemployment to examine theconsequences of an increase of migrants' human capital on remittance within a small open dual economy. By using indirect utility functions, the paper endogenizes the remittance. The theoretical analysis shows that an increase of human capital level of rural migrants increases their income, urban consumption and remittance, while its effect on the proportion of remittance in migrants' income depends on the impact of remittance on agricultural production.

Keywords: Human capital; Labor migration; Remittance

JEL: R23; I24; J6

1. Introduction

Remittance refers to the money and goods that are transmitted to households by migrant workers working outside of their origin communities, either in urban areas or abroad. Particular attention has been paid to international remittance, namely external remittance. The World Bank (2015) estimates that $440 billion in remittance goes to developing countries in 2015. External remittance attracts the headlines and draws research and policy attention, while internal remittance has largely escaped notice. For developing countries, especially in large countries like China, India and Brazil, they are experiencing internal labor migration currently; consequently, remittance flows into migrants' origin communities. In China, scholars estimate internal remittance reached nearly one trillion RMB (around160 billion US dollar) in 2013 on the basis of national statistics (Li and Wang,2015). Since this does not include transfers in cash and remittance sent through informal channels, the actual amount of remittance is substantially

higher. Remittance is perceived as an important external channel in alleviating poverty and improving livelihoods of rural regions in developing countries (Du,Yang et al.,2005; Hein de Haas,2006; Nwaogu and Ryan, 2015). In addition, remittance is a safety way for relatively poor areas, as it is freer from political barriers and controls than either product or other capital flows in developing countries (Jones, 1998). Therefore, the change of remittance affects the development of rural regions.

The significance of remittance flows has meant that its determinants have become an important field of research, among which scholars deal with microeconomic factors that determine the magnitude of remittances. Micro-level studies of remittance conduct from two aspects: the sending and the receiving. Much of empirical studies has used data to examine factors that affect remittance, such explanatory variables include: migrants' income, migrants' human capital level, migrants' urban household structure, their rural family statue, future intention, etc(Banerjee, 1984; Hoddinott,1994; Rapoport and Docquier, 2006; Markova etal, 2015;Catia, and Umblijs,2016). Although empirical studies about the determinants of remittance is immense from different countries perspective, theoretical analysis on the determinants of remittance is few. Funkhouser(1995) proposes a simply behavioral model of remittances based on altruism and concludes that remittance is determined by human capital, household income, further intention, other migrants' remittance, and discount factor. However, most theoretical papers on remittance are treated the remittance as an exogenous variable and examine the effect of remittance on economy(McCormick and Wahba, 2000; Ball et al. 2013; Li and Zhou, 2013; Li and Zhou, 2015; Li and Wang, 2015;Wu and Li,2020;Fu and Li,2023).

Meanwhile, with economic development, human capital level of migrants also improved significantly. And an increasing number of rural labors could access to higher education or training and their human capital levels are increasing as a wholey. Take China for example, it is experiencing a structural change in migrant labor market: old generation of migrant worker is stepping down from the urban labor market, while new generation of migrant worker is taking its place and becoming the main force of China's migrant worker. New generation of migrant workers are officially defined as those who were born from 1980 onwards, which obtain a higher education and tend to have a higher average consumption rate and live a similar life as urban residents in urban area .The proportion of migrants with primary and secondary levels of education declines, while the proportion of migrants with high and college and above levels of

education raises (see Table 1). Those facts indicate that the human capital of migrants increases as a whole.

Table 1 Educational level of rural-urban migrants in China

Year	Uneducated	Elementary School	Middle School	High School	College and Above
2015	1.10%	14%	59.70%	16.90%	8.30%
2016	1%	13.20%	59.40%	17%	9.40%
2017	1%	13%	58.60%	17.10%	10.30%
2018	1.20%	15.50%	55.80%	16.60%	10.90%
2019	1%	15.30%	56%	16.60%	11.10%
2020	1%	14.70%	55.40%	16.70%	12.20%
2021	0.80%	13.70%	56.00%	17.00%	12.60%
2022	0.70%	13.40%	55.20%	17.00%	13.70%

Data source:Migrant workers monitoring survey reports, published by NBS.

The human capital level of migrants affects their income, which directly affects the capacity to remit. Since the migrants exhibit some new characteristics in human capital, a practical question is: how those changes affect remittance? Generally speaking, migrant labors with higher human capital level earn more income and remit more money back consequently; on the other hand, since they are more likely to spend their income in the urban region, the capacity of remittance declines, which has a negative influence on the amount of remittance.

As to the effect of migrants' human capital level on remittance, most studies are concentrated on the empirical research, using macro data (Siegfried,2006;Faini,2007; Niimi *et al.*,2010;Gibson and McKenzie, 2011)or micro data(Naufal, 2007; Duval and Wolff, 2010;Dustmann and Mestres ,2010; Albert *et al*,2011;Docquier *et al*,2012). Unfortunately, the findings obtained from empirical studies so far are inconclusive. Faini (2007), Niimi et al.(2010),Dustmann and Mestres(2010)obtain a negative impact of migrants' education on remittances, while Naufal(2007)obtains a positive impact for Nicaragua and Schioupu and Siegfried(2006) concludes migrants' skills tend to raise remittance by using a bilateral remittance database. A recent study by Docquier et al.(2012) investigate the effect of migrants' human capital level on remittance both theoretically and empirically, using original bilateral remittance data. The model predicts that the effect is ambiguous and depends on the immigration policy conducted at destination.

As mentioned above, the paper makes two comments on existing research. First, theoretical research has been sparse compared with empirical research in this area. Most of the existing studies provide, if any a simple theoretical model to investigate the effect of migrants' human capital levelon remittance, as a basis for empirical analysis rather than establish a model to consider the whole economy. However, the amount of remittance is determined under the whole economy activity, including the amount of labor migration, migrants' consumption and utility, the rural household, etc. Second, theoretical research sheds little light on the effect of migrants' human capital level on remittance within one economy.Most of the studies about the remittance consider the international migrants' remittance, and internal remittance has not been paid attention. Therefore, the effect of human capital level on remittance within one economy is not clear.

Harris and Todaro (1970) established a sample labor migration model with urbanunemployment in the long equilibrium for developing countries. This model has been widely used as a basic analytical framework for studying rural-urban migration in developing countries, especially in theoretical literature.The paper develops a three-sector model with Harris–Todaro type unemployment to examine the consequences of an increase of migrants' human capital on the remittance within a small open dual economy, considering migrants consumption and utility in urban region. The theoretical analysis shows that an increase of human capital level of rural migrants increases their income, urban consumption and remittance, while its effect on the proportion of remittance in migrants' income depends on the impact of remittance on agricultural production.

The paper is organized as follows. Section 2 establishes a general equilibrium within one economy. Section 3 conducts the theoretical analysisof the established model; and in section 4, the main conclusions are summarized and their implications for policy making arediscussed

2. Theoretical model

The article uses the three-sectorHarris–Todaromodel; namely, a small open developing economy with three sectors: urban manufacturing sector (sector 1), urban service sector(sector 2) and rural agricultural sector (sector 3). Manufacturing sector and agricultural sectorproduce tradable goods, while service sectorproduces non-tradable goods. Consider the real economy of developing

countries, service sector refers to low-skilled service sector. Activities in the service sectorfacilitate residents' daily life, including food service, clean service, recreation, etc. Products of service sector cannot transport and the consumption confined to the local residents. Since such services are rare in the rural areas, the service sector provides domestic services to urban residents only. Such division basically matches the current situation in developing economy and separate out the service sector on the other hand.

It is assumed that the three sectors all rely on labor as factor for production in short term. Wage of the urban manufacturing sector is inelastic, but wages of the agricultural and service sectors are elastic. Note that the service production process requires special skills and the elastic wage of that sector is higher than that in the agricultural sector. Due to the downward rigid wage rate of the manufacturing sector, there exists unemployment in the urban region. Denote L_1^0, L_2^0 and L_{UU}^0 as labor employed in manufacturing, service sector and unemployment in the initial stage, respectively. L_U and L_R refer to urban and rural labor endowment.

With the accumulation of capital, the manufacturing sector in developing countries has experienced the industrial upgrading and transformation (Liu and Li, 2015). Human resources are replacing natural resources as an important indicator of a country's wealth. Developing relevant skills for industrial upgrading and economic transformation is a key challenge facing current many developing countries (Asian Development Bank, 2014). Since the rural education resource falls behind the urban in developing countries, the human capital level of urban labors is higher than that of rural labors. The human capital level or the skill is playing an increasing role in deciding whether migrants could meet the demand of manufacturing sector. Though the human capital level of migrants isrising as a whole, there still exists disparity between urban residents. In addition, the economic situation and technical requirements have changed dramatically in recent years. Hence, technical and vocational education and training is requirement for meeting economic objectives. Therefore, during the process of employment in the urban sectors, assume that the urban labors could be employed in the manufacturing and service sector directly, while rural labors only enter the manufacturing sector. Vocational training is an essential prerequisite for employment in the manufacturing sector. There are two main channels for manufacturing sector to absorb new labor: rural transferred migrants and the unemployment labor in the initial stage, and new employed labor will not crowd out previous

employed labor in the manufacturing sector. In terms of transferred labors, they are in unemployment if they could not enter the manufacturing sector.

With the labor migration, the production functions for each sector are:

$$X_1 = F^1(L_1)$$

$$X_2 = F^2(L_2)$$

$$X_3 = k(\beta)F^3(L_3)$$

where$F^i(i = 1, 2, 3)$ means the production function of the three sectors, all are strictly quasi-concave, linearly homogeneous function. L_1, L_2, L_3 refer to the labor employed of the three sectors. β is the remittance sent by transferred labors. Assume that remittance has a positive effect on agricultural production, use $k$to denote the impact. And $k(\beta)$ has the property that:$k(0) = 1$, $k'(\beta) > 0$, $k''(\beta) < 0$.

To meet the demand of manufacturing sector, the sector would invest in the employees' skill. The amount of investment is depending on the total sector output value. Use $T$to express the investment on training in the manufacturing sector and use λ to denote the proportion, and $T = \lambda p_1 F^1(L_1)$,where p_1 is the price of the manufacturing goods relative to that of agriculture goods. p_1 is assumed to be given and constant in a small open economy. The training cost of each transferred labor is h. In this paper, h also measures the level of human capital, labor with higher human capital requires less training costs than labor with lower human capital. Use L_{TR} is the amount of transferred labor employed in the manufacturing sector:

$$L_{TR} = \frac{T}{h} = \frac{\lambda p_1 X_1}{h} = \frac{\lambda p_1 F^1(L_1)}{h} \quad (1)$$

L_{TR}^U is the amount of unemployment transferred labor. And the market-clearing conditions of the rural labor could be shown as follows:

$$L_R = L_{TR} + L_3 + L_{TR}^U \quad (2)$$

Profit maximization yields:

$$(1-\lambda)p_1F_L^1(L_1)=\bar{w} \tag{3}$$

$$p_2F_L^2(L_2)=w_2 \tag{4}$$

$$k(\beta)F_L^3(L_3)=w_3 \tag{5}$$

where $\bar{w}$ is the wage level of the manufacturing sector, while w_2 and w_3 refer to the wage levels of the service and agricultural sectors. p_2 is the price of the service sectors goods relative to that of agriculture goods.

The amount of unemployment in the urban region is

$$L_{UU}=L_{UU}^0-[(L_1-L_1^0)+(L_2-L_2^0)-L_{TR}]+L_{TR}^U \tag{6}$$

$L_1-L_1^0, L_2-L_2^0$ and $(L_1-L_1^0)+(L_2-L_2^0)-L_{TR}$ represent the change of employment in the manufacturing sector, the amount of labors flows between the manufacturing sector and the service sector, and the amount of initial unemployment turns into employment in the manufacturing sector, respectively. From equation (6), the unemployment consists of two parts: the initial unemployment and the rural migrants who cannot find jobs.

The Harris-Todaro labor allocation mechanism in two sectors yields:

$$w_3=\frac{L_1}{L_{UU}+L_1}\bar{w} \tag{7}$$

where $L_1/(L_{UU}+L_1)$ can be regarded as the probability of rural-urban migrants to be employed by the manufacturing sector. From rural migrants' perspective, the probability of rural-urban migrants to be employed by the manufacturing sector is $L_{TR}/(L_{TR}^U+L_{TR})$, thus,

$$\frac{L_{TR}}{L_{TR}^U+L_{TR}}=\frac{L_1}{L_{UU}+L_1} \tag{8}$$

The inter-urban migration equilibrium yields:

$$\bar{w}=w_2 \tag{9}$$

The following is the consumption of three different categories of labor: urban labor, rural labor and migrant labor.Each category of labor has a representative labor. Assume that changes of the representative labor correspond to changes in his category as a whole. For urban labor, $U^1(D_1^1, D_2^1, D_3^1) = \alpha_1^1 \ln D_1^1 + \alpha_2^1 \ln D_2^1 + \alpha_3^1 \ln D_3^1$ is the urban representative labor utility function, where D_1^1, D_2^1 and D_3^1 denote the consumption of goods of the manufacturing sector, service sector and agricultural sector, respectively; α_1^1, α_2^1 and α_3^1 are all parameters, and $\alpha_1^1 + \alpha_2^1 + \alpha_3^1 = 1$.The budget constraint is $y_u = (L_1 - L_{TR})\bar{w} + w_2 L_2$ .For migrant labor, $U^2(D_1^2, D_2^2, D_3^2) = \alpha_1^2 \ln D_1^2 + \alpha_2^2 \ln D_2^2 + \alpha_3^2 \ln D_3^2$ is the representative labor utility function, where D_1^2, D_2^2 and D_3^2 denote the consumption of goods of the manufacturing sector, service sector and agricultural sector, respectively. α_1^2, α_2^2 and α_3^2 are all parameters, and $\alpha_1^2 + \alpha_2^2 + \alpha_3^2 = 1$.The budget constraint is $y_T = L_{TR}\bar{w} - \beta$,which means income deduces the remittance. The indirect utility from the consumption is $V^2(p_1, p_2, 1, y_T) = \sum_{i=1}^{3} \alpha_i^2 \ln \alpha_i^2 (L_{TR}\bar{w} - \beta) - \alpha_1^2 \ln p_1 - \alpha_2^2 \ln p_2$. For rural labor, $U^3(D_1^3, D_3^3) = \alpha_1^3 \ln D_1^3 + \alpha_3^3 \ln D_3^3$ is the rural representative labor utility function, where D_1^3 and D_3^3 denote the consumption of goods of the manufacturing sector and agricultural sector. α_1^3 and α_3^3 are parameters, and $\alpha_1^3 + \alpha_3^3 = 1$. In the model, the price of agricultural goods is assumed as 1. Therefore, the amount of agricultural production is equal to the income of agricultural sector. Moreover, regarding to the remittance, instead of increasing the income directly, this paper assumes remittance is used on the investment in production, education and health care, which in turn have a positive effect on the production. Budget constraint of rural labor is $y_a = k(\beta)F^3(L_3)$. The indirect utility is $V^3(p_1, 1, y_a) = \alpha_1^3 \ln \alpha_1^3 k F^3 + \alpha_3^3 \ln \alpha_3^3 k F^3 - \alpha_1^3 \ln p_1$.

As to the consumption of service goods, urban residents spend α_2^1 partsof their income on consumption of output from the service sector, and migrants spend α_2^2 parts of their income on service sector goods, and assume $\alpha_2^1 > \alpha_2^2$ .Service goods market-clearing condition can be demonstrated by:

$$p_2 F^2(L_2) = \alpha_2^1[(L_1 - L_{TR})\bar{w} + w_2 L_2] + \alpha_2^2(L_{TR}\bar{w} - \beta) \quad (10)$$

The paper assumes that migrants remit for purely altruistic reasons in order to increase the well-being of family members at home by providing additional income. Consequence, the utility of migrants consists of two parts: their own utility and their rural household's utility. In this model, the remittance mobiles from urban to rural and the use of remittance at different regions will bring different effects on migrants' utility. If more funds outflow to the rural region, which improves the external production environment, it enhances the rural household utility directly and increase the migrants' utility indirectly. If more funds keep to the urban region, it increases the migrants' utility directly. The weight of own utility is θ, while the weight of rural household is $1-\theta$. Thus, the utility of migrants V^T is the weighted average of two items:

$$V^T = \theta\left[\sum_{i=1}^{3}\alpha_i^2 \ln \alpha_i^2 (L_{TR}\bar{w}-\beta) - \alpha_1^2 \ln p_1 - \alpha_2^2 \ln p_2\right] + (1-\theta)\left[\alpha_1^3 \ln \alpha_1^3 kF^3 + \alpha_3^3 \ln \alpha_3^3 kF^3 - \alpha_1^3 \ln p_1\right]$$

Migrants choose an amount of remittance to maximize their utility,

$$\frac{\theta}{L_{TR}\bar{w}-\beta} = \frac{(1-\theta)k'}{k} \quad (11)$$

According to the equation (11), k'/k expresses the change of remittance leads to the change of income of rural household. Remittance improves the rural external production environment and increase the production even with no change of employment. Therefore, the change of utility of migrants is $(1-\theta)k'/k$. $1/\left(L_{TR}\bar{w}-\beta\right)$ means the change of remittance on their utility directly, and $\theta/\left(L_{TR}\bar{w}-\beta\right)$ is the change of remittance on the weight utility.

The theoretical model thus consists of eleven equations: (1)–(11). Eleven endogenous variables are determined: L_{TR} , L_{TR}^U, L_1, L_2, L_3, λ, w_3, w_2, L_{UU}, p_2 and β.

3 Comparative statics

This section focuses on the economic effect of an increase of migrant's human capital level on the remittance based on the established model. In this paper, an increase in human capital is identified with a decrease in *h*. Total differentiation of equations (1) to (11) and write in a matrix notation,

$$\begin{pmatrix} h & -C & 0 & 0 & 0 \\ 0 & -\bar{w} & -w_3 & DkF_{LL}^3 - w_3 & Dk'F_L^3 \\ D & -(L_{TR}+L_{TR}^U) & -L_{TR} & L_1 - L_{TR} & 0 \\ (\alpha_2^2-\alpha_2^1)\bar{w} & \alpha_2^1\bar{w} & E & 0 & -\alpha_2^2 \\ (1-\theta)k'\bar{w} & 0 & 0 & 0 & B \end{pmatrix} \begin{pmatrix} dL_{TR} \\ dL_1 \\ dL_2 \\ dL_3 \\ d\beta \end{pmatrix} = \begin{pmatrix} -L_{TR} \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} dh \quad (12)$$

where $B=(1-\theta)(k''y_T-k')-\theta k'<0$, $C=p_1[\lambda F_L^1 F_L^1+(1-\lambda)F^1F_{LL}^1]/F_L^1$, $D=L_U+L_{TR}+L_{TR}^U-L_2>0$, $E=p_2F^2F_{LL}^2/F_L^2-\bar{w}(1-\alpha_2^1)<0$.

The sign of *C* is ambiguous in equation(12). Use $\varepsilon_1=\dfrac{dF^1/F^1}{dL_1/L_1}$ to denote labor elasticity of production in the manufacturing sector and use $\varepsilon_L^1=-\dfrac{dF_L^1/F_L^1}{dL_1/L_1}$ to denote labor elasticity of marginal production. Since the proportion of training cost is low in the manufacturing sector, hence, the value of $\lambda/(1-\lambda)$ is small. In order to determine the sign of *C*, the paper assumes $\dfrac{\varepsilon_L^1}{\varepsilon_1}>\dfrac{\lambda}{1-\lambda}$ holds and *C*<0.

The determinant of the coefficient matrix of the above equation system is denoted as Δ,

$$\Delta = hB\bar{w}E(L_1-L_{TR})+BE(DkF_{LL}^3-w_3)[CD-h(L_{TR}^U+L_{TR})]$$
$$+B\bar{w}(DkF_{LL}^3L_{TR}-w_3L_1)[h\alpha_2^1+c(\alpha_2^2-\alpha_2^1)]+(1-\theta)Ck'\bar{w}[EDk'F_L^3+\alpha_2^2(DkF_{LL}^3L_{TR}-w_3L_1)]>0$$

Using the Cramer Rule to solve the equation (12) and obtain:

$$\frac{dL_1}{dh}=\frac{L_{TR}\left\{(L_{TR}DkF_{LL}^2-w_3L_1)[\bar{w}B(\alpha_2^2-\alpha_2^1)+(1-\theta)k'\bar{w}\alpha_2^2]+BDE(DkF_{LL}^2-w_3)+(1-\theta)k'\bar{w}EDk'F_L^3(L_1-L_{TR})\right\}}{\Delta}<0$$

$$\frac{dL_{TR}}{dh}=\frac{-L_{TR}B\left\{\bar{w}\alpha_2^1(L_{TR}DkF_{LL}^2-w_3L_1)-E[(DkF_{LL}^2-w_3)(L_{TR}+L_{TR}^U)-\bar{w}(L_1-L_{TR})]\right\}}{\Delta}<0$$

$$\frac{d\beta}{dh}=\frac{L_{TR}(1-\theta)k'\bar{w}\left\{\bar{w}\alpha_2^1(L_{TR}DkF_{LL}^2-w_3L_1)-E[(DkF_{LL}^2-w_3)(L_{TR}+L_{TR}^U)-\bar{w}(L_1-L_{TR})]\right\}}{\Delta}<0$$

Since the urban wage $\bar{w}$ is assumed to be constant and an increase in human capital, expressed by a decrease in *h.* As to the labor employment in the manufacturing sector, decreased training cost reduces the training investment and the manufacturing sector enlarges employment.

Correspondingly, more labor migrates to the urban and employed by the manufacturing sector, and migrants' income $\bar{w}L_{TR}$ increases.

Proposition 1: In the model, an increase in human capital level of rural migrants increases their income and remittance.

An increase in human capital of migrants reduces the training cost of manufacturing sector; therefore, manufacturing sector enlarges the production and employ more labors, both from unemployed and transferred labors channels. More rural labors will transfer to the manufacturing sector, and their income increases. With an increased income, migrants' marginal utility from direct urban consumption reduces. In order to maximize their weighted utility, they will send more remittance back and enhance their utility indirectly.

As to the consumption of service sector,

$$\frac{d[\alpha_2^2(\bar{w}L_{TR}-\beta)]}{dh}=\alpha_2^2(\bar{w}\frac{dL_{TR}}{dh}-\frac{d\beta}{dh})<0$$

Though migrants' income and remittance increase, they put more the increased income on consumption.As to the change of proportion of remittance in migrants' income,

$$\frac{d(\beta/L_{TR}\bar{w})}{dh}=\frac{d\beta}{dh}-\frac{\beta}{L_{TR}}\frac{dL_{TR}}{dh}$$
$$=\frac{[(1-\theta)y_T(k'+k'')-\beta\theta k']\left\{\bar{w}\alpha_2^1(L_{TR}DkF_{LL}^2-w_3L_1)-E[(DkF_{LL}^2-w_3)(L_{TR}+L_{TR}^U)-\bar{w}(L_1-L_{TR})]\right\}}{\Delta}$$

The sign depends on the property of *k*. If $1+\frac{k''}{k'}<\frac{\theta}{1-\theta}\frac{\beta}{\bar{w}L_{TR}-\beta}$, then $\frac{d(\beta/L_{TR}\bar{w})}{dh}>0$,an increase of human capital level of rural migrants decreasesthe proportion of remittance in migrants' income.If $1+\frac{k''}{k'}>\frac{\theta}{1-\theta}\frac{\beta}{\bar{w}L_{TR}-\beta}$,then $\frac{d(\beta/L_{TR}\bar{w})}{dh}>0$, we have the opposite conclusion.

When the remittance is small, an increase of remittance improves the external agricultural production greatly and $\frac{d(\beta/L_{TR}\bar{w})}{dh}>0$ more likely holds. With the increase of remittance, the sign

of $1+\frac{k''}{k'}$ may be negative, and an increase of human capital level of rural migrants decreasesthe proportion of remittance in migrants' income.

Proposition 2: An increase of human capital level of rural migrants increases their consumption on service goods, while its impact on the proportion of remittance in migrants' incomedepends on the impact of remittance on agricultural production.

4 Conclusion

Based on the new characteristic of migrants in developing countries, the article analyzes theoretically the effect of migrants' human capital level on remittance within one economy. We find that an increase of human capital level of rural migrants increases their income, urban consumption and remittance, while its effect on the proportion of remittance in migrants' income depends on the impact of remittance on agricultural production. Since similar analyses have been sparse, the main contents of this paper provide new perspectives to the best of our knowledge. Higher human capital migrants send less percent of their income to their rural household, and pays more weight on urban consumption, which shows that they gradually alienate their rural family. As time elapses, they gradually integrate into the urbanthat definitely affects the remittance. Considering the remittance is an important external source to develop the rural region in the developing countries, the government should pay more attention to the trend of the amount of the remittance and adopt corresponding measures in order to minimize the negative impacts of reduced remittance, even though remittance may increase at the present.

The paper establishes a simple tractable framework for a developing economy that might be useful for theoretically analyzing the relationship between human capital and remittance of migrants. Several limitations exist. First, we assume remittance plays a positive influence on agricultural production. However, we should explore this issue in more depth. For example, Li and Fu (2022) assume that all remittance is used for purchasing agricultural producer service, through which facilitates agricultural production. Second, we do not consider environmental

issue. Pollution may affect migration decision and also exert an impact on remittance(Fu and Li,2023).

Several topics on the impacts of human capital and remittance can be further discussed. For example, we could add rural public infrastructure into the model. The rural infrastructure affects agricultural productivity and promotes rural labor migration. Thus, more provision of rural public investment exerts an impact on remittances. The second extension follows Li and Fu (2022) and incorporates agricultural producer service sector into the general equilibrium model. The third extension incorporates government that maximizes social welfare.

References

Albert Bollard, David McKenzie, Melanie Morten, and Hillel Rapoport , "Remittances and the Brain Drain Revisited: The Microdata Show That More Educated Migrants Remit More", *The World Bank Economic Review* 25 (2011):132– 156.

Asian Development Bank, "Sustainable vocational training toward industrial upgrading and economic transformation", (2014). Available at http://www.adb.org/sites/default/files/publication/82793/sustainable-vocational-training.pdf.

Ball, Christopher P., Lopez, Claude, Reyes, Javier, "Remittance, inflation and exchange rate regimes in small open economies",*World Economy*. 36 (2013):487–507.

Banerjee, B,"The probability, size and uses of remittances from urban to rural areas in India", *Journal of Development Economics*, 16,(1984) :293–311.

Batista, Catia, and Janis Umblijs. "Do migrants send remittances as a way of self-insurance?." *Oxford Economic Papers* 68.1 (2016): 108-130.

Dustmann,C.and Mestres, J., "Remittances and temporary migration". *Journal of Development Economics*,92 (2010): 62–70.

Duval, L. and Wolff, F.C.,"Remittances matter: Longitudinal evidence from Albania", *Post-Communist Economies* 22 (2010): 73-97.

Du, Y, Park, A, Wang, SG, "Migration and rural poverty in China",*Journal of Comparative Economics* 33 (2005): 688-709.

Docquier Frédéric, Rapoport Hillel, Salomone Sara, "Remittances, migrants' education and immigration policy: Theory and evidence from bilateral data", *Regional Science and Urban Economics* 42 (2012):817-828.

Faini, Riccardo, "Remittances and the brain drain: do more skilled migrants remit more?", *World Bank Economic Review* 21 (2007) :177-191.

Fu, H. and Li, X., 2023, Rural-urban migrants' remittance and agricultural pollution in the presence of agricultural dualism, *The Annals of Regional Science*, 70, 535–558.

Funkhouser, E. ,"Remittances from international migration: a comparison of El Salvador andNicaragua", *Review of Economics and Statistics* 77 , (1995):137 – 146.

Hein de Haas, "Migration, remittances and regional development in Southern Morocco", *Geoforum* 37(2006): 565-580.

Harris J. and M. Todaro , "Migration, unemployment and development: a two-sector analysis", *American Economic Review* 60 (1970): 126-142.

Hoddinott, John. "A model of migration and remittances applied to Western Kenya." *Oxford economic papers* (1994): 459-476.

Gibson John and McKenzie David, "Eight Questions about Brain Drain", *Journal of Economic Perspectives* 25 (2011): 107-128.

Jones, R.C., "Introduction: The Renewed Role of Remittances in the New World Order",*Economic Geography* 74 (1998) :1–7.

McCormick, B., Wahba, J., "Overseas employment and remittances to a dual economy",*The Economic Journal* 110 (2000):509–534.

Markova, Eugenia, and Barry Reilly. "Bulgarian migrant remittances and legal status: Some micro-level evidence from Madrid." *South-Eastern Europe Journal of Economics* 5.1 (2015).

Naufal, G. "Who Remits? The Case of Nicaragua", Institute for Study of Labor (IZA) Discussion Paper(2007), No.3081, Bonn, Germany.

NiimiYoko, CaglarOzden and MauriceSchiff , "Remittances and the Brain Drain: Skilled Migrants Do Remit less", *Annuals of Economics and Statistics* No.97/98 (2010): 123-141.

R. Layard, S. Nickell, G. Mayraz, "The marginal utility of income", *Journal of Public Economics*92 (2008):1846–1857.

Rapoport, Hillel and Frédéric Docquier,"The economics of migrants' remittances" ; in S.-C. KOLM and J. MERCIER YTHIER, eds.: Handbook of the Economics of Giving, Altruism and Reciprocity, North Holland, 2006. Vol. 2, Chapter 17, pp. 1135-98.

Schioupu, I. and N. Siegfried , "Determinants of Workers' Remittances. Evidence from the European Neighbouring Region", *European Central Bank Working Paper Series*,No 688 (2006).

The World Bank, "Migration and Development Brief 24"(2015).

The World Economic Forum, The Human Capital Report 2013 to 2016

Li, X. and Wang,D., "The impacts of rural–urban migrants' remittances on the urban economy", *The Annual of Regional Science* 54 (2015): 591-603.

Li,X. and Zhou,J., "Environmental effects of remittance of rural-urban migrant",

Economic Modelling, 47(2015):174–179.

Li ,X. and Zhou,Y., "An Economic Analysis of Remittance of Unskilled Migration on Skilled-Unskilled Wage Inequality in Labor Host Region", *Economic Modelling*, 33(2013):428–432

Li ,X. and Fu,H., Migrant remittance, agricultural producer services and environmental pollution, *Asia-Pacific Journal of Accounting & Economics*, 29(5) (2022), 1267-1282.

Uwaoma G. Nwaogu,and Michael J. Ryan, "FDI, Foreign Aid, Remittance and Economic Growth in Developing Countries", *Review of Development Economic* 19 (2015): 100-115.

Wu, Y. and Li, X., Rural-Urban Migrants' Remittances and Wage Inequality: Evidence from China, *Agricultural Economics(Czech)*, 2020,66(3), 129-139.

Liu, Z. and Li,X., "Transition of the Yangtze River Delta---From Global Manufacturing Center to Global Innovation Center", Springer Japan (2015).