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Rural-urban migrants' remittances and wage inequality: Evidence from China

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Abstract: There is a link between rural-urban remittances and wage inequality. However, the existing literature sheds little light on this topic. In this study, we establish a three-sector general equilibrium model to investigate the effects of rural-urban migrants' remittances on wage inequality. Further, we use Chinese macroeconomic data to calibrate the parameters and conduct analysis with numerical simulation. We find that, when rural-urban migrants raise their remittance rate, wage inequality between skilled labour and the urban formal sector remains unchanged in the sector--specific capital case but narrows in the sector-mobile capital case. Moreover, in the sector-specific case, skilled and unskilled wage inequalities, w_{SY} and w_{SZ}, decrease at the same rate as the urban-rural wage inequalities, w_{XY} and w_{XZ}, respectively. In the mobile case, however, the former declines faster than the latter.

Keywords: endogenous remittance; externality; less-developed country; rural-urban migration; wage inequality

"Rural-urban migrants' (RUMs') remittances" refers to the portion of their income that RUMs obtain in an urban area and transfer to a rural area in a less-developed country (LDC). To support their family still living in a rural area, RUMs either travel in person or entrust friends to physically carry part of their income to their family. In this study, all funds from RUMs transferred back to rural areas constitute their remittances. The RUMs' remittances are income transfers within one economy, which differentiates it from external or international remittances. There is a massive number of RUMs in LDCs. For example, in China, there were 281.71 million RUMs in 2016 according to The Survey Report on the Monitoring of Chinese Migrant Workers 2016 (SRMCMW2016 2017). Along with economic development and people's increasing incomes, RUMs' remittances are increasing yearly. In the numerical simulation conducted in this study, the volume of RUMs' remittances within China in 2016 was estimated as being 367 414 million USD, accounting for 3.3% of China's gross domestic product (GDP) and roughly twice the GDP of New Zealand in the same year. Thus, RUMs' remittances are significant for the development of rural areas in LDCs.

Recently, the literature on migrant remittances has become richer and more diverse. They mainly consider the economic impacts of remittances on rural income distribution, agricultural production, the development of the rural economy, and some macroeconomic elements, such as the current exchange rate. Such studies have included those by Lundahl (1985), Taylor and Wyatt (1996), Quibria (1997), Djajic (1998), Pradhan et al. (2008), and Ball et al. (2013), but they focus on international remittances. Li and Zhou (2013), Li and Wang (2015) and Li and Zhou (2015) investigate the RUMs' remittances, but

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Li and Zhou (2013) do not consider the rural sector, Li and Wang (2015) do not consider skilled labour, and Li and Zhou (2015) focus on the environment. In addition, Li and Wang (2015) treat the number of remittances as an exogenous variable. However, the remittance volume is determined for the whole economy, including the amount of labour migration, consumption and rural income.

Moreover, researchers who studied wage inequality did not consider remittances. For example, Beladi et al. (2008) analyse the influence of the liquidity of international elements on wage inequality in a dual economy. Chaudhuri and Yabuuchi (2007) study the impact of the economic system on wage inequality and find that when the degree of economic liberalization is higher, the wage gap becomes greater. Wang (2019) investigates the impacts of environmental protection policies and a rise in the self-mitigation cost of skilled and unskilled labour on wage inequality. Some researchers demonstrate the impacts of technological innovation in LDCs on wage inequality, such as Kar (2004), Moore and Ranjan (2005), Fang et al. (2008). Das (2002) and Chaudhuri and Banerjee (2010) research the impacts of foreign direct investment on wage inequality.

Few studies consider the effects of remittances on income distribution from both sides of migration – the labour-outsourcing and labour host regions. The above studies consider either the impacts of international remittances in the labour-outsourcing country (i.e. a LDC) or the impacts of RUMs' remittances from an urban area (labour host region). However, RUMs' remittances are greatly helpful in improving the production environment of rural areas and raising rural productivity (Rozelle et al. 1999). As a result, on one hand, they influence the income of rural areas, but on the other hand, they cause input factors to flow into rural areas, which in turn affects the urban economy and then influences the income of urban labourers, including skilled labourers. Therefore, the effect of RUMs' remittances on wage inequality is not clear.

To deal with this topic, the present study establishes a three-sector general equilibrium model with the characteristics of a LDC. We consider two cases: one where capital was sector specific and the other where capital was mobile between sectors. Then, the paper examines the effects of an increase in the RUMs' remittance rate on wage inequality. Finally, we use Chinese macroeconomic data[1] to calibrate the parameters and conduct a numerical simulation.

THEORETICAL MODEL

Consider a small, open, developing country consisting of three sectors: an urban formal sector, an urban informal sector, and a rural sector, denoted by the indices *X*, *Y*, and *Z*, respectively. The economy uses labour and capital as production factors, and they do not move internationally. Labour is divided into skilled labour and unskilled labour. Because the rate of education is lower in rural areas than in urban areas in LDCs, the human capital level of urban labourers is higher than that of rural labourers. Therefore, it should simply be assumed that the urban labourers are skilled but that rural labourers are unskilled. RUMs can find jobs in sector *X* or sector *Y* as unskilled labourers. The urban informal sector[2] depends only on those migrants who do not have jobs in sector *Y*. Further, as mentioned, the RUMs' remittances will raise the production of sector *Z*.

Under the condition that the market is perfectly competitive, we could obtain the following:

$$p_X = a_{SX} w_S + a_{LX} \overline{w}_X + a_{KX} r_X \tag{1}$$

$$p_Y = a_{LY} w_Y \tag{2}$$

$$1 = \frac{a_{LZ}}{g(k)} w_Z + \frac{a_{KZ}}{g(k)} r_Z \tag{3}$$

where a_{ij} ($i = S, L, K$; $j = X, Y, Z$)[3] represents the factor i used in producing a unit product in sector j without considering RUMs' remittances k in the economy. The function $g(k)$ expresses the positive externality generated by k on rural production, with the properties $g \geq 1$, $g' > 0$, and $g'' < 0$. r_X and r_Z are the interest rates of capital in sector X and sector Z, respectively. w_S is the wage rate of skilled labour used in sector X. Generally, the LDCs lack skilled labourers, so we assume that skilled labourers could be fully employed in sector X. Thus, w_S is flexible. $\overline{w}_X$ is the wage rate of unskilled labour in sector X, which is downwardly rigid due to some political and institutional considerations. w_Y and w_Z are the wage rates in sector Y and sector Z, respectively, which are both flexible. Suppose that rural

[1]Because China has the largest population of RUMs in the world, conducting a numerical simulation of migrant remittances using China's data is regarded as representative of conditions in other countries.

[2]See, for example, Chatterjee and Turnovsky (2018), who discussed the informal sector in detail.

[3]Because the market is perfectly competitive, a_{LY} is constant.

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goods are exported and serve as *numeraire*, so that their price equals unity, while the urban formal goods are importable goods with a fixed world price, p_X; the urban informal goods are nontraded goods, and their price, p_Y, is determined endogenously in the domestic market.

It is supposed that goods and services produced by sector *Y* can only be provided to urban residents. Thus, the equilibrium condition of the urban informal market is shown as:

$$p_Y Y = \phi(p_X X + p_Y Y - k) \tag{4}$$

Here, ϕ ($0 < \phi < 1$) is the proportion of their budget that people in urban areas spend on urban informal products and *X* and *Y* are the outputs in sector *X* and sector *Y*, respectively.

Skilled labour is fully employed, and unskilled labour moves freely between sectors. Thus, the market-clearing condition of skilled labour and unskilled labour could be shown as follows:

$$a_{SX} X = S \tag{5}$$

$$a_{LX} X + a_{LY} Y + \frac{a_{LZ}}{g(k)} Z = L \tag{6}$$

where *Z* is the output in sector *Z* and, *S* and *L* represent the endowments of skilled labour and unskilled labour, respectively, in the entire economy.

According to Harris and Todaro (1970), rural labour moves to urban regions until the expected urban wage equals the actual rural wage. Thus, the unskilled labour allocation mechanism between sectors can be shown as follows:

$$\frac{a_{LX} X}{a_{LX} X + a_{LY} Y} \overline{w}_X + \frac{a_{LY} Y}{a_{LX} X + a_{LY} Y} w_Y = w_Z \Leftrightarrow (w_Z - w_Y) a_{LY} Y = (\overline{w}_X - w_Z) a_{LX} X \tag{7}$$

Then, we obtain three types of skilled-unskilled wage inequality: (a) wage inequality between skilled labour and sector *X*, $w_{SX} = w_S - \overline{w}_X$; (b) wage inequality between skilled labour and sector *Y*, $w_{SY} = w_S - w_Y$; and (c) wage inequality between skilled labour and sector *Z*, $w_{SZ} = w_S - w_Z$. Similarly, we obtain three types of urban-rural wage inequality: (a) wage inequality between sector *X* and sector *Y*, $w_{XY} = \overline{w}_X - w_Y$; (b) wage inequality between sector *X* and sector *Z*, $w_{XZ} = \overline{w}_X - w_Z$; and (c) wage inequality between sector *Y* and sector *Z*, $w_{ZY} = w_Z - w_Y$.

According to Equation (7), w_Y is even lower than w_Z; thus, we assume that labourers' income in sector *Y* can only meet their basic living needs, and no surplus is repatriated in the form of rural subsidies. However, RUMs employed in sector *X* will remit part of their wages to their rural homes, and then the amount of remittance transferred to rural areas is as follows[4]:

$$k = \theta \overline{w}_X a_{LX} X \tag{8}$$

where θ ($0 \le \theta \le 1$) is the remittance-wage ratio of RUMs in sector *X* (hereafter called the "remittance rate").

SECTOR-SPECIFIC CAPITAL CASE

In this chapter, we consider the case where capital is specific to a sector and cannot move between sectors. In this case, K_X and K_Z are fixed as the capital employed in sector *X* and sector *Z*, respectively. Then the capital market-clearing condition is as follows:

$$a_{KX} X = K_X \tag{9}$$

$$\frac{a_{KZ}}{g(k)} Z = K_Z \tag{10}$$

In particular, from Equations (1), (5), and (9), we can discern that *X*, w_S, and r_X will be unaffected by θ. This is to say, the production and factor inputs of sector *X* are not affected. Therefore, RUMs' remittances increase on the same scale as the remittance rate does. The complete differentiation of Equations (2) (3), (4), (6), (7) and (10) can be reorganized as follows[5]:

$$\begin{bmatrix} a & -(a+b) \\ \lambda_{LY} c & -\lambda_{LY}(a+b) - \lambda_{LZ} d \end{bmatrix} \begin{bmatrix} \hat{w}_Y \\ \hat{w}_Z \end{bmatrix} = \begin{bmatrix} -e \\ -\varepsilon \lambda_{LZ} d \end{bmatrix} \hat{\theta} \tag{11}$$

where $a = w_Z/(w_Z - w_Y) > 0$, $b = w_Z/(\overline{w}_X - w_Z) > 0$, $c = w_Y/(w_Z - w_Y) > 0$, $d = (\varepsilon^Z_{KL} + \varepsilon^Z_{LK})/\theta_{KZ} > 0$,

[4]We do not consider the transaction costs of currency transfers. In fact, RUMs usually send money through unofficial channels that rarely involve remittance costs.

[5]Detailed derivation is presented in Electronic Supplementary Material S2 (EMS).

[6]Note that *e* denotes the ratio of RUMs' remittances to disposable income (total income minus the remittance) in sector *X*. Because most LDCs suffer from uneven development and increasing income disparities between rural and urban areas, the amount of RUMs' remittances is huge but the value of *e* is still small.

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$e=k/(p_X X-k)>0$[6], $\varepsilon=g'k/g>0$, $\lambda_{LY}=a_{LY}Y/L$, $\lambda_{LZ}=a_{LZ}Z/gL$, $\theta_{KZ}=r_Z a_{KZ}/g$, $\varepsilon_{KL}^{Z}=(\partial a_{KZ}/\partial w_Z)(w_Z/a_{KZ})>0$, and $\varepsilon_{LK}^{Z}=(\partial a_{LZ}/\partial r_Z)(r_Z/a_{LZ})>0$. By denoting Δ_1 as the determinant of the coefficient matrix in Equation (11), we have:

$$\Delta_1=-\lambda_{LY}(a+b)-\lambda_{LZ}ad<0$$

According to the definition of e, we might assume it satisfies $e<\lambda_{LZ}d(a+b)\varepsilon/[\lambda_{LZ}d+\lambda_{LY}(a+b)]$. By solving Equation (11) with Cramer's rule, we can obtain the following:

$$\frac{\hat{w}_Y}{\hat{\theta}}=\frac{\lambda_{LZ}ed+\lambda_{LY}(a+b)e-\varepsilon\lambda_{LZ}(a+b)d}{\Delta_1}>0 \qquad (12)$$

$$\frac{\hat{w}_Z}{\hat{\theta}}=\frac{\lambda_{LY}ce-\varepsilon\lambda_{LZ}da}{\Delta_1}>0 \qquad (13)$$

An increase in θ also increases w_Y and w_Z. To specify this mechanism, note that increasing the remittance rate (or the amount of RUMs' remittances) raises labour productivity in rural areas through the purchase of machines, equipment, and fertilizer needed for rural production. Thus, w_Z increases, thereby attracting some labourers in sector Y to return to rural areas. This produces a higher w_Y.

Turning to wage inequality, we consider the impact of the remittance rate on wage inequality. The results are reported in Table 1.

In accordance with Table 1, we present Propositions 1 and 2:

Proposition 1. *Consider a small, open country where capital is immobile between sectors. When RUMs raise their remittance rate, it will not affect wage inequality between skilled labour and the urban formal sector, w_{SX}, but it will generate the following impacts on other skilled-unskilled wage inequalities:*

(1) Wage inequality between skilled labour and the urban informal sector, w_{SY}, narrows.

(2) Wage inequality between skilled labour and the rural sector, w_{SZ}, narrows.

Proposition 2. *Consider a small, open country where capital is immobile between sectors. When RUMs raise their remittance rate, it will generate the following impacts on urban-rural wage inequalities:*

(1) Wage inequality between the urban formal sector and the urban informal sector, w_{XY}, narrows.

(2) Wage inequality between the urban formal sector and the rural sector, w_{XZ}, narrows.

As for wage inequality between sector Y and sector Z, conventional wisdom regards it as a direct comparison of the change between the two wage rates (Chaudhuri and Yabuuchi 2007; Chao et al. 2016). In this study, we can calculate that $\hat{w}_Z/\hat{\theta}<\hat{w}_Y/\hat{\theta}$. However, when w_Z is much higher than w_Y, notwithstanding the fact that $\hat{w}_Z/\hat{\theta}<\hat{w}_Y/\hat{\theta}$, the increase of w_Z might be larger than the increase of w_Y, leading to a larger w_{ZY}. Therefore, we believe that the effect on w_{ZY} is ambiguous. Finally, with the unaffected w_S and exogenous $\bar{w}_X$, w_{SY} and w_{SZ} decrease by the same percent as do w_{XY} and w_{XZ}, respectively.

Table 1. Effect of an increase in θ on wage inequality for the capital-specific case

Variable	Sign
$\hat{w}_{SX}/\hat{\theta}$	0
$\hat{w}_{SY}/\hat{\theta}$	–
$\hat{w}_{SZ}/\hat{\theta}$	–
$\hat{w}_{XY}/\hat{\theta}$	–
$\hat{w}_{XZ}/\hat{\theta}$	–
$\hat{w}_{ZY}/\hat{\theta}$	/
$\hat{w}_{SY}/\hat{\theta}-\hat{w}_{XY}/\hat{\theta}$	0
$\hat{w}_{SZ}/\hat{\theta}-\hat{w}_{XZ}/\hat{\theta}$	0

Note: $\frac{\hat{w}_{ZY}}{\hat{\theta}}=\frac{\varepsilon\lambda_{LZ}d\left[(a+b)c-a^2\right]-ce(\lambda_{LZ}d+\lambda_{LY}b)}{\Delta_1}$, its sign is ambiguous

Source: Author's own elaboration

MOBILE CAPITAL CASE

In this chapter, we examine the case where capital can move freely between sector X and sector Z. Then, the capital market-clearing condition becomes the following:

$$a_{KX}X+\frac{a_{KZ}}{g(k)}Z=K \qquad (14)$$

where K is the endowment of capital in the economy. Due to the perfectly sectoral mobility of capital, we have $r_X=r_Z=r$.

In the mobile capital case, we focus on the main difference of impacts on wage inequality from the specific capital case. The comparison of substitutions of capital and skilled labour for unskilled labour in sector X plays an important role in the following discussion. Therefore, in this chapter, we make the following assumption:

Assumption 1: $\tau_{LK}^{X}=\tau_{LS}^{X}$.

Here $\tau_{LK}^{X}=\varepsilon_{LK}^{X}/\theta_{KX}>0$ and $\tau_{LS}^{X}=\varepsilon_{LS}^{X}/\theta_{SX}>0$ are the Allen-Uzawa partial elasticities of factor substitution in sector X between unskilled labour and capital, and unskilled labour and skilled labour, respectively;

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$\varepsilon_{LK}^{X}=(\partial a_{LX}/\partial r)(r/a_{LX})>0$, $\varepsilon_{LS}^{X}=(\partial a_{LX}/\partial w_S)(w_S/a_{LX})>0$; $\theta_{SX}=w_S a_{SX}/p_X$ and $\theta_{KX}=ra_{KX}/p_X$. The complete differentiation of Equations (4–11) and (14) can be reorgaized as follows:

$$\begin{bmatrix} 0 & \theta_{LZ} & \theta_{KZ}+\varepsilon h \\ -a & a+b & 0 \\ \lambda_{LY} & \lambda_{LZ}\left(\varepsilon_{KL}^{Z}-\varepsilon_{LL}^{Z}\right) & A \end{bmatrix}\begin{bmatrix} \hat{w}_Y \\ \hat{w}_Z \\ \hat{r} \end{bmatrix}=\begin{bmatrix} \varepsilon \\ e \\ -\lambda_{LY}e \end{bmatrix}\hat{\theta} \quad (15)$$

where: $A=h\left(\lambda_{LX}+\lambda_{LY}-\lambda_{LZ}\lambda_{KX}/\lambda_{KZ}\right)+$
$+j\lambda_{LZ}\lambda_{KX}/\lambda_{KZ}-\lambda_{LZ}\left(\varepsilon_{LK}^{X}-\varepsilon_{KK}^{X}\right)$

$h=\varepsilon_{SK}^{X}-\varepsilon_{SS}^{X}\theta_{KX}/\theta_{SX}>0$ and $j=\varepsilon_{KK}^{X}-\varepsilon_{KS}^{X}\theta_{KX}/\theta_{SX}<0$. In LDCs, relative to the rural sector Z, the urban formal sector X is generally capital-intensive, that is $\lambda_{KX}/(\lambda_{LX}+\lambda_{LY})>\lambda_{KZ}/\lambda_{LZ}$. Therefore, we can conclude that $A<0$. We defined the determinant of the matrix in Equation (19) as Δ_2 and calculated Δ_2 to obtain the following:

$$\Delta_2=-\left[a\lambda_{LZ}\left(\varepsilon_{KL}^{Z}-\varepsilon_{LL}^{Z}\right)+\lambda_{LY}(a+b)\right](\theta_{KZ}+\varepsilon h)+a\theta_{LZ}A<0$$

Given a small enough value of e ($e<\min\{e_1, e_2\}$[7]), solving Equation (15) using Cramer's rule yields the following:

$$\frac{\hat{w}_Y}{\hat{\theta}}=\frac{\varepsilon(a+b)A+e\left\{(\theta_{KZ}+\varepsilon h)\left[\lambda_{LZ}\left(\varepsilon_{KL}^{Z}-\varepsilon_{LL}^{Z}\right)+\lambda_{LY}(a+b)\right]-\theta_{LZ}A\right\}}{\Delta_2}>0 \quad (16)$$

$$\frac{\hat{w}_Z}{\hat{\theta}}=\frac{c\lambda_{LY}e(\theta_{KZ}+\varepsilon h)+aA\varepsilon}{\Delta_2}>0 \quad (17)$$

$$\frac{\hat{r}}{\hat{\theta}}=-\frac{a\varepsilon\lambda_{LZ}\left(\varepsilon_{KL}^{Z}-\varepsilon_{LL}^{Z}\right)+\lambda_{LY}\theta_{LZ}ec+\varepsilon(a+b)\lambda_{LY}}{\Delta_2}>0 \quad (18)$$

Substituting the expression in Equation (16) into Equation (2) results in $\hat{p}_Y/\hat{\theta}=\hat{w}_Y/\hat{\theta}>0$[7]; substituting the expression in Equation (18) into Equations (4), (8), and (11) then yields $\hat{w}_S/\hat{\theta}=-(\theta_{KX}/\theta_{SX})\hat{r}/\hat{\theta}<0$, $\hat{X}/\hat{\theta}=-h\hat{r}/\hat{\theta}<0$, and $\hat{k}/\hat{\theta}=1-h\hat{r}/\hat{\theta}>0$; completely differentiating Equations (7) and (9), one obtains $\hat{Y}/\hat{\theta}<0$. To specify this mechanism, note that an increase in θ also increases k, improving the production environment in sector Z. This increases the marginal productivity of factors in sector Z and then increases their prices, that is r_Z and w_Z. Because capital moves freely between sector X and sector Z, a higher r_Z attracts urban capital into sector Z. An increase in w_Z results in a reflow of labour into sector Z. As a result, sector Z expands while sector X scales back production. Thus, the wage rate of skilled labour, for a given S, decreases. Similarly, sector Y shrinks too, leading to an increase in its wage rate. As for the amount of RUMs' remittances, note that the employment of unskilled labour in the urban formal sector decreases. This means that the amount of RUMs' remittances, in the mobile capital case increases on a smaller scale than that in the capital-specific case because $0<\hat{k}/\hat{\theta}<1$.

Table 2. Effect of an increase in θ on wage inequality for the mobile capital case

Variable	Sign
$\hat{w}_{SX}/\hat{\theta}$	–
$\hat{w}_{SY}/\hat{\theta}$	–
$\hat{w}_{SZ}/\hat{\theta}$	–
$\hat{w}_{XY}/\hat{\theta}$	–
$\hat{w}_{XZ}/\hat{\theta}$	–
$\hat{w}_{ZY}/\hat{\theta}$	/
$\hat{w}_{SY}/\hat{\theta}-\hat{w}_{XY}/\hat{\theta}$	–
$\hat{w}_{SZ}/\hat{\theta}-\hat{w}_{XZ}/\hat{\theta}$	–

Note: sign is ambiguous

$$\frac{\hat{w}_{ZY}}{\hat{\theta}}=\frac{\left[a^2-c(a+b)\right]\varepsilon A+e\left\{c\theta_{LZ}A-(\theta_{KZ}+\varepsilon h)\left[\lambda_{LZ}c\left(\varepsilon_{KL}^{Z}-\varepsilon_{LL}^{Z}\right)+\lambda_{LY}\left[a+a^2-(a+b)c\right]\right]\right\}}{\Delta_2}$$

Source: Author's own elaboration

Turning to wage inequality, we consider the impact of the remittance rate on wage inequality, which is shown in Table 2.

In accordance with Table 2, we obtain Propositions 3 and 4:

Proposition 3. *Consider a small, open country where capital is mobile between the urban formal sector and the rural sector. When RUMs increase their remittance rate, the wage inequality between skilled labour and the urban formal sector narrows.*

Proposition 4. *Consider a small, open country where capital is mobile between the urban formal sector and*

[7]The exact expressions for e_1 and e_2 are as follows: $e_1=\frac{-(a+b)A\varepsilon}{(\theta_{KZ}+\varepsilon h)\left[\lambda_{LZ}\left(\varepsilon_{KL}^{Z}-\varepsilon_{LL}^{Z}\right)+\lambda_{LY}(a+b)\right]-\theta_{LZ}A}>0$ and $e_2=-\frac{aA\varepsilon}{c\lambda_{LY}(\theta_{KZ}+\varepsilon h)}>0$

[8]This result differs from that of Li and Wang (2015), who take RUMs' remittance as given.

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Table 3. Calibration of Parameter values to Chinese data

Parameter	Description	Calibration Value
α_1	Share of skilled labour in urban formal sector	0.131
α_2	Share of unskilled labour in urban formal sector	0.304
β	Effective parameter of labour in urban formal sector	1.441
γ_1	Share of unskilled labour in rural sector	0.442
σ	Externality parameter of RUMs' remittances on rural production	0.209
θ	Remittance rate	0.118
ϕ	Proportion of their budget for labour in urban sectors spend on urban informal products	0.009

Source: Author's own elaboration

the rural sector. When RUMs increase their remittance rate, each of the skilled-unskilled wage inequalities, w_{SY} and w_{SZ}, decreases by a larger percent than the urban-rural wage inequalities, w_{XY} and w_{XZ}, do separately.

In the mobile capital case, when RUMs increase their remittance rate, w_{SY} and w_{SZ} both decrease and w_{XY} and w_{XZ} both narrow, which is the same as the effects in the capital-specific case. However, considering the rate of change in wage inequalities, there are some differences between the effects in the two cases. Proposition 3 is different from the result in Proposition 1; meanwhile, Proposition 4 is different from the results indicated in Table 1. These reflect that capital plays a different role in different cases. In the capital-specific case, the output level of each sector depends on its labour pool. The amount of skilled labour is given, and $\bar{w}_X$ is downwardly rigid; thus, a change in θ does not affect production of sector X. Hence, w_S remains unaltered by changes in θ. However, in the mobile capital case, capital moves freely between sectors X and Z. This may cause a new mechanism, wherein an increase in θ improves the production environment in sector Z and raises the marginal productivity of factor inputs, causing higher factor prices and so attracting a flow of factor into sector Z. Thus, sector Y shrinks, resulting in a slowdown in demand for skilled labour and then a lower wage rate. Therefore, in the mobile capital case, the wage inequalities between skilled labour and the other sectors diminish by a larger percent than those in the capital-specific case do.

NUMERICAL SIMULATION ANALYSIS

To examine whether the model presented in this paper correctly explains the impacts of RUMs' remittances on wage inequality, we use related economic data from China to calibrate the parameters of the model, and then we use the General Algebraic Modeling System to perform numerical simulations. Finally, we carry out a sensitivity analysis to test the robustness of the model's conclusions.

Calibration of parameters. We set up the production functions of three sectors as a Cobb-Douglas form:

$$X = S^{\alpha_1} L_1^{\alpha_2} K_1^{\alpha_3},\ Y = \beta L_2,\ Z = g(k) L_3^{\gamma_1} K_3^{\gamma_2} \tag{19}$$

where α_1, α_2, α_3, γ_1, and γ_2 are the respective output elasticities of the associated factors; β is the effective labour parameter in sector X; and $g(k)$ is the external effect function of remittance on rural production. According to the model, let $g(k)$ be represented as $g(k) = 1 + k^{\sigma}$, where σ is the externality parameter of RUMs' remittances on rural production.

Based on the three strata of industry in the National Bureau of Statistics of China (2017), let the primary industry be the rural sector Z and the secondary and tertiary industries be the urban formal sector X. As for the urban informal sector Y, we define labour employed in sector Y as including both the economically active population excluding employed persons, as well as RUMs who provide hotel and catering services, services to households, repair services, and other services. Turning to RUMs' remittances, according to the SRMCMW2016 (2017), the total number of RUMs in China was about 281.71 million, and their average monthly wage was about 487.23 USD. According to some Chinese survey data[9], we can calculate that the RUMs' remittances were about 363 414 million USD. As for the interest rate, it was calculated as being 6.9% according to the benchmark 1-to-5-year lending rate announced by China's central bank in 2016. Generally, in LDCs, the interest rate in the rural sector is higher than that of other sectors, which is 10.35% (= 1.5 × 6.9%).

[9]For details, see Electronic Supplementary Material S1 (ESM).
[10]The process of parameters calibration is discussed in greater detail in Supplementary Material S1 (ESM).

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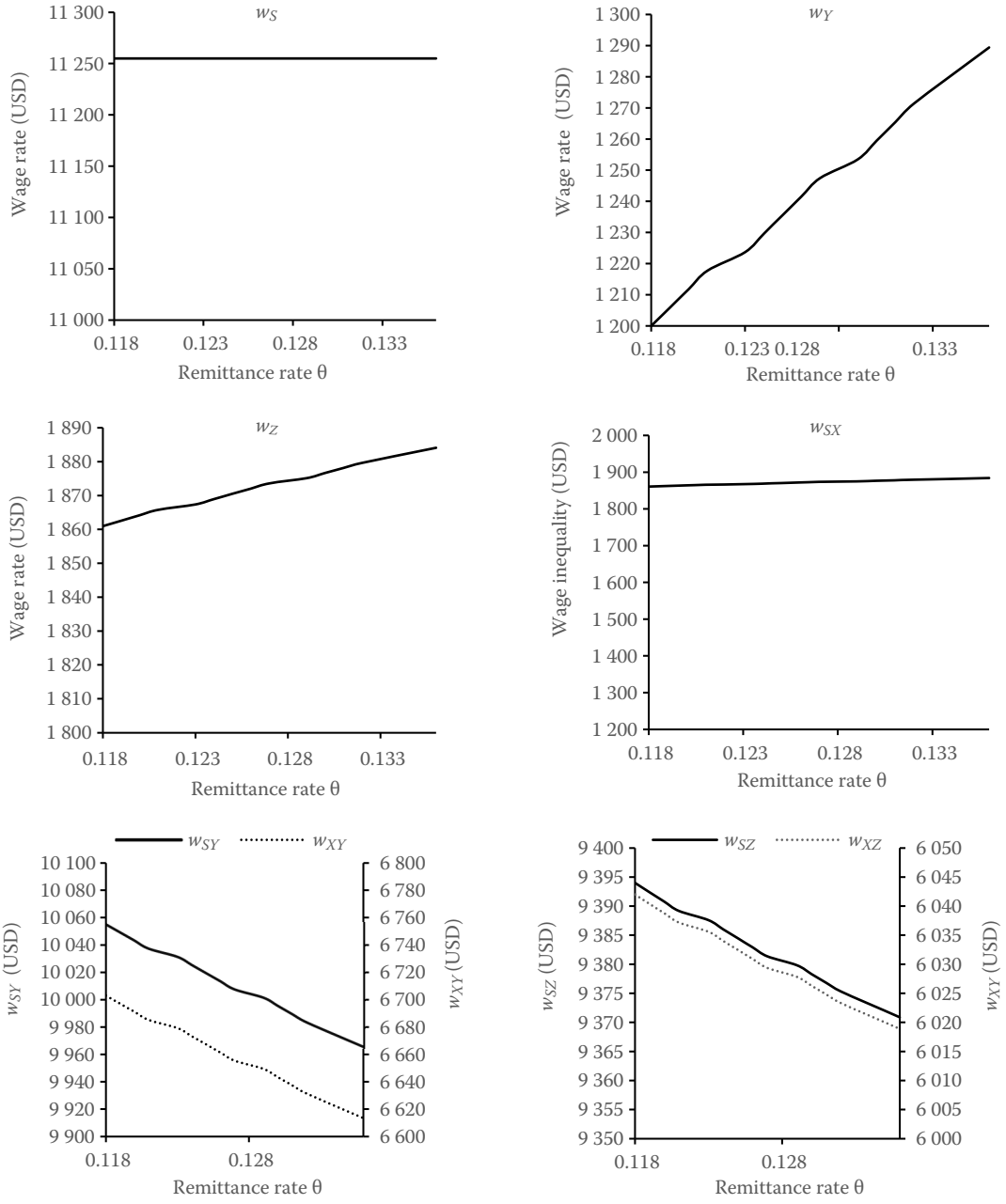

Figure 1. The numerical simulation results for the capital-specific case

Source: Author's own elaboration

We used the economic data described above to calibrate the parameters. The results are summarized in Table 3[10].

Numerical simulation. Based on the parameter calibration, we conducted a numerical simulation to test whether the conclusions of the model with realistic economic data are consistent with the results of comparative static analysis.

Numerical simulation for the capital-specific case. The numerical simulation results for the capital-specific case are shown in Figure 1. According to Figure 1, as the remittance rate, θ, increases, the wage rate of skilled labour, w_S, remains unchanged, but the wage rates in sector Y and sector Z, w_Y and w_Z, respectively, both increase. Therefore, w_{SX} remains unchanged, but the skilled-unskilled wage inequalities, w_{SY} and w_{SZ}, both decrease and the urban-rural wage inequalities, w_{XY} and w_{XZ}, also both decrease. This is consistent with the numerical characteristics of Propositions 1 and 2.

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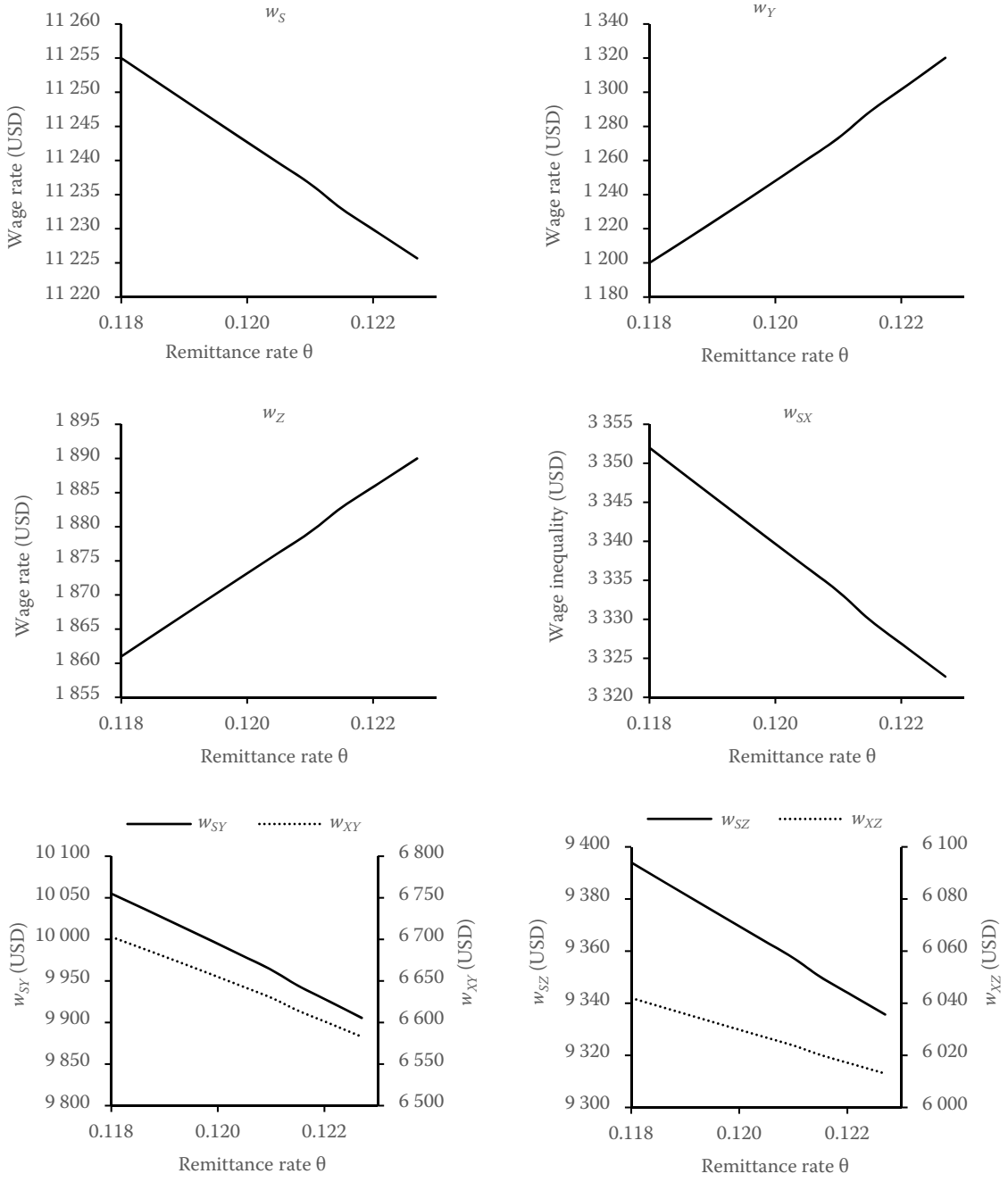

Figure 2. The numerical simulation results for the mobile capital case

Source: Authors' own elaboration

Numerical simulation for the mobile capital case. The numerical simulation results for the mobile capital case are shown in Figure 2. According to Figure 2, as θ increases, w_{SX} decreases, which is consistent with the numerical characteristics of Proposition 3. In addition, the skilled-unskilled wage inequalities, w_{SY} and w_{SZ}, decrease by a larger scale than the corresponding urban-rural wage inequalities, w_{XY} and w_{XZ}, respectively. This is consistent with the numerical characteristics of Proposition 4. However, in Figure 1, w_{SY} decreases by the same percentage as w_{XY}, while w_{SZ} decreases by the same percentage as w_{XZ}, which is different from Figure 2.

Sensitivity analysis. In the economy of China, the cost of rural capital varies in different regions and seasons. Thus, the rural interest rate, r_Z, cannot be reflected by a single rate. Therefore, we determined whether different values of r_Z could have a significant

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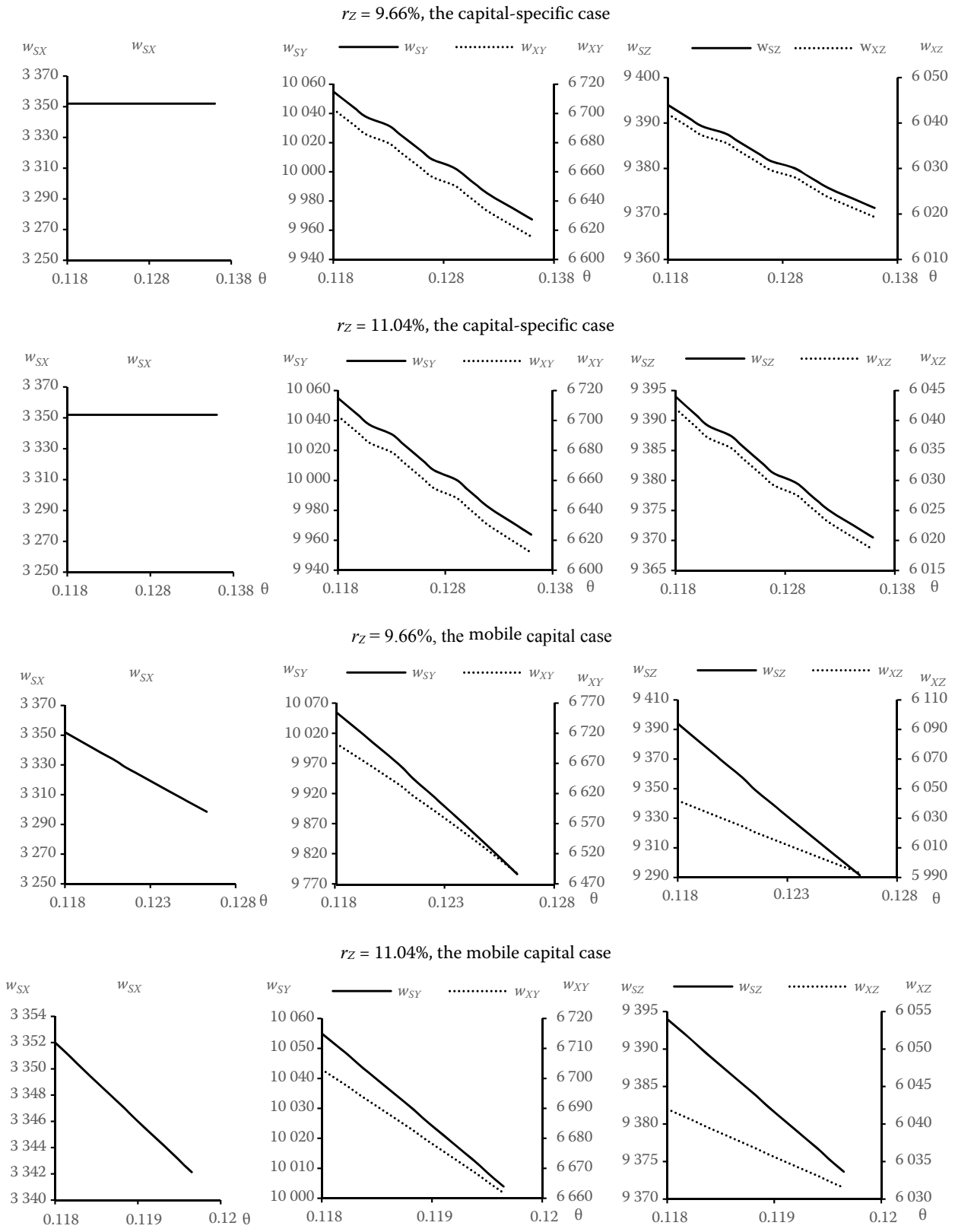

Figure 3. The numerical simulation results using different rural interest rates

Unit: USD

Source: Authors' own elaboration

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impact on our conclusions. In the analysis presented in the previous section, we set r_Z at 1.5 times the urban interest rate, r_X; here, we will use 1.4 times (9.66%) and 1.6 times (11.04%). Using different values of r_Z, we recalibrated σ: when r_Z is 9.66%, σ is 0.206, and when r_Z is 11.04%, σ is 0.212. As seen in Figure 3, differences in r_X had no influence on our conclusions. Thus, the numerical simulation was robust.

CONCLUSION

In this study, we used a general equilibrium model of endogenous remittances from RUMs and positive externality on agriculture, with which one can examine the effects of remittance rate on wage inequality in a small open economy. Similar to the findings of Quibria (1997), we find that an increase in RUMs' remittance volume (or rate) raises the wage rate in rural areas (labour-outsourcing region). Note that the main concern of Quibria (1997) is with international remittance. Furthermore, we take urban-rural wage inequality into consideration and hence complement those studies that only focused on the skilled-unskilled wage inequality, such as Li and Zhou (2013). It is shown that RUMs' remittances could help ease the wage inequalities between urban and rural areas. Further, dividing labour into skilled and unskilled labour makes our model different from those used by Li and Wang (2015). In this study, an increased remittance rate increases the low wage rate (w_Y), but does not affect or even reduces the high wage rate (w_S), in urban areas. That is to say, an increased remittance rate also improves the wage inequalities within urban areas. However, in Li and Wang (2015), the effects hinge on whether capital is sector specific or mobile.

These conclusions are not only of academic value, but also of practical significance for relevant economic policies. Using the parameters calibrated with Chinese macroeconomic data, we perform numerical simulations and find that the results support the theoretical analysis. Consequently, in a LDC, encouraging RUMs to raise their remittance rate would be an effective policy alternative for reducing wage inequality.

It should be noted that the results for the mobile capital case are dependent on the assumption of factor substitution in sector *X*. It is clear that further analysis should be done with this assumption relaxed. Obviously, taking rural skilled labour into account is also a good avenue for future research.

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