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ABSTRACT

Could the policy to promote overseas migrant work be to blame for the sluggish development in some South Asian countries? I employ a macro-dynamic model of two small open economies to examine the policy of the developing, labor-exporting country to promote migrant work in a rich, labor-importing economy. The results from calibration exercises show that remittances received from migrant workers are expansionary through its collateral impact. However, the loss of labor due to the policy hinders capital accumulation in the poor country; as a result, it reduces income in the long run. Welfare, however, increases due to the increase in consumption stimulated by the increase in remittances. The impacts are more pronounced for a poorer country such as Nepal whose remittance receipts amounted to more than 30 percent of GDP.

1. Introduction

In an era of industrialization, Lewis (1954) argues that new industries can be created and old industries expanded without any shortage of labor in countries with abundant cheap labor that moved from agriculture into manufacturing. However, since the 1970s many South Asian countries including Bangladesh, India, Pakistan, Nepal, and Sri Lanka have put in many efforts to promote overseas migrant work. This policy was triggered by significant labor demand in the Middle East and foreign currency earnings as migrant workers send remittances back to their families at home (Lim and Basnet, 2017). According to the World Bank's Migration and Remittances Data, by 2017 India had over 16 million of its citizens working outside of India, followed by Bangladesh and Pakistan, which exported 7.7 million and 6 million migrants, respectively. Nepal and Sri Lanka each had over 1.7 million of its citizens working abroad. These workers also sent in billions of dollars annually back home. For example, the flow of remittances in Nepal amounted to more than 30% of its GDP in 2016. However, according to the latest 2019–2020 classification by the World Bank, Nepal is still in a low-income group with income less than $1,025; Bangladesh, India and Pakistan are still in lower-middle-income group; and Sri Lanka has just graduated into the upper-middle-income group.

In views of Lewis's (1954) argument, could the policy to promote overseas migration be to blame for the sluggish development in these poor Asian countries? In this paper, I employ a macro-dynamic model of two small open economies – a rich, labor-importing country and a developing, labor-exporting country – to examine the macroeconomic impacts of this policy. The model employed in this study combines the model used in Lim and Morshed (2017) and that used in Chatterjee and Turnovsky (2018). I extend the model used in Lim and Morshed (2017) by introducing Chatterjee and Turnovsky's (2018) collateral effect of remittances in the borrowing constraint of the labor-exporting country. I also relax the assumption of inelastic supply of capital in the rich country by allowing capital to be converted from the traded goods with an adjustment cost. Different from Chatterjee and Turnovsky (2018), the model captures endogenous remittances that are linked to the household's decision to migrate.[1]

Here I briefly describe the analytical framework. The focus should be on the developing country while the rich country is included mainly to capture the endogenous flow of migrant labor and remittances. Thus, there is an abstract in the structure of the rich country. The rich country is assumed to be a small open economy, so that it faces the world interest rate which is exogenously determined outside the model. The assumption of this rich, small open economy is, in fact, consistent with a sample of Middle Eastern countries like Bahrain, Kuwait, Oman,

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[1] Naval (2019) and Shen et al. (2010) also allow for endogenous migration and remittances in a migration model to examine the relationship between migration and inequality.

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0165-4896/

Qatar, Saudi Arabia, and United Arab Emirates, which employ significant amount of migrant labor in their economies. In the rich economy, households consume a traded good and leisure. The production of the traded good uses private capital, native labor, and migrant workers. Private capital can be converted from the traded good with an adjustment cost. The households in the rich country decide only between leisure and working in the domestic production. Thus, no labor migrates from the rich country to work in the developing country. In contrast, households in the developing country decide on the allocation of time between (i) leisure, (ii) domestic manufacturing production, (iii) and migrant work. Migrant workers earn a migrant wage and remit a portion of their earning after consuming in the rich country. This gives rise to an endogenous flow of remittances that is associated with migration, in line with the findings of Lim and Morshed (2015). Labor in both countries including migrant workers is paid with its respective marginal product.

Households in both countries are assumed to have access to the international financial market, but they are constrained by the upward-sloping supply curve of debt. That is, they are charged an interest rate that includes a borrowing premium above the given world interest rate. The borrowing premium – a proxy for the country's risk – reflects the country repayment capacity and comprises the current level of debt relative to the size of its GDP. For the developing country, the risk premium also captures the country's remittances as foreign currency earnings in the repayment capacity. Thus, a larger remittance inflow raises its foreign reserves and repayment capacity, thus reducing the risk premium. I assume that migration incurs a cost due to frictions that result from tightened immigration laws or stricter control over hiring migrant workers. This friction parameter also serves as the policy to promote migration of the poor country. For example, this friction can be reduced when the government of the poor country puts forward efforts to establish a formal process to find jobs for migrant labor. This policy is discussed in details in the next section.

The model is then calibrated to yield a long-run equilibrium consistent with the data for samples of Middle Eastern, labor-importing countries and South Asian, labor-exporting countries. In the calibration exercises, I show that remittances are expansionary for the labor-exporting, developing economy through its collateral impact. However, the policy to promote overseas migrant work is contractionary because the negative income effect due to labor migration significantly outweighs the expansionary effect from the remittance inflow. The loss of labor due to the policy hinders domestic capital accumulation, costing its long-run economic development. However, the welfare increases due to rising consumption as a result of increased remittance receipts. Additional results from applying the model to the case of Nepal show that the macroeconomic impacts of the policy to promote overseas migration are more pronounced for a poorer country although it receives a substantial share of remittances to its GDP. The collateral impact of remittances is also larger for a large share of remittances. However, with a large elasticity of wage at a lower level of income, Nepal also suffers a great loss of output due to migration.[2]

The paper contributes to the literature in two important ways. First, the paper provides a theoretical implication for the policy of many poor countries to promote overseas migrant work for its citizens, which has not been studied before. Second, the paper extends the macro-dynamic model in the literature by combining two features – the endogenous migration and the collateral effect of remittances. The extension allows us to evaluate two opposing impacts – the gain from remittances vs the loss of labor due to migration – on the labor-exporting country.

The remainder of the paper is organized as follows: Section 2 provides some background information. Section 3 details the analytical model. Section 4 derives the macroeconomic equilibrium. Section 5 presents and discusses the numerical calibration exercises including the exercise for Nepal, a country that receives a large share of remittances. Section 6 provides some robustness tests. Finally, Section 7 concludes the findings.

2. Background

Since 1970, many South Asian countries including Bangladesh, India, Pakistan, Nepal, and Sri Lanka have put in many efforts to promote overseas migrant work. These efforts are in large part driven by the increase in labor demand in the Middle East. Formal institutions have been established to formalize and govern the migration processes. In 1971, the Pakistani government created the Bureau of Emigration and Overseas Employment to promote overseas employment. India enacted the Emigration Act in 1983, and later established the Ministry of Overseas Indian Affairs, to centralize all processes related to the Indian migrant workers. In 1984, the Bangladeshi government formed the Bangladesh Overseas Employment and Services Limited for the export of Bangladeshi workers. Nepal approved the Foreign Employment Act in 1985, which led to the establishment of the Department of Foreign Employment. Sri Lanka established the Sri Lanka Bureau of Foreign Employment under legislation approved in 1985.

These institutions are established to promote overseas migrant work for their citizens by setting up and governing a formal procedure for the migrant employment markets. The governance involves a variety of roles including as a regulator and a policy maker. As a regulator, they license and supervise the overseas employment agencies which operate as recruiters, advertising the available jobs, recruiting migrant workers, training them, acquiring necessary documents including passports and visas, and so on. The institutions also ensure that the employment activities are in compliance with the labor law. As a policy maker, the institutions get involved in the cooperation between the labor-exporting and labor-importing countries. In some cases, they may also represent their government as a signatory in the Memorandum of Understanding (MOU) on the migrant labor agreement.

The efforts have led to significant surge in migrant workers seeking jobs overseas and remittances that they send back home. Fig. 1 illustrates the trends of the share of migrant workers and the remittance–GDP ratio in each of the five South Asian countries. The share of migrant workers is the number of migrant workers (excluding those migrating within the region) as a percentage of the labor-exporting country's population and remittance–GDP ratios are averaged over each decade to smooth out any short-run fluctuations. The reason that migrant workers within the region are excluded is that traditionally there was migration within these South Asian countries even before the

[2] Human capital is not modeled in this study. There are two channels that international migration can have a positive effect on human capital of the labor-exporting countries: a direct remittance effect and an effect of skilled migration prospects. While there is micro evidence that remittance-receiving families spend more on education of their kids (Yang, 2008), there is no evidence that remittances increase the level of education at the macro level (see Beine et al., 2008; Lim and Simmons, 2016). Beine et al. (2008) also show that there is a possible brain gain for countries with small skilled migration rates as the effect of skilled migration incentive dominates that of actual skilled emigration. In the 1990 data, they find that the gain in terms of proportion of skilled population is relatively small for South Asian countries, 0.3% for India, 0.2% for Bangladesh, 0.1% for Nepal and barely 0% for Pakistan while for Sri Lanka the proportion of skilled population dropped by 0.6% due to skilled emigration. Given a large increase in migration in these countries in recent years due to the policy to promote labor migration, the gains for these countries may be smaller or even disappear. Nonetheless, this issue deserves a more careful investigation.

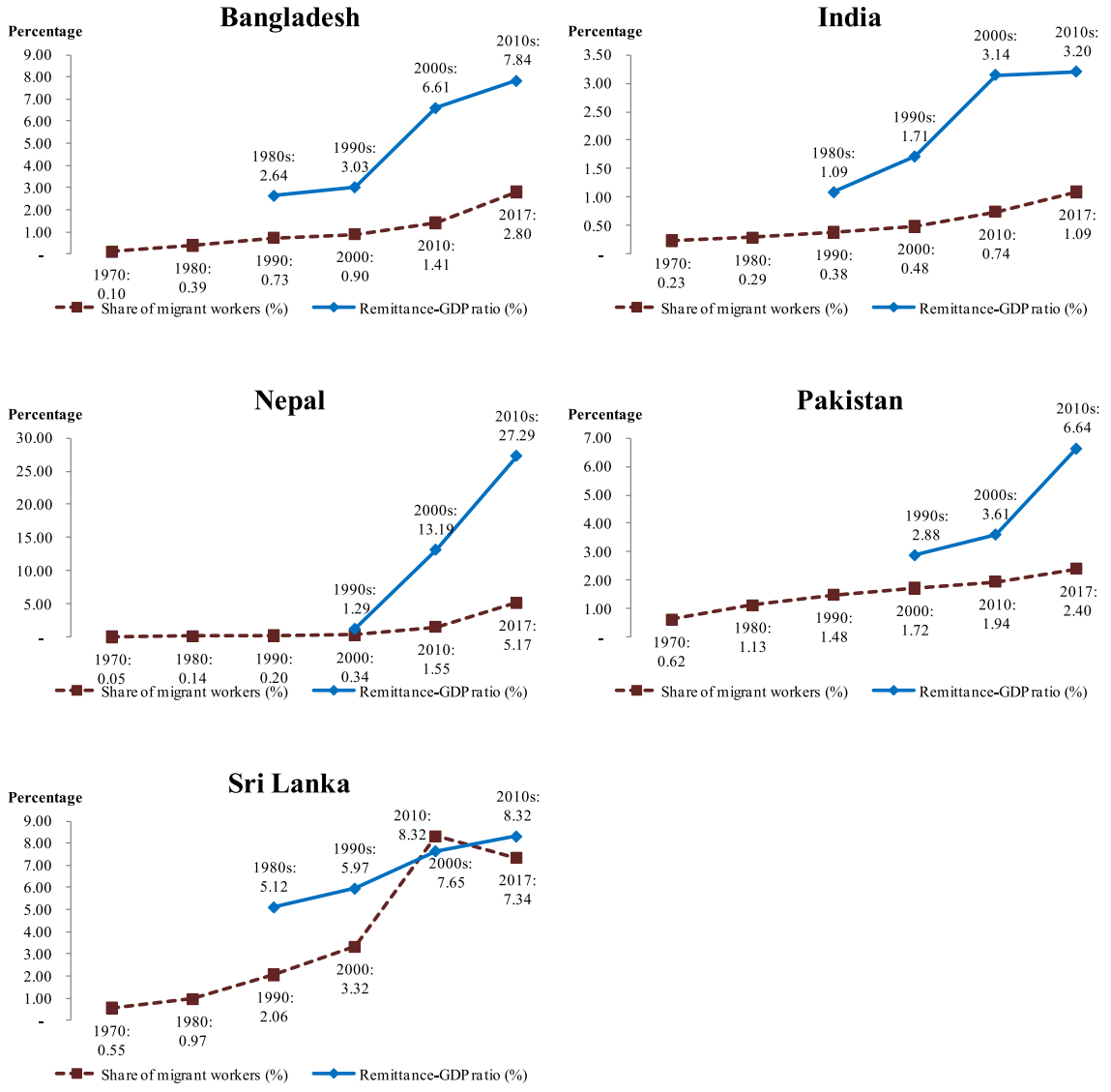

Fig. 1. Migration and remittances in South Asian countries. Notes: Share of migrant workers (excluding migrant workers within the region) is the percentage of the population of its respective country. Remittance–GDP ratio is the annual average share within the respective decade. The data for Nepal's remittances in 1980s are missing and those for Pakistan's are not included as they could be manipulated by huge Pakistani migrants within the region as discussed in the text.
Source: Author's calculations of data from World Bank's Migration and Remittances Data and World Development Indicators.

policy was in place. For instance, there were more than 8 million Pakistani migrants in India between 1960 and 1970 and then the number dropped to nearly 2 million in 1990, and to just above 1 million between 2000 and 2010 (World Bank's Migration and Remittances Database, 2020).

According to Fig. 1, the share of migrant workers from each of these South Asian countries has been on the rise, indicating that the growth of migrant workers is higher than that of its population. By 2017, India had about 1.09% of its 1.3 billion people working as migrant workers outside the region; Bangladesh had 2.8% of its 159 million people as migrant workers; Pakistan had 2.4% of its 207 million people while the small countries like Nepal and Sri Lanka had the largest share, 5.17% of its 27 million people and 7.34% of its 21 million people, respectively, as migrant workers. These increased outflows of migrant workers also coincided with the rising inflows of remittances. Between 2010 and 2019, the average share of remittances (as percentage of GDP) reached 3.2% in India from about 1% in 1980s, 7.8% in Bangladesh from 2.6% in 1980s, 6.6% in Pakistan from 2.9% in 1990s, 27% in Nepal from 1.3% in 1990s, and 8.3% in Sri Lanka from 5.1% in 1980s.

3. Model

I set up a simple macro-dynamic model of two small open economies consisting of a rich, labor-importing country and a developing, labor-exporting country. Both economies produce the same traded good and are small in that they take the price of the traded good as given. Both economies also have access to the world financial market, but are subject of a borrowing premium, which reflects their associated risk. The world interest rate is exogenously determined outside the model. The two countries are described as follows.

3.1. Rich, labor-importing country

Firms in the rich country use capital (K_h), native labor (N_h) and migrant workers (N_m) to produce traded output (Y_h). The

country's production technology is given by the neoclassical function

$$Y_h = f\left(K_h, N_h, N_m\right) \tag{1}$$

where $f_{K_h} > 0, f_{N_h} > 0, f_{N_m} > 0, f_{K_hK_h} < 0, f_{N_hN_h} < 0, f_{N_mN_m} < 0, f_{K_hN_h} > 0, f_{K_hN_m} > 0$ and $f_{N_hN_m} > 0$. So, all three productive factors, and more specifically, native and migrant workers, are complements in production. The assumption of complementarity of migrant and native workers in production $\left(f_{N_hN_m} > 0\right)$ implies that the inflow of migrant workers will raise the marginal product of native workers and thus, their wage rate (given stock of physical capital).

The profit maximizing behavior of firms yields the conventional demand functions for capital, native labor and migrant workers as follows

$$r_{K_h} = pf_{K_h}\left(K_h, N_h, N_m\right) \tag{2}$$

$$w_h = pf_{N_h}\left(K_h, N_h, N_m\right) \tag{3}$$

$$w_m = pf_{N_m}\left(K_h, N_h, N_m\right) \tag{4}$$

where r_{K_h}, w_h and w_m are the return on capital, the wage rate for natives and the wage rate for migrant workers, respectively. p is the output price in the rich country. Both countries take this price as given since they are too small to influence it. Eq. (2) is the rich country's demand for capital which equates the marginal product of capital to the return on capital; Equation (3) is the rich country's demand for native labor which equates their marginal product to the natives' wage rate while Equation (4) is the rich country's demand for migrant workers which equates migrants' marginal product to the migrants' wage rate. Furthermore, if natives are more productive than migrant workers then $w_h > w_m$, and vice versa.

The households in this economy invest domestically an amount I_h; however, converting traded goods into domestic investment incurs an adjustment cost. The gross investment cost can be expressed

$$\Phi_h\left(I_h, K_h\right) = I_h\left(1 + \frac{hI_h}{2K_h}\right) \tag{5}$$

where h is the unit-free cost parameter. The specification follows Hayashi (1982). Without the depreciation cost, the capital accumulation can be written as

$$\dot{K}_h = I_h \tag{6}$$

Each household in the rich country is endowed with one unit of time and allocates it between leisure (L_h) and work (N_h). Native labor supply is subject to the constraint

$$N_h = 1 - L_h \tag{7}$$

Households in the rich economy obtain utility from consumption (C_h) and leisure (L_h) which follows the concave utility function

$$W_h = \int_0^\infty H\left(C_h, L_h\right) e^{-\beta t} dt \tag{8}$$

where β is the rate of time preference, subject to their accumulation of foreign debt

$$\dot{B}_h = r_h B_h + C_h + T_h + \Phi_h\left(I_h, K_h\right) - r_{K_h}K_h - w_h N_h \tag{9}$$

where r_h denotes unit borrowing costs, and B_h is the rich country's stock of debt. T_h is the lump-sum tax imposed by the government of the rich economy.

The household in the rich economy has access to the international financial markets; however, they are subject to a borrowing premium, which reflects their associated risk. This borrowing premium is assumed to be strictly increasing and convex in the nation's aggregate debt (B_h), relative to its ability to service the debt, as reflected by GDP, Y_h. The cost of borrowing is thus specified by[3]

$$r_h = r^* + \omega\left(\frac{B_h}{Y_h}\right); \qquad \omega' > 0, \omega'' > 0 \tag{10}$$

where r^* is the exogenous real world interest rate, and $\omega\left(B_h/Y_h\right)$ is the borrowing premium. In the decision process, the household, in a decentralized economy, takes the borrowing cost as given. This is because it is a function of the economy's aggregate debt to output ratio which in a small open economy an individual household is too small to influence.

The households in the rich economy maximize (8) by choosing consumption C_h, leisure L_h, investment I_h, capital stock K_h, and debt B_h, subject to (6), (7) and (9). The Hamiltonian equation can be written as

$$\begin{aligned} \mathrm{H}^{\mathrm{R}} \equiv\ & H_{C_h}\left(C_h, L_h\right) e^{-\beta t} + \pi' e^{-\beta t}\left(1 - L_h - N_h\right) + q_h e^{-\beta t}\left(I_h - \dot{K}_h\right) \\ & - \pi e^{-\beta t}\left(r_h B_h + C_h + T_h + I_h + \frac{hI_h^2}{2K_h} - r_{K_h}K_h - w_h N_h - \dot{B}_h\right) \end{aligned} \tag{11}$$

and the optimality conditions are given by

$$H_{C_h}\left(C_h, L_h\right) = \pi \tag{12}$$

$$H_{L_h}\left(C_h, L_h\right) = \pi w_h \tag{13}$$

$$\beta - \frac{\dot{\pi}}{\pi} = r_h \tag{14}$$

$$q_h - 1 = h\frac{I_h}{K_h} \tag{15}$$

$$\frac{\dot{q}_h}{q_h} + \frac{1}{q_h}\left[r_{K_h} + \frac{\left(q_h - 1\right)^2}{2h}\right] = r_h \tag{16}$$

where π and q_h are the shadow prices of wealth and private capital, each of which is relative to that of foreign bonds, respectively.

Eq. (12) equates the marginal utility of consumption to the shadow price of wealth. Eq. (13) is the native labor supply equation which implies that the marginal utility of leisure is equal to the utility-adjusted return to labor. Eq. (14) is the Keynes–Ramsey consumption rule which equates the rate of return on consumption to the borrowing cost. Eq. (15) is the optimum decision for private investment while Eq. (16) is the no-arbitrage condition for private investment, equating the return on physical capital to the cost of borrowing.

The transversality conditions require that

$$\lim_{t\to\infty} \pi_h K_h e^{-\beta t} = 0; \lim_{t\to\infty} \pi B_h e^{-\beta t} = 0 \tag{17}$$

where $\pi_h = q_h\pi$ is the shadow price of private capital stock.

Finally, I assume a very simple form of government budget in the rich economy. This government balances the budget at all times by spending all the tax revenue. Thus,

$$G_h = T_h \tag{18}$$

3.2. Developing, labor-exporting country

Firms in the developing country use its own labor and capital to produce a traded (manufacturing) good. The neoclassical production function is of the form

$$Y_d = F\left(K_d, N_d\right) \tag{19}$$

[3] Foreign borrowing constraint of Eq. (10) has long been used in macrodynamic models and forms a convenient way of closing the "small economy model"; see Turnovsky (1997). Empirical evidence supporting functions of this form is provided by Edwards (1984) and more recently by Chung and Turnovsky (2010).

where Y_d is the economy's traded output. N_d is labor employed in the traded sector. I assume that $F_{K_d} > 0, F_{K_dK_d} < 0, F_{N_d} > 0$ and $F_{N_dN_d} < 0$. The profit-maximization behavior of firms in the developing country yields the following demand functions for labor and physical capital

$$F_{N_d}(K_d, N_d) = w_d \tag{20}$$

$$F_{K_d}(K_d, N_d) = r_{K_d} \tag{21}$$

where r_{K_d} and w_d are the real return on physical capital and the real wage rate, respectively. By appropriate choice of units, the price level in this economy is assumed to be unity.

The households in this economy invest domestically an amount, I_d; however, converting traded goods into investment incurs an adjustment cost. The gross investment cost is expressed as

$$\Phi_d(I_d, K_d) = I_d\left(1 + \frac{\eta I_d}{2K_d}\right) \tag{22}$$

where η is the unit-free cost parameter. Without the depreciation cost, the capital accumulation can be written as

$$\dot{K}_d = I_d \tag{23}$$

Each household is endowed with one unit of time and allocates it among traded production (N_d), migrant work abroad (N_m) and leisure (L_d). The labor market constraint is then expressed as

$$N_d + N_m + L_d = 1 \tag{24}$$

I assume that like the rich country, the household in the developing country also has access to the world financial market. The household faces an upward-sloping supply curve for debt. As noted in Chatterjee and Turnovsky (2018), remittances have become important for some developing countries, especially those with high remittance-to-GDP ratio, to use as collateral in securing borrowing. Thus, I explicitly allow for possible portion, κ, where $0 \leq \kappa \leq 1$, of the flow of remittances to serve as a component of repayment capacity. Thus, the interest rate function is specified as

$$r = r^* + \Omega\left(\frac{B_d}{Y_d + \kappa R}\right); \quad \Omega' > 0, \Omega'' > 0 \tag{25}$$

where B_d is the country's stock of debt; r is the interest rate faced by the household in the developing country; and $\Omega\,(B_d/(Y_d + \kappa R))$ is the borrowing premium. Similar to the rich economy, the assumption of small open economy implies that individual household cannot influence the interest rate and so takes it as given.

The developing economy household's instantaneous budget constraint can be written as

$$\dot{B}_d = rB_d + C_d + C_m + T_d + \Phi_d(I_d, K_d) - (1-\tau) r_{K_d} K_d - w_d N_d - \xi w_m N_m \tag{26}$$

where C_d is the consumption of the representative household (located in the developing country) and C_m is the consumption of migrant workers chosen by the household in this economy. T_d represents the lump-sum tax. τ is the tax rate imposed on private capital income.

Migrant workers remit a fraction of income after consumption (C_m) back to their family in the home country. This specification draws upon the empirical work of Lim and Morshed (2015) who empirically show that the increased remittances to developing countries is the result of migration triggered by income shocks. The equation for remittances (R) can be written as

$$R = \xi w_m N_m - C_m \tag{27}$$

where $0 < 1 - \xi < 1$ is the cost associated with migration. This cost includes expenses such as job search, work permits and transportation. This cost could be high for an informal migrant labor market where migrant workers must go through many hurdles including time spent on the immigration process of the host country to obtain the work visa/permit. While migrant workers are paid with their marginal product, the loss of migrant income due to the friction is treated as a deadweight loss which disappears from the model. In this paper, I use ξ as the policy variable. In an effort to promote overseas migrant work, the South Asian governments have formalized the migrant labor market by establishing institutions within the administrations to help facilitate and govern the process. I assume that this formalization leads to a lower migration cost; thus, the policy to promote labor migration is associated with $\xi \to 1$.

The representative household derives utility from domestic consumption, migrant consumption abroad and leisure. The utility function is

$$W_d = \int_0^\infty \left[U(C_d, L_d) + M(C_m)\right] e^{-\beta t} dt \tag{28}$$

where $U_{C_d} > 0, U_{L_d} > 0, U_{C_dC_d} < 0$, and $U_{L_dL_d} < 0$. $M(C_m)$ is the utility of migrants from consuming while working abroad, with $M_{C_m} > 0$ and $M_{C_mC_m} < 0$. For simplicity, $M(C_m)$ is assumed to be additively separable from $U(C_d, L_d)$.

The households in the developing country maximize (28) by choosing domestic consumption C_d, migrant consumption C_m, leisure L_d, migrant workers N_m, investment I_d, capital stock K_d, and debt B_d, subject to (23), (24) and (26). The Hamiltonian equation can be written as

$$\begin{aligned} \mathrm{H}^{\mathrm{D}} \equiv\ & \left[U(C_d, L_d) + M(C_m)\right] e^{-\beta t} + \lambda' e^{-\beta t}\left(1 - L_d - N_d - N_m\right) \\ & + q_d e^{-\beta t}\left(I_d - \dot{K}_d\right) \\ & - \lambda e^{-\beta t}\left[rB_d + C_d + C_m + T_d + + I_d + \frac{\eta I_d^2}{2K_d}\right. \\ & \left. - (1-\tau) r_{K_d} K_d - w_d N_d - \xi w_m N_m - \dot{B}_d\right] \end{aligned} \tag{29}$$

and the optimality conditions are given by

$$U_{C_d}(C_d, L_d) = \lambda \tag{30}$$

$$M_{C_m}(C_m) = \lambda \tag{31}$$

$$U_{L_d}(C_d, L_d) = \lambda w_d = \lambda \xi w_m \tag{32}$$

$$\beta - \frac{\dot{\lambda}}{\lambda} = r \tag{33}$$

$$q_d - 1 = \eta \frac{I_d}{K_d} \tag{34}$$

$$\frac{\dot{q}_d}{q_d} + \frac{1}{q_d}\left[(1-\tau) r_{K_d} + \frac{(q_d - 1)^2}{2\eta}\right] = r \tag{35}$$

where λ is the shadow price of wealth in the form of foreign bonds. q_d denotes the shadow price of private capital relative to that of foreign bonds.

Eqs. (30) and (31) equate the marginal utility of domestic consumption and that of migrant consumption, respectively, to the shadow price of wealth. Eq. (32) is the labor supply equations for all labor markets including the domestic traded good production and the migrant labor market. That is, the marginal utility of leisure is equal to the utility-adjusted return to work in each of the labor markets. This means that any changes in either of the wage incomes will affect the amount of leisure, as well as consumption of final goods. Eq. (33) is the Keynes–Ramsey consumption rule which equates the return on consumption to the cost of borrowing, given by (25). Eq. (34) is the optimum decision for private investment while Eq. (35) is the no-arbitrage

condition for private investment, equating the return on physical capital to the cost of borrowing.

In addition, the transversality conditions require

$$\lim_{t\to\infty} \lambda_d K_d e^{-\beta t} = 0; \quad \lim_{t\to\infty} \lambda B_d e^{-\beta t} = 0 \tag{36}$$

where $\lambda_d = q_d\lambda$ is the shadow price of private capital stock.

Finally, the government of the developing country collects its revenue from a tax on capital income and a lump-sum tax, T_d, from the domestic household. The total tax revenue is used for public consumption, G_d. For simplicity, it is assumed that public consumption yields no utility. Following Baxter and King (1993), I assume that the government uses lump-sum tax, T_d, to maintain a balanced budget at all points of time. The government budget constraint is

$$\tau r_{K_d} K_d + T_d = G_d \tag{37}$$

where $G_d = gY_d$. That is, the government of the developing country sets its expenditure policy so as to claim a fixed share, g, of GDP, where $0 < g < 1$. Thus, the size of the government increases with the size of the economy.

4. Macroeconomic equilibrium

In this section, I combine the two economies to derive their macroeconomic equilibrium. The important feature is that labor migration links the two economies, so that the economic performance in the developing country depends on not just the physical capital at home, but also capital stock and labor employed in the rich country.

Using (3) and (7), the rich economy's consumption (C_h) and native labor supply (N_h) can be derived from (12) and (13) as

$$C_h = C_h(\pi, K_h, N_m; p) \tag{38}$$

$$N_h = N_h(\pi, K_h, N_m; p) \tag{39}$$

I can derive the equilibrium consumption (C_d) and labor supplies in the two labor markets (N_d and N_m) from Eqs. (20), (24), (30) and (32) as

$$C_d = C_d(\lambda, K_h, K_d, N_h; p) \tag{40}$$

$$N_d = N_d(\lambda, K_h, K_d, N_h; p) \tag{41}$$

$$N_m = N_m(\lambda, K_h, K_d, N_h; p) \tag{42}$$

4.1. Equilibrium dynamics

Using Eqs. (38)–(42), I can derive C_h, N_h, C_d, N_d, and N_m as a function of π, λ, K_h and K_d. This suggests that once I determine the time paths of both capital stocks (K_d, K_h), the shadow price of wealth of the developing economy (λ), and that of the rich economy (π), I can derive the time paths of both consumption quantities (C_d, C_h) and labor supplies (N_d, N_m, N_h). These time paths of K_d, K_h, λ and π, together with q_d, q_h, B_d and B_h can be determined from the following equilibrium dynamics of the model

$$\dot{\lambda} = \lambda(\beta - r) \tag{43}$$

$$\dot{B}_d = rB_d + C_d + C_m + \frac{K_d}{2\eta}\left(q_d^2 - 1\right) - (1-g)F(K_d, N_d) - \xi p f_{N_m} N_m \tag{44}$$

$$\dot{\pi} = \pi(\beta - r_h) \tag{45}$$

$$\dot{B}_h = r_h B_h + C_h + \frac{K_h}{2h}\left(q_h^2 - 1\right) + G_h - p f_{K_h} K_h - p f_{N_h} N_h \tag{46}$$

$$\dot{q}_h = r_h q_h - \left[p f_{K_h} + \frac{(q_h - 1)^2}{2h}\right] \tag{47}$$

$$\dot{K}_h = \frac{K_h}{h}(q_h - 1) \tag{48}$$

$$\dot{q}_d = r q_d - \left[(1-\tau)F_{K_d} + \frac{(q_d - 1)^2}{2\eta}\right] \tag{49}$$

$$\dot{K}_d = \frac{K_d}{\eta}(q_d - 1) \tag{50}$$

where Eqs. (44) and (46) describe the evolutions of debt for the developing and rich economies, respectively. r_h and r are given by Eqs. (10) and (25), respectively.

The equilibrium is characterized by an autonomous system of eight differential equations. The rich country's capital stock (K_h), the capital stock of the developing country (K_d), the rich country's foreign debt (B_h), and the debt of the developing country (B_d) are assumed to move sluggishly, while the shadow prices of wealth, λ and π, and the capital prices, q_d and q_h, are free to jump instantaneously. In Appendix A, I show how to solve for the linearized stable solutions for K_d, K_h, λ, π, q_d, q_h, B_d and B_h to the equilibrium dynamics of the model.

4.2. Steady state

In the long run, the model economies progress to a steady-state position in which $\dot{\lambda} = \dot{B}_d = \dot{\pi} = \dot{B}_h = \dot{q}_h = \dot{K}_h = \dot{q}_d = \dot{K}_d = 0$ and along with Eqs. (31) and (38)–(42), I can solve for the steady-state values of $\tilde{\lambda}, \tilde{B}_d, \tilde{\pi}, \tilde{B}_h, \tilde{q}_h, \tilde{K}_h, \tilde{q}_d, \tilde{K}_d, \tilde{C}_d, \tilde{C}_m, \tilde{N}_d, \tilde{N}_m, \tilde{C}_h$ and $\tilde{N}_h$ where the "$\sim$" denotes a steady-state value for an endogenous variable. The steady-state equilibrium can be summarized by the set of relationship, applicable to the rich and developing countries, respectively. See the set of steady-state equations in Appendix B. There are thirteen equations that determine the long-run equilibrium. They indicate some interdependence between the two economies. The economy of the labor-importing country can be affected by any changes in the labor-exporting country that impact migrant workers. The economy of the labor-exporting country can also be affected by any changes that impact the remittances it receives from the labor-importing countries. The numerical simulations will demonstrate these cases with the policy of the labor-exporting country to promote overseas migrant work for its workers.

5. Numerical analysis

The dynamic system comprises highly non-linear equations. Also, because of the high dimensionality of the system, further insights can be obtained by calibrating the model to reflect the real-world data. The calibration exercises are performed to illustrate the theoretical mechanism and the analyses are done to fit the real data as much as possible. The results would depend on the chosen values of parameters; therefore, the robustness tests are presented in the next section. The following functional forms are used.

The rich, labor-importing country's utility function is of the form

$$H(C_h, L_h) = \frac{1}{\phi}\left(C_h L_h^{\varphi}\right)^{\phi} \tag{51}$$

where φ represents the relative importance of leisure in utility and $1/(1-\phi)$ is the intertemporal elasticity of substitution. The labor-importing country's production is expressed by the three-input nested constant-elasticity-of-substitution (CES) function

$$Y_h = A_h\left[\alpha_1 K_h^{\rho_1} + (1-\alpha_1)\left[\alpha_2 N_h^{\rho_2} + (1-\alpha_2)N_m^{\rho_2}\right]^{\frac{\rho_1}{\rho_2}}\right]^{\frac{1}{\rho_1}} \tag{52}$$

In the first stage native and migrant workers combine via a CES aggregator to yield total labor, which is then combined with

capital to produce final output; $-\infty < \rho_1, \rho_2 < 1$ and $1/(1-\rho_1)$ and $1/(1-\rho_2)$ are the CES between capital stock and labor, and between native and migrant workers, respectively. In addition, $0 < \alpha_1, \alpha_2 < 1$ are the relative intensities of capital and native labor, respectively. A_h is the level of technology of the rich, labor-importing country.

The increasing borrowing cost faced by the residents of the labor-importing country is given by[4]

$$r_h = r^* + \omega\left(e^{a\frac{B_h}{Y_h}} - 1\right) \tag{53}$$

where r^* is the world interest rate. ω is the weight on the premium, and a parameterizes the rate at which the borrowing premium increases with its debt position. In the case of a perfect world capital market $a = 0$, the cost of borrowing reduces to r^*.

The developing, labor-exporting country's utility functions for domestic households and migrant workers are given by

$$U(C_d, L_d) = \frac{1}{\gamma}\left(C_d L_d^{\sigma}\right)^{\gamma}; M(C_m) = \zeta_m \frac{C_m^{1+1/\delta_m}}{1+1/\delta_m} \tag{54}$$

where σ represents the relative importance of leisure in domestic households' utility and $1/(1-\gamma)$ is the intertemporal elasticity of substitution. ζ_m and δ_m are the weight and the elasticity of migrant consumption in their utility.

The production function in the labor-exporting country is of the CES form

$$Y_d = A_d\left[\theta K_d^{\zeta} + (1-\theta)N_d^{\zeta}\right]^{\frac{1}{\zeta}} \tag{55}$$

where $-\infty < \zeta < 1$; $1/(1-\zeta)$ is the CES between the stock of capital and labor and $0 < \theta < 1$ is the relative intensity of capital used in production. A_d is the level of technology of the developing country. The interest rate faced by its residents is given by

$$r = r^* + \Omega\left(e^{b\frac{B_d}{Y_d+\kappa R}} - 1\right) \tag{56}$$

where Ω is the weight on the premium, b is the rate of premium on borrowing, and κ parameterizes the extent to which remittances may serve as collateral in determining the premium.

Table 1 presents the parameter values used for calibrating the model and the steady-state values of the benchmark economies. I choose six Middle Eastern countries to represent rich countries which have imported a sizeable number of migrants from developing South Asian countries. The equilibrium dynamics are linearized around the steady-state equilibrium described in Appendix B. The numerical simulations confirm the existence of a saddle-point equilibrium, characterized by four stable (negative) and four unstable (positive) eigenvalues, ensuring a unique stable transitional path.

The parameter values are chosen in light of literature and the data. The choice of $\phi = \gamma = -1.5$ yields an intertemporal elasticity of 0.4, well within in the range of empirical evidence provided by Guvenen (2006). For the production in the two economies, $\rho_1 = 0.08$ and $\zeta = -0.21$ are to yield elasticity of substitution between capital and labor equal to, 1.087 and 0.82, respectively, for rich and developing countries (see Duffy and Papageorgiou, 2000). The choice of $\rho_2 = 0.5$ is to get an elasticity of substitution between migrants and natives equal to 2 (see Cortes, 2008).[5] The technology level of the rich country is set at $A_h = 6$ while that of the developing country at $A_d = 2.2$. The relative capital intensity in the rich country is set at $\alpha_1 = 0.15$ to obtain a capital–GDP ratio of 3.857, which is within the range for the data of the Middle Eastern countries while that in the developing country is set at $\theta = 0.15$ to obtain a capital–GDP ratio of 1.982, which is consistent with the data for the South Asian countries. Also, the relative migrant labor intensity of 0.13 ($\alpha_2 = 0.87$) is chosen to obtain a ratio of migrants to labor force equal to 16%, which is within the range for the data of the South Asian countries. The elasticity on leisure for the two economies, $\varphi = \sigma = 1.75$, is standard (see Turnovsky, 2004) and would yield consistent labor supplies for the two economies. The time allocation for the rich country, $\widetilde{N}_h = 0.382$, is well documented in the real business cycle literature (see Cooley, 1995) while the time allocation for the developing country, $\widetilde{N}_d = 0.367$, is consistent with the time use survey for India and Bangladesh (Narasimhan and Pandey, 1999; Bangladesh Bureau of Statistics, 2013). For government spending in the rich country, $G_h = 0.9$ is set to get a public spending-GDP ratio of 24%, within the range consistent with the data of the Middle Eastern countries while government spending-GDP ratio for the developing country is set at 30%, a plausible faction for the South Asian countries. The parameters in the utility of migrants ($\zeta_m = 0.2$; $\delta_m = -0.7$) are chosen to give a plausible level of migrant consumption and as a result a plausible share of remittances equal to 9.7% $\left(\tilde{R}/\tilde{Y}_d = 0.097\right)$ which is well within the range for the South Asian countries.[6]

The world interest rate is set at 3.5% and the borrowing premium parameters are chosen to yield debt–GDP ratios that are consistent with the data. In particular, for the benchmark calibration, the collateral parameter pertaining to remittances is set at $\kappa = 0$. The time preference, β, is set at 5% which is plausible for a developing country and with $\beta > r^*$ this will ensure that the economy is a net debtors in the equilibrium. The choice of $\xi = 0.94$ is equivalent to Mandelman and Zlate's (2012) assumption of 5-quarter income loss due to migration friction.

Another interesting thing to note is that given all the chosen parameters, the model produces the natives' real wage in the rich country ($\tilde{w}_h = 7.448$), that of migrant workers ($\tilde{w}_m = 2.591$), and that of workers in the developing country ($\tilde{w}_d = 2.436$). Thus, the native workers are more productive than migrant workers. The relative wage in the rich country to that in the developing country is about 3 times, which is consistent with the data ranging from 3 to 6 times (ILO, 2020). The difference between the wage rates of migrants and domestic labor in the developing country is due to migration friction, so the workers of the developing country are homogeneously less productive. At that wage level in the developing country, the elasticity of wage is 0.133, which is below Mishra's (2007) estimate of 0.4 for Mexican emigration to the U.S. and Bouton et al.'s (2011) estimate of 0.32 in the case of Moldovans' emigration. I will examine a higher elasticity of wage in the following case for Nepal.

5.1. Collateral effect of remittances

First, I examine the impact of remittances on the developing country as they enter and relieve the borrowing constraint of the recipient households. The case of full collateral effect ($\kappa: 0 \to 1$) is considered. The long-run result provided in Column (1) of Table 2 shows that remittances are expansionary for the developing country. The country also borrows more from the international market for investment. Domestic labor supply increases. As a

[4] This functional form is a widely adopted and offers a convenient representation of increasing borrowing costs for numerical simulations.

[5] To my knowledge, there are no estimates for the elasticity of substitution between migrant and native workers in the Middle East. I resort to using Cortes's (2008) estimate for low-skilled immigrants and native workers in the U.S.

[6] The choice of the adjustment cost parameters, $h = 0.35$ for the labor-importing country and $\eta = 0.85$ for the labor-exporting country, does not affect the steady-state values because in the steady state investments in both countries are zero and capital stocks are determined by the system of steady-state equations (B.1)–(B.13).

Table 1
Parameter values and steady-state values of the benchmark economies.

A. Parameter values				
Rich, labor-importing country				
Utility	$\phi = -1.5$; $\varphi = 1.75$; $\beta = 0.05$			
Production	$A_h = 6$; $\alpha_1 = 0.15$; $\alpha_2 = 0.87$; $\rho_1 = 0.08$; $\rho_2 = 0.5$; $h = 0.35$; $p = 1$			
Interest rate	$a = 0.04$; $\omega = 2$			
Government	$G_h = 0.9$			
Developing, labor-exporting country				
Utility	$\gamma = -1.5$; $\sigma = 1.75$; $\zeta_m = 0.2$; $\delta_m = -0.7$			
Production	$A_d = 2.2$; $\theta = 0.15$; $\zeta = -0.21$; $\eta = 0.85$			
Interest rate	$b = 0.05$; $\Omega = 1$; $\kappa = 0$			
Government	$\tau = 0.1$; $g = 0.3$			
Migration cost	$\xi = 0.94$			
World interest rate	$r^* = 0.035$			
B. Steady-state values of the benchmark economies				
Variable	Description	Model	Data	Data source
Rich country				
$\tilde{K}_h/\tilde{Y}_h$	Capital–GDP ratio	3.857	3.045 [1.813–3.927]	PWT 9.0
$\tilde{C}_h/\tilde{Y}_h$	Consumption-GDP ratio	0.702	0.330 [0.182–0.414]	WDI
$G_h/\tilde{Y}_h$	Gov't spending-GDP ratio	0.240	0.181 [0.111–0.235]	WDI
$\tilde{N}_h$	Native labor employment	0.382	0.3	Cooley (1999)
$\tilde{B}_h/\tilde{Y}_h$	External debt–GDP ratio	0.187	0.147 [0.023–0.303]	GFD
Developing country				
$\tilde{N}_m/\left(1-\tilde{L}_d\right)$	Ratio of migrant to labor force	0.161	0.106 [0.031–0.189]	World Bank
$\tilde{R}/\tilde{Y}_d$	Remittance–GDP ratio	0.097	0.107 [0.032–0.273]	WDI
$\tilde{K}_d/\tilde{Y}_d$	Capital–GDP ratio	1.982	2.801 [1.827–3.193]	PWT 9.0
$\tilde{C}_d/\tilde{Y}_d$	Consumption-GDP ratio	0.783	0.716 [0.576–0.809]	WDI
$\tilde{N}_d$	Labor employment	0.366		
$\tilde{B}_d/\tilde{Y}_d$	External debt–GDP ratio	0.298	0.277 [0.203–0.517]	WDI

Notes: The sample of the rich countries includes Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates. The sample of the developing countries includes Bangladesh, India, Nepal, Pakistan, and Sri Lanka. The data (means and cross-section ranges in brackets) are between 2010 and 2017. Ratio of migrant to labor forces is calculated as migrant stock divided by total labor force.

Table 2
Long-run calibration results.

Variables	Description	Collateral effect of remittances	Policy to promote migration $\xi: 0.94 \to 1$	
		$\kappa: 0 \to 1$	$\kappa = 0$	$\kappa = 1$
		(1)	(2)	(3)
Rich country			Change from steady state	
$\tilde{N}_h$	Native labor employment	0	−0.05%pts	−0.05%pts
$\tilde{K}_h$	Capital stock	0	+0.70%	+0.70%
$\tilde{Y}_h$	Output	0	+0.70%	+0.70%
$\tilde{C}_h$	Native consumption	0	+0.49%	+0.49%
Developing country				
$\tilde{N}_m/\left(1-\tilde{L}_d\right)$	Ratio of migrant to labor force	0	+2.25%pts	+2.25%pts
$\tilde{R}/\tilde{Y}_d$	Remittance–GDP ratio	+0.01%pts	+2.71%pts	+2.70%pts
$\tilde{N}_d$	Labor employment	+0.04%pts	−1.13%pts	−1.12%pts
$\tilde{K}_d$	Capital stock	+0.11%	−3.09%	−3.06%
$\tilde{Y}_d$	Output	+0.11%	−3.09%	−3.06%
$\tilde{C}_d$	Consumption	−0.07%	+0.26%	+0.25%
$\tilde{C}_m$	Migrant consumption	−0.25%	+0.94%	+0.88%
$\tilde{B}_d/\tilde{Y}_d$	External debt–GDP ratio	+2.91%pts	0	+0.81%pts

result, capital and output expand at the expense of its consumption. At the same time, migrant workers also squeeze their consumption to send a little more remittances due to its positive externality.[7]

This evidence seems consistent with Yang (2008) who shows that households in the Philippines who receive remittances work more hours in self-employment and are more likely to invest in capital-intensive businesses. However, our result shows that this effect is very small at the macro level. This could be because the effect is more concentrated among remittance-receiving households without spillovers across the entire economy.

5.2. Policy to promote overseas migrant work

Now I examine the macroeconomic impact of the policy to promote overseas migrant work. The government of the developing country reduces the migration friction for its workers by signing memorandum of understanding with the rich country to formally establish the recruitment markets and processes. South Asian governments have since 1970s established public agencies within the department of foreign affairs or labor to help with

[7] Though not reported here, the dynamics show that consumption jumps instantly with the decrease in borrowing cost. However, as the return to capital is higher than the cost, capital rises with investment. Gradually, consumption falls back to a new long-run value, lower than the pre-shock level.

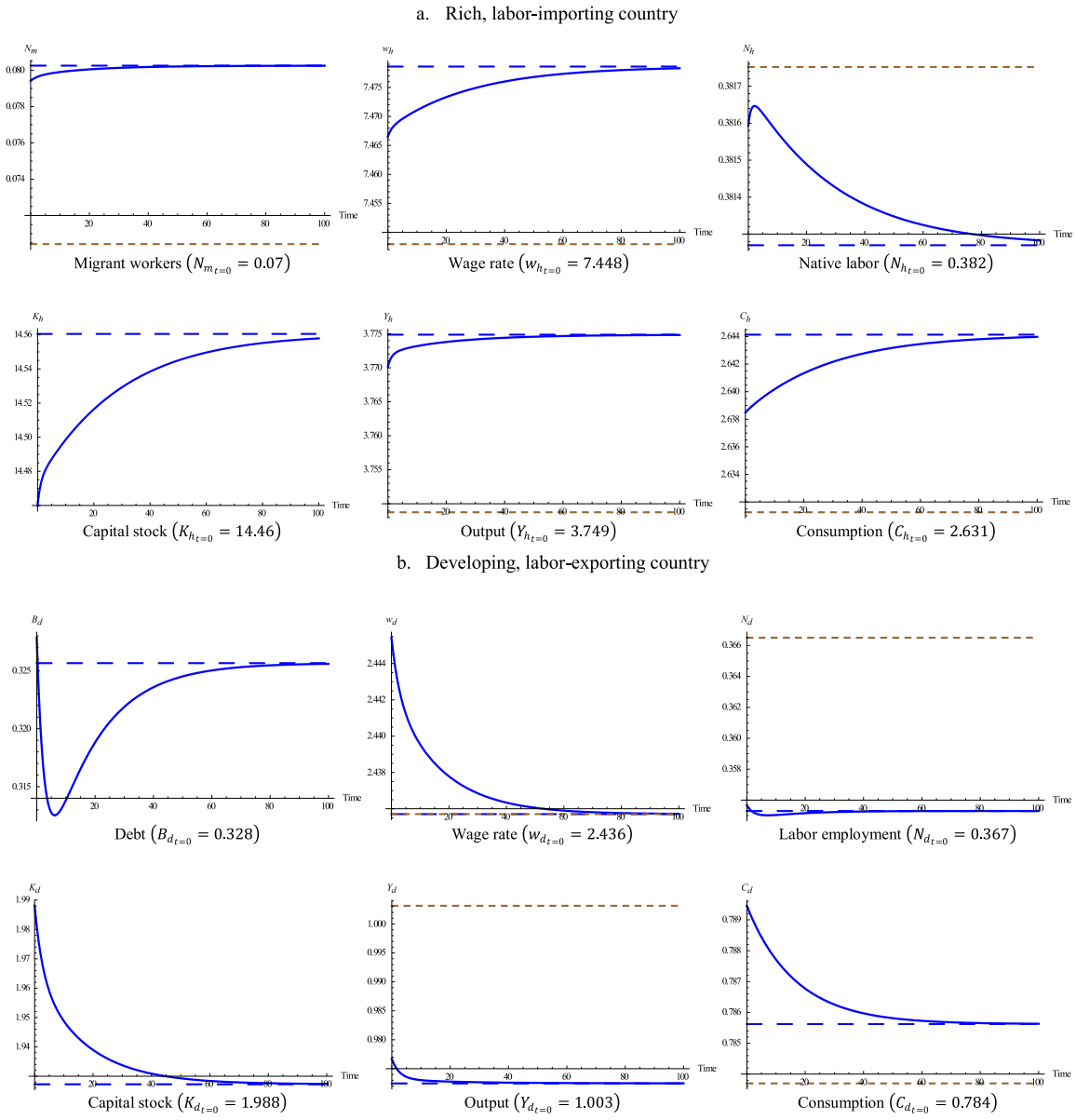

Fig. 2. Policy to promote overseas migrant work ($\xi: 0.94 \rightarrow 1; \kappa = 1$). Note: - - - - - new steady state, - - - - - - - initial steady state.

these processes. The case of free labor mobility ($\xi: 0 \rightarrow 1$) is considered with no collateral effect ($\kappa = 0$) and full collateral effect ($\kappa = 1$). The long-run results are given in Columns (2) and (3) of Table 2, respectively. The policy to encourage migration is contractionary for the developing, labor-exporting country. Its capital and output fall by about 3% as a result of labor migration. Consumption increases with remittances. Under the full collateral effect, the output impact of the policy is only marginally different, showing that the impact of the loss of labor due to migration outweighs the positive externality of remittances to relieve the borrowing constraint. It is also interesting to note that the rich, labor-importing country benefits from the policy. Its output grows 0.7% although the native employment falls by 0.05 percentage points as a result of the inflow of migrant workers.

Fig. 2 shows the transitional dynamics of the two economies in response to the policy under the full collateral effect of remittances. In the rich country, the influx of migrant workers due to the policy instantly raises the demand for native workers due to labor complementarity between native and migrant workers. As a result, the real wage of the natives instantaneously jumps up. However, the natives respond to the increase in wage by cutting down their supply of labor. Although there is a reduction in the supply of native labor, the influx of migrant workers fuels economic growth in the rich country. Output instantaneously jumps up and capital stock gradually rises. Consequently, native labor tends to rise back slightly before starting to decline to a new lower level in the long run as migrant workers continue to move in. The output continues to rise with capital and consumption also rises to a new higher long-run level.

In the developing country, labor shortage due to migration impacted by the policy causes its domestic wage to jump up instantly. In consequence, its output contracts instantaneously. However, consumption jumps up with remittances. As migrant workers continue to leave the country, reducing the return to domestic private capital, private capital for its manufacturing output starts to decline gradually. As a result, its output continues to decline to a lower long-run level. The initial output contraction has reduced its borrowing needs, so its debt position improves in the short run. However, as remittances increase due to labor migration, reducing its borrowing risk, the country starts to

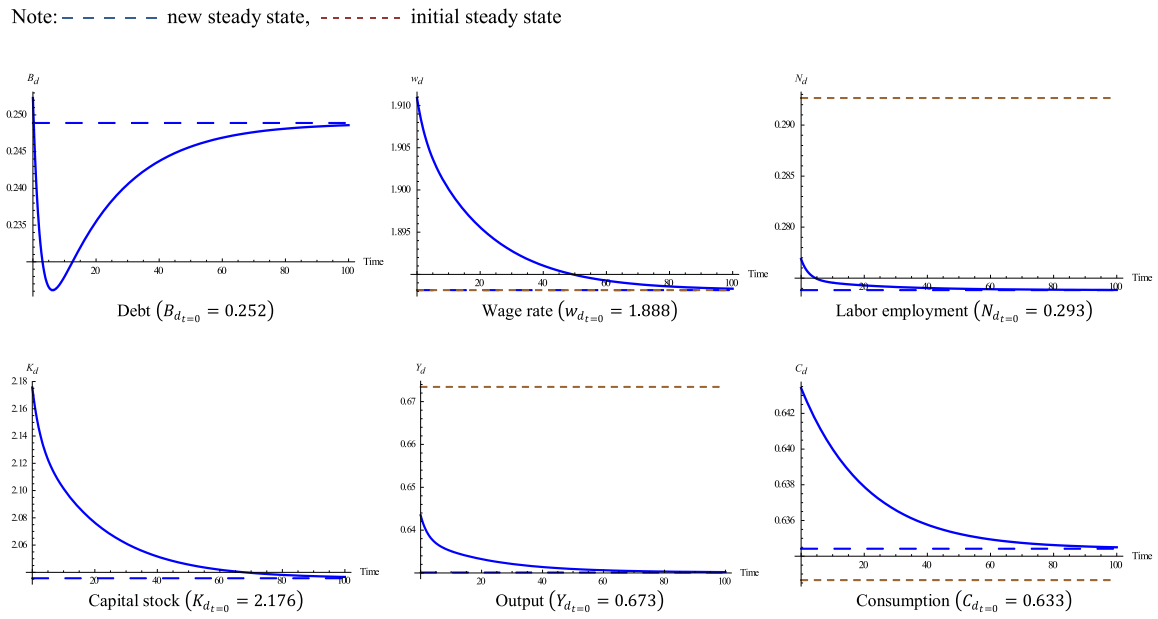

Fig. 3. The case of Nepal (ξ: 0.94 → 1; $\kappa = 1$). Note: – – – – – new steady state, - - - - - - - initial steady state.

borrow again, though to a level lower than the pre-shock level. Together with remittances, consumption only declines slightly after its initial jump, and gradually to a new higher level in the long run. The result for the long-run positive impact of remittances on consumption is consistent with empirical evidence in the literature (see Lim and Simmons, 2015 for evidence in the Caribbean and Donou-Adonsou and Lim, 2016 for evidence in West Africa).[8]

5.3. The case of Nepal

However, one may suggest that the collateral impact of remittances may be large for a country with a large remittance–GDP ratio, thus the policy to promote labor migration can be expansionary for the poor country. For example, the remittance flow into Nepal accounted for more than 30% of its GDP in 2015 and 2016. So, in this section I modify a few parameters of the labor-exporting, developing country to fit the data of Nepal and re-examine the collateral effect of remittances and the policy to encourage labor migration. The production technology is chosen at $A_d = 1.5$, so that Nepal is poorer than the sample average. As a result, Nepal exports more labor and receives more remittances. The remittance–GDP ratio is now equal to 26%. Relative capital intensity is set at 0.25 ($\theta = 0.25$) to obtain capital–GDP ratio of 3.23. These ratios are consistent with the data of Nepal. In the 2010s, the data show that Nepal had an average remittance–GDP ratio of 27% and an average capital–GDP ratio of 3.11. For the benchmark economy, the collateral parameter, κ, is set at zero.

With these new parameters, the model produces the real wage for native workers in the rich country ($\tilde{w}_h = 7.589$), that of migrant workers ($\tilde{w}_m = 2.009$), and that of workers in the developing country ($\tilde{w}_d = 1.888$). The workers in Nepal are even less productive, compared to the average of the South Asian sample. This is consistent with the data since Nepal is the poorest among South Asian countries in the sample. Also, at that wage level in Nepal, the elasticity of wage is 0.22, which is higher than the South Asian sample. The results of the calibration exercises for Nepal are presented in Table 3 and the transitional paths are shown in Fig. 3.

In Column (1) of Table 3, the positive externality of remittances as collateral is larger for a country with larger share of remittances. Its capital and output rise by 0.3% for Nepal with a remittance–GDP ratio of 30% (compared to 0.1% in Table 2). The country also takes on more debt due the positive externality of remittances.

Columns (2) and (3) provide results for the impact of the policy to promote overseas migrant work. First, without the collateral impact of remittances, a poor country like Nepal suffers a significant loss due to labor migration. With a lower cost in getting jobs for migrants, migrant workers to home labor force has increased by over 4 percentage points. Its impact on domestic output is even drastic. Domestic labor contracts by close to 2 percentage points. Capital and output contract by 6.5%. With collateral impact of remittances, the contraction is a little smaller, at 6.4%, even though remittance–GDP ratio increases by additional 6.8 percentage points. The contractionary impacts of the policy are more pronounced for a poor country like Nepal because of a larger elasticity of wage. At a very low wage, labor migration puts a greater upward pressure on the domestic wage, thus hurting the manufacturing sector of the country even more. At the same time, the country also enjoys a greater increase in consumption due to a large inflow of remittances.

The transitional paths provided in Fig. 3 are consistent with those in Fig. 2.

6. Robustness tests

According to KPMG Tax Database, in 2010s the corporate tax rates for the South Asian countries range from 15% to 30%. Since the paper focuses on remittances and capital accumulation for small businesses, this capital income tax rate could be lower, so a choice of 10% seems reasonable. However, one may contend that small businesses in the poor countries operate in the informal

[8] Given the structure of the current model, FDI would also appear negatively related to labor migration (see Lim, 2021, for this result). The decrease in the return to capital stock due to labor leaving the country would put a downward pressure on capital accumulation. However, as pointed out in Burchardi et al. (2019) and Kugler and Rapoport (2007), there is also an information effect from migrants to FDI. The increase in migrant workers helps reduce information barriers for firms that are investing in the migrants' country of origin. The relationship deserves a careful examination; however, incorporating this effect is beyond the scope of this paper.

Table 3
The case of Nepal.

Variables	Description	Collateral effect of remittances	Policy to promote migration $\xi: 0.94 \rightarrow 1$	
		$\kappa: 0 \rightarrow 1$	$\kappa = 0$	$\kappa = 1$
		(1)	(2)	(3)
Rich country			Change from steady state	
$\tilde{N}_h$	Native labor employment	0	−0.06%pts	−0.06%pts
$\tilde{K}_h$	Capital stock	0	+0.92%	+0.92%
$\tilde{Y}_h$	Output	0	+0.92%	+0.92%
$\tilde{C}_h$	Native consumption	0	+0.64%	+0.64%
Developing country				
$\tilde{N}_m/\left(1-\tilde{L}_d\right)$	Ratio of migrant to labor force	0	+4.17%pts	+4.16%pts
$\tilde{R}/\tilde{Y}_d$	Remittance–GDP ratio	−0.03%pts	+6.87%pts	+6.84%pts
$\tilde{N}_d$	Labor employment	+0.09%pts	−1.90%pts	−1.88%pts
$\tilde{K}_d$	Capital stock	+0.30%	−6.51%	−6.43%
$\tilde{Y}_d$	Output	+0.30%	−6.51%	−6.43%
$\tilde{C}_d$	Consumption	−0.15%	+0.30%	+0.28%
$\tilde{C}_m$	Migrant consumption	−0.53%	+1.10%	+1.00%
$\tilde{B}_d/\tilde{Y}_d$	External debt–GDP ratio	+7.69%pts	0	+2.04%pts

Table 4
Robustness tests.

Variables	Description	Policy to promote migration $\xi: 0.94 \rightarrow 1$; $\kappa = 1$	
		$\tau = 0$	$\zeta = 0.08$
		(1)	(2)
Rich country		Change from steady state	
$\tilde{N}_h$	Native labor employment	−0.05%pts	−0.04%pts
$\tilde{K}_h$	Capital stock	0.69%	+0.64%
$\tilde{Y}_h$	Output	0.69%	+0.64%
$\tilde{C}_h$	Native consumption	0.48%	+0.45%
Developing country			
$\tilde{N}_m/\left(1-\tilde{L}_d\right)$	Ratio of migrant to labor force	+2.18%pts	+1.94%pts
$\tilde{R}/\tilde{Y}_d$	Remittance–GDP ratio	+2.60%pts	+2.01%pts
$\tilde{N}_d$	Labor employment	−1.09%pts	−0.90%pts
$\tilde{K}_d$	Capital stock	−2.96%	−2.47%
$\tilde{Y}_d$	Output	−2.96%	−2.479%
$\tilde{C}_d$	Consumption	+0.24%	+0.14%
$\tilde{C}_m$	Migrant consumption	+0.87%	+0.49%
$\tilde{B}_d/\tilde{Y}_d$	External debt–GDP ratio	+0.77%pts	+0.60%pts

sector; thus, they are not subject to these formal taxes. Hence, a robustness test is carried out for the policy to promote migration as the tax on capital income is zero, $\tau = 0$. The result is reported in Column (1) of Table 4. The results do not change much. The changes from the initial steady-state values for capital, labor supply and output are only slightly smaller than those presented in Table 2, possibly due to a slightly higher initial steady-state values with $\tau = 0$.

Another concern is the parameter, ζ, governing the substitutability between labor and capital in the developing country. While the numerical calibration is done to fit the data in the recent years, $\zeta = -0.21$ taken from Duffy and Papageorgiou (2000) is obtained from data between 1960 and 1987. One may contend that this parameter may be higher in the current economic environment and thus labor migration may affect the economy at a lesser extent. I test this taking $\zeta = 0.08$, which implies that the elasticity of substitution between labor and capital is 1.087, the same as that in the rich country. The result reported in Column (2) of Table 4 shows that the policy to promote migrant work still has a negative impact on the output of the labor-exporting economy albeit the magnitude is a little smaller due to a higher substitutability of capital for labor.

7. Conclusions

In recent decades, several developing countries have adopted the policy to promote overseas migrant work to deal with domestic unemployment pressure at home. This has allowed many poor families to send members of their family to work as migrant workers in richer countries. As a result, those migrant workers can earn higher income and send back home remittances. In this study, I employ a macro-dynamic model of two small open economies – a rich, labor-importing country and a poor, labor-exporting country – to examine the macroeconomic impacts of this policy. The model employed in this study combines the model used in Lim and Morshed (2017) and that used in Chatterjee and Turnovsky (2018). I extend the model used in Lim and Morshed (2017) by introducing the collateral effect of remittances in the borrowing constraint of the labor-exporting country. I also relax the assumption of inelastic supply of capital in the rich country by allowing capital to be converted from the traded goods, but with an adjustment cost. Different from Chatterjee and Turnovsky (2018), the model captures endogenous remittances that are linked to the household's decision to migrate.

The results from the calibration exercises show that remittances have a positive impact on the economy of the developing country due to the collateral effect. Domestic households increase their supply of labor and domestic output increases with capital stock. This result is similar to that found in Chatterjee and Turnovsky (2018). However, this effect is very small. Thus, the policy to promote overseas migrant work benefits the rich, labor-importing country at the expense of poor, labor-exporting country. The loss of labor due to migration crowds out capital in the manufacturing, traded sector of the developing country. Because the crowding-out effect outweighs the expansionary effect from remittances, the policy to promote overseas migrant work leads to a decline in the long-run economic development of the labor-exporting country. However, its welfare improves as consumption increases with remittances. This result is consistent with the empirical evidence in the literature that remittances have helped reduce poverty in poor countries.

In addition, I examine the case of Nepal, the poorest country among the South Asian countries in the sample. However, Nepal received a very large share of remittances, equal to more than 30% of its GDP in 2016. The results show that although the collateral impact of remittances on the economy is larger due to a larger share of remittances, the negative impact on its output due to labor migration is even more pronounced. This is due to a larger elasticity of wage. That is, the increase in labor migration as a result of the policy has a larger upward pressure on domestic wage, causing an even larger reduction in domestic labor demand. As a result, capital stock declines significantly with the output.

In an era of industrialization, Lewis (1954) argues that new industries can be created and old industries expanded without any shortage of labor in countries with abundant cheap labor that moved from agriculture into manufacturing. However, the policy to promote overseas migrant work has diverted this labor movement into the rich countries, boosting the economy of these rich countries at the expense of industrial expansion of the poor countries. The idea that the country can depend on remittances from migrant workers for its development is a myth and the policy is misleading.

The choice of the parameters produces the model economies with native labor more productive than migrant workers. With the assumption that migrant workers are complementary to native workers in the rich country's production, the results from the calibration are also interesting and seem consistent with some observations, especially concerning the inflow of low-skilled migrant workers into the U.S. The inflow of migrant workers raises the wage of the skilled native workers due to complementarity. However, native workers supply less labor in the equilibrium as the income effect from the wage increase outweighs the substitution effect. Given different skills of labor in certain host countries like the U.S., this result should be further examined by properly including the unskilled native workers as well.

It is also interesting to note that South Asian countries like India, Pakistan and Bangladesh are exporting not only unskilled, but also skilled labor to the Middle East. Although this study does not differentiate the skill levels of migrant workers, one may believe that the exports of skilled labor would dampen the economies' manufacturing even more if the developing countries are producing highly-skilled-labor-intensive goods. Given different stages of manufacturing development (i.e. from light to heavy industries which require different skills of labor at a different stage) and a possible effect of skilled emigration prospects (as discussed in Beine et al., 2008), the issue of migrant skills deserves a more careful investigation.

Appendix A. Solution to the equilibrium dynamics of the model

For convenience, I re-write the system of Eqs. (43)–(50) in a general form as

$$\dot{\lambda} = X_{\lambda}\left(\lambda, B_d, \pi, K_h, K_d\right), \dot{B}_d = X_{B_d}\left(\lambda, B_d, \pi, K_h, q_d, K_d\right),$$
$$\dot{\pi} = X_{\pi}\left(\lambda, \pi, B_h, K_h, K_d\right), \dot{B}_h = X_{B_h}\left(\lambda, \pi, B_h, q_h, K_h, K_d\right),$$
$$\dot{q}_h = X_{q_h}\left(\lambda, \pi, B_h, q_h, K_h, K_d\right), \dot{K}_h = X_{K_h}\left(q_h, K_h\right),$$
$$\dot{q}_d = X_{q_d}\left(\lambda, B_d, \pi, K_h, q_d, K_d\right), \dot{K}_d = X_{K_d}\left(q_d, K_d\right).$$

The local equilibrium dynamics are obtained by linearizing the system of differential equations around the steady state $\left(\tilde{\lambda}, \tilde{B}_d, \tilde{\pi}, \tilde{B}_h, \tilde{q}_h, \widetilde{K}_h, \tilde{q}_d, \widetilde{K}_d\right)$:

$$\begin{pmatrix} \dot{\lambda} \\ \dot{B}_d \\ \dot{\pi} \\ \dot{B}_h \\ \dot{q}_h \\ \dot{K}_h \\ \dot{q}_d \\ \dot{K}_d \end{pmatrix} = \begin{pmatrix} \frac{\partial X_\lambda}{\partial \lambda} & \frac{\partial X_\lambda}{\partial B_d} & \frac{\partial X_\lambda}{\partial \pi} & 0 & 0 & \frac{\partial X_\lambda}{\partial K_h} & 0 & \frac{\partial X_\lambda}{\partial K_d} \\ \frac{\partial X_{B_d}}{\partial \lambda} & \frac{\partial X_{B_d}}{\partial B_d} & \frac{\partial X_{B_d}}{\partial \pi} & 0 & 0 & \frac{\partial X_{B_d}}{\partial \lambda} & \frac{\partial X_{B_d}}{\partial q_d} & \frac{\partial X_{B_d}}{\partial K_d} \\ \frac{\partial X_\pi}{\partial \lambda} & 0 & \frac{\partial X_\pi}{\partial \pi} & \frac{\partial X_\pi}{\partial B_h} & 0 & \frac{\partial X_\pi}{\partial \lambda} & 0 & \frac{\partial X_\pi}{\partial K_d} \\ \frac{\partial X_{B_h}}{\partial \lambda} & 0 & \frac{\partial X_{B_h}}{\partial \pi} & \frac{\partial X_{B_h}}{\partial B_h} & \frac{\partial X_{B_h}}{\partial q_h} & \frac{\partial X_{B_h}}{\partial \lambda} & 0 & \frac{\partial X_{B_h}}{\partial K_d} \\ \frac{\partial X_{q_h}}{\partial \lambda} & 0 & \frac{\partial X_{q_h}}{\partial \pi} & \frac{\partial X_{q_h}}{\partial B_h} & \frac{\partial X_{q_h}}{\partial q_h} & \frac{\partial X_{q_h}}{\partial \lambda} & 0 & \frac{\partial X_{q_h}}{\partial K_d} \\ 0 & 0 & 0 & 0 & \frac{\partial X_{K_h}}{\partial q_h} & \frac{\partial X_{K_h}}{\partial K_h} & 0 & 0 \\ \frac{\partial X_{q_d}}{\partial \lambda} & \frac{\partial X_{q_d}}{\partial B_d} & \frac{\partial X_{q_d}}{\partial \pi} & 0 & 0 & \frac{\partial X_{q_d}}{\partial \lambda} & \frac{\partial X_{q_d}}{\partial q_d} & \frac{\partial X_{q_d}}{\partial K_d} \\ 0 & 0 & 0 & 0 & 0 & 0 & \frac{\partial X_{K_d}}{\partial q_d} & \frac{\partial X_{K_d}}{\partial K_d} \end{pmatrix} \times \begin{pmatrix} \lambda - \tilde{\lambda} \\ B_d - \tilde{B}_d \\ \pi - \tilde{\pi} \\ B_h - \tilde{B}_h \\ q_h - \tilde{q}_h \\ K_h - \widetilde{K}_h \\ q_d - \tilde{q}_d \\ K_d - \widetilde{K}_d \end{pmatrix} \tag{A.1}$$

Using the functional forms and parameters described in Section 5, the system of linearized equations (A.1) is characterized by four stable (negative) and four unstable (positive) eigenvalues, so that the equilibrium yields a unique stable saddle path. The linearized stable solutions for λ, B_d, π, B_h, q_d, K_d, q_h, and K_h are written in the following forms

$$\lambda(t) = \tilde{\lambda} + Z_1 e^{\mu_1 t} + Z_2 e^{\mu_2 t} + Z_3 e^{\mu_3 t} + Z_4 e^{\mu_4 t} \tag{A.2}$$
$$B_d(t) = \tilde{B}_d + v_{21} Z_1 e^{\mu_1 t} + v_{22} Z_2 e^{\mu_2 t} + v_{23} Z_3 e^{\mu_3 t} + v_{24} Z_4 e^{\mu_4 t} \tag{A.3}$$
$$\pi(t) = \tilde{\pi} + v_{31} Z_1 e^{\mu_1 t} + v_{32} Z_2 e^{\mu_2 t} + v_{33} Z_3 e^{\mu_3 t} + v_{34} Z_4 e^{\mu_4 t} \tag{A.4}$$
$$B_h(t) = \tilde{B}_h + v_{41} Z_1 e^{\mu_1 t} + v_{42} Z_2 e^{\mu_2 t} + v_{43} Z_3 e^{\mu_3 t} + v_{44} Z_4 e^{\mu_4 t} \tag{A.5}$$
$$q_h(t) = \tilde{q}_h + v_{51} Z_1 e^{\mu_1 t} + v_{52} Z_2 e^{\mu_2 t} + v_{53} Z_3 e^{\mu_3 t} + v_{54} Z_4 e^{\mu_4 t} \tag{A.6}$$
$$K_h(t) = \widetilde{K}_h + v_{61} Z_1 e^{\mu_1 t} + v_{62} Z_2 e^{\mu_2 t} + v_{63} Z_3 e^{\mu_3 t} + v_{64} Z_4 e^{\mu_4 t} \tag{A.7}$$
$$q_d(t) = \tilde{q}_d + v_{71} Z_1 e^{\mu_1 t} + v_{72} Z_2 e^{\mu_2 t} + v_{73} Z_3 e^{\mu_3 t} + v_{74} Z_4 e^{\mu_4 t} \tag{A.8}$$
$$K_d(t) = \widetilde{K}_d + v_{81} Z_1 e^{\mu_1 t} + v_{82} Z_2 e^{\mu_2 t} + v_{83} Z_3 e^{\mu_3 t} + v_{84} Z_4 e^{\mu_4 t} \tag{A.9}$$

where μ_i for $i = 1, 2, 3, 4$ denotes the stable eigenvalues and the vector $(1 \ v_{2i} \ v_{3i} \ v_{4i} \ v_{5i} \ v_{6i} \ v_{7i} \ v_{8i})$ is the normalized eigenvector associated with stable eigenvalues, μ_i, and the constants, Z_i, are obtained by imposing the given initial values on B_d, B_h, K_h, and K_d, $B_d(0) = B_{d,t=0}$, $B_h(0) = B_{h,t=0}$, $K_h(0) = K_{h,t=0}$,

$K_d(0) = K_{d,t=0}$. After obtaining the time paths as set out in (A2–A9), the implied dynamics of the remaining variables can be easily derived.

Appendix B. Steady state

The steady-state equilibrium can be described by the following set of equations.

B.1. Rich country

$$\beta = r^* + \omega\left(\frac{\tilde{B}_h}{f\left(\widetilde{K}_h, \widetilde{N}_h, \widetilde{N}_m\right)}\right) \tag{B.1}$$

$$\beta\tilde{B}_h + \tilde{C}_h + G_h = p\left[f_{K_h}\left(\widetilde{K}_h, \widetilde{N}_h, \widetilde{N}_m\right)\widetilde{K}_h - f_{N_h}\left(\widetilde{K}_h, \widetilde{N}_h, \widetilde{N}_m\right)\widetilde{N}_h\right] \tag{B.2}$$

$$r^* + \omega\left(\frac{\tilde{B}_h}{f\left(\widetilde{K}_h, \widetilde{N}_h, \widetilde{N}_m\right)}\right) = pf_{K_h}\left(\widetilde{K}_h, \widetilde{N}_h, \widetilde{N}_m\right) \tag{B.3}$$

$$\frac{H_{L_h}\left(\tilde{C}_h, \tilde{L}_h\right)}{H_{N_h}\left(\tilde{C}_h, \tilde{L}_h\right)} = pf_{N_h}\left(\widetilde{K}_h, \widetilde{N}_h, \widetilde{N}_m\right) \tag{B.4}$$

$$\widetilde{N}_h + \tilde{L}_h = 1 \tag{B.5}$$

B.2. Developing country

$$\beta = r^* + \Omega\left(\frac{\tilde{B}_d}{F\left(\widetilde{K}_d, \widetilde{N}_d\right) + \kappa\tilde{R}}\right) \tag{B.6}$$

$$\beta\tilde{B}_d + \tilde{C}_d = (1-g)F\left(\widetilde{K}_d, \widetilde{N}_d\right) + \tilde{R} \tag{B.7}$$

$$r^* + \Omega\left(\frac{\tilde{B}_d}{F\left(\widetilde{K}_d, \widetilde{N}_d\right) + \kappa\tilde{R}}\right) = (1-\tau)F_{K_d}\left(\widetilde{K}_d, \widetilde{N}_d\right) \tag{B.8}$$

$$\frac{U_{L_d}\left(\tilde{C}_d, \tilde{L}_d\right)}{U_{C_d}\left(\tilde{C}_d, \tilde{L}_d\right)} = F_{N_d}\left(\widetilde{K}_d, \widetilde{N}_d\right) \tag{B.9}$$

$$\frac{U_{L_d}\left(\tilde{C}_d, \tilde{L}_d\right)}{U_{C_d}\left(\tilde{C}_d, \tilde{L}_d\right)} = \xi pf_{N_m}\left(\widetilde{K}_h, \widetilde{N}_h, \widetilde{N}_m\right) \tag{B.10}$$

$$U_{C_d}\left(\tilde{C}_d, \tilde{L}_d\right) = M_{C_m}\left(\tilde{C}_m\right) \tag{B.11}$$

$$\tilde{R} = \xi pf_{N_m}\left(\widetilde{K}_h, \widetilde{N}_h, \widetilde{N}_m\right)\widetilde{N}_m - \tilde{C}_m \tag{B.12}$$

$$\widetilde{N}_d + \widetilde{N}_m + \tilde{L}_d = 1 \tag{B.13}$$

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