Remittances Inflows, Resource Reallocation and Real Exchange Rate in Developing Countries

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Abstract

Emigrants remittances are important sources of income for many developing countries. This paper examines the effects of remittances in developing countries using a two-sector model (tradable sector and nontradable sector), in which capital can be sector-specific. The paper shows that a permanent increase in remittances lead to an appreciation in the steady-state real exchange rate only if capital is sector-specific. If capital is homogeneous across sector, a permanent increase in remittances have no effect on the steady state real exchange rate. About the dynamics, positive shocks to exogenous altruistic remittances lead an increase in consumption and a Dutch disease effect. Following a negative shock to productivity, countercyclical altruistic remittances attenuate the decrease in consumption, but, deepen the decline in tradable sector. Positive shocks to self-interested remittances also cause an increase in consumption and a Dutch disease effect. If capital is sector-specific, the shocks effects on consumption, resource reallocation and real exchange rate are more persistent.

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1 Introduction

Emigrants' transfers or remittances are important sources of income for many developing countries. So, it is important to examine the macroeconomic implications of these transfers. In recent years the amount of remittances received by several developing countries has exceeded the inflow of official aid and private capital. In fact, the amount of remittances in 2007 was estimated to be about 3% of gross national income in the developing world.

By examining the macroeconomic effects of remittances, like any type of international transfer, one asks some questions. The first question is about the international transfers problem: how an international transfer does affect an economy through an adjustment of external trade balance ? This is an issue of real resource transfers that is related to financing availability. Economic analysis of transfers problems yields straightforward conclusions: the international transfers effects are generally a combination of higher imports and lower exports associated with a real exchange rate appreciation.

An application of the international transfers problem is so-called the '' Dutch disease". This is defined as the adverse effect of natural resource revenues on the manufacturing sector, associated with a real exchange rate appreciation, such as was experienced following the discovery of natural gas in the Netherlands. In the case of international transfer, the idea of Dutch disease is the following: the inflow of international transfer increases the supply of tradable goods and, ceteris paribus, lowers their price. But, through the income effect of the transfer, it increases the demand for and price of nontradable goods. As a result, production factors are redirected toward the sector producing nontradable goods.

A second question is how does the logic of the transfer, usually developed in a static two-good model, carries over to the dynamic context in which transfers, can also affect savings and capital accumulation. It has traditionally been argued that international transfer may boost growth because it supplements the limited supply of domestic saving available for investment.

A third question is why does Dutch disease matters. The transfer problem is generally analysis in the context of models in which the resulting decline in production of tradables is an optimal adjustment to the transfer, so that Dutch disease is not really a disease. However, discussions of the Dutch disease phenomenon in the context of developing countries usually refer to the importance of the export industries for growth (Michael 1981). Indeed, some studies have elaborated the idea that trade can be the engine of growth for developing countries through technological diffusion and learning by doing effect (Grossman and Helpman, 1991; Barro and Sala-i-Martin, 1997 ; Connolly, 1999; and Bigsten et al. 2002). Empirical papers have also found a positive relation between trade and growth (Levine and Renelt, 1993 or Sala-i-Martin, 1997). But, these studies - with the exception of Adam and Bevan (2003)- have not generally integrated the analysis of the decline in the tradables sector in response to transfers inflows.

In this paper, we examine the effects of remittances on developing countries economies using a two-sector model (tradable sector and nontradable sector), in which capital can be sector-specific.

In this model, I assume the absence of learning by doing effect resulting by the resource reallocation caused by transfers. The model is calibrated on parameters values which are plausible and comparable to that of previous literature.

The main results are the following. Remittances lead to, at the steady-state, an increase in consumption, a decrease in home investment-GDP ratio, a decline in tradable sector. Remittances also lead to an appreciation in the steady-state real exchange rate only if capital is not homogeneous across sector. If capital is homogeneous across sector, remittances have no effect on the steady-state real exchange rate. About the dynamics, positives shocks of exogenous altruistic remittances lead to an increase in consumption and a decline in tradable sector associated with an appreciation in real exchange rate. Following negative shocks to tradable productivity, countercyclical altruistic remittances attenuate the decrease in consumption and the depreciation in real exchange rate but deepen the decline in tradable sector. Positive shocks to self-interested remittances also cause the same effects as positive shock to exogenous altruistic remittances.

The dynamics caused by the shocks depend on the capital elasticity of substitution across sector. Particularly, if capital is sector-specific, shocks effects on consumption, resource reallocation and real exchange rate are more persistent.

The remainder of paper is structured as follows. In Section 2 a literature review on remittances is presented. The model is developed in Section 3. Section 4 presents the description of remittances. The effects of remittances are examined in Section 5. Finally, Section 6 contains some concluding comments.

2 Review of literature

Remittances constitute a significant part of the income for many developing countries (Neyapti, 2004 and Heilman, 2006). Remittances inflows to developing countries strongly increased in recent decades. Recorded remittances to developing countries were estimated to reach 240 billion dollars in 2007, which represents an increase of 107% between 2002 and 2007 (Word Bank's Global Economic Prospects). The true size of remittances including unrecorded flows is even larger. This strong increase is partially due to the fast expansion in money transfer agencies. In fact, the proliferation of money transfer agencies decreased the cost of money transfer. .

The literature on remittances was mainly concentrated on the microeconomic aspects of the motivation to remit. According to Lucas and Stark (1985), there are differences in views regarding the motivation to remit. One group argues that remittances are altruistically motivated whereas the other argues that they are driven by selfish motivations i.e driven by exploitation of investment opportunities (Lucas and Stark, 1985). In the first case, remittances are altruistic and can be exogenous (i.e independent of economic conditions of home country and can be explained by the host economic cycles) or countercyclical (i.e emigrant send more remittances if economic conditions of home country are worst). In the second case, remittances are procyclical because remittances behave like any other transfer looking for exploitation of investment opportunities.

The literature of macroeconomic implications of remittances is condensed. From a macroeconomic perspective, Chami et al. (2006) use a general equilibrium framework to study the impact of countercyclical remittances on government policy in a one-sector closed economy context. This study concludes that optimal monetary policy in country without remittances is not the same as that in country with remittances. Loser et al. (2006) present a discussion of remittances and Dutch disease using a descriptive IS-LM-BP textbook model. The former study does not capture the Dutch disease phenomenon, and the latter does not use an optimizing framework in the analysis. Moreover, both papers do not take account of the standard relative price movements and the sectoral resource reallocation.

Empirically, Chami et al. (2003) use panel techniques to show that remittances tend to be countercyclical. On the contrary, Giuliano and Ruiz-Aranz (2006) conclude that remittances are mostly procyclical. Finally, Acosta (2006) and Hanson (2005) document the negative impact of remittances in the labor supply.

3 The Model

3.1 Households

There is a continuum of infinitely-lived households of unit mass. The representative household maximizes the following expected utility function:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t) \tag{1}$$

where

$$U(C_t) = \log(C_t)$$

$$C_t = \left[\gamma (C_{T,t})^{-\mu} + (1-\gamma)(C_{N,t})^{-\mu}\right]^{\frac{-1}{\mu}} \tag{2}$$

The single-period utility function is defined over consumption, C_t.

$\beta \in (0,1)$ denotes the subjective discount factor. Consumption is a composite of consumption of tradable goods, $C_{T,t}$, and nontradable goods, $C_{N,t}$. The aggregated function takes a CES form with $1/(1+\mu) > 0$ measuring the elasticity of substitution between tradable goods and nontradable goods.

Household maximize her utility subject to the following constraints:

$$C_{T,t} + P_{N,t} C_{N,t} + I_t + B_{t+1} = r_t K_t + w_t L_t + (1 + r_t^*) B_t + X_t \tag{3}$$

$$K_{t+1} = (1-\delta) K_t + I_t \tag{4}$$

Equations (3) is the households' budget constraint in units of tradable good.

The left-hand-side of (3) represents total expenditures in consumption, investment, I_t, foreign bonds, B_t, with $P_{N,t}$ defining the relative price of nontradables or the real exchange rate. An increase in $P_{N,t}$ represents an appreciation in real exchange rate.

The right-hand-side of (3) represents the sources of income. Household receives factor payments (labor, L_t, and capital, K_t, at the rental rates w_t and r_t respectively) one-period foreign bonds B_t (that pay the exogenous real interest r_t^*) and altruistic remittances, X_t^a, from abroad. The distinction on the definition of remittances will be discussed latter. PPP in tradable goods holds and foreign prices are assumed to be constant.

The labor endowment, L_t, is set to 1.

Equations (4) is the law of motion of the capital stock, where δ is the depreciation rate. The production of tradable good is assumed to be the only convertible in capital.

3.2 Firms technologies

The firms that are part of the industries that produce tradable goods (T) and nontradable goods (N) operate in competitive goods and factors markets. The production of the tradable good is given by the following constant returns to scale technology:

$$Y_{T,t} = F\left(K_{T,t}, L_{T,t}\right) = A_t^T K_{T,t}^{\alpha} L_{T,t}^{1-\alpha} \tag{5}$$

where A_t^T is the exogenous productivity factor in the tradable sector.

As the tradable good, the production of nontradable good is given by the following constant returns to scale technology:

$$Y_{N,t} = H(K_{N,t}, L_{N,t}) = A_t^N K_{N,t}^{\eta} L_{N,t}^{1-\eta} \tag{6}$$

A_t^N is the exogenous productivity factor in the nontradable sector.

Since factor markets are competitive, factors of production earn their marginal products and the standard zero-profits condition holds:

$$w_t L_t + r_t K_t = Y_{T,t} + P_{N,t} Y_{N,t}$$

Large changes in the relative price of nontradables are made possible by discarding the assumption that factors of production are homogeneous across sector. This assumption was widely regarded as unrealistic in the trade literature that developed the specific-factors models (Mendoza and Uribe, 2000). These models recognized that factors of production are specific to each sector to some degree, and thus introduced transformation curves to represent feasible sectoral factor allocations. For simplicity, I adopt Mussa's (1978) or Mendoza and Uribe (2000) specification, in which capital is sector-specific but labor remains a homogeneous factor. Thus, the factor transformation curves are:

$$K_t = \kappa(K_{T,t}, K_{N,t}) = \left[(K_{T,t})^{-\nu} + (K_{N,t})^{-\nu}\right]^{\frac{-1}{\nu}} \quad \text{and} \quad L_t = L_{T,t} + L_{N,t} = 1 \tag{7}$$

$\kappa(.)$ is assumed to be a CES function, where $\nu \leq 0$ and $\zeta = 1/(1+\nu)$ is the elasticity of substitution between capital in tradable sector and capital in nontradable sector.

3.3 Optimal conditions

The optimality conditions of maximizations problem of households and firm are thus given by the following equations:

$$U_T(C_{T,t}, C_{N,t}) = \lambda_t \tag{8}$$

$$U_N(C_{T,t}, C_{N,t}) = P_{N,t} * \lambda_t \tag{9}$$

$$\lambda_t = \beta E_t[\lambda_{t+1}(1 + r^*_{t+1})] \tag{10}$$

$$\lambda_t = \beta E_t[\lambda_{t+1}(r_{t+1} + 1 - \delta)] \tag{11}$$

$$F_L(K_{T,t}, L_{T,t}) = P_{N,t} H_L(K_{N,t}, L_{N,t}) = w_t \tag{12}$$

$$\frac{F_K(K_{T,t}, L_{T,t})}{\kappa_1(K_{T,t}, K_{N,t})} = P_{N,t} \frac{H_K(K_{N,t}, L_{N,t})}{\kappa_2(K_{T,t}, K_{N,t})} = r_t \tag{13}$$

In these expressions, λ_t is the state-contingent Lagrange multiplier on the households budget constraint, i.e, the marginal utility of wealth appropriately measured in terms of the numeraire (tradable good).

Equations (8)-(9) equate the marginal utilities of the two consumption goods to the shadow price of wealth. These equations show that the marginal rate of substitution between the two goods is equal to P_N. Equations (10)-(11) are Euler equations that equalize the marginal cost of sacrificing a unit of current consumption with the marginal benefit of allocating the resulting extra savings into foreign assets and aggregate capital respectively. Equations (12)-(13) indicate that optimal allocation of factors of production requires equalization of the sectoral marginal products of labor and capital, respectively. In equation (13), we note that, since capital is sector-specific, the effective rate of return in each sector incorporates the degree of factor substitutability between the two sectors given by the derivative of κ with respect to the sectoral capital.

The intuition for behavior of the real exchange rate can be derived by combining equations (12)-(13) to solve for P_N and taking logs of the resulting expression:

$$ln(P_{N,t}) = \underbrace{\left[ln\left(\left(\frac{1-\alpha}{1-\eta} \right)^{1-\alpha} \left(\frac{\alpha}{\eta} \right)^{\alpha} \left(\frac{A^T_t}{A^N_t} \right) \right) + (\alpha - \eta)\, ln\left(\frac{K_{N,t}}{L_{N,t}} \right) \right]}_{\text{Balassa}-\text{Samuelson effect}} - \frac{\alpha}{\zeta} ln\left(\frac{K_{N,t}}{K_{T,t}} \right) \tag{14}$$

This expression illustrates how sector-specific capital alters the determination of real exchange rate relative to the Balassa-Samuelson effect. The Balassa-Samuelson result is the term in square brackets in the right-hand side of (14).This term shows that the time series variation of P_N is determined by the fraction $(\alpha - \eta)$ of the change in the capital-labor ratio of the nontradables sector. Sector-specific capital modifies this result by introducing changes in P_N as result of sectoral reallocation of capital, even if capital-labor remain constant or if $\alpha = \eta$. The elasticity of the real exchange rate with respect to K_N/K_T is given by $-\alpha/\zeta$, which is non-negative because $0 \leq \alpha \leq 1$ and $\zeta \leq 0$. Note, however, that (14) is not a closed-form solution for the real exchange rate, but only a condition that reflects efficient factor allocation. The equilibrium real exchange rate also depends on the optimal sectoral allocation of consumption, as determined by equations (8) and (9).

Equation (14) illustrates particularly how international transfers (remittances in this model) can change the real exchange rate. Even if $\alpha = \eta$, at the steady-state, with sector-specific capital, international transfer can change the real exchange rate by changing sectoral reallocation of capital. So, if capital is sector-specific, a permanent increase in international transfer leads to an appreciation in the steady-state real exchange rate.

3.4 Resources constraints

The market-clearing conditions are the following:

$$C_{N,t} = Y_{N,t} \tag{15}$$

$$Y_t - C_{T,t} - I_t + X_t^a = B_{t+1} - (1 + r_t^*)B_t \tag{16}$$

$$L_t = L_{T,t} + L_{N,t} = 1 \tag{17}$$

Equation (16) is market-clearing conditions of nontradable sector. Equation is that of tradable sector, it also represent current account for domestic economy.

3.5 The Foreign Economy

In standard small open economy models, the foreign bonds flow a unit process. In this case, log-linearization methods are not appropriate to solve the model. The unit root implies that deviations from the steady state are permanent while the log-linearization procedure is accurate only around the steady state. To overcome this problem, Schmitt-Grohé and Uribe (2003) propose four different methods to induce stationarity of the foreign bonds. In this model, I introduce the method of debt elastic interest rate. This is a mechanism that generates fluctuations in the international interest rate premium when the foreign bond departs from its steady state value. The functional form I assume for the debt elastic interest rate premium is:

$$r_t^* = \bar{r}^* + \varphi(e^{(b_t - \bar{b})} - 1) \tag{18}$$

where $\bar{i}^*$ is the steady state foreign interest rate, b_t is the ratio of foreign bond to GDP and $\bar{b}$ is its steady-state value. The parameter φ characterizes the elasticity of debt to the interest rate and $\varphi(e^{(b_t - \bar{b})} - 1)$ is the country-specific interest rate premium.

4 Remittances

4.1 Altruistic Remittances

As mentioned in the Section 2, emigrants may send money to home country, for altruistic motivations, in order to sustain consumption of their families. This altruistic remittances may be exogenous (i.e independent of economic conditions of home country) or countercyclical (i.e remittances increase during bad economic conditions in home).

4.1.1 Altruistic exogenous remittances

Altruistic remittances send by emigrant can be independent to economic conditions of home country. In other words, emigrants send money, in order to sustain consumption, whatever the economic conditions of home country. These exogenous transfers inflows are independent of the business cycles of home economy and can be explained by the business cycles of host country. For example, a boom in host country can improve the economic conditions of migrants and they can send more money to home country for altruistic motivations. Since this is a small open economy model, these considerations can not be affected by domestic events and are taken as given. Thus, the exogenous altruistic remittances are specified by an exogenous transfer denoted by X_t^e independent of home business cycles.

4.1.2 Altruistic countercyclical remittances

Altruistic remittances can be countercyclical to home country. In fact, emigrants may choose to send money in order to sustain consumption if economic conditions in home country are bad. In this case, remittances are countercyclical to home economy. As in Chami et al. (2006), these countercyclical transfers are specified by the following process:

$$X_t^c = \bar{X}^c \left(\frac{Y_t}{\bar{Y}} \right)^{\xi}; \qquad \xi < 0$$

where $\bar{X}^c$ and $\bar{Y}$ are respectively the steady levels of remittances and home gross domestic product (GDP).

ξ is the factor of the countercyclical pattern of the altruistic remittances. It represents the elasticity of aggregate remittances with respect to aggregate output of home country.

4.2 Self-Interested remittances

Emigrants can be motivated to send money in order to exploit investment opportunities. In this case, remittances behave like any other capital inflow, driven by selfish reasons and reflecting the desire of emigrant to invest in the home country. Domestic households could therefore be viewed as merely intermediaries that receive funds from home-born foreign residents and use these funds to take advantage of local opportunities. It is clear that self-interested remittances do not form part of the locals households' budget constraint. As in Lucas and Stark (1985), households do not have any command over them and they only purchase or maintain assets on the migrant's behalf.

These self-interested remittances react to changes in the relative price of foreign assets with respect to domestic assets price.

5 Simulation and results

5.1 Calibration

Parameters are calibrated so that they reflect the characteristics of developing countries. The model is numerically resolved by log linearizing variables around their steady state levels.

The parameter of intertemporal preference, β, is set to 0.98. The share of tradable good in the consumption portfolio is taken equal to the weight of tradable good in consumption price index which is 0.5 (Arrellano et al., 2005). The rate of capital depreciation is set to 0.05.

The capital intensity of tradable sector is assumed to exceed that of the nontradable sector, ($\alpha = 0.3 < \eta = 0.4$), as in Arrellano et al. (2005). Two stylized facts support this assumption. On one hand, exporters in developing countries specialize typically in labor-intensive and low-skill technologies (agriculture, footwear, apparel, and so on). On the other hand, most nontradable infrastructure projects in those countries are highly capital intensive (electricity, telecommunications, and so on), see, for example, Brock and Turnovsky (1994) and Goldstein and Lardy (2005) for this argument.

In the benchmark model, the elasticity of substitution between K_T and K_N, $\zeta = 1/(1+\nu)$ is set to -0.1, as in Mendoza and Uribe (2000). However, I vary this parameter in order to analyze the effect of international transfers under different value of capital elasticity of substitution.

The debt elasticity to the interest rate φ is set to 10^{-3}. As argued by Schmitt-Grohé and Uribe (2001), a small elasticity of the supply of funds schedule reduce the fluctuations in the country risk premium. The steady state debt-to-GDP ratio is set to 25 percent.

The steady state level of remittances is set to 15 percent of GDP. This value is the mean of the 25 first top remittance-recipient countries.

5.2 Steady state analysis

In this part, the analysis is about the steady state where the capital is at its long run level and the level of remittances is constant with absence of productivity shocks. The following values (in % of GDP) are considered: 0%, 15%, 25%. The results are in Table 1.

By looking Table 1, we note that the impact of transfers changes the consumption, investment rate, composition of output (labor shares and capital shares), as well as the relative price of nontradable goods.

We note that the investment-to-GDP ratio is an increasing in remittances, whereas the investment-to-total income ratio is a decreasing in remittances. Contrary to the investment, the consumption-to-GDP ratio and the consumption-to-total income ratio are both increasing in remittances. The reason why investment-to-GDP ratio is higher is that production of nontradables is relatively capital-intensive. So, the rate of return to capital is higher than in the absence of transfer, providing a greater incentive for investment.

An important result, in line with the classical paradox on international transfers, is that the relative price of nontrabable goods is higher in the case where remittances are higher. In other words, increase in remittances lead to an appreciation of long run real exchange rate. However, we will see in the following section that this appreciation of long run real exchange rate depends on the capital elasticity of substitution across sector.

A last result, in line with the above previews results, is the decline in tradable sector if remittances increase. The decline in tradable sector results in the movement of production factors from tradable sector to nontradable. This decline in tradable sector associated with the real appreciation is called the dutch disease effect, caused by remittances. The inflow of transfers increases the supply of tradable goods and, ceteris paribus, lowers their price. But, through the income effect of the transfer, it increases the demand for and price of nontradable goods. As a result, production factors are redirected toward the sectors producing nontradable goods.

While these results are in line with the static model findings, we observe some new features. On one hand, remittances are associated with a decline in the investment-to-total income ratio. On the other hand, the results are sensitive to the capital elasticity of substitution. We will explore this point in the next section.

Table 1: steady state analysis

Variables	Remittances (% of GDP)		
	0%	15%	25%
Y_T/Y	0.6188	0.5450	0.4939
Y_N/Y	0.5930	0.6457	0.6768
P_N	0.6430	0.7046	0.7477
C/Y	0.5011	0.5655	0.6065
$C/Income$	0.5011	0.4927	0.4852
I/Y	0.1862	0.1895	0.1930
$I/Income$	0.1862	0.1651	0.1544
K_T/K_N	1.0180	0.9902	0.9720
L_T/L_N	1.8935	1.3973	1.1384
K_T/L_T	32.3324	39.0436	45.4194
K_N/L_N	60.1369	55.0939	53.1951

5.3 Sensitivity analysis

In this section I perform a series of sensitivity tests on the deterministic model to understand the mechanisms by which remittances lead to real exchange rate appreciation by changing the composition of output. In this experiment I vary the level of remittances, capital intensity of the two sectors and the capital elasticity of substitution. All the other parameters are held constant. The results are in Table 2.

In Table 2 we note that the effect of remittances on steady state real exchange rate depends on the capital elasticity of substitution. If the capital is homogeneous across sector, whatever the level of remittances the steady state real exchange rate remains constant. But, if capital is not homogeneous across sector, the increase in remittances leads to an appreciation in the steady state real exchange rate. This result do not depend on the relative intensity of capital (Models 1 and 3 compared to Models 2 and 4, respectively). The appreciation in real exchange rate can be explained by the fact that if capital is sector-specific, an increase in transfers lead to an increase of the ratio K_N/K_T (i.e capital reallocates toward the nontradable sector) and a decrease in the ratio K_N/L_N. An increase in the ratio K_N/K_T causes a rise in real exchange rate (equation (14)). According to equation (14), the ratio K_N/K_T and a decrease in the ratio has a positive effect on the real exchange rate ($-\frac{\alpha}{\zeta} > 0$). The ratio K_N/L_N has a negative (resp. a positive) effect on the real exchange rate if $\alpha \leq \eta$ (resp. $\alpha \geqslant \eta$). So, remittances by increasing K_N/K_T and by decreasing K_N/L_N cause an appreciation in the real exchange rate [1]. So, whatever the relative capital intensity, an increase in remittances lead to an appreciation in the steady state real exchange rate. These findings can be noted by comparing, respectively, the Models 1 and 2 to the Models 3 and 4 which is benchmark model. In Models 1 and 2 (homogeneous capital) we note that transfers have no effect on relative price of nontradables, because if capital is homogeneous across sector transfers do not change the ratios K_N/K_T and K_N/L_N . By comparing Model 5 (low elasticity of substitution $\zeta = -0.01$) to

1. The combination of two effects is positive even if $\alpha > \eta$, because in this case the positive effect of an increase in K_N/K_T dominates the negative effect of a decrease in K_N/L_N

Model 4, we also note that, if the capital elasticity of substitution is lower, transfers lead to more real exchange rate appreciation.

Table 2: Sensitivity analysis

Models	Variables	Remittances (in % of GDP) 0%	15%	25%
Model 1 $\zeta = -\infty; \alpha = \eta = 0.3$	Y_T/Y	0.5850	0.5101	0.4601
	Y_N/Y	0.4150	0.4890	0.5388
	P_N	1.0000	1.0000	1.0000
	C/Y	0.4150	0.4899	0.5399
	$C/Income$	0.4150	0.4260	0.4319
	I/Y	0.1652	0.1652	0.1652
	$I/Income$	0.1652	0.1436	0.1321
	K_T/K_N	1.4101	1.0412	0.8522
	L_T/L_N	1.4101	1.0412	0.8522
	K_T/L_T	14.8392	14.8392	14.8392
	K_N/L_N	14.8392	14.8392	14.8392
Model 2 $\zeta = -\infty; \alpha = 0.3; \eta = 0.4$	Y_T/Y	0.6111	0.5408	0.4940
	Y_N/Y	0.5209	0.6151	0.6778
	P_N	0.7465	0.7465	0.7465
	C/Y	0.4665	0.5508	0.6070
	$C/Income$	0.4665	0.4790	0.4856
	I/Y	0.1865	0.1904	0.1930
	$I/Income$	0.1865	0.1656	0.1544
	K_T/K_N	1.1785	0.8834	0.7321
	L_T/L_N	1.8333	1.3741	1.1388
	K_T/L_T	14.8392	14.8392	14.8392
	K_N/L_N	23.0832	23.0832	23.0832
Model 3 $\zeta = -0.1; \alpha = \eta = 0.3$	Y_T/Y	0.5905	0.5110	0.4568
	Y_N/Y	0.4525	0.4950	0.5181
	P_N	0.9050	0.9881	1.0483
	C/Y	0.4359	0.4927	0.5272
	$C/Income$	0.4359	0.4285	0.4218
	I/Y	0.1652	0.1652	0.1652
	$I/Income$	0.1652	0.1436	0.1321
	K_T/K_N	1.0338	1.0040	0.9844
	L_T/L_N	1.4420	1.0445	0.8441
	K_T/L_T	29.4120	35.4982	41.0474
	K_N/L_N	41.0246	36.9323	35.0705
Model 4 $\zeta = -0.1; \alpha = 0.3; \eta = 0.4$	Y_T/Y	0.6188	0.5450	0.4939
	Y_N/Y	0.5930	0.6457	0.6768
	P_N	0.6430	0.7046	0.7477
	C/Y	0.5011	0.5655	0.6065
	$C/Income$	0.5011	0.4927	0.4852
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	K_T/L_T	32.3324	39.0436	45.4194
	K_N/L_N	60.1369	55.0939	53.1951
Model 5 $\zeta = -0.01; \alpha = 0.3; \eta = 0.4$	Y_T/Y	0.6195	0.5446	0.4939
	Y_N/Y	0.6003	0.6496	0.6767
	P_N	0.6338	0.7010	0.7479
	C/Y	0.5045	0.5678	0.6065
	$C/Income$	0.5045	0.4937	0.4852
	I/Y	0.1861	0.1902	0.1930
	$I/Income$	0.1861	0.1654	0.1544
	K_T/K_N	1.0020	0.9990	0.9969
	L_T/L_N	1.8994	1.3954	1.1384
	K_T/L_T	34.5846	42.8001	50.1773
	K_N/L_N	65.5577	59.7876	57.3000

5.4 Impulse responses analysis

In this section I analyze the dynamics of the models after different shocks depending on the cyclicality of remittances. In the first case, the effects of exogenous altruistic remittances shocks are examined. In the second case, the effects of productivity shocks in presence of countercyclical remittances are compared to the effects of productivity shocks with constant remittances. In the last case, the effects of shock on self-interested remittances are analyzed.

5.4.1 Exogenous altruistic remittances

In this part, I analyze the effects of positives shocks on exogenous remittances. These effects are considered for two values of capital elasticity of substitution. The impulse responses of the variables are in the figure 1.

The positive shock on altruistic remittances leads to an increase on household income which causes an increase in demand of consumption. The increase in remittances augments the availability of resources in capital (expressed in term of tradable good). This results in a decrease in the capital acquisition cost, and so, the increase in investment. The inflows of remittances increase the supply of tradable good, ceteris paribus, lowers its price. Through the income effect of transfers, the demand and the price of nontradable goods increase. This increase in relative price of nontradable goods represents an appreciation of real exchange rate. As a result, there is a reallocation of production factors from tradable sector to nontradable sector. The decline in tradable sector associated to the appreciation in real exchange rate is called the Dutch disease effect.

Nervetheless, after the first periods of the shock, the relative price of nontradable goods go down below its level of steady state. In fact, during the first periods of the shock the demand of nontradable good consumption being stronger, its price increase. But, after the first periods of the shock, because of the reallocation of production factors, the nontradable good production deals easily with its demand. Thus, there is a decrease in nontradable goods price after the first periods of the shock, before the return to the steady state. The reason that relative price of nontradable good goes down under its steady state level is the fact that tradable good is labor-intensive. If tradable sector is capital-intensive, we don't note this phenomenon. In this case, after the shock, the relative price of nontradable good increases and return to its steady-state level, without going down under its steady-state level.

We note that, if capital is sector-specific, the increase in consumption and the Dutch disease effect are more persistent.

5.4.2 Countercyclical altruistic remittances

In order to analyze the effect of countercyclical altruistic remittances, we consider a negative shock to global productivity. We compare the effects of this shock between the case without remittances and the case with countercyclical remittances. Figures 2 and 3 give the impulse response functions. Figure 2 displays the case where capital is homogeneous across sector and figure 3 displays the case where capital is sector-specific.

Whatever the capital elasticity of substitution, we note the following results. In the case without remittances, the negative productivity shock in tradable sector leads to a fall in output and inputs in that sector. As a result, household income decreases. The negative effect on income leads to a decline in consumption demand. Lower consumption generates an deflationary pressure on the relative price of nontradable goods. Consequently, the foreign demand for the home-produced tradable goods increases, ameliorating the negative effect of the negative productivity shock.

The dynamics change if remittances are countercyclical. The negative productivity shock is followed by an increase in remittances. The increase in remittances attenuates the negative effect of productivity shock on household income. In this case, the decrease in consumption is less than that of the previous case. Since nontradable output is biased toward consumption demand, the fall in the relative price of nontradable goods is modest. So, the depreciation in the real exchange rate is reduced and the decline in tradable sector is deepened.

The Dutch-disease effect is present when remittances are countercyclical. The negative shock to tradable sector causes a decline in tradable sector which is deepened if remittances are countercyclical.

If capital is sector-specific, the Dutch-disease effect of countercyclical remittances is more persistent.

5.4.3 Self-interested (or procyclical) remittances

I consider a negative shock to foreign interest rate. Since remittances here are motivated by exploitation of investment opportunities, I assume that the family of emigrant receives the return on investment. We examine the case where capital is homogeneous across sector and the case where capital is not homogeneous across sector. The impulse response functions are in the figure 4.

The negative shock to the price of foreign investment leads to an increase on emigrant investment inflows. These investment inflows cause a fall in domestic interest rate and a decrease in home resident investment. Nevertheless, the total investment increases and the capital stock augments in the two sector sectors. Since, home residents receive the return on total investment (residents investment and emigrants investment), the boom in investment cause an increase in consump-

tion demand.

The increase in consumption demand pushes relative price of nontradable goods to rise. Consequently, the tradable sector declines and production factors move from tradable sector to nontradable sector.

However, the decline in tradable sector is temporary because the increase in investment demand benefits the tradable sector

We also note that, the capital elasticity of substitution have the same effects on the Dutch-disease effect.

6 Conclusion

In this paper, we examine the effects of remittances on developing countries economies using a two-sector dynamic model, in which capital can be imperfectly homogeneous across sector. The effects of remittances depend on the capital elasticity of substitution.

In the steady state, a increase in remittances leads to an appreciation of real exchange rate only if capital is sector-specific. If capital is homogeneous across sector, remittances have no effect on the steady-state real exchange rate.

Positive shocks to exogenous altruistic remittances cause an increase in consumption, a decline in tradable sector and an appreciation in real exchange.

The countercyclical altruistic remittances attenuate the decrease in consumption following a negative productivity shock and the decline in tradable sector.

Positive shocks to self-interested remittances, as positive shocks to exogenous altruistic remittances, have the same effects on consumption, output composition and on real exchange rate .

If capital is sector-specific, the shocks effects are more persistent. Particularly, the effect on consumption and the Dutch-disease effect are persistent if capital is sector-specific.

The purpose of a future research would consist in analyzing the best monetary policy which manages the remittances inflows in presence of imperfection (like price rigidity). This monetary policy would have to manage the Dutch disease effect (i.e decline in the tradable sector and the real exchange rate appreciation) caused by remittances shocks.

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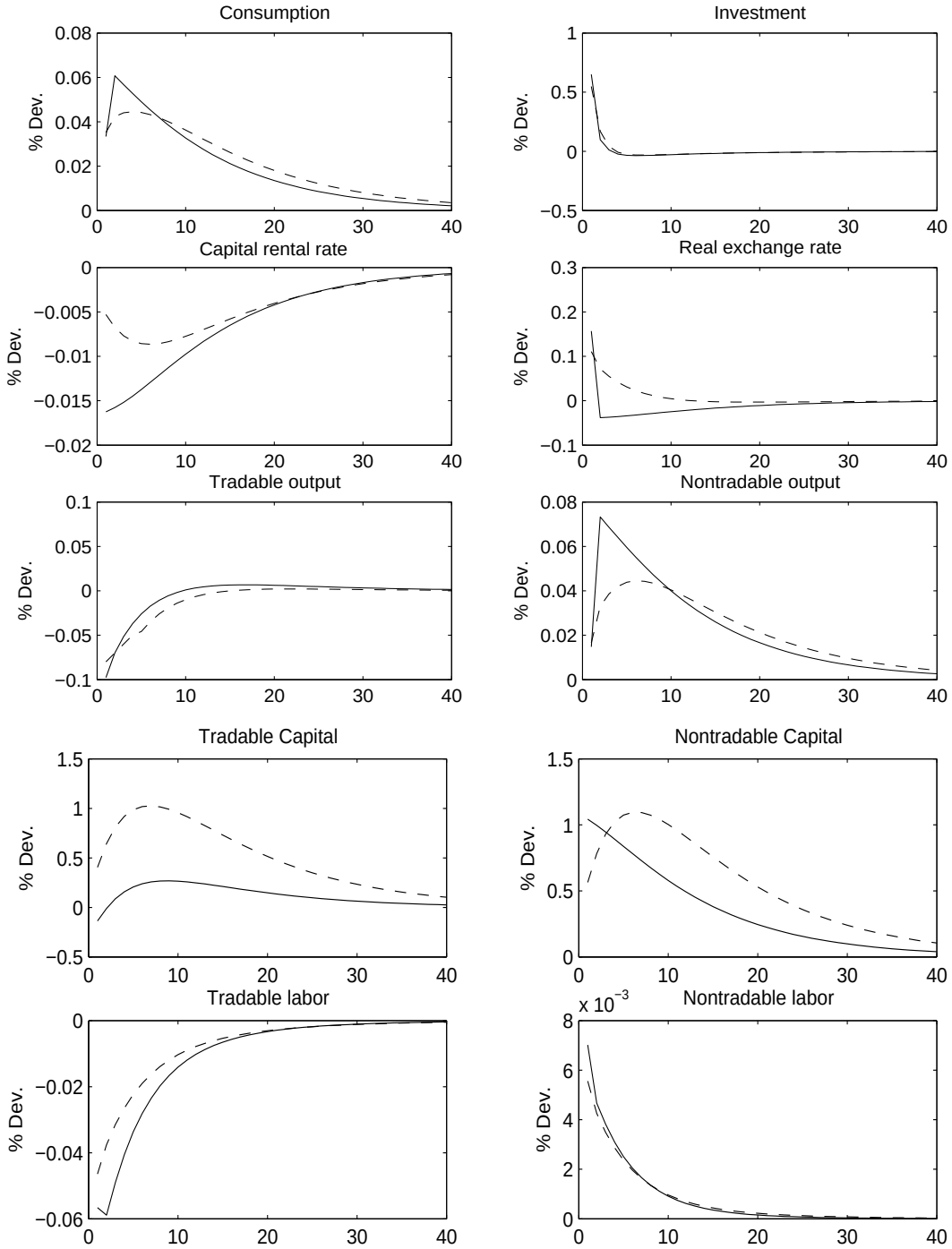

Figure 1. Impulse Response Function of positive shock to exogenous altruistic remittances. Solid line is for homogeneous capital ($\nu = -1$), dot line for sector-specific capital ($\nu = -11$).

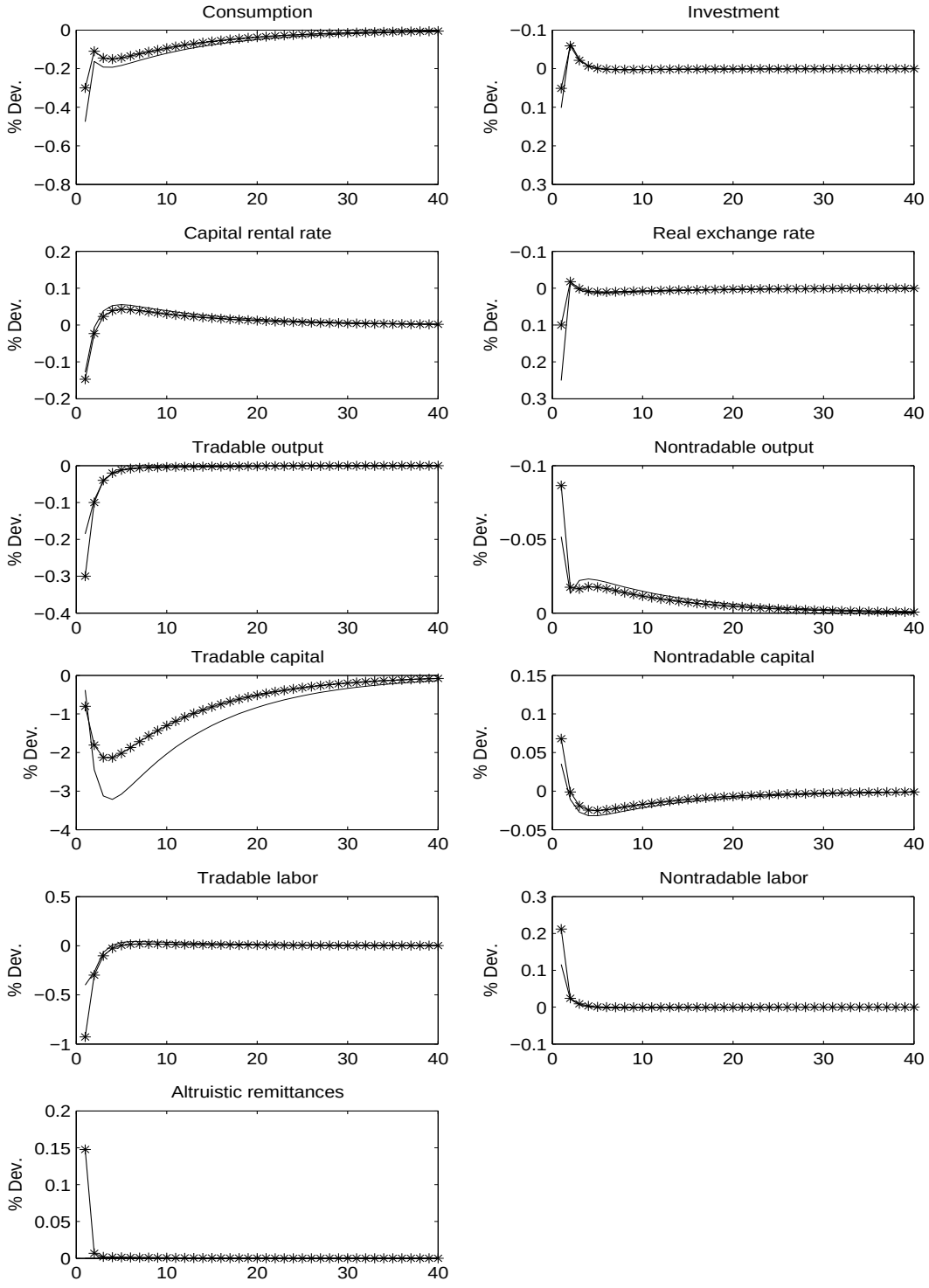

Figure 2. Impulse Response Function of negative shock to global productivity with homogeneous capital. Line not marked: without remittances, line with asterisk: countercyclical remittances

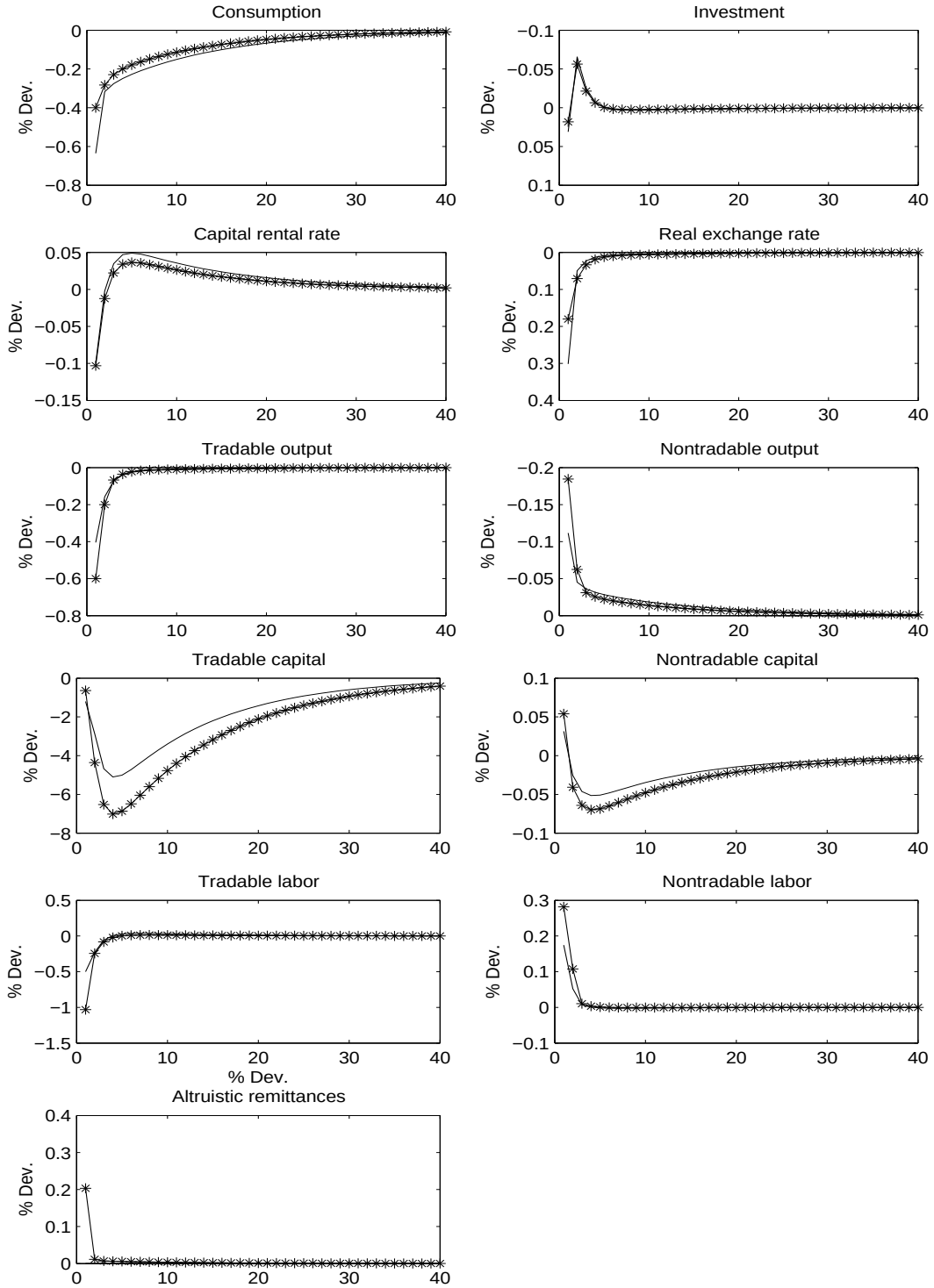

Figure 3. Impulse Response Function of negative shock to global productivity with sector-specific capital. Line not marked: without remittances, line withasterisk: with countercyclical remittances.

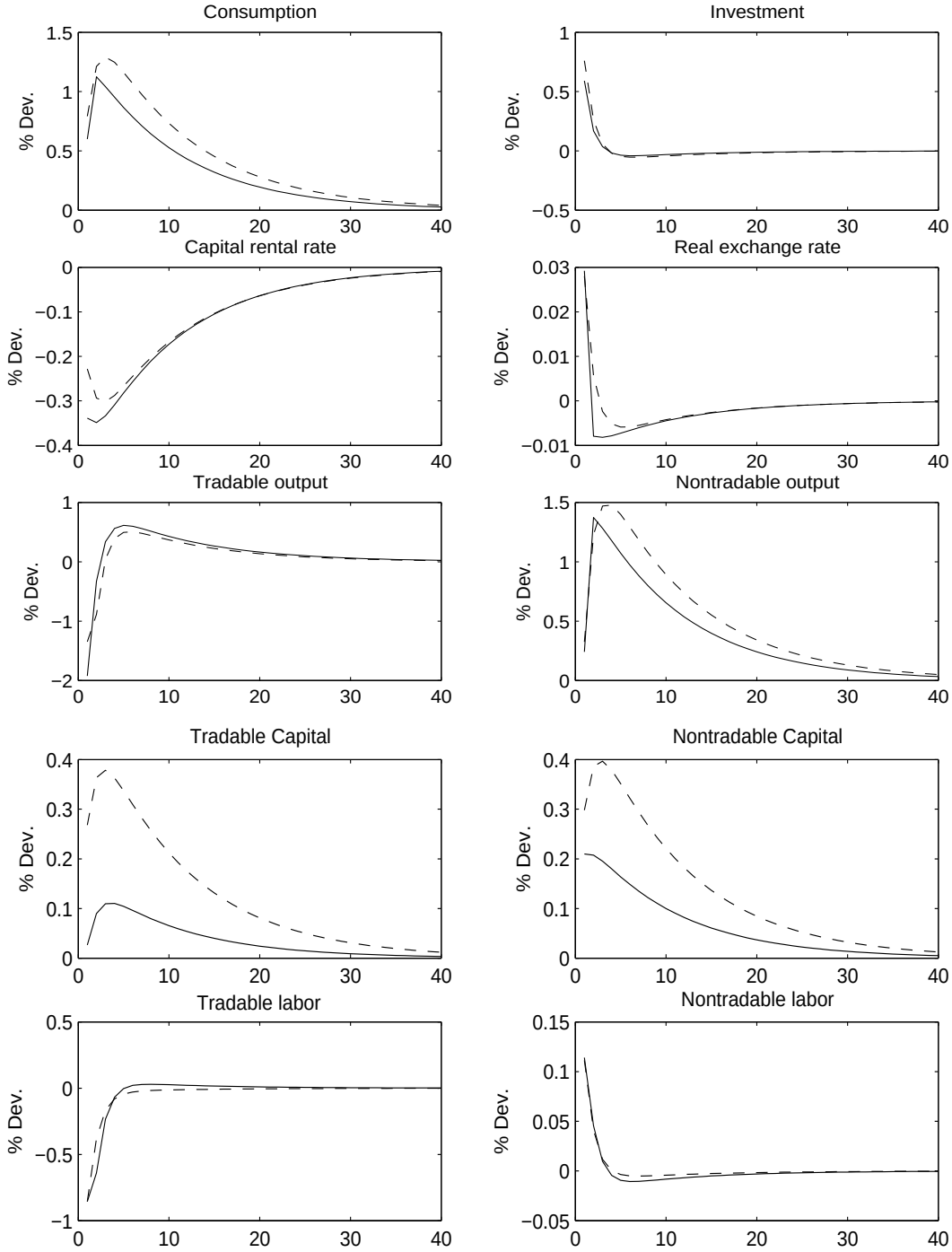

Figure 4. Impulse Response Function of positive shock to exogenous altruistic remittances.
Solid line is for homogeneous capital , dot line for sector-specific capital