# The Macroeconomic Impact of Migrant Remittances

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*This paper studies the impact of migrant remittances on welfare, consumption, savings, and the structure of production between traded and non-traded sectors in remittance-sending and remittance-receiving countries. Micro foundations are used to model remittances explicitly in two alternative frameworks – in the first framework, an overlapping-generations approach is adopted where remittances are driven entirely by the savings decisions of migrants who return to their home country upon retirement. In the second framework, remittances are driven by family decisions rather than through the savings motive of migrants. Data from South Africa and Lesotho are used to calibrate the two-country, two-sector, steady-state models. The results from the first model (remittances as retirement savings) show that remittances are influenced by the economic prospects in the host country while the second model (remittances driven by familial altruism) predicts that remittances are influenced by the economic prospects in the both the host country and the recipient country. The solutions for both models indicate that restricting migration reduces both home country and aggregate welfare even though remittances have an impact on the real exchange rate and the structure of production in the recipient country in accordance with the phenomenon known as 'Dutch Disease.' A counterfactual exercise demonstrates that citizens of the host country would suffer a welfare loss (1.2% of per period consumption for the first model, 3.7% for the second model) if it were to choose assisting the recipient country with foreign aid instead of allowing migration.*

## 1 Introduction

The magnitude of migrant remittances has increased tremendously in recent years. According to World Bank estimates, developing countries received 240 Billion US Dollars worth of remittances from migrants in 2007[1]. Thus, remittances have become an increasingly important area of research in recent years.

Empirical literature on remittances suggests that their volume is influenced by aggregate variables in both, sending and receiving countries. Papers that study recipient country effects include Chami et al (2003) who find remittances to be countercyclical, and Giuliano and Ruiz-Aranz (2006) who find them to be procyclical. Vargas-Silva and Huang (2005) study both host (sending) and home (receiving) country effects and they conclude that remittances depend more strongly on the sending country's aggregate variables.

At the same time, due to their large magnitude, remittances also have significant consequences for recipient economies. Many papers in the literature study the impact of migrant remittances on various relevant macroeconomic variables such as welfare, the structure of production and the real exchange rate. One issue that has received considerable attention is the role played by remittances in causing a phenomenon known as 'Dutch Disease.' In the words of Acosta et al (2007):

[1] Source: World Bank: http://go.worldbank.org/QOWEWD6TA0 (World Bank, 2008)

*The term 'Dutch Disease' was originally used to describe the difficulties faced by manufacturing in the Netherlands following the development of natural gas on a large scale which triggered a major appreciation of the real exchange rate. It has since been used to refer to any situation in which a natural resource boom, or large foreign aid, or capital inflows, cause real appreciation that jeopardizes the prospects of the tradable sector.*

Therefore, a model with two sectors (traded and non-traded goods) is required in order to study the macroeconomic impact of remittances while allowing for Dutch Disease effects. Moreover, since both host and home country macroeconomic variables are empirically seen to be relevant, the model should also feature both countries.

Although various motives for remittances have been proposed and studied, the first model assumes that all remittances are driven by the savings motive of migrants who relocate to their home country upon retirement. Thus, this model needs at least two generations, one working and the other retired. All these features are included in a parsimonious, deterministic, general equilibrium, overlapping-generations model involving two countries (home or remittance receiving country and host or remittance sending country), two sectors (traded and non-traded) and agents who live for two periods (working and retirement) each.

In the second model, remittances are assumed to be driven solely by familial altruism. The second model is deliberately constructed such that it closely matches the previous model in order to facilitate convenient comparisons. Therefore, this model also considers two sectors (traded and non-traded) and two countries (host/sending/foreign and home/recipient). However, the second model features dynastic households rather than overlapping-generations. The households of the home country have a certain fraction of their members working as migrants in the host country. Households maximize a household-level problem and this implies altruistic behavior among the members. Similarly, since the households are dynasties, the model features inter-generational altruism as well. Thus, a home country household's optimal solution might involve transfers from its migrant members to its resident members and this is modeled as remittances in this paper.

SA and Lesotho were chosen for this study because sector level GDP and remittance data are readily available for the pair and almost all of the remittances (84%, according to World Bank sources[2]) into Lesotho come from SA. Thus, ignoring the presence of other countries in the model should not affect the findings significantly.

The models are parameterized using various features of the data. In both models, remittances are welfare enhancing despite their adverse impact on the real exchange rate and their contribution to the phenomenon of Dutch Disease. For both models, aggregate welfare decreases when migration is decreased. In the first model, restricting migration greatly reduces home country welfare even though it marginally improves host country welfare. In the second model, restricting migration has an adverse effect on both the home country and the host country. Regardless of the model applied, the host country gains higher welfare by allowing migration from the home country rather than providing it equivalent foreign aid.

## 1.1 Related Literature

For detailed surveys of the literature please refer to Page and Plaza (2006), Rapoport and Docquier (2005) and Loser et al (2006). Although most papers on remittances have a microeconomic focus, there are some informative papers that adopt a macroeconomic perspective. Giuliano and Ruiz-Aranz (2006) conduct an empirical study and find that remittances lead to growth. Other empirical papers include Bourdet and Flack (2006) as well as Amuedo-Dorantes and Pozo (2004), both of which show that remittances cause Dutch Disease. McComick and Wahba (2000) is a theoretical paper that studies a model involving two countries, two sectors, and two skill levels of labor supply to study the causes and consequences of migration and remittances. Papers that solve structural models and are closely related to this chapter include Chami et al (2006) and Acosta et al (2007).

Chami et al (2006) do not consider Dutch Disease effects while Acosta et al (2007) focus primarily on this issue. However, both these papers ignore the role played by the macroeconomic variables of the remittance sending country. Rather than model remittance decisions explicitly, they assume an exogenous

[2] Source: World Bank: http://go.worldbank.org/ U4RXL56V20 (World Bank, 2008)

process for remittances. In the former paper, remittances are assumed to be countercyclical, while the latter considers acyclical, procyclical and countercyclical remittances in three separate scenarios.

Rapoport and Docquier (2005) present a very detailed and methodical discussion of the various possible motives behind remittances. These include altruism, exchange for services provided in the home country, as a strategy to deter more migration, as an insurance arrangement, as a family loan arrangement where the migrant repays his debt to the family, as a means to retain the rights of inheritance etc. After closely studying evidence from microeconomic literature and empirical studies of survey data, Rapoport and Docquier (2005) conclude:

> *On the whole, the evidence from micro surveys confirms that patterns of remittances are better explained as familial inter-temporal contracts than as a result of altruism or other purely individualistic considerations. This is not to deny the importance of individualistic motives; however altruism, intentions to return, and prospects for inheritance explain why implicit migration contracts emerge mainly if not exclusively within a familial context.*

For the first model in this paper, individual retirement motives are assumed to be the driver of migrant remittances – this approach appears consistent with Rapoport and Docquier's (2005) suggestion that intentions to return could explain migration contracts. The second model considers altruism. However, in this paper, 'altruism' is not used in the strict sense of Rapoport and Docquier (2005). Rather, the word altruism is used to suggest a familial motive for remittances consistent with Rapoport and Docquier's conclusion above; this is clear from the model (described in the next section) which features household level decision making and utility maximization. This approach abstracts away from intra-household game theoretic elements while maintaining the relevance of the family since a household can be thought of as an arrangement where a household-level benevolent dictator makes all decisions and is constrained only by the entire household's budget.

This paper adds to the current literature on the macroeconomics of remittances by solving a structural model that includes host and home country effects explicitly and treats remittances as an endogenous variable determined through micro foundations. The next section examines the data, section

three presents the first model, section four presents the second model, and section five provides details regarding the calibration. The results and implications of the model are discussed in the sixth section which is followed by a brief exploration of possible future work.

## 2 Examining the Data

The data used for this exercise are from Lesotho and South Africa. Although Lesotho is much less developed than SA, both economies can be considered to belong to the 'Global South' and according to Ratha and Shaw (2007), South-South remittances are very important economically (amounting to almost 20% of all inward remittances to developing countries) warranting the need for detailed studies in the area. This is particularly true for Lesotho which receives annual remittances that amount to almost 25% of its total GDP. Moreover, in the context of the models being considered these two economies form a good country pair as almost all (84%)[3] of Lesotho's inward remittances come from SA. At the same time, a significant fraction (70%)[4] of South Africa's outward remittances goes to Lesotho. Thus ignoring the influence of other countries can be somewhat justified for a model of remittances between SA and Lesotho, especially from the perspective of Lesotho (the 'home economy' and the country of focus in this paper).

Lesotho is a small, landlocked, mountainous country surrounded on all sides by South Africa.


**Figure 1**

[3] Source: World Bank: http://go.worldbank.org/ U4RXL56V20 (World Bank, 2008)
[4] *ibid*

A significant fraction (20% of the labor force)[5] of working age Basotho find employment in South Africa. Mining is the predominant occupation (68%) of these Basotho migrants according to UN-INSTRAW and SAIIA (2007). Further, in Migration Policy Series (#2, 1997) of the South Africa Migration Project, Sechaba Consultants report that more than 70% of Basotho miners prefer to return to Lesotho rather than stay on in South Africa after the duration of their employment. These facts support the proposed two-country overlapping-generations model where migrants return to their home country upon retirement. Also, most of the Basotho miners who plan to return have family in Lesotho. This fact supports the proposed familial altruism model.

As can be seen from Figure 2, data from the national accounts of Lesotho and South Africa suggest that to a significant extent, the two economies share the same business cycle. Remittances to Lesotho too are positively and strongly correlated to this cycle. This could be considered as supporting the findings of Vargas-Silva and Huang (2005) who report that remittances depend more strongly on the sending countries economic circumstances. Alternatively, the figure could be used to support the hypothesis that remittances are procyclical with the recipient country's economy because they are driven by investment motives rather than altruistic motives.

[5] Source: Global Policy Network: http://www.gpn.org/ (Global Policy Network, 2006)

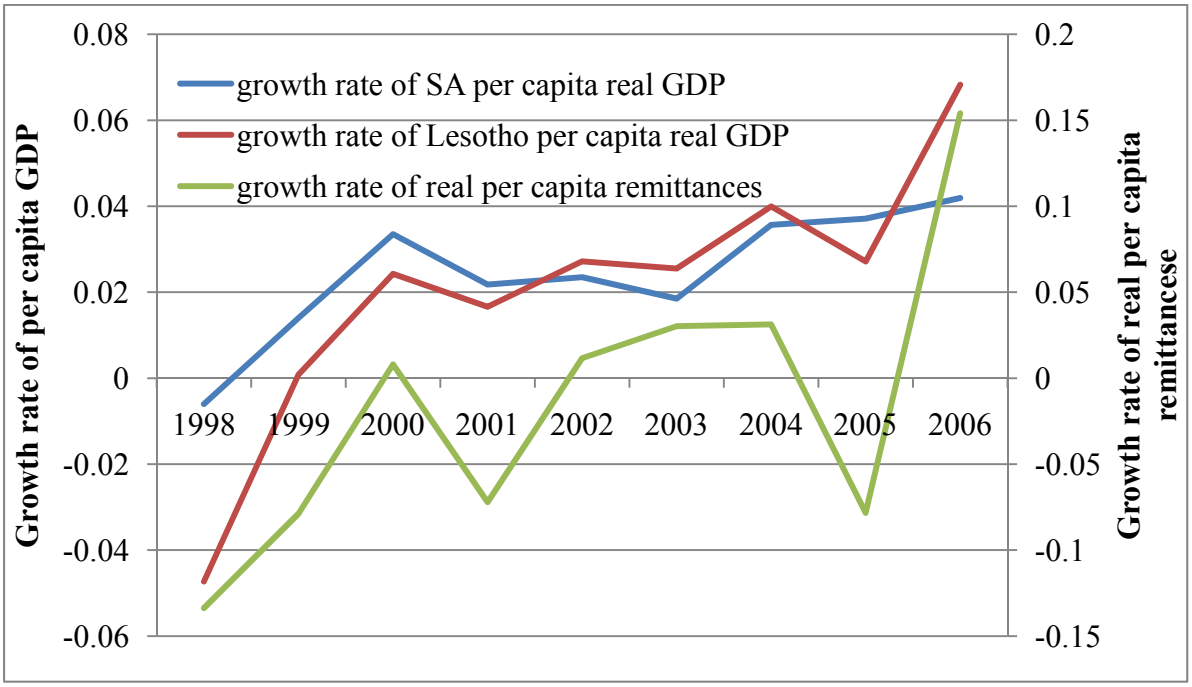


**Figure 2**

Since Lesotho and South Africa appear to be on almost the same business cycle, it is hard to disentangle the two possibilities by looking cursorily at the data. The correlations reported in Table 1 verify these co-movements. The growth rate of remittances is positively and significantly correlated with the per capita real GDP growth of both Lesotho and South Africa. Although the value of this correlation is higher for Lesotho, the two correlation statistics are not significantly different from each other.

| **Selected Correlations from the Data** | |
|---|---|
| Growth rate of SA per capita real GDP - Growth rate of Lesotho per capita real GDP | 0.92* |
| Growth rate of Lesotho per capita real GDP - Growth rate of real per capita remittances | 0.86* |
| Growth rate of SA per capita real GDP - Growth rate of real per capita remittances | 0.69* |
| Growth rate of real exchange rate - Growth rate of real per capita remittances | 0.74 |

| Selected Correlations from the Data | |
|---|---|
| Growth rate of real per capita non-traded output - Growth rate of real per capita remittances | 0.70* |
| Growth rate of real per capita traded output - Growth rate of real per capita remittances | 0.73* |
| * significant at 95% level | |

**Table 1**

The data can also be analyzed to find whether remittances cause Dutch Disease in Lesotho. In terms of exchange rates, the data is unambiguous. As can be seen in Figure 3 and Table 1, the growth rate of remittances is correlated with the growth rate of the real exchange rate (the correlation is not significant even at the 90% level probably due to the short length of the series for the real exchange rate). In this paper, real exchange rate is defined as the price of one unit of the composite South African good in terms of the composite Lesotho good. Thus, according to Figure 3, as remittances increase, it takes a greater number of composite Lesotho goods to buy 1 composite South African good lending support to a positive diagnosis for Dutch Disease.

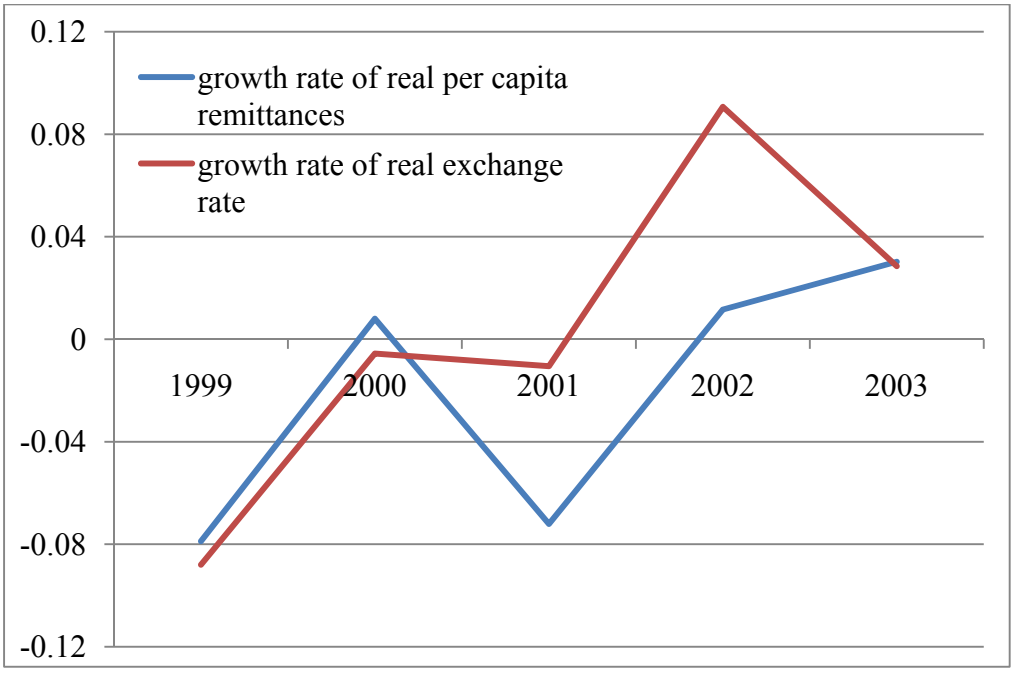


**Figure 3**

Another way to test for the presence of Dutch Disease is by studying the correlation between the non-traded goods sector and remittances. Figure 4 suggests that as remittances increase, so does the output of the non-traded goods sector, suggesting the presence of Dutch Disease. This can also be seen from the high correlation between the growth rate of real per capita non-traded output and the growth rate of real per capita remittances in Table 1. However, at the same time, it can be seen that remittances are also strongly correlated to the traded goods sector. Once again, while both correlations are positive and significant individually, the two statistics are not significantly different from each other. Therefore, these sectoral analyses fail to provide any conclusive evidence regarding Dutch Disease.

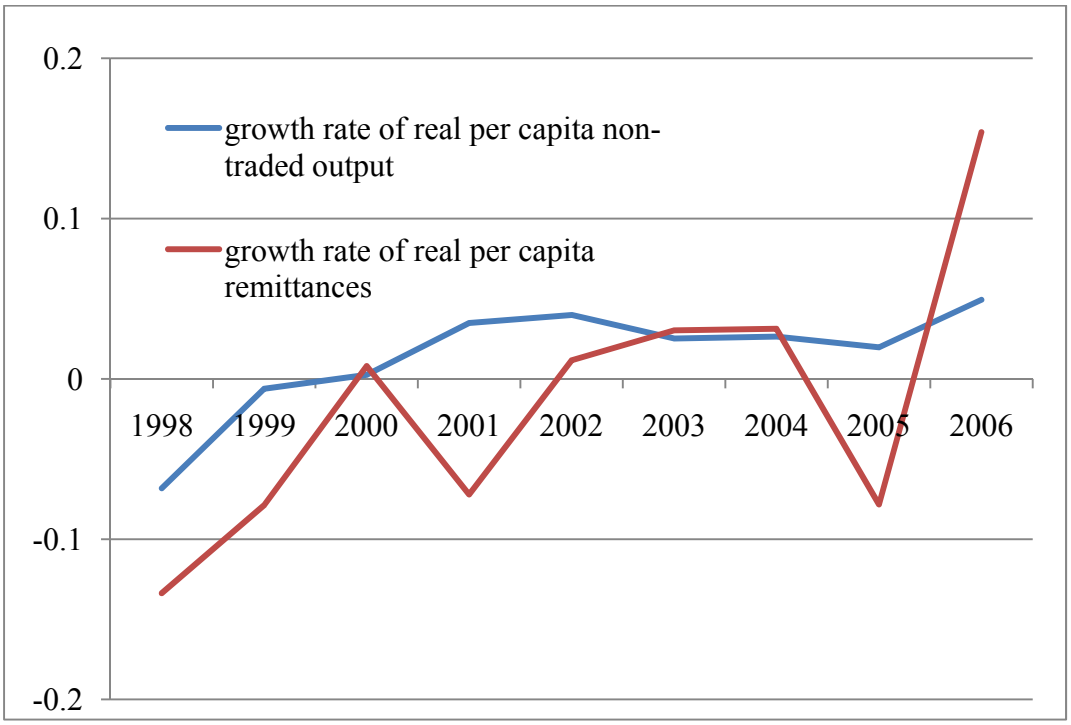


**Figure 4**

In order to obtain a better understanding of remittances, two possible structural models are set up and solved in the following sections.

## 3 Model: Remittances Driven by Retirement Savings

In order to consider the impact of remittances driven by retirement savings, the data are analyzed using a two-country, two-sector, general equilibrium, overlapping-generations model with agents who live for two periods (youth and retirement). A constant fraction of the home country population spends their youth as migrants in the foreign country. Remittances in this model take the form of the savings made by these young migrants who relocate to their home country upon retiring. Two countries are considered in order to capture home and host country effects in explicitly modeled remittance decisions. Two sectors are also necessary in order to study the issue of Dutch Disease. The model abstracts away from capital accumulation decisions and young agents can save for retirement only by purchasing land (a productive asset that yields rent) in their home country using traded goods (the only commodity in the economy that can cross borders). This is broadly consistent with the idea that ultimately all foreign aid, remittances and other international transfers involve the flow of tradable goods since non-traded goods cannot cross borders. Another important aspect of this model is that the resources in both economies stay fixed as capital accumulation is ignored. Host country residents are therefore unable to adjust to increases in migration by increasing their level of capital. Hence this model solution suggests an upper bound for the welfare loss experienced by the host country due to migration. This feature of the model is useful for some of the welfare studies performed later in the paper. Moreover the presence of an immobile factor of production for tradable goods guarantees that both countries manufacture both kinds of goods.

One of the major limitations of this model is that agents live only for two periods. Although two periods can adequately describe the work-retirement effects the model seeks to capture, more periods could have mirrored actual demographic details better. However, increasing the number of periods in the life of each agent caused computational difficulties, probably due to the presence of multiple equilibria in multi-sector OLG models. For a detailed discussion of this issue, please refer to Galor (1992). With two-period lived agents however no problems were encountered during computation. In fact, even a dynamic, stochastic version of the two-period model was solved. But this model was difficult to calibrate as each period in an agent's life is equivalent to half an adult life time and the span of available time series data (10 years for most

variables and even less for others) was inadequate for the exercise. Thus, a steady state version of the model was solved and calibrated in terms of key ratios available in data that are independent of the frequency of sampling.

## 3.1 Agents

All agents in the model live for two periods each. At any given time there are two generations:

- The working generation - each member of this generation is endowed with one unit of labor which is supplied inelastically as labor in order to earn wages. These wages are used to finance consumption (of both traded and non-traded goods) and savings for retirement through the purchase of land.
- The retired generation - members of this generation are not endowed with labor. They rent out the land they purchased during youth to firms for production. Finally they sell their land holdings and use the revenue from the sales as well as their rental income in order to consume traded and non-traded goods.

Both generations have the same size which stays fixed over time. In other words, each period a new generation enters the workforce which replaces the identically sized generation that retires from the workforce which in turn is of the same size as the previous retired generation that has now died.

Also, this model features three kinds of agents - home agents, migrant agents and foreign agents.

- Home agents – These agents live for both periods in the home country. They can buy and sell land only in their home country.
- Foreign agents – These agents live for both periods in the foreign country (which is home for them). Foreign agents can buy and sell land only in the foreign country.
- Migrant agents – These agents live in the foreign country in the first period but relocate to their home country for retirement. Migrant agents can only buy and sell land in their home country even though they live, work, and consume goods in the foreign country during their youth.

Again, the population size of both the home country and foreign country stays fixed and the fraction of the home country young employed abroad stays fixed over time. In the model, populations are normalized in

terms of the number of home country citizens (citizens include home agents and migrants), which is given a value of 2.

The demographic structure can be described thus:

Total population of home country citizens = 2

Fraction of young home country citizens that are migrants = α

Total population of home country citizens = 2 x F

To see the demographics in terms of residents, please refer to Tables 2 and 3.

| **Home Residents** | |
|---|---|
| Young home agents | 1 - α |
| **Total young agents at home** | **1 - α** |
| Old home agents | 1 - α |
| Old migrant agents who have returned home | α |
| **Total old agents at home** | **1** |
| **Total population at home** | **2 - α** |

**Table 2**

| **Foreign Residents** | |
|---|---|
| Young foreign agents | F |
| Young migrant agents | α |
| **Total young agents abroad** | **F + α** |
| **Total old agents abroad** | **F** |
| **Total population abroad** | **2 F + α** |

**Table 3**

## 3.2 Preferences and Budget Constraints

Preferences are time separable with an appropriate discount rate for future utility during retirement. Agents derive utility by consuming a composite consumption good that aggregates tradable and non-tradable goods. The consumption aggregator is of CES (constant elasticity of substitution) form with unit elasticity of substitution. This utility function is adopted as it is computationally and analytically tractable and is very common in the literature. In particular this is the functional form used by Acosta et al (2007). Agents receive no disutility from working and hence do not face a labor-leisure decision. In log terms, the utility function of an agent who is young in period t can be expressed thus:

$$U = \gamma \log C^{Y}_{T,t} + (1-\gamma) \log C^{Y}_{NT,t} + \beta\left[\gamma \log C^{O}_{T,t+1} + (1-\gamma) \log C^{O}_{NT,t+1}\right]$$

Where:

$\gamma$ is the share of tradable goods in total consumption

$C^{Y}_{T,t}$ is the quantity of tradable goods consumed in period t by the young agent

$C^{Y}_{NT,t}$ is the quantity of non-tradable goods consumed in period t by the young agent

$C^{O}_{T,t+1}$ is the quantity of tradable goods consumed in period t+1 by the old agent

$C^{O}_{NT,t+1}$ is the quantity of non-tradable goods consumed in period t+1 by the old agent

$\beta$ is the discount rate

Income and substitution effects perfectly cancel each other with log utility specifications and this helps capture the findings of Vargas-Silva and Huang (2005) who emphasize that host country conditions largely determine the volume of remittances.

Agents face a budget constraint in each period of their lives. While young they earn wage income which they can spend on traded goods, non-traded goods and savings in the form of land holdings. When old, agents earn rental income and sales revenue from their land holdings which they spend on traded goods and non-traded goods. It should be noted that young migrants receive the same wage and face the same the price for non-traded goods as do foreign agents. However as young migrants buy the home country's land, they pay the same price for land as do home agents. Of course, all agents regardless of country of residence or immigration status pay the same price for traded goods.

The budget constraints for a home agent who is young in period t can be expressed thus:

When young: $C_{T,t}^{Y} + p_t\, C_{NT,t}^{Y} + q_t\, L_t^{Y} \leq w_t$

When old: $C_{T,t+1}^{O} + p_{t+1}\, C_{NT,t+1}^{O} \leq (r_{t+1} + q_{t+1})\, L_{t+1}^{O}$

And with $L_t^{Y} = L_{t+1}^{O}$

Where:

$p_t$ is the price of the non-traded good at home at time t

$q_t$ is the price of land at home at time t

$w_t$ is the wage rate at home at time t

$r_t$ is the rental income from land at home at time t

$L_t^{Y} = L_{t+1}^{O}$ is the amount of land the agent chooses to buy (in order to rent and sell later)

The budget constraints for a foreign agent who is young in period t can be expressed thus (decision variables of foreign agents are starred):

When young: $C_{T,t}^{Y*} + p_t^{*}\, C_{NT,t}^{Y*} + q_t^{*}\, L_t^{Y^*} \leq {w_t}^{*}$

When old: $C_{T,t+1}^{O*} + p_{t+1}\, C_{NT,t+1}^{O*} \leq (r_{t+1}^{*} + q_{t+1}^{*})\, L_{t+1}^{O*}$

And with $L_t^{Y^*} = L_{t+1}^{O*}$

Where:

$p_t^{*}$ is the price of the non-traded good abroad at time t

$q_t^{*}$ is the price of land abroad at time t

$w_t^{*}$ is the wage rate abroad at time t

$r_t^{*}$ is the rental income from land abroad at time t

The budget constraints for a migrant agent who is young in period t can be expressed thus (decision variables of migrants are accented with a tilde):

When young: $\tilde{C}_{T,t}^{Y} + p_t^{*}\, \tilde{C}_{NT,t}^{Y} + q_t\, \tilde{L}_t^{Y} \leq {w_t}^{*}$

When old: $\tilde{C}_{T,t+1}^{O} + p_{t+1}\, \tilde{C}_{NT,t+1}^{O} \leq (r_{t+1} + q_{t+1})\, \tilde{L}_{t+1}^{O}$

And with $\tilde{L}_t^{Y} = \tilde{L}_{t+1}^{O}$

$L_t^Y$ equals $L_{t+1}^O$ in every case since the amount of land a young agent buys in period t is the amount of land he can rent and sell as an old agent in period t+1. Prices are normalized in terms of the tradable good which has unit price in both countries.

Therefore, the utility maximization problem of the home agent is:

$$\max_{C_{T,t}^Y; C_{NT,t}^Y; C_{T,t+1}^O; C_{NT,t+1}^O; L_t^Y} \left\{\gamma \log C_{T,t}^Y + (1-\gamma) \log C_{NT,t}^Y + \beta\left[\gamma \log C_{T,t+1}^O + (1-\gamma) \log C_{NT,t+1}^O\right]\right\}$$

Subject to

$$C_{T,t}^Y + p_t\, C_{NT,t}^Y + q_t\, L_t^Y \leq w_t$$

$$C_{T,t+1}^O + p_{t+1}\, C_{NT,t+1}^O \leq (r_{t+1} + q_{t+1})\, L_{t+1}^O$$

$$L_t^Y = L_{t+1}^O$$

**Maximization Problem 3.1**

The utility maximization problem of the foreign agent is:

$$\max_{C_{T,t}^{Y*}; C_{NT,t}^{Y*}; C_{T,t+1}^{O*}; C_{NT,t+1}^{O*}; L_t^{Y*}} \left\{\gamma \log C_{T,t}^{Y*} + (1-\gamma) \log C_{NT,t}^{Y*} + \beta\left[\gamma \log C_{T,t+1}^{O*} + (1-\gamma) \log C_{NT,t+1}^{O*}\right]\right\}$$

Subject to

$$C_{T,t}^{Y*} + p_t^*\, C_{NT,t}^{Y*} + q_t^*\, L_t^{Y^*} \leq w_t{}^*$$

$$C_{T,t+1}^{O*} + p_{t+1}\, C_{NT,t+1}^{O*} \leq (r_{t+1}^* + q_{t+1}^*)\, L_{t+1}^{O*}$$

$$L_t^{Y*} = L_{t+1}^{O*}$$

**Maximization Problem 3.2**

Therefore, the utility maximization problem of the migrant agent is:

$$\max_{\tilde{C}^Y_{T,t};\tilde{C}^Y_{NT,t};\tilde{C}^O_{T,t+1};\tilde{C}^O_{NT,t+1};\tilde{L}^Y_t} \{\gamma \log \tilde{C}^Y_{T,t} + (1-\gamma)\log \tilde{C}^Y_{NT,t} + \beta[\gamma \log \tilde{C}^O_{T,t+1} + (1-\gamma)\log \tilde{C}^O_{NT,t+1}]\}$$

Subject to $\tilde{C}^Y_{T,t} + p^*_t\, \tilde{C}^Y_{NT,t} + q_t\, \tilde{L}^Y_t \leq w_t{}^*$

$\tilde{C}^O_{T,t+1} + p_{t+1}\, \tilde{C}^O_{NT,t+1} \leq (r_{t+1} + q_{t+1})\, \tilde{L}^O_{t+1}$

$\tilde{L}^Y_t = \tilde{L}^O_{t+1}$

**Maximization Problem 3.3**

## 3.3 Land and Production Technology

In each country the amount of land is fixed. Land is immobile and is bought from old agents by young agents wishing to save. Prior to selling it, old agents rent out their land holdings to firms who use it while producing traded goods. The total amount of land in the home country is given by $\bar{L}$ and the total amount of land in the foreign country is given by $\bar{L}^*$.

There are two sectors in each country. The factors of production for the tradable goods sector are land and labor while the non-traded sector requires only labor. Labor is perfectly mobile between sectors in the same country, enforcing a uniform wage for both sectors. Including an immobile factor such as land sector ensures that traded goods are produced in both economies regardless of the relative total factor productivity between the home and foreign country. The non-traded sector too is active in both economies simply because agents desire both types of goods and non-traded goods by definition do not cross borders. Each sector in each country is represented by a perfectly competitive firm that maximizes profits by choosing the amount of labor to hire (and land to rent, for traded goods firms) while producing with a constant returns to scale technology – with a Cobb-Douglas structure for the traded goods sector and a linear form for the non-traded goods sector. The different sectors in different countries have different total factor productivities.

The profit maximization problem for the traded goods sector at home is:

$$\max_{n_{T,t}^D, L_{T,t}^D} A_T \left(L_{T,t}^D\right)^{\theta} \left(n_{T,t}^D\right)^{1-\theta} - r_t L_{T,t}^D - w_t n_{T,t}^D$$

**Maximization Problem 3.4**

Where:

$L_{T,t}^D$ is the amount of land demanded by the home firm in the traded goods sector

$n_{T,t}^D$ is the amount of labor demanded by the home firm in the traded goods sector

$A_T$ is the total factor productivity of the home firm in the traded goods sector

$\theta$ is the share of land in production

The profit maximization problem for the traded goods sector abroad is:

$$\max_{n_{T,t}^{D*}, L_{T,t}^{D*}} A_T^* \left(L_{T,t}^{D*}\right)^{\theta} \left(n_{T,t}^{D*}\right)^{1-\theta} - r_t^* L_{T,t}^{D*} - w_t^* n_{T,t}^{D*}$$

**Maximization Problem 3.5**

Where:

$L_{T,t}^{D*}$ is the amount of land demanded by the foreign firm in the traded goods sector

$n_{T,t}^{D*}$ is the amount of labor demanded by the foreign firm in the traded goods sector

$A_T^*$ is the total factor productivity of the foreign firm in the traded goods sector

The profit maximization problem for the non-traded goods sector at home is:

$$\max_{n_{NT,t}^D} p_t A_{NT} n_{NT,t}^D - w_t n_{NT,t}^D$$

**Maximization Problem 3.6**

Where:

$n_{NT}^D$ is the amount of labor demanded by the home firm in the non-traded goods sector

$A_{NT}$ is the total factor productivity of the home firm in the non-traded goods sector

The profit maximization problem for the non-traded goods sector abroad is:

$$\max_{n_{NT,t}^{D*}} \; p_t^* \, A_{NT}^* n_{NT,t}^{D*} - w^* \, n_{NT,t}^{D*}$$

**Maximization Problem 3.7**

Where:

$n_{NT}^{D}{}^{*}$ is the amount of labor demanded by the foreign firm in the non-traded goods sector

$A_{NT}{}^{*}$ is the total factor productivity of the foreign firm in the non-traded goods sector

Again, it should be noted that all prices (including wage rates and rents) are normalized in terms of the price of the traded good which has a unit price in both countries. As all the firms are competitive, they make zero profits and factors of production are paid their marginal products.

## 3.4 Remittances

Remittances in this model are the savings made by young migrant agents. The remittance made by each young migrant agent in period t $= q \, \tilde{L}_t^Y$. As the number of young migrant agents in any period is given by α, the total remittances made in period t $= \alpha \, q \, \tilde{L}_t^Y$. The model does not specify to whom exactly each remittance goes. The remittances are received by old agents at home and they include migrants who have retired and are now at home as well as old home agents who never ventured abroad.

## 3.5 Market Clearing Conditions

Only the market clearing condition for the traded good is common to both countries. All other markets are country specific. Market clearing conditions are:

**Traded Goods:**

$(1-\alpha)(C_{T,t}^{Y}+C_{T,t}^{O})+F(C_{T,t}^{Y*}+C_{T,t}^{O*})+\alpha(\tilde{C}_{T,t}^{Y}+\tilde{C}_{T,t}^{O})=A_T\left(L_{T,t}^{D}\right)^{\theta}\left(n_{T,t}^{D}\right)^{1-\theta}+A_T^{*}\left(L_{T,t}^{D*}\right)^{\theta}\left(n_{T,t}^{D*}\right)^{1-\theta}$

**Non-traded Goods:**

Home: $(1-\alpha)(C_{NT,t}^{Y}+C_{NT,t}^{O})+\ \alpha\left(\tilde{C}_{T,t}^{O}\right)=\ A_{NT}\ n_{NT,t}^{D}$

Foreign: $F(C_{NT,t}^{Y*}+C_{NT,t}^{O*})+\ \alpha\left(\tilde{C}_{T,t}^{Y}\right)=\ A_{NT}^{*}n_{NT,t}^{D*}$

**Land for Production:**

Home: $(1-\alpha)L_t^{O}+\alpha\ \tilde{L}_t^{O}=L_{T,t}^{D}=\bar{L}$

Foreign: $FL_t^{O*}=L_{T,t}^{D*}=\bar{L}^{*}$

**Land for Sales:**

Home: $(1-\alpha)L_t^{O}+\alpha\ \tilde{L}_t^{O}=(1-\alpha)L_t^{Y}+\alpha\ \tilde{L}_t^{Y}=\bar{L}$

Foreign: $FL_t^{O*}=FL_t^{Y*}=\bar{L}^{*}$

**Labor:**

Home: $n_{T,t}^{D}+n_{NT,t}^{D}=(1-\alpha)$

Foreign: $n_{T,t}^{D*}+n_{NT,t}^{D*}=F+\alpha$

**Market Clearing Conditions**

### 3.6 Steady State Equilibrium

A Steady State Equilibrium is defined as a set of time-independent prices, wages, rents and allocations for consumption, labor and land such that all maximization problems are solved subject to their respective constraints and all markets clear. The model was solved and a unique steady state was obtained.

## 4 Model: Remittances Driven by Familial Altruism

To consider the macroeconomic impact of remittances driven by familial altruism, the data are analyzed using a two-country, two-sector, general equilibrium model with perpetually lived household-dynasties. All dynasties in a given country are assumed to be identical. A constant fraction of the members of a home household-dynasty is situated as migrants in the foreign country. Remittances in this model take the form of the effective transfers made by a migrant to the rest of her home household. To permit easy comparison, all other features of the model are left unchanged from the previous chapter. Thus, the model abstracts away from capital and as all dynasties in a given country are identical, each owns a fixed fraction of the land. As in the previous model, land in a particular country can only be bought and sold by a household belonging to that country. However, as all households in this model are identical, land is not bought or sold in any period. Hence land markets are ignored in the model and each household is given a fixed perpetual share of land. Although this model can be easily extended to a dynamic framework, in order to retain the similarity with the previous model, all parameters (most notably, the TFPs) and the resultant variables are assumed to be time independent. Since none of the decisions are inter-temporal, this model reduces to a very simple general equilibrium model that can be solved analytically. Yet, the model is rich in terms of the features it can be used to study and understand – especially after it is calibrated from actual data.

### 4.1 Households

This decision making unit in this model is the household rather than the agent. All households in a given country are identical and all members within a household are considered to be working age. Since the previous model included equal numbers of working and non-working agents, in order to stay consistent, every agent in this model is endowed with only 0.5 units of labor (as opposed to the 1 unit of the previous

paper). Thus, the effective labor force to population ratio for this model too is 0.5. The model has two kinds of households – home households and foreign households:

- Home households – a fraction of each household resides abroad as migrants. The rest of the household stays in the home country. Unlike the previous model, there are no overlapping-generations and each home household member can either be a working migrant or a working resident and is endowed with 0.5 units of labor. This labor is supplied inelastically in order to earn wages. Migrants earn the foreign wage rate while residents earn the home wage rate. These wages are pooled together and used to finance the consumption of traded and non-traded goods both by migrants (who obtain non-traded goods from the foreign country at foreign prices) and residents (who get their non-traded good from home at home prices).
- Foreign households – All members of foreign households stay in the country. Again, unlike the previous model, there are no distinctions between retired and working members – all members are considered to be working and are each endowed with 0.5 units of labor for consistency with the previous model. This labor is supplied inelastically in order to earn wages. These wages are used to finance the consumption of traded and non-traded goods by members of the foreign household.

As with the previous model, populations are normalized in terms of the number of home country citizens (citizens include home agents and migrants), which is given a value of 2. The demographic structure can be described thus:

Total population of home country citizens = 2

Fraction of citizens that are migrants = $\alpha$

Total population of home country citizens = 2 x F

Effective labor force to population ratio for each country = 0.5

## 4.2 Preferences and Budget Constraints

Rather than individuals maximizing their utility, preferences in this model are given in terms of households. The household planner collects all the resources and redistributes them to maximize a household level utility function.

The model allows the planner of the home household to assign different weights to the migrants and residents. The weights assigned by the planner are assumed to be proportional but not equal to the population weights as migrants and residents may have different bargaining powers due to their differences in income.

Utility for the home household is therefore derived as the appropriately weighted sum of migrant and resident utilities, which in turn are derived through the consumption of a composite good that aggregates tradable goods and non-tradable goods. As in the previous model, the consumption aggregator is of CES (constant elasticity of substitution) form with unit elasticity of substitution. The utility function of the home household is given by:

$$U = (1-\delta)(1-\alpha)[\gamma \log C_T + (1-\gamma)\log C_{NT}] + \delta\,\alpha\,[\gamma \log \tilde{C}_T + (1-\gamma)\log \tilde{C}_{NT}]$$

Where:

$\gamma$ is the share of tradable goods in total consumption

$\delta$ is preference weight for migrants

$C_T$ is the quantity of tradable goods consumed by the resident

$C_{NT}$ is the quantity of non-tradable goods consumed by the resident

$\tilde{C}_T$ is the quantity of tradable goods consumed by the migrant

$\tilde{C}_{NT}$ is the quantity of non-tradable goods consumed by the migrant

This formulation ensures that the weight assigned per migrant and the weight assigned per resident stay the same regardless of the value of α. While conducting welfare calculations with changes in α, the utility value was scaled to ensure that comparisons were being made in terms of a constant household size.

Utility for the foreign household is more straightforward as all members are weighted equally. The utility function of the foreign household is given by:

$$U^* = [\gamma \log C_T^* + (1-\gamma)\log C_{NT}^*]$$

Where:

$C_T^*$ is the quantity of tradable goods consumed by the foreign resident

$C_{NT}^*$ is the quantity of non-tradable goods consumed by the foreign resident

The budget constraint faced by the home household planner is given by:

$$(1-\alpha)[C_T + p\ C_{NT}] + \alpha\left[\tilde{C}_T + p^*\ \tilde{C}_{NT}\right] \ \leq \ (1-\alpha)\frac{w}{2} + \alpha\ \frac{w^*}{2} + r\ L$$

Where:

$p$ is the price of non-traded good in home country

$p^*$ is the price of non-traded good in foreign country

$w$ is the wage rate in home country

$w^*$ is the wage rate in foreign country

$r$ is the rent in home country

$L$ is the amount of land owned by the home household

As can be seen, the planner is able to collect all the income – the wages earned at home by the (1-α) home residents who are each endowed with half a unit of labor, the wages earned abroad by α migrants who are also each endowed with half a unit of labor and the rent earned from the land. After collecting the income, the planner decides how much migrants and residents can consume though she has to keep in mind that the prices of non-traded goods differ in the two countries. The budget constraint faced by the foreign household planner is straightforward and is given by:

$$C_T^* + p^* C_{NT} \ \leq \ \frac{w^*}{2} + r^*\ L^*$$

Where:

$L^*$ is the land owned by a foreign household

Therefore the utility maximization problem of the home household is:

$$\max_{C_T;C_{NT};\tilde{C}_T;\tilde{C}_{NT}} \{(1-\delta)(1-\alpha)[\gamma \log C_T + (1-\gamma)\log C_{NT}] + \delta\,\alpha\,[\gamma \log \tilde{C}_T + (1-\gamma)\log \tilde{C}_{NT}]\}$$

Subject to $(1-\alpha)[C_T + p\,C_{NT}] + \alpha\left[\tilde{C}_T + p^*\,\tilde{C}_{NT}\right] \leq (1-\alpha)\frac{w}{2} + \alpha\,\frac{w^*}{2} + r\,L$

**Maximization Problem 4.1**

And the utility maximization problem of the foreign household is:

$$\max_{C_T^*;C_{NT}^*} \gamma \log C_T^* + (1-\gamma)\log C_{NT}^*$$

Subject to $C_T^* + p^* C_{NT} \leq \frac{w^*}{2} + r^*\,L^*$

**Maximization Problem 4.2**

## 4.3 Land and Production Technology

This model is identical to the previous chapter in terms of the production and technology side. Please refer to section 3.3 for a detailed description. In order to present the full set of equations, only the maximization conditions have been presented below.

The profit maximization problem for the traded goods sector at home is:

$$\max_{n_T^D, L_T^D} A_T\,(L_T^D)^{\theta}(n_T^D)^{1-\theta} - r\,L_T^D - w\,n_T^D$$

**Maximization Problem 4.3**

Where:

$L_T^D$ is the amount of land demanded by the home firm in the traded goods sector

$n_T^D$ is the amount of labor demanded by the home firm in the traded goods sector

$A_T$ is the total factor productivity of the home firm in the traded goods sector

$\theta$ is the share of land in production

The profit maximization problem for the traded goods sector abroad is:

$$\max_{n_T^{D*}, L_T^{D*}} A_T^* \, (L_T^{D*})^{\theta} (n_T^{D*})^{1-\theta} - r^* \, L_T^{D*} - w^* \, n_T^{D*}$$

**Maximization Problem 4.4**

Where:

$L_T^{D*}$ is the amount of land demanded by the foreign firm in the traded goods sector

$n_T^{D*}$ is the amount of labor demanded by the foreign firm in the traded goods sector

$A_T^*$ is the total factor productivity of the foreign firm in the traded goods sector

The profit maximization problem for the non-traded goods sector at home is:

$$\max_{n_{NT}^D} \; p \, A_{NT} \, n_{NT}^D - w \, n_{NT}^D$$

**Maximization Problem 4.5**

Where:

$n_{NT}^D$ is the amount of labor demanded by the home firm in the non-traded goods sector

$A_{NT}$ is the total factor productivity of the home firm in the non-traded goods sector

The profit maximization problem for the non-traded goods sector abroad is:

$$\max_{n_{NT}^{D*}} \; p^* \, A_{NT}^* n_{NT}^{D*} - w^* \, n_{NT}^{D*}$$

**Maximization Problem 4.6**

Where:

$n_{NT}^{D\,*}$ is the amount of labor demanded by the foreign firm in the non-traded goods sector

$A_{NT}{}^*$ is the total factor productivity of the foreign firm in the non-traded goods sector

Again, it should be noted that all prices (including wage rates and rents) are normalized in terms of the price of the traded good which has a unit price in both countries. As all the firms are competitive, they make zero profits and factors of production are paid their marginal products.

## 4.4 Remittances

Remittances in this model are given by the difference between the income and consumption of the migrant fraction of home households. This is given by:

$$\alpha \frac{w^*}{2} - \alpha \left[\tilde{C}_T + p^* \tilde{C}_{NT}\right]$$

As the number of households is given by 2, the total remittances are given by:

$$2 \{\alpha \frac{w^*}{2} - \alpha \left[\tilde{C}_T + p^* \tilde{C}_{NT}\right]\}$$

## 4.5 Market Clearing Conditions

Only the market clearing condition for the traded goods is common to both countries. All other markets are country specific. Market clearing conditions are:

**Traded Goods:**

$$2\,(1-\alpha)\,C_T + 2\,\alpha\,\tilde{C}_T + 2\,F\,C_T^* = A_T\,(L_T^D)^{\theta}(n_T^D)^{1-\theta} + A_T^*\,(L_T^{D*})^{\theta}(n_T^{D*})^{1-\theta}$$

**Non-traded Goods:**

Home: $2\,(1-\alpha)\,C_{NT} = A_{NT}\,n_{NT}^D$

Foreign: $2\alpha\tilde{C}_{NT} + 2FC_{NT}^* = A_{NT}^* n_{NT}^{D*}$

**Land for Production:**

Home: $2L = \bar{L}$

Foreign: $2FL^* = \bar{L}^*$

**Labor:**

Home: $(1-\alpha) = n_T^D + n_{NT}^D$

Foreign: $F + \alpha = n_T^{D*} + n_{NT}^{D*}$

**Market Clearing Conditions**

### 4.6 Steady State Equilibrium

As for the previous model, the Steady State Equilibrium is defined as a set of time-independent prices, wages, rents and allocations for consumption, labor and land such that all maximization problems are solved subject to their respective constraints and all markets clear. The model was solved and a unique steady state was obtained. The details of the calibration and the results are presented in the next two sections.

## 5 Calibration and Solution Techniques

Some of the parameters used in this model were assumed due to normalization or obtained from other studies. The share of labor in the production of traded goods was assumed to be 0.7 – this is standard in

the literature in general and used in particular for traded goods by Acosta et al (2007) in a remittances model used for detecting Dutch Disease. The amount of land per worker in both countries was assumed to be one – this is the value used by Klein and Ventura (2007) for a model of migration. The total factor productivity in the home country was fixed at one. Similarly, by normalization, the population of agents from the home country (this includes residents and emigrants) was set to two. Other demographic parameters were computed directly from the data. As South Africa is about 24 times more populous than Lesotho, total foreign population was assigned the value 48.

For the first model this implies that the young home country citizens (this includes emigrants and residents) form a population of one and the young foreign country citizens form a population of 24. Similarly, in the first model, the old home country citizens form a population of 1and the old foreign country citizens form a population of 24. For the second model, this implies that the population of home country citizens is two and the population of foreign country citizens is 48. However, to be consistent with the first model, each agent was assigned only half a unit of labor endowment – therefore making the labor force to population ratio equal for both models.

For the first model, the fraction of young home country citizens who are migrants was calculated from the data to be about 0.2. For the second model too, the fraction of home country citizens who are migrants was set to 0.2.

### 5.1 Calibration for Model with Remittances driven by Retirement Savings

The remaining parameters were obtained by solving the models and matching key ratios obtained from the model to corresponding ratios from the data. These ratios were used so that the difference between model time (2 periods equal one lifetime) and data time (one period equals one year) would not affect results. The parameters obtained thus are given in Table 4 and the values of the 'moments' used from the data and the model are given in Table 5. All the variables in the model other than the price for non-traded goods at home were solved for analytically. To solve for price, a computational technique was used such that there was no excess demand in the market for traded goods.

| | Moments from Data | Moments from Model |
|---|---|---|
| Ratio of Traded Sector to Total GDP at Home | 0.316 | 0.316 |
| Ratio of Home to Foreign GDP per capita | 0.233 | 0.234 |
| Ratio of Remittances to GDP | 0.253 | 0.255 |
| Real Exchange Rate | 1.58 | 1.58 |

**Table 4**

| **Parameters obtained from model solution** | |
|---|---|
| Discount factor for old utility ($\beta$) | 0.463 |
| Traded TFP abroad ($A_T^*$) | 4.343 |
| Non-traded TFP abroad ($A_{NT}^*$) | 1.544 |
| Weight parameter for traded goods ($\gamma$) | 0.456 |

**Table 5**

Some of the moments that were not matched explicitly also yielded similar values for the data and model. These are given in Table 6. The discount factor for old utility obtained implies that the duration of working age is about 15 years if we assume the common value of 0.95 for annual discount. This number has some support from the data due to the fact that the average tenure of a Mosotho miner is between 13 and 16 years according to Van der Weil (1977).

| | Moments from Data | Moments from Model |
|---|---|---|
| Ratio of Home Traded to Foreign Traded | 0.012 | 0.01 |
| Ratio of Home Non-traded to Foreign Non-traded | 0.009 | 0.011 |

**Table 6**

## 5.2 Calibration for Model with Remittances driven by Familial Altruism

The remaining parameters were obtained by solving the second model and matching key ratios to corresponding ratios from the data. The same ratios are chosen for this model as for the previous model. The only parameter that is different in this model is δ, the weight assigned by the home household planner to a migrant (relative to 1- δ, the weight for of the resident). This parameter replaces β, used in the previous model as the preference weight for old migrants. As the value obtained for δ is greater than 0.5, it indicates that the planner weights migrant utilities higher than resident utilities.

The parameter values are given in Table 7 and the values of the 'moments' used from the data and the model are given in Table 8.

| | Moments from Data | Moments from Model |
|---|---|---|
| Ratio of Traded Sector to Total GDP at Home | 0.316 | 0.316 |
| Ratio of Home to Foreign GDP per capita | 0.233 | 0.233 |
| Ratio of Remittances to GDP | 0.253 | 0.253 |
| Real Exchange Rate | 1.58 | 1.58 |

**Table 7**

| Parameters obtained from model solution | |
|---|---|
| Preference weight for migrants (δ) | 0.644 |
| Traded TFP abroad ($A_T$*) | 4.396 |
| Non-traded TFP abroad ($A_{NT}$*) | 1.567 |
| Weight parameter for traded goods (γ) | 0.454 |

**Table 8**

Some of the moments that were not matched explicitly also yielded similar values for the data and model. These are given in Table 9.

| | Moments from Data | Moments from Model |
|---|---|---|
| Ratio of Home Traded to Foreign Traded | 0.012 | 0.01 |
| Ratio of Home Non-traded to Foreign Non-traded | 0.009 | 0.01 |

**Table 9**

## 6 Results and Implications

Once the models were solved numerous exercises were conducted in order to obtain a better understanding of the causes and impact of remittances.

For the first exercise, the total factor productivity of the traded sector abroad was changed. This led to an increase in remittances, an appreciation of the real exchange rate and a decrease in the share of traded goods produced at home. This indicates that when the foreign country becomes more productive in the traded goods sector, migrants remit more traded goods to their home country and in turn the home country manufactures fewer traded goods. The results of this exercise for the two models were not qualitatively different, however in terms of magnitude, for the model with familial altruism remittances and the structure

of production changed more for a given change in TFP while the real exchange rate changed less. Figures 5 and 6 below show this graphically.

The term '% Deviation' used in the figure refers to how different the value under consideration is in the alternative scenario compared to the corresponding value obtained through model solutions discussed in the previous section. Also, 'Home structure of Production' is defined as the ratio of the value of traded goods manufactured at home to the value of the total GDP at home. Thus, to obtain the first points on Figure 1, all parameters were kept the same as in the calibrated solution except for the TFP of the traded sector abroad. This TFP was first by decreased by 1% (a change of -1%) and the values of the variables obtained thus were compared in percent terms to their values from the original calibrated solution. These percent changes were then plotted (on the y- axis) versus the corresponding percent change of TFP (on the x-axis).

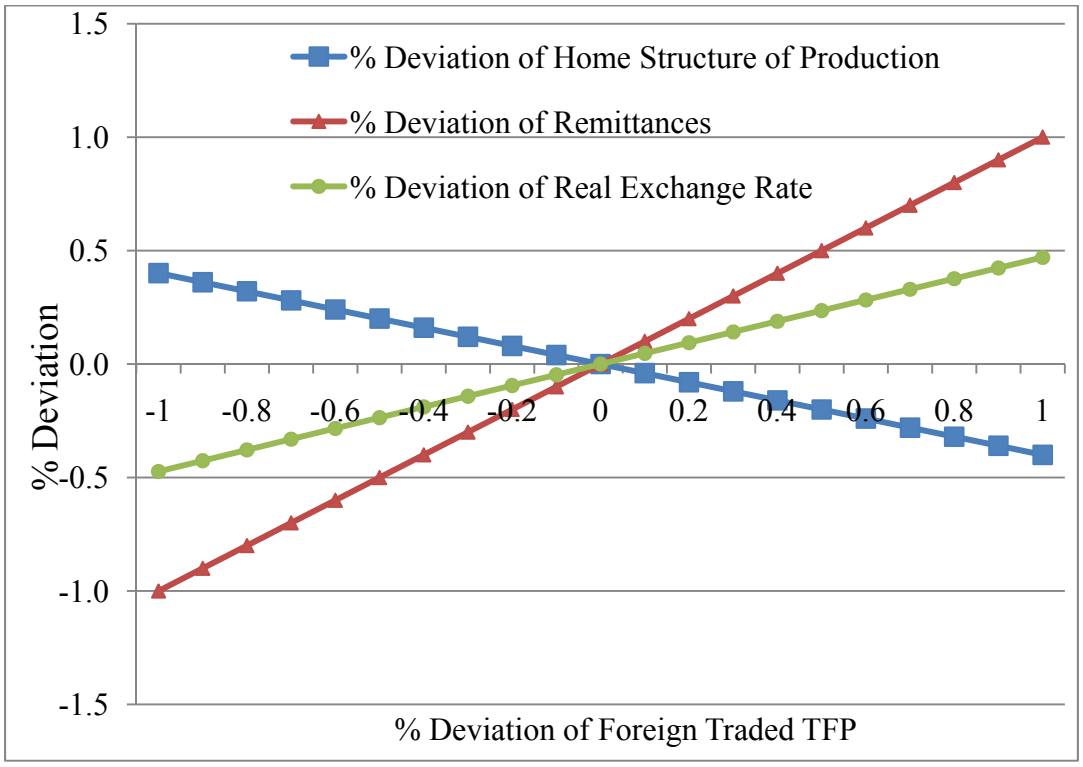


**Figure 5 – Remittances Driven by Retirement Savings**

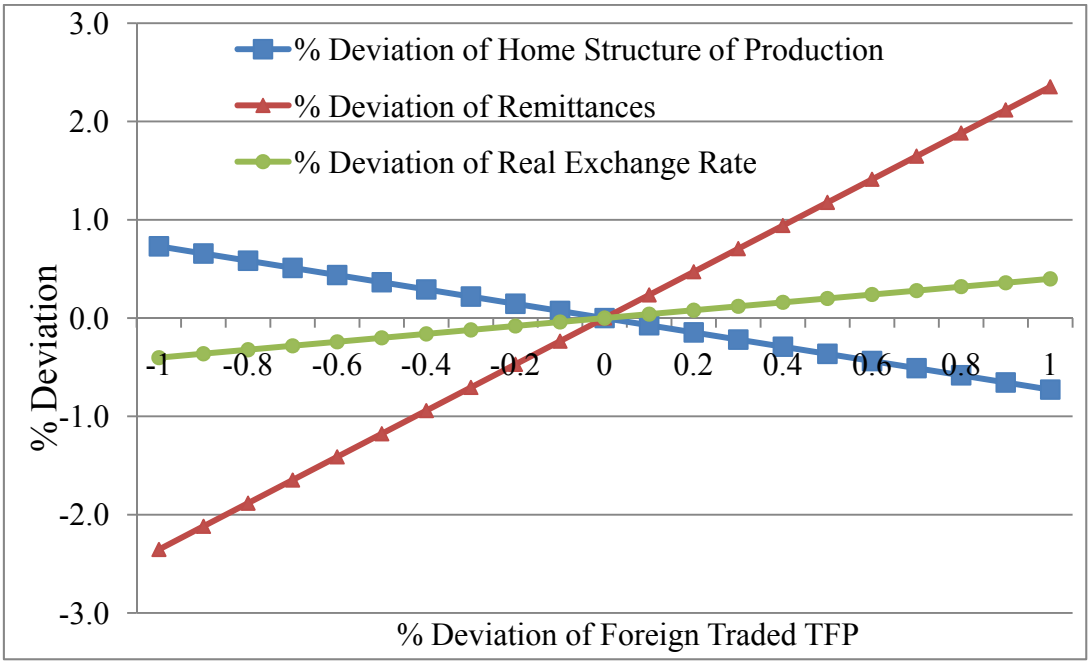


**Figure 6 – Remittances Driven by Familial Altruism**

Next, the total factor productivity of the non-traded sector was changed abroad. The results of this exercise were almost identical for both models. Reducing the total factor productivity of the non-traded sector abroad caused no change in remittances, a depreciation of the real exchange rate and no change in the share of traded goods in home production. This implies that when the foreign country becomes more productive in the non-traded goods sector, migrants do not remit more traded goods to their home country and the home country's structure of production stays unchanged as well. Please refer to Figures 7 and 8.

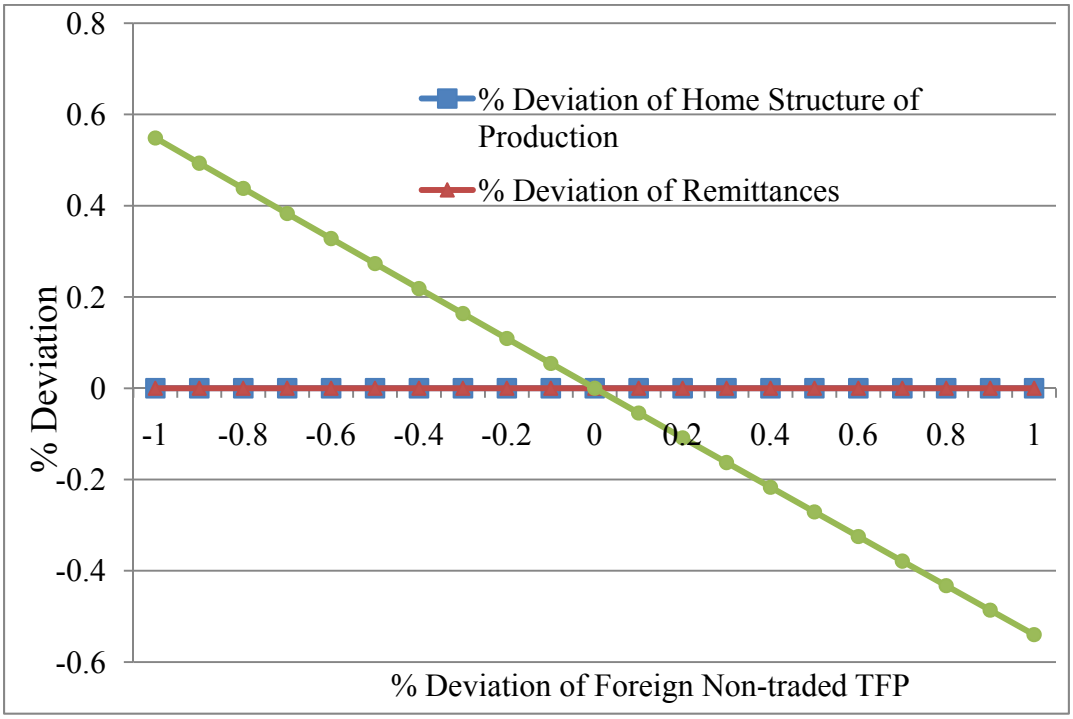


**Figure 7 – Remittances Driven by Retirement Savings**

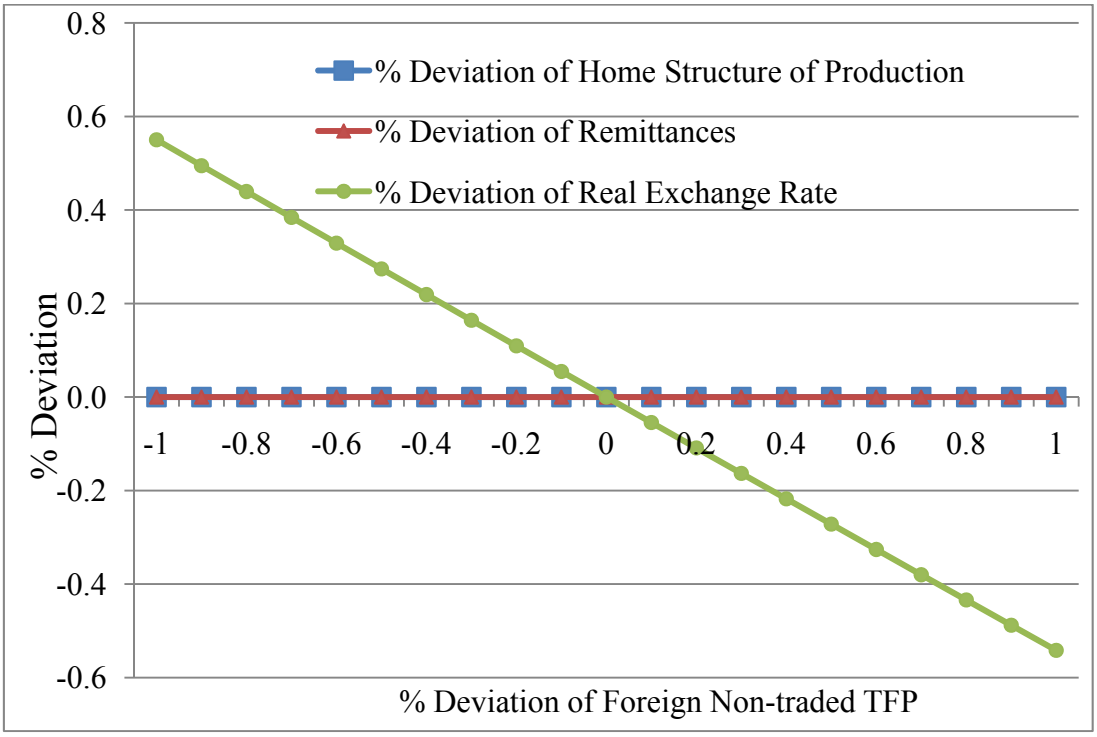


**Figure 8 – Remittances Driven by Familial Altruism**

The total factor productivity of the traded sector at home was changed next. For the model with remittances driven by retirement savings, remittances stayed unchanged while the real exchange rate depreciated and share of traded goods produced at home increased. Thus, in this model when the home country becomes more productive in the traded goods sector, migrants do not change their remittances. The home country's structure of production however changes as more traded goods are produced. These results can be seen in Figure 9. However, in the altruistic model, an increase in home's traded TFP led to a decrease in remittances decreased, real exchange rate depreciation, and more traded goods produced at home. This result contrasts sharply with the result in the overlapping-generations model where remittances stayed unchanged. In other words, with altruism, given the current framework and parameters, remittances display a countercyclical pattern relative to the traded sector at home. On the other hand, in the overlapping-generations model (with log utility), remittances do not change in response to key home country variables. In the literature too, altruism and family arrangements are often used to explain occurrences of counter-cyclicality. The results for the altruistic model can be seen in Figure 10.

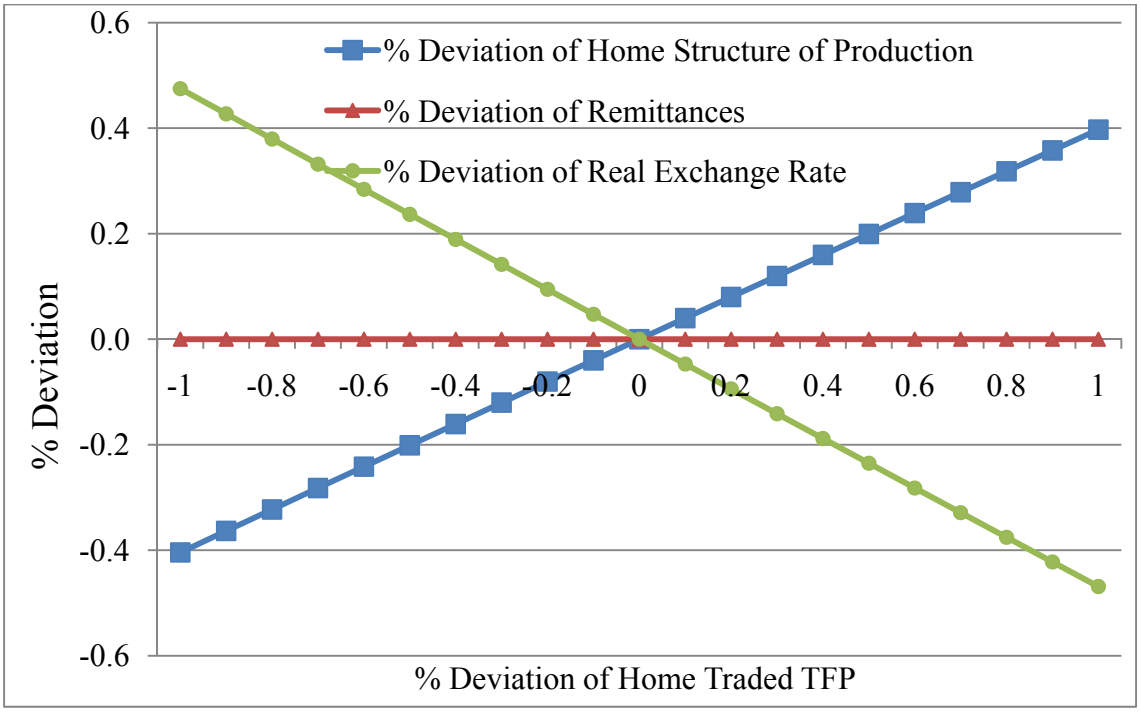


**Figure 9 – Remittances Driven by Retirement Savings**

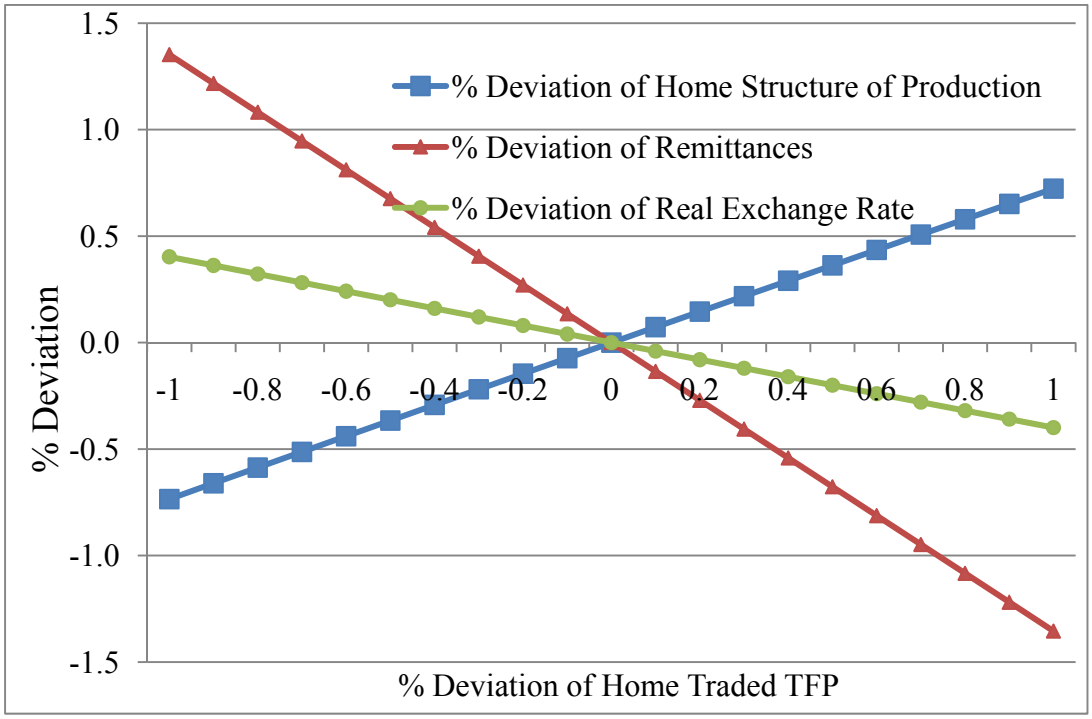


**Figure 10 – Remittances Driven by Familial Altruism**

Finally, to conclude the TFP related exercises, home's non-traded TFP was changed. For the model with remittances driven by retirement savings, this once again resulted in unchanged remittances. The real exchange rate appreciated and there was no change in the share of traded goods in home production. This indicates that when the home country becomes more productive in the traded goods sector, migrants do not change their remittances and the home country's structure of production also stays unchanged. Figure 11 displays these results. The results obtained in the model with familial altruism were no different from the results of the overlapping-generations model. Please refer to Figure 12 for the graph.

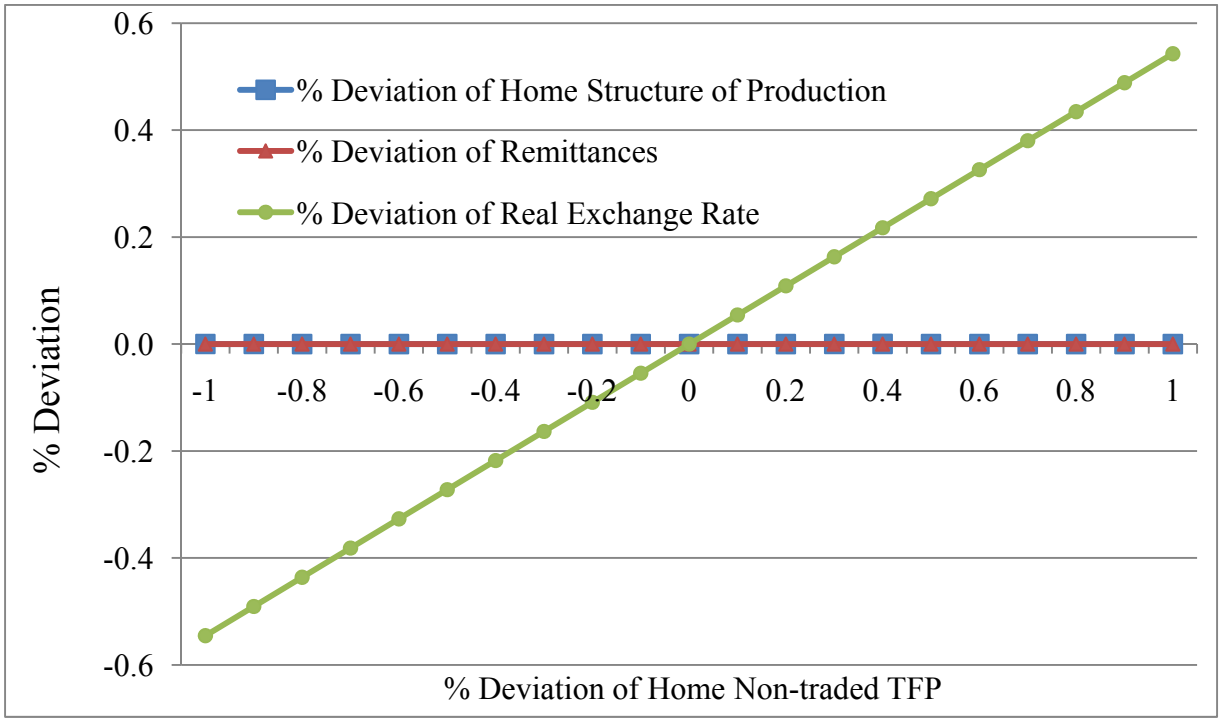


**Figure 11 – Remittances Driven by Retirement Savings**

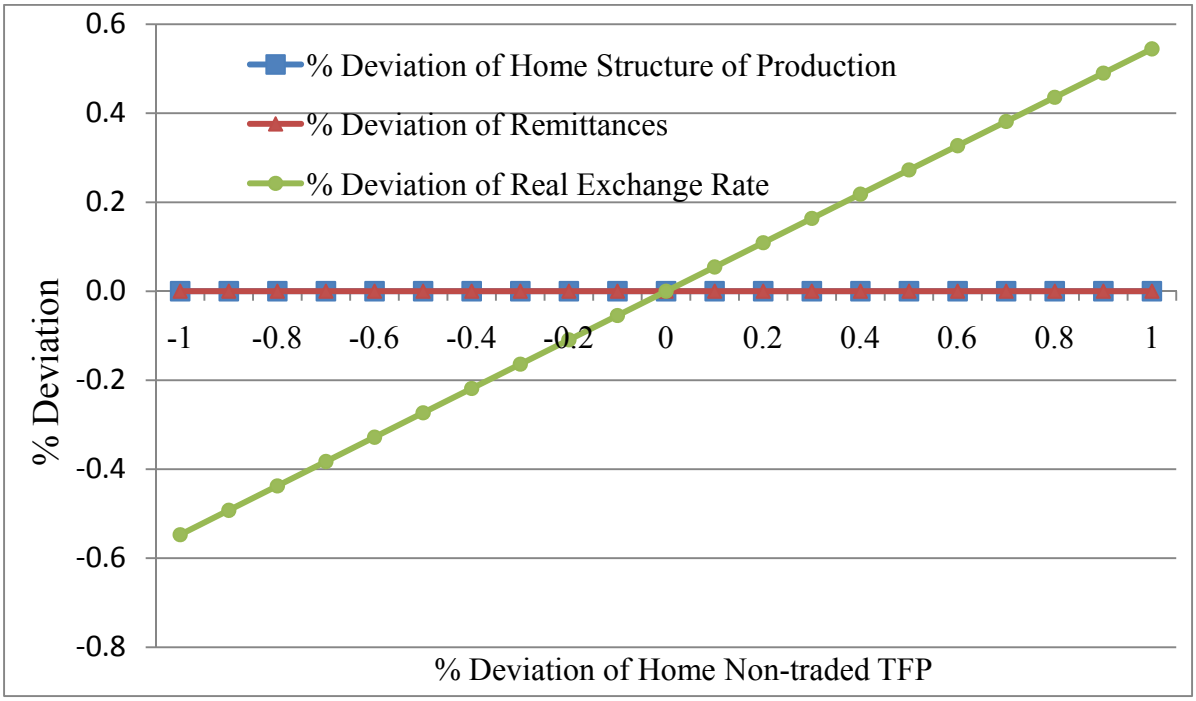


**Figure 12 – Remittances Driven by Familial Altruism**

Together, these graphs indicate that for both models, remittances do not change with any change in non-traded TFPs. When traded TFP is changed abroad, remittances are affected in both models while a change in the traded TFP at home has an impact only in the model where remittances are driven by altruism. For both models, the real exchange rate appreciates when the foreign traded sector or home non-traded sector becomes more productive. Conversely, the real exchange rate depreciates when the foreign non-traded sector or home non-traded sector becomes more productive. The share of the traded sector at home is positively related with its own TFP and negatively related with foreign traded TFP. The share of the traded sector does not change with any change in the non-traded TFPs. For both models, in instances where remittances increase, less traded goods are produced at home and the real exchange rate appreciates as well, lending support to the idea of Dutch Disease.

In order to study how the volume of migration affects remittances and other variables, an exercise similar to the ones above was conducted, this time by varying alpha (the percent of young home citizens who are migrants) and recording its impact on different variables of interest. These results for the model with remittances driven by retirement savings are shown in Figure 13 and the results for the model with remittances driven by altruism are shown in Figure 14. In both models, predictably, as migration increases, so do remittances. Moreover, in both models, when remittances increase due to increased migration, there is some evidence of Dutch Disease as the traded sector at home shrinks (although an increase in migration also results in a depreciation of the real exchange rate). This corroborates the various empirical and theoretical studies discussed in previous sections and suggests that concerns about the Dutch disease may be indeed founded.

An interesting difference between the two models is that for the model with remittances driven by familial altruism, unlike the overlapping-generations model, remittances rise at a rapidly decreasing rate – and correspondingly, the structure of production and the real exchange rate also do not change as quickly with greater increases in migration. This can be explained intuitively from the fact that when the number of migrants increases, so does their assigned weight in the household level planner's problem. One way to

interpret this would be to say that as migrants get more say in the household's optimization problem, they remit less.

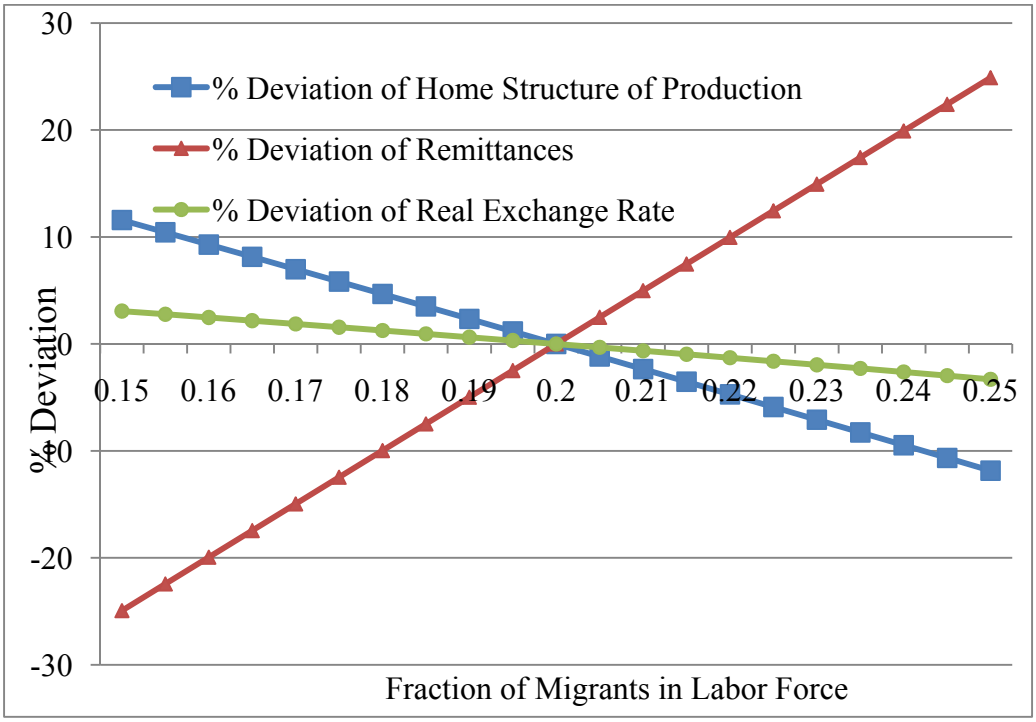


**Figure 13 – Remittances Driven by Retirement Savings**

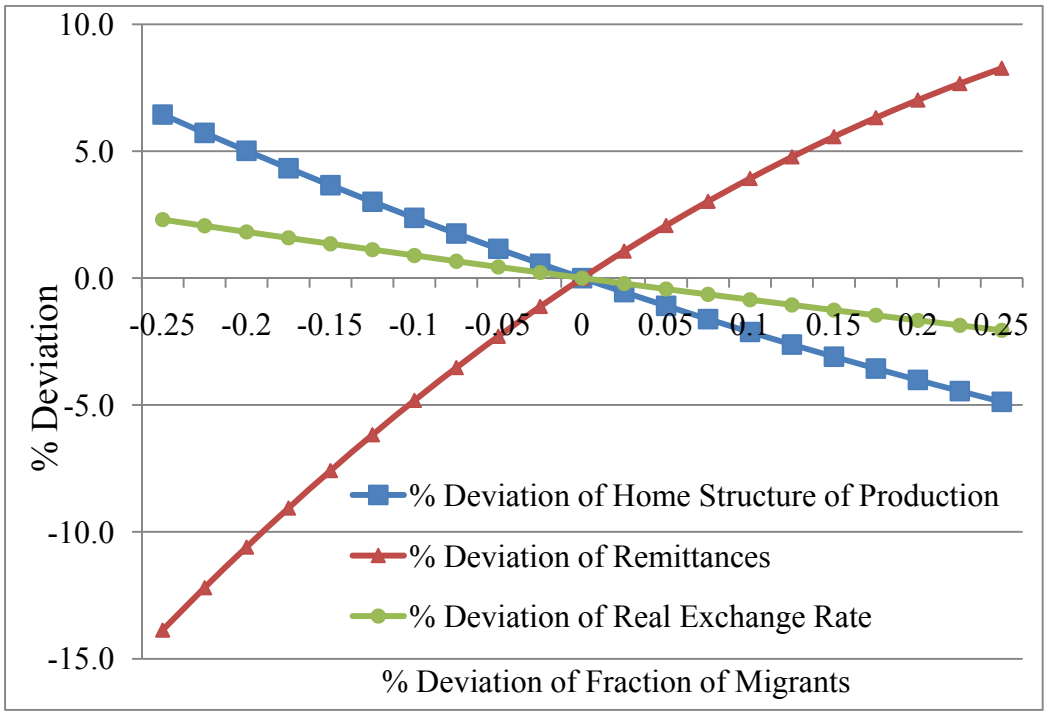


**Figure 14 – Remittances Driven by Familial Altruism**

However, on closer examination it can be seen that despite the occurrence of Dutch Disease, the home country's welfare increases significantly from increased migration. Welfare gain here is defined in terms of the composite consumption good per period. In the model with remittances driven by retirement savings, while home agents gain from increased migration the same does not hold true for foreign agents and migrants as can be seen from Figures 15, 16 and 17. Aggregate welfare on the other hand, obtained by summing up population-weighted welfare increases significantly with an increase in migration as can be seen in Figure 18. In fact, when plotted on the same scale as in Figure 19, it can be seen that the benefits of increased migration for home agents is orders of magnitude greater than the costs of increased migration for foreign agents.

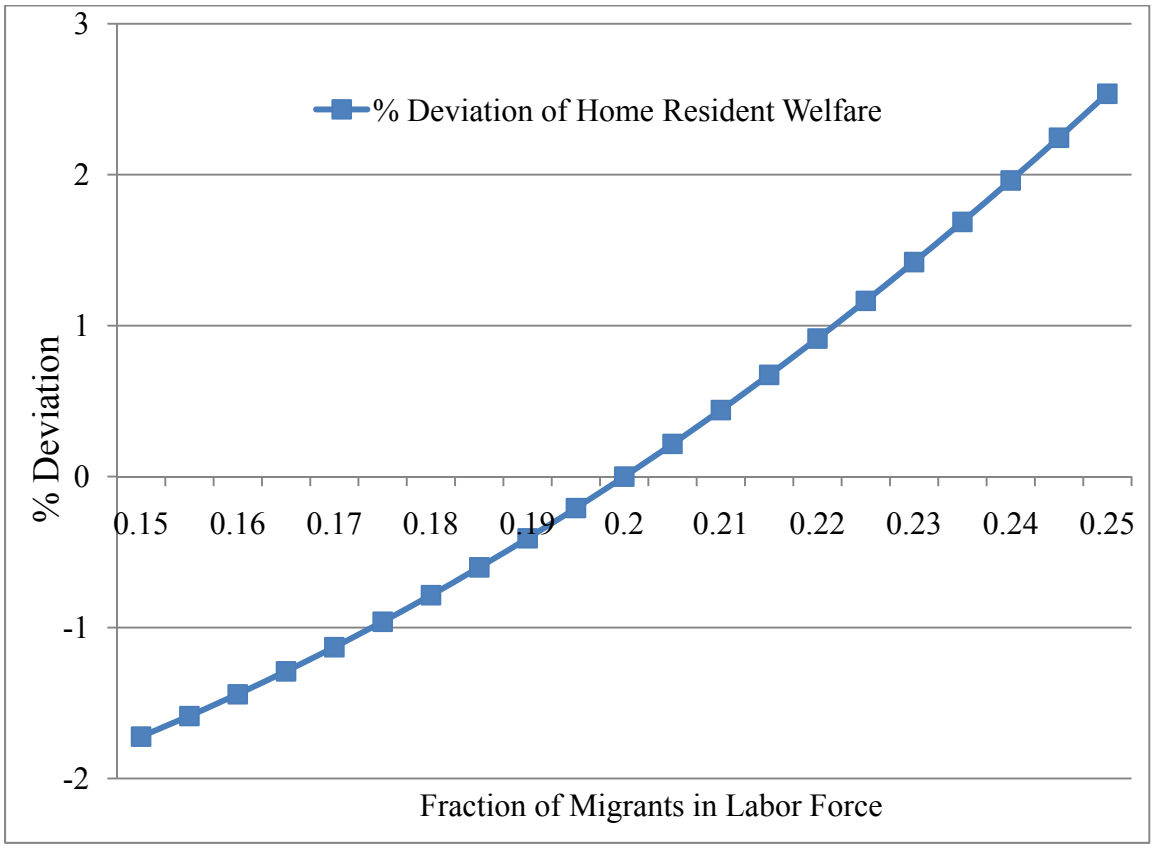


**Figure 15 – Remittances Driven by Retirement Savings**

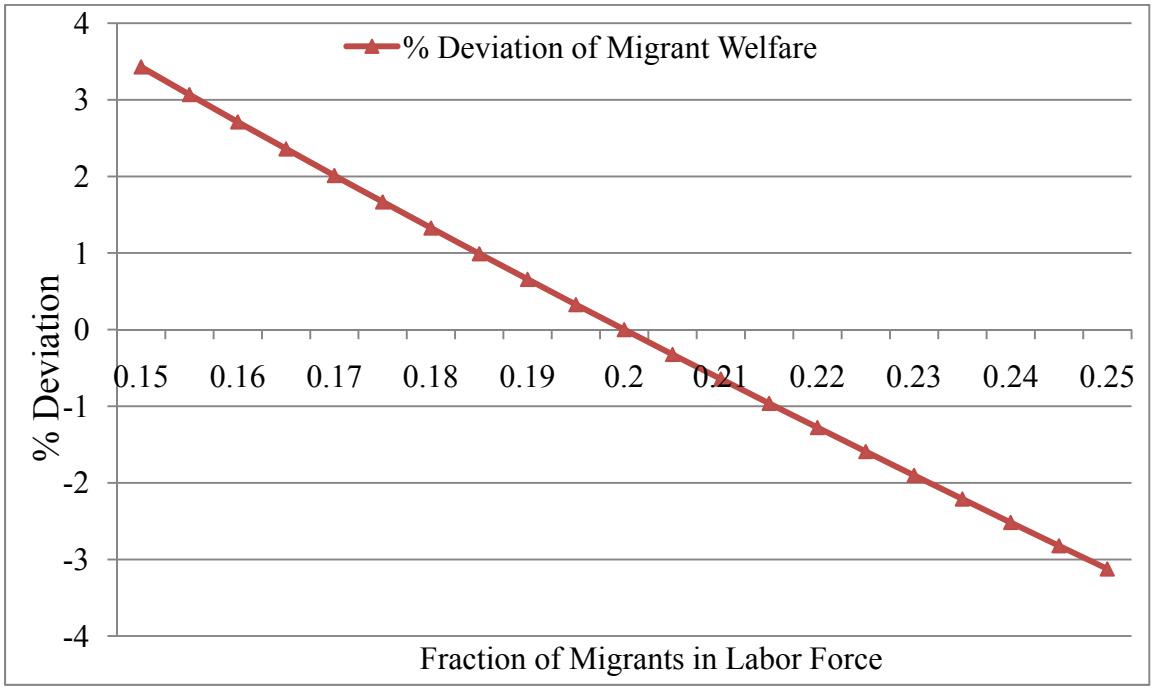


**Figure 16 – Remittances Driven by Retirement Savings**

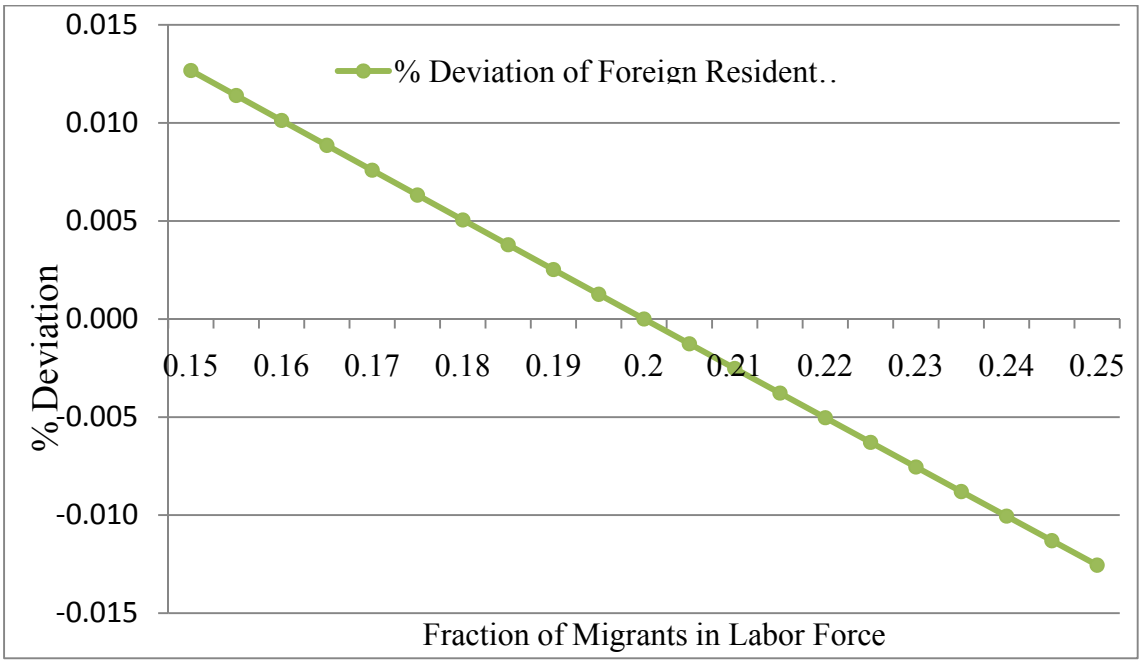


**Figure 17 – Remittances Driven by Retirement Savings**

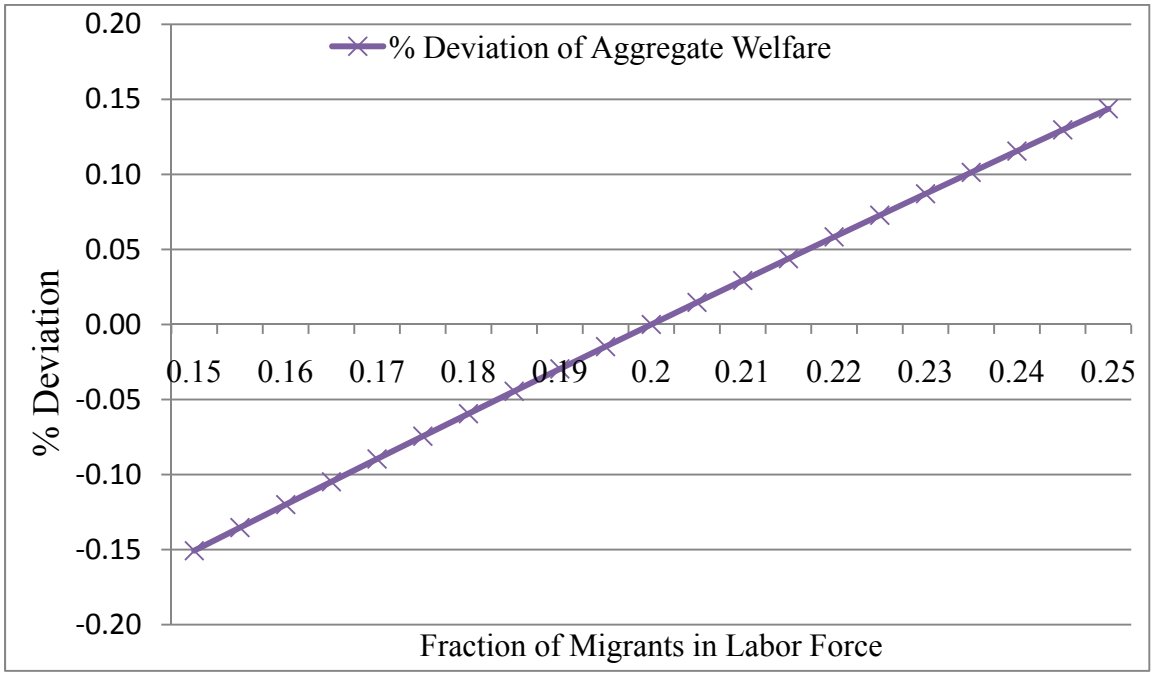


**Figure 18 – Remittances Driven by Retirement Savings**

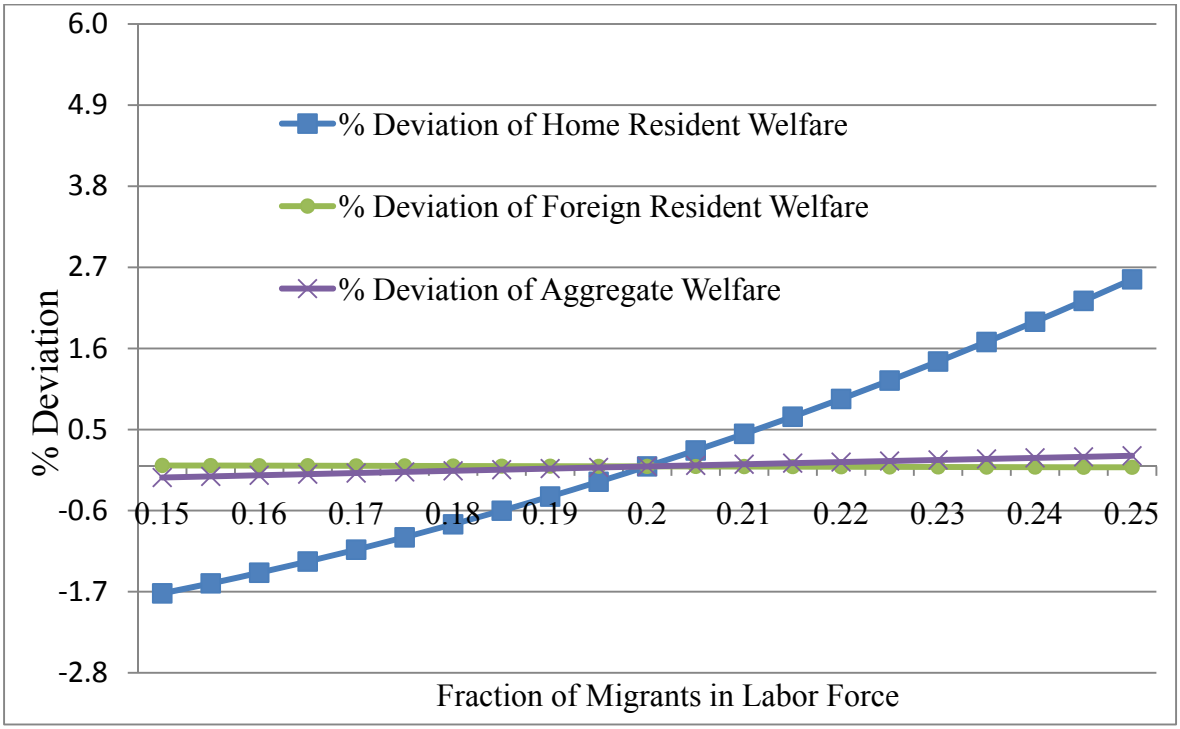


**Figure 19 – Remittances Driven by Retirement Savings**

When this exercise was repeated for the model with remittances driven by altruism, once again, as in the model with remittances driven by retirement savings, it was found that despite any ill-effects of Dutch Disease, home country welfare increases significantly from increased migration. In fact, unlike the previous overlapping- generations model, even foreign households gain from increased migration (although to a lesser extent). Therefore, aggregate welfare increases as well with increased migration. The magnitude of home welfare gain is much higher than aggregate or foreign welfare gains. These results can be seen in Figures 20, 21, 22 and 23.

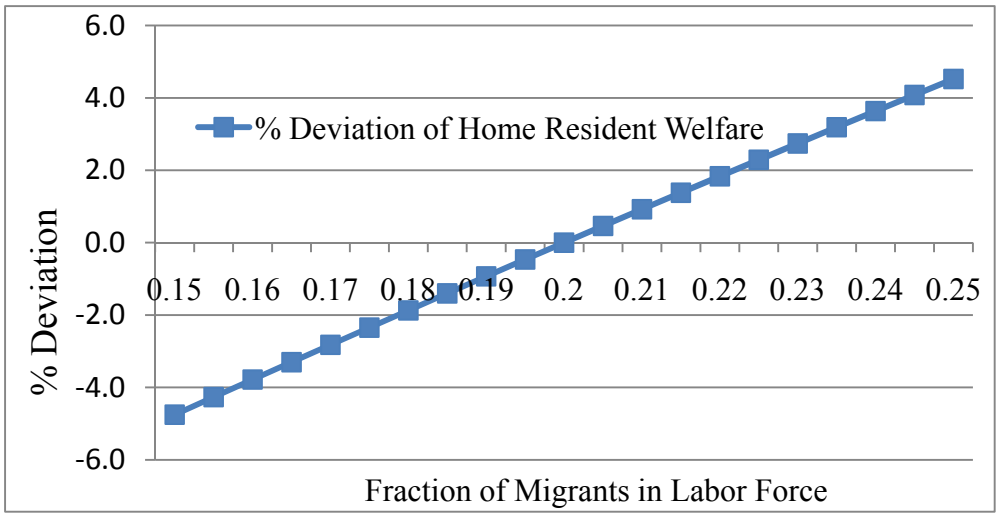


**Figure 20 – Remittances Driven by Familial Altruism**

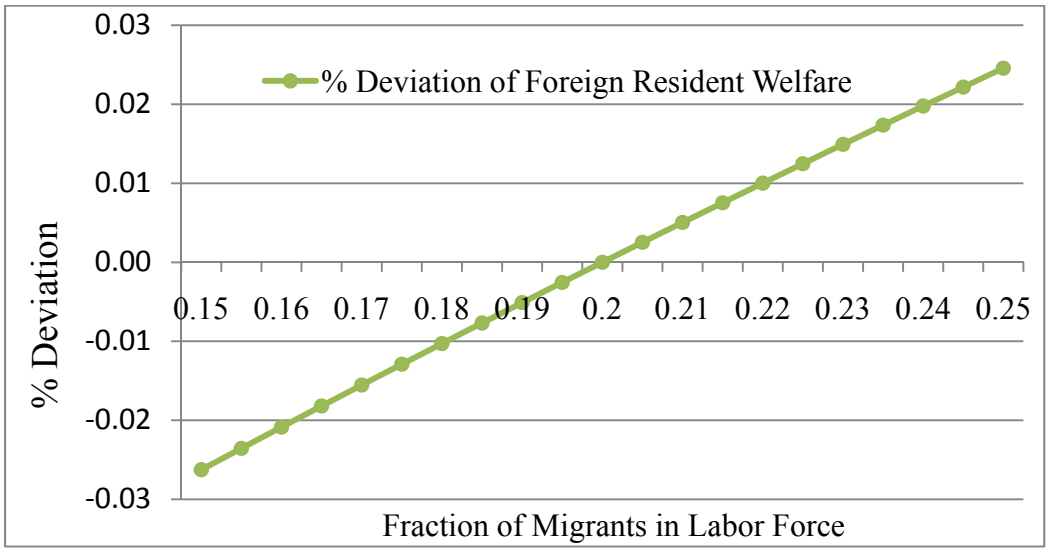


**Figure 21 – Remittances Driven by Familial Altruism**

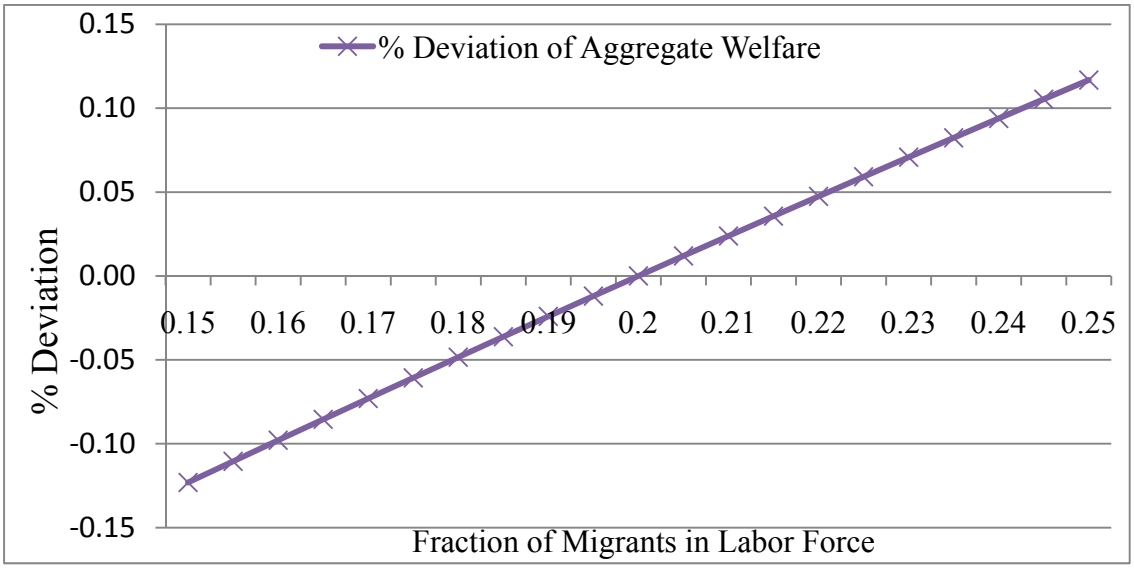


**Figure 22 – Remittances Driven by Familial Altruism**

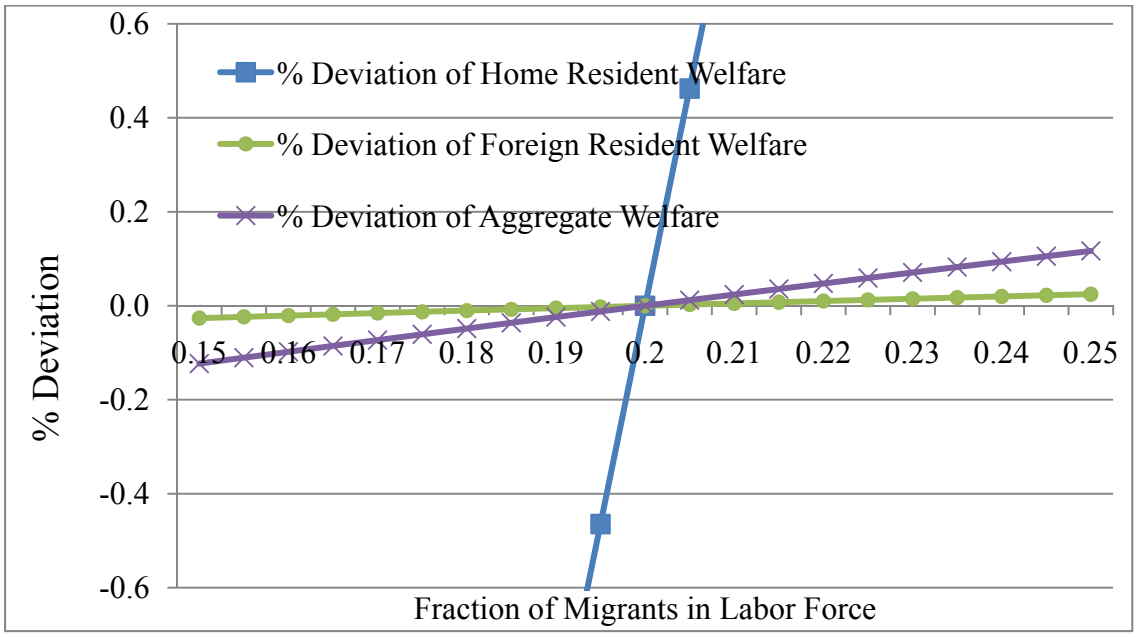


**Figure 23 – Remittances Driven by Familial Altruism**

In order to better understand why the model with altruism results in welfare gain for both home and foreign households, while the model with remittances driven by retirement savings results in welfare gains for only home agents, the key prices faced abroad are plotted. Figure 24 shows these variables for the model with remittances driven by savings and Figure 25 portrays the results from the model with altruism.

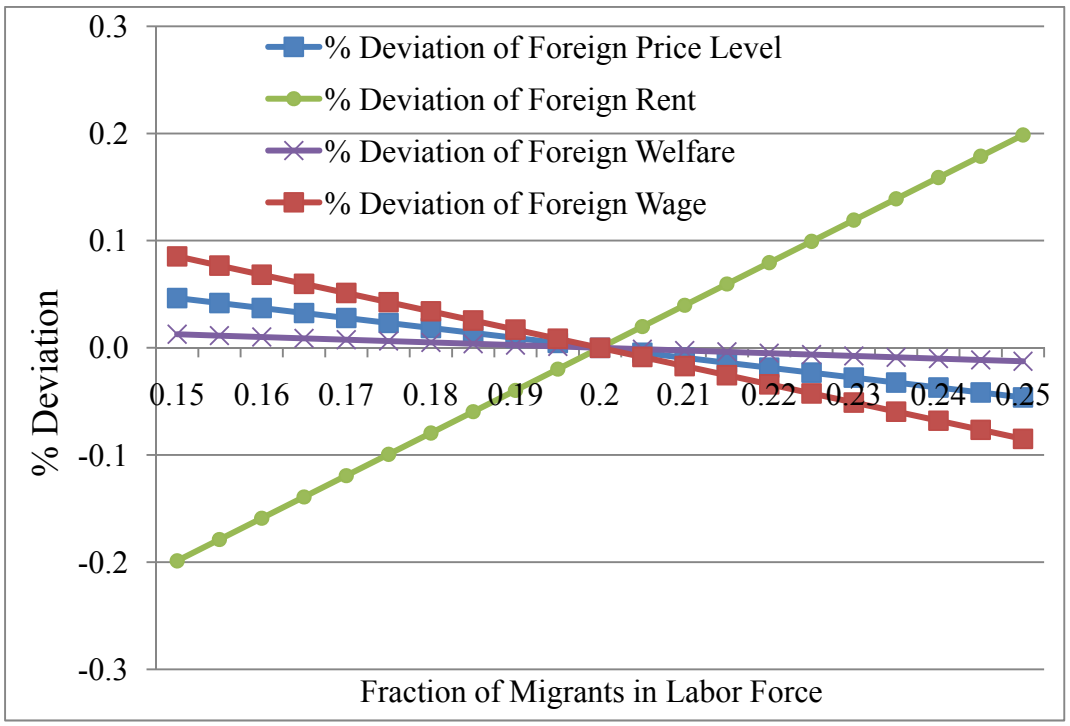


**Figure 24 - Remittances Driven by Retirement Savings**

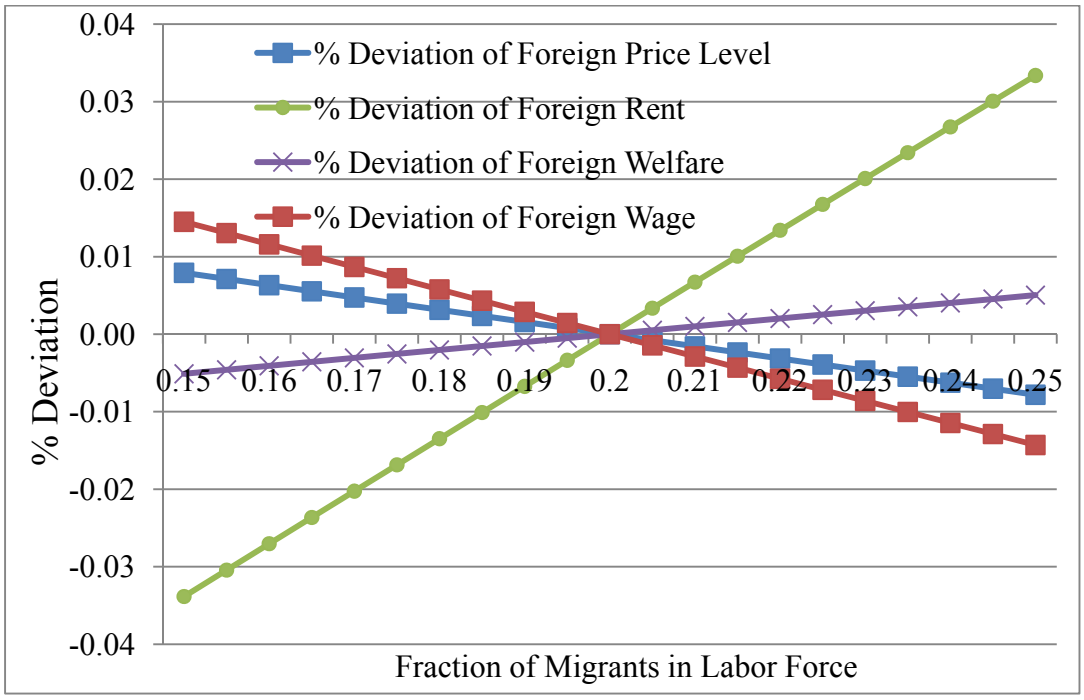


**Figure 25 – Remittances Driven by Familial Altruism**

It can be seen that an increase in migration helps foreign agents by lowering the price level and raising rental incomes. However, in the case of the model with remittances driven by retirement savings,

these gains do not offset the loss suffered due to wages depressed by increased migration. In the model with altruism between migrants and their resident households, once again, increased migration leads to lower prices, higher rental income, and lower wages. However, unlike the overlapping-generations model, the gains from lower prices and higher rental incomes exceeds the losses from lower wages and increased migration makes even foreign households better off.

The results from both models suggest that allowing more immigrant workers from a poor economy might be an effective way to boost the welfare of its agents. To test this quantitatively, another counterfactual exercise was conducted. Instead of allowing migration, the foreign country is now made to donate a certain amount of foreign aid to the home country. The exact amount of foreign aid is determined such that it would leave home country agents' welfare unchanged when compared to the situation in which migration is allowed but no aid is transferred. The foreign country's government extracts the foreign aid through equal lump sum taxation of all its citizens and then transfers this aid to the home country government which in turn provides equal lump sum transfers to all its citizens. The results of this exercise are given in Table 7.

| | Remittances driven by Retirement Savings | Remittances driven by Familial Altruism |
|---|---|---|
| Decrease in welfare of foreign citizens when aid used instead of migration | 1.2% | 3.7% |
| Percent of output that needs to be transferred as foreign aid | 0.8% | 0.3% |

**Table 7**

The overall results of the model and the above exercises in particular suggest that remittances are very effective in boosting the welfare of recipient economies despite any occurrence of the Dutch Disease. Also, from a donor country's standpoint, allowing greater migration from the recipient country is preferable to sending it foreign aid.

## 5.1 The Road Ahead and Future Work

While this model provides good intuition, it does not capture dynamic and stochastic effects. A computable model that incorporates these features can provide more accurate results. Capital could also be added to the model instead of or in addition to land. With capital included in the model, agents can respond

to changes in migration by adjusting their behavior in terms of capital as well. By adding a labor-leisure choice, this model can also be used to test whether remittances cause a decrease in the total labor hours in the recipient country. Another possibility is to model the family's internal optimization problem more explicitly within the current macroeconomic framework of the model in which remittances are driven by familial altruism. Similarly, the model can be made more realistic by introducing heterogeneity among home agents and allowing migration to become an endogenous decision variable while retaining some of the migration restrictions set by the host country. Some of these modifications may be best addressed through simulation models.

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