



When Migrant Remittances Are Not Everlasting, How Can Morocco Make Up?

Fida Karam^{*†}

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Abstract

In this paper, I run a computable general equilibrium (CGE) model of the Moroccan economy to investigate the transmission channels through which remittances affect households and sectors. I give a particular attention to the investment of remittances in the real estate sector, by allowing a segmentation of the savings market. To begin with, I assess the negative impact of immigration restrictive policies and permanent migration on the future evolution of remittances. Then I ask what would be the appropriate policies to take the maximum profit from current flows. It turns out that channelling investment from real estate to productive sectors is unexpectedly harmful in terms of growth and welfare. Positive effects stem only from government ability to attract investors through an improvement in the country risk premium, and private efforts to reduce international transfer costs.

Keywords: Sequential Dynamics, Computable General Equilibrium Model, Migration, Remittances.

JEL Classification: C68, F22, F24.

^{*}Paris School of Economics, University of Paris 1 & CNRS, Sorbonne Economic Center (TEAM), 106-112 boulevard de l'Hôpital, 75647 Paris Cedex 13, France; karam@univ-paris1.fr.

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1 Introduction

According to data from the International Monetary Fund's (IMF) Balance of Payments Yearbook, Morocco is the fourth-largest recipient of official remittances among developing countries, totaling US\$ 3.3 billion (37 billions of dirhams) in 2001. After their surge in 2001, their level remained high compared to other developing countries, about 9% of GDP and 25% of exports. For instance, they amounted to only 3% of GDP and 16% of exports in Egypt, 1% of GDP and 3% of exports in Turkey, 5% of GDP and 13% of exports in Tunisia (Bouhga-Hagbe, 2004). Since the early 70s, they have become increasingly important for the Moroccan external balance of payments (BoP). In 2001, they were six times higher than official development aid and five times higher than foreign direct investment (FDI) (de Haas, 2007). They represent the country's major source of foreign currency receipts and exceed receipts from phosphate and tourism (Nyberg-Sorensen, 2004).

This paper investigates the impact of remittances on the Moroccan economy. Unlike the best part of the literature that focuses households, ignoring linkages that transmit the influence of migration and remittances to other households and economic sectors, I use a CGE approach. To take into account the use of remittances for investment needs, I adopt a dynamic framework that allows the allocation of investment to the different sectors. I further assume a segmentation of the savings market in order to show clearly that remittances, unlike other sources of savings, mainly finance investment in real estate.

The scale and growth of remittances by destination of developing countries have attracted increased attention regarding their development impact. Many studies were concerned by their effect on poverty and inequality, on the balance of payments, and others by their use for consumption and investment needs. Putting aside the poverty reducing effect of remittances on which the different studies agree (Adams, 2006; Yang and Martinez, 2006), the results are mixed. To begin with, empirical works on the income distribution effects of remittances are not conclusive¹. Second, remittances are supposed to affect unemployment, productivity and growth, depending on the breakdown between consumption and investment. If they are invested, they will promote output and employment and thereby finance future consumption in a sustainable way. Alternatively, if they are spent only on current consumption goods, then future consumption has to be financed by future remittances. However, Glytsos (1993) argues that remittances, even when not invested, can have an important multiplier effect. His study

¹For example, Ahlburg (1996) and Taylor and Wyatt (1996) find that remittances have an equalizing effect on income distribution in Tonga and Mexico. By contrast, evidence from Egypt (Adams, 1991), Pakistan (Adams, 1998) and the Philippines (Rodriguez, 1998) show that remittances induced income inequality to rise. Adams (2006) shows that internal and international remittances have little impact on income inequality in Guatemala. The evidence from the Mexican case found support to the inverse U-shape relationship between migration and inequality (McKenzie and Rapoport, 2005).

applied to Greece shows that this multiplier effect arises when consumption stimulates the demand of goods and services, which promotes, in turn, output and employment. Third, remittances affect the BoP and they have a more positive impact than other monetary flows such as financial aid, FDI and loans because they are a more stable source of foreign currency, bear no interest and do not have to be repaid. But one should be cautious here because remittance flows can also have negative inflationary effects if they stimulate demand more than supply and this demand falls on non-tradable goods. Finally, they can induce a moral hazard problem where people choose to work less due to the positive income effect of remittances (Chami, Fullenkamp and Jahjah, 2005).

The results of the previous works show that the effects of remittances are heterogeneous across space and depend on the amount of remittances received and other macroeconomic variables that are country-specific. In this context, it is worth mentioning that the literature is unevenly distributed with regard to country analyses. A lot of works have been done on Latin migrants living in the United States (US) while the interest for migrants from Middle East and North Africa countries (MENA) in the European Union (EU) has just began, in spite of the large flows of remittances received by these countries. According to the IMF's Balance of Payments Yearbook, MENA countries received in 2001, as well as South Asia, the largest flow of remittances in percentage of GDP (2.3%) and the second largest flow, after Latin America and the Caribbean, in billions of US dollars (US\$ 14 billion v/s US\$ 23 billion). In particular, Morocco is ranked first between MENA countries and stood internationally after India, Mexico and the Philippines in 2001. Despite its place among the largest developing countries receiving remittances, works concerned by the impact of remittances on Morocco are limited to unpublished reports, theses or working papers on particular regions². On the national level, only general surveys like those of Hamdouch (2000) and Nyberg-Sorensen (2004) are available. Regardless of empirical gaps and methodological flaws, available evidence suggests that migration and remittances have considerably improved living conditions, education, and triggered economic activity, from which non-migrants indirectly profit. However, this impact is fundamentally heterogeneous across space and time, as well as across socio-ethnic and gender groups. In many cases, the development of migrant-sending regions is a prerequisite for return and/or investment rather than a consequence of migration. Consequently, additional works are needed to assess the effects of migration on marginal propensities to invest and multiplier effects of remittance expenditure (de Haas, 2007).

Yet, the literature based on households or on CGE models³ has given less attention to the sectoral distribution of remittances invested, especially when the

²See for example Berriane (1996), Lazaar (1987, 1989), McMurray (1992) cited in Nyberg-Sorensen (2004) on the Rif Mountains, and Bijaad (1987), de Haas (2003, 2006) on Southern Morocco.

³I could identify only few CGE models studying the impact of remittances in a dynamic framework. See for example the paper of Taylor and Dyer (2006) on Mexico.

largest part of remittances in developing countries is invested in real estate. The problem with this sector is that construction services are offered domestically, unlike other sectors that export to international markets and compete with international products. On the one hand, increasing openness generates strong competitive pressures that drive costs down and ameliorate the product quality. On the other, it accelerates institutional change that reduces transaction costs for all business activities. This is the export-growth relationship in the heart of export-led growth strategy. In order to model the particular investment of remittances in real estate in a dynamic CGE framework, I resort to a segmentation of the savings market: unlike FDI and domestic savings that finance productive sectors, remittances finance mainly the real estate sector. Indeed, remittances by Moroccans residing abroad (MRA) are driven by altruistic motives: they tend to satisfy the family basic needs, among other things having more comfortable and decent houses. If remittances are treated analogously to foreign and domestic savings that finance productive sectors, this will overestimate the volume of capital invested in these sectors and create an illusion of a sustainable growth. This is the main contribution of the paper. Then, I look to the long-term tendency of migratory flows and remittances. With family reunification and strict immigration policies in receiving countries, remittances are expected to be cut away. In partial equilibrium, one may conclude that the economy would not be affected by the downward evolution of remittances if they are invested in a non productive sector like real estate. However, in a general equilibrium framework, the drop of remittances will be harmful to the economy, even when invested in real estate, due to the existing linkages between sectors.

It turns out that the fear from the cut down in remittances is justified. Therefore, the economy should take a maximum profit from current flows. This could be achieved for example by reducing the international cost of transfer in order to channel a larger amount of money to the receiving country. Another option consists of transmitting remittances to the exporting sectors rather than to real estate. Finally, the government should undertake policies that are likely to improve the investment climate and thus reduce the country risk premium in favour of investors. The improvement of the country risk premium and the reduction of transfer costs seem to give the best results.

The paper is structured as follows. Section 2 illustrates Morocco's dependency upon remittances. Section 3 is devoted to the theoretical framework. The results of our simulations are presented in section 4. Section 5 concludes and discusses the policy implications of my results.

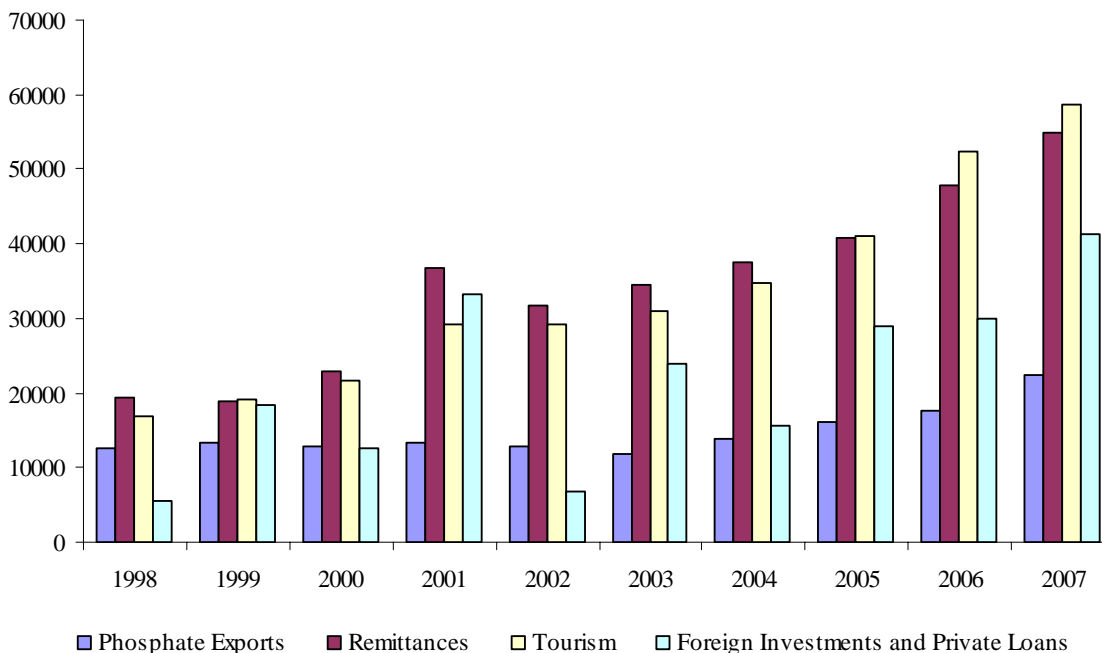
2 A Brief Overview of Remittances to Morocco

Morocco's dependency on migration and remittances is as old as migration into Europe. This dependency is such that the Kingdom's budgetary plans (1968-72) proposed emigration as a means of solving the unemployment problem, providing

additional foreign currency through remittances and creating a group of nationals with professional skills favourable to economic development. Moreover, migrant remittances would help finance internal investments. The five-year plan of 1973-77 further proposed to set up a network of social bureaus abroad.

Morocco is the fourth-largest developing country receiving official remittances, totaling MAD 37 billion (US\$ 3.3 billion) in 2001. Remittance flows moved from MAD 2 billion in 1975 to MAD 10 billion in 1985 and MAD 19 billion in 1998. They reached a record level of nearly MAD 37 billion in 2001 before moving down to MAD 32 billion in 2002. In 2003, they rose again to MAD 35 billion. They have particularly increased during the past five years, encouraged by some events such as the renewed interest of the new king for the Moroccan community living abroad, the adoption of the Euro that dismantled the savings made in the old European currencies, the devaluation of the Dirham in 2001, the strong increase in the number of Moroccan immigrants to Italy and Spain and the remarkable attachment of Moroccans to their country of origin. Remittances role in the BoP is often higher than phosphate, tourism, foreign investments and private loans (Figure 1).

Figure 1:
Remittances and other flows of the BoP, 1998-2007 (MAD million)



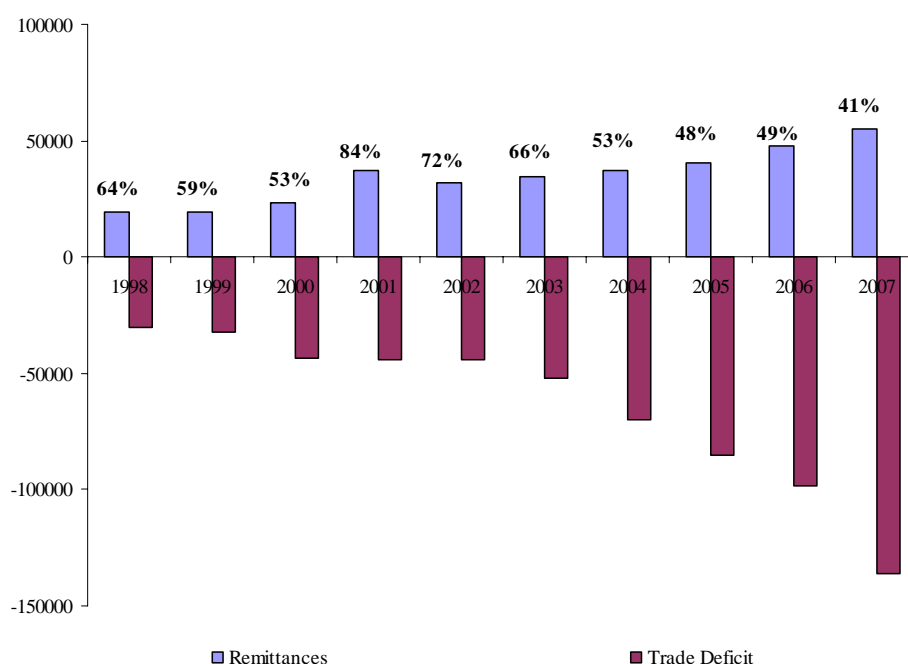
Source: Ministry of Foreign Trade, Rabat.

Notes: The word remittances refers here to workers' remittances that are registered as current transfers.

As it is shown in Figure 2, remittances almost cover the trade deficit and have

contributed to the recent surpluses of the external current account, as well as the overall BoP surplus. In spite of their magnitude in the balance of payments, they do not seem to constitute a significant risk in terms of stability because they are mainly driven by altruism and attachment to the home country. Portfolio diversification motives are not significant among the long run explanatory factors of remittances to Morocco (Bouhga-Hagbe, 2004). According to van Dalen et al. (2005), it is the parent-child relation that determines the motive for remitting money.

Figure 2:
Remittances as % of trade deficit, 1998-2007 (Values in MAD million)



Source: Ministry of Foreign Trade, Rabat.

Notes: The word remittances refers here to workers' remittances that are registered as current transfers.

However, the long term tendency goes against the increase of remittances. With the restriction of Western immigration policies, the rise in the number of educated migrants that tend to settle abroad, family reunification, naturalization, and the succession of generations living abroad, remittances are expected to decrease, negatively affecting the Moroccan economy largely dependent on this source of foreign currency. That is why it is important to know the treatment reserved for them: are they consumed or invested? And if invested, are they in productive sectors? In this context, the allocation of remittances between sectors plays an essential role, mainly because the best part is invested in real estate. First, construction services are offered domestically and do not profit from technical progress due to competitiveness with international products. Secondly, real

estate accounts only for 4% of GDP at factor costs, compared to 17% for agriculture, 14% for trade and repair and 11% for rental services. It also constitutes only 3% of the wage payroll compared to 34% in agriculture. At first sight, one concludes that remittances should be channelled to productive sectors in order to promote the economic activity and guarantee a sustainable growth. Furthermore, what about the obstacles to remit, such as high transfer costs? Here is some data on remittance investment and transfer costs.

The main purpose of sending money to Morocco is to support the family and other close relatives and/or build a house. Real estate monopolizes the lion's share with nearly 83.7% of investments by MRA in their country of origin. There is only limited evidence of investments in productive sectors (Table 1). Migrants find it difficult and unattractive to make investments in Morocco because of the lack of information about investment opportunities, a slow bureaucratic system, widespread corruption and the insecurity resulting from the economic and political situation. To this is added, especially in rural villages, the lack of infrastructure such as electricity, water and roads that deeply inhibits the productive use of remittances.

However, things are changing: first, fewer migrants consider investing in the future. Second, future projects are more concentrated into productive sectors (Table 1). Real estate, while remaining the principal sector of investment, consists of no more than 35.6% of the projects. This reflects the change in migrants' behaviour, especially the second generation of migrants, and also the fact that MRA have already invested heavily in real estate.

Table 1: **Sectoral distribution of MRA's investments (%)**

Sectors	MRA's investments	MRA's investment projects
Real estate	83.7	35.6
Agriculture	7.5	10.6
Trade	4.9	27.4
Tourism	1.4	12.1
Manufacturing	1.3	7.5
Other services	1.1	5.3
Other sectors	0.1	1.5

Source: Hamdouch (2000).

Transfers are increasingly taking place through official channels after the tighter control imposed by the authorities on financial flows to and from the Arab countries in the wave of the "war on terror" declared by the United Nations (FEMISE, 2004). Official remittance flows have also been stimulated by

the expansion of the national banking system and the extension of banking services to the principal immigration countries. More than 62% of migrants transfer their funds through Moroccan banks⁴ compared with only 4.4% for foreign banks. 16% of migrants use the post office and 3.4% private intermediaries (Hamdouch, 2000)). The Banque Populaire charges low commission for money transfer (the half of that charged by private companies). However, according to Hamdouch (2000), transfer costs should be further reduced and transfer delays shortened. Table 2 presents an example of transfer costs charged by different channels from the Netherlands to Morocco. Moreover, the major problem is the lack of transparency on the cost and speed of the transaction: product information can only be obtained through the actual use of the different transfer services. Money transfer organisation are transparent on fee costs and speed prior to the transaction, but only provide exchange rate costs when the transaction takes place. The bank channel seems even less transparent: they do not provide information on total fee costs prior to the transaction nor on exchange rates, and only give an estimate of the transaction time (Barendse et al., 2006).

Table 2: **Cost of remitting 250 euros from the Netherlands to Morocco**

Official channels	Cost in euros
Western Union	21.14
MoneyGram	23.95
Postbank (internet)	7.5
ABN Amro (urgent at counter)	39.6
ABN Amro (internet)	16.10

Source: Barendse et al. (2006).

3 Theoretical Framework

As mentioned earlier, I am interested in the impact of remittances on Morocco, a country that has been subject to various surveys on remittances and studies applied to specific regions. The general conclusion is analogous to the one of Hamdouch (2000): given the expected downward trend of remittances due to the restriction of immigration policies in the Western countries and to permanent migration, it is necessary to alleviate in the short run the barriers to remit.

⁴At present, migrant remittances are monopolized by two main banks: the Banque Populaire and Bank Al Amal. The first one has been the main reference for residents abroad since the 1970s. It charges relatively low commission for money transfer and gives access to normal bank credit with favourable interest rates. Bank Al Amal is an investment bank established in 1989, following the demand by residents abroad to have an Islamic investment bank supporting their entrepreneurial initiatives. It is specialized in financing investments and it does not transfer money and does not open bank accounts. Its main function is to encourage migrants to transfer their money to Morocco in order to invest.

This could be done for example by moderating the high cost and the long delay of transfers, by channelling them to productive investments, and by improving the investment climate. Such policies involve all economic agents and sectors: a shock on remittances has its most direct impact on household income. But since remittances are also invested, the shock affects as well the economic sectors, and consequently the demand for production factors and their corresponding prices. Once again, households' income changes because of the wage variation. In addition, remittances contribute to the receipts of the BoP, and therefore induce an appreciation or a depreciation of the exchange rate. The exchange rate variation affects the value in domestic currency of the international wage and thus, the decision to migrate and remit. In sum, this is a general equilibrium problem, requiring a CGE approach to illustrate the linkages that transmit the influence of remittances on economic agents and sectors.

This section provides a short description of our benchmark model inspired from Decaluwé, Martens and Savard (2001) and developed by Cockburn, Decaluwé, Fofana and Robichaud (2006). Very briefly, our version of this model contains 34 mono-productive sectors distributed between two aggregate sectors: a rural sector (agriculture and fishing) and an urban sector (industry, tradable and non tradable services); five agents (rural and urban households, firms, government, and the Rest of the World). The production process employs two factors of production: labour and capital. The capital is sector-specific. Rural labour is perfectly mobile between rural sectors and urban labour is mobile between urban sectors but urban labour market is considered imperfect due to the existence of unemployment. Finally, labour movement between rural and urban blocks involves transactions costs. The migration block is borrowed from Karam and Decaluwé (2008): migratory flows are triggered by the wage differential between the region of destination and the region of origin, net of migration costs. The rural worker has the possibility to migrate abroad or to urban areas. He carries out a choice in two stages: initially, he maximises his expected income considering the choice of staying in Morocco (staying in rural zones or migrating to the cities) or leaving the country. In the second stage, the rural worker who has decided to stay in Morocco carries out the choice of staying in rural areas or migrating to the cities. Similarly, the urban worker maximises his expected income by choosing to stay in Morocco or to migrate abroad. The last model is a static one where remittances are treated as exogenous. Because the impact of remittances is different depending on whether they are spent on consumption or investment, it would be more cautious to adopt a dynamic version of the migration model. The advantage of dynamic models is that they allow to investigate the allocation of investment between sectors. The innovation with respect to traditional dynamic CGE models, and especially the very few ones interested in the impact of remittances, consists in a segmentation of the savings market. In other words, remittances are not invested in the same way as other sources of savings. They mainly finance real estate. On the contrary, the proportion of domestic and foreign savings not funding the public debt is invested in productive sectors, mainly in industry and services. Putting aside the fact that different sources of

savings finance different sectors distort the share of investment going to the most or the least productive sectors, and consequently bias the results.

For the sake of brevity, I only deal here with the segmentation of the savings market and the dynamics. All equations can be examined in Appendix 3. The model is calibrated on a disaggregated Social Accounting Matrix (SAM) for 1998. Data on migration come from the Organisation of Economic Co-operation Development (OECD). Appendix 1 presents a detailed explanation of all data sources. The model is implemented in GAMS (Brooke et al., 1988) and solved with MILES, a solver for mixed complementarity problems.

3.1 The Segmentation of the Savings Market

Traditional dynamic CGE models postulate that total savings are distributed between sectors according to their rental rate of capital, which means that all kinds of savings are identically treated. This would be however contestable when investment by MRA occurs mainly in real estate. Construction has become one of the pillars of the Moroccan economy, not least because of migrant investments. By contrast, FDI and firms' investments take place mostly in productive sectors, particularly in services and industry.

But why is investment in real estate so frowned? In fact, the nature of real estate services limits the scope of supply to local markets. On the contrary, tradable products are offered on international markets and compete with international products. Export expansion has a positive effect on total factor productivity (TFP) growth, through exploiting economies of scale, technology transfer, or increasing competitive incentives. Indeed, openness to international trade enforces the mastering of foreign technology in order to meet world market standards in quality, distribution and marketing, and to reduce production costs. Export promotion also accelerates institutional change which contributes to productivity growth by reducing transaction costs for all business activities. This is the relation between exports and growth at the heart of the export-led industrialisation strategy. De Melo and Robinson (1990) captured these effects by introducing an export externality. In their model, exports affect the scale parameter of the constant elasticity of transformation function (CET) between production to domestic and international markets. In this paper, I follow the specification of Rodrigo and Thorbecke (1997) and add the externality by stating that value added of tradable sectors is an increasing function of exports beyond some base level volume of exports:

$$VA_{tr,t} = A_{tr,t}[\alpha_{tr}LD_{tr,t}^{(\sigma_{tr}-1)/\sigma_{tr}} + (1 - \alpha_{tr})KD_{tr,t}^{(\sigma_{tr}-1)/\sigma_{tr}}]^{\sigma_{tr}/(\sigma_{tr}-1)}$$

and

$$A_{tr,t} = A_{tr,t-1} \left(\frac{EXS_{tr,t}}{EXS_{tr,t-1}} \right)^\zeta \quad \text{for } EXS_{tr,t} > EXS_{tr,t-1}$$

$$A_{tr,t} = A_{tr,t-1} \quad \text{for } EXS_{tr,t} \leq EXS_{tr,t-1}$$

where

$VA_{tr,t}$	is the value added of tradable sector tr at period t ,
$A_{tr,t}$	the export externality shift parameter in value added at period t ,
α_{tr}	the share parameter of the constant elasticity of substitution (CES) function,
$LD_{tr,t}$	the labour demand of sector tr at period t ,
$KD_{tr,t}$	the capital demand of sector tr at period t ,
σ_{tr}	the elasticity of substitution (positive),
ς	the export externality (positive).

Following the study of de Melo and Robinson (1990) applied to Korea, I choose a fairly small value of 0.1 for ς to describe the export externality for Morocco. Now, it is time to depict the specific use of each source of savings.

Scholars and policy makers blame migrants for investing essentially in real estate, what they call a “refugee sector”, which reflects a lack of entrepreneurial mentality. Indeed, the first objective of migrants is to meet the household’s immediate needs such as space, safety, privacy, fewer conflicts and better health. Second, there are specific social and cultural reasons that explain the priority for housing construction, such as the priority for migrants’ wives to have their own house, away from the authority of their parents-in-law, in order to enjoy their personal freedom and privacy. This means that investment in real estate by MRA depends on exogenous personal factors such as the willingness to maintain ties with the country of origin. Consequently, I find it plausible to consider investment in housing as a fixed part of the amount of remittances invested. According to Hamdouch (2000), this proportion represents 80% of investments by MRA in their country of origin. Thus, investment by MRA in real estate is given by the following equation:

$$\sum_h estate(1 - cons_h)(1 - ty_h)(1 - tc)REM_{h,t} = MRA_t PINV_t$$

where

$estate$	is the proportion of remittances after consumption invested in real estate,
$cons_h$	the proportion of remittances consumed by household h ,
ty_h	the direct tax rate on household h income,
tc	the transfer cost,
$REM_{h,t}$	the value of remittances received by household h at period t ,
MRA_t	the investment in real estate financed by remittances at period t (in volume),
$PINV_t$	the aggregate price of investment at period t .

The remainder of remittances not consumed⁵ and not invested in real estate, together with households and firms’ savings, help financing investment in produc-

⁵According to the National Survey on Household Living Standards of 1998-1999, the pro-

tive sectors $DINV_t$ according to the differential between the sectoral rental rate of capital and the aggregate price of investment, as well as the domestic public debt: when government savings are negative and the external sources of funding are limited, the government is obliged to borrow from domestic agents, particularly from the urban household and firms⁶, in order to finance public investment. This domestic funding of the public debt is positively dependent on the country risk premium ϵ_2 . In other words, if the country risk premium rises making domestic agents reluctant to invest, they will opt for a risk-free investment, such as lending to the government, and the latter will have a crowding-out effect on private investment.

$$DD_t = K_t(F \times \epsilon_2^\xi)(S_{"hu",t} + (1 - estate)(1 - cons_{"hu"}) \\ (1 - ty_{"hu"})(1 - tc)REM_{"hu",t} + S_{"fm",t})$$

where

DD_t	is the domestic public debt at period t financed by urban household and firms,
K_t	an adjustment variable in the debt equation at period t ,
F	a scale parameter,
ϵ_2	the country risk premium perceived by domestic investors,
ξ	the elasticity of internal public debt funding with respect to the country risk premium (positive),
$S_{ag,t}$	Agent ag 's savings (hu for urban household and fm for firms) at period t .

Public investment is financed by government savings, if they are positive, and the public debt. It is composed of investment in infrastructure $INVG_t$ and the additional capital required to support the increased production of non-tradable services $VARKD_t$. Public investment in infrastructure $INVG_t$ is treated as exogenous since it comes from a public decision while $VARKD_t$ is endogenously determined due to the specification of public sectors where capital stock is supposed endogenous (detailed in the next section).

$$S_{"gv",t} + DD_t + e_t FD_t = VARKD_t PINV_t + INVG_t PINV_t$$

where

e_t	is the nominal exchange rate at period t (the price of foreign currency in domestic currency),
FD_t	the foreign public debt at period t .

Foreign savings $S_{"row",t}$ finance foreign public debt, as well as foreign invest-

portion of remittances going to consumption is the quarter of the total amount of remittances recorded in the BoP (Bourchachen, 2000).

⁶The data in the SAM show that only urban households and firms lend to the government (Abdelkhalek and Zaoujal, 2004).

ment⁷ and a fraction of the stock variation. Foreign investment⁸ is triggered by the differential between the rental rate of capital and the international return on capital.

$$e_t(S^{\text{“row”}},t - FD_t) = \sum_{pro} FDI_{pro,t} PINV_t + FDI^{\text{“con”}},t PINV_t + v \sum_i STK_{i,t} PC_{i,t}$$

where

- $FDI_{pro,t}$ is the foreign direct investment in productive sector pro at period t (in volume),
 $FDI^{\text{“con”}},t$ the foreign direct investment in the construction sector at period t (in volume),
 v the fraction of the stock variation at period t financed by foreign savings,
 $STK_{i,t}$ the stock variation of product i at period t (in volume),
 $PC_{i,t}$ the composite price of product i at period t .

To sum up, each sector receives two kinds of investments: domestic investment funded by firms and households' savings as well as the proportion of remittances not consumed, and foreign investment funded by foreign savings. In addition, the determinants of domestic and foreign investments are different. Domestic investment is motivated by the differential between the sectoral rental rate of capital and the investment aggregate price. In contrast, foreign investment is triggered by the differential between the domestic and international return on capital in the corresponding sector.

The macroeconomic equilibrium should be still verified despite the segmentation of the savings market, in the sense that all savings should match total investment (gross fixed capital formation + stock variation).

$$IT_t + \sum_i STK_{i,t} PC_{i,t} = e_t S^{\text{“row”}},t + \sum_{da} S_{da,t} + \sum_h (1 - cons_h)(1 - ty_h)(1 - tc) REM_{h,t}$$

where

- IT_t is the gross fixed capital formation at period t (in value),
 da for domestic agents.

None of right-hand side values is free to equilibrate aggregate savings-investment

⁷Foreign direct investment to Morocco surged in the 90s after the Structural Adjustment Program of 1983 that dismantled the “Moroccanisation” Decree of foreign ownership restriction and promoted trade liberalisation. The government adopted attractive measures of foreign investment such as the possibility of full foreign ownership of local companies, the repatriation of capital and dividends, fiscal incentives, and guaranteed foreign investment against the risks of nationalisation and expropriation.

⁸Foreign direct investment in the construction sector, contrary to MRA's investments in real estate, is motivated by economic factors.

balance. Government savings is a fixed share of GDP. Uniform adjustments in the rate of value-added tax across all sectors assure that the government savings target is met. Foreign savings are fixed. A flexible real exchange rate clears the current account balance. For each household category, savings is a fixed share of his disposable income. Hence, the model is savings-driven, in accordance with other studies on Morocco (Agénor et al., 2003; Löfgren et al., 1999): gross fixed capital formation adjusts to achieve savings-investment equilibrium.

The gross fixed capital formation in volume, $ITVOL_t$, is the sum of investments by sectors of destination.

$$ITVOL_t = IT_t / PINV_t$$

$$ITVOL_t = SI_t \left(\sum_{pro} INVD_{pro,t} + INVD^{“con”},t + VARKD_t \right)$$

where

SI_t is the investment adjustment variable at period t .

$INVD_{pro,t}$ the investment by destination of sector pro at period t given by:

$$INVD_{pro,t} = DINV_{pro,t} + FDI_{pro,t}$$

$INVD^{“con”},t$ the investment by destination of the construction sector at period t given by:

$$INVD^{“con”},t = MRA_t + DINV^{“con”},t + INVG_t + FDI^{“con”},t$$

3.2 The Dynamics

In this paper, I develop a sequential (recursive)⁹ dynamic CGE model where agents have myopic behaviour. It consists of multiple static CGE models linked between periods by an exogenous variable updating procedure, mainly for the capital stock and the population. Capital stock is updated endogenously at each period with investment and the population is updated between periods with an exogenous growth rate. It is also possible to add updating mechanisms for other variables, such as public expenditures, transfers and debt if they are supposed fixed in the first period. I begin with the accumulating mechanism of the capital stock. The stock of capital of private sector ps in the following period is equal to the current capital stock net of depreciation, plus current investment in this sector:

$$KD_{ps,t+1} = (1 - dep_{ps})KD_{ps,t} + INVD_{ps,t}$$

⁹There is two types of dynamic CGE models: sequential and intertemporal. Unlike sequential dynamic CGE, intertemporal ones are based on optimal growth theory where the behaviour of economic agents is characterised by perfect foresight. They know everything about the future and react to future changes in prices. Households maximise their intertemporal utility function under a wealth constraint to determine their consumption schedule over time. Investment decisions by firms are the results of cash flow maximisation over the whole time horizon.

where

dep_{ps} is the capital depreciation rate of sector ps (parameter).

In line with the segmentation of the savings market where each source of savings finance a particular investment category, investment by sector of destination $INVD_{ps,t}$ is not homogeneous. It consists of two kinds of investments: foreign investment funded by external savings and domestic investment funded by local savings. The former is stimulated by the differential between the domestic and international rental rate of capital in the corresponding sector whereas the second is triggered by the differential between the rental rate of capital and the aggregate investment price. For both types of investment, I adopt the quadratic form proposed by Bourguignon et al. (1989).

I assume that multinationals distribute first their investment choices between sectors then between countries. In other words, after having selected a sector, the multinational will choose between investing inside or outside Morocco. In line with FDI theories, many factors intervene in the investment decision across countries, such as market size, production costs, the exchange rate, institutional credibility and other factors that affect the country risk premium. For lack of data on the nature of FDI (horizontal/vertical) that occurs in the different sectors, I use the differential between the international and local rental rate of capital as a determinant of FDI in a particular sector, and take into account the negative effect of the exchange rate depreciation on profit repatriation and the positive effect of the country risk premium on the investment decision:

$$\frac{FDI_{pro,t}}{KD_{pro,t}} = D_{1pro} \left(\frac{r_{pro,t}}{e_t r_t^* (i_t + \epsilon_1 + dep_{pro})} \right)^2 + D_{2pro} \left(\frac{r_{pro,t}}{e_t r_t^* (i_t + \epsilon_1 + dep_{pro})} \right)$$

$$\frac{FDI_{con,t}}{KD_{con,t}} = D_{1con} \left(\frac{r_{con,t}}{e_t r_t^* (i_t + \epsilon_1 + dep_{con})} \right)^2 + D_{2con} \left(\frac{r_{con,t}}{e_t r_t^* (i_t + \epsilon_1 + dep_{con})} \right)$$

where

- D_{1pro} is a scale parameter,
- $r_{pro,t}$ the rental rate of capital in sector pro at period t ,
- r_t^* the international rental rate of capital at period t (exogenous),
- i_t the interest rate on domestic public debt at period t (exogenous),
- ϵ_1 the country risk premium perceived by foreign investors (parameter),
- D_{2pro} a scale parameter.

I think that the rental rate of capital is a good determinant of FDI because it incorporates the influence of many FDI determinants identified in the empirical

literature such as market size, growth rate or production costs. Indeed, it is given residually after deducing the value of intermediary consumption $\sum_i PC_{i,t} DI_{i,ps,t}$ and labour cost $w_t LD_{ps,t}$ from the value of production $P_{ps,t} XS_{ps,t}$.

$$r_{ps,t} = \frac{P_{ps,t} XS_{ps,t} - \sum_i PC_{i,t} DI_{i,ps,t} - w_t LD_{ps,t}}{KD_{ps,t}}$$

Domestic firms make their investment choice between sectors. Following Bourguignon et al. (1989), domestic investment increases with respect to the ratio of capital rental rate to its user cost:

$$\begin{aligned} \frac{DINV_{pro,t}}{KD_{pro,t}} &= D_{3pro} \left(\frac{r_{pro,t}}{PINV_t(i_t + \epsilon_2 + dep_{pro})} \right)^2 + \\ &\quad D_{4pro} \left(\frac{r_{pro,t}}{PINV_t(i_t + \epsilon_2 + dep_{pro})} \right) \\ \frac{DINV_{con,t}}{KD_{con,t}} &= D_{3con} \left(\frac{r_{con,t}}{PINV_t(i_t + \epsilon_2 + dep_{con})} \right)^2 + \\ &\quad D_{4con} \left(\frac{r_{con,t}}{PINV_t(i_t + \epsilon_2 + dep_{con})} \right) \end{aligned}$$

where

- $DINV_{pro,t}$ represents domestic investment in productive sectors at period t (in-volume),
- D_{3pro} a scale parameter,
- ϵ_2 the country risk premium perceived by domestic investors (parameter. It is convenient to think that it is lower than the one perceived by foreign investors. I assume that ϵ_2 is the half of ϵ_1 ,
- D_{4pro} a scale parameter.

In tradable sectors, firms maximise their profits. Then, if the capital available is sector-specific, the profit or capital remuneration is residual and varies from a sector to another. This approach is obviously irrelevant in the public sector since the government, as a supplier of non tradable services, does not have an optimisation behaviour. The cost and thus the price of public services is then the result of the combination of wage and capital costs. Consequently, the rental rate of capital is normalised in the public sector and capital demand is calculated in the following way:

$$KD_{pub,t} = \frac{PV_{pub,t} VA_{pub,t} - w_t LDG_{pub,t}}{r_{pub,t}}$$

where

- $PV_{pub,t}$ is the value added price of sector pub at period t ,
- w_t the public wage at period t (exogenous),
- $LDG_{pub,t}$ the labour demand of sector pub at period t .

Therefore, the evolution of capital stock in public sectors can not agree with the updating mechanism of capital stock in private sectors, and investment in non-tradable sectors is endogenously determined by the model:

$$VARKD_{t+1} = KD^{“edu”,t+1} - KD^{“edu”,t}$$

As well, I need to add updating mechanisms for the following exogenous variables. Over time, rural population LSR_t grows at the exogenous population growth rate g_{LSR} , net of migration to urban areas MIG_t and of international migration from rural areas EMR_t .

$$LSR_{t+1} = LSR_t(1 + g_{LSR}) - MIG_t - EMR_t$$

Urban population LSU_t grows at the exogenous growth rate g_{LSU} . It receives internal migrants from rural areas MIG_t and sends migrants abroad EMU_t .

$$LSU_{t+1} = LSU_t(1 + g_{LSU}) + MIG_t - EMU_t$$

Migrant stock at period t is updated periodically with current migrant flows. This means that migrant stock at each period is composed of several generations of migrants that obviously have different remitting behaviours. Assuming that there is only three migrant generations, one should expect that new migrants remit more because they have the strongest ties with the family left behind. In contrast, the second generation that later brought spouses and children in the process of family reunification has lost some of its attachment to the country of origin, but still remits in order to support the parents left behind. The amount remitted is lower than the amount it should remit if all the family was still behind. The third generation of migrants is supposed to be highly integrated in the country of destination and barely remits. To sum up, the remitting behaviour depends on migrant generations that are determined by the length of migration. However, the duration of living abroad can not be reproduced in sequential dynamic models because they do not accommodate calculations that involve variables from an indefinite long past. Therefore, some simplifications need to be done. I present the adjustment mechanism of rural and urban migrant stocks in the following way: I assume that rural and urban migrant stocks of each period are composed of three generations according to the age of migrants and that the first generation always receive current migrants. This assumption is plausible since 74% of current migrant flows are aged between 15 and 29, according to Erf and Heering (2002). And, after years of migration, those young migrants pass to the second and third generations of older migrants. At the base year and for lack of data, I postulate that rural and urban migrant stocks have the same age distribution: 35% of migrants are aged between 15 and 29, 42% between 30 and 44, and 23% more than 45 (Erf and Heering, 2002). At the following period, a fraction of the first generation loses some of its attachment to the home country and is added to the second generation. As well, a fraction of the second generation becomes more disconnected from the family left behind and is added to the third generation.

$$STKR_{1,t+1} = STKR_{1,t}(1 - \chi_1) + EMR_t$$

for the first generation of rural migrants and:

$$STKU_{1,t+1} = STKU_{1,t}(1 - \chi_1) + EMU_t$$

for the first generation of urban migrants.

where

- $STKR_{1,t}$ is the first generation of rural migrants at period t
 EMR_t the flow of rural migrants at period t ,
 $STKU_{1,t}$ the first generation of urban migrants at period t
 EMU_t the flow of urban migrants at period t ,
 χ_1 the proportion of the first generation that passes periodically to the second generation. Assuming that migrants who are 29 years old at t will pass to the second generation at $t + 1$ and that the number of migrants aged between 25 and 29 is equally distributed between age brackets, this parameter will be equal to 13%.

Now, the second generation of migrants at the following period is given by:

$$STKR_{2,t+1} = STKR_{2,t}(1 - \chi_2) + \chi_1 STKR_{1,t}$$

for rural migrants and,

$$STKU_{2,t+1} = STKU_{2,t}(1 - \chi_2) + \chi_1 STKU_{1,t}$$

for urban ones.

where

- χ_2 is the proportion of the second generation that passes periodically to the third one. Assuming that migrants who are 44 years old at t will pass to the third generation at $t + 1$ and that the number of migrants aged between 30 and 44 is equally distributed between age brackets, this parameter will be equal to 7%.

Finally, the evolution of the third generation is given by:

$$STKR_{3,t+1} = STKR_{3,t} + \chi_2 STKR_{2,t}$$

$$STKU_{3,t+1} = STKU_{3,t} + \chi_2 STKU_{2,t}$$

The first generation of migrants remits to support the family left behind. Since remittances are motivated by altruism, the remittance rate by migrant rises with his income in the country of destination and decreases with the family real disposable income. The remittance rate for rural and urban households is respectively given by:

$$RR^{hr},t = V_1^{hr} \left(\frac{YD^{hr},t}{CPIR_t} \right)^{\gamma_1^{hr}} w_t^{\gamma_2^{hr}}$$

$$RR^{“hu”},t = V_1^{“hu”} \left(\frac{YD^{“hu”},t}{CPIU_t} \right)^{\gamma_1^{“hu”}} w_t^{\gamma_2^{“hu”}}$$

where

$RR_{h,t}$	is the remittance rate to household h at period t ,
V_{1h}	a scale parameter,
$YD_{h,t}$	the disposable income of household h at period t ,
$CPIR_t$	the consumer price index in rural areas at period t ,
$CPIU_t$	the consumer price index in urban areas at period t ,
$\gamma_{1,h}$	the elasticity of remittance rate with respect to household h 's income (-4.2% according to Bouhga-Hagbe, 2004),
w_t	the international wage rate at period t (exogenous),
$\gamma_{2,h}$	the elasticity of remittance rate with respect to the international wage (1.8% according to Bouhga-Hagbe, 2004).

I arbitrarily assume that an individual belonging to the second generation of migrants remits the half of what it is supposed to remit, i.e. the half of the remittance rate by migrant, and that the third generation does not remit at all. Therefore, the value of remittances $REM_{h,t}$ received by household h at period t is:

$$REM^{“hr”},t = RR^{“hr”},t STKR_{1,t} + 1/2 RR^{“hr”},t STKR_{2,t}$$

for the rural household and:

$$REM^{“hu”},t = RR^{“hu”},t STKU_{1,t} + 1/2 RR^{“hu”},t STKU_{2,t}$$

for the urban household.

The parameters χ_1 and χ_2 will be subject, later on, to a shock (a rise of 20%) in order to reflect how the restriction of Western immigration policies or permanent migration reduce the amount of remittances and thus affect the Moroccan economy.

Migratory movements involve financial costs (travel cost, search for an apartment, search for a job...) and psychological costs (change of the way of life, adaptation to a new culture and a new community...). However, the more people migrate to a particular destination, the more these costs are likely to decline. The existence of migrant networks improves the access to information by potential migrants left behind. For example, old migrants help reducing search costs regarding jobs and housing, providing additional insurance in case of anticipated events... The relation between migration costs and migrant networks is described as follows:

$$MC_t = V_3 (TSTK_t)^\nu$$

where

MC_t represents migration costs at period t ,
 V_3 a scale parameter,
 $TSTK_t$ the total stock of migrants at period t :

$$TSTK_t = STKR_{1,t} + STKR_{2,t} + STKR_{3,t} + STKU_{1,t} + STKU_{2,t} + STKU_{3,t}$$

ν the elasticity of migration costs with respect to the total stock of migrants (negative).

The stock of internal migrants to urban areas at the following period $ISTK_{t+1}$ is equal to the current stock to which is added the current internal migration flow:

$$ISTK_{t+1} = ISTK_t + MIG_t$$

Another adjustment equation is required for both domestic and external public debts. The stock of domestic public debt at the following period SDD_{t+1} is equal to the current stock SDD_t to which are added the interest rate on the current stock i_t and the accumulated debt during the current period DD_t . Besides, at each period, an adjustment variable internal debt IA_t is introduced so that to keep the ratio of internal debt to GDP fixed and avoid infinite growth of interest rates paid by the government. The same adjustment mechanism prevails for the external public debt SFD_t ¹⁰.

$$SDD_{t+1} = (1 + i_t)SDD_t + DD_t - IA_t$$

$$SFD_{t+1} = (1 + i_t^*)SFD_t + FD_t - EA_t$$

The remaining exogenous variables evolve according to an average annual growth rate calculated over 5 or 10 years, depending on the availability of the data.

$$G_{i,t+1} = G_{i,t}(1 + g_G)$$

$$INVG_{t+1} = INVG_t(1 + g_{IG})$$

where

$G_{i,t}$ represents government expenditures on good i at period t ,
 g_G the average annual growth rate of government expenditures,
 g_{IG} the average annual growth rate of public investment in infrastructure.

¹⁰Internal and external public debt are respectively fixed to 56% and 15% of GDP (Ministry of Finance, Rabat).

4 Simulation Experiments

The long-term tendency goes against the maintenance or increase of remittances. This is due to restrictive immigration policies especially in Europe and to the basic immigration tendencies: permanent installation of Moroccans in the immigration countries, family reunification, naturalisation, integration, ageing, and the succession of generations living abroad. Is this fear of remittance shortage justified? I answer this question by allowing a reduction in the number of migrants expected to remit. This shock, called SIM1, consists of a 20% rise in the erosion rate of the first and second generation of migrants, χ_1 and χ_2 . As long as this fear of remittance scarcity is economically approved, what would be the best policies in order to take profit from current flows? According to Hamdouch (2000), this could be done by channelling remittances away from real estate to productive sectors in order to guarantee the conditions for a sustainable growth. Another option consists of reducing international transfer costs in order to increase the value of remittances received by the economy. SIM2 gives the impact of a 50% drop in the proportion of remittances invested in real estate, represented by the parameter *estate*. SIM3 represents a 20% drop in international transfer costs *tc*. Finally, according to the FEMISE Research Project (2004), the Moroccan government should remedy to the slow bureaucratic system and widespread lack of transparency that hamper migrants' intention to invest. In this context, government's policies to ameliorate the investment climate also affect the country risk premium perceived by domestic and foreign investors. Consequently, I run an additional simulation, SIM4, consisting of a 10% drop in the country risk premium perceived by foreign and domestic investors ϵ_1 and ϵ_2 .

Table 3: **Alternative Simulations**

Item	Scenario Definitions
SIM1	Remittance Slowdown: 20% rise in χ_1 and χ_2 , the erosion rates of migrant generations
SIM2	Remittance Investment in Productive Sectors: 50% drop in <i>estate</i> , the proportion of remittances invested in real estate
SIM3	Lower Transfer Costs: 20% drop in international transfer costs <i>tc</i>
SIM4	Better Investment Climate: 10% drop in ϵ_1 and ϵ_2 , the country risk premium perceived by foreign and domestic investors

Before displaying the results of the above simulations, let me recall that in dynamic models, the economy grows between periods even without a policy shock due to the updating mechanisms of the first period exogenous variables. This growth path of the economy in the absence of any shock is called "Business As Usual" (BAU). In this model, updating procedures were added for public investment in infrastructure, public expenditures, the stock of foreign and domestic

public debt, migrant stocks, population and capital stock. How does the economy react to these mechanisms over periods?

The growing population induces a rise in rural and urban households' consumption that affects positively the demand addressed to sectors. Given that other things are equal, prices increase in order to equilibrate the markets. Firms are thus incited to produce more. This is translated in a higher economic growth (Table 4). The additional demand for labour creates a pressure on rural and urban labour markets. Rural wage adjust upward in order to balance rural labour market. Surprisingly, unemployment increases in urban areas, in spite of higher labour demand. Indeed, urban population grows not only accordingly to the population natural growth rate but also due to internal migration from rural areas. In other words, labour supply growth exceeds the increase in labour demand so that unemployment rises. The wage curve insures that real urban wage decreases following the rise of unemployment. Furthermore, the increasing prices raise the value of intermediary consumption by sector. Given that labour remuneration is improved and that capital is sector-specific, capital remuneration decreases *ceteris paribus*. In sum, total factor remuneration increases over the first periods in rural areas, inducing a rise in rural household income. However, rural household welfare¹¹ decreases by about 5% of his consumption budget due to higher prices. Despite the lower remuneration of urban labour and capital, urban household income also grows. Indeed, urban household receives interest payments on his lending to the government. Given that other things are equal, the government borrows more in order to meet its investment in infrastructures. This results in higher interest payments to urban household and firms. Urban household welfare increases by about 2% of their consumption budget.

The increasing rural wage dampens migration intentions. On the contrary, urban individuals are forced to leave the country. Additional migration of urban individuals helps reduce migration costs due to the increased network effect. Besides, urban household is expected to receive a higher amount of remittances, contrary to rural household. This is not the case here because remittances are motivated by altruism. It happens that rural household's real disposable income declines, encouraging rural migrants to remit more in order to support their family left behind. The total amount of remittances grows, inducing an appreciation of the real exchange rate. On the one hand, the appreciated real exchange rate hampers exports. On the other hand, it lowers the price of the foreign good in domestic currency and promotes imports. While the exchange rate appreciation should stimulate FDI due to profit repatriation, the diminishing rental rate of capital impedes FDI flows in almost all sectors. Domestic investment also decreases for the same reason.

Gross fixed capital formation, public debt and public savings remain constant, as a percentage of GDP. Current account is also fixed. Then, the BAU growth

¹¹Households' welfare is given by the equivalent variation (Equation 120 in Appendix 3).

path could be considered as a status quo. After the shock, the economy will have another growth path due to the simultaneous effect of the shock and the updating mechanisms of the first period exogenous variables. Consequently, the analysis should be done with respect to the BAU growth path. In other words, the value of a given variable at period t after the shock should be compared to its value at period t before the shock.

4.1 SIM1: Remittance Slowdown

A 20% rise in the erosion rate of migrant stocks has its first immediate impact on household income. When migrant stock is eroded, fewer rural and urban migrants will remit in the following period, leading, *ceteris paribus*, to a drop in rural and urban households' income (Table 5). In addition, a part of remittances enters households' total savings and helps funding the domestic public debt. Since the amount of money remitted decreases, the government will be less able to borrow domestically and thus will have to pay a smaller amount of interest rates to the urban household and firms¹². Consequently, urban household income decreases after the simultaneous drop of remittances and interest rates received from the government. Given this evolution of households' income, it is not surprising to see households' consumption budget and welfare reduced. Rural and urban households' welfare maximum decreases with respect to the BAU growth path at the last period, respectively by 0.64% and 0.85% of their consumption budget. If all prices remain constant with respect to the BAU growth path, households will consume less goods and services, inducing *ceteris paribus* a drop in total internal demand addressed to each industry. Producers should reduce their production in order to meet the falling demand.

Since the proportion of remittances not consumed is saved and channelled to investment, one should expect, after the fall in the number of migrants who remit, a drop in domestic investments by destination of all sectors. However, domestic investments becomes more profitable in some sectors because, as it will be shown later, the domestic rental rate of capital rises with respect to the investment aggregate price (agriculture, mining industry, textile and clothing, leather industry, chemistry, rubber and plastic, metallurgy, radios and TV, medical instruments, manufacture of other transport means). In these sectors, domestic investment increases, and consequently the volume of production, in spite of the drop in domestic demand addressed to them. But finally, the overall economic activity slows down with respect to the BAU growth path. On the one hand, the contraction of the overall urban activity induces a drop of urban labour demand. Consequently, urban unemployment rate increases, inducing a drop in urban real wage. On the other hand, the expansion of the agricultural sectors stimulates rural labour demand. Rural wage adjusts upward in order to balance the market.

¹²I recall that in Morocco, only urban households and firms lend the government (Abdelkhalek and Zaoujal, 2004).

Table 4: The BAU Growth Path

	t+1	t+5	t+10	t+15	t+20
Economic growth					
Real GDP at factor cost	0,00	1,47	3,46	4,71	5,13
Real GNP	0,00	4,99	10,07	15,09	20,16
Real wage					
Rural	0,00	11,84	14,39	13,76	10,76
Urban	0,00	-1,15	-1,47	-1,85	-2,64
Unemployment					
	0,00	26,12	40,94	52,64	62,53
Migration flows					
Rural	0,00	-12,01	-13,68	-13,42	-11,61
Urban	0,00	29,12	63,28	94,68	128,02
Internal	0,00	-40,04	-53,42	-59,02	-61,59
Migration costs	0,00	-30,78	-53,28	-66,84	-75,59
Households' real disposable income					
Rural	0,00	2,14	1,51	-0,08	-2,54
Urban	0,00	1,50	2,98	3,73	3,59
Remittances					
To rural household	0,00	7,94	22,95	40,04	62,84
To urban household	0,00	0,69	2,47	4,61	6,25
External trade					
Total export volume	0,00	-5,13	-9,19	-15,92	-25,80
Total import volume	0,00	4,69	6,73	7,51	7,26
Real exchange rate	0,00	-2,18	-2,32	-2,16	-1,77
Total investment volume					
Average rental rate of capital	0,00	-6,28	-10,31	-14,15	-18,12
FDI	0,00	-0,02	-0,05	-0,08	-0,12
Domestic investment	0,00	-5,82	-12,64	-21,81	-32,68

Notes: Percentage change with respect to the base year.

Source: Author's calculations.

Remittances to Morocco are computed in the BoP as current transfers. Since external savings are constant for a given period, the drop in remittances should be compensated by a decrease of the payments to the Rest of the World. Therefore, a depreciation of the real exchange rate is necessary. On the one hand, the depre-

ciated real exchange rate boosts exports. On the other hand, it raises the price of imports in domestic currency and thus affects upward the composite price of tradable goods. This results in higher consumer price indexes in rural and urban areas. Domestic agents prefer then to rely on domestic products. Total import volume decreases. It happens that the above-expanding sectors compete the most with imports. Therefore, when imports become more expensive, domestic agents consume mostly domestic products and sectors that initially highly compete with imports expand.

The rise in rural consumer price index decreases rural real wage. The depreciated exchange rate also raises the wage of international migrants in domestic currency. With the exchange rate depreciation and the wage drop, rural and urban people are motivated to migrate. At each period, the network effect increases with the accumulation of migrant flows and reduces migration costs. This further stimulates migration in the following period. Despite the increase of migration flows, the total value of remittances continues to shrink because at each period, fewer migrants are supposed to remit.

The exchange rate depreciation reduces the value of repatriated profits and consequently discourages FDI. After few periods, the increasing domestic investment in some of the above sectors (agriculture, leather industry, rubber and plastic, metallurgy) is more than compensated by falling FDI. In total, the aggregate volume of capital invested in these sectors decreases. Given that other things are equal, the initially expanded sectors shrink. In sum, it turns out that the drop in capital invested in the different sectors is higher than the fall in labour demand so that the marginal productivity of capital, and *ceteris paribus* the return on capital, increases.

The segmentation of the savings market better draws the allocation of investment between sectors, by allowing different types of savings to finance different investments. While domestic investment is driven by the differential between the sectoral rental rate of capital and the aggregate price of investment, foreign investment is triggered by the differential between the domestic and international rental rate of capital, and public investment is exogenous because it stems from a public decision. Therefore, there is no reason at all to have the same evolution for these different types of investments with respect to the BAU growth path. Domestic investment could be rising in some sectors and foreign investment decreasing due to the nominal exchange rate depreciation (such as agriculture, textile and clothing, chemistry, rubber and plastic, metallurgy, manufacture of other transport means). Therefore, the evolution of total investment in these sectors is ambiguous: it depends on the magnitude of each investment flow. The results show that the change in domestic investment outweighs the change in foreign investment. Without a segmentation of the savings market, investment by destination of all sectors will have the same determinants and the results will absolutely be different from above because investment determines the volume of capital used in the production process and, *ceteris paribus*, the volume of pro-

duction. Depending on the evolution of the production in the different sectors, the economy will grow or shrink, affecting the demand for labour and factor remuneration.

Table 5: **SIM1: Remittance Slowdown**

	t+1	t+5	t+10	t+15	t+20
Economic growth					
Real GDP at factor cost	0.00	-0.04	-0.13	-0.27	-0.46
Real GNP	0.00	-0.08	-0.17	-0.29	-0.41
Real wage					
Rural	0.00	-0.03	-0.15	-0.32	-0.54
Urban	0.00	-0.04	-0.07	-0.10	-0.17
Unemployment					
	0.00	0.24	0.31	0.42	0.55
Migration flows					
Rural	0.00	0.42	0.75	1.01	1.29
Urban	0.00	0.71	1.15	1.55	2.01
Internal	0.00	-0.24	-0.17	-0.05	0.05
Migration costs	0.00	-0.06	-0.30	-0.58	-0.88
Households' real disposable income					
Rural	0.00	-0.31	-0.65	-0.99	-1.33
Urban	0.00	-0.32	-0.59	-0.85	-1.13
Remittances					
To rural household	0.00	-3.05	-5.24	-6.28	-6.49
To urban household	0.00	-2.77	-4.12	-4.37	-4.01
External trade					
Total export volume	0.00	0.40	0.93	1.16	1.21
Total import volume	0.00	-0.42	-0.73	-1.04	-1.37
Real exchange rate	0.00	0.28	0.42	0.53	0.64
Total investment volume					
Average rental rate of capital	0.00	0.04	0.22	0.47	0.59
FDI	0.00	-0.55	-0.85	-1.18	-1.59
Domestic investment	0.00	-0.30	-0.61	-1.02	-1.55

Notes: Percentage change with respect to the BAU growth path.

Source: Author's calculations.

4.2 SIM2: Remittance Investment in Productive Sectors

As mentioned earlier, the proportion of remittances invested in real estate is considered exogenous because the main purpose of sending money to Morocco is to support the family left behind and/or to build a large new house offering the family more convenient living, privacy and safety that were virtually absent in traditional dwellings (de Haas, 2003; FEMISE, 2004). This means that investment in real estate is driven by altruistic motives and not by profitability, like investment in other sectors. Real estate absorbs 80% of investments by MRA in their country of origin. However, Hamdouch (2000) noticed a change in the investment intentions of the migrants interviewed, who plan to accord, from now on, only 36% of their investment projects to real estate, mainly because they have intensively invested in real estate. How does this change in MRA's investment behaviour affect the Moroccan economy?

A 50% drop in the proportion of remittances invested in real estate should raise the proportion of remittances going to productive sectors and thus, domestic investment in productive sectors. Given that other things are equal, this should lead to a contraction of the construction sector and to an expansion of the productive sectors. Surprisingly, the vast majority of productive sectors shrink, negatively affecting the overall economic activity (Table 6). But this does not look odd anymore when one looks deeply to the structure of the construction sector: intermediary consumption accounts for 66% of the production value. So, when investment is reduced, inducing *ceteris paribus* a contraction of this sector, producers cut their consumption of intermediary inputs, given the existing complementarity between production and intermediary consumption. Thus, internal demand addressed to the different sectors decreases, and producers choose to restrain their production. Only the following sectors (agriculture, food industry, editing and reproduction, furniture and non financial services) are not affected because they offer no or little intermediary inputs to the real estate sector.

The expanding sectors increase rural and urban labour demand. This causes rural wage to rise and urban unemployment rate to fall in order to balance rural and urban labour markets. The wage curve guarantees that real urban wage increases following the lower unemployment rate. Given that capital is sector-specific, the lower labour demand in the contracted sectors induces a drop in the marginal productivity of capital, and *ceteris paribus* a fall in the rental rate of capital that negatively affects overall capital remuneration. The downward evolution of capital remuneration reduces rural household income, consumption budget and welfare. Welfare deterioration with respect to the BAU growth path reaches -0.68% of rural household's consumption budget. However, urban household income rises and his welfare maximum improves at period 6 by 0.08% of his consumption budget. Lower consumption further depresses the demand addressed to the different sectors, whatever the goods are imported or produced domestically. Given that other things are equal, producers lower their prices. After some periods, agriculture is also affected by the diminishing consumption.

Labour demand decreases in rural areas and rural wage falls in order to equilibrate the market. Later on, the initially expanding urban sectors are touched as well. Urban labour demand then decreases and unemployment increases. Real urban wage falls, as expected. Now, urban household income also decreases with respect to the BAU growth path, and so does his welfare. Welfare deterioration reaches 0.21% of his consumption budget at the final period.

Migration intentions to foreign countries are dampened with the wage improvement. When fewer people migrate, in comparison with the BAU growth path, the network effect is lessened and migration becomes more expensive. This further discourages international migration. However, since internal migration costs are supposed constant, the wage differential between rural and urban areas stimulates internal migration. Although lower migration is expected to reduce the amount of money remitted, this is only true, over some periods, for urban household. Indeed, in accordance with the altruistic motive, rural migrants remit a greater amount of remittances because rural household's real disposable income falls. But in sum, the total amount of remittances increases, inducing an appreciation of the real exchange rate in order to maintain external savings fixed. The competitiveness of local producers on international markets is thus deteriorated. While one expects that the exchange rate appreciation would have a stimulating effect on FDI, the results show that this positive effect is counterbalanced by the detrimental role of a lower rental rate of capital on FDI intentions in the different sectors.

The predictions of this shock are unexpected. Scholars think that the allocation of migrant investment to productive sectors should promote economic growth by allowing a better productivity growth. However, it appears that there is a strong demand effect that comes into play. This demand effect is related to the linkages that transmit the negative impact of a particular shock on the production and thus intermediary consumption of the real estate sector to the other ones.

4.3 SIM3: Lower Transfer Costs

As showed in section 2, the cost and delay of transfers are high. I evaluate here the impact of a 20% drop in international transfer costs and look if this could constitute a good opportunity to take the maximum profit from remittances before their long-term downward evolution.

When transfer costs decrease, households receive a larger value of remittances with respect to the BAU growth path, that increases their income, consumption budget and welfare (Table 7). Welfare improvement is maximum at the last period, reaching 0.16% of the consumption budget for rural household and 0.2% for urban household.

Table 6: **SIM2: Remittance Investment in Productive Sectors**

	t+1	t+5	t+10	t+15	t+20
Economic growth					
Real GDP at factor cost	0.00	-0.13	-0.39	-0.69	-1.01
Real GNP	0.00	-0.09	-0.28	-0.48	-0.67
Real wage					
Rural	0.00	0.00	-0.11	-0.32	-0.62
Urban	0.00	0.05	0.04	0.01	-0.03
Unemployment					
	0.00	-0.51	-0.44	-0.11	0.30
Migration flows					
Rural	0.00	-0.30	-0.65	-0.91	-1.18
Urban	0.00	-0.71	-1.23	-1.31	-1.27
Internal	0.00	0.47	0.83	1.01	1.18
Migration costs	0.00	0.04	0.29	0.56	0.78
Households' real disposable income					
Rural	0.00	-0.03	-0.15	-0.32	-0.50
Urban	0.00	0.06	-0.02	-0.16	-0.26
Remittances					
To rural household	0.00	0.08	0.43	0.96	1.53
To urban household	0.00	-0.34	-0.51	-0.33	0.04
External trade					
Total export volume	0.00	-0.13	-0.57	-1.32	-2.39
Total import volume	0.00	-0.15	-0.43	-0.74	-1.00
Real exchange rate	0.00	-0.20	-0.39	-0.55	-0.76
Total investment volume					
Average rental rate of capital	0.00	-0.29	-0.69	-1.09	-1.49
FDI	0.00	-0.26	-0.61	-0.99	-1.33
Domestic investment	0.00	0.17	0.16	0.02	-0.09

Notes: Percentage change with respect to the BAU growth path.

Source: Author's calculations.

Furthermore, as long as a fraction of remittances is invested, the drop in transfer costs should, *ceteris paribus*, boost domestic investment in all sectors, and mostly in real estate. However, domestic investment by destination of some sectors shrinks (agriculture, mining industry, textile and clothing, leather and

shoes industry, chemistry, rubber industry, metallurgy, machines and equipment, radios and TV, medical instruments and manufacture of other transport means) because the rental rate of capital in these sectors decreases with respect to the aggregate price of investment. At the next period, the volume of capital follows, *ceteris paribus*, the evolution of domestic investment. When it rises, the corresponding sectors produce more and vice versa. Since the majority of sectors expand, the GDP grows, dragging in its way the GNP.

Producers ask for additional rural and urban labour. Thus, rural wage adjusts upward in order to balance rural labour market. In urban areas, unemployment decreases and the wage curve insures that real urban wage increases. Therefore, migration flows are dampened. The network effect is then reduced, inducing a rise in migration costs. Moreover, when the economy receives a larger amount of remittances, an appreciation of the real exchange rate is necessary in order to increase the payments to the Rest of the World and maintain external savings constant. The exchange rate appreciation reduces the value of the international wage in domestic currency and besides higher migration costs, further discourage international migration. Fewer people migrate, and the less will be the amount of remittances in the following period.

On the one hand, the real exchange rate appreciation restrains export competitiveness on international markets, inducing a drop in total export volume. On the other hand, it decreases the relative price of imports in domestic currency, and thus encourages domestic agents to consume cheaper imported products. It happens that the above-contracted sectors compete the most with imports. Given that other things are equal, producers facing lower internal demand are obliged to reduce their sales. The contracted sectors release labour, and given that the capital is sector-specific, the marginal productivity of capital and, *ceteris paribus*, the rental rate of capital go down. This explains the drop of investment by destination of these sectors.

FDI, triggered by the differential between the domestic and international return on capital, is more profitable in almost all sectors (in comparison with the BAU growth path) due to the real exchange rate appreciation. This is however not the case of domestic investment that rises only in some sectors. Therefore, the total volume of capital invested in each sector depends on the magnitude of each kind of investment financed by different sources of savings. This is how our assumption about a segmentation of the savings market affects the result.

Now, should transfer costs be reduced in the short run? What about the effect of a late implementation of this measure? I answer this question by simulating an additional shock, SIM3B, that explores the simultaneous impact of permanent migration and lower international transfer costs, i.e the combination of SIM1 and SIM3 (Table 8). I find that permanent migration reduces the positive effect of lower transfer costs on household income. Rural and urban households' income

Table 7: **SIM3: Lower Transfer Costs**

	t+1	t+5	t+10	t+15	t+20
Economic growth					
Real GDP at factor cost	0.02	0.04	0.07	0.11	0.14
Real GNP	0.04	0.05	0.07	0.09	0.11
Real wage					
Rural	0.01	0.04	0.08	0.11	0.15
Urban	0.03	0.01	0.02	0.02	0.03
Unemployment					
	-0.22	-0.10	-0.11	-0.13	-0.15
Migration flows					
Rural	0.00	-0.18	-0.18	-0.19	-0.21
Urban	0.00	-0.27	-0.26	-0.31	-0.36
Internal	0.00	0.03	-0.03	-0.05	-0.05
Migration costs	0.00	0.07	0.13	0.18	0.22
Households' real disposable income					
Rural	0.14	0.15	0.18	0.21	0.25
Urban	0.16	0.15	0.17	0.21	0.24
Remittances					
To rural household	-0.59	-0.69	-0.86	-1.02	-1.19
To urban household	-0.66	-0.73	-0.91	-1.09	-1.29
External trade					
Total export volume	-0.11	-0.19	-0.17	-0.12	-0.05
Total import volume	0.23	0.16	0.19	0.22	0.26
Real exchange rate	-0.18	-0.08	-0.07	-0.08	-0.08
Total investment volume					
Average rental rate of capital	0.04	-0.04	-0.09	-0.09	-0.15
FDI	0.36	0.18	0.21	0.26	0.32
Domestic investment	0.16	0.15	0.21	0.28	0.36

Notes: Percentage change with respect to the BAU growth path.

Source: Author's calculations.

increase over the first periods by less than SIM3 and so does households' consumption budget. Households' demand motivates producers to adjust upward their production and this promotes economic growth. Economic performance is however inferior to the one obtained when SIM3 is ran alone. Nonetheless, after

some periods, the negative effect of permanent migration on the amount remitted compensates the positive effect of lower transfer costs. On the BoP level, the drop in the amount remitted induces a depreciation of the real exchange rate that encourages exports and discourages more expensive imports. It also dampens FDI because of lower profit repatriation. On the household level, decreasing remittances reduce households' income and welfare. On the one hand, private consumption decreases. On the other hand, domestic investment financed by remittances falls. Producers adjust their production downward in order to meet the lower demand. But the slowdown of economic activity is lower than SIM1. Wages decrease following the falling demand for labour and people are motivated to leave the country. In short, if this option should be undertaken, this has to be done before the slowdown of remittances.

4.4 SIM4: Better Investment Climate

There is a widespread perception that migrants might invest in their country of origin if they possessed the necessary information and were encouraged to do so. The increased allocation of remittances for private investment could then contribute to sustained and higher economic growth. In this regard, measures to enhance the investment climate characterised by a slow bureaucratic system and widespread lack of transparency (FEMISE, 2004) should help. Such measures influence the country risk premium. Its improvement can perfectly reflect the policies adopted by the government in order to attract investments. For this reason, I assess the impact of a 10% drop in the country risk premium perceived by domestic investors. As pointed out earlier, the risk premium perceived by local investors is lower than the one perceived by foreign investors because the formers are more familiar with investment procedures and business atmosphere in their country. However, when the country risk premium perceived by local investors is improved, foreigners will also have a better perception of the investment climate that should trigger foreign investment.

As expected, foreign and domestic investors have greater confidence in investment: this is reflected by a simultaneous increase of domestic and foreign investments in comparison with the BAU growth path (Table 9). Given that other things are equal, the capital used in the production of all sectors rises in the next period. The production follows, *ceteris paribus*, the evolution of the capital volume. This is translated in higher GDP and GNP. Since domestic producers offer their production on local and international markets, the production growth should be reflected in increased exports and local supply. A depreciation of the real exchange rate is therefore necessary to guarantee the competitiveness of local producers on international markets and stimulate exports. I recall that export expansion increases total factor productivity growth in the corresponding sectors. Imports also increase in order to maintain external savings fixed.

Rural and urban labour demand increase with the expansion of rural and ur-

Table 8: **SIM3B: Remittance Slowdown and Lower Transfer Costs**

	t+1	t+5	t+10	t+15	t+20
Economic growth					
Real GDP at factor cost	0.02	0.00	-0.06	-0.17	-0.32
Real GNP	0.04	-0.04	-0.10	-0.20	-0.30
Real wage					
Rural	0.01	0.01	-0.07	-0.21	-0.39
Urban	0.03	-0.03	-0.05	-0.08	-0.13
Unemployment					
	-0.22	0.15	0.20	0.29	0.40
Migration flows					
Rural	0.00	0.24	0.57	0.83	1.08
Urban	0.00	0.45	0.90	1.24	1.65
Internal	0.00	-0.21	-0.20	-0.09	0.00
Migration costs	0.00	0.02	-0.17	-0.41	-0.67
Households' real disposable income					
Rural	0.14	-0.17	-0.48	-0.79	-1.09
Urban	0.16	-0.18	-0.42	-0.65	-0.90
Remittances					
To rural household	-0.59	-3.71	-6.04	-7.21	-7.58
To urban household	-0.66	-3.47	-4.98	-5.41	-5.24
External trade					
Total export volume	-0.11	0.22	0.70	1.01	1.17
Total import volume	0.23	-0.26	-0.55	-0.82	-1.12
Real exchange rate	-0.18	0.21	0.35	0.45	0.55
Total investment volume					
Average rental rate of capital	0.04	0.00	0.13	0.37	0.49
FDI	0.36	-0.38	-0.64	-0.93	-1.28
Domestic investment	0.16	-0.15	-0.41	-0.75	-1.20

Notes: Percentage change with respect to the BAU growth path.

Source: Author's calculations.

ban sectors. Rural wage rises, as expected in order to balance rural labour market. In urban areas, unemployment falls and real urban wage rises, as predicted by the wage curve. While one should expect a drop in international migration from rural and urban areas after the increase in rural and urban wages, it seems

that the exchange rate depreciation counterbalances the downward effect of wage improvement on migration intentions. However, this is only true over the first periods. Later on, international migration flows decrease. The network effect strengthens with migrant number and is inversely related to migration costs. Internal migration is dampened, as expected. The growing labour demand rises the marginal productivity of capital, and *ceteris paribus*, capital remuneration. This further encourage FDI and domestic investment. Households' income and welfare increases following the improvement of labour and capital remuneration. Welfare improvement is the greatest here, reaching respectively about 2% and 1.55% of rural and urban households' consumption budget at the last period. Since remittances are motivated by altruism, migrants remit a smaller amount.

The improvement of the risk premium reduces the possibilities for the government to borrow domestically by channelling a part of local savings to investment. But the government's investment objective in infrastructures is met thanks to the improvement of public savings. Indeed, the amount of direct taxes and imports tariffs collected by the government induces a rise in public savings. This leads to a downward adjustment of indirect taxes in order to keep the ratio of government savings to GDP fixed.

I should also point out that this policy needs to be settled before the cut down in remittances. Indeed, I run SIM4B that is a combination of SIM1 and SIM4 (Table 10) and find that permanent migration reduces the economic performance due to the improvement of the country risk premium, because permanent migration is translated in lower remittances, and thus, lower domestic investment. It also reduces households' welfare with respect to SIM4: permanent migration causes a negative economic growth that induces a lower labour demand. Consequently, wages fall down in comparison to SIM4, dragging in their way households' income and welfare. The economy receives now a smaller amount of remittances because of permanent migration (SIM1) and the altruistic motive (SIM4). Therefore, the real exchange rate depreciates more in order to maintain external savings fixed. On the one hand, the real exchange rate depreciation further boosts exports. On the other hand, it raises the price of imported products in domestic currency. This is translated in higher composite prices of tradable goods. Real urban wage decreases because the wage increase is more than compensated by the growth of the urban consumer price index.

5 Conclusion

This paper tackles a debatable issue regarding the impact of remittances on the Moroccan economy. Policy makers in less developed as well as developed countries have implicitly assumed that remittances benefit the country of origin. Morocco has even used these possible benefits to underpin its emigration policy. But now, this is not the main question. Surveys on Morocco showed that remittances have

Table 9: SIM4: Better Investment Climate

	t+1	t+5	t+10	t+15	t+20
Economic growth					
Real GDP at factor cost	0.00	0.49	1.12	1.67	2.12
Real GNP	0.00	0.22	0.68	1.05	1.29
Real wage					
Rural	0.00	0.60	1.14	1.64	2.09
Urban	0.00	0.00	0.00	0.04	0.10
Unemployment					
	0.00	-0.65	-1.64	-2.22	-2.47
Migration flows					
Rural	0.00	0.34	0.13	-0.03	-0.01
Urban	0.00	0.43	-0.64	-1.50	-1.93
Internal	0.00	-0.84	-0.77	-0.81	-0.97
Migration costs	0.00	-0.16	-0.16	0.05	0.33
Households' real disposable income					
Rural	0.00	0.38	0.78	1.12	1.37
Urban	0.00	0.21	0.62	0.92	1.11
Remittances					
To rural household	0.00	-1.47	-3.06	-4.43	-5.48
To urban household	0.00	-0.61	-2.46	-4.18	-5.48
External trade					
Total export volume	0.00	1.23	2.89	4.89	7.27
Total import volume	0.00	-0.01	0.46	0.81	0.93
Real exchange rate	0.00	0.35	0.36	0.39	0.52
Total investment volume					
Average rental rate of capital	0.00	0.09	0.31	0.66	1.08
FDI	2.73	3.28	4.00	4.59	4.96
Domestic investment	1.56	2.52	3.67	4.64	5.45

Notes: Percentage change with respect to the BAU growth path.

Source: Author's calculations.

most of the time been beneficial. The question is how to take the maximum profit from this external source of funding in a way to enhance the development of this country and cushion its transition to be gradually less dependent on remittances.

Table 10: SIM4B: Permanent Migration and Better Investment Climate

	t+1	t+5	t+10	t+15	t+20
Economic growth					
Real GDP at factor cost	0.00	0.45	0.99	1.40	1.67
Real GNP	0.00	0.14	0.52	0.77	0.89
Real wage					
Rural	0.00	0.56	1.00	1.33	1.57
Urban	0.00	-0.07	-0.06	-0.06	-0.06
Unemployment					
	0.00	-0.41	-1.34	-1.83	-1.94
Migration flows					
Rural	0.00	0.75	0.85	0.94	1.21
Urban	0.00	1.14	0.46	-0.05	-0.06
Internal	0.00	-1.08	-0.93	-0.85	-0.92
Migration costs	0.00	-0.21	-0.45	-0.51	-0.51
Households' real disposable income					
Rural	0.00	0.07	0.14	0.15	0.06
Urban	0.00	-0.11	0.05	0.09	0.00
Remittances					
To rural household	0.00	-4.50	-8.21	-10.56	-11.81
To urban household	0.00	-3.37	-6.56	-8.55	-9.53
External trade					
Total export volume	0.00	1.63	3.77	6.04	8.53
Total import volume	0.00	-0.42	-0.24	-0.19	-0.39
Real exchange rate	0.00	0.63	0.76	0.89	1.12
Total investment volume					
Average rental rate of capital	0.00	0.09	0.54	1.12	1.67
FDI	2.73	2.71	3.16	3.42	3.38
Domestic investment	1.56	2.23	3.06	3.64	3.90

Notes: Percentage change with respect to the BAU growth path.

Source: Author's calculations.

This paper fills the gap in the Moroccan literature on remittances by assessing the impact of remittances and their alternative uses. In this sense, it differs from the work on Morocco that consists of surveys and studies on particular regions. It also adds to the literature on MENA countries that have been generally ruled out

in this context, in spite of their high dependency on remittances. The main contribution of this paper is to model a segmentation of the savings market, where remittances do not finance the same sectors as domestic investment or FDI. This is supposed to better draw the reality since different sources of investment do not have the same determinants and affect differently the sectors of destination.

The fear from the cut down of remittances seems to be justified. The overall economic growth and households' welfare are reduced. I use a dynamic CGE model of the Moroccan economy, calibrated on the SAM of the year 1998, to investigate policies allowing to take the best profit from current remittance flows. I simulate the effects of a 50% drop in the proportion of remittances invested in real estate, a 20% drop in transfer costs and a 10% drop in the country risk premium perceived by investors. Nonetheless, not all the policies proposed by surveys are advantageous. Surprisingly, it turns out that the drop of the proportion of remittances invested in real estate reduces economic growth and welfare. Indeed, the linkages between construction and other sectors appear to be important so that a negative shock on real estate production also affects others sectors through a drop in intermediary demand addressed to them. Lower transfer costs and the improvement of the country risk premium both lead to an overall activity growth and to welfare improvement, still more pronounced in the second case.

References

- [1] Abdelkhalek, T. and N. Zaoujal (2004), Une Matrice de Comptabilité Sociale de l'Economie Marocaine Base 1998 : Cadre Comptable d'un MCEG Micro Simulé, *Cahiers de recherche de l'équipe MIMAP-Maroc*, INSEA, Rabat.
- [2] Adams, R.Jr. (1991), The Effects of International Remittances on Poverty, Inequality and Development in Rural Egypt, *Research Report No. 96*, International Food Policy Research Institute, Washington D.C.
- [3] Adams, R.Jr. (1998), Remittances, Investment, and Rural Asset Accumulation in Pakistan, *Economic Development and Cultural Change*, **47(1)**, 155-173.
- [4] Adams, R.Jr. (2006), Remittances, Poverty, and Investment in Guatemala, in *International Migration, Remittances and the Brain Drain*, The World Bank, Washington D.C.
- [5] Agénor, P.R. and K. El Aynaoui (2003), Labour Market Policies and Unemployment in Morocco: A Quantitative Analysis, *Policy Research Working Paper Series 3091*, The World Bank, Washington D.C.
- [6] Ahlburg, D.A. (1996), Remittances and the Income Distribution in Tonga, *Population Research and Policy Review*, **15(4)**, 391-400.

- [7] Barendse, J., C. Hiddink, A. Janzsen and A. Stavast (2006), The Remittance Corridor the Netherlands-Morocco: Review of Obstacles and Recommendations on How to Increase the Use of the Bank Channel, *mimeo*.
- [8] Berriane, M. (1996), Migration Internationale et Extension du Cadre Bâti: Le Cas des Villes du Maroc Nord, *mimeo*.
- [9] Bijaad, H. (1987), Conséquences Socio-Economiques des Migrants Maghrébins de Retour: Enquête dans la région Sud du Maroc, Doctoral dissertation, Aix-Marseille University.
- [10] Bouhga-Hagbe, J. (2004), A Theory of Workers' Remittances With an Application to Morocco, *IMF Working Paper WP/04/194*, IMF International Monetary Fund, Washington D.C.
- [11] Bouchachen, J. (2000), Apports des Transferts des Résidents à l'Etranger à la Réduction de la Pauvreté: Cas du Maroc, Paper presented at the seminar "Statistique, développement et droits de l'homme", Montreux, 4-8 September.
- [12] Bourguignon, F., W.H. Branson and J. de Melo (1989), Macroeconomic Adjustment and Income Distribution: A Macro-Micro Simulation Model, *Technical paper No. 1*, OECD, Paris.
- [13] Brooke, A., D. Kendrick and A. Meeraus (1988), GAMS: A user's guide, Scientific Press, Redwood City, CA.
- [14] Chami, R., C. Fullenkamp and S. Jahjah (2005), Are Immigrant Remittance Flows a Source of Capital for Development?, *IMF Staff Papers*, **52(1)**, International Monetary Fund, Washington D.C.
- [15] Cockburn, J., B. Decaluwé, I. Fofana and V. Robichaud (2006), Un Modèle Standard d'Equilibre Général Calculable pour l'Analyse de l'Impact des Politiques Economiques, *mimeo*.
- [16] Dalen, H.P. van, G. Groenewold and T. Fokkema (2005), The Effect of Remittances on Emigration Intentions in Egypt, Morocco and Turkey, *Population Studies*, **59(3)**, 375-392.
- [17] Decaluwé, B., A. Martens and L. Savard (2001), La Politique Economique du Développement et les Modèles d'Equilibre Général Calculable, Les Presses de l'Université de Montréal, Montréal.
- [18] Erf, R. and L. Heering (2002), Moroccan Migration Dynamics: Prospects for the Future, *IOM Migration Research Series No.10*, International Organisation for Migration, Geneva.
- [19] Femise Research Project (2004), A Favourable Macro-economic Environment, Innovative Financial Instruments and International Partnership to

- Channel Workers' Remittances Towards the Promotion of Local Development. Two Case Studies in Morocco and Tunisia, *Research N.FEM-21-08*, directed by Bruno Amoroso, Federico Caffè Center - Dept. of Social Sciences, Roskilde University, Denmark.
- [20] Glytsos, N.P. (1993), Measuring the Income Effects of Migrant Remittances: A Methodological Approach Applied to Greece, *Economic Development and Cultural Change*, **42(1)**, 131-168.
- [21] Haas, H. de (2003), Migration and Development in Southern Morocco. The Disparate Socio-Economic Impacts of Out-Migration on the Todgha Oasis Valley, Unpublished PhD Thesis, Radboud University, Nijmegen.
- [22] Haas, H. de (2006), Migration, Remittances and Regional Development in Southern Morocco, *Geoforum*, **37(4)**, 565-580.
- [23] Haas, H. de (2007), The Impact of International Migration on Social and Economic Development in Moroccan Sending Regions: a Review of the Empirical Literature, *Working paper 3*, International Migration Institute, University of Oxford.
- [24] Hamdouch, B. (2000), Les Marocains Résidant à l'Etranger, une Enquête Socioéconomique, INSEA, Rabat.
- [25] Karam, F. and B. Decaluwé (2008), Migration Impact on Moroccan Unemployment: a Static Computable General Equilibrium Analysis, *CES Working Papers 2008.52*, (2008), Paris School of Economics, University of Paris 1.
- [26] Lazaar, M. (1987), International Migration and its Consequences in the Central Rif (Morocco), *European Review of International Migration*, **3, 3**, 97-114.
- [27] Lazaar, M. (1989), La migration internationale de travail et ses effets sur les campagnes du Rif, *mimeo*.
- [28] Löfgren, H., M. El-Said and S. Robinson (1999), Trade Liberalization and Complementary Domestic Policies: A Rural-Urban General Equilibrium Analysis of Morocco, *TMD Discussion Paper No.41*, International Food Policy Research Institute, Washington D.C.
- [29] McKenzie, D. and H. Rapoport (2005), Migration Incentives, Migration Networks and the Dynamics of Education Inequality in Rural Mexico, presented at the "Economic Integration, Remittances, and Development" Conference, Inter-American Development Bank, Washington, DC.
- [30] Melo, J. de and S. Robinson (1990), Productivity and Externalities: Models of Export-Led Growth, *Working paper 387*, The World Bank, Washington D.C.
- [31] OCDE, Migration, Remittances and Development, Edition 2006.

- [32] Rutherford, T.F, E.E. Rutström and D. Tarr (1997), Morocco's Free Trade Agreement with the EU: A Quantitative Assessment, *Economic Modelling*, **14**, 237-269.
- [33] Rodriguez, E. (1998), International Migration and Income Distribution in the Philippines, *Economic Development and Cultural Change*, **46(2)**, 329-350.
- [34] Nyberg-Sorensen, N. (2004), Migrant Remittances as a Development Tool: The Case of Morocco, *IOM Migration Research Series No.2*, International Organisation for Migration.
- [35] Rodrigo, G.C. and E. Thorbecke (1997), Sources of Growth: A Reconsideration and General Equilibrium Application to Indonesia, *World Development*, **25(10)**, 1609-1625.
- [36] Taylor, J.E. and G. Dyer (2006), Migration and the Sending Economy: A Disaggregated Rural Economy Wide Analysis, *ARE Working Papers 06-002*, Department of Agricultural and Resource Economics, University of California, Davis.
- [37] Taylor, J.E. and T.J. Wyatt (1996), The Shadow Value of Migrant Remittances, Income and Inequality in a Household-Farm Economy, *Journal of Development Studies*, **32(6)**, 899-912.
- [38] Yang, D. and C.A. Martinez (2006), Remittances and Poverty in Migrants' Home Areas: Evidence from the Philippines, in *International Migration, Remittances and the Brain Drain*, the World Bank.

Appendix 1

Data

The SAM constitutes the empirical database required to satisfy the accounting coherence of a CGE model. I use the Moroccan SAM built by Touhami Abdelkhalek and Nouzha Zaoujal (2004) for the year 1998 from several Moroccan data sources: the Input-Output table of the Moroccan economy for 1998, built by the Direction of Statistics and published, in a preliminary version, in 2002, the National Survey on Household Living Standards in 1998-1999 (NSHLS) carried out by the Direction of Statistics, documents from the Ministry of the Economy and Finance, from External Trade department, from the Ministry of Agriculture, from Foreign Exchange department, and from Bank Al-Maghrib. The SAM gathers two factors of production (labour and capital), four types of agents (Households, Firms, Government, the Rest of the World), 34 sectors of activity that correspond exactly to those of the Input-Output table of the Moroccan economy in 1998. I further decompose the SAM in order to distinguish between rural and urban areas and take into account two categories of household: a rural household offering his working hours to rural sectors and an urban household offering his working hours to urban sectors¹³.

FDI flows are distributed between sectors according to data from the Moroccan BoP of 1998. Even though the number of sectors considered in the SAM does not match those of the BoP, the correspondence between sectors is easy to establish. The repartition of the gross fixed capital formation between aggregate sectors is derived from national accounts. The difference between total gross fixed capital formation and FDI volume gives the volume of investment by domestic agents (households, firms and the government). Public investment in infrastructure represents 3.5% of GDP (author's calculation from national accounts). In 1998, the public debt represented 89% of GDP with 51% of GDP external and 38% internal (Ministry of Finance, Rabat).

For lack of data on Moroccan emigration, I resort to the data published by the OECD in 2006 on immigrant inflows by nationality in some OECD countries. More specifically, I approximate Moroccan emigration by the flows of Moroccan migrants to their traditional destinations in 1999, such as Belgium, France, Italy, the Netherlands and Spain. The sum of these flows is reported to the Moroccan working population of 1999 in order to calculate the annual percentage of emigrants. I also use the stocks of Moroccan migrants in the previous selected countries in order to approximate the stock of migrants necessary to the adjustment of the model in the dynamic framework. In addition, according to a report

¹³For further details, see Karam and Decaluwé (2008).

of the International Organisation of Migration (Erf and Heering, 2002), Moroccan emigration towards European countries is more originated from rural areas. I suppose that 60% of the national emigration flow/stock takes place from rural areas and 40% from urban areas.

For the majority of exogenous variables, I observed their evolution over 5 or 10 years, according to data availability, and calculated their average annual growth rate. I retained respectively the following values for public expenditures and public investment in infrastructure: 2.9%, 2.3%. The rural population natural growth rate (2.6%) is taken from Agénor and El Aynaoui (2003). The urban population natural growth rate (0.8%) is based on author's calculations.

Finally, I report the values of some parameters imported from external sources: transfer costs represent 9% of the amount of the transaction (Barendse, Hiddink, Janszen and Stavast, 2006), the risk premium is fixed at 4.88% (United States Agency for International Development (USAID)) and the capital depreciation rate at 8% (Agénor and El Aynaoui, 2003). Armington and exports elasticities, respectively 2 and -5, are borrowed from the literature on Morocco (Löfgren et al., 1999; Rutherford et al., 1997).

Appendix 2

Sectoral Aggregation

AGR	Agriculture
FIS	Fishing
MII	Mining industry
FOO	Food industry
TOB	Tobacco industry
TEX	Textile industry
CLO	Clothing industry
LEA	Leather and shoes industry
WOO	Fabrication of wood and wood-based products
PAP	Paper industry
EDI	Edition, printing and reproduction
OIL	Oil refining
CHE	Chemical industry
RUB	Rubber and plastic industry
MIN	Manufacture of other non-metallic mineral products
MET	Metallurgy
MEP	Metal processing
MAC	Machines and equipment manufacturing
OFF	Office machinery
RAD	Radio and TV equipment
MED	Medical instruments manufacturing
CAR	Car industry
MTR	Manufacture of other transport means
FUR	Furniture manufacturing, other industries
ELE	Electricity and water - production and distribution
CON	Construction
TRR	Trade and repair
HOT	Hotels and restaurants
TRA	Transports and telecommunication
FIN	Financial activities and insurance
REN	Rental services
ADM	Public administration and social security
EDU	Education and health
SER	Other non financial services

Appendix 3

Mathematical Statement of the Model

Set indices are given by lower-case Latin letters as subscripts to variables and parameters. Parameters are represented with lower-case Latin letters or lower-case Greek letters, endogenous variables with upper-case Latin letters without a bar, exogenous variables with upper-case Latin letters with a bar.

Sets

$j \in J$	Sectors
$i \in I$	Products (=J)
$tr \in TR \subset J$	Tradable sectors
$ntr \in NTR \subset J$	Non-tradable sectors
$ps \in PS \subset J$	Private sectors
$pub \in PUB \subset J$	Public sectors
$pro \in PRO \subset PS$	Productive sectors
$ru \in RU \subset PS$	Rural private sectors
$up \in UP \subset PS$	Urban private sectors
$ag \in AG$	Agents
$da \in DA \subset AG$	Domestic agents
$h \in H \subset AG$	Households
$t \in T$	Time period

Parameters

α_{ps}	Share parameter of the CES value added of sector ps
σ_{ps}	Elasticity of substitution between labour and capital (positive)
l_{pub}	Labour share in public value added (Leontief)
k_{pub}	Capital share in public value added (Leontief)
io_j	Share of intermediary consumption in the production (Leontief) of sector j
v_j	Share of value added in the production (Leontief) of sector j
$aij_{i,j}$	Intermediary consumption of good i by unit of production of sector j
B_1	Scale parameter of the CET function of the rural population
ϖ_1	Share parameter of this function
ϵ_1	Elasticity of transformation between international rural migrants and national workers (negative)

B_2	Scale parameter of the CET function of the rural population that decides to stay in Morocco
ϖ_2	Share parameter of this function
ε_2	Elasticity of transformation between internal migrants and rural workers (negative)
B_3	Scale parameter of the CET function of the urban population
ϖ_3	Share parameter of this function
ε_3	Elasticity of transformation between international urban migrants and urban workers (negative)
imc	Internal migration costs
η_{ag}	Share of capital remuneration received by agent ag
ϕ_{ag}	Share of labour remuneration received by agent ag
tc	transfer costs
ϑ_{ag}	Part of interest rates on domestic public debt going to agent ag
V_{1h}	Parameter in the international remittance rate function of household h
v	Part of stock variation financed by foreign firms
$\gamma_{1,h}$	Elasticity of international remittance rate with respect to household h 's real income
$\gamma_{2,h}$	Elasticity of international remittance rate to household h with respect to the international wage
V_2	Parameter in the remittance rate function from urban to rural household
γ_3	Elasticity of internal remittance rate with respect to rural household real income
ψ_h	Household's h propensity to save
ty_h	Direct tax rate on household h 's income
tye	Direct tax rate on firms' income
tx_j	Indirect taxes on sector j products
tm_{tr}	Import tariff rate on product tr
te_{tr}	Export tariff rate on product tr
ς	Export externality (positive)
C_{1tr}	Scale parameter of the CET production function
δ_{1tr}	Share parameter of this function
κ_{1tr}	Transformation elasticity of the CET production function (negative)
φ_{tr}	Price elasticity of export demand
C_{2tr}	Scale parameter of the Armington CES function
δ_{2tr}	Share parameter of this function
κ_{2tr}	Substitution elasticity of the Armington function (positive)
$\beta_{i,h}$	Budgetary share of good i in the supernumerary income of household h
μ_i	Share of product i in total investment value
D_c	Scale parameter of the wage curve
θ_{1i}	Weight of commodity i in the consumer price index
$\theta_{2i, "hr"}$	Weight of commodity i in rural consumer price index
$\theta_{2i, "hu"}$	Weight of commodity i in urban consumer price index

θ_j	Share of sector j value added in GDP at factor cost
χ_1	Erosion rate of the first generation of migrants
χ_2	Erosion rate of the second generation of migrants
dep_{ps}	Capital depreciation rate of sector ps
D_{1ps}	Parameter in the FDI equation
D_{2ps}	Parameter in the FDI equation
ϵ_1	The country risk premium perceived by foreign investors
ϵ_2	The country risk premium perceived by domestic investors
D_{3ps}	Parameter in the equation of domestic investment by households and firms
D_{4ps}	Parameter in the equation of domestic investment by households and firms
V_3	Parameter in the international migration cost function
ν	Elasticity of international migration costs to the stock of international migrants (negative)
g_G	Growth rate of government expenditures
g_{IG}	Growth rate of public investment in infrastructure
g_{LSR}	Natural growth rate of rural population
g_{LSU}	Natural growth rate of urban population
F	Parameter in the domestic public debt function
ξ	Elasticity of domestic public debt financed by households and firms with respect to the risk factor (positive)
$cons$	Part of international remittances going to consumption
$estate$	Part of international remittances (net of the amount consumed) going to real estate

Endogenous Variables

a) Prices

wr_t	Rural wage rate
wu_t	The wage rate paid by urban private sectors
wg_t	The wage rate paid by urban public sectors
wi_t	International wage rate, in foreign currency
wn_t	National wage rate
wug_t	Average urban wage rate
wa_t	Expected urban wage rate
$r_{j,t}$	Capital return in sector j
r_t^*	International average rate of capital
$PV_{j,t}$	Value added price of sector j
$PL_{j,t}$	Producer price of local product j
$PD_{j,t}$	Market price of local product j sold on the domestic market
$P_{j,t}$	Production price of sector j
$PC_{j,t}$	Market price of the composite good belonging to sector j
$Pwm_{tr,t}$	International import price of product tr , in foreign currency

$Pwe_{tr,t}$	International export price of product tr , in foreign currency
$PM_{tr,t}$	Domestic price of the imported good tr
$PE_{tr,t}$	Producer price of the exported good tr
$Pfob_{tr,t}$	Fob price of the exported good tr
$PINV_t$	Aggregate price of investment
e_t	Nominal exchange rate (the price of a unit of foreign currency in domestic currency)
i_t	Interest rate on domestic public debt
i^*_t	Interest rate on foreign public debt
CPI_t	Consumer price index
$CPIR_t$	Consumer price index in rural areas
$CPIU_t$	Consumer price index in urban areas
$Pindex_t$	GDP deflator, numéraire

b) Production

$XS_{j,t}$	Production of sector j (volume)
$A_{ps,t}$	Export externality shift parameter in the production of sector ps
$VA_{j,t}$	Value added of sector j (volume)
$DI_{i,j,t}$	Intermediary demand of product i by sector j (volume)
$CI_{j,t}$	Total intermediary consumption of sector j (volume)

c) Factors of production

$KD_{j,t}$	Capital demand by sector j (volume)
$LDR_{ru,t}$	Labour demand by rural sector ru (volume)
$LDU_{up,t}$	Labour demand by urban private sector up (volume)
$LDG_{pub,t}$	Labour demand by public sector pub (volume)
LSR_t	Rural population
LSU_t	Urban population
u_t	Urban unemployment rate

d) Migration

NAT_t	Rural workers who decide to stay in Morocco
EMR_t	Rural emigrant flow
$NATR_t$	Rural workers who decide to stay in rural areas
MIG_t	Rural migrant flow towards urban areas
$NATU_t$	Urban workers who decide to stay in urban areas
EMU_t	Urban emigrant flow
$STKR_{1,t}$	The first generation of rural migrants
$STKU_{1,t}$	The first generation of urban migrants

$STKR_{2,t}$	The second generation of rural migrants
$STKU_{2,t}$	The second generation of urban migrants
$STKR_{3,t}$	The third generation of rural migrants
$STKU_{3,t}$	The third generation of urban migrants
$TSTK_t$	Total stock of international migrants
$ISTK_t$	Stock of internal migrants from rural to urban areas
MC_t	International migration costs

e) **Income/Savings**

$Y_{ag,t}$	Agent ag 's income
$YWR_{h,t}$	Income of household h , excluding remittances
$YD_{h,t}$	Disposable income of household h
$YDWR_{h,t}$	Disposable income of household h , excluding remittances
$PROF_t$	The proportion of capital remuneration repatriated by foreign firms
$S_{ag,t}$	Agent ag 's savings
$T_{ag,ag,t}$	Transfers between agents
$RR_{h,t}$	Remittance rate to household h
IR_t	Internal remittance rate from urban to rural household
$REM_{h,t}$	Migrant remittances
DD_t	Domestic public debt
K_t	Adjustment variable in the debt equation
FD_t	Foreign public debt
SDD_t	Stock of domestic public debt
SFD_t	Stock of foreign public debt
IA_t	Internal debt reimbursement
EA_t	External debt reimbursement

f) **Tax revenues**

$TI_{j,t}$	Indirect taxes on product j
$TIM_{tr,t}$	Import tariffs on product tr
$TIE_{tr,t}$	Export tariffs on product tr
adj_t	Compensatory tax

g) **External trade**

$EXS_{tr,t}$	Export supply of product tr (volume)
$DOM_{j,t}$	Domestic production of sector j sold on the domestic market (volume)
$Q_{j,t}$	Supply of composite product belonging to sector j (volume)
$EXD_{tr,t}$	Export demand of product tr (volume)
$M_{tr,t}$	Import demand of product tr (volume)

h) Final demand

$CT_{i,h,t}$	Consumption of good i by household h (volume)
$CMIN_{i,h,t}$	Minimum consumption of good i by household h (volume)
$BC_{h,t}$	Consumption budget of household h
$G_{i,t}$	Public consumption of product i (volume)
$DIT_{i,t}$	Total intermediary consumption of product i (volume)
$INV_{i,t}$	Investment demand of product i (volume)
$STK_{i,t}$	Stock variation of product i (volume)
$NGDP_t$	Nominal GDP

i) Investment

$ITVOL_t$	Gross fixed capital formation (volume)
IT_t	Gross fixed capital formation (value)
SI_t	Savings-Investment adjustment variable
$INVD_{ps,t}$	Investment in sector ps (volume)
$FDI_{ps,t}$	FDI in sector ps (volume)
$DINV_{ps,t}$	Investment in sector ps financed by households and firms (volume)
$INVG_t$	Public investment in the construction sector (volume)
MRA_t	Investment by MRA in the real estate sector (volume)
$VARKD_t$	Capital demand variation in the public sector (volume)

$CLOSE_t$ Closure

Exogenous Variables

wg_t	Wage rate in the urban public sector
wi_t	International wage rate, in foreign currency
$r_{pub,t}$	Capital return of public sector pub
r_t^*	International rental rate of capital
i_t	Domestic interest rate
i_t^*	International interest rate
$Pwm_{tr,t}$	International import price of product tr , in foreign currency
$Pwe_{tr,t}$	International export price of product tr , in foreign currency
$KD_{ps,t}$	Capital demand by sector ps (volume)
$CMIN_{i,h,t}$	Minimum consumption of product i by household h (volume)
$G_{i,“1”}$	Public consumption of product i , at the first period (volume)
$STK_{i,t}$	Stock variation of product i (volume)
$S_{row,t}$	External savings
$T_{h,da,t}$	Transfers by agent da to household h
$T_{“fm”,da,t}$	Transfers by agent da to firms

$T^{“row”,da,t}$ Transfers by agent da to the Rest of the World
 $T^{“gv”,“gv”,t}$ Transfers made by the government to itself
 $T_{ag,“row”,t}$ Transfers by the Rest of the World to agent ag
 $LSR_{“1”}$ Rural population, at the first period
 $LSU_{“1”}$ Urban population, at the first period
 $STKR_{1,“1”}$ The first generation of rural migrants, at the first period
 $STKU_{1,“1”}$ The first generation of urban migrants, at the first period
 $STKR_{2,“1”}$ The second generation of rural migrants, at the first period
 $STKU_{2,“1”}$ The second generation of urban migrants, at the first period
 $STKR_{3,“1”}$ The third generation of rural migrants, at the first period
 $STKU_{3,“1”}$ The third generation of urban migrants, at the first period
 $TSTK_{“1”}$ Total stock of international migrants, at the first period
 $ISTK_{“1”}$ Stock of internal migrants, at the first period
 $SDD_{“1”}$ Stock of internal public debt, at the first period
 $SFD_{“1”}$ Stock of external public debt, at the first period
 $INVG_{“1”}$ Public investment in the construction sector, at the first period (volume)
 $CLOSE_t$ Closure
 $Pindex_t$ GDP deflator, numéraire

Equations

Rural Sectors

$$XS_{ru,t} = VA_{ru,t}/v_{ru} \quad (A1)$$

$$CI_{ru,t} = io_{ru}XS_{ru,t} \quad (A2)$$

$$DI_{i,ru,t} = aij_{i,ru}CI_{ru,t} \quad (A3)$$

$$VA_{ru,t} = A_{ru,t}[\alpha_{ru}LDR_{ru,t}^{(\sigma_{ru}-1)/\sigma_{ru}} + (1 - \alpha_u)\overline{KD}_{ru,t}^{(\sigma_{ru}-1)/\sigma_{ru}}]^{\sigma_{ru}/(\sigma_{ru}-1)} \quad (A4)$$

$$LDR_{ru,t}/\overline{KD}_{ru,t} = \left(\frac{\alpha_{ru}}{1 - \alpha_{ru}} \frac{r_{ru,t}}{wr_t}\right)^{\sigma_{ru}} \quad (A5)$$

Urban Private Sectors

$$XS_{up,t} = VA_{up,t}/v_{up} \quad (A6)$$

$$CI_{up,t} = io_{up}XS_{up,t} \quad (A7)$$

$$DI_{i,up,t} = aij_{i,up}CI_{up,t} \quad (A8)$$

$$VA_{up,t} = A_{up,t}[\alpha_{up}LDU_{up,t}^{(\sigma_{up}-1)/\sigma_{up}} + (1 - \alpha_{up})\overline{KD}_{up,t}^{(\sigma_{up}-1)/\sigma_{up}}] \sigma_{up}/(\sigma_{up}-1) \quad (A9)$$

$$LDU_{up,t}/\overline{KD}_{up,t} = \left(\frac{\alpha_{up}}{1 - \alpha_{up}} \frac{r_{up,t}}{wu_t} \right)^{\sigma_{up}} \quad (A10)$$

Public Sectors

$$XS_{pub,t} = VA_{pub,t}/v_{pub} \quad (A11)$$

$$CI_{pub,t} = io_{pub}XS_{pub,t} \quad (A12)$$

$$DI_{i,pub,t} = aij_{i,pub}CI_{pub,t} \quad (A13)$$

$$VA_{pub,t} = KD_{pub,t}/k_{pub} \quad (A14)$$

$$LDG_{pub,t} = l_{pub}VA_{pub,t} \quad (A15)$$

$$KD_{pub,t} = \frac{PV_{pub,t}VA_{pub,t} - \overline{wg}_t LDG_{pub,t}}{r_{pub,t}} \quad (A16)$$

Migratory Flows

$$\overline{LSR}_t = B_1[\varpi_1 NAT_t^{(\varepsilon_1-1)/\varepsilon_1} + (1 - \varpi_1)EMR_t^{(\varepsilon_1-1)/\varepsilon_1}]^{\varepsilon_1/(\varepsilon_1-1)} \quad (A17)$$

$$\frac{EMR_t}{NAT_t} = \left(\frac{\varpi_1}{1 - \varpi_1} \frac{\overline{wi}_{t-1}e_{t-1}(1 - MC_{t-1})}{wn_{t-1}/CPI_{t-1}} \right)^{-\varepsilon_1} \quad (A18)$$

$$NAT_t = B_2[\varpi_2 NATR_t^{(\varepsilon_2-1)/\varepsilon_2} + (1 - \varpi_2)MIG_t^{(\varepsilon_2-1)/\varepsilon_2}]^{\varepsilon_2/(\varepsilon_2-1)} \quad (A19)$$

$$\frac{MIG_t}{NATR_t} = \left(\frac{\varpi_2}{1 - \varpi_2} \frac{wa_{t-1}(1 - imc)/CPIU_{t-1}}{wr_{t-1}/CPIR_{t-1}} \right)^{-\varepsilon_2} \quad (A20)$$

$$\overline{LSU}_t = B_3[\varpi_3 NATU_t^{(\varepsilon_3-1)/\varepsilon_3} + (1 - \varpi_3)EMU_t^{(\varepsilon_3-1)/\varepsilon_3}]^{\varepsilon_3/(\varepsilon_3-1)} \quad (A21)$$

$$\frac{EMU_t}{NATU_t} = \left(\frac{\varpi_3}{1 - \varpi_3} \frac{\overline{wi}_{t-1}e_{t-1}(1 - MC_{t-1})}{wa_{t-1}/CPIU_{t-1}} \right)^{-\varepsilon_3} \quad (A22)$$

Households and Firms

$$Y^{hr},t = \sum_{ru} wr_t LDR_{ru,t} + \eta^{hr} \sum_j r_j \overline{KD}_{j,t} + \sum_{da} \overline{T^{hr},da,t} + e_t \overline{T^{hr},row},t + IR_t \overline{ISTK}_t + (1 - tc) REM^{hr},t \quad (A23)$$

$$Y^{hu},t = (1 - \phi_{row}) \left[\sum_{up} wu_t LDU_{up,t} + \sum_{pub} \overline{wg}_t LDG_{pub,t} \right] + \eta^{hu} \sum_j r_{j,t} \overline{KD}_{j,t} + \sum_{da} \overline{T^{hu},da,t} + e_t \overline{T^{hu},row},t + \vartheta^{hu} (\overline{i_t SDD}_t) + (1 - tc) REM^{hu},t \quad (A24)$$

$$YWR^{hr},t = \sum_{ru} wr_t LDR_{ru,t} + \eta^{hr} \sum_j r_j \overline{KD}_{j,t} + \sum_{da} \overline{T^{hr},da,t} + e_t \overline{T^{hr},row},t + IR_t \overline{ISTK}_t \quad (A25)$$

$$YWR^{hu},t = (1 - \phi_{row}) \left[\sum_{up} wu_t LDU_{up,t} + \sum_{pub} \overline{wg}_t LDG_{pub,t} \right] + \eta^{hu} \sum_j r_{j,t} \overline{KD}_{j,t} + \sum_{da} \overline{T^{hu},da,t} + e_t \overline{T^{hu},row},t + \vartheta^{hu} (\overline{i_t SDD}_t) \quad (A26)$$

$$YDWR^{hr},t = \frac{YWR^{hr},t(1 - ty^{hr}) - \overline{T^{hr},hr},t}{\overline{T^{hu},hr},t - \overline{T^{fm},hr},t - e_t \overline{T^{row},hr},t} \quad (A27)$$

$$YDWR^{hu},t = \frac{YWR^{hu},t(1 - ty^{hu}) - \overline{T^{hr},hu},t - \overline{T^{hu},hu},t}{\overline{T^{fm},hu},t - e_t \overline{T^{row},hu},t - IR_t \overline{ISTK}_t} \quad (A28)$$

$$YD^{hr},t = \frac{Y^{hr},t(1 - ty^{hr}) - \overline{T^{hr},hr},t}{\overline{T^{hu},hr},t - \overline{T^{fm},hr},t - e_t \overline{T^{row},hr},t} \quad (A29)$$

$$YD^{hu},t = \frac{Y^{hu},t(1 - ty^{hu}) - \overline{T^{hr},hu},t - \overline{T^{hu},hu},t}{\overline{T^{fm},hu},t - e_t \overline{T^{row},hu},t - IR_t \overline{ISTK}_t} \quad (A30)$$

$$REM^{hr},t = RR^{hr},t \overline{STKR}_{1,t} + 1/2 RR^{hr},t \overline{STKR}_{2,t} \quad (A31)$$

$$REM^{hu},t = RR^{hu},t \overline{STKU}_{1,t} + 1/2 RR^{hu},t \overline{STKU}_{2,t} \quad (A32)$$

$$RR^{hr},t = V_1^{hr} \left(\frac{YD^{hr},t}{CPIR_t} \right)^{\gamma_1^{hr}} \overline{wit}^{\gamma_2^{hr}} \quad (A33)$$

$$RR^{“hu”},t = V_1^{“hu”} \left(\frac{YD^{“hu”},t}{CPIU_t} \right)^{\gamma_1^{“hu”}} \overline{w_t}^{\gamma_2^{“hu”}} \quad (A34)$$

$$IR_t = V_2 \left(\frac{YD^{“hr”},t}{CPIR_t} \right)^{\gamma_3} \quad (A35)$$

$$S_{h,t} = \psi_h YDW R_{h,t} \quad (A36)$$

$$BC^{“hr”},t = \frac{Y^{“hr”},t(1 - ty^{“hr”}) - \overline{T^{“hr”},“hr”},t - \overline{T^{“hu”},“hr”},t - \overline{T^{“fm”},“hr”},t - e_t \overline{T^{“row”},“hr”},t - S^{“hr”},t - (1 - cons^{“hr”})(1 - ty^{“hr”})(1 - tc)REM^{“hr”},t}}{(1 - cons^{“hr”})(1 - ty^{“hr”})(1 - tc)REM^{“hr”},t}} \quad (A37)$$

$$BC^{“hu”},t = \frac{Y^{“hu”},t(1 - ty^{“hu”}) - \overline{T^{“hr”},“hu”},t - \overline{T^{“hu”},“hu”},t - \overline{T^{“fm”},“hu”},t - e_t \overline{T^{“row”},“hu”},t - IR_t \overline{ISTK}_t - S^{“hu”},t - (1 - cons^{“hu”})(1 - ty^{“hu”})(1 - tc)REM^{“hu”},t}}{(1 - cons^{“hu”})(1 - ty^{“hu”})(1 - tc)REM^{“hu”},t}} \quad (A38)$$

$$Y^{“fm”},t = (1 - \eta^{“hr”} - \eta^{“hu”} - \eta^{“gv”} - \eta^{“row”} - PROF_t) \sum_j r_{j,t} \overline{KD}_{j,t} + \sum_{da} \overline{T^{“fm”},da,t} + e_t \overline{T^{“fm”},“row”},t + (1 - \vartheta^{“hu”}) (\overline{i_t SDD_t}) \quad (A39)$$

$$PROF_t = \frac{\sum_{ps} FDI_{ps,t}}{ITVOL_t} \quad (A40)$$

$$S^{“fm”},t = \frac{Y^{“fm”},t(1 - tye) - \overline{T^{“hr”},“fm”},t - \overline{T^{“hu”},“fm”},t - \overline{T^{“fm”},“fm”},t - e_t \overline{T^{“row”},“fm”},t}}{\overline{T^{“fm”},“fm”},t - e_t \overline{T^{“row”},“fm”},t}} \quad (A41)$$

The Government

$$TI_{tr,t} = tx_{tr} adj_t (P_{tr,t} X S_{tr,t} - PE_{tr,t} EX S_{tr,t}) + tx_{tr} adj_t (1 + tm_{tr}) e_t \overline{Pm}_{tr,t} M_{tr,t} \quad (A42)$$

$$TI_{ntr,t} = tx_{ntr} adj_t PL_{ntr,t} X S_{ntr,t} \quad (A43)$$

$$TIM_{tr,t} = tm_{tr} e_t \overline{Pm}_{tr,t} M_{tr,t} \quad (A44)$$

$$TIE_{tr,t} = te_{tr} PE_{tr,t} EX S_{tr,t} \quad (A45)$$

$$T^{“gv”,h,t} = ty_h Y_{h,t} \quad (A46)$$

$$T^{“gv”,“fm”,t} = tye Y^{“fm”,t} \quad (A47)$$

$$Y^{“gv”,t} = \eta^{“gv”} \sum_j r_{j,t} \overline{KD}_{j,t} + \sum_{tr} TIM_{tr,t} + \sum_{tr} TIE_{tr,t} + \sum_j TI_{j,t} + \sum_h T^{“gv”,h,t} + T^{“gv”,“fm”,t} + \overline{T^{“gv”,“gv”,t}} + e_t \overline{T^{“gv”,“row”,t}} \quad (A48)$$

$$S^{“gv”,t} = Y^{“gv”,t} - \sum_i PC_{i,t} \overline{G}_{i,t} - \sum_{da} \overline{T_{da,“gv”,t}} - e_t \overline{T^{“row”,“gv”,t}} - \overline{i_t SDD_t} - e_t \overline{i_t^* SFD_t} \quad (A49)$$

External Trade

If $EXS_{tr,t} > EXS_{tr,t-1}$,

$$A_{tr,t} = A_{tr,t-1} \left(\frac{EXS_{tr,t}}{EXS_{tr,t-1}} \right)^\varsigma \quad (A50)$$

If $EXS_{tr,t} \leq EXS_{tr,t-1}$

$$A_{tr,t} = A_{tr,t-1} \quad (A51)$$

$$XS_{tr,t} = C_{1tr} [\delta_{1tr} EXS_{tr,t}^{(\kappa_{1tr}-1)/\kappa_{1tr}} + (1 - \delta_{1tr}) DOM_{tr,t}^{(\kappa_{1tr}-1)/\kappa_{1tr}}]^{\kappa_{1tr}/(\kappa_{1tr}-1)} \quad (A52)$$

$$XS_{ntr,t} = DOM_{ntr,t} \quad (A53)$$

$$\frac{EXS_{tr,t}}{DOM_{tr,t}} = \left(\frac{\delta_{1tr}}{1 - \delta_{1tr}} \frac{PL_{tr,t}}{PE_{tr,t}} \right)^{\kappa_{1tr}} \quad (A54)$$

$$EXD_{tr,t} = EXD_{tr,t-1} \left(\frac{\overline{Pwe_{tr,t}}}{\overline{Pfo_{tr,t}}} \right)^{\varphi_{tr}} \quad (A55)$$

$$Q_{tr,t} = C_{2tr} [\delta_{2tr} M_{tr,t}^{(\kappa_{2tr}-1)/\kappa_{2tr}} + (1 - \delta_{2tr}) DOM_{tr,t}^{(\kappa_{2tr}-1)/\kappa_{2tr}}]^{\kappa_{2tr}/(\kappa_{2tr}-1)} \quad (A56)$$

$$Q_{ntr,t} = DOM_{ntr,t} \quad (A57)$$

$$\frac{M_{tr,t}}{DOM_{tr,t}} = \left(\frac{\delta_{2tr}}{1 - \delta_{2tr}} \frac{PD_{tr,t}}{PM_{tr,t}} \right)^{\kappa_{2tr}} \quad (A58)$$

$$\begin{aligned} \overline{S^{“row”},t} = & \sum_{tr} \overline{Pwm_{tr,t}} M_{tr,t} + \phi_{row} \frac{\sum_{up} wu_t LDU_{up,t} + \sum_{pub} \overline{wgt} LDG_{pub,t}}{e_t} \\ & + (\eta^{“row”} + PROF_t) \frac{\sum_j r_{j,t} \overline{KD}_{j,t}}{e_t} + \sum_{ag} \overline{T^{“row”,ag,t}} + \overline{i_t^* SFD_t} \\ & - \sum_{tr} P fob_{tr,t} EXS_{tr,t} - \sum_{ag} \overline{T_{ag,row,t}} - \frac{\sum_h (1 - tc) REM_{h,t}}{e_t} \quad (A59) \end{aligned}$$

Final Demand

$$CT_{i,“hr”},t = \overline{CMIN_{i,“hr”},t} + \frac{\beta_{i,“hr”}}{PC_{i,t}} (BC_{“hr”},t - \sum_i PC_{i,t} \overline{CMIN_{i,“hr”},t}) \quad (A60)$$

$$CT_{i,“hu”},t = \overline{CMIN_{i,“hu”},t} + \frac{\beta_{i,“hu”}}{PC_{i,t}} (BC_{“hu”},t - \sum_i PC_{i,t} \overline{CMIN_{i,“hu”},t}) \quad (A61)$$

$$INV_{i,t} = \mu_i IT_t / PC_{i,t} \quad (A62)$$

$$DIT_{i,t} = \sum_i aij_{i,j} CI_{j,t} \quad (A63)$$

$$ITVOL_t = IT_t / PINV_t \quad (A64)$$

$$\begin{aligned} NGDP_t = & \sum_i PC_{i,t} \overline{G}_{i,t} + \sum_h \sum_i PC_{i,t} CT_{i,h,t} + \sum_i PC_{i,t} INV_{i,t} + \sum_i PC_{i,t} \overline{STK}_{i,t} + \\ & \sum_{tr} e_t P fob_{tr,t} EXD_{tr,t} - \sum_{tr} \overline{Pwm_{tr,t}} e_t M_{tr,t} \quad (A65) \end{aligned}$$

Prices

$$\ln \frac{wu_t}{CPIU_t} = D - 0.1 \ln u_t \quad (A66)$$

$$\overline{wgt} \succ wu_t \quad (A67)$$

$$wn_t = \frac{wr_t \sum_{ru} LDR_{ru,t} + wu_t \sum_{up} LDU_{up,t} + \overline{wg}_t \sum_{pub} LDG_{pub,t}}{\sum_{ru} LDR_{ru,t} + \sum_{up} LDU_{up,t} + \sum_{pub} LDG_{pub,t}} \quad (A68)$$

$$wug_t = \frac{wu_t \sum_{up} LDU_{up,t} + \overline{wg}_t \sum_{pub} LDG_{pub,t}}{\sum_{up} LDU_{up,t} + \sum_{pub} LDG_{pub,t}} \quad (A69)$$

$$wa_t = wug_t(1 - u_t) \quad (A70)$$

$$r_{ru,t} = \frac{PV_{ru,t}VA_{ru,t} - wr_t LDR_{ru,t}}{KD_{ru,t}} \quad (A71)$$

$$r_{up,t} = \frac{PV_{up,t}VA_{up,t} - wu_t LDU_{up,t}}{KD_{up,t}} \quad (A72)$$

$$PV_{j,t} = \frac{P_{j,t}XS_{j,t} - \sum_i PC_{i,t}DI_{i,j,t}}{VA_{j,t}} \quad (A73)$$

$$PM_{tr,t} = e_t \overline{Pwm}_{tr,t} (1 + tm_{tr})(1 + tx_{tr}) \quad (A74)$$

$$PE_{tr,t} = \frac{e_t Pfo_{tr,t}}{(1 + te_{tr})} \quad (A75)$$

$$PC_{tr,t} = \frac{DOM_{tr,t}PD_{tr,t} + M_{tr,t}PM_{tr,t}}{Q_{tr,t}} \quad (A76)$$

$$PC_{ntr,t} = PD_{ntr,t} \quad (A77)$$

$$PD_{j,t} = PL_{j,t}(1 + tx_j adj_t) \quad (A78)$$

$$P_{tr,t} = \frac{PL_{tr,t}DOM_{tr,t} + PE_{tr,t}EXS_{tr,t}}{XS_{tr,t}} \quad (A79)$$

$$P_{ntr,t} = PL_{ntr,t} \quad (A80)$$

$$PINV_t = \prod_i \left(\frac{PC_{i,t}}{\mu_i} \right)^{\mu_i} \quad (A81)$$

$$CPI_t = \sum_{i,h} \theta_{1i} PC_{i,t} \quad (A82)$$

$$CPIR_t = \sum_i \theta_{2i, "hr"} PC_{i,t} \quad (A83)$$

$$CPIU_t = \sum_i \theta_{2i, "hu"} PC_{i,t} \quad (A84)$$

$$\overline{Pindex}_t = \sum_j \theta_j PV_{j,t} \quad (A85)$$

Dynamics

$$STKR_{1,t+1} = \overline{STKR}_{1,t}(1 - \chi_1) + EMR_t \quad (A86)$$

$$STKU_{1,t+1} = \overline{STKU}_{1,t}(1 - \chi_1) + EMU_t \quad (A87)$$

$$STKR_{2,t+1} = \overline{STKR}_{2,t}(1 - \chi_2) + \chi_1 \overline{STKR}_{1,t} \quad (A88)$$

$$STKU_{2,t+1} = \overline{STKU}_{2,t}(1 - \chi_2) + \chi_1 \overline{STKU}_{1,t} \quad (A89)$$

$$STKR_{3,t+1} = \overline{STKR}_{3,t} + \chi_2 \overline{STKR}_{2,t} \quad (A90)$$

$$STKU_{3,t+1} = \overline{STKU}_{3,t} + \chi_2 \overline{STKU}_{2,t} \quad (A91)$$

$$TSTK_t = \frac{\overline{STKR}_{1,t} + \overline{STKR}_{2,t} + \overline{STKR}_{3,t}}{\overline{STKU}_{1,t} + \overline{STKU}_{2,t} + \overline{STKU}_{3,t}} \quad (A92)$$

$$ISTK_{t+1} = \overline{ISTK}_t + MIG_t \quad (A93)$$

$$KD_{ps,t+1} = (1 - dep_{ps}) \overline{KD}_{ps,t} + INVD_{ps,t} \quad (A94)$$

$$\frac{FDI_{ps,t}}{KD_{ps,t}} = D_{1ps} \left(\frac{r_{ps,t}}{e_t r_t^* (\bar{i}_t + \epsilon_1 + dep_{ps})} \right)^2 + D_{2ps} \left(\frac{r_{ps,t}}{e_t r_t^* (\bar{i}_t + \epsilon_1 + dep_{ps})} \right) \quad (A95)$$

$$\frac{DINV_{ps,t}}{KD_{ps,t}} = D_{3ps} \left(\frac{r_{ps,t}}{PINV_t (\bar{i}_t + \epsilon_2 + dep_{ps})} \right)^2 + D_{4ps} \left(\frac{r_{ps,t}}{PINV_t (\bar{i}_t + \epsilon_2 + dep_{ps})} \right) \quad (A96)$$

$$VARKD_t = KD^{\text{"edu"},t} - KD^{\text{"edu"},t-1} \quad (A97)$$

$$INVD_{pro,t} = DINV_{pro,t} + FDI_{pro,t} \quad (A98)$$

$$INVD^{\text{"con"},t} = MRA_t + DINV^{\text{"con"},t} + \overline{INVG}_t + FDI^{\text{"con"},t} \quad (A99)$$

$$SDD_{t+1} = (1 + \bar{i}_t) \overline{SDD}_t + DD_t - IA_t \quad (A100)$$

$$SFD_{t+1} = (1 + \bar{i}_t^*)\overline{SFD}_t + FD_t - EA_t \quad (A101)$$

$$MC_t = V_3(TSTK_t)^\nu \quad (A102)$$

$$G_{i,t+1} = \bar{G}_{i,t}(1 + g_G) \quad (A103)$$

$$INVG_{t+1} = \overline{INVG}_t(1 + g_{IG}) \quad (A104)$$

$$LSR_{t+1} = \overline{LSR}_t(1 + g_{LSR}) - MIG_t - EMR_t \quad (A105)$$

$$LSU_{t+1} = \overline{LSU}_t(1 + g_{LSU}) + MIG_t - EMU_t \quad (A106)$$

Equilibrium Conditions and Closure

$$NATR_t = \sum_{ru} LDR_{ru,t} \quad (A107)$$

$$(NATU_t + (1 - imc)MIG_t)(1 - u_t) = \sum_{up} LDU_{up,t} + \sum_{pub} LDG_{pub,t} \quad (A108)$$

$$Q_{i,t} = \bar{G}_{i,t} + DIT_{i,t} + \sum_h CT_{i,h,t} + INV_{i,t} + \overline{STK}_{i,t} \quad (A109)$$

$$EXS_{tr,t} = EXD_{tr,t} \quad (A110)$$

$$S^{“gv”,t} + DD_t + e_t FD_t = VARKD_t PINV_t + \overline{INVG}_t PINV_t \quad (A111)$$

$$DD_t = K_t(F \times \epsilon_2^\xi)(S^{“hu”,t} + (1 - estate)(1 - cons^{“hu”}) \\ (1 - ty^{“hu”})(1 - tc)REM^{“hu”,t} + S^{“fm”,t}) \quad (A112)$$

$$\sum_h estate(1 - cons_h)(1 - ty_h)(1 - tc)REM_{h,t} = MRA_t PINV_t \quad (A113)$$

$$e_t(S^{“row”,t} - FD_t) = \sum_{pro} FDI_{pro,t} PINV_t + \\ FDI^{“con”,t} PINV_t + v \sum_i \overline{STK}_{i,t} PC_{i,t} \quad (A114)$$

$$IT_t + \sum_i \overline{STK_{i,t}} PC_{i,t} = e_t \overline{S^{row},t} + \sum_{da} S_{da,t} + \sum_h (1 - cons_h)(1 - ty)(1 - tc) REM_{h,t} \quad (A115)$$

$$ITVOL_t = SI_t \left(\sum_{pro} INV D_{pro,t} + INV D^{con},t + VAR KD_t \right) \quad (A116)$$

$$\overline{CLOSE}_t = S^{gv},t / NGDP_t \quad (A117)$$

$$SDD_{t+1} = share_1 NGDP_{t+1} \quad (A118)$$

$$e_t SFD_{t+1} = share_2 NGDP_{t+1} \quad (A119)$$

$$EV_h = (BC_{h,t} - \sum_i PC_{i,t} CMIN_{i,h,t}) \left(\frac{\prod_i PCO_i}{\prod_i PC_{i,t}} \right)^{\beta_{i,h}} - (BCO_h - \sum_i PCO_i CMINO_{i,h}) \quad (A120)$$