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

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Abstract

Specialists of migration and its development impact gave little attention to the sectoral allocation of remittances invested. This is an interesting topic especially when remittances by destination of developing countries are invested in real estate. Putting aside this fact overestimates the volume of investment in the most productive sectors and creates an illusion of a sustainable growth. Besides, unlike the best part of the literature that focuses on the household impact of remittances, a CGE1 approach is necessary in order to model the linkages that transmit the influence of migration to other households and sectors. This specific investment of remittances in the real estate sector is taken in consideration in our CGE model by allowing a segmentation of the saving market. This is the main contribution of our paper. We apply this study to Morocco, a country largely dependent on remittances. Furthermore, the literature on Morocco is limited to unpublished reports and surveys. We particularly investigate the impact of immigration restrictive policies and permanent migration on the future evolution of remittances. We then ask what would be the appropriate policies to take the maximum profit from current flows. We find that public policies that diminish the country risk premium in favour of domestic and foreign investors and the reduction of transfer costs are the most favourable in term of economic growth and welfare. The increase in the proportion of remittances invested in productive sectors is unexpectedly harmful.

Keywords: Sequential Dynamics, Computable general equilibrium model, Migration, Remittances.


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1Computable General Equilibrium
1 Introduction

According to data from the IMF’s Balance of Payments Yearbook, Morocco is the fourth-largest recipient of official remittances among developing countries, both in billion of dollars and as a percentage of GDP. Remittance flows surged to 3.3 billions of dollars (37 billions of dirhams) in 2001, which is equivalent to 9% of GDP and 25% of exports. After their surge in 2001, their level remained high compared to other developing countries. For example, 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. 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 on the household impact of remittances, ignoring linkages that transmit the influence of migration to other households and economic sectors, we use a CGE approach in order to describe the transmission channels by which remittances and their corresponding use affect all economic agents and sectors of activity. To take into account the use of remittances for investment needs, we consider a dynamic framework that allows the allocation of investment to the different sectors. We also consider a segmentation of the saving market where the various sources of savings are not analogously affected to investment.

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 conclusive. 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 help finance future consumption in a sustainable way. Alternatively, if they are spent only on current consumption goods, then future consumption has

2International Monetary Fund.
3For 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)).
to be financed by future remittances. However, Glytsos (1993) argues that re-
mittances, even when not invested, can have an important multiplier effect. His
study applied to Greece shows that this multiplier effect arises when consumption
stimulates the demand of goods and services, which promotes, at its turn, output
and employment. Third, remittances affect the balance of payments (BOP) and
they have a more positive impact than other monetary flows such as financial aid,
foreign direct investment and loans because they are a more stable source of for-
eign 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 induce demand greater 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 macro variables that are country specific. In this context, we point out
that the literature is unevenly distributed with regard to country analyses. A lot
of works have been done on Latin migrants living in the US while the interest for
the MENA migrants in the European Union has just began, in spite of the large
flows of remittances received by these countries. According to the IMF’s Bal-
ance 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 dollars (14
billions v/s 23 billions). 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 remit-
tances, works concerned by the impact of remittances on Morocco are limited
to unpublished reports, theses or working papers on particular regions. 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 consid-
erable improved living conditions, education, and triggered economic activity,
from which non-migrants indirectly profit. However, this impact is fundamen-
tally heterogeneous across space and time, as well as across socio-ethnic and
gender groups. In many cases, the development in migrant-sending regions is a
prerequisite for return and/or investment rather than a consequence of migration.
Because much empirical work is methodologically flawed, more analytical rigour
is needed to formally test 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 models has given less at-

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4See for example Berriane (1996), Lazaar (1987, 1989), McMurray (1992) cited in Nyberg-
Morocco.

5We could identify only few CGE models studying the impact of remittances in a dynamic
tention on the sectoral distribution of remittances invested, especially when the 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 therefore compete with international products. On one hand, increasing openness generates strong competitive pressures that drive costs down and ameliorate the product quality. On the other hand, it accelerates institutional change that is able to reduce transaction costs for all business activity. 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, we resort to a segmentation of the saving 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 our paper. We are also interested in 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 concludes 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 if they are invested in real estate, due to the linkages between sectors and economic agents.

We find 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 the country risk premium in favour of investors. The amelioration 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. In section 5, we conclude and discuss the policy implications of our 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 37 billions of dirhams (3.3 billions of dollars) in 2001. Remittance flows moved from 2 billions of dirhams in 1975 to 10 billions in 1985 and 19 billions in 1998. They reached a record level of nearly 37 billions of dirhams in 2001 before moving down to 32 billions in 2002. In 2003, they rose again to 35 billions. 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 balance of payment is higher than phosphate, tourism, foreign investments and private loans (Table 1).

<table>
<thead>
<tr>
<th>Year</th>
<th>Phosphate and derivates</th>
<th>Remittances</th>
<th>Travels and Tourism</th>
<th>Foreign Inv.&amp;loans</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td></td>
<td>18033</td>
<td>13780</td>
<td>12337</td>
</tr>
<tr>
<td>1998</td>
<td>12573</td>
<td>19311</td>
<td>16754</td>
<td>5433</td>
</tr>
<tr>
<td>1999</td>
<td>13346</td>
<td>19002</td>
<td>19112</td>
<td>18467</td>
</tr>
<tr>
<td>2000</td>
<td>12924</td>
<td>22962</td>
<td>21666</td>
<td>12647</td>
</tr>
<tr>
<td>2001</td>
<td>13238</td>
<td>36858</td>
<td>29196</td>
<td>33268</td>
</tr>
<tr>
<td>2002</td>
<td>13908</td>
<td>31708</td>
<td>29159</td>
<td>6811</td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td>34582</td>
<td>30881</td>
<td>23900</td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td>37423</td>
<td>34794</td>
<td>15686</td>
</tr>
</tbody>
</table>

Source: http://www.oc.gov.ma

As it is shown in Table 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.

6The word remittances refers here to workers’ remittances that are registered as current transfers.
Table 2- Remittances to balance of trade deficit, in millions of Moroccan Dirhams

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Remittances</td>
<td>18033</td>
<td>19311</td>
<td>19002</td>
<td>22962</td>
<td>36858</td>
<td>31708</td>
<td>34582</td>
<td>37423</td>
</tr>
<tr>
<td>Trade deficit</td>
<td>−23656</td>
<td>−30068</td>
<td>−32314</td>
<td>−43700</td>
<td>−44051</td>
<td>−44020</td>
<td>−52183</td>
<td>−70025</td>
</tr>
<tr>
<td>As % of B.O.T. deficit</td>
<td>76.2</td>
<td>64.2</td>
<td>58.8</td>
<td>52.5</td>
<td>83.7</td>
<td>72</td>
<td>66.3</td>
<td>53.4</td>
</tr>
</tbody>
</table>

Source: http://www.oc.gov.ma

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. It is for this reason that it is important to know the treatment reserved for them (the breakdown between consumption and investment, incentives and obstacles) and the transfer costs of the different channels. In particular, lower transfer costs rise the value of remittances received by the country, and the investment of remittances in productive sectors, instead of real estate or their use for consumption needs, should promote the economic activity and guarantee a sustainable growth.

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 3). 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 well 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 3). 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 had already invested heavily in real estate.

Table 3- Sectoral distribution of MRA’s investments, in %

5The word remittances refers here to workers’ remittances that are registered as current transfers.
<table>
<thead>
<tr>
<th>Sectors</th>
<th>MRA’s investments</th>
<th>MRA’s investment projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real estate</td>
<td>83.7</td>
<td>35.6</td>
</tr>
<tr>
<td>Agriculture</td>
<td>7.5</td>
<td>10.6</td>
</tr>
<tr>
<td>Trade</td>
<td>4.9</td>
<td>27.4</td>
</tr>
<tr>
<td>Tourism</td>
<td>1.4</td>
<td>12.1</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1.3</td>
<td>7.5</td>
</tr>
<tr>
<td>Other services</td>
<td>1.1</td>
<td>5.3</td>
</tr>
<tr>
<td>Other sectors</td>
<td>0.1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

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 banks 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 4 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 4- Cost of remitting 250 euros from the Netherlands to Morocco, in euros

8At the 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.
<table>
<thead>
<tr>
<th>Official channels</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Union</td>
<td>21.14</td>
</tr>
<tr>
<td>MoneyGram</td>
<td>23.95</td>
</tr>
<tr>
<td>Postbank (internet)</td>
<td>7.5</td>
</tr>
<tr>
<td>ABN Amro (urgent at counter)</td>
<td>39.6</td>
</tr>
<tr>
<td>ABN Amro (internet)</td>
<td>16.10</td>
</tr>
</tbody>
</table>

Source: Barendse, Hiddink, Janszen and Stavast (2006)

3 Theoretical framework

As we pointed out earlier, we are interested in the impact of remittances on Morocco, a country that has been a 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. 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 in order to illustrate the linkages between different uses of remittances and the 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 monoproducive sectors distributed between two aggregate sectors: a rural sector (subsistence and industrial agriculture) 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 (2007): 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 maximizes 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. At his turn, the urban worker maximizes 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 their 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. We also introduce an innovation with respect to traditional dynamic CGE models and especially the very few ones interested in the impact of remittances, by considering a segmentation of the saving 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 the different sources of savings do not finance the same sectors distort the share of investment going to the most or the least productive sectors, and therefore bias the results.

For the sake of brevity, we deal here only with the segmentation of the saving market and the dynamics. All equations can be examined in Appendix 3. The model is calibrated on the Moroccan SAM of 1998.

3.1 The segmentation of the saving 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 investment in real estate is 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 thus 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 in turn contributes to productivity growth by reducing transaction costs for all business activity.
This is the relation between exports and growth at the heart of the export-led industrialisation strategy. In the neoclassical model, TFP growth appears by magic, with no link to changes in economic structure or policy choices. Then, the neoclassical framework must be expanded. One plausible way is to introduce externalities. To capture this in our model, we 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. The only difference is that we make it depend on the export variation of the previous year because technology acquisition, quality improvement, cost reduction and institutional changes are not instantaneous:

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

and

\[
A_{tr,t} = A_{tr,t-1} \frac{EXS_{tr,t-1}}{EXS_{tr,t-2}} \zeta \quad \text{for } EXS_{tr,t-1} > EXS_{tr,t-2}
\]

\[
A_{tr,t} = A_{tr,t-1} \quad \text{for } EXS_{tr,t-1} \leq EXS_{tr,t-2}
\]

where

- \( VA_{tr,t} \) is the value added of tradable sector \( tr \) at period \( t \),
- \( A_{tr,t} \) the export externality shift parameter in production at period \( t \),
- \( \alpha_{tr} \) the share parameter of the CES (Constant elasticity of substitution),
- \( LD_{tr,t} \) the labour demand of sector \( tr \) at period \( t \),
- \( KD_{tr,t} \) the capital demand of sector \( tr \) at period \( t \),
- \( \sigma_{tr} \) the elasticity of substitution (positive),
- \( \zeta \) the export externality.

Following the study of de Melo and Robinson (1990) applied to Korea, we choose a fairly small value of 0.1 for \( \zeta \) to describe the export externality for Morocco. Now, we can 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, we 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. Therefore we write the following equation:

\[
\sum_{h} estate(1 - cons_{h})(1 - ty_{h}adj)(1 - tc)REM_{h,t} = MRA_{t}PINV_{t} \quad (1)
\]
where

\( estate \) is the proportion of remittances after consumption invested in real estate,

\( cons_h \) the proportion of remittances to household \( h \) going to consumption,

\( ty_h \) the direct tax rate on household \( h \) income,

\( adj_t \) a compensatory tax at period \( t \),

\( tc \) the transfer cost,

\( REM_{h,t} \) the value of remittances to 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 consumed and not invested in real estate, together with households and firms’ savings, help financing investment in productive 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 firms, in order to finance public investment. This domestic funding of the public debt is negatively dependent on the country risk premium \( \epsilon \). 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.

\[
DD_t = K_t (F \times \epsilon^2)(S_{hu,t} + (1 - estate)(1 - cons_{hu})
\]

\[
(1 - ty_{hu} adj_t)(1 - tc)REM_{hu,t} + REM_{fm,t} \]

where

\( DD_t \) is the domestic public debt at period \( t \) financed by the urban household and firms,

\( K_t \) an adjustment variable in the debt equation at period \( t \),

\( F \) a scale parameter,

\( \epsilon^2 \) the country risk premium perceived by domestic investors,

\( \xi \) the elasticity of the public debt funding by domestic agents with respect to the country risk premium,

\( S_{ag,t} \) 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 \( INV_G_t \) and the

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\( ^9 \) According to the National Survey on Household Living Standards of 1998-1999, the proportion of remittances going to consumption is the quarter of the total amount of remittances recorded in the BOP (Bourchachen (2000)).

\( ^{10} \) In Morocco, only urban households and firms lend the government (Abdelkhalek and Zaoujal (2004)).
additional capital required to support the increased production of non-tradable services \( \text{VARKD}_t \). Public investment in infrastructure \( \text{INVG}_t \) is treated as exogenous since it comes from a public decision while \( \text{VARKD}_t \) is endogenously determined due to the specification of public sectors where capital stock is supposed endogenous (detailed in the next section).

\[
S_{\text{gov},t} + DD_t + e_t FD_t = \text{VARKD}_t PINV_t + \text{INVG}_t PINV_t \quad (3)
\]

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 \( S_{\text{row},t} \) finance foreign public debt, as well as foreign investment\(^{11}\) and a fraction of the stock variation. Foreign investment\(^{12}\) is triggered by the differential between the rental rate of capital and the international return on capital.

\[
e_t (S_{\text{row},t} - FD_t) = \sum_{\text{pro}} FDI_{\text{pro},t} PINV_t + FDI_{\text{con},t} PINV_t + \nu \sum_i STK_{i,t} PC_{i,t} \quad (4)
\]

where

- \( FDI_{\text{pro},t} \) is the foreign direct investment in productive sector \( \text{pro} \) at period \( t \) (in volume),
- \( FDI_{\text{con},t} \) the foreign direct investment in the construction sector at period \( t \) (in volume),
- \( \nu \) 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

\(^{11}\)Foreign 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.

\(^{12}\)Foreign direct investment in the construction sector, by contrast to MRA’s investments in real estate, is motivated by economic factors.
the corresponding sector.

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

\[ IT_t + \sum_i STK_{i,t} PC_{i,t} = \epsilon_t S_{row,t} + \sum_{da} S_{da,t} + \]
\[ \sum_h (1 - cons_h)(1 - ty \times adj_t)(1 - tc) REM_{h,t} \]

where

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

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

\[ ITVOL_t = IT_t / PINV_t \]

\[ ITVOL_t = \sum_{pro} INVD_{pro,t} + INVD_{con,t} + VARKD_t \]

where

\[ INVD_{pro,t} \] is 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, we develop a sequential dynamic CGE model where agents have myopic behaviour. It consists of multiple static CGE models that are 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. We 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:

\[ K D_{ps,t+1} = (1 - \text{dep}_{ps}) K D_{ps,t} + I N V D_{ps,t} \]  

(8)

where

\text{dep}_{ps} \quad \text{is the capital depreciation rate of sector ps (parameter).}

In line with our segmentation of the saving market where each source of sav-
ings finance a particular investment category, investment by sector of destination
\( I N V D_{ps,t} \) 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 aggre-
gate investment price. For both types of investment, we adopt the quadratic form
proposed by Bourguignon et al. (1989).

We assume that multinationals distribute first their investment choices be-
tween sectors then between countries. In other words, after having selected a sec-
tor, 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 sec-
tors, we 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 decision to invest:

\[ \frac{F D I_{pro,t}}{K D_{pro,t}} = P_{1pro} \left( \frac{r_{pro,t}}{\epsilon_t r_t^* (i_t + \epsilon_1 + \text{dep}_{pro})} \right)^2 + P_{2pro} \left( \frac{r_{pro,t}}{\epsilon_t r_t^* (i_t + \epsilon_1 + \text{dep}_{pro})} \right) \]  

(9)

\[ \frac{F D I_{con.,t}}{K D_{con.,t}} = P_{1con.} \left( \frac{r_{con.,t}}{\epsilon_t r_t^* (i_t + \epsilon_1 + \text{dep}_{con.})} \right)^2 + P_{2con.} \left( \frac{r_{con.,t}}{\epsilon_t r_t^* (i_t + \epsilon_1 + \text{dep}_{con.})} \right) \]  

(10)

where

\[ P_{1pro} \quad \text{is a scale parameter}, \]
\[ r_{pro,t} \quad \text{the rental rate of capital in sector pro at period t}, \]
\[ r_t^* \quad \text{the international rental rate of capital at period t (exogenous)}, \]
\[ i_t \quad \text{the interest rate on domestic public debt at period t (exogenous)}, \]
\[ \epsilon_1 \quad \text{the country risk premium perceived by foreign investors}, \]
\[ P_{2pro} \quad \text{a scale parameter}. \]
We 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 and labour cost from the value of production.

\[
\mathit{r}_{ps,t} = \frac{P_{ps,t} X S_{ps,t} - \sum_i P C_{i,t} D H_{i,ps,t} - w_t L D_{ps,t}}{K D_{ps,t}} \tag{11}
\]

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

\[
\frac{D I N V_{pro,t}}{K D_{pro,t}} = P_{3 pro} \left( \frac{r_{pro,t}}{P I N V_t(i_t + \epsilon_2 + d e p_{pro})} \right)^2 + \frac{r_{pro,t}}{P_{4 pro} P I N V_t(i_t + \epsilon_2 + d e p_{pro})} \tag{12}
\]

\[
\frac{D I N V_{con^*,t}}{K D_{con^*,t}} = P_{3 con^*} \left( \frac{r_{con^*,t}}{P I N V_t(i_t + \epsilon_2 + d e p_{con^*})} \right)^2 + \frac{r_{con^*,t}}{P_{4 con^*} P I N V_t(i_t + \epsilon_2 + d e p_{con^*})} \tag{13}
\]

where

- \( D I N V_{pro,t} \) represents domestic investment in the construction sector at period \( t \) (in volume),
- \( P_{3 pro} \) a scale parameter,
- \( \epsilon_2 \) the country risk premium perceived by domestic investors. It is convenient to think that this risk premium is lower than the one perceived by foreign investors. We assume that \( \epsilon_2 \) is the half of \( \epsilon_1 \),
- \( P_{4 pro} \) a scale parameter.

In tradable sectors, firms maximize 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, we normalize the rental rate of capital in the public sector and we calculate capital demand in the following way:

\[
K D_{pub,t} = \frac{P V_{pub,t} V A_{pub,t} - w g_t L D G_{pub,t}}{r_{pub,t}}
\]
where

\[ PV_{\text{pub},t} \] is the value added price of sector \( \text{pub} \) at period \( t \),
\[ VA_{\text{pub},t} \] the value added of public sector \( \text{pub} \) at period \( t \),
\[ w_{g,t} \] the public wage at period \( t \) (exogenous),
\[ LDG_{\text{pub},t} \] the labour demand of sector \( \text{pub} \) at period \( t \).

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

\[ VARKD_{t+1} = KD_{\text{edu}^*,t+1} - KD_{\text{edu}^*,t} \]

As well, we 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. We present the adjustment mechanism of rural and urban migrant stocks in the following way: we 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, we 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 looses 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.

$$STKR_{1,t+1} = STKR_{1,t}(1 - \chi_1) + EMR_t$$ \hspace{1cm} (17)

for the first generation of rural migrants and:

$$STKU_{1,t+1} = STKU_{1,t}(1 - \chi_1) + EMU_t$$ \hspace{1cm} (18)

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 $t$,
- $\chi_1$ 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:

$$STKR_{2,t+1} = STKR_{2,t}(1 - \chi_2) + \chi_1 STKR_{1,t}$$ \hspace{1cm} (19)

for rural migrants and,

$$STKU_{2,t+1} = STKU_{2,t}(1 - \chi_2) + \chi_1 STKU_{1,t}$$ \hspace{1cm} (20)

for urban ones.

where

- $\chi_2$ 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:

$$STKR_{3,t+1} = STKR_{3,t} + \chi_2 STKR_{2,t}$$ \hspace{1cm} (21)

$$STKU_{3,t+1} = STKU_{3,t} + \chi_2 STKU_{2,t}$$ \hspace{1cm} (22)
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 disposable income. The remittance rate is written as follows:

\[ RR_{h,t} = V_{1h} YD_{h,t}^{\gamma_1} w_{i,t}^{\gamma_2} \]  

(23)

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 \( t \),
- \( \gamma_1 \) the elasticity of remittance rate with respect to household \( h \)'s income (-4.2% according to Bouhga-Hagbe (2004)),
- \( w_{i,t} \) the international wage rate at period \( t \) (exogenous),
- \( \gamma_2 \) the elasticity of remittance rate with respect to the international wage (1.8% according to Bouhga-Hagbe (2004)).

We assume arbitrarily 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:

\[ REM_{hr,t} = RR_{hr,t} STKR_{1,t} + 1/2 RR_{hr,t} STKR_{2,t} \]  

(24)

for the rural household and:

\[ REM_{hu,t} = RR_{hu,t} STKU_{1,t} + 1/2 RR_{hu,t} STKU_{2,t} \]  

(25)

for the urban household.

The parameters \( \chi_1 \) and \( \chi_2 \) 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.

When an individual or a household migrates from a region to another or when he decides to leave his country, this can not be done without costs. Any migratory movement induces 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...) for the migrant. 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:

\[ MC_t = V_3(TSTK_t)^\nu \]  

(26)
where

\[ MC_t \] represents migration costs at period \( t \),

\[ V_3 \] a scale parameter,

\[ TSTK_t \] the total stock of migrants at period \( t \):

\[ TSTK_t = STKR_{1,t} + STKR_{2,t} + STKR_{3,t} + STKU_{1,t} + STKU_{2,t} + STKU_{3,t} \]

\( \nu \) the elasticity of migration costs with respect to the total stock of migrants.

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:

\[ ISTK_{t+1} = ISTK_t + MIG_t \] (27)

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 \( DD_t \). The same adjustment mechanism prevails for the external public debt \( SFD_t \).

\[ SDD_{t+1} = (1 + i_t)SDD_t + DD_t \] (28)

\[ SFD_{t+1} = (1 + i^*_t)SFD_t + FD_t \] (29)

For the remaining exogenous variables, we examine their evolution over time and we calculate their average annual growth rate over 5 or 10 years, depending on the availability of the data. We add an adjustment mechanisms for the following variables:

\[ G_{i,t+1} = G_{i,t}(1 + g_G) \] (30)

\[ INVG_{t+1} = INVG_t(1 + g_{IG}) \] (31)

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.

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? We answer this question by running a scenario of a 20% rise in the erosion rate of the first and second generation of migrants, $\chi_1$ and $\chi_2$, that leads to a decline in the number of migrants expected to remit. And if 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), some options consist of channelling remittances away from real estate to productive sectors and reducing international transfer costs. Therefore, we run a scenario of a 50% drop in of the parameter estate which is the proportion of remittances invested in real estate. This is supposed to channel investments to productive sectors and guarantee the conditions for a sustainable growth. We also run a second simulation consisting of a a 20% drop in international transfer costs $tc$ that should increase the value of remittances received by households. 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, we run an additional simulation consisting of a 10% drop in the country risk premium perceived by domestic investors $\epsilon_2$.

Before beginning our study, we should indicate 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 our model, we have added updating procedures for public investment in infrastructure, public expenditure, the stock of foreign and domestic public debt, migrant stock, 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. Firms are then incited to produce more. This is translated in a higher economic growth. The additional demand for labour creates a pressure on rural and urban labour markets that drive wages upward. Surprisingly, this is true only for the rural wage. The logic is as follows: the urban labour market is characterised by unemployment. Urban population growth seems to be greater than the increasing labour demand by urban sectors, so that the unemployment rate increases and the urban wage decreases. However, urban household income rises. Indeed, the increasing public expenditures reduce public savings and raise government’s reliance on public debt. Consequently, the urban household accumulates more interest on his public lending that compensate for the drop of urban labour remuneration and allow an increase of his income. But his disposable income diminishes because the government can only adjust direct taxes in order
to preserve its savings\textsuperscript{13}. The urban household is then forced to reduce his consumption. Given that other things are equal, the lower demand generates a drop in the composite price of the main goods and services consumed by the urban household. The falling prices allow an improvement of urban household welfare. On the contrary, rural household’s income and welfare increase. The higher rural wage reduces migration intentions from rural areas while the lower urban wage stimulates urban migration. Given that remittances are motivated by altruism and depend on households’ disposable income, rural migrants must remit less and urban migrants more. Finally, the total amount of remittances grows, inducing an exchange rate appreciation necessary to maintain external savings constant. The exchange rate appreciation makes FDI profitable. Remittance growth also allows to finance additional domestic investment.

\textbf{Table 5- The BAU growth path\textsuperscript{14}}

<table>
<thead>
<tr>
<th>Variables</th>
<th>t + 1</th>
<th>t + 5</th>
<th>t + 10</th>
<th>t + 15</th>
<th>t + 20</th>
<th>t + 25</th>
</tr>
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<tbody>
<tr>
<td>wr</td>
<td>0.000</td>
<td>23.929</td>
<td>30.691</td>
<td>33.443</td>
<td>35.209</td>
<td>36.790</td>
</tr>
<tr>
<td>wu</td>
<td>0.000</td>
<td>-2.270</td>
<td>-2.718</td>
<td>-2.721</td>
<td>-2.574</td>
<td>-2.342</td>
</tr>
<tr>
<td>Y\textsubscript{hr}</td>
<td>0.000</td>
<td>8.543</td>
<td>11.864</td>
<td>13.853</td>
<td>15.311</td>
<td>16.445</td>
</tr>
<tr>
<td>Y\textsubscript{hu}</td>
<td>0.000</td>
<td>3.036</td>
<td>13.003</td>
<td>27.863</td>
<td>49.605</td>
<td>82.418</td>
</tr>
<tr>
<td>Welfare\textsubscript{hr}</td>
<td>0.000</td>
<td>7.321</td>
<td>9.787</td>
<td>11.152</td>
<td>12.160</td>
<td>13.014</td>
</tr>
<tr>
<td>Welfare\textsubscript{hu}</td>
<td>0.000</td>
<td>7.560</td>
<td>10.124</td>
<td>11.539</td>
<td>12.583</td>
<td>13.472</td>
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<tr>
<td>EMR</td>
<td>0.000</td>
<td>-21.258</td>
<td>-24.842</td>
<td>-24.171</td>
<td>-23.548</td>
<td>-23.865</td>
</tr>
<tr>
<td>EMU</td>
<td>0.000</td>
<td>16.993</td>
<td>31.980</td>
<td>43.397</td>
<td>51.364</td>
<td>55.893</td>
</tr>
<tr>
<td>REMIT\textsubscript{hr}</td>
<td>0.000</td>
<td>-17.782</td>
<td>-23.161</td>
<td>-26.113</td>
<td>-28.067</td>
<td>-29.634</td>
</tr>
<tr>
<td>REMIT\textsubscript{hu}</td>
<td>0.000</td>
<td>42.987</td>
<td>69.676</td>
<td>94.188</td>
<td>121.794</td>
<td>155.058</td>
</tr>
<tr>
<td>Total domestic inv.</td>
<td>0.000</td>
<td>4.750</td>
<td>4.999</td>
<td>5.283</td>
<td>5.718</td>
<td>6.283</td>
</tr>
<tr>
<td>Total FDI</td>
<td>0.000</td>
<td>0.766</td>
<td>0.782</td>
<td>1.132</td>
<td>1.649</td>
<td>2.372</td>
</tr>
<tr>
<td>GDP</td>
<td>0.000</td>
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<td>4.962</td>
<td>9.266</td>
<td>13.678</td>
<td>18.190</td>
</tr>
<tr>
<td>GNP</td>
<td>0.000</td>
<td>1.849</td>
<td>5.477</td>
<td>9.336</td>
<td>13.294</td>
<td>17.400</td>
</tr>
<tr>
<td>e</td>
<td>0.000</td>
<td>-6.639</td>
<td>-7.166</td>
<td>-6.401</td>
<td>-5.730</td>
<td>-5.523</td>
</tr>
</tbody>
</table>

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, we compare the value of a given variable at period \( t \) after the shock to its value at period \( t \) before the shock.

\textbf{4.1 Shock 1: A 20\% rise in the erosion rate of the first and second generations of migrants}

Such a shock has its first immediate impact on household income. When migrant stock is eroded, fewer rural and urban migrants will remit in the following

\textsuperscript{13}The direct tax on rural household income is null in the SAM of 1998 (Abdelkhalek and Zaoujal (2004))

\textsuperscript{14}All percentages are computed with respect to the base year. For variable notations, the reader should refer to Appendix 3.
period, leading ceteris paribus to a drop in rural and urban households’ income (Table 6). 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 firms\textsuperscript{15}. 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 (given by the equivalent variation) reduced. If all prices remain constant with respect to the BAU growth path, households will consume less goods and services, leading, ceteris paribus, to a drop in total internal demand addressed to each industry. Producers should reduce their production in order to meet the falling demand. However, not the production of all sectors decreases. This will be better understood once we examine the alternative uses of remittances, i.e for investment purposes.

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 we will see later, the domestic rental rate of capital rises with respect to the investment aggregate price (industrial agriculture, mining industry, textile and clothing, leather industry, paper industry, chemistry, rubber and plastic, metallurgy, machines and equipment, office machinery, 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. The expansion of industrial agriculture is sufficient to raise rural labour demand. Rural wage should therefore increase in order to balance the labour market. In contrast, private urban wage decreases because the majority of urban sectors shrink. We will see later how the evolution of rural and urban wages affects migration flows and future remittance flows. We turn now to the BOP effects of remittances.

Remittances to Morocco are computed in the BOP as current transfers. In order to maintain external savings 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 nominal exchange rate depreciation is necessary. Furthermore, this depreciation raises the wage of international migrants in domestic currency and encourages rural and urban people 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 and the drop of rural and urban household’s

\textsuperscript{15}We recall that in Morocco, only urban households and firms lend the government (Abdelkhalek and Zaoujal (2004)).
income that should encourage migrants to remit more, the total value of remittances continues to shrink over the following periods due to the erosion of the first and second generations of migrants.

In addition, the nominal exchange rate depreciation makes local producers more competitive on international markets and the exports of all tradable products increase. We point out that the above mentioned expanded sectors sell the most part of their production on international markets. Therefore, export expansion has a greater positive impact on their production. Producers will then ask for additional labour. But since capital is fixed for a given period, the increased labour demand rises the marginal productivity of capital, which is reflected in a better capital remuneration. We understand now, why domestic investment is attractive in these sectors, for a given aggregate price of investment.

After few periods, as soon as more capital is accumulated in the expanded sectors, the physical marginal productivity of capital decreases, ceteris paribus. Domestic investment in these sectors is no more profitable and given that other things are equal, the production of these sectors falls. Rural labour demand decreases now, pushing down the rural wage and further stimulating migration from rural areas.

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 (such as industrial agriculture, clothing and leather industry, paper industry, chemistry, rubber and plastic, metallurgy, machines and equipment, office machinery, radios and TV) and foreign investment decreasing due to the nominal exchange rate depreciation that lowers the differential, in domestic currency, between the domestic and international rental rate of capital. Therefore, the evolution of total investment in these sectors is ambiguous: it depends on the magnitude of each investment flow. Our 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 production. 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.
4.2 Shock 2: A 50% drop in the proportion of remittances invested in real estate

We have mentioned earlier that 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. This change in MRA’s investment behaviour is mainly explained by the fact that they have intensively invested in real estate.

A 50% drop in the proportion of remittances invested in real estate raises, since the first period, the proportion of remittances going to productive sectors (Table 7). Given that the current volume of investment affects the volume of capital in the next period, the volume of capital used in construction falls in the following period while productive sectors employ more capital (except tobacco industry, wood industries, oil refining, rubber industry, manufacture of

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### Table 6 - Shock 1: Percentage change of some macroeconomic variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>t + 1</th>
<th>t + 5</th>
<th>t + 10</th>
<th>t + 15</th>
<th>t + 20</th>
<th>t + 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>$REMIT_{hr}$</td>
<td>0.000</td>
<td>-3.687</td>
<td>-6.234</td>
<td>-7.685</td>
<td>-8.582</td>
<td>-9.203</td>
</tr>
<tr>
<td>$REMIT_{hu}$</td>
<td>0.000</td>
<td>-2.447</td>
<td>-3.419</td>
<td>-3.546</td>
<td>-3.394</td>
<td>-3.138</td>
</tr>
<tr>
<td>$Y_{hr}$</td>
<td>0.000</td>
<td>-0.166</td>
<td>-0.458</td>
<td>-0.708</td>
<td>-0.900</td>
<td>-1.048</td>
</tr>
<tr>
<td>$Y_{hu}$</td>
<td>0.000</td>
<td>-0.300</td>
<td>-0.506</td>
<td>-0.652</td>
<td>-0.775</td>
<td>-0.875</td>
</tr>
<tr>
<td>$Welfare_{hr}$</td>
<td>0.000</td>
<td>-0.898</td>
<td>-2.660</td>
<td>-3.901</td>
<td>-4.729</td>
<td>-5.296</td>
</tr>
<tr>
<td>$Welfare_{hu}$</td>
<td>0.000</td>
<td>-0.824</td>
<td>-2.561</td>
<td>-3.793</td>
<td>-4.614</td>
<td>-5.173</td>
</tr>
<tr>
<td>Total domestic inv.</td>
<td>0.000</td>
<td>-0.349</td>
<td>-0.664</td>
<td>-0.809</td>
<td>-0.890</td>
<td>-0.953</td>
</tr>
<tr>
<td>$GDP$</td>
<td>0.000</td>
<td>-0.073</td>
<td>-0.224</td>
<td>-0.395</td>
<td>-0.553</td>
<td>-0.686</td>
</tr>
<tr>
<td>$GNP$</td>
<td>0.000</td>
<td>-0.182</td>
<td>-0.387</td>
<td>-0.554</td>
<td>-0.691</td>
<td>-0.803</td>
</tr>
<tr>
<td>$w_r$</td>
<td>0.000</td>
<td>0.102</td>
<td>-0.103</td>
<td>-0.275</td>
<td>-0.379</td>
<td>-0.436</td>
</tr>
<tr>
<td>$w_u$</td>
<td>0.000</td>
<td>-0.025</td>
<td>-0.033</td>
<td>-0.044</td>
<td>-0.059</td>
<td>-0.075</td>
</tr>
<tr>
<td>$e$</td>
<td>0.000</td>
<td>0.415</td>
<td>0.603</td>
<td>0.584</td>
<td>0.500</td>
<td>0.406</td>
</tr>
<tr>
<td>Total FDI</td>
<td>0.000</td>
<td>-0.834</td>
<td>-1.256</td>
<td>-1.435</td>
<td>-1.553</td>
<td>-1.658</td>
</tr>
<tr>
<td>$EMU$</td>
<td>0.000</td>
<td>0.448</td>
<td>0.970</td>
<td>1.058</td>
<td>0.931</td>
<td>0.731</td>
</tr>
<tr>
<td>$EMU$</td>
<td>0.000</td>
<td>0.830</td>
<td>1.405</td>
<td>1.488</td>
<td>1.413</td>
<td>1.295</td>
</tr>
<tr>
<td>$TSTK$</td>
<td>0.000</td>
<td>0.034</td>
<td>0.218</td>
<td>0.405</td>
<td>0.541</td>
<td>0.625</td>
</tr>
<tr>
<td>$MC$</td>
<td>0.000</td>
<td>-0.052</td>
<td>-0.326</td>
<td>-0.604</td>
<td>-0.806</td>
<td>-0.931</td>
</tr>
</tbody>
</table>

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16 All percentages are computed with respect to the BAU growth path.
other non-metallic mineral products, metallurgy, metal processing, machines and equipment manufacturing, office machinery, radios and TV, car industry, trade and repair, hotels and restaurants, transports and telecommunication, financial activities). As we will see later, the drop of the capital remuneration with respect to the aggregate price of investment makes investment by households and firms in the last sectors not profitable. Also FDI seems not to be profitable in these sectors: the domestic rental rate of capital decreases with respect to the international one. When the volume of capital varies, one should expect, ceteris paribus, that the volume of production follows capital variation. The contraction of the above sectors is sufficient to drive down the economic growth: GDP and GNP both decrease with respect of the BAU growth path.

Since rural sectors expand, producers ask for additional labour in order to meet the rise in production. The increase in the rural wage is therefore necessary to rebalance the rural labour market. On the urban market, labour demand declines because the most part of the contracted sectors are labour intensive. This causes the private urban wage to fall. The wage evolution explains, ceteris paribus, the increase in rural household’s income and welfare (given by the equivalent variation). Urban household income decreases as expected but his disposable income and welfare are improved. Indeed, with the rise of rural household disposable income, internal migrants send fewer amounts of money to their family in rural areas.

In accordance with the altruistic motive for remittances, rural and urban migrants remit a smaller amount in comparison with the BAU growth path because rural and urban households’ income rise. An exchange rate depreciation is therefore necessary in order to maintain external savings fixed. Rural and urban migration are motivated by the exchange rate depreciation and by lower migration costs due to the network effect.

With the detected drop in remittances, we can give now an explanation to the contraction of the above mentioned sectors. Since the proportion of remittances not consumed is saved and helps to determine the aggregate value of investment, the fall in remittances induce, ceteris paribus, a drop in the total value of investment and consequently in the demand for investment goods by firms. It happens that the weight of investment demand in total internal demand addressed to these sectors is very high. Consequently, the drop of investment demand is sufficient to decrease the demand addressed to these sectors and motivates the producers to adjust downward their production. The decreasing production frees up labour and, since capital is fixed for a given period, capital becomes abundant and its marginal productivity decreases. Given that other things are equal, the rental rate of capital also decreases, negatively affecting domestic and foreign investments.

After some periods, the drop of remittances manages to compensate the pos-
itive evolution of the rural wage and induces a drop of rural household income. The latter will be obliged to reduce his consumption of goods and services. This is able to reduce total internal demand addressed to industrial agriculture and motivates the producers to diminish their production. When rural production decreases after few periods, producers reduce their demand for labour, leading to a shift from the upward trend of the rural wage. Indeed, the rural wage falls, contributing to a further drop in rural households’ income and welfare. Urban household income increases after few periods. The argument is as follows: the declining economic growth reduces indirect taxes collected by the government. This will have ceteris paribus a negative effect on public savings. The government will be then obliged to raise the direct tax on urban household income and contract more debt in order to finance public investment. The rise of domestic public debt increases the interest payments received by the urban household and firms. This is able to compensate the drop of the urban wage and explains the increase of urban household income. And the higher direct tax reduces his disposable income and therefore his welfare. The negative evolution of rural household income motivates migrants to remit in order to support the family left behind. The total amount of remittances increases finally and induces an exchange rate appreciation in order to maintain external savings constant.

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. Once again, these results could not be obtained without the segmentation of the savings market. This is due to the fact that domestic and foreign investments have different determinants that allow to have increasing domestic investment in one sector and decreasing foreign investment in the same sector, and vice versa. This is for example the case of mining and textile industries. If both investments had the same determinants, say the differential between the rental rate of capital and the aggregate price of investment, investment by destination of the latter two sectors would be higher as well as production.

Table 7- Shock 2: Percentage change of some macroeconomic variables\textsuperscript{17}

\textsuperscript{17}All percentages are computed with respect to the BAU growth path.
the GDP grows, dragging in its way the GNP. The above mentioned sectors slows down. Since the majority of sectors expand, produce more and vice versa. Now it becomes clear why only the production of same evolution of domestic investment. When it rises, the corresponding sectors of capital in these sectors decreases with respect to the aggregate price of investment instruments and manufacture of other transport means) because the rental rate of metallurgy, machines and equipment, office machinery, radios and TV, medical try, textile and clothing, leather and shoes industry, chemistry, rubber industry, and mostly in real estate (Table 8). However, we notice that domestic investment by destination of some sectors shrinks (industrial agriculture, mining industry, textile and clothing, leather and shoes industry, chemistry, rubber industry, metallurgy, machines and equipment, office machinery, 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 following period, the volume of capital will have, ceteris paribus, the same evolution of domestic investment. When it rises, the corresponding sectors produce more and vice versa. Now it becomes clear why only the production of the above mentioned sectors slows down. Since the majority of sectors expand, the GDP grows, dragging in its way the GNP.

<table>
<thead>
<tr>
<th>Variables</th>
<th>t + 1</th>
<th>t + 5</th>
<th>t + 10</th>
<th>t + 15</th>
<th>t + 20</th>
<th>t + 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>$MRA$</td>
<td>-51.949</td>
<td>-51.792</td>
<td>-51.394</td>
<td>-51.500</td>
<td>-52.026</td>
<td>-52.810</td>
</tr>
<tr>
<td>Total $DINV_{pro}$</td>
<td>0.352</td>
<td>-1.219</td>
<td>-2.039</td>
<td>-2.368</td>
<td>-2.451</td>
<td>-2.387</td>
</tr>
<tr>
<td>$GDP$</td>
<td>-0.173</td>
<td>-0.234</td>
<td>-0.571</td>
<td>-0.834</td>
<td>-0.987</td>
<td>-1.039</td>
</tr>
<tr>
<td>$GNP$</td>
<td>-0.874</td>
<td>-0.998</td>
<td>-1.153</td>
<td>-1.234</td>
<td>-1.244</td>
<td>-1.184</td>
</tr>
<tr>
<td>$wr$</td>
<td>2.716</td>
<td>-0.058</td>
<td>-0.632</td>
<td>-0.767</td>
<td>-0.788</td>
<td>-0.775</td>
</tr>
<tr>
<td>$wu$</td>
<td>-0.262</td>
<td>-0.007</td>
<td>0.028</td>
<td>0.006</td>
<td>-0.026</td>
<td>-0.051</td>
</tr>
<tr>
<td>$Y_{hr}$</td>
<td>1.183</td>
<td>0.217</td>
<td>-0.221</td>
<td>-0.477</td>
<td>-0.639</td>
<td>-0.736</td>
</tr>
<tr>
<td>$Y_{hu}$</td>
<td>-1.100</td>
<td>0.052</td>
<td>1.567</td>
<td>3.437</td>
<td>5.840</td>
<td>8.776</td>
</tr>
<tr>
<td>Welfare$_{hr}$$^e$</td>
<td>8.415</td>
<td>-0.431</td>
<td>-1.413</td>
<td>-1.455</td>
<td>-1.372</td>
<td>-1.202</td>
</tr>
<tr>
<td>Welfare$_{hu}$$^e$</td>
<td>8.560</td>
<td>-0.475</td>
<td>-1.476</td>
<td>-1.508</td>
<td>-1.419</td>
<td>-1.248</td>
</tr>
<tr>
<td>REMIT$_{hr}$</td>
<td>-4.924</td>
<td>-0.586</td>
<td>1.909</td>
<td>3.061</td>
<td>3.411</td>
<td>3.302</td>
</tr>
<tr>
<td>REMIT$_{hu}$$^e$</td>
<td>-7.249</td>
<td>-5.979</td>
<td>-3.250</td>
<td>-1.647</td>
<td>-0.811</td>
<td>-0.455</td>
</tr>
<tr>
<td>$e$</td>
<td>1.112</td>
<td>1.178</td>
<td>0.346</td>
<td>-0.390</td>
<td>-0.920</td>
<td>-1.287</td>
</tr>
<tr>
<td>EMR</td>
<td>0.000</td>
<td>2.338</td>
<td>1.564</td>
<td>0.287</td>
<td>-0.743</td>
<td>-1.479</td>
</tr>
<tr>
<td>EMU</td>
<td>0.000</td>
<td>2.509</td>
<td>0.584</td>
<td>-0.725</td>
<td>-1.523</td>
<td>-2.028</td>
</tr>
<tr>
<td>TSTK</td>
<td>0.000</td>
<td>0.348</td>
<td>0.672</td>
<td>0.636</td>
<td>0.430</td>
<td>0.168</td>
</tr>
<tr>
<td>MC</td>
<td>0.000</td>
<td>-0.519</td>
<td>-0.999</td>
<td>-0.946</td>
<td>-0.642</td>
<td>-0.252</td>
</tr>
<tr>
<td>Total $FDI$</td>
<td>-2.909</td>
<td>-1.929</td>
<td>-1.113</td>
<td>-0.611</td>
<td>-0.226</td>
<td>0.122</td>
</tr>
</tbody>
</table>

### 4.3 Shock 3: A 20% drop in transfer costs

We have seen in section 2 that the cost and delay of transfers are high. We try to see in what follows if lower international transfer costs really constitute a good opportunity in order 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 and extends their consumption budget and welfare.

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 (Table 8). However, we notice that domestic investment by destination of some sectors shrinks (industrial agriculture, mining industry, textile and clothing, leather and shoes industry, chemistry, rubber industry, metallurgy, machines and equipment, office machinery, 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 following period, the volume of capital will have, ceteris paribus, the same evolution of domestic investment. When it rises, the corresponding sectors produce more and vice versa. Now it becomes clear why only the production of the above mentioned sectors slows down. Since the majority of sectors expand, the GDP grows, dragging in its way the GNP.
The expanded sectors being mostly urban ones, total demand for urban labour increases, inducing a rise in the urban wage in order to rebalance the urban labour market. Therefore, migration flows from urban areas are dampened. Fewer people migrate, and the less will be the amount of remittances in the following period. The network effect is then reduced, inducing a rise in migration costs. On the other hand, the demand for rural labour decreases after the drop in rural production. The rural wage falls ceteris paribus and should encourage migration from rural areas. Indeed, internal migration to urban areas increases. However, rural migration to foreign countries unexpectedly decreases. This is easily explained once we observe the BOP effects of remittances: when the economy receives a larger amount of remittances, an appreciation of the nominal 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, discourage international migration from rural areas. Migration is further discouraged by higher migration costs due to the lower network effect. Unsurprisingly, the amount of remittances received decrease with respect to the BAU growth path. Nevertheless, the downward evolution of remittances is more than compensated by the drop in transfer costs.

The exchange rate appreciation also deteriorates the competitiveness of domestic producers and reduces their sales on foreign markets. It happens that the contracted sectors above offer the best part of their production on international markets. Thus the exchange rate appreciation that discourages exports will have, ceteris paribus, a higher negative impact on their production. The contracted sectors release labour, and given that the capital used in production is fixed for a given period, the marginal productivity of capital and, ceteris paribus, capital remuneration go down. This explains the drop of investment by destination of these sectors.

As soon as the other sectors expand, they ask for additional intermediary products. This rises the internal demand addressed to the contracted sectors to such an extent that they are obliged, after some periods, to increase the production offered on the domestic market. The increased supply on the local market compensates for the loss of export competitiveness so that total production of the previously contracted sectors expands. Additional rural labour is thus necessary, leading to a rise in the rural wage. This creates, besides the exchange rate appreciation, an additional motive for rural individuals to stay at home, and further justifies the reduction in the total amount remitted.

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 nominal 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? We answer this question by simulating an additional shock, Shock 3B that explores the simultaneous impact of permanent migration and lower international transfer costs, i.e. the combination of Shock 1 and Shock 3. We find that permanent migration reduces the positive effect of lower transfer costs on household income. Rural and urban households’ income increase over the first periods by less than Shock 3 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 Shock 3 is ran alone. Since remittances are driven by altruism, migrants will remit less. Together with permanent migration, the additional drop of remittances compensates the positive effect of lower transfer costs on incomes and induces a decrease of households’ income and welfare. Households reduce then their consumption budget and producers adjust down their production in order to meet the lower demand. Finally, the slow down of economic activity is lower than Shock 1. The conclusion is that if this option should be undertaken, this has to be done before the slow down of remittances.

Table 8- Shock 3: Percentage change of some macroeconomic variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>t + 1</th>
<th>t + 5</th>
<th>t + 10</th>
<th>t + 15</th>
<th>t + 20</th>
<th>t + 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_{hr}$</td>
<td>0.062</td>
<td>0.119</td>
<td>0.145</td>
<td>0.157</td>
<td>0.165</td>
<td>0.170</td>
</tr>
<tr>
<td>$Y_{hu}$</td>
<td>0.125</td>
<td>0.123</td>
<td>0.137</td>
<td>0.158</td>
<td>0.180</td>
<td>0.203</td>
</tr>
<tr>
<td>Welfare$_{hr}$</td>
<td>0.840</td>
<td>0.937</td>
<td>0.950</td>
<td>0.929</td>
<td>0.913</td>
<td>0.900</td>
</tr>
<tr>
<td>Welfare$_{hu}$</td>
<td>0.775</td>
<td>0.908</td>
<td>0.929</td>
<td>0.910</td>
<td>0.895</td>
<td>0.882</td>
</tr>
<tr>
<td>Total domestic inv.</td>
<td>0.098</td>
<td>0.176</td>
<td>0.152</td>
<td>0.136</td>
<td>0.131</td>
<td>0.131</td>
</tr>
<tr>
<td>GDP</td>
<td>0.024</td>
<td>0.046</td>
<td>0.083</td>
<td>0.107</td>
<td>0.121</td>
<td>0.130</td>
</tr>
<tr>
<td>GNP</td>
<td>0.064</td>
<td>0.090</td>
<td>0.112</td>
<td>0.124</td>
<td>0.132</td>
<td>0.137</td>
</tr>
<tr>
<td>$wr$</td>
<td>−0.139</td>
<td>0.052</td>
<td>0.083</td>
<td>0.082</td>
<td>0.077</td>
<td>0.073</td>
</tr>
<tr>
<td>$wu$</td>
<td>0.019</td>
<td>0.005</td>
<td>0.007</td>
<td>0.010</td>
<td>0.013</td>
<td>0.014</td>
</tr>
<tr>
<td>EMR</td>
<td>0.000</td>
<td>−0.321</td>
<td>−0.224</td>
<td>−0.127</td>
<td>−0.063</td>
<td>−0.022</td>
</tr>
<tr>
<td>EMU</td>
<td>0.000</td>
<td>−0.394</td>
<td>−0.263</td>
<td>−0.187</td>
<td>−0.143</td>
<td>−0.114</td>
</tr>
<tr>
<td>$e$</td>
<td>−0.179</td>
<td>−0.167</td>
<td>−0.096</td>
<td>−0.051</td>
<td>−0.026</td>
<td>−0.011</td>
</tr>
<tr>
<td>TSTK</td>
<td>0.000</td>
<td>−0.055</td>
<td>−0.109</td>
<td>−0.126</td>
<td>−0.128</td>
<td>−0.123</td>
</tr>
<tr>
<td>MC</td>
<td>0.000</td>
<td>0.083</td>
<td>0.163</td>
<td>0.190</td>
<td>0.192</td>
<td>0.185</td>
</tr>
<tr>
<td>REMIT$_{hr}$</td>
<td>−0.267</td>
<td>−0.579</td>
<td>−0.763</td>
<td>−0.825</td>
<td>−0.839</td>
<td>−0.833</td>
</tr>
<tr>
<td>REMIT$_{hu}$</td>
<td>−0.656</td>
<td>−0.924</td>
<td>−1.211</td>
<td>−1.363</td>
<td>−1.459</td>
<td>−1.534</td>
</tr>
<tr>
<td>Total FDI</td>
<td>0.372</td>
<td>0.306</td>
<td>0.243</td>
<td>0.224</td>
<td>0.221</td>
<td>0.223</td>
</tr>
</tbody>
</table>

18All percentages are computed with respect to the BAU growth path.
Table 8B- 

**Shock 3B: Percentage change of some macroeconomic variables**

<table>
<thead>
<tr>
<th>Variables</th>
<th>t + 1</th>
<th>t + 5</th>
<th>t + 10</th>
<th>t + 15</th>
<th>t + 20</th>
<th>t + 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_{hr}$</td>
<td>Shock 1</td>
<td>0.000</td>
<td>-0.166</td>
<td>-0.458</td>
<td>-0.708</td>
<td>-0.900</td>
</tr>
<tr>
<td></td>
<td>Shock 3B</td>
<td>0.062</td>
<td>0.119</td>
<td>0.145</td>
<td>0.157</td>
<td>0.165</td>
</tr>
<tr>
<td>$Y_{hu}$</td>
<td>Shock 1</td>
<td>0.000</td>
<td>-0.300</td>
<td>-0.506</td>
<td>-0.652</td>
<td>-0.775</td>
</tr>
<tr>
<td></td>
<td>Shock 3B</td>
<td>0.125</td>
<td>-0.180</td>
<td>-0.372</td>
<td>-0.498</td>
<td>-0.598</td>
</tr>
<tr>
<td>Welfare$^{hr}$</td>
<td>Shock 1</td>
<td>0.124</td>
<td>-0.898</td>
<td>-2.660</td>
<td>-3.901</td>
<td>-4.729</td>
</tr>
<tr>
<td></td>
<td>Shock 3B</td>
<td>0.840</td>
<td>0.937</td>
<td>0.950</td>
<td>0.929</td>
<td>0.913</td>
</tr>
<tr>
<td>GDP</td>
<td>Shock 1</td>
<td>0.000</td>
<td>-0.073</td>
<td>-0.224</td>
<td>-0.395</td>
<td>-0.553</td>
</tr>
<tr>
<td></td>
<td>Shock 3B</td>
<td>0.024</td>
<td>0.046</td>
<td>0.083</td>
<td>0.107</td>
<td>0.121</td>
</tr>
<tr>
<td>GNP</td>
<td>Shock 1</td>
<td>0.000</td>
<td>-0.182</td>
<td>-0.387</td>
<td>-0.554</td>
<td>-0.691</td>
</tr>
<tr>
<td></td>
<td>Shock 3B</td>
<td>0.064</td>
<td>0.090</td>
<td>0.112</td>
<td>0.124</td>
<td>0.132</td>
</tr>
<tr>
<td>REMIT$^{hr}$</td>
<td>Shock 1</td>
<td>0.000</td>
<td>-3.687</td>
<td>-6.234</td>
<td>-7.685</td>
<td>-8.582</td>
</tr>
<tr>
<td></td>
<td>Shock 3B</td>
<td>-0.267</td>
<td>-0.579</td>
<td>-0.763</td>
<td>-0.825</td>
<td>-0.839</td>
</tr>
<tr>
<td>REMIT$^{hu}$</td>
<td>Shock 1</td>
<td>0.000</td>
<td>-2.447</td>
<td>-3.419</td>
<td>-3.546</td>
<td>-3.394</td>
</tr>
<tr>
<td></td>
<td>Shock 3B</td>
<td>-0.656</td>
<td>-0.924</td>
<td>-1.211</td>
<td>-1.363</td>
<td>-1.459</td>
</tr>
</tbody>
</table>

4.4 **Shock 4: A 10% drop in the country risk premium perceived by domestic investors**

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. Therefore, an amelioration of the country risk premium can perfectly reflect the policies adopted by the government in order to attract investments. For this reason, we assess the impact of a 10% drop in the country risk premium perceived by domestic investors. We have pointed out earlier that the risk premium perceived by local investors is lower than the

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19All percentages are computed with respect to the BAU growth path.
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 must follow, ceteris paribus, the evolution of the capital volume. Surprisingly, the production of food industry, paper and editing, furniture industry and electricity decreases. This is due particularly to the fall of internal demand addressed to these sectors. Indeed, the disposable income of the urban household decreases after the rise of the compensatory tax imposed on his income, forcing him to reduce his consumption budget and consequently, the demand for each good and service. This is able to lower the demand addressed to some sectors, leading to a drop in their production. However, the overall activity grows. Since domestic producers offer their production on local and international markets, the production growth should be reflected in increased exports and local supply. An exchange rate depreciation is therefore necessary to guarantee the competitiveness of local producers on international markets and stimulate exports. We recall that export expansion increases total factor productivity growth in the corresponding sectors.

We give the following argument to the drop of the urban household disposable income: we recall that the improvement of the risk premium reduces the possibilities for the government to borrow domestically by channelling a part of local savings to investment. In addition to government savings, the public debt helps financing public investment in infrastructure. When the possibilities of domestic borrowing are reduced, the government should ceteris paribus extract more savings in order to meet its objectives. It rises particularly the direct compensatory tax imposed on urban household income. The disposable income of the latter is therefore reduced. The drop of urban household consumption creates a downward pressure on the demand addressed to producers. They will be obliged to reduce, ceteris paribus, their price in order to stimulate this demand (food industry, clothes industry, leather industry, paper industry, editing, chemistry, furniture industry, electricity, trade and repair, education and health, other services). The drop in the prices of goods and services that enter in the utility of urban household induce an improvement of his welfare.

Rural labour demand increases with the expansion of rural production and the rural wage rises, as expected, in order to rebalance the market. The urban

\[\text{The indirect tax on rural household income is zero in the SAM of 1998 (Abdelkhalek and Zaoujal (2004)).}\]
wage also increases with the growth of the majority of urban sectors. While one should expect a drop in international migration from rural and urban areas after the increase in rural and urban wages, we remark that the exchange rate depreciation counterbalance the downward effect of the wage improvement on migration intentions. As expected, households’ income follows the wage evolution. Since remittances are based on altruistic motives, the increase in rural household’s disposable income lowers the intentions to remit. On the contrary, urban migrants remit more in order to support the urban household whose disposable income decreases. However, after few periods, urban household income decreases because the drop of the domestic public debt, that lowers the interest revenues received by the urban household and firms, compensates the rise of the urban wage. Indeed, with the economic growth of the majority of urban sectors, the government will collect more indirect taxes. This will help it to reduce its deficit without any need for additional domestic debt nor additional direct taxes on urban household income. The disposable income of urban household therefore increases and urban migrants remit less than before.

With the drop of the direct tax imposed his income after few periods, the urban household profits from a higher disposable income, allowing him to raise his consumption. The positive evolution of his consumption will have a positive effect on the demand addressed to the contracted sectors. Consequently, the production of the latters will be adjusted upward.

We also point out that this policy needs to be settled before the cut down in remittances. We run Shock 4B that is a combination of Shock 1 and Shock 4 and find that permanent migration reduces the economic performance due to the improvement of the country risk premium, because it restricts the proportion of remittances that is invested. It also reduces households’ welfare: permanent migration causes a negative economic growth that induces a lower labour demand. Consequently, wages fall down in comparison to Shock 4, dragging in their way households’ income and welfare.

Table 9- Shock 4: Percentage change of some macroeconomic variables

\[21\] All percentages are computed with respect to the BAU growth path.
Table 9B-

<table>
<thead>
<tr>
<th>Variables</th>
<th>t + 1</th>
<th>t + 5</th>
<th>t + 10</th>
<th>t + 15</th>
<th>t + 20</th>
<th>t + 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total domestic inv.</td>
<td>2.351</td>
<td>2.845</td>
<td>2.755</td>
<td>2.673</td>
<td>2.627</td>
<td>2.589</td>
</tr>
<tr>
<td>Total FDI</td>
<td>3.604</td>
<td>2.795</td>
<td>2.292</td>
<td>2.038</td>
<td>1.866</td>
<td>1.720</td>
</tr>
<tr>
<td>GDP</td>
<td>0.000</td>
<td>0.437</td>
<td>0.793</td>
<td>0.984</td>
<td>1.071</td>
<td>1.092</td>
</tr>
<tr>
<td>GNP</td>
<td>-0.042</td>
<td>0.266</td>
<td>0.474</td>
<td>0.586</td>
<td>0.636</td>
<td>0.643</td>
</tr>
<tr>
<td>e</td>
<td>0.036</td>
<td>0.474</td>
<td>1.026</td>
<td>1.386</td>
<td>1.613</td>
<td>1.761</td>
</tr>
<tr>
<td>wr</td>
<td>-0.449</td>
<td>0.871</td>
<td>1.176</td>
<td>1.233</td>
<td>1.224</td>
<td>1.194</td>
</tr>
<tr>
<td>wu</td>
<td>0.036</td>
<td>0.057</td>
<td>0.108</td>
<td>0.151</td>
<td>0.182</td>
<td>0.202</td>
</tr>
<tr>
<td>$Y_{hr}$</td>
<td>-0.198</td>
<td>0.519</td>
<td>0.864</td>
<td>1.032</td>
<td>1.117</td>
<td>1.154</td>
</tr>
<tr>
<td>$Y_{hu}$</td>
<td>0.243</td>
<td>0.075</td>
<td>-0.179</td>
<td>-0.562</td>
<td>-1.118</td>
<td>-1.836</td>
</tr>
<tr>
<td>Welfare^{hus}</td>
<td>3.408</td>
<td>5.891</td>
<td>6.788</td>
<td>6.894</td>
<td>6.701</td>
<td>6.338</td>
</tr>
<tr>
<td>EMR</td>
<td>0.000</td>
<td>0.053</td>
<td>0.844</td>
<td>1.543</td>
<td>2.030</td>
<td>2.362</td>
</tr>
<tr>
<td>EMU</td>
<td>0.000</td>
<td>0.363</td>
<td>1.003</td>
<td>1.354</td>
<td>1.556</td>
<td>1.698</td>
</tr>
<tr>
<td>REMIT_{hr}</td>
<td>0.857</td>
<td>-2.173</td>
<td>-3.484</td>
<td>-3.853</td>
<td>-3.805</td>
<td>-3.571</td>
</tr>
<tr>
<td>REMIT_{hu}</td>
<td>2.794</td>
<td>0.952</td>
<td>-0.376</td>
<td>-0.866</td>
<td>-0.920</td>
<td>-0.723</td>
</tr>
</tbody>
</table>

Shock 4B: Percentage change of some macroeconomic variables$^{22}$

$^{22}$All percentages are computed with respect to the BAU growth path.
the saving market, where remittances do not finance the same sectors as domestic expenditures.

In this context, surveys on remittances from the work on Morocco that consists of surveys and general statements not necessarily show that remittances have most of the time been beneficial. The national accounts of Morocco showed that remittances have 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.

5 Conclusion

Policy makers in less developed as well as developed countries have implicitly assumed that remittances benefit the country of origin. Some less developed countries, such as Morocco, have even used these possible benefits to underpin their emigration policy. But now, this is not the main question. Surveys on Morocco showed that remittances have 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.

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 general statements not verified empirically. It also adds to the literature on MENA countries that have been generally ruled out in this context, in spite of being highly dependent on remittances. Another contribution of this paper is to model a segmentation of the saving market, where remittances do not finance the same sectors as domestic spending.
investment or FDI. This is supposed to better draw the reality since not all kinds of investment have the same determinants and will 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. We 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. We 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 domestic investors. Nonetheless, not all the policies proposed by surveys are advantageous. Surprisingly, we find that the drop of the proportion of remittances invested in real estate reduces economic growth and welfare. Indeed, since remittances are motivated by altruism, the rise of households’ income induces a drop in the amount remitted. Given that other things are equal, the nominal exchange rate depreciates and discourages FDI. But also, the drop of the amount remitted decreases total savings and consequently the demand of investment goods by firms that affects the total internal demand addressed to sectors. The drop in 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 case of the risk premium amelioration.

References


APPENDIX 1

DATA

The social accounting matrix (SAM) constitutes the empirical database required to satisfy the accounting coherence of a CGE model. We 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 tables of the Moroccan economy in 1998. We 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 sectors\textsuperscript{23}.

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).

For lack of data on Moroccan emigration, we resort to the data published by the OECD in 2006 on immigrant inflows by nationality in some OECD countries. More specifically, we 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. We 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 of the International Organization of Migration (Erf and Heering (2002)),

\textsuperscript{23}For further details, see Karam and Decaluwé (2007).
Moroccan emigration towards European countries is more originated from rural areas. We suppose that 60% of the national emigration flow/stock take place from rural areas and 40% from urban areas.

For the majority of exogenous variables, we observed their evolution over 5 or 10 years, according to the data, and calculated their average annual growth rate. We 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, we 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% (US-AID\textsuperscript{24}) and the capital depreciation rate at 8% (Agénor and El Aynaoui (2004)).

\textsuperscript{24}United States Agency for International Development.
APPENDIX 2

SECTORS AND PROFESSIONAL CATEGORIES NOTATIONS

Sectors

SA  subsistence agriculture
IA  industrial agriculture
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 ad health
SER other non financial services
APPENDIX 3

EQUATIONS OF THE MODEL

Notations

$i$ and $j$ refers to sectors, $ps$ and $pub$ to private and public sectors respectively, $pro$ to productive sectors i.e $ps$ minus real estate, $up$ and $ru$ to urban and rural private sectors, $tr$ and $ntr$ to tradable and non tradable sectors, $ag$ to agents, $da$ to domestic agents, $h$ to households, and $t$ to the period of time.

Parameter definition

\begin{align*}
A_{O ps} & \quad \text{Scale parameter of the value added CES function} \\
\alpha_{ps} & \quad \text{Share parameter of this function} \\
\sigma_{ps} & \quad \text{Elasticity of substitution between labor and capital} \\
a & \quad \text{Parameter in the value added function of subsistence agriculture} \\
b & \quad \text{Parameter in the value added function of subsistence agriculture} \\
f & \quad \text{Parameter in the value added function of subsistence agriculture} \\
l_{pub} & \quad \text{Labour share in public value added (Leontief)} \\
k_{pub} & \quad \text{Capital share in public value added (Leontief)} \\
io_j & \quad \text{Share of intermediary consumption in the production (Leontief) of sector } j \\
v_j & \quad \text{Share of value added in the production (Leontief) of sector } j \\
aij_{i,j} & \quad \text{Intermediary consumption of good } i \text{ by unit of production of sector } j \\
B_1 & \quad \text{Scale parameter of the CET function of the rural population} \\
\varpi_1 & \quad \text{Share parameter of this function} \\
\varepsilon_1 & \quad \text{Elasticity of transformation between international rural migrants and national workers} \\
B_2 & \quad \text{Scale parameter of the CET function of the rural population that decides to stay in Morocco} \\
\varpi_2 & \quad \text{Share parameter of this function} \\
\varepsilon_2 & \quad \text{Elasticity of transformation between internal migrants and rural workers} \\
B_3 & \quad \text{Scale parameter of the CET function of the urban population} \\
\varpi_3 & \quad \text{Share parameter of this function} \\
\varepsilon_3 & \quad \text{Elasticity of transformation between international urban migrants and urban workers} \\
imc & \quad \text{Internal migration costs} \\
\psi_h & \quad \text{Household’s } h \text{ propensity to save}
\end{align*}
\( \eta_{ag} \) Share of capital remuneration received by agent \( ag \)

\( \phi_{ag} \) Share of labour remuneration received by agent \( ag \)

\( tc \) transfer costs

\( \vartheta_{ag} \) Part of interest rates on domestic public debt going to agent \( ag \)

\( V_3 \) Parameter in the international migration cost function

\( \nu \) Elasticity of international migration costs to the stock of international migrants

\( V_{1h} \) Parameter in the international remittance rate function of household \( h \)

\( \nu \) Elasticity of stock variation financed by foreign firms

\( \gamma_1 \) Elasticity of international remittance rate with respect to household \( h \)'s income

\( \gamma_2 \) Elasticity of international remittance rate with respect to the international wage

\( V_2 \) Parameter in the remittance rate function from urban to rural household

\( \gamma_3 \) Elasticity of internal remittance rate with respect to rural household income

\( tx_j \) Indirect taxes on sector \( j \) products

\( tm_{tr} \) Import tariff rate on product \( tr \)

\( te_{tr} \) Export tariff rate on product \( tr \)

\( t_{gh} \) Direct tax rate on household \( h \)'s income

\( t_{ge} \) Direct tax rate on firms' income

\( C_{1tr} \) Scale parameter of the CET production function

\( \delta_{1tr} \) Share parameter of this function

\( \kappa_{1tr} \) Transformation elasticity (CET production function)

\( \varphi_{tr} \) Price elasticity of export demand

\( C_{2tr} \) Scale parameter of the Armington CES function

\( \delta_{2tr} \) Share parameter of this function

\( \kappa_{2tr} \) Substitution elasticity (Armington function)

\( \beta_{i,h} \) Budgetary share of good \( i \) in the supernumerary income of household \( h \)

\( \mu_i \) Share of product \( i \) in total investment value

\( D_c \) Scale parameter of the wage curve

\( \theta_j \) Share of sector \( j \) value added in GDP at factor cost

\( \chi_1 \) Erosion rate of the first generation of migrants

\( \chi_2 \) Erosion rate of the second generation of migrants

\( dep_{ps} \) Capital depreciation rate of sector \( ps \)

\( P_{1ps} \) Parameter in the FDI equation

\( P_{2ps} \) Parameter in the FDI equation

\( \epsilon_1 \) The country risk premium perceived by foreign investors

\( \epsilon_2 \) The country risk premium perceived by domestic investors

\( P_{3ps} \) Parameter in the equation of domestic investment by households and firms

\( P_{4ps} \) Parameter in the equation of domestic investment by households and firms

\( gg \) Growth rate of government expenditures

\( gIG \) Growth rate of public investment in infrastructure
Natural growth rate of rural population

Natural growth rate of urban population

Parameter in the domestic public debt function

Elasticity of domestic public debt financed by households and firms with respect to the risk factor

Part of international remittances going to consumption

Part of international remittances (net of the amount consumed) going to real estate

**Variable definition**

### 5.1 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 \( j \)
- \( P_{wm_{tr,t}} \): International import price of product \( tr \), in foreign currency
- \( P_{we_{tr,t}} \): 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
- \( P\text{index}_t \): GDP deflator, numéraire

#### b) Production

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

c) **Factors of production**

\( KD_{j,t} \) Capital demand by sector \( j \)
\( LDR_{ru,t} \) Labour demand by rural sector \( ru \)
\( LDU_{up,t} \) Labour demand by urban private sector \( up \)
\( LDG_{pub,t} \) Labour demand by public sector \( pub \)
\( LSR_t \) 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_{ht} Migrant remittances
DD_t Domestic public debt
FD_t Foreign public debt
SDD_t Stock of domestic public debt
SFD_t Stock of foreign public debt

f) Tax revenues

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

h) Final demand

CT_{i,h,t} Consumption of good i by household h
CMINI_{i,h,t} Minimum consumption of good i by household h
BC_{h,t} Consumption budget of household h
G_{i,t} Public consumption of product i
DIT_{i,t} Total intermediary consumption of product i
INV_{i,t} Investment demand of product i
STK_{i,t} Stock variation of product i
ITVOL_t Gross fixed capital formation (volume)
IT_t Gross fixed capital formation (value)

i) Investment

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)

K_t Adjustment variable in the debt equation
adj_y_t Adjustment variable for direct tax
Exogenous variables

\[ \begin{align*}
wg_t & \quad \text{Wage rate in the urban public sector} \\
w_i & \quad \text{International wage rate, in foreign currency} \\
r_{pub,t} & \quad \text{Capital return of public sector} \text{ pub} \\
r_{t}^{*} & \quad \text{International rental rate of capital} \\
i_t & \quad \text{Domestic interest rate} \\
i_{t}^{*} & \quad \text{International interest rate} \\
P_{wm_{tr,t}} & \quad \text{International import price of product } tr, \text{ in foreign currency} \\
P_{we_{tr,t}} & \quad \text{International export price of product } tr, \text{ in foreign currency} \\
KD_{ps,t} & \quad \text{Capital demand by sector } ps \\
CMIN_{i,h,t} & \quad \text{Minimum consumption of product } i \text{ by household } h \\
G_{i,1} & \quad \text{Public consumption of product } i, \text{ at the first period} \\
STK_{i,t} & \quad \text{Stock variation of product } i \\
S_{row,t} & \quad \text{External savings} \\
T_{h,ag,t} & \quad \text{Transfers by agent } ag \text{ to household } h \\
T_{fm,ag,t} & \quad \text{Transfers by agent } ag \text{ to firms} \\
T_{row,ag,t} & \quad \text{Transfers by agent } ag \text{ to the Rest of the World} \\
T_{gov,,row,t} & \quad \text{Transfers made by the government to itself} \\
T_{gov,row,t} & \quad \text{Transfers by the Rest of the World to the government} \\
LSR_{1} & \quad \text{Rural population, at the first period} \\
LSU_{1} & \quad \text{Urban population, at the first period} \\
STKR_{1,1} & \quad \text{The first generation of rural migrants, at the first period} \\
STKU_{1,1} & \quad \text{The first generation of urban migrants, at the first period} \\
STKR_{2,1} & \quad \text{The second generation of rural migrants, at the first period} \\
STKU_{2,1} & \quad \text{The second generation of urban migrants, at the first period} \\
STKR_{3,1} & \quad \text{The third generation of rural migrants, at the first period} \\
STKU_{3,1} & \quad \text{The third generation of urban migrants, at the first period} \\
TSTK_{1} & \quad \text{Total stock of international migrants, at the first period} \\
ISTK_{1} & \quad \text{Stock of internal migrants, at the first period} \\
SDD_{1} & \quad \text{Stock of internal public debt, at the first period} \\
SFD_{1} & \quad \text{Stock of external public debt, at the first period} \\
INVG_{1} & \quad \text{Public investment in the construction sector, at the first period} \\
VARKD_{1} & \quad \text{Capital demand variation in the public sector, at the first period} \\
P_{index_{t}} & \quad \text{GDP deflator, numéraire} \\
\end{align*} \]

Equations

Rural sector

\[ \begin{align*}
XS_{ru,t} &= VA_{ru,t}/v_{ru} \quad \text{(A1)} \\
CI_{ru,t} &= io_{ru}XS_{ru,t} \quad \text{(A2)} \\
DI_{i,ru,t} &= aij_{i,ru}CI_{ru,t} \quad \text{(A3)}
\end{align*} \]
VA_{sa^*,t} = a(1 - e^{-(LDR_{sa^*,t}/b)}), \quad (A4)\\
VA_{ia^*,t} = A_{ia^*,t} \{ \alpha_{ia^*} LDR_{ia^*,t}^{(\sigma_{ia^*}-1)/\sigma_{ia^*}} + (1 - \alpha_{ia^*}) KD_{ia^*,t}^{(\sigma_{ia^*}-1)/\sigma_{ia^*}} \} \sigma_{ia^*} / (\sigma_{ia^*}-1), \quad (A5)\\
LDR_{sa^*,t} = \frac{PV_{sa^*,t} VA_{sa^*,t}}{w_{rt}} \quad (A6)\\
LDR_{ia^*,t}/KD_{ia^*,t} = \left( \frac{\alpha_{ia^*}}{1 - \alpha_{ia^*}} \frac{r_{ia^*,t}}{w_{rt}} \right)^{\sigma_{ia^*}} \quad (A7)\\

Urban private sector\\
XS_{up,t} = VA_{up,t}/v_{up} \quad (A8)\\
CI_{up,t} = io_{up} XS_{up,t} \quad (A9)\\
DI_{i,up,t} = a_{ij_{i,up}} CI_{up,t} \quad (A10)\\
VA_{up,t} = A_{up,t} \{ \alpha_{up} LDU_{up,t}^{(\sigma_{up}-1)/\sigma_{up}} + (1 - \alpha_{up}) KD_{up,t}^{(\sigma_{up}-1)/\sigma_{up}} \} \sigma_{up} / (\sigma_{up}-1) \quad (A11)\\
LDU_{up,t}/KD_{up,t} = \left( \frac{\alpha_{up}}{1 - \alpha_{up}} \frac{r_{up,t}}{w_{ut}} \right)^{\sigma_{up}} \quad (A12)\\

Public sector\\
XS_{pub,t} = VA_{pub,t}/v_{pub} \quad (A13)\\
CI_{pub,t} = io_{pub} XS_{pub,t} \quad (A14)\\
DI_{i,pub,t} = a_{ij_{i,pub}} CI_{pub,t} \quad (A15)\\
VA_{pub,t} = KD_{pub,t}/k_{pub} \quad (A16)\\
LDG_{pub,t} = l_{pub} VA_{pub,t} \quad (A17)\\
KD_{pub,t} = \frac{PV_{pub,t} VA_{pub,t} - w_{gt} LDG_{pub,t}}{r_{pub,t}} \quad (A18)
Migratory flows

\[
LSR_t = B_1 [\omega_1 NAT_t^{(\epsilon_1-1)/\epsilon_1} + (1 - \omega_1) EMR_t^{(\epsilon_1-1)/\epsilon_1}]^{\epsilon_1/(\epsilon_1-1)} \tag{A19}
\]

\[
EMR_t \frac{NAT_t}{NAT_t} = \frac{\omega_1}{1 - \omega_1} \frac{w_{t-1}e_{t-1}(1 - MC_{t-1})}{w_{t-1}} - \epsilon_1 \tag{A20}
\]

\[
NAT_t = B_2 [\omega_2 NATR_t^{(\epsilon_2-1)/\epsilon_2} + (1 - \omega_2) MIG_t^{(\epsilon_2-1)/\epsilon_2}]^{\epsilon_2/(\epsilon_2-1)} \tag{A21}
\]

\[
MIG_t \frac{NATR_t}{NATR_t} = \frac{\omega_2}{1 - \omega_2} \frac{w_{t-1}(1 - MC_{t-1})}{w_{t-1}} - \epsilon_2 \tag{A22}
\]

\[
LSU_t = B_3 [\omega_3 NATU_t^{(\epsilon_3-1)/\epsilon_3} + (1 - \omega_3) EMU_t^{(\epsilon_3-1)/\epsilon_3}]^{\epsilon_3/(\epsilon_3-1)} \tag{A23}
\]

\[
EMU_t \frac{NATU_t}{NATU_t} = \frac{\omega_3}{1 - \omega_3} \frac{w_{t-1}e_{t-1}(1 - MC_{t-1})}{w_{t-1}} - \epsilon_3 \tag{A24}
\]

Income/Savings of households and firms

\[
Y_{hr}^{\cdot},t = \sum_{ru} w_{r,t} LDR_{ru,t} + \eta_{hr}^{\cdot} \sum_j r_j KD_{j,t} + \sum_{ag} T_{hr,\cdot,ag,t} + \text{IR}_t ISTK_t + (1 - \text{tc})REM_{hr}^{\cdot,\cdot,t} \tag{A25}
\]

\[
Y_{hu}^{\cdot},t = (1 - \phi_{row})\left[\sum_{up} w_{u,t} LDU_{up,t} + \sum_{pub} w_{g,t} LDG_{pub,t}\right] + \eta_{hu}^{\cdot} \sum_j r_{j,t} KD_{j,t} + \sum_{ag} T_{hu,\cdot,ag,t} + \vartheta_{hu}^{\cdot}(i_t SDD_t) + (1 - \text{tc})REM_{hu}^{\cdot,\cdot,t} \tag{A26}
\]

\[
Y_{WR}^{hr}^{\cdot},t = \sum_{ru} w_{r,t} LDR_{ru,t} + \eta_{hr}^{\cdot} \sum_j r_j KD_{j,t} + \sum_{ag} T_{hr,\cdot,ag,t} + \text{IR}_t ISTK_t \tag{A27}
\]

\[
Y_{WR}^{hu}^{\cdot},t = (1 - \phi_{row})\left[\sum_{up} w_{u,t} LDU_{up,t} + \sum_{pub} w_{g,t} LDG_{pub,t}\right] + \eta_{hu}^{\cdot} \sum_j r_{j,t} KD_{j,t} + \sum_{ag} T_{hu,\cdot,ag,t} + \vartheta_{hu}^{\cdot}(i_t SDD_t) \tag{A28}
\]

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\[ Y_{\text{fm},t} = \left( 1 - \eta^{\text{hr}}, - \eta^{\text{hu}}, - \eta^{\text{gu}}, - \eta^{\text{row}}, - \text{PROF}_t \right) \sum_j r_{j,t} KD_{j,t} + \sum_{ag} T_{\text{fm},ag,t} + (1 - \vartheta_{\text{hu}}) (t_t SDD_t) \] (A29)

\[ Y D W R_{\text{hr},t} = Y W R_{\text{hr},t} (1 - ty^{\text{hr}} \times \text{adj}_t) - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{row},t} - T_{\text{hr},t}^{\text{row},t} \] (A30)

\[ Y D W R_{\text{hu},t} = Y W R_{\text{hu},t} (1 - ty^{\text{hu}} \times \text{adj}_t) - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{row},t} - T_{\text{hr},t}^{\text{row},t} \] (A31)

\[ Y D_{\text{hr},t} = Y_{\text{hr},t} (1 - ty^{\text{hr}} \times \text{adj}_t) - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{row},t} - T_{\text{hr},t}^{\text{row},t} \] (A32)

\[ Y D_{\text{hu},t} = Y_{\text{hu},t} (1 - ty^{\text{hu}} \times \text{adj}_t) - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{row},t} - T_{\text{hr},t}^{\text{row},t} \] (A33)

\[ \text{REM}_{\text{hr},t} = \text{RR}_{\text{hr},t} STKR_1,t + 1/2\text{RR}_{\text{hr},t} STKR_2,t \] (A34)

\[ \text{REM}_{\text{hu},t} = \text{RR}_{\text{hu},t} STKU_1,t + 1/2\text{RR}_{\text{hu},t} STKU_2,t \] (A35)

\[ \text{RR}_{i,t} = V_{i \text{h}} Y D_{i,t}^{\gamma_1} \gamma_2 \] (A36)

\[ \text{IR}_t = V_2 Y D_{\text{hr},t}^{\gamma_3} \] (A37)

\[ \text{PROF}_t = \frac{\sum_{ps} FDI_{ps,t}}{ITVOL_t} \] (A38)

\[ S_{i,t} = \psi_{i} Y D W R_{i,t} \] (A39)

\[ B C_{\text{hr},t} = Y_{\text{hr},t} (1 - ty^{\text{hr}} \times \text{adj}_t) - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{row},t} - T_{\text{hr},t}^{\text{row},t} - (1 - \text{cons}_{\text{hr}}) (1 - ty^{\text{hr}} \times \text{adj}_t) (1 - tc) \text{REM}_{\text{hr},t} \] (A40)

\[ B C_{\text{hu},t} = Y_{\text{hu},t} (1 - ty^{\text{hu}} \times \text{adj}_t) - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{hr},t} - T_{\text{hr},t}^{\text{row},t} - T_{\text{hr},t}^{\text{row},t} - \text{IR}_t \text{ISTK}_t - S_{\text{hu},t} \] (A41)

\[ S_{\text{fm},t} = Y_{\text{fm},t} - \sum_{ag} T_{ag,\text{fm},t} \] (A42)
Government receipts and expenditures

\[ TI_{tr,t} = tx_{tr}(P_{t}XS_{tr,t} - PE_{t}EXS_{tr,t}) + tx_{tr}(1 + tm_{tr})e_{t}Pmw_{tr,t}M_{tr,t} \] (A43)

\[ TI_{ntr,t} = tx_{ntr}PL_{ntr,t}XS_{ntr,t} \] (A44)

\[ TIM_{tr,t} = tm_{tr}e_{t}Pmw_{tr,t}M_{tr,t} \] (A45)

\[ TIE_{tr,t} = te_{tr}PE_{tr,t}EXS_{tr,t} \] (A46)

\[ T_{^\text{gov},h,t} = (t_{h} \times adj_{t})Y_{h,t} \] (A47)

\[ T_{^\text{gov}^\ast,fm^\ast,t} = tyeY_{fm^\ast,t} \] (A48)

\[ Y_{^\text{gov},t} = \eta_{^\text{gov}} \sum_{j} \bar{r}_{j,t}KD_{j,t} + \sum_{tr} TIM_{tr,t} + \sum_{tr} TIE_{tr,t} + \sum_{j} T\text{I}_{j,t} + \sum_{ag} T_{^\text{gov}^\ast,ag,t} \] (A49)

\[ S_{^\text{gov}^\ast,t} = Y_{^\text{gov}^\ast,t} - \sum_{i} PC_{i,t}G_{i,t} - \sum_{ag} T_{ag,^\text{gov}^\ast,t} - t_{i}SDD_{t} - e_{i}SFD_{t} \] (A50)

External trade

\[ A_{tr,t} = A_{tr,t-1}(EXS_{tr,t-1})^{\kappa} \] (A51)

for \( EXS_{tr,t-1} > EXS_{tr,t-2} \)

\[ A_{tr,t} = A_{tr,t-1} \] (A52)

for \( EXS_{tr,t-1} \leq EXS_{tr,t-2} \)

\[ A_{ps,t} = AO_{ps} \] (A53)

for \( ps \neq tr \)

\[ XS_{tr,t} = C_{tr}[\delta_{tr}EXS_{tr,t}^{\kappa_{tr,t-1}}/\kappa_{tr,t} + (1 - \delta_{tr})DOM_{tr,t}^{\kappa_{tr,t-1}}/\kappa_{tr,t}/(\kappa_{tr,t-1})] \] (A54)

\[ XS_{ntr,t} = DOM_{ntr,t} \] (A55)
\[
\frac{EXS_{tr,t}}{DOM_{tr,t}} = (\delta_{1tr} \frac{PL_{tr,t}}{PE_{tr,t}})^{\kappa_{1tr}}
\]

(A56)

\[
EXD_{tr,t} = EXDO_{tr}(\frac{Pw_{tr,t}}{Pfob_{tr,t}})^{\varphi_{tr}}
\]

(A57)

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

(A58)

\[
Q_{ntr,t} = DOM_{ntr,t}
\]

(A59)

\[
\frac{M_{tr,t}}{DOM_{tr,t}} = (\delta_{2tr} \frac{PD_{tr,t}}{PM_{tr,t}})^{\kappa_{2tr}}
\]

(A60)

\[
S_{row,t} = \sum_{tr} Pwm_{tr,t}M_{tr,t} + \phi_{row} \frac{\sum_{up} wu_{l}LDU_{up,t} + \sum_{pub} wg_{t}LDG_{pub,t}}{e_t}
\]

\[
+ (\eta_{row} + PROF_t) \sum_{j} r_{j,t}KD_{j,t} + \sum_{ag} T_{row,ag,t} + i^*SFD_t
\]

\[
- \sum_{tr} Pfob_{tr,t}EXS_{tr,t} \frac{\sum_{ag} T_{ag,row,t}}{e_t} - \sum_{h} (1 - tc)REM_{h,t}
\]

(A61)

\[
S_{row,t} = \sum_{tr} Pwm_{tr,t}M_{tr,t} + \phi_{row} \frac{\sum_{up} wu_{l}LDU_{up,t} + \sum_{pub} wg_{t}LDG_{pub,t}}{e_t}
\]

\[
+ (\eta_{row} + PROF_t) \sum_{j} r_{j,t}KD_{j,t} + \sum_{ag} T_{row,ag,t} + i^*SFD_t
\]

\[
- \sum_{tr} Pfob_{tr,t}EXS_{tr,t} \frac{\sum_{ag} T_{ag,row,t}}{e_t} - \sum_{h} (1 - tc)REM_{h,t}
\]

Final demand

\[
CT_{i,hr,t} = CMIN_{i,hr,t} + \frac{\beta_{i,hr}}{PC_{i,t}}(BC_{hr,t} - \sum_{i} PC_{i,t}CMIN_{i,hr,t})
\]

(A62)

\[
CT_{i,hu,t} = CMIN_{i,hu,t} + \frac{\beta_{i,hu}}{PC_{i,t}}(BC_{hu,t} - \sum_{i} PC_{i,t}CMIN_{i,hu,t})
\]

(A63)

\[
INV_{i,t} = \mu_{i}IT_{i}/PC_{i,t}
\]

(A64)

\[
DIT_{i,t} = \sum_{j} a_{ij}CI_{j,t}
\]

(A65)

\[
ITVOL_{t} = IT_{t}/PINV_{t}
\]

(A66)
Prices

\[
\ln \frac{wu_t}{P_{\text{index}}_t} = D - 0.1 \ln u_t \tag{A67}
\]

\[w_{gt} \succ w_{ut} \tag{A68}\]

\[
w_{ut} = \frac{w_{ut} \sum_{ru} LDR_{ru,t} + w_{ut} \sum_{up} LDU_{up,t} + w_{gt} \sum_{pub} LDG_{pub,t}}{\sum_{ru} LDR_{ru,t} + \sum_{up} LDU_{up,t} + \sum_{pub} LDG_{pub,t}} \tag{A69}\]

\[
w_{ugt} = \frac{w_{ut} \sum_{up} LDU_{up,t} + w_{gt} \sum_{pub} LDG_{pub,t}}{\sum_{up} LDU_{up,t} + \sum_{pub} LDG_{pub,t}} \tag{A70}\]

\[w_{at} = w_{ugt}(1 - u) \tag{A71}\]

\[r^{\text{ar}^r,t} = \frac{PV_{\text{ar}^r,t}VA_{\text{ar}^r,t} - W_{\text{ar}^r,t}LDR_{\text{ar}^r,t}}{KD_{\text{ar}^r,t}} \tag{A72}\]

\[r_{up,t} = \frac{PV_{up,t}VA_{up,t} - w_{ut}LDU_{up,t}}{KD_{up,t}} \tag{A73}\]

\[PV_{j,t} = \frac{P_{j,t}XS_{j,t} - \sum_{i} PC_{i,t}DI_{i,j,t}}{VA_{j,t}} \tag{A74}\]

\[PM_{tr,t} = e_tP\text{wm}_{tr,t}(1 + tm_{tr})(1 + tx_{tr}) \tag{A75}\]

\[PE_{tr,t} = \frac{e_tP\text{fob}_{tr,t}}{(1 + te_{tr})} \tag{A76}\]

\[PC_{tr,t} = \frac{DOM_{tr,t}PD_{tr,t} + M_{tr,t}PM_{tr,t}}{Q_{tr,t}} \tag{A77}\]

\[PC_{ntr,t} = PD_{ntr,t} \tag{A78}\]

\[PD_{j,t} = PL_{j,t}(1 + tx_j) \tag{A79}\]

\[P_{tr,t} = \frac{PL_{tr,t}DOM_{tr,t} + PE_{tr,t}EX_{tr,t}}{XS_{tr,t}} \tag{A80}\]

\[P_{ntr,t} = PL_{ntr,t} \tag{A81}\]

\[PINV_t = \prod_i \left(\frac{PC_{i,t}}{\mu_i}\right)^{\mu_i} \tag{A82}\]

\[P_{\text{index}}_t = \sum_j \theta_j PV_{j,t} \tag{A83}\]
Dynamics

\[ STKR_{1,t+1} = STKR_{1,t}(1 - \chi_1) + EMR_t \]  \hspace{1cm} (A84)

\[ STKU_{1,t+1} = STKU_{1,t}(1 - \chi_1) + EMU_t \]  \hspace{1cm} (A85)

\[ STKR_{2,t+1} = STKR_{2,t}(1 - \chi_2) + \chi_1 STKR_{1,t} \]  \hspace{1cm} (A86)

\[ STKU_{2,t+1} = STKU_{2,t}(1 - \chi_2) + \chi_1 STKU_{1,t} \]  \hspace{1cm} (A87)

\[ STKR_{3,t+1} = STKR_{3,t} + \chi_2 STKR_{2,t} \]  \hspace{1cm} (A88)

\[ STKU_{3,t+1} = STKU_{3,t} + \chi_2 STKU_{2,t} \]  \hspace{1cm} (A89)

\[ TSTK_t = STKR_{1,t} + STKR_{2,t} + STKR_{3,t} + STKU_{1,t} + STKU_{2,t} + STKU_{3,t} \]  \hspace{1cm} (A90)

\[ ISTK_{t+1} = ISTK_t + MIG_t \]  \hspace{1cm} (A91)

\[ KD_{ps,t+1} = (1 - \text{dep}_{ps})KD_{ps,t} + INV_D_{ps,t} \]  \hspace{1cm} (A92)

\[ \frac{FDI_{pro,t}}{KD_{pro,t}} = P_{1pro}\left(\frac{r_{pro,t}}{\epsilon t r^*_t (i_t + \epsilon_1 + \text{dep}_{pro})}\right)^2 + \frac{P_{2pro}}{P_{1pro}}\left(\frac{r_{pro,t}}{\epsilon t r^*_t (i_t + \epsilon_1 + \text{dep}_{pro})}\right) \]  \hspace{1cm} (A93)

\[ \frac{FDI^{\text{con}},t}{KD^{\text{con}},t} = P_{1\text{con}^*}\left(\frac{r^{\text{con}},t}{\epsilon t r^*_t (i_t + \epsilon_1 + \text{dep}_{\text{con}^*})}\right)^2 + \frac{P_{2\text{con}^*}}{P_{1\text{con}^*}}\left(\frac{r^{\text{con}},t}{\epsilon t r^*_t (i_t + \epsilon_1 + \text{dep}_{\text{con}^*})}\right) \]  \hspace{1cm} (A94)

\[ \frac{DINV_{\text{con},t}}{KD^{\text{con},t}} = P_{3\text{con}^*}\left(\frac{r^{\text{con}},t}{PINV_t (i_t + \epsilon_2 + \text{dep}_{\text{con}^*})}\right)^2 + \frac{P_{4\text{con}^*}}{P_{3\text{con}^*}}\left(\frac{r^{\text{con}},t}{PINV_t (i_t + \epsilon_2 + \text{dep}_{\text{con}^*})}\right) \]  \hspace{1cm} (A95)

\[ \frac{DINV_{pro,t}}{KD_{pro,t}} = P_{3pro}\left(\frac{r_{pro,t}}{PINV_t (i_t + \epsilon_2 + \text{dep}_{pro})}\right)^2 + \frac{P_{3pro}}{P_{3pro}}\left(\frac{r_{pro,t}}{PINV_t (i_t + \epsilon_2 + \text{dep}_{pro})}\right) \]  \hspace{1cm} (A96)
\[ VARKD_{t+1} = KD_{edu,t+1} - KD_{edu,t} \]  
(A97)

\[ INV_{pro,t} = DINV_{pro,t} + FDI_{pro,t} \]  
(A98)

\[ INV_{con,t} = MRA_t + DINV_{con,t} + INV_{con,t} + FDI_{con,t} \]  
(A99)

\[ INVOL_t = \sum_{pro} INV_{pro,t} + INV_{con,t} + VARKD_t \]  
(A100)

\[ SDD_{t+1} = (1 + i_t)SDD_t + DD_t \]  
(A101)

\[ SFD_{t+1} = (1 + i^*t)SFD_t + FD_t \]  
(A102)

\[ MC_t = V_3(TSTK_t)^\nu \]  
(A103)

\[ G_{i,t+1} = G_{i,t}(1 + gG) \]  
(A104)

\[ INV_{G,t+1} = INV_{G,t}(1 + g_{IG}) \]  
(A105)

\[ LSR_{t+1} = LSR_t(1 + g_{LSR}) - MIG_t - EMR_t \]  
(A106)

\[ LSU_{t+1} = LSU_t(1 + g_{LSU}) + MIG_t - EMU_t \]  
(A107)

**Equilibrium conditions**

\[ NATR_t = \sum_{ru} LDR_{ru,t} \]  
(A108)

\[ (NATU_t + (1 - imc)MIG_t)(1 - u_t) = \sum_{up} LDU_{up,t} + \sum_{pub} LDG_{pub,t} \]  
(A109)

\[ Q_{i,t} = G_{i,t} + DIT_{i,t} + \sum_{h} CT_{i,h,t} + INV_{i,t} + STK_{i,t} \]  
(A110)

\[ EXS_{tr,t} = EXD_{tr,t} \]  
(A111)
\[ S_{^y^g^{vu},t} + DD_t + e_t FD_t = varKd_t PINV_t + INVG_t PINV_t \]  \hspace{1cm} (A112)

\[ DD_t = K_t (F \times e_2^\xi (S_{^h^u^v},t + (1 - estate)(1 - cons_{^h^u^v}) + (1 - ty_{^h^u} adj_{^i}) (1 - tc) REM_{^h^u^v},t + S_{^f^m,v},t) \hspace{1cm} (A113)\]

\[ \sum_h estate(1 - cons_h)(1 - ty_h adj_i)(1 - tc) REM_{^h,t} = MRA_t PINV_t \]  \hspace{1cm} (A114)

\[ e_t(S_{^row^v},t - FD_t) = \sum_{pro} FDI_{pro,t} PINV_t + FDI_{^con^v,t} PINV_t + v \sum_i STK_{i,t} PC_{i,t} \]  \hspace{1cm} (A115)

\[ IT_t + \sum_i STK_{i,t} PC_{i,t} = e_t S_{^row^v},t + \sum_{da} S_{da,t} + \sum_h (1 - cons_h)(1 - ty \times adj_i)(1 - tc) REM_{^h,t} \]  \hspace{1cm} (A116)