Micromacro Consultants

**Paper
Macro Rwanda Model
Marumo
Rwanda Scenarios
2015-2030**

Kigali, The Hague, July 2015

Rwanda Scenarios 2015-2030

This paper is based on Handbook Marumo pages 196-220, and the update Marumo model of 8July. That update was the fruit of the collaboration of Mr. Marcel Nshimiyimana (at that time with MINECOFIN) and Dr. Marein van Schaaijk and Mr. Sibren Vegter (MMC).

In order to contribute to the answer of this question, Rwanda's Macroeconomic model (Marumo) and Micro Poverty Module will be used. Marumo model was developed in collaboration by Micromacro Consultants (MMC) and MINECOFIN Rwanda. In producing this paper, we build upon documentation of Marumo.

The paper starts with a brief description of this model and poverty module, including underlining of the fact that macroeconomic models incorporate several inaccurate coefficients, so they cannot be used to proof something, but can be helpful for better understanding of the economic processes.

Then, the economic development of Rwanda 2000-2015 and baseline 2015-2030 will be discussed including development of poverty using the database and macroeconomic model (Marumo) and Micro Poverty Module (based on EICV3). The Micro Poverty Module translates macroeconomic developments into changes in the numbers of households above the poverty line.

Then several policy scenarios will be run, including the effects of policy measures like export growth by promotion of productivity, more FDI, changes in taxes etc. on: GDP to sectors of industry, government deficit, foreign exchange stock, number of households above the poverty line, including breakdown to socio-economic groups and regions of Rwanda.

# Poverty reduction by private sector development in Rwanda

INTRODUCTION and SUMMARY

In this paper it is analyzed what might be done to realise Rwanda's main target, a big decrease of poverty with the constraint that the foreign reserve stock does not decrease and government deficit stays below 3% of GDP?

This analysis is done using MARUMO the Macro Rwanda Model & Poverty Module. This paper is based on the Handbook Marumo, February 2011, but with update of MARUMO of 8th July 2015 and extended till 2030.

To be able to do this impact analysis we need a calculation framework consisting of assumptions (policy measures) that go as input into a macro model. The model contains the relations within and between the fiscal sector, external sector, real sector, monetary sector and household sector. The household sector needs to contain a breakdown of the numbers of household and incomes into main categories as wage earners, self-subsistence agricultural sector, informal sector etc. Then the growth of numbers and incomes of the several groups has to be translated into a poverty module, to calculate the change in the numbers below the poverty line. The scheme below provides an idea what we have in mind.

Effects Analysis scheme
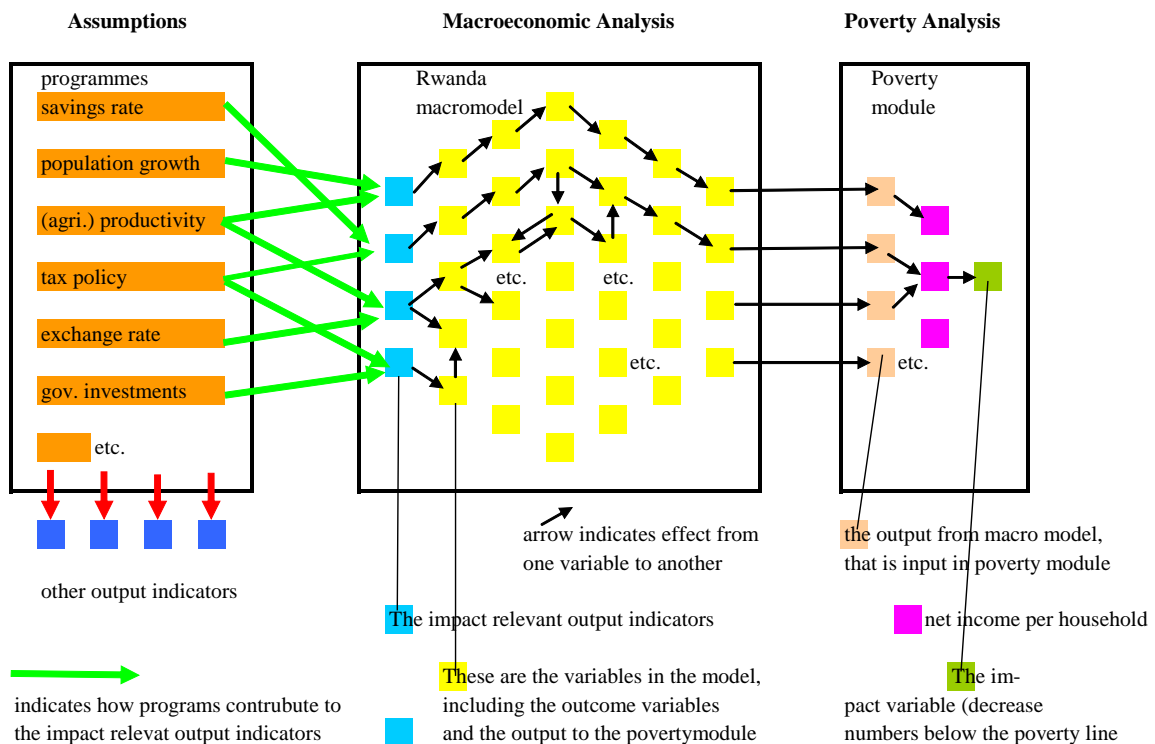
The scheme above shows how we can use a macro model in combination with the sector module and the poverty module to estimate the effects of policy measures on the poverty indicators and other relevant indicators in Rwanda.

The scheme should be read from left to right, starting with a (set of) policy measures (orange rectangulars) on the left. On the basis of these policy measures we calculate two types of indicators:

The dark blue (lower part of the left block) squares below the red arrows indicate the "other output indicators". These are the indicators that are important to measure the results of the programs, but are not relevant to calculate the impact of the programs on poverty. An example of this type of output indicator is the construction of a railway track. The track will not have any impact on poverty, unless it leads to an increase in the capacity to export. The impact relevant indicator is therefore the "x% additional exports" transported by rail.

The light blue squares in the middle part of the scheme indicate the impact relevant output of the programs: extra export, higher agricultural productivity, etc. that is inserted as input into the macro model.

The light blue squares together with the yellow squares make up the macromodel. The model (the block in the middle of the scheme) contains the relations within and between the fiscal sector, external sector, real sector, monetary sector and household sector. For example, wages influence prices and prices the wage rates. Government deficit affects money supply and the same for deficit on BoP. A crucial variable is the cost price: if the domestic cost price is lower then the export price, which will stimulate volume growth of exports. And a lower domestic cost price compared to import price will stimulate domestic production. So, the lower cost price results in higher GDP. The cost price is the result of import costs, indirect taxes, plus wage rate minus productivity growth. The household sector includes a breakdown of the number of households and average household incomes into the main socio-economic categories such as wage earners, self-subsistence farmers and other self-employed (traders, etc.). The growth rate in the number of households and average household income of the socio-economic categories is output from the macro model.

This output from the macromodel is input into the poverty module. This are indicated by the pink squares in the right block of the scheme. The pink squares affect the purple squares in the poverty module, i.e. the net incomes of the groups, which in turn affect the number of households below the poverty line indicated by the green colored squares (the impact variable).

The most difficult, but most important step in the quantification of the policy measures, is to identify the effects of the programs on the impact relevant output indicators. This is indicated

by the bold green arrows in the scheme (⟶   ). To do this we need the expertise of the sector, fiscal and other experts. For instance, we need agricultural experts to tell us what the effects are of government programs that invest in e.g. higher quality seeds, irrigation or fertilizer support. We need to know to what extend these programs raise the productivity of the small farms. Once we know this we can insert this increase in agricultural productivity in the macro model. The latter then, in combination with the sectoral module and poverty module, simulates the effects on the outcome and impact relevant variables (such as poverty reduction).

Should we have such a combination of policy assumptions, macro model and poverty module, loaded with the accurate data and the accurate coefficients in behavioural relations, then we are able to answer the question of how to reduce poverty.

However, economic science is not developed so far that we know exactly how the economy works and the data are estimates. So there is no model to proof exactly how policy measures via several channels at the end will affect poverty.
But one can try to construct a model & poverty module that reflect the Rwandan economy as good as possible to get an idea of how policies affect poverty.
Actually that is what MINECOFIN decided. The Rwandan government established a macro model team in August 2009 consisting of economists from the Macro Economic Policy Unit and the Budget Unit of MINECOFIN, National Bank Rwanda, Rwanda Revenue Authority, and National Institute Statistics Rwanda. The macro model team, supported by a consultant (Dr. Marein van Schaaijk, Director of Micromacro Consultants and Stephen Chong poverty specialist of that bureau) created step-by-step a combination of assumptions, macro model and poverty module from scratch in three sessions of workshops of each two weeks in September, October and December 2009.

First the structure of the new model was discussed based on a demo macroabc model and the Financial Programming files of Rwanda, both running in Excel. Then we started from scratch with an empty sheet. First the formulas have been discussed, using the white board, then one of the participants (the ''driver'') brought the formulas in his draft model file in a notebook with overhead projection, so all participants could see what happened. Then in the third step the new formulas were cleaned and the model file distributed to all participants. Then each (group of) participants did the same again in its own computer. So the whole model process went through the hands of the participants.
First a data consistency framework was made, including all needed variables and definition relations. Then we injected row by row the behavioral equations, using knowledge of the several specialists in the model team. In the third stage the model was tested by running many baselines till 2020 and also scenarios and scenarios till 2020.

The new model is close to the Financial Programming of IMF, but with three additional things: a) a household sector (data from Household Surveys), b) a poverty module, and c) behavioral equations including the role of incentives (cost price, productivity).

Once the model was tested, first a technical baseline was made based on trend assumptions, endogenous exports (international trade, difference between export price and cost price, trend equal to residual last 9 years) and investments (follows the growth of real GDP of last years plus trend equal to residual last 9 years). In the baseline the depreciation was set on 4% a year, the average of last 4 years. In the base line we added -2% per annum in exports to get a cautious scenario.

This technical baseline shows a decrease of poverty from 40% in 2015 to 31% in 2030/31, so too high compared to the target of reduction of poverty by half in 15 years.

Then we ran several combinations of scenarios to arrive at a result of around 20% below the poverty line, and no decrease in foreign reserve stock. This exercise demonstrates that productivity growth is the main road to poverty reduction. But higher savings, higher direct taxes and/or depreciation of the exchange rate are needed to prevent the foreign reserve stock to become negative.

A combination scenario of 6 variants realizes the targets. It also results in a share of donor aid in government total revenues to go down from 30% in 2014/15 to 9% in 2030/31. So the package also realizes less dependence on foreign aid.

Please realize that the assumptions are input to the model. Thanks to the what if simulations we found what levels of productivity growth etc. are needed. Next question is how to realize that. The answer on that question requires other then macroeconomic expertise. So other experts need to be invited too.
One might think of a mixture of policy measures like:
- ✓ Enabling business environment
- ✓ All Government activities reshuffled from viewpoint how they contribute to higher productivity in private sector (better roads, better-educated employees, high speed in providing licenses to starting firms etc.)
- ✓ Decrease of other Government activities, resulting in lower taxes without increase of Government deficit
- ✓ Promote foreign direct investments, and take care that technology transfers take place

The underpinning of the assumptions

In this section we give the underpinning of the block "Programs", the block most left of the three blocks in the scheme.

To run a growth & poverty reduction scenario with Macroabc-RW and poverty module, we need several assumptions, like: X % additional growth of productivity in general and Y% in the selfsubsistence agricultural sector, with costs for Government Z mln. V % growth of non-traditional exports; W mln. Cash transfers to the poor, etc. These V, W, X, Y and Z are not output from the model, but input, coming from sectoral experts that has to be injected.

This section is written to bridge between macro and sectoral experts. It is based on our experiences in other countries like Curaçao and Zambia.

A crucial factor to decrease poverty is to increase productivity, especially productivity in the selfsubsistence agriculture. Actually many government activities are important to realize that. For example better education will increase, once the young people have finalized their schooling and enter the labor market. You can see the importance of education for schooling, because the wages of high educated are on average higher then low educated persons. So the activities of the Ministry of Education are very important to increase productivity after a while. Furthermore education financed by the Government gives a lower burden to the poor: many of them would not even be able to go to school if the teachers and schools are not paid by Government. Not only education of young people at school is important, but also education of older people. Think of education in modern agricultural technology, communication technology etc.

Also a good health is important for productivity. So the spending by Ministry of health is important also for productivity.

See the sectors in the following scheme row by row: Also infrastructure is very important: without roads the production made in the rural areas cannot be sold in urban areas or exported. Access to water is also important.

Then access to energy like electricity will improve productivity.

Agriculture has a special line in the scheme because such important part of the economy of Rwanda is in agriculture. Actually, improvement of productivity in the selfsubsistence agriculture seems the most important factor to decrease poverty. So the activities of the Ministry of Agriculture are very important to take into account when constructing a growth and poverty reduction scenario.

Actually all sectors, all Ministries of Government can contribute to productivity growth.

So far productivity growth thanks to spending by several Ministries. But not only spending by investments in education, infrastructure etc. is important. Some activities are not that

expensive, but require organisation. We think of all government activities that create together an enabling business environment: security, low interest rates for producers, access to credit, stable exchange rates and prices; easy to get licenses etc..

Another important factor is foreign direct investments and aid.

So the following scheme for an overview:

			Impact relevant output indicators						
How sector of government expenditures & policies can contribute to impact relevant output indicators									
Nr	Sector	Summary	Labor Productivity	Agricultural productivity	Exports diversification	Taxes, transfers, grants	Exchange rate	capital costs	other
		mainly spending to increase productivity							
1	Education	Access of poor to secondary and tertiary education	•	•				•	•
2	Health	health is needed for productivity	•	•					•
3	Infrastructure (Transport)	Road network (rural-urban)	•	•					
		Acces to water (peri-urban and rural areas)	•	•					
4	Energy	Electricity generation capacity	•						
5	Agriculture	education in new technologies		•					
		Fertilizers, irrigation etc.		•					
		Access to markets and information		•				•	
6	Tourism	marketing, hotels			•				
7	Manufacturing	new technology like ICT							
8	other secors								
		Mainly activities for enabling business environment							
9	Security	stable environment							•
10	Finance	Access to financial services	•	•					
		Broadening the tax base on profit and income tax				•			
		Reducing the interest rate spread (overhead costs)			•			•	•
11	monetairy policy	Prudential macroeconomic and monetary policy			•		•		•
12	Commerce & Trade	Enabling business environment	•	•					•
		other:							
13	FDI, Aid	financing of investments				•	•		

It might be an idea to present a draft growth scenario to sectoral experts, based on preliminary assumptions. That will show them what kind of sectoral assumptions we need and how important they are in scenario building. Once the sectoral experts understand better what information we need from them from the macro point of view, they will be in a better position to deliver those assumptions, or at least start to comment which level of assumptions is feasible and what it might costs to realize such assumptions.

Macroeconomic Development Rwanda in figures 2000-2015-2030

(The tables in this paper are based on the version Marumo 8 July 2015)

In this chapter paper a quantitative description of the macroeconomic development will be given by using the new systematic dataframework & model of Rwanda, called "Marumo".
In this framework the data 1999/2000 till 2015/16 and from there the projections till 2030/31 are given for each sector:
Real Sector,
Fiscal Sector,
External Sector,
Monetary Sector,
Household Sector,
Sectors of Industries
The projections in Marumo are based on the links within and between these sectors, assumptions concerning exogenous variables and assumptions concerning coefficients in behavioural equations. These links and coefficients have been described in the Manual to the model. Here we concentrate on the results. And we present in this draft only the averages of the years 2000-2015 and 2015-2030.

The period 2000-2015

Real Sector 2000-2015

Table 1 shows that Rwanda has had strong economic growth in the last fifteen years, mainly driven by exports and investments (11,5 res. 11,7 % average per annum). But also private consumption had a real growth of on average 6,9% per annum. That growth also required a strong growth in imports. Consequently the GDP growth was 7,3% on average. The share of imports/GDP was around 21%, and increasing from 17% in 2000 till 24% in 2015. The private consumption rate was around 76% in this period.

The average import price increase was 5,7% per annum, of which 1 % can be explained by the international inflation and 4,6% from depreciation of the Frw. The export price was a little bit higher: 7% on average. The international inflation has increased the cost price, then the prices of domestic produced goods and services go up. Export price increase above cost price increase implies an improvement of profitability in the export sector.

Thanks to the figures from EICV 2001, 2006 and 2010, we are now able to complete the National Accounts with figures concerning the disposable income with break down to 6

socio-economic groups. (Sector specialist might tell more about that here or in chapter on Households)

The national savings amount 18,4% of GDP, but those of Government are negative. The investments are higher, and the gap is financed by grants from abroad.

Fiscal Sector 2000-2015

The total of the revenues and grants of Government is on average 22,1% of GDP. Grants went up from 7,3% of GDP in 2000 to 11,3% of GDP in 2005 and then went down to 7,4% in 2014. The total of expenditures is a little bit higher (24,1%), resulting in a deficit after grants of around 2% on average. The share of grants in total revenues of Government is around 41,5%. The domestic debt is on average 10% of GDP and declining after 2003/04 and stabilising around 7 to 8 % of GDP after 2010/11. The external debt was increasing till 77% in 2003/04, and declined till 12% in 2014/15.

External Sector 2000-2015

The world trade price on average was 1.8% in 2000-2015, as we noticed already in the chapter concerning real sector when discussing prices.
World trade volume was on average 5,1 %, so far lower then the export growth of Rwanda of on average 11,5% per annum in that period.
Table 3 also presents the BoP in US$ and in % of GDP. It appears that exports of goods and services are far lower then imports and the gap is financed by grants. (In Fiscal sector the official transfers are called ''budgetary grants'', and what is called capital transfers in the External Sector, is called "capital grants" in the Fiscal Sector). Total grants are equal to 48% of imports of goods and services.

Net foreign assets (in months of imports of G&S) are on average equal to 6,4 months. However this is declining after a peak in 2006/07.

Monetary Sector 2000-2015

Broad money increased with 14,9% per annum, close to the average nominal GDP growth of 15,0%. This increase of broad money was mainly from increase of net foreign assets and a slight increase of domestic credit in total money supply.
The ratio net foreign assets/ broad money is declining, and the months imports covered by foreign assets stock, is declining from 9,2 in 2006/07 to 5,1 months in 2014/15.
The exchange rate had a depreciation of on average 4,6% per annum in last fifteen years.

Household Sector 2000-2015

Changes in the Household sector can be calculated by comparing the EICV 2010 with EICV 2006 and EICV 2001.

The number of wage earners private sector had during 2001-2006 an average growth rate of 13,7% and 16,3% during 2006-2010. These figures are way above the average GDP growth of the private sector (excluding agriculture); 8,2%. This indicates that there was no productivity growth. The growth of the number of wage earners in public sector was close to the population growth between 2001-2006 but much higher at 8,2% between 2006-2010. The number of independent farmers was rather stable (increase of less then 1% per annum). So, given the increase of the total number of households, their share went down in total number of households. The increase of the numbers of high income has been close to the GDP growth of the non-agricultural sector. The informal sector (low income independent non farmers and others) had the highest increase in 2001-2006. However, in 2006-2010 this changed and there has been a shift from the informal to the formal sector.

The comparison of EICV 2006 with 2001 shows only small changes in real income, only for independent farmers going up around 4% per annum on average per household. And because this is the biggest group, total real GDP per capita goes up 4% per annum.

The share of households below the moderate poverty line (close to 1 US$ a day) declines from 55% in 2005/06 to 45% in 2009/10 to 40% in 2014.2015.

Sectors of Industries 2000-2015

Table 6 shows that the growth rates per sector of industry differ a lot from the total real GDP growth of 7,3 % on average per annum in 2000/2015. Agriculture is lower, but mining and trade are much higher.

Table 1 real sector Output Table including averages of Baseline and Scenario Package	Unit	average 2000/01 2014/15	**Baseline** average 2015/16 2030/31	**Scenario** average 2015/16 2030/31
Real Sector				
GDP				
Nominal GDP (in billions of Rwanda francs)		2.662	12.478	13.386
Nominal GDP	%	15,0	9,6	10,3
Volumes in %				
exports	%	11,5	9,3	10,9
investment businesses	%	11,7	11,2	13,9
investment government	%	15,4	0,3	1,5
private consumption	%	6,9	5,5	6,6
gov. consumption	%	7,9	6,5	8,3
imports	%	12,4	7,5	8,9
GDP	%	7,3	7,1	9,0
GDP private sector (excluding agr. independent)	%	8,2	7,9	9,8
GDP agric independent	%	2,9	1,3	2,7
Shares				
import rate	Rate	0,21	0,27	0,29
private consumption rate	Rate	0,76	0,72	0,69
Prices in %				
exports	%	7,0	3,8	3,7
investment businesses	%	7,1	3,4	2,5
investment government	%	7,1	3,4	2,5
private consumption	%	7,1	3,4	2,5
gov. consumption	%	5,4	3,7	3,4
imports	%	5,7	4,1	4,1
GDP	%	7,1	3,3	2,3
cost price	%	6,3	3,4	2,5
Shares in disposable income private sector				
Net wage income	%	0,21	0,33	0,33
Low income independent non-farm	%	0,02	0,03	0,02
High income independent non-farm	%	0,11	0,15	0,15
Agricultural sector	%	0,33	0,18	0,17
Other household income	%	0,05	0,05	0,03
Other(mainly big companies)	%	0,27	0,26	0,30
Total		1,00	1,00	1,00
National income accounts in % of GDP				
National savings	in %GDP	18,4	17,0	18,7
of which: public	in %GDP	-7,1	-5,4	-6,0
Gross investment	in %GDP	20,4	30,6	34,1
of which: public	in %GDP	9,6	10,5	10,7
of which: private	in %GDP	10,8	20,1	23,4
Savings-Investment gap 4/	in %GDP	-2,5	-13,6	-15,4
Government net savings (- deficit)	in %GDP	-16,9	-15,9	-16,7

Table 2 Fiscal sector Output Table including averages of Baseline and Scenario Package	Unit	average 2000/01 2014/15	**Baseline** average 2015/16 2030/31	**Scenario** average 2015/16 2030/31
Fiscal Sector				
Government finance				
Total revenue and grants	in %GDP	22,1	22,2	23,0
direct taxes	in %GDP	4,3	6,4	7,6
indirect taxes	in %GDP	7,5	10,3	10,0
non tax revenues	in %GDP	1,1	2,0	2,0
Grants	in %GDP	9,2	3,5	3,4
Tax Revenue	in %GDP	11,8	16,7	17,6
Total expenditure and net lending	in %GDP	24,1	26,9	27,7
Wages and salaries	in %GDP	3,8	3,9	4,3
Goods and services	in %GDP	3,4	2,4	2,4
Interest payments	in %GDP	0,7	3,0	2,9
Transfers	in %GDP	4,2	5,4	5,8
Exceptional expenditure	in %GDP	2,0	0,9	0,9
Capital expenditure	in %GDP	9,4	10,4	10,6
Primary fiscal balance 2/	in %GDP	-2,0	1,9	1,5
Domestic fiscal balance 3/	in %GDP	-5,0	-1,0	-1,3
Overall balance (payment order)				
After grants	in %GDP	-2,0	-4,7	-4,8
Before grants	in %GDP	-11,1	-8,3	-8,1
Grants in % of Gvmnt revenues		41,5	15,8	14,5
Government Debt				
Domestic debt	in %GDP	10	19	20
External debt	in %GDP	34	31	29

Table 3 External sector Output Table including averages of Baseline and Scenario Package	Unit	average 2000/01 2014/15	**Baseline** average 2015/16 2030/31	**Scenario** average 2015/16 2030/31
External Sector				
World				
world trade price goods in US$	%	1,8	0,4	0,4
world trade volume goods and services	%	5,1	5,5	5,5
BoP in US$				
Exports goods and services	%			
Trade balance goods	mln. US$	-629	-2.354	-2.730
Exports goods, f.o.b.	mln. US$	301	1.508	1.748
Imports goods, f.o.b.	mln. US$	930	3.862	4.477
Exports of services	mln. US$	262	944	1.095
Imports of services	mln. US$	404	1.096	1.271
Current account G&S	mln. US$	-770	-2.506	-2.906

Factor income (net)	mln. US$	-38	0	0
Current transfers (net) 2/	mln. US$	511	566	566
of which Official transfers	mln. US$	419	368	368
Current account	mln. US$	-297	-1.940	-2.340
Capital and financial account balance	mln. US$	351	1.995	2.504
of which Capital transfers	mln. US$	143	368	368
Errors and omissions	mln. US$	2	0	0
Overall balance	mln. US$	56	55	163
Financing	mln. US$	-55	-55	-163
Check Net foreign assets BOP-MS	mln. US$	3	9	9
estimated valuation differences	mln. US$	15	83	109
Total grants	mln. US$	562	736	736
Total grants in % imports g&S	%	48	17	15
Foreign Direct Investment	% GDP	1,4	4,0	8
Foreign Direct Investment	mln. US$	80	508	1.017
stocks:		end 14/15	end 30/31	end 30/31
External debt (end of period)	mln. US$	965	6.626	6.626
Net foreign assets	mln. US$	1.058	2.084	3.820
Net foreign assets (in months of imports of G&S)		6,4	6,0	6,7

External sector in % GDP				
Export of G&S, f.o.b	in %GDP	13,2	19,2	20,5
Imports of G&S, f.o.b	in %GDP	25,9	37,8	40,7
External current account balance				
Including official transfers	in %GDP	-5,9	-15,5	-17,5
Excluding official transfers	in %GDP	-15,6	-18,8	-20,6
External debt (end of period)	in %GDP	34,4	31,5	29,5

Table 4 Monetary sector Output Table including averages of Baseline and Scenario Package	Unit	average 2000/01 2014/15	**Baseline** average 2015/16 2030/31	**Scenario** average 2015/16 2030/31
Monetary Sector				
Money and Credit				
Net foreign asets	change in % Broad Money	14,9	5,8	8,8
Net domestic assets 1/	change in % Broad Money	4,8	7,7	5,6
of which Government	change in % Broad Money	-2,7	6,7	7,4
Broad money (M2)	Growth in %	20,1	13,5	14,5
Reserve money	%	15,5	13,5	14,5
velocity (GDP/M3; end of period)		5,4	3,0	3,0
Net foreign asets as % of broad money	share	76,3	56,5	66,3
Exchange rate USD (average, fiscal year)	Rate	566	987	987
Exchange rate % change	Rate	4,6	4,0	4,0
Discount rate (end fiscal yr)	%	12,3	12,9	12,9

			Baseline	**Scenario**
Net foreign assets (in months of imports of G&S)		6,4	6,0	6,7
private sector credit in % GNI		11,4	3,0	-1,1
private sector credit in % GDP		12,7	3,1	-1,1
Gross fixed investment in % GDP		21,3	30,6	34,1

Table 5 Household sector **Output Table including averages of** **Baseline and Scenario** **Package**	Unit	average 2000/01 2014/15	**Baseline** average 2015/16 2030/31	**Scenario** average 2015/16 2030/31
Household Sector				
Numbers of Households % growth to social economic group				
Wage earner non-farm private sector	Growth rate in %	12,9	6,9	6,9
Wage earner public sector	Growth rate in %	5,9	7,1	9,0
Agricultural sector	Growth rate in %	1,0	1,0	1,0
Low income independent non-farm	Growth rate in %	14,3	3,3	-7,9
High income independent non-farm	Growth rate in %	9,6	6,9	6,9
Other (incl non active)	Growth rate in %	4,4	3,3	-7,9
Total number of households	Growth rate in %	3,4	3,5	2,8
Population	Growth rate in %	3,0	2,6	1,9
Numbers of Households, shares to social economic group				
Wage earner non-farm private sector	% in total	11,4	22,7	24,8
Wage earner public sector	% in total	3,6	5,8	7,4
Agricultural sector	% in total	68,5	46,9	49,2
Low income independent non-farm	% in total	5,6	8,5	5,2
High income independent non-farm	% in total	4,1	7,4	8,1
Other (incl non active)	% in total	6,8	8,7	5,4
Total		100	100	100
Total number of households	million	2,047	3,504	3,315
Population	million	9,919	14,963	14,169
Share of population living in extreme poverty		26	19	16
Share of population living in poverty		45	35	30
Gini coefficient		0,48	0,48	0,47
real income growth rates				
Wage earner non-farm private sector	Growth rate in %	0,2	0,4	1,4
Wage earner public sector	Growth rate in %	2,5	0,4	1,4
Agricultural sector	Growth rate in %	1,7	0,3	1,7
Low income independent non-farm	Growth rate in %	0,8	0,5	1,4
High income independent non-farm	Growth rate in %	0,6	0,5	1,4
Other (incl non active)	Growth rate in %	1,7	0,4	1,4
GDP real/capita	Growth rate in %	4,1	4,4	6,9
			End of period	
Share of population living in poverty		40	30	21

Table 6 Real growth to Sectors Output Table including averages of Baseline and Scenario Package	Unit	average 2000/01 2014/15	**Baseline** average 2015/16 2030/31	**Scenario** average 2015/16 2030/31
Sectors of industry				
Volume growth				
Agriculture	**%**	4,4	5,5	7,0
Food				
crop	%	4,9	5,7	7,1
Export crop	%	3,2	5,9	7,7
Livestock, fisheries, forestry	%	3,6	5,1	6,6
Industry	**%**	9,0	8,3	10,6
Mining	%	16,3	10,2	12,0
Manufacturing	%	5,6	6,9	8,7
Utilities	%	9,9	9,9	11,5
Construction and public works	%	11,8	8,6	11,2
Services	**%**	7,2	7,5	9,4
Wholesale & retail trade, rest. & hotels	%	4,7	5,6	7,3
Transport, storage, communication	%	10,7	8,4	10,3
Finance & insurance,	%	13,7	10,6	12,7
Real estate & business services	%	5,8	6,7	8,4
Public administration	%	7,8	8,8	10,9
Education	%	11,4	8,4	10,2
Health	%	9,4	8,4	10,2
Other personal services	%	13,4	7,1	8,4

The period 2015- 2030: baseline assumptions

The test baseline scenario is a technical scenario in which we do not include policies changes. In the baseline scenario for the period 2015/16 till 2030/31 we use assumptions mainly based on the trends in the past:

- ✓ Trend labour productivity growth: During 2000-2010 (EICV1 to EICV3) there is no productivity in private sector, and because of that we assume for the future only 1%
- ✓ Agricultural production growth: We assume agricultural production growth of 1,3%
- ✓ The growth rate of households in agriculture is set on 1% per annum, close to its actual growth in 2001-2006 and 2006-2010.
- ✓ Real export growth: The average growth of Export is 11,5% in 2000-2015. From 2016/17 the exports and investments are endogenous including an add factor equal to the average residual of last ten years.
- ✓ Export price: follows the international inflation in US$ plus the depreciation.
- ✓ Real private investment growth: We assume private investments to grow with 10%. However, from 2016/17 investments are endogenous in the model.
- ✓ Population growth: The average growth of population is 2.7% last nine years. For the future in the baseline scenario we assume 2.6%. We also include household growth as households become smaller and thus grow at a faster rate (important for the household sector in the model).
- ✓ For the fiscal sector we make some assumptions till 2018 to bring the model in line with the fiscal tables projections. This has implications for real growth of domestic public investments which show large increases till 2017 and grants which decrease till 2017.
- ✓ We assume a depreciation of 4% per year (the same as average of last 4 years)
- ✓ Interest rates are assumed to be constant
- ✓ Concerning the behavioural equations: see the information concerning the assumed coefficients in the Manual.

We assume concerning the grants that they will not be stable as % of GDP. In the base line scenario we assume grants to be constant in US$ in nominal terms.

The period 2015- 2030: a policy scenario

We ran a few partial what if simulations to find out what assumptions are needed to realise simultaneously a reduction of poverty by half in 2030 compared to the level in 2014/15 (50% of the 40% in 2014/14 is 20% of households below the moderate poverty line) under constraint that government deficit stays below 3% per annum and that the foreign reserve stock in months of imports covered stays above 2.

First we made several individual scenarios, and noticed that most of them have different, even contradictory effects on decrease of poverty and reduction of net foreign assets stock. Furthermore, it is not realistic to have too high assumptions concerning some variables. During the process we therefore tried to find a package, a combination of scenarios that together can realise the target of reduction of poverty by half under constraint that foreign reserve stock comes not below 3 months imports.

This package seems to best fit our goals. It is the combination of the following:
1. household growth and population growth -0.7
2. Agriculture production growth +1,5% per annum
3. Domestic Investment government +30% one time
4. Labour productivity + 2% per annum
5. Direct tax rate in 2016/17 and 2017/18 +10%
6. FDI 100 bln Frw p.a.

Please note that number 2,4 and 3 belong together. If we assume an ICOR of 2 an increase of 1,5% in agricultural productivity would require 37,5 bln Frw more government investments. And for the time being we assumed that only 80 bln Frw government investments is needed to increase total labour productivity with 2%, because Rwanda can profit from high technology that already exists in other countries. This and the other assumptions are for the time being just technical assumptions, and they need to be discussed with agricultural experts and export experts to find out what levels of assumptions are realistic.

Now we can discuss the results on the foreign reserve stock in months of import covered, real GDP per capita and decrease of poverty, followed by detailed discussion of the policy scenario sector by sector.

Table 7. Effects on main targets, compared to the baseline.

Scenarios (Impact Analysis) **What if, scenarios**	Foreign reserve stock / months imports 2030/31 period end	HH below upper pov line % 2030/31 period end	Real GDP % **per capita** ave % 2015/16 2030/31
base line fixed	3,1	31,1	4,4
base line running	4,6	21,3	6,9
deviation of baseline	1,5	-9,9	2,5
Consumption -0.25 per annum	2,9	0,3	-0,2
Exchange rate, Depreciation +3% per annum	1,6	0,4	0,0
Scenario Package (from 2016/17)			
1. household growth and population growth -0.7	3,1	-0,5	0,5
2. Agriculture production growth +1,5% per annum	-1,7	-5,2	0,2
3. Domestic Investment government +30% one time	-1,4	-0,1	0,1
4. Labour productivity + 2% per annum	1,0	-3,1	1,2
5. Direct tax rate in 2016/17 and 2017/18 +10%	1,6	0,1	-0,1
6. FDI 100 bln Frw p.a.	-0,3	-1,3	0,7

The first line of table 7 presents the results of the baseline, the foreign reserve stock in months imports covered is 3 and poverty goes down till 31% of the households below the moderate poverty line.

Then we explored a scenario of reducing consumption by 0,25% per annum from 2016/17 till 2030/31. This seems like a tiny amount but because of compounding (every year another -0,25%) we end up with an increase in the foreign reserve stock of 3 months of imports compared to the baseline. This is because less consumption means less imports needed. As it was not necessary to increase the foreign reserve stock by this much and it only increased poverty, we dropped this scenario from our package. Another scenario we used was that of a depreciation of the exchange rate by 3% per year. This increases the months of imports covered because of decreasing imports as they become more expensive. We also dropped this scenario because it is not necessary to increase the foreign reserves stock by months of imports by this much.

Moving on to the scenarios in our package, a decrease of population growth and household growth of 0,7% (scenario 1) diminishes the number of households below the poverty line and

increases net foreign assets, because less consumption is required. However it is not realistic to assume that a huge decrease of population growths might be realistic.

An increase of productivity in the agricultural sector has a huge effect on poverty reduction. However it requires foreign assets as the months of imports covered decrease. Also because this policy requires government investments and that also requires foreign assets to finance the import component.

An increase in labour productivity reduces cost prices and gives higher profits. That incentive will stimulate exports and increase real incomes. In this case the poverty will go down and foreign assets stock will go up. However how much increase of labour productivity is realistic? For that reason we have included also other measures in this package.

Increase of direct taxes, used to decrease the deficit of government, increase the foreign assets, but do not decrease poverty.

More investments financed by Foreign Direct Investments contribute to increase of foreign assets and decrease in the households below the poverty line.

After running each of the six scenarios step by step, we made packages of them in different intensity of each of the individual measures/assumptions, till we found a combination in which poverty is reduced by half compared to some years ago, and foreign reserve stock in months of imports covered not below 2.
Of course also other combinations might be analysed. Actually we need to involve the expertise of agricultural experts, exports experts etc, to come to a realistic package.

Economic developments 2015-2030 in case of the policy scenario sector by sector

The model produces output till 2030/31 for each year. And the averages 2015/16 till 2030/31 are given for each sector in the tables 1 to 6 that are printed in the preceding section.

Real Sector 2015-2030

Thanks to the assumed additional productivity growth in this scenario, the real export growth will be 10,9% per year on average so 1,6% higher than in the average of the baseline. This will also stimulate private investments as it increases to 13,9%, 2,7% higher than in the baseline. Furthermore thanks to higher agricultural production the real private consumption will go up and with it imports. In total GDP real growth rate will be 9% per annum almost 2% higher than in the baseline.

Because we did not include the extra depreciation of the exchange rate in our scenario package the export and import prices are the same as in the baseline. Thanks to productivity increase, the domestic inflation will be a little bit lower.

The national savings rate will improve in this scenario and also the investment rate will go up, because investments will have a higher growth rate than GDP.

Fiscal Sector 2015-2030

Because the GDP goes up and grants in this scenario are constant in nominal terms, the share of grants declines. In % of government revenues grants go down from 30% in 2014/15 to 9% in 2030/31. The share of taxes in government revenues increases. The deficit in the overall balance of government is decreasing: the over balance after grants in 2014/15 is -7,1% and in 2030/31 -2,1%. And because the deficit in the overall balance is smaller in the end , the debt as % of GDP goes down in the end.

External Sector 2015-2030

As we have seen real exports % goes up a bit, but the starting level is low in 2014/2015. The % growth of imports is lower, but the level is high. As a consequence and because of an assumed depreciation of 4% the current account balance in US$ till 2030 deteriorates. (These annual figure are in the model, Table 3 only gives the averages 2015/2031). And thanks to the

positive capital account, the overall balance of BoP is positive, that means that net foreign reserve stock increase.

Monetary Sector 2015-2030

The Frw is depreciating 4% per annum. The increase of broad money is below nominal GDP growth. The share of net foreign assets as % of broad money is higher in the policy package than in the baseline. Thus, net foreign assets are higher because of the policy package.

Household Sector 2015-2030

The share of the agricultural households goes down in both the baseline and the scenario compared to 2000/2015, and because many of them are poor, this decreases poverty. Real income per household goes up in the policy package compared to the baseline, especially in the agricultural sector. The percentage of households below moderate poverty line goes down from 40% in 2014/15 to 20% in 2030/31

Sectors of Industries 2015-2030

For the next years this scenario shows on average 9% real GDP growth in the policy package, a little bit less for agriculture, and more for industry and services.

Conclusions

In this paper we show how this model might be helpful to find a mix of policy measures to realise decrease of poverty.

Because this model includes crucial behavioural equations including the role of cost prices and productivity, it is able to show how private sector development can give sustainable decrease of poverty.

The model runs, but some data and coefficients are inaccurate, so research is needed to improve this step-by-step during the coming years. Furthermore also the expertise of other experts then macro economists is needed to translate assumptions concerning additional productivity into realistic policy measures that will realise that.