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Foreword

In this third edition of National Bank of Rwanda's Economic Review are published two papers as well as the monetary statement by the Governor which is essentially a mid-term review of the implementation of the monetary and financial sector development program of the year 2008, presented on 21st February 2008.

The two papers analyze two pillars of the National Bank of Rwanda's monetary policy framework namely the stability of money multiplier and the relation between the stock of money and the inflation.

The National Bank of Rwanda assumes no responsibility for the views expressed by the authors of the two papers. Reprinting of any figures or statements contained herein is permitted on condition that proper citation and/or referencing is given to the National Bank of Rwanda's Economic Review.

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**MONETARY POLICY AND FINANCIAL STABILITY
STATEMENT, August 2008**

François KANIMBA

Governor of National Bank of Rwanda

**THE STABILITY OF MONEY MULTIPLIER AND
MONETARY CONTROL IN RWANDA**

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MONEY AND INFLATION IN RWANDA

Dr. Thomas KIGABO RUSUHUZWA

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I. INTRODUCTION

This statement by the Governor of National Bank of Rwanda is essentially a mid-term review of the implementation of the monetary and financial sector development program of the year 2008, presented on 21st February 2008.

After a brief overview of the international and national economic environments during the first half of 2008, an assessment is done on the implementation of monetary policy orientation and financial sector development plan during the first six months of this year.

Secondly, this statement presents prospects for monetary and exchange rate policies as well as the expected achievements in the financial sector development for the second half of the year.

This statement should be of great interest for the Central Bank's partners in Rwanda's economic and financial management and the private sector who need to have a good understanding of the economic and financial environment in which they operate. It also interests university institutions, especially for their research activities.

II. ECONOMIC OUTLOOK IN 2008

II.1. International economic environment

The global economic expansion has engaged in a slow trend following a major financial crisis especially in the advanced economies, particularly in the United States, where turbulences in the housing market continue to exacerbate financial stress. The emerging and developing economies have so far been less affected by financial market developments and have continued to grow at a rapid pace, led by China and India, although activity is beginning to slow down in some countries.

In Africa, the economic growth rate was registered at 5.8% at the end of December 2007, and it is projected to 6.2% at the end 2008. These performances are the result of a combination of factors such as the significant appreciation of the terms of trade for the non-energy commodities exporters and the rise of the foreign assistance in favor of certain countries. Moreover, the contribution to the growth of the oil-producer countries was very significant.

At the same time, the world is experiencing one of the worst inflationary shocks in the last 60 years. The inflation

developments in many countries were largely affected by increases in prices of food and oil in the global markets leading to change in relative prices. Oil prices started rising sharply at the beginning of the decade, and has currently climbed to record-high levels. In New York market, the oil price rose by 43%, from USD 99.29/barell in December 2007 to USD142/barell in June 2008.

While consumer nations have suggested that a higher supply of oil by OPEC countries would help to calm oil markets, in accordance with a high demand, OPEC member countries have repeatedly blamed factors including speculation, a weak dollar and political instability. Some sources indicate that a recent 25 percent rise in the price of oil had nothing to do with underlying supply and demand but it's a pure speculation. It can be noted for example that the number of transactions involving oil futures on the New York Mercantile Exchange has almost tripled from 2004 to May 2008.

More recently, we have seen an impressive increase in food prices with serious inflationary effects in many countries. Food prices have reached in some cases their highest levels in history. This is mainly due to increased demand from emerging markets (especially China, India

and oil-exporting countries) and the use of grains in biofuels production.

In the financial market, the Federal Reserve has been cutting interest rates successively by 125 basis points in January and twice by 25 basis points in March and April 2008, bringing the Fed funds rate to 2% in June. The three months interest rates followed the same momentum and significantly dropped since end 2007. While they set at 4.7% in the last quarter 2007, they fell to 2.69% during the first quarter 2008 and slightly picked up to 2.78% in the second quarter of 2008.

In the context of strong inflationary pressures, interest rates in other markets followed the same trend as in US, except in Japan.

On the foreign exchange market, the American dollar continued to depreciate compared to the euro in the first quarter 2008. On quarterly average, euro was equivalent to 1.58USD. However, as the American economy strengthened in the second quarter, the trend was reversed and the dollar recorded a slight appreciation as the Euro was traded at 1.56\$US. Vis-à-vis the Japanese yen, the dollar would appreciate by 3.4% standing at an average of

103 yens at the end of the second quarter and by 0.5% in comparison with the GDP.

II.2. National Economic Environment

The real sector of the economy recorded good performance in the first half of 2008. According to MINAGRI, the agriculture sector improved following government policies to increase the availability, accessibility and affordability of fertilizer to farmers, on the one hand, and to use certified seed, on the other hand.

Table 1: Food crop production (I tonns)

	2005	2006	2007	2008	% Change
Total crops	7293028	7137071	6905486	8234188	-
Annual % Change	19.6	-2.1	-3.2	19.2	-
Cereals	409358	361674	355550	461163	29.7
Sorghum	227972	187380	166769	144418	-13.4
Maize	97251	91813	102447	166853	62.9
Wheat	21942	19549	24633	67868	175.5
Paddy	62194	62932	61701	82024	32.9
Pulses	252304	333743	404827	392305	-3.1
Beans	199648	283387	331107	308563	-6.8
Peas	18854	14198	16649	17150	3.0
Groundnuts	10099	9020	16118	24472	51.8
Soya	23703	27138	40953	42120	2.8
Roots & Tubers	3118051	2930095	2543501	3815125	50.0
Irish potatoes	1314052	1285149	769912	1161943	50.9
Sweet potatoes	885468	777034	845132	826440	-2.2
Taro	136895	125387	151513	144919	-4.4
Cassava	781637	742525	776944	1681823	116.5
Bananas	2813075	2653548	2698176	2603949	-3.5
Market gardening & fruits	700240	858011	903432	961646	6.4

Source: Minagri

Comparing with 2007, the production (MT) of roots and tubers, fruits, vegetables and cereals for 2008 has improved significantly, thanks to ongoing green revolution program. This program explains the good performances in

some crops like roots and tubers (+50%), as well as cereals, particularly wheat (+175.5%) and maize (+62.9%).

In non agriculture sectors, there was a noticeable improvement essentially in the industry and service sectors. The total turnovers achieved by large companies reached RWF 504.23 billion compared with RWF 359.25 billion realized in the same period of year 2007, which represents an increase of 40.36%. The industrial and services sectors activities grew their turnover by 38.93% and 40.95% respectively. The good performance in industrial sector is essentially due to increasing activity of construction and public works sector 45.17% and manufacturing sector 42.68%.

In the service sector, general trade, importers and distributors of petroleum products, as well as the banks and insurances companies recorded a turnover growth of 38.19%, 53.26% and 45.54% respectively, whereas large telecommunication companies have achieved a growth of 23.94% of their turnovers compared with the corresponding period in 2007.

During the first semester of 2008, imports rose by 56% in value and 4.3% in volume when we compared with the same period in 2007. The higher increase in value is mainly

due to the increase in import prices, especially for equipment goods (68.2%), consumption goods (56%), fuel (31.3%) and intermediate goods (24.6%). The lower growth of imports' volume (4.3%) is essentially due to the decrease by 30.1% of foods import volume. Import of capital goods, intermediate goods and energy increased respectively by 16.4%, 27.4% and 8.1%.

Table 2: Imports by end June 2008

Imports	2008		2007		Variation	
	By end June		By end June		value	Volum e
	Value	Volum e	value	Volum e		
Capital Goods	160,8	16 980	82,1	14 593	95,8%	16,4%
Intermediate Goods	132,9	160 371	83,7	125 883	58,8%	27,4%
Energy Products	73,0	92 128	51,4	85 188	42,0%	8,1%
Consumer Goods	118,7	118 597	93,8	146 279,6	26,5%	-18,9%
Food Products	38,4	82 604	35,4	118 148	8,5%	-30,1%
Other Goods	80,3	35 993	58,5	28 132	37,3%	27,9%
Total	485,38	388 077	311,1	371 943	56,0%	4,3%

Source: Foreign exchange inspection and balance of payment

In the same period, exports value increased by 53.5%, compared with the same period in 2007, due to the good performance of mining, coffee and tea sectors which represented respectively 39.8%, 9.8% and 18.3% of the total exports value.

Table 3: Exports by end June 2008

Exports	2008		2007		Variation	
	By end June		By end June			
	Value	Volum e	value	Volum e	value	Volum e
Coffee	12,0	4 916	8,1	3 654	48,2%	34,5%
Tea	22,4	10 867	17,1	10 164	31,1%	6,9%
Cassiterite (Tins)	22,3	2 277	13,9	2 162	59,9%	5,3%
Coltan	19,5	570	7,1	413,6	174,5 %	37,8%
Wolfram	6,8	905	10,9	1 499	-37,4%	-39,6%
Hides And Skins	1,6	951	1,8	873	-8,7%	9,0%
Pyrethrium	0,4	3,3	1,8	30	-78,7%	-89,0%
Reexports	19,4	7 611	13,3	9 625	46,3%	-20,9%
Other Products	17,7	36 455	5,6	9 564	217,2 %	284,4 %
Total	122,12	64 554	79,57	16 394	53,5%	70,3%

Source: Foreign Exchange Inspection and balance of Payment

Department

According to provisional data, total Government expenditure amounted to Rwf 267.4 billion at the end of the first semester 2008, close to the target of Rwf 268.1 billion for the period. The performance of the same period in the previous year was Rwf 225.6 billion; this is an increase of 18.5%.

In particular, capital spending has taken up big momentum, arising at Rwf 99.2 billion slightly above the target of Rwf 95.6 billion; this category of public expenditure amounted to

RWF80.8 billion at the end of the same period of 2007, thus the increase was 23% in 2008.

On the revenue side, tax collection performed well and external aid to support government program has been increasing both budgetary and projects support (\$313.4 million in 2008 compared with \$240.3 million in 2007). The tax revenue amounted to Rwf 161.1 billion, far beyond the target of Rwf 143.9 billion; the performance for the corresponding period of 2007 was Rwf 124.3 billion.

III. MONETARY DEVELOPMENTS IN FIRST SEMESTER 2008

III.1. Inflation

Rwanda experienced high inflationary pressures during the first half of 2008. The change of the overall price index as of end June 2008 is 13.1% compared to December 2007, against 4.5% in the corresponding period of 2007. The change in the index of locally produced goods and services was 12.4%, while the increase for imported goods was 15.8%. The imported inflation is mainly attributed to oil prices and food prices particularly cereals, cooking oil, fish and sugar. Other items fuelling inflation are alcoholic beverages, transport and education. It's the first time for several years that imported inflation has been so much

significant in Rwanda; indeed, as already mentioned; imported inflation had decreased by 1% during the first half 2007.

It is important to underscore that the cost imported raw materials for local industries recorded a significant increase at the same time, which affected almost all locally produced goods by main local manufactures. Compared to the same period of 2007, the unit value of raw materials for these industries increased by around 24.6% during the first half of 2008.

Table 4: Inflation in 2008 by categories and origin (%change)

Categories	Weights	Annual change (June 07- June 08)			Semester 1, 2008 (Dec 07- June 08)		
		Global	Local	Imported	Global	Local	Imported
1. Food and non-alcoholic beverages	3 709	19.5	14.8	34.8	16.3	13.6	25.7
2. Alcoholic beverages and tobacco	221	13.5	13.1	14.1	13.4	12.2	13.2
3. Clothing and footwear	500	7.2	10.7	5.2	3.3	1.8	4.0
4. Housing, water, electricity, gas and other fuels	1,579	12.2	10.9	39.2	11.5	10.8	26.1
5. Furnishing, household equipment and routine household maintenance	764	19.4	24.8	5.6	17.2	21.4	5.8
6. Health	708	8.9	7.7	8.7	7.3	7.5	5.6
7. Transport	987	21.2	19.7	24.2	14.5	13.4	16.6
8. Communication	37	-10.4	-12.5	1.4	-13.6	-15.1	1.2
9. Recreation and culture	206	0.7	3.7	0.8	-0.2	0.5	0.5
10. Education	432	12.6	12.2	-	14.5	13.9	-
11. Restaurants and hotels	273	7.1	6.9	-	14.5	14.2	-
12. Miscellaneous goods and services	584	9.8	4.6	16.0	5.4	4.7	6.2
Total	10 000	15.4	13.5	21.9	13.1	12.4	15.8

Source: NBR, Research Department

It is worth to underscore the following facts which clarify the origin and nature of the inflationary pressures the country is facing:

1. The national economy is facing two crucial external shocks related to the rise in oil and food prices, particularly for cereals. This is a world phenomenon which related to the rise of the overall demand for the consumption and production of the bio-fuels in the emerging and developed countries.

2. The increasing domestic and sub-regional aggregate demand, as well as the substitution effect, are also behind the inflationary pressures the country continues to face. Despite the improvement in agriculture production, a new phenomenon was recently noticed whereby a bulk of food products particularly beans, potatoes and vegetables were by some time exported to the neighbouring countries, creating a situation of shortage on local markets. The increasing prices on imported products has been creating pressure on local products by the substitution effect, exacerbating the inflation. In addition, some speculative behaviour in domestic trade system (intermediate cooperatives) has been contributing to increase inflation, before such distortions were removed in May 2008 by the Government.

3. While the aggregate demand is increasing, some reforms in the environment sector have a short term negative

impact on supply of some products. It is the case with meat for which the price has been increasing significantly due to a progressive fall in livestock size, following the restrictive measures to ban cattle breeding outside farms. In addition, the current livestock policy is focussing on promoting dairy cattle than beef cattle, as this is economically much more profitable for small farmers.

4. The increasing in housing rent constitutes also a big challenge for householders. This increase resulted from a significant increase in prices of construction materials imported or produced locally. It should be noted that the rent experienced a higher rise at the beginning of 2007 and 2008, after a long period of stability.

5. School fees again had increased at the beginning of this year, a situation which had been recorded for the past few years. The rise in the school fees significantly contributed in overall inflation in January 2008. The private schools at all levels are the most responsible for this increase which resulted from the competition to attract and retain the best teachers, whereby the majority of them reviewed the fees upward to be able to increase wages and accommodate other operating expenses.

III.2. Monetary Aggregates, Liquidity Management And Interest Rates

By end of the first half of 2008, extended broad money increased by 4.4% against an increase of 6.5% recorded during the same period of 2007. This development is a result of a moderate increase in net foreign assets (15 %) against a strong decrease in net domestic assets (-46.8%), following a strong decline in net credit to Government (-94.6) and an increase in credit to private sector (13.8 %).

The strong decrease in net credit to Government observed in the first half of 2008 is explained by the high volume of external disbursements. Indeed, Government budget and projects supports amounted to USD 313.4 million against USD 240.34 recorded during the first semester of 2007.

However net foreign assets recorded a moderate increase following intensive sales of foreign exchange by the NBR to commercial banks; these sales totaled USD 234.8 million during the first half of the year, which represents an increase of 51.6% in comparison with the same period of 2007.

The moderate increase in broad money is also explained by BNR's open market operations and by significant transfers abroad by local investors. The credit to private sector rose by 13.8%; this rate was 9% at the same period of 2007. Commerce, restaurants and hotels sector leads with 29.1% of total credit allocated, closely followed by the construction sector with 28.2%.

As to the demand for money, one would mention that currency in circulation increased by 14.6%, while deposits increased by 2.6%. The growth of currency in circulation (14.6%) associated with a low growth of M2 (4.4%) indicates a preference for people to hold cash, as a consequence of increasing in inflation and seasonality factors (coffee campaign).

Table 3: Broad money (in Rwf billion)

	2007				2008					
	Mar	June	Sept	Dec.	Jan.	Feb.	Mar	Apr	May	June
Net foreign assets	261.2	347.7	319.4	351.6	350.6	326.4	367.2	358.2	371,8	405,0
Net domestic assets	52.0	-5.9	54.8	74.1	66.9	94.5	61	83.8	77,3	39,4
Domestic credit	164.1	106.2	176.1	183.7	183.6	201.3	171.3	198	190,1	148,4
Net credit to Government	-59.9	125.6	-73.8	-75.4	-75.8	-60.1	-98.7	-81.2	101,9	146,7
Autonomous agencies	-0.5	-0.5	-1.8	-1.3	-0.9	-0.9	-0.2	-0.3	-0.3	-0,5
Public enterprises	2.0	1.7	1.9	1.8	1.5	1.4	1.4	1.4	5,6	1,3
Private Sector	222.5	230.5	249.8	258.6	258.7	260.9	268.8	278	286,7	294,3
Other items net	112.1	-112	121.3	109.6	116,70	106.8	110.4	114.1	112,8	109,0
Broad Money	313.2	341.8	374.2	425.7	417.5	420.9	428.2	442.1	449,1	444,4
Currency in circulation	47.2	51.7	52.8	63.2	61.1	59.7	61.3	65.4	67.5	72,4
Deposits	265.9	290.1	321.4	362.4	356.4	361.3	366.9	376.7	381,6	372,0
On Which:										
Demand deposits	104.7	113.4	126.2	154.7	144.5	145.5	151.3	130.3	150,7	147,1
Time deposits	104.7	118.3	133.5	139.1	143	145.4	146	170.7	151,8	145,1
Foreign exchange deposits	56.6	58.5	61.7	68.6	68.9	70.3	69.6	75.7	79,1	79,8

Source: Research department

The excess liquidity observed in the banking system during the year 2007 persisted during the first semester of 2008, but has been decreasing. To adjust this liquidity with monetary indicators such as defined in the annual program, the National Bank of Rwanda significantly mopped up excess liquidity through weekly auctions, the overnight facility, the issuance of Treasury bills coupled with sales of

foreign exchange. During the first quarter 2008, Government bonds were issued for a total amount of RWF14.257 billion and helped to transform a significant portion of government debt into medium and long-term debt.

The NBR domestic debt reduced significantly from FRW 57.3 billions on 31/12/2007 to 33.2 billions on 31/07/08. The interest rates in the money market increased moderately compared to June 2007. The mopping-up rate has increased from 5.59 % in June 2007 to 6.79 % in June 2008. This is a result of NBR's operations in the money market to sterilize the excess liquidity in the banking system by selling foreign exchange and extending maturity for Government securities. The lending rates applied by the banks have been fluctuating around 16%, while the deposit rates and short terms T-bills rates have been pursuing their declining trend as shown in the following table.

Table 6: Interest rate developments (in %)

	2007			2008	
	Jun	Sep	Dec	Mar	June
Mopping up rate	5.59	5.52	5.26	5.20	6.79
Interbank market rate	6.33	5.20	6.00	6.99	6.62
Discount rate	12.50	12.50	12.50	12.50	12.50
Weighted treasury bills rate	7.03	6.62	5.89	6.34	6.50
Deposit rate	7.65	7.35	6.77	5.69	6.05
Lending rate	16.03	15.84	16.10	15.59*	16.09*

Source: DMMF

III.3. Exchange rate developments

As in 2007, the Rwanda franc exchange rate was stable in the first half of 2008. A slight appreciation of 0.9% against the \$US was observed between December 2007 and June 2008. The behaviour of the Rwanda franc was a bit different against the GBP and the EURO, as a depreciation of 0.4% against the GBP was recorded between December 2006 and June 2007, while a reverse trend with an appreciation of 3.3 % was observed between December 2007 and June 2008. In contrast, the Rwandan franc was weak against the EURO, as it depreciated by 0.7% between December 2006 and June 2007, and by 5.9% in the same period in 2008.

The stability of the Rwanda franc is a combined result of important inflows of foreign exchange stemming from

external aid (budget and project supports), private transfers good performance of exports and the intervention policy of the Central Bank in the foreign exchange market.

By end of June 2008, the foreign exchange stock of the whole banking system amounted to Rwf 405 billion, while it was established at Rwf 347.7 billion in June 2007 that is an increase of 16.5 %.

On the inflow side, one should mention that the external aid recorded a significant increase in 2008 compared with 2007. The combined budget and project supports amounted to \$US 240.2 million between December 2006 and June 2007 against \$US 313.4 million in the same period in 2008. Its important to mention that there is a significant amount of projects support which doesn't transit on NBR accounts.

On the expenditure side, the huge increase in foreign exchange inflows was compensated by a strong upward trend in foreign exchange demand by Government and by private sector through commercial banks. The total sales of foreign exchange by the Central Bank to Government and commercial banks amounted to \$US 234.8 million between

December 2007 and June 2008 against \$US 154.9 million in 2007 in the same period. This increase (51.6%) of sales of foreign exchange is a result of higher demand of foreign exchange and the economy's capacity to absorb growing inflows from scaling up of external assistance. The ratio expenditure-foreign aid inflow is estimated at 75 % by the end June 2008.

The big push in selling foreign exchange by the Central Bank in 2008 was a deliberate policy by NBR in the current circumstances where Rwanda benefited from a scaling up in external aid, because the only way to allow substantial increase in Government expenditure without jeopardizing macroeconomic stability is to allocate higher amount of foreign exchange to imports corresponding to more real resource transfer from the rest of the world to national economy. One consequence of such a policy would be an appreciation of the local currency that might lead to the so-called Dutch disease by hampering the flow of exports, but in the case of Rwanda, the appreciation of the local currency has been moderate and does not constitute a big issue so far.

However, it should be noted that, the bulk of the aid inflows has been disbursed in the first half of 2008 and much less additional budget support is expected in the second half of the year (\$US 110 million).

IV. FINANCIAL SYSTEM STABILITY

IV.1. Banking sector performance

In order to strengthen the banking financial stability, it was requested to all banks in December 2006 to increase the minimum share capital to RWF 5 billions at latest on 01/01/2008 and all banks respect this share capital requirement on 30/06/2008.

With consolidated assets of RWF 492 billions as of 30/06/2008 against RWF 467.5 billions of end December 2007, representing an increase of 5.2%, the Rwandan commercial banks activity, including “Banque Populaire du Rwanda, experienced a moderate increase. Although credit increased by 14.8% from RWF 279.9 to 321.2 billions, deposits increased by 3.9% only from RWF 363.2 billions to RWF 377.3 billions.

The NPL (non performing loan) size reduced substantially from 14.3 % end December 2007 to 8.8 % to end June 2008 and the solvency of the whole banking sector system has strengthened from 15.1 % to 16.6 %.

With regard to the profitability, a net improvement is recorded in 2008 since the return on equity increased from 15.5% to 24.5% between December 2007 and June 2008.

Table 7: Banking stability indicators

				With BPR	Without BPR	With BPR	Without BPR
	31/06/07	30/09/2007	31/12/2007	31/03/2008	30/03/2008	30/06/2008	30/06/2008
Solvency ratio (in %)	13.30 %	12.80%	16.60%	15.10%	18%	16.60%	15.70%
NPLs /total loan Gross (in %)	23.70 %	23.70%	18.10%	12.20%	10.60%	12%	10.70%
NPLs / total loans without agios (in%)	17.60 %	19.60%	14.30%	7.40%	7.20%	7.60%	8.80%
Provisions /NPLs	81.30 %	61%	58.80%	78.10%	76.1%	75.50%	71.3%
NPL Gross (in Billion)	46	47	40.9	35.9	30.9	38.5	34.1
Gross loans (in billion)	187.4	218.8	221.3	294.7	225.8	321.2	316.8
Net loans(in billion)	172.3	202.9	204.4	280.2		305.9	
Write off loans(in billion)				21.9	18.2	24.5	20.9
Gross loan with write off loans	187.4	218.8	221.3	316.6	313	345.7	342.2
ROA	3%	2.30%	1.50%	3.40%		3%	
ROE	7.90%	25.90%	15.50%	27.80%		24.50%	

IV.2. Ongoing reforms in the banking sector

The Reform of the banking sector legal framework to comply with international standards has been accelerated with the publication of the new banking law. Several regulations have been updated to start implementation of this new law. We will mention those related to licensing, corporate governance, risk concentration, etc.

The restructuring of banks has accelerated as well with the acquisition of 75 % shares in BANCOR by ACCESS Bank from Nigeria, the acquisition of 40 % shares in COGEBANQUE by a group of three institutional investors (BIO, AFRICINVEST and SHORE CAPITAL).

The Banques Populaires Network has been transformed into a fully fledged commercial bank with the participation of a strategic investor RABOBANK, which currently holds 35% of BPR share capital. BRD has been recapitalized during the first quarter 2008, with the entry of a new shareholder, ADC (African Development Corporation) who acquired 25% of BRD share capital.

With regard to the Bank of Kigali, the privatization process is still underway. Barclay bank has completed the due diligence. We are waiting for its technical and financial offer.

The BHR restructuring constitutes one of our priorities as well. Discussions are underway to transform this bank into a Mortgage Liquidity Facility to refinance primarily mortgage lenders (mainly commercial banks) operations. A MOU (memorandum of understanding) has been signed with IFC which expressed interest to support this reform.

IV.3. Opening new banks and branches

One of the main objectives of the financial sector development plan is to increase access to financial services by the population. This will be achieved by easing conditions to open bank accounts, expanding the banks branches network and licensing new banks. During the first half of 2008, three new bank branches were opened and a Kenyan bank got a license to operate in Rwanda. Furthermore, the transformation of Banque Populaire du Rwanda as a commercial bank has dramatically increased the number of bank branches offering a complete range of financial services to the population. The BPR network has

currently 18 large branches, 111 sub-branches as well as an increasing number of points of sale over the country. The number of deposit accounts operated by commercial banking system (including BPR) increased by 2 % from 751.142 end December 2007 to 765.945 end June 2008, which represent roughly 17 % of adult population.

IV.4. Microfinance Sector

A law governing micro finance activities has been adopted by the Parliament and will be official published in the gazette together with its implementing regulations.

Two funds (capacity building fund and credit fund) were put in place for the training of directors and managers and refinancing activities that have a significant impact on poverty reduction. Decisions on such support are in the implementation phase and the New Association of microfinance institutions which will assist the Government in monitoring the programmes planned for the microfinance sector has set up its permanent office headed by an Executive Secretary.

Licensing new micro finance and off site and on site examinations has been an ongoing process. A number of big microfinance institutions operating in a network are conducting organisational and financial audits to improve the efficiency of their operations. These audits will provide strategic directions to be taken to develop these institutions.

The activity in the microfinance sector has been consolidating during the first half of 2008, with a 17 % increase in total assets, 23% increase in total deposits, 13 % increase in total outstanding volume of credit while the NPL (Non Performing Portfolio) has been declining by 3%.

Table 8: MFI consolidated financial position (in thousands of RWF)

Rubriques	31/12/2007	Variation en %	30/06/2008
Total assets	46 203	17	54 466
Deposits	28 556	23	35 272
Gross loans	28 617	13	32 266
NPLs	2 257	- 3	2 178
Provisions	1 541	-20	1 225
Net loans	27 075	14	31 040
Liquidity	9 780	27	12 455
Equity (Including subventions)	12 595	25	15 734

We would point out that CSS occupies respectively 63% of deposits and 57% of outstanding credits as at the end of June 2008 of microfinance sector. The beneficiaries of services rendered by MFIs amount with 639 thousand persons as at the end of June 2008 against 626 thousand as at December 2007, an increase of 2 % like for the banking sector.

IV.3. Credit Reference Bureau

Compuscan which is a credit bureau from South Africa has accepted to operate in Rwanda. The project discussions with all stakeholders have been held and a partnership agreement is expected to be signed before the end of the year.

IV.4. Nonbanking financial sector regulation

Concerning the supervision of the financial system, the Bank's mandate was extended to include supervision of Non-bank Financial Institutions (Pension Funds, Insurance Companies, etc). To fulfil this new mission, the National Bank of Rwanda will develop the legal and regulatory framework for the sound functioning and supervision of Non-bank Financial Institutions.

To this effect, a law governing the organization and supervision of insurance industry was approved by the government and passed by the Parliament in July 2008.

IV.5. Capital market developments

The Capital Market Advisory Council was officially launched on January 31st, 2008 by H. E the President of the Republic. During the first semester of 2008, the government issued three Treasury bonds and another corporate bond was issued by the BCR bank to finance its mortgage portfolio. Secondary market operations have also taken place at the Rwanda OTC market (ROTC).

To date, the bond market transacted a total turnover of Rwf 281,800,000 and the two active debt securities so far are the two 2 years government Treasury bonds that will mature in 2010 and a three years treasury bond. There is also a 10 years BCR bond that will mature in 2017.

The results indicate a good opportunity to issue bonds with long duration in order to efficiently intermediate the use of increasing inflows the country is getting. The Bank pursues this program in collaboration with the Capital Market Advisory Council whose Executive Secretariat is already operational.

Table 9: Existing t-bonds issuances (Amount in billion)

Auction date	Amount of the Bond in RWF	Offered amount by Bidders	Retained amount by the Bank	Average price/RWF 100	Interest rate	Maturity
17/01/2008	5	7.550	5	99.951	8%	2 Years
31/01/2008	5	4.257	4.257	99.558	8%	2 Years
28/02/2008	5	7.227	5	99.444	8.25%	3 Years
31/01/2008	1 *	1.5	1	100.25	9%**	10 years

Source: DMMF

*: approved bond issuance program was RWF 5 billion to be issued in note series. The first note series was 1 Billion.

** : floating rate

CMAC is also working on the development of an appropriate legal framework for the capital market in Rwanda. The process of appointing a consultant to draft the legal framework is supposed to be completed in the 3rd quarter of 2008.

A public education program is also underway. Its first pilot program targeted the media, C.E.O.s, managers and employees of leading institutions in the country, plus the Senate and Parliament, Cabinet ministers and Secretary Generals, opinion leaders in all 30 districts of the country plus members of the military, women associations and academic institutions. The mode of communication involved a series of seminars and workshops countrywide to

sensitize the public on capital markets, especially in view of the upcoming IPOs. The next phase of public education is being recorded and will start being aired on TV and Radio to target the larger audience.

IV.6. Payment System Modernization

In line with the Payment Systems modernisation program, during the first half 2008, the National Payments Council (NPC) was put in place, the National Payment Systems law and the National Payment System Framework and Strategy were drafted and are ready to be presented to the Government. On the other hand all agreements and procedures were completed to enable ADC takeover of SIMTEL. SIMTEL has been restructured and has new majority ownership by ADC as well as new management. Within its new mandate SIMTEL is earnestly working on the Rwanda Payment Card project. This is a project to integrate and embed a Banking card aspect into the National ID cards.

To ensure that time critical payments are settled in real time, the NBR is working to implement a real time settlement system-the RIPPS. This system will encompass the Automated Clearing House, the Real Time Gross Settlement and the Central Securities Depository in one. The Bidding documents have been drafted and RFP

(Request for Proposal) will be sent shortly to selected potential service providers to bid.

The API (Automated Payment Invoice) is a project to automate the payment of regular invoices by both individuals and companies to particular service providers notably, electricity and water company and telecommunications. It is in the pilot testing phase with one service provider-Electrogaz and two banks Banque Populaire du Rwanda and Banque de Kigali.

V. MONETARY POLICY AND FINANCIAL SECTOR REFORMS IN THE SECOND HALF OF 2008

Current inflationary shocks pose a serious challenge to monetary policy, because the imported inflation is one that monetary policy has little power to tackle. The world is at a moment in which monetary policy is put under a serious stress test that will be crucial in identifying future refinements in the policy frameworks.

V.1. Monetary and Exchange policy guidelines in the second half of 2008

Taking into account the pass-through from fuel and imported items prices to domestic inflation and indication that prices are still going higher, National Bank of Rwanda will continue to closely monitor the monetary developments so as to minimize the adverse effects of money increase on prices. This requires continuously monitoring the expansion of liquidity within the banking system and if necessary intervening on the money market to maintain liquidity at the desired level.

Foreign exchange sales to banks and Government by the NBR will continue to be one of the important instruments to regulate the liquidity within the Rwandan economy.

During the first semester 2008, Interest rates in money market fluctuated between 5% and 7%. As preliminary indications tend to show, the banks' cash flow has significantly reduced in July and would soon become tight, since a number of important projects requiring funding in foreign exchange are likely to be implemented in a short period ahead. One could predict that these developments will bring interest rates in an upward trend.

Following a massive sale of foreign exchange to the market, the NBR domestic debt reduced significantly from FRW 57.3 billions on 31/12/2007 to 33.2 billions on 31/07/08. Inter bank operations have resumed and are likely to intensify in the near future. In line with the interest rate policy set in August 2005 and taking into account the recent developments, the time has come for NBR to provide banks with a new reference for their exchange of liquidity. From the 8th August 2008, the REPOS (Repurchase Agreements) operations have replaced the overnight and 7 days auctions for an efficient management of liquidity in the current environment. This new mechanism had started with Repo operations varying from 1 to 14 days but the duration will be reviewed from time to time depending on the way this instrument will prove to be successful.

Based on the situation prevailing on the money market, the expected trend in the near future, the NBR set the Money market reference rate at 8% (Key Repo rate) per annum and the inter bank rate corridor has been set to 125 basis points (1.25%) below and above the key Repo rate. This choice has taken into account the fact that the current trend

in inflation is mainly driven by exogenous shocks. Indeed, despite a lower money increase and a relative appreciation of the domestic currency, the overall inflation is increasing compared with last year.

In case of shortage of liquidity in the banking system, the NBR will lend money to banks on a competitive basis at a minimum rate equal to the upper limit of the inter bank corridor (9.25%). In a similar manner, if there is excess liquidity in the system, the NBR will absorb excess funds on a competitive basis at a maximum rate equal to the above limit of the interbank corridor (6.75%).

The NBR last resort facility remains available just in case a bank fails to get the desired liquidity from the Repo auction or the inter bank market. The interest rate to be applied on this facility is set at the daily clearing Repo auction rate plus a penalty of 2%.

Banks and other investors have also the opportunity to invest in medium and long term instruments, namely T- bills and T-bonds which are not concerned by the above policy rate. These instruments will continue to be issued at interest rates driven by the market forces.

Prudent monetary policy is necessary but not a sufficient condition to achieve price stability in the current context. The fiscal policy and structural reforms in the real sector are also critical in this respect.

V.2. Reforms in the financial sector for the second half of 2008

The ongoing programs to implement the FSDP (Financial Sector Development Program) will be accelerated during the second half of the year. These programs cover the banking system and micro finance sector reforms, the capital market development, the non bank financial service regulation and the modernization of the payment systems.

A. Banking sector reforms

The main actions during the second half of 2008 will be consolidating the achievements in strengthening the financial position of banks and putting in place a legal and regulatory framework in conformity with international banking supervision standards. The new banking law and its implementing regulations will be subject to monitoring for compliance by banks from the second half of 2008.

The efforts to reorganize the banks' credit portfolio will be pursued to reduce the level of non performing loan with the objective of a level less than 10% to be observed by each bank by the end of 2008. The establishment of a Credit Reference Bureau will consolidate the good performance observed so far in this area.

Other developments expected in the banking sector during the second half of 2008 are:

- The opening of international operations by BPR
- The opening of the newly licensed bank
- The expansion of the branches network by current banks
- Finalising the process of privatization of BK
- The restructuring of BHR which will be transformed into a Mortgage liquidity facility

B. Modernization of microfinance institutions

As mentioned, two funds (capacity building fund and credit fund) are in place to finance training of directors and managers of MFIs and supported the building of MIS (Management Information System) and refinancing

activities that have a significant impact on poverty reduction. During the second semester 2008, these funds will start implementation.

C. Nonbanking financial sector regulation

To deliver on the new mandate to supervise the NBF, the National Bank of Rwanda is developing the legal and regulatory framework for the sound functioning and supervision of Non-bank Financial Institutions.

To this effect, a law governing the organization and supervision of insurance industry was approved by the government and passed by the Parliament in July 2008. During the remainder of the 2008, various laws will be drafted and submitted to the Government for approval. These include the law governing insurance contracts and the law governing compulsory/mandatory insurance, the law regulating Pension Funds, and the law governing collective investment schemes. The last two laws (pensions and collective investment schemes) are intended to support the development of the contractual savings as well as long-term investment vehicles.

In addition, financial and management audit of insurance companies will be carried out in 2008; the procurement process to do the assignment is under way and is expected to have been finished not later than September 2008. This audit will enable the NBR to assess the management and financial health of insurance companies.

Furthermore, the Bank will follow up closely two new Government projects: the Universal Medical Insurance and Rural Insurance Strategy. During the first half of 2008, the project conceptual framework papers were put in place and stakeholders' workshops conducted in respect of each project and further recommendations leading to implementation were made. The two projects form part of the Economic Development and Poverty Reduction Strategy (EDPRS) and Vision 2020.

D. Capital market developments

As mentioned, three issues of government bonds have taken place as of June 2008. There are some other issuers working on raising debt capital through the bond market. The city of Kigali is presently working on a municipal bond which they are planning to launch next month. We expect

also some big corporate coming to the market to raise funds by issuing bonds.

CMAC will continue to work on the development of an appropriate legal framework for the capital market in Rwanda.

E. Payment system modernisation

During the second semester, the National Payment System (NPS) Framework and Strategy shall be passed by Government and published. It is also envisaged that the Payment Systems law will be approved by the Government too. More to that the Securities holding law will be drafted to give legal protection and backing securities operations.

Concerning SIMTEL Action Plan, the RPC will be developed and tested during the second semester 2008 and ready for launching early 2009. Furthermore, in order to promote the VISA debit cards usage, we plan to start personalizing the current VISA debit cards here in Rwanda at SIMTEL. This will ensure that all account holders in banks are given cards in less than 48 hours. Better still, our ATMs will be enhanced to accept international cards and

the ATM network expanded to offer a wider coverage. Within the second semester 2008 we expect to conclude negotiations with the winning company for the provision of the RIPPS software and sign a contract.

THE STABILITY OF MONEY MULTIPLIER AND MONETARY CONTROL IN RWANDA

**Pascal Munyankindi, Gichondo Ananias and Amahoro
Adha²**

² This study has been conducted under the supervision of Dr Kigabo Thomas, Chief Economist. We really thank him for orientations and comments.

I. Introduction

The World-wide acceleration of inflation was the most important problem in 1970s, for which practical remedies might be immediately offered. One of the solutions against the global inflationary trend was to adopt monetary targeting strategy by the most major industrial countries' central banks. The monetary targeting was considered as the best strategy through which a central bank chooses the money stock as nominal anchor to provide price stability, when there is a long-run relation between the money stock and the prices as ultimate objective of monetary policy and when the demand for money is stable.

The control of money aggregate by the central bank requires two elements: First, the choice of an operational target by the monetary authority, which incorporates all instruments it uses to implement the monetary policy. Second, a strong relationship between the operational target and the money supply.

While the ultimate goal of the monetary policy is clear, there are frequent misunderstandings and misbeliefs even among economic professionals regarding the tools

and mechanisms central bank should use in order to achieve this goal. The central bank should utilize the available indirect means at its disposal to encourage the economy to move towards the ultimate goal. In practice, the central bank must define the chain of target variables that can be directly influenced by the central bank (operational targets) and others economic variables, through which monetary policy can exert an influence on its final target. This is what is called the “**transmission mechanism**”.

In the case of Rwanda, the National Bank of Rwanda is influencing economic trend by indirectly controlling the money supply, through the control of the monetary base as operational target. In this context, the transmission mechanism set out from the quantity of base money and moves toward inflation, through the money supply in the economy. This approach is based on the traditional monetarist theory of inflation, which argues that in the long run, the price level is determined by the amount of money available in the economy. In this context, the money multiplier must be stable and predictable, and this is the main issue to be analyzed in this paper. Assuming that the base money (BM) is under the control of the monetary authority, the determination of the reasons behind the

changes in the money multiplier becomes important in the implementation of monetary policy.

The objective of this paper is to discuss the way that the link between the central bank's controls over the money base to the control of the broad money supply is modeled by the NBR. The rest of the paper is organized as follows. Section II describes the standard money multiplier model. Section III analyses the stability of money multiplier during the period from January 1995 to December 2007. Section IV provides a conclusion and policy implications.

II. The standard money multiplier model

The underlying idea behind the money multiplier model is that the central bank is responsible for controlling the growth rate of money, by controlling the money base. This model tries to explain the relationship between base money (BM) and the monetary aggregates (M):

$$**M = kB** \tag{2.1}$$

Where k is the money multiplier

Despite that the monetary authority can control the larger portion of the changes in the money supply by controlling the size of changes in B , for effective control of money aggregates; it is pertinent that the monetary authorities predict the movement in money multiplier with some level of accuracy. An error in forecasting money multiplier can affect the desired growth rate on money stock.

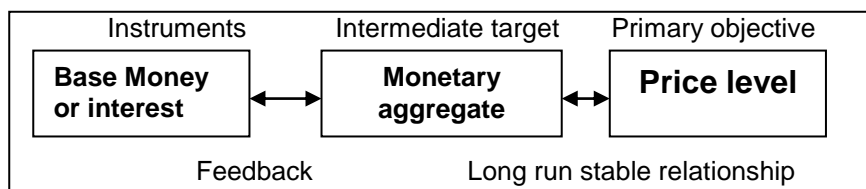
It is not very often an easy task because policymakers have to take into account households behavior, business community and financial institutions that can act independently.

In other words, there are other factors in this model which are outside the control of monetary authority such as changes in the composition of deposits between demand and time deposits, changes in the composition of money between currency and deposits and commercial banks' behavior in holding excess reserves.

The equation (2.1) describes a transmission mechanism in which the operational target (base money) affects through the money multiplier, the money supply (money multiplier theory), whose growth rate determines the rate of inflation (quantity theory of money). This equation is responsible for

the erroneous view, held by a great number of economists not specializing in monetary macroeconomics that the central bank's operational duty is to manipulate the size of the monetary base. The transmission mechanism described is based on the assumption of the money multiplier stability.

Figure 1: Monetary targeting



The components of monetary base (B) in Rwanda are the currency in circulation (C) outside NBR plus bank reserves plus non bank deposits in the NBR. Note that while non bank deposits in the NBR do not, strictly speaking, we have what is called high powered money. M_1 is currency in circulation (C) plus demand deposits (D) with commercial banks. M_2 is M_1 plus time and savings deposits and foreign exchange deposits (T) with commercial banks.

The components of money multiplier are the currency ratio ($c=C/TD$), the deposit ratio ($t = T/TD$) and the reserve ratio ($r = R/TD$), where $TD = D +T$.

The multipliers and their components are related as follows:

$$M_1 = C + D = C + TD - D \quad (2.2)$$

$$B = C + R \quad (2.3)$$

Then

$$\frac{M_1}{BM} = \frac{C + TD - T}{C + R} = \frac{1 + c - t}{c + r} \quad (2.4)$$

$$\text{Where } c = \frac{C}{TD}; r = \frac{R}{TD}; t = \frac{T}{TD}$$

$$\text{Equation (2.4) gives } M_1 = k_1 B \quad (2.5)$$

$$\text{Where } k_1 = \frac{1 + c - t}{c + r} \quad (2.6)$$

For the broad money multiplier, the same procedure gives:

$$\frac{M_2}{BM} = \frac{C + TD}{C + R} = \frac{c + 1}{c + r} \quad (2.7)$$

And then,

$$k_2 = \frac{c + 1}{c + r} = \frac{1 + k + t}{c + r} \quad (2.8)$$

Where $k = c - t$ is the difference between currency and time deposits ratio.

Two types of reserves are recognized: Required Reserves (RR) and Excess Reserves (ER):

$$R = RR + ER = m TD + ER \quad (2.9)$$

Then, $r = m + er / td$ (2.10)

With $er / td = f(r_{mark})$; r_{mark} is the market rate³.

The relation (2.9) indicates that banks may want to hold excess reserves beyond the required level to facilitate unexpected cash payments to depositors or to other banks without allowing total reserves to fall the required minimum. Excess reserves can be caused by a decline in supply of loanable funds i.e. a credit crunch, or a reduction in the demand for credit. This situation has important implications for the effectiveness of monetary and fiscal policy as for the efforts to improve the efficiency of the financial sector (Agénor, Aizenman and Hoffmaister, 2004).

These excess reserves earn no interest, and by reducing such reserves, a bank would be able to increase his capacity to invest. Consequently, the opportunity cost of holding excess reserves can be represented by r_{mark} in general. Banks' portfolio decisions on excess reserves are influenced by the expected return from alternative uses of the fund. Because reserves deposited with the central bank

³ Excess reserves can be explained by other variables, e.g exchange rate.

fetches no interest, an increase in market interest rate, increases the opportunity cost of holding excess reserves.

The non-bank public decides on how much of its wealth to hold in the form of currency. For the economy as a whole, as national wealth increases the currency-deposit ratio decreases, given that the financial system is well developed. In general, the non-bank public compares the expected return on the assets, in choosing the currency or deposits. An increase in interest paid on deposits reduces the demand for currency relative to deposits, because holding currency yields no interest.

III. Methodology and empirical analysis

This section discusses the money multiplier theory in the case of Rwanda. We analyze if the quantity of central bank money carry any information content with respect to the current and/or future monetary policy intentions in Rwanda. To answer this question, two elements will be analyzed here: the stability of money multiplier and the existence of a long run relationship between the monetary base and the money aggregate M_2 using monthly data from January 1995 to December 2007.

3.1. Sources of monetary expansion

As already mentioned, the money multiplier model is given by the following equation:

$$M = K.BM \text{ where, } K = \frac{c+1}{c+r}. \quad (3.1)$$

The money stock⁴ becomes therefore a function of currency in circulation ratio (c), commercial bank reserves ratio (r) and the base money (BM).

$$M_2(t) = f[c(t), r(t), BM(t)] \quad (3.2)$$

The decomposition of this function over a given period allows to measure the contribution of each component in variation of M_2 and understand the sources of monetary expansion in relation of the behavior of the three sectors namely nonbanking private sector through changes in currency in circulation ratio (c), commercial banks through changes in commercial bank reserves ratio (r) and the central bank through variations in base money.

Therefore, differentiating this function, we obtain the variation of broad money $M_2(t+1) - M_2(t)$ between the period $t+1$ and t and the terms of that decomposition are partial

⁴ Money stock corresponds to broad money M_2

differences of M2(t) function and correspond to the effects of each sector on broad money.

$$M_2(t+1) - M_2(t) = \frac{\partial f}{\partial c}(t) \cdot [c(t+1) - c(t)] + \frac{\partial f}{\partial r}(t) \cdot [r(t+1) - r(t)] + \frac{\partial f}{\partial BM}(t) \cdot [BM(t+1) - BM(t)] \quad (3.3)$$

where :

$$\frac{\partial f}{\partial c}(t) = \frac{r(t)-1}{[(c(t)+r(t))^2]} \cdot BM(t), \quad \frac{\partial f}{\partial r}(t) = -\frac{c(t)+1}{[(c(t)+r(t))^2]} \cdot BM(t) \quad \text{and}$$

$$\frac{\partial f}{\partial BM}(t) = \frac{c(t)+1}{c(t)+r(t)} \cdot$$

By calculating cumulative changes between the initial period T₀ and the actual period T_n, each term obtained constitutes a sum which gives monetary expansion and its sources and finally the equation (3.3) becomes:

$$M2(t+1) - M2(t) = \sum_{t=T_0}^{T_n} \frac{\partial f}{\partial c}(t) [c(t+1) - c(t)] + \sum_{t=T_0}^{T_n} \frac{\partial f}{\partial r}(t) [r(t+1) - r(t)] + \sum_{t=T_0}^{T_n} \frac{\partial f}{\partial BM}(t) [BM(t+1) - BM(t)] \quad (3.4)$$

Applying the relation (3.4) in the case of Rwanda, it comes that base money contributes by 77.2% on average in monetary expansion. Sectors like nonbanking private sector, commercial banks contribute respectively by 16.0% and 6.8% in M₂ movements. For the whole period, the minimum and maximum contribution of base money in the broad money expansion is respectively 48.5% and 98.2%.

It is important to point out that when the annual data are used (table 1), this contribution of the monetary base decreases, to the detriment of other sectors, until reaching the average of 59.8% whereas the nonbanking private sector and the commercial banks' contributions increase and reach respectively the average of 16.9% and 25.9%.

Table 1: Sectoral distribution of sources of monetary expansion: gross cumulative annual changes of M2 since 1997⁵

Period	$\sum_{t=T_0}^T \frac{\partial f}{\partial c}(t)[c(t+1)-c(t)]$	$\sum_{t=T_0}^T \frac{\partial f}{\partial r}(t)[r(t+1)-r(t)]$	$\sum_{t=T_0}^T \frac{\partial f}{\partial BM}(t)[BM(t+1)-BM(t)]$	$M2(t+1)-M2(t)$
dec.-97	9.40	11.02	-2.30	18.12
dec.-98	10.46	3.17	11.60	25.23
dec.-99	14.86	17.16	3.24	35.26
dec.-00	15.68	24.53	13.52	53.73
dec.-01	17.79	20.63	29.02	67.45
dec.-02	15.29	26.49	48.09	89.87
dec.-03	17.83	26.46	63.16	107.45
dec.-04	4.86	40.24	95.68	140.78
dec.-05	25.21	50.31	122.58	198.10
dec.-06	37.26	38.73	213.14	289.12
Contribution (average in %)	16.86	25.87	59.77	

Source: NBR, Research Department

⁵Is the launching of money market in Rwanda.

3.2. Stability of money multipliers

By calculating the ratio between the various monetary aggregates (M_1 and M_2) and the monetary base, it is possible to obtain a money multiplier for each aggregate. In the multiplier model, what matters is not so much the level of the money multiplier but rather its movements over time. As we mentioned, a stable multiplier would mean that the central bank could manage the aggregate money supply by controlling the monetary base. A stable multiplier is therefore one of the conditions for steering the monetary base. Modest fluctuations in the multipliers generate large fluctuations in the aggregates, hampering the conduct of a monetary base policy. In Rwanda, the money multiplier k_2 has largely fluctuated over time (figure 2). This is an indication of non stability of money multipliers. The figure 2 shows that over the period of study, monthly variation of k_2 is between -14.2% and 14.5%.

Figure 2: Variation of money multiplier k2 in % and evolution of k2

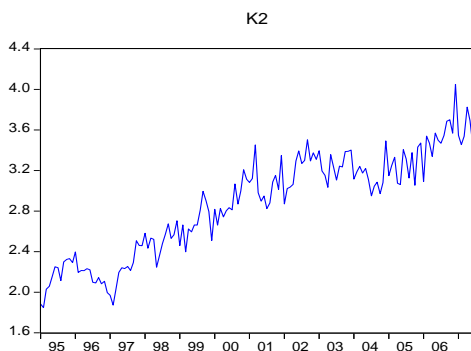
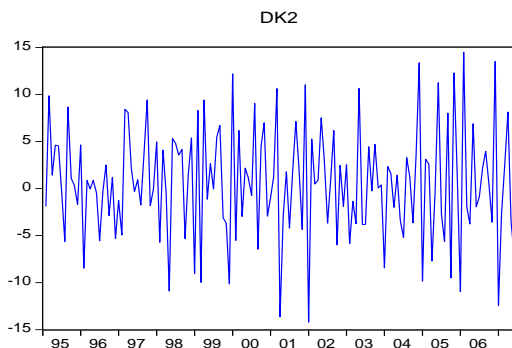


Table 2: Some descriptive statistics of k2

	VK2
Mean	0.57
Median	0.86
Maximum	14.5
Minimum	-14.2

The empirical analysis of the money multiplier stability is to test its stationarity. If k_2 is stationary, this implies that the money aggregate m_2 and the base money bm are

cointegrated with (1,-1) as cointegrated vector, because $k_2 = m_2 - bm$ ⁶.

In this context, the stability of money multiplier can be assessed by testing its stationarity or by testing if the two money aggregates are cointegrated with the mentioned cointegrated vector. The figure 2 shows that the first difference (Dk_2) is stationary and then k_2 integrated of order one. This is confirmed by the ADF unit roots tests (table 3). These results indicate that the money multiplier is not stationary and then non stable.

Table 3. Unit root test of money multipliers

Variables in level							Variables in first difference*
Variables	P (Number of lags)	Model with trend		Model with constant		Simple model	
		t	F3	t	F2	t	
m_2	4	-2.75	3.77	-0.45	9.04	4.24	-4.39
bm	4	-1.75	1.55	-0.47	7.03	3.73	-6.69
k_2	4	-2.55	3.27	-0.86	2.14	1.71	-7.15

* The three variables are stationary in first difference

⁶ The small letter is the logarithm of the corresponding aggregate.

3.3. Long run relation between the monetary base and the money aggregate M2

The Validity of the money multiplier stability approach was questioned by some researchers (i.e. Ford and Morris, 1996) who consider that the need is to test the stability of long-run relationships between monetary aggregates and the monetary base, rather than explicitly the stability of the money multiplier. We then test the existence of cointegrating relationship between the monetary aggregate m_2 and the base money bm , by using the Johansen cointegration test. Given that the two variables are $I(1)$, the maximum cointegration rank is 1 and can vary with the specification of deterministic terms (constant and trend) in the VEC model. Model 2 (no trend term, intercept restricted to the co integration space) was founded to be the most consistent with the sample data.

The results for Johansen's trace test are given in table 4 and indicate that the null hypothesis of no cointegration between M_2 and BM is rejected. This means that there is a long-run relationship between the two variables.

Table 4: Co integration test: Johansson approach

Included observations: 154 after adjustments

Trend assumption: No deterministic trend (restricted constant)

Series: LOG(M2) LOG(BM)

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.137977	28.90140	20.26184	0.0025
At most 1	0.038440	6.036576	9.164546	0.1879

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

We estimated the parameters of the long run cointegration equation along with all the other parameters in a Vector Error Correction model (VEC) representation of the co integrated VAR(1) model⁷. The restriction that the co integrated vector is (1,-1) is rejected (Chi-square (1) = 5.02E-06, p=0.99). This confirms that money multiplier k2 is not stable.

⁷ Based on Akaike and Schwarz criterion, the selected lag is one.

Table 5: VAR estimation

Vector Error Correction Estimates		
Included observations: 155 after adjustments		
Standard errors in () & t-statistics in []		
Cointegrating Eq:	CointEq1	
LOG(M2(-1))	1.000000	
LOG(BM(-1))	-1.150220	
	[-3.05190]	
C	-1.205870	
	[-0.84857]	
Error Correction:	D(LOG(M2))	D(LOG(BM))
CointEq1	-0.021023	-0.012251
	[-5.11404]	[-1.82509]

In this paragraph, we test if monetary base has temporal precedence to M_2 by using exogeneity tests. The results suggest rejection of the null that M_2 is weakly exogenous for the cointegration parameters using t-stat = -5.11. The null that the base money (BM) is weakly exogenous for the cointegration parameters is not rejected. This indicates that the monetary base has temporal precedence to the money aggregate M_2 . Based on these findings, we can conclude that monetary authority in Rwanda can control the money supply through the control of the monetary base, if a reliable multiplier forecast is available. We can, for example, observe that in some months in the sample, monetary base decreases and monetary aggregate M_2 increases because the money multiplier has increased.

3.4. Sources of volatility in money multiplier

As mentioned, the money multiplier k_2 depends on the three factors: c , r and t . In this paragraph, we analyze the contribution of each factor in the observed volatility in the multiplier k_2 . The ADF test shows that all the tree variables are $I(1)$.

The Johansen cointegration test proves that there is a cointegrating vector among money multiplier k_2 and the foreign currency ratio (Cr), k_2 and the reserve ratio (r), (r) and the deposit ratio (t) but not between k_2 and the deposit ratio (t).

Table 6: Sources of volatility in the money multiplier k_2

Regressions	cr	r	t	R2
Regression 1	-4.02*			0.59
Regression 2		-9.02*		0.89
Regression 3	-1.54*	-6.56*	0.26*	0.95

*significant at 5% level.

The three regressions (K_2 on cr ; K_2 on r and K_2 on cr, r, t) indicate that the reserve ratio is the important source of the volatility in the money multiplier k_2 with a coefficient equal to -9.02 followed by the currency ratio (coefficient = -4.02).

In addition, the demand of currency held by commercial banks is under estimated in the monetary policy program. The table 7 shows what is big the gap between the real cash in vault and the cash in vault defined in the program. This is a source of under estimation of the currency outside NBR, which is the highest component of the monetary base. This situation obliges NBR to intervene intensively on monetary market to meet a target on reserve money each month, defined by the program. These interventions contributed in instability of money multiplier.

Table 7: Cash in vault (CIV), Cash in Vault extended to UBPR (CIVEXT) and Cash in Vault program (CIVPROG) from January 2007 to July 2008

	CIVext	CIV	CIVprog
2007:01	8,57	6,1	3,8
2007:02	9,29	5,7	3,8
2007:03	8,26	5,5	5,5
2007:04	8,47	5,6	3,8
2007:05	7,33	5,7	3,8
2007:06	7,53	4,8	4,8
2007:07	8,58	6,1	3,8
2007:08	8,68	5,9	3,8
2007:09	8,48	5,7	5,8
2007:10	9,08	6,2	5,8
2007:11	10,69	6,9	5,8
2007:12	9,51	5,4	5,4

	CIVext	CIV	CIVprog
2008:01	9,32	6,0	4,0
2008:02	9,90	6,6	4,0
2008:03	11,25	8,1	8,1
2008:04	10,71	7,7	3,0
2008:05	8,50	6,1	3,0
2008:06	9,91	7,6	3,0
2008:07	10,04	7,4	3,0

IV. Conclusion and policy implications

This paper examined the relationship between monetary aggregate (M_2) and monetary base (BM) in Rwanda. The empirical analysis shows that the money multiplier is not stable and a long-run relation between M_2 and BM have been identified. The main conclusion of this study is that the control of the growth of the broad money through the monetary base is not easy. Indeed, the money multiplier is not stable. In this case, modest fluctuations in the money multiplier can generate large fluctuations in the aggregates and hamper the conduct of a monetary base policy.

The National Bank of Rwanda cannot easily exert a full control on the size of the monetary base which depends also on the decision of households, business and financial institutions. In the other words, the monetary base is affected by some factors outside the control of monetary authority such as changes in the composition of deposits between demand and time deposits, changes in the composition of money between currency and deposits and commercial banks' behavior in holding excess reserves. For example, the currency in circulation outside National Bank of Rwanda represents around 70% of the base money over the sample. In this case, the growth rate of

monetary base is an endogenous variable and the monetary transmission mechanism defined in the money multiplier model is weakening.

This study shows that the changes in reserve ratio are the important source of the volatility in the money multiplier k_2 . The volatility in excess reserves in Rwanda reflects essentially, deficiencies in the interbank money markets and is a sign of an over liquidity of the banking sector resulting from unsterilized capital inflows.

To contribute in the stabilization of money multiplier k_2 , the National Bank of Rwanda has to reinforce concrete measures which will help to reduce the volatility in excess reserves and encourage the interbank market. These measures include:

- (a) The reinforcement of monetary policy instruments which permit to sterilize capital inflows over a long period.
- (b) Different measures to reactivate the interbank market.
- (c) The money creation by the banking system is limited by the reserve requirements which credit institutions have to respect and the public's preference for currency. The constitution of required reserves in foreign currency in NBR doesn't help to achieve that objective. Indeed, the

differentiated reserve requirement system between reserve requirement imposed on domestic and foreign currency deposits may be introduced to attract or discourage foreign currency deposit inflows. But this has a cost of complicating central bank's liquidity management. Therefore, it should be important to think about the current constitution of reserve requirement.

- (d) The current monetary program with IMF should be more flexible and take into account the development of important aggregates. The monthly data from 2004 to 2007 show that the currency in circulation represents around 70% of the monetary base. The sum of currency in circulation and the reserve requirement varies between 87.3% and 109.6% of the monetary base target. This clearly shows that many of the factors affecting the monetary base in Rwanda are exogenous for the National Bank of Rwanda. In that context, the traditional money multiplier model is weakened. In addition, the cash in vault and then the currency outside NBR is underestimated.

References

1. Andras Komaromi. 2007. "The effect of the monetary base on money supply-does the quantity of central bank money carry any information?", MNB Buletin.
2. Andrea Schaechter. 2001. "Implementation of monetary policy and the Central Bank's balance Sheet". IMF Working Paper
3. Arto Kovanen. 2002. "Reserve Requirements on Foreign Currency Deposits in Sub-Saharan Africa-Main Features and Policy Implications". IMF Working Paper.
4. David Hauner and Gabriel Di Bella. 2005. "How Useful Is Monetary Econometrics in Low-Income Countries? The Case of Money Demand and the Multipliers in Rwanda", IMF Working Paper.
5. Luc AUcremanne, Jef Boeckx, Olivier Vergogne. 2007. "Interest rate policy or monetary base policy: implications for a central bank's balance sheet". National Bank of Belgium Economic Review.
6. Korap, H. Levent. 2006. "An empirical investigation upon money multipliers and their stability in Turkish

- economy for the post 1990 period". Turkish economic association, Discussion paper.
7. Otmar Issing. 2005. "Why did the great inflation not happen in Germany?" Federal Reserve Bank of St. Louis Review.
 8. Raghbendra, Deda Prasad Rath. 2000. "On the Endogeneity of money multiplier in India".
 9. Sveriges Riksbank. 2007. What have economists learned about monetary policy over the past 50 years? Press release, no. 38.
 10. T.K. Jayaraman, Bert D.Ward. 2003." Is money multiplier relevant in a small, open economy? Empirical evidence from FIJI". USPEC

Money and Inflation in Rwanda

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⁸ The views expressed in this paper are those of the author and not of the National Bank of Rwanda.

Abstract

The objective of this study was to analyze the relation between money and inflation in Rwanda, one of the important assumptions in monetary targeting framework. Change in production was identified as the dominant determinant of inflation in the short-run, followed by inflation inertia. The relation between money and inflation is also established. The money pass-through to inflation depends on the level of money gap which is the difference between supply and demand of money.

This study offers perspectives for better understanding and forecasting inflation in Rwanda. In the next study, a complete model of inflation in Rwanda will be estimated by including other factors as variables which explain the inflation. These variables are especially a measure of the disequilibrium of external sector, the rainfall factor, dummies to take in account different events supposed to affect inflation development in Rwanda and the world food and fuel prices.

I. Introduction

The primary objective of monetary policy, as stated in the National Bank of Rwanda's (NBR) chart is to maintain price stability. To achieve this objective, the NBR conducts monetary policy within a monetary programming framework that focuses on achieving an annual target for rate of growth of broad money M2, based on assumptions regarding the real GDP growth rate and CPI inflation. The M2 target for annual program is translated into an operating guide for base money, using an assumed stable money multiplier.

One of the important assumptions in this framework is that there is a long run relationship between the money stock and the price (ultimate objective), by assuming a stable money demand function. A previous study on monetary transmission mechanism in Rwanda shows that a shock on monetary aggregates M2 should have a modest positive effect on inflation⁹ which appears after 12 months.

⁹ Rusuhuzwa Kigabo Thomas, Munyankindi Pascal and Amahoro Adha, monetary transmission mechanism in Rwanda, NBR Economic Review n°2, April 2007.

The purpose of this study is to test this assumption by modeling inflation, with a view to strengthening the effectiveness of NBR monetary policy. To achieve this objective different approaches are adopted. First, we analyze the relationship between money stock M_2 , real output Y and the price level P based on monetarist view which postulates that inflation is a monetary phenomenon in long -run. Second, we estimate a p^* model of inflation which suggests that besides the output gap, the deviation of money from its long run path helps to explain the future path of inflation. Third, a single error correction model for inflation is estimated.

The results indicate that changes in the monetary aggregates, exchange rate and production have impact on inflation. In addition, the results show that the link between money aggregates and inflation depends on the level of the disequilibrium in the money market (difference between money supply and money demand). Finally this study shows inflation has an inertia component which can be associated to a sluggish adjustment of inflationary expectations.

The rest of the paper is structured as follow: The second section reviews literature on relation between money and inflation. Section three presents methodology, empirical analysis and results. The last section considers the conclusions and policy implications of the study.

II. Theoretical and empirical literature review

2.1. Theoretical literature review

The long- run relation between money growth and inflation has been subject of a vast empirical literature which can be divided into three groups. The first group uses cross section data over a long period of time on a big number of countries. In general, a long- run average of money supply or its growth and price level or inflation are calculated for the set of countries and used to compute the correlation between the two. In these studies, countries include in the sample are treated equally, in other words, there is no distinction based on economic or monetary regimes. In most case of these studies, the relation between money supply and price level is strong and positive. One of the limits of these studies is that the used money growth and inflation are averages for different countries. For this approach we can refer to Dwyer and Hafer (1999), Vogel (1974), Barro (1990), PAKko (1994), McCandless and Weber (1995). These studies have not attempted to analyze how the level of inflation affects relation between money growth and inflation.

The second group of empirical study uses single country time series analysis. In this approach the long-term quantity theory relationship is analyzed by using a high frequency time series (see for example Lucas, 1980; Fitzgerald, 1999; Gregory C Chow, 2004). Researchers adopted also the approach which test explicitly coefficient restrictions based on the quantity theory in a VAR model (Stock and Watson, 1988, and Boschen and Mills, 1995; King and Watson, 1997, Gregory C Chow, 2005). This approach has been criticized by considering that long run economic propositions are not well described by high frequency time series (McCallum, 1984; Rolnick and Weber, 1995).

In this group we can mention studies on relation between money and inflation by using the p^* model, suggested by Hallman, Porter and Small (1991) and further explored by Vega and Trecroci (2002), Gerlach and Svensson (2004), Jansen (2004). This model may be considered as a modern monetarist approach to modeling inflation. It starts by defining the price gap as the difference between the price level and its long- run level which is implied by the long-run quantity relation. This model allows testing the effect of money gap on inflation and the direct effect from lagged price to the current price level.

The last group uses a methodology which can be considered as an expansion of the p^* model and modeling inflation by assuming that inflation results in the long run from disequilibrium in the money market and the external market (Juselius, 1991; Nachege, 2001; Durevall and Ndug'u, 2001; Mame Astou, 2007).

2.2. Empirical literature review

We first focus on studies which analyze the relationship between money stock M , real output Y and the price level P based on monetarist view which postulates that inflation is a monetary phenomenon in long –run (Milton Friedman,1994). The major assumption in this analysis is that when money supply increases, whatever the cause, real output reacts first but the effect is short-lived and prices react later but the effect lasts longer. This view of monetarists is summarized in the Quantity Theory of Money (QTM) which postulates that changes in money supply growth are followed by equal changes in the inflation rate.

The starting point of the QTM is the following identity:

$$MV = YP \quad (1)$$

Where M is money supply, V is the velocity of money, Y is real output, and P is the price level.

By using the growth rates of the variables, equation (1) becomes:

$$\Delta M + \Delta V = \Delta Y + \Delta P \quad (2)$$

Or

$$\Delta P = \Delta M + \Delta V - \Delta Y \quad (3)$$

This identity is transformed into the quantity theory with two assumptions. The first is that there exist a proportionality relation between money growth and inflation in the long-run. This means that in the regression of inflation on money growth, the estimated coefficient is one.

The second assumption is the neutrality of money, which means that a permanent increase in the growth leaves output and velocity unaffected in the long- run. In other word, if there is an effect of money growth on output, it only holds in the short run.

The way to analyze the two assumptions is to formulate the QTM in the following testable econometric equation.

$$p_t = \alpha_0 + \alpha_1 m_t + \alpha_2 y_t + \varepsilon_t \quad (4)$$

Lower case variables are the natural logarithms of their upper case counterparts. In such equation, velocity of money is including in the error term, since there is not an independent estimates of velocity.

As mentioned, the p^* model proposed by Hallman, Porter and Small (1998, 1991) assigns a crucial role to the real money gap as a predictor of future inflation, as the role of the output gap in traditional Phillips curves. This model may be considered as a modern monetarist approach to modeling inflation.

The p^* model has been intensively used in different central banks to discuss the monetary growth targeting¹⁰. We apply this model because of its empirical success of the theory as reported by Gerlach and Svensson (2003), Reimers (2003) and Aurelijus Dabusinska (2005).

¹⁰ See for example different studies in Bundesbank (1994, 1995, 1997). This model has been considered as part of the Bundesbank's view of the transmission mechanism of monetary policy (see Jahnke and Reimers, 1995) and Bank of Canada.

The p^* theory consists of two hypotheses: First, there exists a long run relationship between aggregate money and price levels. Second, the rate at which prices adjust to their long-run equilibrium (i.e. inflation rate) depends on the gap between the current price level and the long run equilibrium level (LRE) of prices.

Based on the first hypothesis, the LRE price level is defined as the price level that would prevail with the current (nominal) money stock if the income velocity of money and output were at their long run equilibrium levels:

$$p_t^* = m_t + v_t^* - y_t^* \quad (5)$$

The second proposition can be summarized as follow

$$\pi_{t+1} = \pi_{t+1,t}^e - \alpha_p (p_t - p_t^*) + \alpha_z z_{t+1} + \varepsilon_{t+1} \quad (6)$$

$\pi_{t+1} = p_{t+1} - p_t$ is the rate of inflation in period t, $\pi_{t+1,t}^e$ is the expectation of this inflation as of period t and z_{t+1} is a set of other exogenous variables affecting inflation at t+1.

If $m_t^r = m_t - p_t$ is the real money balances and m_t^{r*} is the LRE stock of real money, we have

$$m_t^{r*} = m_t - p_t^* = y_t^* - v_t^* \quad (7)$$

This allows expressing the price gap in terms of real money balances:

$$-(p_t - p_t^*) = (m_t - p_t) - (m_t - p_t^*) = m_t^r - m_t^{r*} \quad (8)$$

Equation (6) becomes

$$\pi_{t+1} = \pi_{t+1,t}^e + \alpha_m (m_t^r - m_t^{r*}) + \alpha_z z_{t+1} + \varepsilon_{t+1} \quad (9)$$

Where $\alpha_m = \alpha_p > 0$

The equation (9) can be contrasted with the augmented Phillips curve

$$\pi_{t+1} = \pi_{t+1,t}^e + \alpha_y (y_t - y_t^*) + \alpha_z z_{t+1} + \varepsilon_{t+1} \quad (10)$$

Where $y_t - y_t^*$ is the real output gap in the period t;

The two equations (9) and (10) are used to compare the ability of money and out put to predict inflation.

In this paper we estimate three equations: equation (9), equation (10) and an equation in which output gap and money gap are used.

$$\pi_{t+1} = \pi_{t+1,t}^e + \alpha_m (m_t^r - m_t^{r*}) + \alpha_y (y_t - y_t^*) + \alpha_z z_{t+1} + \varepsilon_{t+1} \quad (11)$$

z is the exchange rate between RWF and USD noted by e .

An other approach to model inflation is to consider that in the long run inflation results from disequilibria in the money market and the external market. These disequilibria are included as variables which explain the level of inflation.

In this study we only consider the disequilibria in the money market, because the objective of this study is to analyze the relation between money and inflation.

III. Methodology, Empirical Analysis and Results

As presented, we use different approaches in this study. We first analyze the relationship between money stock M , real output Y and the price level P based on monetarist view which postulates that that inflation is a monetary phenomenon in long -run. Second, we estimate a p^* model of inflation which suggests that besides the output gap, the deviation of money from its long run path helps to explain the future path of inflation.

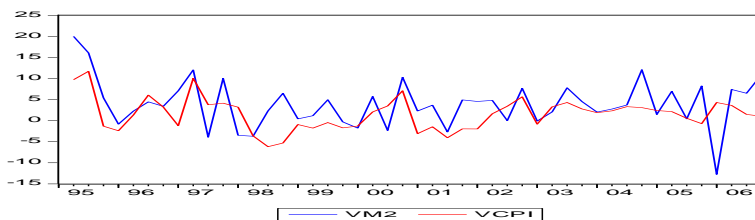
Third, we estimate a single error correction model for inflation in Rwanda. We estimate first a general model with four lags of each variable (m_2 , y , e) in first differences and

the error correction term from the money demand function (ec). We derive an empirically parsimonious model by reducing the number of lags and dropping insignificant explanatory variables from the model.

3.1. Quantitative Theory of Money

In this paragraph we analyze the relationship between money stock M , constant output Y and the price level P , based essentially to the work of Milton Friedman (1994). We assess here the changes in the price level and output in relation to the changes in money stock in Rwanda. The data used are quarterly for the period 1995:1 to 2006:4.

Figure 1: Broad money growth and inflation changes in percentage



The Granger causality test shows that money and production cause CPI and that money does not cause GDP. This is conform to the monetarist views. The Granger causality test results are confirmed by significant correlation

coefficient between CPI and M2 (0.72) and between CPI and real GDP (0.77).

Table 1: Granger causality test

Pairwise Granger Causality Tests

Sample: 1995Q1 2006Q4

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
CPI does not Granger Cause M2	46	1.02289	0.3685
M2 does not Granger Cause CPI		3.61818	0.0357
YR does not Granger Cause M2	46	0.25610	0.7753
M2 does not Granger Cause YR		0.58217	0.5632
YR does not Granger Cause CPI	46	8.04894	0.0011
CPI does not Granger Cause YR		2.95196	0.0634

In this section, we first estimate a long-run relation between p , m and y by using the Engle-Granger approach (1987). The ADF unit root test shows that the three variables are $I(1)$. Having confirmed the existence of unit root, then we test for co-integration between the three series. The Engle-Granger approach shows that the three variables are co-integrated as indicated in table1. The

residual (ϵ) from the regression of p on $m2$ and y is stationary, $ADF = -2.48$ less than -1.95 (critical value at 5%).

The existence of one cointegrating relation between the three variables is confirmed by the Johansen cointegration test.

Table 2: Trace test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.370790	37.34269	35.19275	0.0289
At most 1	0.177438	15.56802	20.26184	0.1956
At most 2	0.127073	6.387450	9.164546	0.1629

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

The coefficients of $m2$ and y in the regression are 0.67 and -0.68 and significantly different from zero. In order to validate the results (equation 1), we use a range of test statistics. The model appears to be not statistically specified. Except a high R^2 , there is evidence of serial correlation (LM test) and ARCH effects (ARCH test). ARCH is Engle's test for autoregressive conditional heteroscedasticity. The hypothesis that the estimated coefficient of money aggregate in the inflation equation is

one is rejected ($\chi^2 = 18.6$; $p=0.00$). Thus, QTM can't be applied in the case of Rwanda;

In order to render the monetarist model more realistic and workable in small open economies, some adjustments such as the incorporation of cost push factors to make the model more consistent with the PPP approach have been recommended (Sani, 1982; Bhalla, 1981; Chibber, 1992, Lim and Papi, 1997;....). In this study, we added the lagged dependant variable $p(-1)$ which accounts for the inflationary momentum and expectations. Indeed, inflation may have a dynamic component result of the sluggish adjustment of expectations or the existence of staggered wage contracts.

The introduction of this new variable reduces significantly the effects of the two others: the elasticity of the monetary aggregate decreases from 0.67 to 0.26 and the elasticity of GDP decreases from -0.68 to -0.35. It also removes the ARCH effects and the serial correlation (equation 2). Indeed, the model appears to be statistically well specified, In addition to a high R^2 , there seems to be no evidence of serial correlation (LM test) or an autoregressive heteroscedasticity (ARCH test). The assumption about normally distributed errors is also accepted (Jarque Bera

test). Based on this model we estimate an ECM model of inflation (equation 3). The estimations indicate that inflation inertia can be considered as an important determinant of inflation (0.77), followed by the production (0.35) and the money growth (0.27). This high inflation inertia at this stage can be attributed at a limit number of inflation's explanatory variables included in the model.

Table 3: Estimation of relation between p, m and y

Equations	Coefficient s	R^2	Diagnostics tests			ADF of residuals
			LM	Jarque- Bera	ARCH	
Equation 1 m2 y	0.67 -0.68	0.87	29.5 (0.00)	10.7 (0.005)	23.8 (0.000)	-2.5
Equation 2 M2 Y P(-1)	0.26 -0.35 0.7	0.96	8.29 (0.08)	0.5 (0.8)	7.3 (0.06)	-4.7
Equation 3 Dm2 Dy Dp(-1) Ecm(-1)	0.27 -0.34 0.77 -0.7	0.40	1.5 (0.46)	0.18 (0.9)	2.66 (0.10)	

3.2. Do monetary aggregates have useful information for forecasting inflation?

In this paragraph we verify if monetary aggregates have useful information for forecasting inflation than that provided by inflation itself. One of possibilities to approach this problem is to conduct forecasting experiments using Root Mean Squared Error (RMSE) and evaluate whether each monetary variable improves the forecasts of a simple AR(p) model of inflation (see for example Orden and Fisher, 1993; Luketpol, 1993 ; Chandra and Tallman, 1996, 1997; Black et al (2000); Simatele, 2003; Feridun et al. 2006). In this paragraph, we first estimate an AR(p) model of inflation in Rwanda as the base model and adding one variable at a time to the AR(p) model. We will then compare the RMSE of the different models to establish ranking of the different forecasts. The RMSE tells us how close the forecasted series is to the original series. The higher is the RMSE for a model less is the information the additional variable has for forecasting inflation.

We use a model of the following form

$$Inf_t = \alpha_0 + \alpha_1 inf_{t-p} + \alpha_2 X_{t-p} + \varepsilon_t \quad (12)$$

Where Inf is the inflation, calculated as variation of CPI, X is the variable used in addition to inflation in the model, p is the number of lags which is the low number of lags that residual autocorrelation in the regression model is eliminated and ε is the forecasting error.

$$\varepsilon = \text{inf} - \text{inf}^{\text{forc}}$$

inf^{forc} is the forecast inflation.

The RMSE is define as follow

$$RMSE = \sqrt{\frac{\sum_{t=1}^n (Y_t - \hat{Y})^2}{n}} \quad (13)$$

Y observed, \hat{Y} forecasted, n number of observations

The partial correlation of inf shows that $\rho=1$, then we estimate un AR (1). This model is used to forecast inflation out of sample. This choice allows us to simulate real time policy decision making. The initial estimation is done between 1995:1 to 2006:4. We then make a forecast for 2007:1 to 2007:4.

Base on equation (12) we calculate RMSE for each model and decide if a variable adds significant information for forecasting or not. From the table 3 it is shown that the RMSE for all the three variables are relatively less than that

of the benchmark AR(1) model. Thus, these monetary variables have some information for forecasting inflation.

Table 3 : Root Mean Squared Error (1995:1-2006:4)

	RMSE
AR(1)	3.07
M1	3.03
M2	3.05
Exchange rate(FRW-USD)	3.05

3.3. P* Model

The p^* model proposed by Hallman, Porter and Small (1998, 1991) assigns a crucial role to the real money gap as a predictor of future inflation, as the role of the output gap in traditional Phillips curves. To estimate such model, we need to calculate two important variables: Money Gap and Out put Gap, and have a measure of expected inflation.

3.3.1. Calculating the Money Gap

In this paper we consider the error term (ec) from the money demand equation as the money gap, defined as the deviation of money aggregate from its long-run path (Koffie Nassar, 2005; H. David and G. Di Bella 2005).

The money demand function to be estimated is of this form¹¹

$$lm_{2t} = \alpha_0 + \alpha_1 lp_t + \alpha_2 ly_t + \alpha_3 ltch_t + \alpha_4 i_t + \varepsilon_t \quad (14)$$

Where m2 is the money aggregate, p is the CPI, y is the constant GDP, tch is the nominal exchange rate (FRW-USD) and i is the deposit interest rate.

The Johansen cointegration test shows that there is one cointegrating equation among the variables which is a money demand function.

¹¹ For details on money demand estimation in Rwanda see Rusuhuzwa Kigabo Thomas, Barebereho Josiane and Gichondo Ananias, NBR Economic Review n°1, June 2007; Goux François and Rusuhuzwa Kigabo Thomas, CNRS, Econpapers, 2007.

Table 4: Johansen cointegration test

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.452762	58.84698	54.07904	0.0177
At most 1	0.272030	31.11487	35.19275	0.1290
At most 2	0.220729	16.51006	20.26184	0.1519
At most 3	0.103734	5.037850	9.164546	0.2793

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

The estimated money demand function is

$$m_{2t} - p_t = -0.25 + 0.82y_t + 0.48e_t \quad (15)$$

$$(-1.30) \quad (8.8) \quad (5.5)$$

ARCH =2.26 (0.13) White = 3.8 (0.58), Ljung test= 16.4(0.7), Jargque- Bera =0.006 (0.99)

The coefficient of deposit interest rate is not significant from zero and this variable has been removed from the equation.

Table 5: Estimation of money demand

	Lm2-Lp
Ly	0.82(8.4)
Le	0.48(5.5)
Jarque Bera	0.006(0.99)
ARCH	2.26(0.13)
White	3.8(0.58)
LJ test	16.4(0.7)

(.): t statistics

The stationary error term (ϵ_c) is used as money gap to estimate the p^* model. We replace the inflation expectation term by lagged inflation rate. This can be considered as trying to analyze the backward looking adjustments in inflation expectations.

3.3.2. Calculating Output Gap

In literature, there are two basic methodologies for recovering unobserved components such as potential output gap: statistical detrending or estimation of structure relationships (see Régis and Shanaka (2007), Cerra and Saxena (2000), Coe and McDermott(1997)). In this paper we adopt the statistical detrending methodology due to the limitation of data. We use the Hodrick-Prescott (HP) filter which is a popular method by which a trend or potential

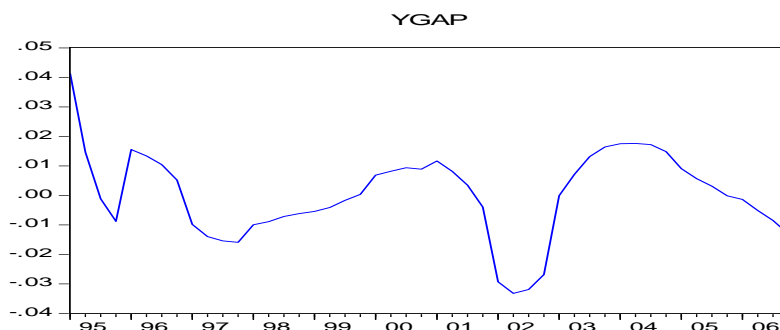
output is extracted from actual output data. This technique minimizes a combination of the size of the actual output fluctuations around its trend and the rate of change in the trend output for the whole sample. The Potential output in the HP filter is the series of values that minimizes the expression

$$\sum_{t=1}^N (Y_t - Y_t^*)^2 + \lambda \sum_{t=2}^N [(Y_{t+1}^* - Y_t^*) - (Y_t^* - Y_{t-1}^*)]^2 \quad (16)$$

Where Y and Y^* are actual and potential output respectively and λ is a weighting factor that determines the degree of smoothness of the trend (Cerra and Saxena, 2000). For quarterly data $\lambda = 1600$.

The advantage of HP filter is that it renders the output gap stationary over a wide range of smoothing values. The output Gap is constructed as the log of potential output minus the log of actual output. An increase in the output Gap reflects a slowdown in economic activity relative to potential or an increase in potential when the actual output remained constant. The estimated output gap varies between -0.03 and 0.04 with a standard deviation equals to 0.01. The ADF test shows that the output gap is stationary (ADF=-3.4).

Figure 2 : Output Gap (Ygap)



3.3.3. Expected inflation

Given data limitations and absence of survey on inflationary expectations in Rwanda as other Sub Saharan countries, expected inflation is generally modeled by lagged inflation and by assuming that $\pi_{t+1,t}^e = \alpha_{\pi} \pi_{t-1}$ (see Régis Barnichon and Shanaka J. Peiris). The rationale for including lagged inflation in the Philips curve is provided by Christiano, Eichenbaum and Evans (2005) and Woodford (2003). Their argument is based on alternative assumptions regarding optimal price setting behavior of firms. The lagged inflation is also included when we estimate that inflation is predominantly backward looking (Rudebusch, 2000).

As shown in the following table the past inflation is found to be a significant determinant of inflation in the short- run as

money gap. Their elasticities are respectively 0.37 and 0.22. The depreciation of FRW is not an important source of inflation, its elasticity (0.001) is small and only significant from zero at 10%. The coefficient of output gap is not significant from zero. This can be one of the limits of the P* model for Rwanda as other developing countries. The used output in the calculation of potential output is accounted for by primary commodities whose production is supply determined. In this case the calculated output gap could be a measure of supply shocks and not demand fluctuations. Taking into account that the money gap plays an important role in the inflation process than the output gap in Rwanda, we can consider that targeting monetary aggregates in Rwanda can provide an effective anchor to control inflation. The inflation inertia is confirmed here but its importance is reduced in comparison with previous results (Table 1). The presence of inflation inertia implies that it is not appropriate in the case of Rwanda, to assume a mechanical contemporaneous relationship between nominal income and money.

Table 6: Estimation of P* model of inflation

	Eq1	Eq2	Eq3
D(p(-1))	0.38*	0.37*	0.37*
D(e(-1))	0.001**	0.001**	0.001**
EC (-1)	0.21*	0.21*	
Ygap		0.01	-0.06
JB	2.57(0.27)	2.27(0.26)	1.9(0.4)
LM test	1.05(0.59)	1.03(0.59)	0.22(0.9)
ARCH	0.16(0.7)	0.16(0.7)	0.09(0.8)
White	8.02(0.2)	9.25(0.5)	6.8(0.3)
DW	2.16	2.01	2.16

* significant at 5% ** significant at 10%.

3.4. Single Error correction model for inflation

In this paragraph we estimate a single error correction model for inflation in Rwanda. We estimate first a general model with four lags of each variable (m2, y, e) in first differences and the error correction term from the money demand function (ec). We derive an empirically parsimonious model by reducing the number of lags and dropping insignificant explanatory variables from the model. The parsimonious model is presented in the table 7. The results indicate that past inflation is a significant determinant of inflation in the short run, the coefficient 0.3 for lagged inflation confirms the presence of inflation inertia. Change in production (-0.6), in growth in money stock (0.3) and disequilibrium in money market (0.2) are also found to be important in the movement of inflation in Rwanda. The

depreciation of RFW seems to be not important factor in the evolution of inflation. Its elasticity is 0.1 and not significant from zero at 5% level (it is significant at 10% level). This can be attributed to good performance of the economy which limited the exchange rate pass-through to domestic prices and a stability of exchange rate during the last years in the sample.

Table 7: Parsimonious Error Correction Model of inflation

Variables	Coefficients
Dp(-1)	0.3*
dy	-0.6*
EC (-1)	0.2*
de	0.1**
Dm2	0.3*
R^2	0.8
Jarque Bera	0.19 (0.90)
ARCH	2.1 (0.15)
Ljung test	19.8(0.5)
RESERT test	1.5 (0.2)

* significant at 5% ** significant at 10%.

IV. Conclusions

The objective of this study was to analyze the relation between money and inflation in Rwanda using essentially monetarist model, over the period 1995 to 2006. The Engle Granger method and the Johansen cointegration test have been used to establish the existence of long run relationship among the variables that constitute the monetary sector. An Error Correction Model was estimated to explain inflation.

The findings identify inflation inertia, change in production, money growth and disequilibrium in money market to be important in determining the level of inflation in the short-run. The effect of exchange rate on inflation is found to be not significant based on the general model. Change in production was identified as the dominant determinant of inflation in the short-run, followed by inflation inertia and growth in money. The money pass-through to inflation depends on the level of money gap which is the difference between supply and demand of money.

Two policy implications can be highlighted: First, the existence of a stable money demand function (see

Rusuhuzwa Kigabo Thomas, Barebereho Josiane and Gichondo Ananias, 2007) and the relation between broad money and inflation imply that one of two important assumptions of the monetary targeting framework in Rwanda is valid. In this regard, the Central bank's ongoing efforts to develop indirect monetary policy instruments and the inter bank money market are important steps in improving the effectiveness of monetary policy. However, the credibility of this monetary targeting framework depends on the stability of money multiplier and the stability of the relationship between broad money and inflation.

Second, the results show that inflation is driven by past events (inflation inertia). In this regard, efforts to stabilize inflation through the management of monetary policy and improvement in production system would need to be complemented by a development of an effective public communication by competent authorities to limit the impact of the inflation inertia.

This paper offers perspectives for better understanding and forecasting inflation in Rwanda. In the next study, a complete model of inflation in Rwanda will be estimated by including other factors as variables which explain the

inflation. These variables are especially a measure of the disequilibrium of external sector, the rainfall factor and dummies to take in account different events supposed to affect inflation development in Rwanda, the world food and fuel prices.

References

1. Adebisi Michael and Feridun Met (2006). "Forecasting inflation in developing economies". International journal of applied econometrics and quantitative studies
2. A M M. Abdel-Rahman (1994). "Determinants of inflation and its stability. A case study of a less developed economy".
3. Boris Hofman (2006). "Do monetary indicators (still) predict euro area inflation?" Deutsche Bundesbank.
4. Gregor C. Chow, Yan Sher (2004). "Money, price level and output in the Chinese Macroeconomy".
5. Jean Claude Nachega (2001). "Financial Liberalization, Money demand and inflation in Uganda" IMF WP
6. Kavi Gounder and Steven Morling (2005). "Measures of potential output in Fiji"
7. Koffie Nassar, Money demand and inflation in Madagascar", IMF WP

8. Mame Astou Diouf (2007). "Modeling inflation for Mali", IMF WP"
9. Manfred J.M. Neuman and Clauss Greiber (2004). "Inflation and core money growth in the Euro area. Deutsche Bundesbank"
10. Mathew Kofi Ocran (2007). "A model of Ghana's inflation"
11. Prakash Loungani and Phillip Swagel (2001). "Sources of inflation in developing countries, IMF WP"
12. Régis Barnichon and Shanaka J. Peiris (2007). "Sources of Inflation in Sub Saharan Africa", IMF WP"
13. Rodolphe Blavy (2004). "Inflation and monetary pass-through in Guinea". IMF WP"
14. Sonia Munoz (2006). "Suppressed Inflation and Money Demand in Zimbabwe", IMF WP"
15. Tao Sun (2004). "Forecasting Thailand's Core Inflation", IMF WP"

16. Uma Ramakrishnan and Athanasios Vamvakidis (2002),
“Forecsating inflation in Indonesia”, IMF WP
17. Yan Sun and Rupa Duttagupta (2008). “Price Dynamics
in the Eastern Caribbean” IMF WP