"Real Effective Exchange Rate Changes and Trade Balance in Senegal: twenty years after CFA franc devaluation".

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1-Introduction.

Senegal is a Sub Saharan Africa’s country whose population is estimated at about 13 million inhabitants according to the official statistics of the National Agency of Statistics and Demography [ANSD, SES 2011]. Since its independence, the country has embarked on wide the organization of African Countries belonged to the Franc Zone (franc zone countries) whose currency, the CFA franc, is pegged to the Euro at a fixed exchange rate regime. Moreover, the Senegalese public authorities, since the beginning of the crisis of structural adjustment, successively implemented extensive programs of reform of trade policy, capped until 2000 by the Structural Adjustment Programs (SAPs). These reforms, which for the most part, related to sectoral, fiscal and border tax policies, aimed to increase the trade openness of Senegal and its competitiveness.

Specifically, the SAPs aimed at redressing pronounced imbalances of major macroeconomic indicators of the Senegalese economy. These imbalances related mainly to public finance accounts whose the deepening makes the State facing insolvency risk. The external sector of the national economy was also at the heart of these imbalances. This is confirmed by the evolution of the Senegal’s trade balance whose deficit is structural.

The failure of these various adjustment programs to permanently straighten macroeconomic accounts led public authorities to use competitive depreciation policy in January, 11, 1994 in the hope of boosting economic competitiveness. Thus, the CFA franc was devalued by 50% against the French franc which was the anchor currency before the introduction of the Euro in 1999.

Devaluation occurred in the context of quasi-stagnation of the exports of WAEMU countries in general and Senegal in particular (Sall, 1999). About this devaluation, many studies have found an overvaluation of the national currency and have considered it as the cause of the erosion of export competitiveness. A loss of competitiveness exacerbated by the limited quality of exported products and high production costs. Already Sall (1999) established that in Senegal, the adjustment of the parity in 1994 was not a sufficient factor to revive some export sectors, while Couharde and al. (2012) show that the devaluation had a net positive effect on the macroeconomic competitiveness of Senegal through the sharp depreciation of REER index that ensued.
Twenty years later, this observation does not seem to be questioned and the devaluation apparently did not resolve the issue of the competitiveness of Senegalese economy and its deep trade deficit. Despite the positive implications of the devaluation on macroeconomic competitiveness, the trade balance of Senegal remains in deficit.

The review of trade policy shows that public authorities have, since the 1980s, successively undertaken reform measures in sectoral, fiscal and border tax policies to liberalize foreign trade. The review of exchange rate policy reveals that the exchange rate is not an instrument that national authorities can manipulate cyclically for adjustment purposes after a shock because the CFA franc is pegged to the Euro at a fixed exchange rate regime. The analysis of the competitiveness of the Senegalese economy reveals that the devaluation of the CFA franc by 50% in 1994 had a positive effect on macroeconomic competitiveness. However, Senegal has failed to take full advantage of this net gain in competitiveness because the export capacity of local firms is strongly constrained by structural problems faced by primary and secondary sectors (random productivity, lack of financing, energy dependence, etc.). Such problems raised real supply constraints that make the economy relies heavily on imports to cover shortfalls in domestic production. This explains the structural deficit of the trade balance. Therefore, we state in favor of a lack of price competitiveness of the Senegalese economy insofar as it undergoes a strong foreign pressure and suffers internally a lack of diversification of the activity that it does not export products with high added value. These kinds of products can enhance export earnings and significantly increase the share of internal and external market of local firms.

Are exchange rate adjustment policies still relevant for understanding the issue of competitiveness of the Senegalese economy? Competitiveness may boost exports and reduce trade deficit.

In other words, real effective exchange rate (REER) is it then a determinant of foreign trade of the Senegalese economy and therefore a factor of competitiveness?

The main objective of this research is to identify the nature of the long-run relationship between real effective exchange rate and trade balance in the case of the Senegalese economy. This work is specifically designed to:
- identify the determinants of foreign trade in Senegal within the general framework of estimating the long-run relationship between trade balance and REER twenty years after 1994 devaluation.
- Test the J-curve

The main hypothesis of this research is that the long-run relationship between trade balance and REER for the case of Senegal is negative. Hence the following specific assumptions:

- There are, in addition to REER, other key determinant variables of trade balance for the case of Senegalese economy.
- J-curve is not verified in the case of the Senegalese economy.

The choice of this subject is justified by the strong trade openness of Senegal. Therefore, the estimation of the long-run relationship between real effective exchange rate and trade balance could provide important lessons on the facts that block internal and external competitiveness of the Senegalese economy and, hence, lead to the formulation of a set of policy recommendations to boost economic competitiveness.

In the following we make, in a second section, a brief survey of the literature on the relationship between exchange rate and trade balance. In a third section, we conduct an analysis of foreign trade of the Senegalese economy in the corners of the foreign economic policy and competitiveness. In the fourth section, we proceed to estimate the long-term relationship between real effective exchange rate and trade balance and test the J-curve. Finally, the fifth section is devoted to results discussion and policy recommendations.

### 2- Theoretical and empirical analysis of the relationship between trade balance and REER.

From the theoretical point of view, the problem of the effects of exchange rate changes on the trade balance arises since the 1920s [with the work of Bickerdicke (1920) on the instability of foreign trade]. Therefore, a fairly diverse literature was developed on the determinants of foreign trade. However, the conventional theory states that the policy of competitive depreciation [or competitive devaluation under a fixed exchange rate regime] is a way to rebalance and improve the trade balance of a nation. This pure theoretical intuition, known as the J-curve theory or J curve phenomenon, raised in the context of the years 1970_1980 marked by the liberalization of exchange rate policy of most of industrialized economies.
Economists thought about the possibilities of evaluating the effects of exchange rate changes on trade balance. From this reflection gradually arose a plethora of research aimed, with the support of econometric tools, to gauge the long-run relationship between trade balance and real effective exchange rate [Bahmani-Oskooee (1985); Himarios (1989); Bahmani-Oskooee (1991); Upadhyaya and Dakal (1997); Onafowora (2003); Duasa (2007); Shahbaz and al. (2012), etc.].

These macro-econometric studies have generally reached conclusions far short of the theoretical intuition that competitive devaluation policies and competitive depreciation would be a remedy for chronic imbalances in the trade balance of a nation. Some studies confirmed the theory of J-curve, others invalidated, others concluded in the absence of a significant relationship between trade balance and exchange rate [real or effective] and other studies led to unconventional results.

2-1- Empirical controversy over the relationship RER / Trade Balance.

Empirical controversies on the theory of J-curve result from the fact that research to gauge the effects of exchange rate changes on trade balance often leads to different conclusions, and sometimes diametrically opposed. Some studies, like Bahmani-Oskooee (1985), Duasa (2007), Shahbaz et al. (2012) overturned the theory of J-curve. Duasa (2007) sought to identify the determinants of Malaysian trade balance reconciling in a macro-econometric model the three theoretical approaches of the trade balance. He concluded the absence of a long-run relationship between real exchange rate changes and trade balance. Shahbaz et al. (2012) used auto regressive model and cointegration techniques with quarterly data from July 1980 to June 2006 to examine the long-run relationship between trade balance and real effective exchange rate changes in the Pakistani economy. The results of their study confirmed the existence of a long-term relationship between the two variables with a negatively significant coefficient of elasticity. Their conclusion was that the competitive depreciation led, for the case of Pakistan, to a rise in the trade balance deficit.

However, there are research works that have confirmed the theory of J-curve (Akbostanci (2002), Onafowora (2003) Petrović and Gligoril (2010)). Akbostanci (2002), for example, concluded that competitive depreciation policy was a source of trade balance improvement in the case of Turkey. Onafowora (2003) examined the relationship between real exchange rate and real trade balance for Thailand, Malaysia and Indonesia in the framework of their bilateral trade with United States and Japan. The results of the study confirmed the existence of a
positive long-run relationship between trade balance and real exchange rate for each country. Petrović and Gligorić (2010) showed that the depreciation of real exchange rate has a positive long-term impact on the trade balance of Serbia. They found a relation of the type J between short-term real effective exchange rate changes and trade balance.

Analyzes of long-run relationship between trade balance and exchange rate have also given other forms of results. Marwah and Klein (1996) found an S curve for the case of United States and Canada. According to Shahbaz et al. (2012, p. 142), the theory of the S-curve states that following a devaluation, or a real exchange rate depreciation, a relation of the type-J is observed in the short-term, but after a few quarters, the trade balance deteriorates again.

2-2- Presentation of some estimation models

There is a plethora of macro-econometric models used to assess foreign trade determinants of a nation and the effects of exchange rate fluctuations on trade balance. Requirements that these models are expected to meet are to integrate the foreign trade specificities of studied economy or economies in the case of a union of countries with common characteristics. We present two econometric models: Duasa’s model (2007) and that of Shahbaz et al. (2012).

- Duasa’s model (2007)

Duasa (2007, p. 24-27) used the autoregressive distributed lag model (ARDL) to examine the determinants of the trade balance of the Malaysian economy. Thus, his model which was to combine the three theoretical approaches of the balance of payments (i.e., elasticities approach, absorption approach and monetary approach), gives the following theoretical model: Trade Balance = f (real exchange rate, national income, money supply). The long-run relationship between variables was specified as follows:

\[
\ln\left(\frac{X}{M}\right)_t = \alpha_0 + \sum_{i=0}^{p} \phi_{1i} \ln\left(\frac{X}{M}\right)_{t-i} + \sum_{i=0}^{p} \beta_{1i} \ln(REER)_{t-i} + \sum_{i=0}^{p} \theta_{1i} \ln(GDP)_{t-i} + \sum_{i=0}^{p} \lambda_{1i} \ln(M3)_{t-i} + \mu_t
\]
Where \( ln \) is the logarithm of variables; trade balance is measured by the ratio \( (X/M)_e \) which corresponds to coverage rate of imports (M) by exports (X); REER variable is real effective exchange rate; GDP is Gross Domestic Product; M3 is money supply and \( \varepsilon \), is an error term.

On this basis, Duasa (2007) used an error correction model to study short-and long-run dynamics.

- **Model of Shahbaz et al. (2012)**

Shahbaz et al. (2012) examine the long-term effects of REER changes on trade balance of the Pakistani economy. The theoretical model they used is as follows:

\[
Balance\ Commerciale = f(taux\ de\ change\ réel)
\]

Econometric regression model was specified as follows:

\[
LTOT = \alpha_1 + \alpha_2 LREER + \mu_e
\]

Where: \( LTOT \) is the logarithm of the ratio of real exports to real imports; LREER is the logarithm of real effective exchange rate; \( \varepsilon \), is the error term.

Shahbaz et al. (2012) used autoregressive distributed lag model (ARDL) to estimate the long-run relationship between REER and trade balance. The error correction equation was specified and :

\[
\Delta LTOT = \phi_0 + \phi_{TOT} LTOT_{t-1} + \phi_{LREER} LREER_{t-1} + \sum_{i=1}^{q} \gamma_{TOT} \Delta LTOT_{t-j} + \sum_{j=0}^{p} \gamma_{LREER} \Delta LREER_{t-j} + \mu_t
\]

Where \( \phi_0 \) is a parameter trend and \( \varepsilon \), is a white noise process; \( \phi_{TOT} \) is the error correction coefficient and \( \phi_{LREER} \) is the long-term coefficient; coefficients \( \gamma_{TOT} \), and \( \gamma_{LREER} \) represent the short term elasticities; \( \mu_t \) is the error term.

The conclusions of these models are controversial insofar as not only their theoretical approaches differ, but they relate to economies that differ in their characteristics, degree of integration to international trade and the nature of their responses to exogenous and endogenous shocks that may affect them.
3 - Trade policy, exchange rate policy and competitiveness of the Senegalese economy.

3-1. A strong dependence on external.

Senegal has a strong foreign demand for food, equipment, energy etc. This is explained by the low level of development of the productive sector which, in addition to structural problems which primary and secondary sectors are facing, still lingers shortcomings such as the lack of diversification of production and inability of local producers to produce goods and services that meet expectations in terms of quality of a strong social demand etc..

Figure 1: Evolution of the trade balance of Senegal (1980_2010)

The graph above shows the evolution of the trade balance° from 1980 to 2010. There is a structural deficit in net exports. This structural deficit, which has also widened over time, is explained by the fact that social demand for goods and services is growing at a time where domestic supply of goods and services is severely constrained by the embryonic character of primary and secondary sectors.

1 Competitiveness refers to the ability of an economy to produce goods and services of international standard quality at efficient prices than its main competitors in trade (Beitone et al., 2010).


3 These are Exports (X) net of Imports (M): XM.
The analysis of trade policies in Senegal shows that public authorities, in the context of macroeconomic policy, had to undertake significant measures of tax, customs and industry reforms in the line of foreign trade liberalization, productivity of real activity sectors boost and economy competitiveness increase. It is clear that these reforms have not been able, as revealed by the specifics of the Senegalese economy, to eradicate structural gaps faced by the growth of real activity particularly in the primary and secondary sectors. Foreign economic policy of Senegal was marked in recent decades by the implementation of major structural reforms to liberalize trade policy. Since the 1980s, exchange rate policy has been used once for the purpose of boosting competitiveness.

3-2- Analysis of competitiveness.

There are several macroeconomic ratios which provide guidance on competitiveness. We will, for Senegal, analyze two types of ratios: indicators of global competitiveness and performance indicators of foreign trade.

3-2-1 - Indicators of global competitiveness.

In its report on the competitiveness of economies of WAEMU\(^4\), BCEAO\(^5\) distinguish two types of indicators of global competitiveness: The real effective exchange rate and the relative ratio of investment.

3-2-1-1- Real Effective Exchange Rate (REER).

The REER of a country establishes the extent to which exchange rates, prices and costs changes in the different partner countries and foreign competitors affect the competitiveness of the country concerned (BCEAO, 2013). An appreciation of REER index is often associated with a loss of competitiveness while its depreciation generally reflects a gain in competitiveness.

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\(^4\) WAEMU : West African Economic and Monetary Union.

The evolution of REER index curve spring two major trends (i) fluctuations imposed on the pre-devaluation period, (ii) some stability in the post-devaluation period.

Couharde et al. (2012) studied the convergence of REER to their equilibrium levels in the countries of the franc zone by applying an error correction model on panel data of the economies of the area, from 1985 to 2007. Their methodology was to estimate, in accordance with the exchange rate equilibrium behavioral approach, a real exchange rate equilibrium solution of the long-term relationship between REER and fundamentals\(^6\) targeted in franc zone economies. On this basis, Couharde et al. (2012) calculated the misalignment of REER from its equilibrium level for all countries in the area.

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\(^6\) These authors have identified as fundamentals (determinants of real exchange rate) the terms of trade, productivity per capita, degree of openness of economies, the ratio of public expenditures to GDP and the ratio of net position of foreign assets to GDP.
Two clear trends can be identified: (i) a period of overvaluation of REER from 1985 to 1993, (ii) a period of undervaluation of REER from 1994 to 2007. The period of overvaluation of REER corresponds to a period of real appreciation of the Index and therefore loss of price competitiveness of exports of goods and services. The period of undervaluation corresponds, in opposite, to a period of real depreciation of the Index and therefore a gain of price competitiveness. As we noted above, the 1994 devaluation of the CFA franc has had a significantly positive effect on the price competitiveness of the Senegalese economy swinging the REER from an overvaluation situation to a situation of under-evaluation. According to the report of BCEAO (2013) on the competitiveness of WAEMU member states, the accumulated gains in competitiveness of Senegal on all its partner countries rises, since the 1994 devaluation of CFA Franc, to 32.4%. The average annual gain in competitiveness over the period 2002-2012 was 0.1% and is essentially justified by the performances of Senegal about inflation management: Senegal had the lowest average annual inflation rate over the period (2%) and therefore benefited from a positive inflation differential relative to its trade partners.

3 -2-1- 2 - Relative Investment ratio.

The relative investment ratio measures the ratio of a country's domestic investment rate to the investment rate of its main trading partners (in percentage). The gross investment rate measures the ratio of gross fixed capital formation in real terms to real GDP (BCEAO, 2013). The relative investment ratio is primarily used to examine the structural competitiveness, i.e., in the point of view of the long term evolution of an economy. An increase in this ratio reflects an increase in domestic investment efforts compared to competitors. In other words, the increase in the investment rate reflects the ability of the economy to sit in the long-term the foundation for a strong development of its productive system, a more marked increase in productivity and its ability to cope with international trade.
Table 1: Evolution of the relative investment rate (%) in Senegal and WAEMU.

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<th>Senegal</th>
<th>WAEMU</th>
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<tbody>
<tr>
<td>1991</td>
<td>81.7</td>
<td>66.1</td>
</tr>
<tr>
<td>2001</td>
<td>106.1</td>
<td>71.8</td>
</tr>
<tr>
<td>2011</td>
<td>90.5</td>
<td>83.6</td>
</tr>
<tr>
<td>Spread 2001_1991</td>
<td>24.4</td>
<td>5.8</td>
</tr>
<tr>
<td>Spread 2011_2001</td>
<td>-15.7</td>
<td>11.8</td>
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</table>

Source: BCEAO (2013, p 20.)

We note for Senegal a net increase in the relative investment rate by 24.4% between 1991 and 2001. In 2001, the relative investment ratio of Senegal exceeded 100%. This implies that Senegal has made significant investment efforts over the period 1991_2001. However, we note a relapse on relative investment ratio of 15.7%, probably reflecting the significant investment efforts achieved by partner countries, as Senegal has engaged since 2000 in a policy of investments promotion with the creation of structures such as APIX7. For WAEMU, there is a continual increase in the relative investment rate drawn primarily by Burkina Faso, Guinea Bissau, Mali and Niger.

3 -2-2 - Performance Indicators in Foreign Trade

There is a plethora of indicators to analyze the performance of external trade of an economy. We chose to study three indicators for the Senegalese economy: coverage rate of imports by exports, export rate and foreign penetration rate.

3-2-2 -1 Ī coverage rate

The coverage rate evaluates the ratio of exports to imports of goods and services of an economy, as a percentage. A coverage rate of over 100% means that the economy has exported more goods than it imported and therefore has realized a net gain on trade. In

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7 Agence de Promotion des Investissements et des Grands Travaux du Sénégal (APIX)
opposite, a coverage rate under 100% implies that the economy imports more goods and services than it exports and therefore carries a net loss on trade.

**Figure 4**: Evolution of coverage rate of Senegal.

![Coverage Rate (CR)](chart.png)

**Source**: Authors, Source of data: ANSD, NACE 2011, p. 41

It is noted that during the period 2000-2011, exports have no cover half of the imports of Senegal. The coverage rate is low and does not exceed 50%. This means that Senegal imports far more than it exports, hence the structural deficit of the trade balance.

Although REER indicates gains in price competitiveness for the Senegalese economy since the 1994 devaluation, there is a low coverage rate, which shows that Senegal does not have still a strong productive sector to impose on the international scene with regard to trade performances.

3 -2 - 2-2 - Export rate.

It measures the share of exports in real GDP (BCEAO, 2012). Otherwise, the export rate measures the share of GDP for the satisfaction of foreign demand. It is an indicator of competitiveness insofar as its progression can result from an increase in market shares abroad, while its regression may result from a decline in market shares.
Table 2: Evolution of the export rate (%) in Senegal and WAEMU.

<table>
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<td>2001</td>
<td>25.7</td>
<td>31.9</td>
</tr>
<tr>
<td>2011</td>
<td>21.6</td>
<td>34</td>
</tr>
<tr>
<td>Average 1992_2001</td>
<td>23.4</td>
<td>29.3</td>
</tr>
<tr>
<td>Average 2002_2011</td>
<td>24.4</td>
<td>33.5</td>
</tr>
<tr>
<td>Spread 2011_2001</td>
<td>-4.1</td>
<td>2.1</td>
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</table>

Source: BCEAO (2012, p. 24.)

The proportion of Senegalese GDP reserved to the satisfaction of the foreign demand is low and turns on average below 25%. Senegalese firms therefore have difficulties in gaining new market shares in foreign countries. This is due to the lack of structural diversification of production plaguing the national productive sector. The decline about 4.1% of the export rate between 2001 and 2011 is attributable to the counter performances of traditional export sectors namely cotton and groundnuts (BCEAO 2013). For WAEMU, there is also a weakness of the export rate reflecting structural order difficulties characterizing the productive sectors of the economies of the area, mostly specialize in the trade of raw materials and of extraction goods with low added value.

3-2-2-4 - Foreign penetration rate.

Foreign penetration rate evaluate the ratio of imports to domestic demand. It reflects the degree of competition between domestic and foreign producers on the domestic market (BCEAO, 2012). An increase in this ratio due to an increase in imports implies a net loss of competitiveness for local enterprises to the extent that they cede market shares to foreign companies. Conversely, when a decline in this ratio stems from a decline in imports, local firms strengthen their internal competitiveness insofar as they gain new shares in the domestic market.
Table 3: Evolution of the foreign penetration rate (%) for Senegal and WAEMU.

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</tr>
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Source: BCEAO (2012, p 25.)

The weight of imports relative to domestic demand runs in average around 35%. This shows that foreign products have a significant representation on the Senegalese domestic market. A difference of 2.7% is noted between 2001 and 2011 due in part to an increase in imports since the demand for imports is increasing in Senegal. It is readily seen that the foreign penetration rate of Senegal is higher than the export rate. This observation confirms the external dependence of Senegal relatively to trade. The relatively high import ratio of the Union merely reflects the problem of external dependence suffered, like Senegal, by most economies of WAEMU.

The analysis of the competitiveness of the Senegalese economy reveals that the devaluation of the CFA franc in 1994 about 50% had a positive effect on the external price competitiveness of Senegal to the extent that it has generated substantial depreciations of REER index since that is undervalued compared to its equilibrium level. However, Senegal has failed to take full advantage of this net price competitiveness gain because the export capacity of local firms are strongly constrained by structural problems in which are exposed primary and secondary sectors (random productivity, lack of funding, energy dependence, etc..) which in principle are highly exposed to international trade.

4- Model specification and estimation methodology.

Estimation of the effects of REER changes on trade balance requires first defining a theoretical model specifying the relationship between REER and trade balance. For example,
the second section was devoted to the presentation of a theoretical and empirical framework. In this section, we present a theoretical model supported by the rationale for the choice of a number of variables, and then we will make the necessary specification tests for the choice of an estimable econometric regression model.

4 - 1 - Model specification and variable selection

We proceed in this first sub-section to the presentation of the theoretical model and the rationale for selection of variables.

4 - 1-1 - Model specification.

We seek to identify the nature of the long run relationship between REER changes and trade balance for the case of the Senegalese economy. Based on the results of the analysis of the specificities of the Senegalese economy, we used the following theoretical model:

\[
XM = f(DD, MS, REER, Dum)
\]

Where endogenous variable (XM) is the trade balance that we calculated by considering the ratio of exports to imports; the variable (DD) represents the domestic demand; the variable (MS) represents the money supply; the variable (REER) is the real effective exchange rate; \(Dum\) is a dummy variable introduced to capture the impact of the 1994 currency devaluation. Our theoretical model consists, like that of Duasa (2007) for Malaysia, to resume the three theoretical approaches of trade balance.

4 - 1-2 - Justification for the choice of variables

Our analysis is based on annual data extending from 1980 to 2010. The data on trade balance (XM), domestic demand (DD) and money supply (M2) are evaluated in billion CFA francs. We will immediately justify the choice of variables and provide more details on the data used.

- Trade balance (XM)

Traditionally, trade balance is measured by assessing exports net of imports (\(exportations - importations\)). We measure trade balance by the ratio Export/Import notified by \(XM\). This ratio corresponds to the coverage rate of imports by exports. In the most recent research on the determinants of trade balance [Onafowora (2003), Duasa (2007), Shahbaz et al. (2012)] the coverage rate was used to measure the trade balance. Bahmani-Oskooee (1991) explains the choice of coverage rate instead of net exports by the fact that the coverage ratio is
insensitive to the unit of measure and can be interpreted as nominal or real trade balance\textsuperscript{8}. Data on exports and imports are those of ANSD\textsuperscript{9}. The exports were valued \textit{free on board} (fob) and imports to their \textit{Cost Insurance Freight} value (CAF).

- **Domestic demand (DD)**

In many macroeconomic studies, like that of Duasa (2007), GDP was considered to account for absorption. In our study, we chose to retain the domestic demand. We justify this choice by the revelations of the utilization analysis of GDP for Senegal, which in return showed a very strong domestic demand weight compared to the weight of exports in GDP. We calculated the domestic demand by summing the final consumption [public and private], gross fixed capital formation (GFCF) and changes in stocks. Data on these variables are taken from macroeconomic and financial database of BCEAO\textsuperscript{10}.

- **Money Supply (MS)**

The stance of monetary policy affects international trade in goods and services. Beyond what we learn from the monetarist vision of the balance of payments, the performance of monetary policy, in terms of inflation targeting, influences the relative prices of internationally traded goods. We therefore chose to introduce the money, specifically the broadly money supply in our model to account for the likely effects of monetary policy on foreign trade. Variable (MS) thus represents the monetary aggregate M2. We obtained data on money supply from the web site of BCEAO\textsuperscript{11}.

- **Real Effective Exchange Rate (REER).**

REER index is an indicator of the overall competitiveness of an economy relatively to its various partners in trade. The choice of REER index is justified by the fact that it is the index that best reflects the external competitiveness of the economy, especially with regard to the

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\textsuperscript{8} See Duasa (2007, p. 24).

\textsuperscript{9} ANSD : NACE (2011, p.41).

\textsuperscript{10} See www.bceao.int

\textsuperscript{11} www.bceao.int  Macroeconomic and financial data.
prices of goods and services internationally traded. Data on REER were provided by DPEE\textsuperscript{12}. Originally, data on REER are evaluated relative to the base year (2005 = 100). Because of the problems posed by the study of the stationarity of REER series, we reassessed the data on REER by not still considering them relative to a base year but by taking the annual values of the index.

- Dummy variable (Dum)

We introduced a dummy variable to account for the effects of currency devaluation in 1994 on international trade in goods and services of the Senegalese economy. This variable takes the value zero throughout the period, except in 1994.

4-2 – Estimation methodology.

It should be noted that the data size of our sample is not harmonic. The size of the endogenous variable [trade balance evaluated by the export / import ratio] is very small compared to the exogenous variables, including domestic demand and money supply (M2) measured in billions of CFA Francs and REER. To remedy this problem, we considered that it was necessary to make the Jarque Bera normality test to verify if the exogenous variables in the model follow a log-normal distribution\textsuperscript{13}. At the threshold of 5\%, Jarque Bera test accepts the normality assumption of the variable if and only if the probability of the Jarque-Bera statistic is greater than 0.05 (Doucouré, 2008). We proceeded to test normality of our exogenous variables [see Table A3 in Annex]. According to the test results, variables DI, MM and REER are lognormal. We will in the following work express them in logarithm to reduce the differences in size of our sample.

Stationarity study shows that our variables are integrated of order 1. Cointegration analysis reveals that our variables have a stable long-run relationship. We can now proceed to estimate the model itself.

\textsuperscript{12} Direction de la Prévision et des Études Économiques (DPEE)/ Direction of Forecasts and Economic Studies, Ministry of Economics and Finance of Senegal.

\textsuperscript{13} According to Doucouré (2008, p.31) a variable follows a lognormal distribution if its logarithm follows a normal distribution.
4-2-1 Model estimation

Stationarity and cointegration tests showed that our variables are stationary in first difference and have a stable long run relationship. These results validate the feasibility of using an Error Correction Model (ECM) for the econometric regression model. For our model, the error correction equation à la Hendry (1986) is written as follows:

\[
\Delta(XM_t) = \beta_0 + \beta_1\Delta(IDD_t) + \beta_2\Delta(IMS_t) + \beta_3(IREER_t) + \beta_4XM_{t-1} + \beta_5IDD_{t-1} + \beta_6MS_{t-1} + \beta_7IREER_{t-1} + \beta_8Dum
\]

Where:
- \(\Delta\) is the first difference operator: \(\Delta(XM_t) = XM_t - XM_{t-1}\)
- \(l\) denotes the logarithm of the variable \(IDD_t = \log(DD_t)\);
- \(\beta_0\) is the constant of the model;
- coefficients \(\beta_1, \beta_2\) and \(\beta_3\) represent the short-term dynamics of ECM. These are the short term elasticity coefficients;
- coefficient \(\beta_4\) represents the coefficient of error correction. It must be less than unity and negative for the MCE specification to be validated.
- coefficients \(\beta_5, \beta_6\) and \(\beta_7\) characterize the long-run equilibrium of ECM;
- coefficient \(\beta_8\) is the elasticity of the trade balance with respect to the dummy variable. Dummy variable is introduced to capture the effect of the 1994 devaluation on trade balance.

The long-run elasticities of the ECM à la Hendry are given by the coefficients

\[
-\frac{\beta_5}{\beta_1}, -\frac{\beta_6}{\beta_4} \text{ and } -\frac{\beta_7}{\beta_4}.
\]

These coefficients indicate the nature of the long run relationship between trade balance and exogenous variables. The results of the estimation are shown in the following Table 4:
Table 4: ECM estimation results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std.error</th>
<th>t.statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>3.117619</td>
<td>1.096798</td>
<td>2.842473</td>
<td>0.0098 **</td>
</tr>
<tr>
<td>D(DD)</td>
<td>-0.551007</td>
<td>0.170982</td>
<td>-3.222600</td>
<td>0.0041</td>
</tr>
<tr>
<td>D(IM)</td>
<td>-0.158480</td>
<td>0.122141</td>
<td>-1.297519</td>
<td>0.2085 NS</td>
</tr>
<tr>
<td>D(REER)</td>
<td>0.183397</td>
<td>0.112590</td>
<td>1.628890</td>
<td>0.1182 NS</td>
</tr>
<tr>
<td>XM(-1)</td>
<td>-0.655213</td>
<td>0.160992</td>
<td>-4.069846</td>
<td>0.0005 **</td>
</tr>
<tr>
<td>DD(-1)</td>
<td>-0.296166</td>
<td>0.185068</td>
<td>-1.600313</td>
<td>0.1245 NS</td>
</tr>
<tr>
<td>MS(-1)</td>
<td>0.059291</td>
<td>0.080443</td>
<td>0.737057</td>
<td>0.4692 NS</td>
</tr>
<tr>
<td>REER (-1)</td>
<td>-0.109324</td>
<td>0.056190</td>
<td>-1.945596</td>
<td>0.0652 *</td>
</tr>
<tr>
<td>Dum</td>
<td>0.070728</td>
<td>0.071668</td>
<td>0.986893</td>
<td>0.3349 NS</td>
</tr>
</tbody>
</table>

R2 = 0.696243   R2 ajust. = 0.580526   prob. (F.stat.) = 0.000451   D.W. (stat.) = 1.963104

Model robustness test

| Breusch-Godfrey (LM serial correlation test) | 0.238305 | 0.7903 |
| Ramsey specification test                  | 0.681275 | 0.5179 |
| White heteroscedasticity test              | 0.243337 | 0.9772 |

(*** significant at 1% and 5% , (*) significant at 10%, (NS) not significant at 10%

Source: authors
5 - Discussion of results and policy recommendations

We evaluated our explanatory variables in logarithms to reduce the effect size as the endogenous variable (trade balance) is not evaluated in logarithm. Therefore, the estimated coefficients $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ and $\beta_7$ do not correspond to the elasticities of the trade balance with respect to the explanatory variables of the ECM. These coefficients are rather semi-elasticity coefficients since the size of exogenous variables of the model are been reduced.

The estimation of our model provides a error correction coefficient negative and less than unity: $\hat{\beta}_4 = -0.655213$. This coefficient is significantly different from zero at the 1%. These results indicate that there is indeed an error correction mechanism. In other words, imbalances between trade balance, domestic demand, money supply and real effective exchange rate is offset in the long term so that these series have a similar evolution over time. The error correction coefficient also represents the speed at which any imbalance between the desired level and the actual level of the trade balance is corrected. $\hat{\beta}_4 = -0.655$ indicates that 65.5% of the imbalance between the desired level and the actual level of the trade balance is adjusted via the error correction mechanism. In other words, the effects of a shock on the trade balance reached during a given year are absorbed up 65.5% during the year following the shock. The shock on the Senegalese trade balance is therefore correct via a "feed back" effect. The annual duration of this "feed back" effect is the inverse of the absolute value of the error correction coefficient: $\frac{1}{\beta_4} = \frac{1}{0.655} = 1.52$ years. A shock occurred during a given year on the trade balance is absorbed after a year and six months (year and a half).

- Short-term semi-elasticities.

They are given by the coefficients $\hat{\beta}_1 = -0.551$ for domestic demand, $\hat{\beta}_2 = -0.158$ for money supply and $\hat{\beta}_3 = 0.183$ for REER.

$\hat{\beta}_1 = -0.551$ means that when domestic demand increases by 10%, the trade balance deteriorated by 5.51% in the short term. The Student\( t \) test indicates that the coefficient $\hat{\beta}_1$ is significant at 1%. We conclude that domestic demand has a negative real short term impact on trade balance of Senegal.
\( \beta_2 = -0.158 \). The Student's test rejects the significance of coefficient \( \beta_2 \) even at the 10% level. This result implies that money supply changes do not affect the short term evolution of trade balance.

\( \beta_3 = 0.183 \). Student's test rejects the significance of this coefficient. This result implies that real effective exchange rate changes do not affect the short term evolution of trade balance.

In summary, the ECM revealed that only domestic demand exerts a significant influence on trade balance in the short term.

- Long-term semi-elasticities.

The long term semi-elasticities are given by the coefficients \( \frac{-\hat{\beta}_5}{\hat{\beta}_4} \), \( \frac{-\hat{\beta}_6}{\hat{\beta}_4} \) and \( \frac{-\hat{\beta}_7}{\hat{\beta}_4} \).

From the results of our estimation, the long-term dynamics is represented by \( \hat{\beta}_5 = -0.296 \) for domestic demand, \( \hat{\beta}_6 = 0.059 \) for money supply and \( \hat{\beta}_7 = -0.109 \) for REER.

The calculation of long-term semi-elasticities gives the following results:

\( \checkmark \checkmark \quad \frac{-\hat{\beta}_5}{\hat{\beta}_4} = - \left( \frac{-0.296}{-0.655} \right) = -0.452 \)

Student's test showed that domestic demand is not significant in the long term.

\( \checkmark \quad \frac{-\hat{\beta}_6}{\hat{\beta}_4} = - \left( \frac{0.059}{-0.655} \right) = 0.09 \)

Student's test revealed that the money supply is not significant in the long term.

\( \checkmark \quad \frac{-\hat{\beta}_7}{\hat{\beta}_4} = - \left( \frac{-0.109}{-0.655} \right) = -0.166 \)

This coefficient implies that a 10% appreciation of real effective exchange rate (REER) leads to a 1.66% deterioration in the trade balance in the long term. Note that the elasticity coefficient of long-run relationship between trade balance and REER is negative. Here, our
result joins that of Shahbaz et al. (2012) who found a negative long run relationship between REER changes and trade balance for the case of Pakistan.

Student’s test indicates that elasticity coefficient of long-run relationship between trade balance and REER is significant at 10%. This result is certainly lowly robust but acceptable, indicating that REER changes affect trade balance in the long term.

In summary, ECM estimation indicates that only the REER has a significant influence on the trade balance of Senegal in the long term.

- Constant and Dummy

Student’s test indicates that the constant of the model is significant at 1%. However, the dummy variable is not significant even at the 10%. This result implies that the currency devaluation in 1994 had no effect on the long-term evolution of the trade balance of Senegal.

- Is there a J Curve?

The theory of J-curve states that competitive devaluation policies and competitive depreciation are a way to address the imbalances in the trade balance. According to Shahbaz et al. (2012, p. 149) studies of Lal and Lowinger (2002) and Narayan (2006) justify the possibility of using the impulse response functions to verify the theory of J-curve. Impulse response functions trace the evolution of macroeconomic variables presenting causality relations when shocks are simulated on these variables. This requires first to model a vector autoregression (VAR) between variables which we want to discuss the reactions. When we contextualize with regard our study, the low robustness of the long run relationship between trade balance / REER, which is significant at the 10% according to the estimation of our ECM, justifies and makes it interesting a VAR analysis.

Since we want to examine the response of trade balance to a shock on REER, we modeled a VAR between the first difference of trade balance (DXM) and the first difference of the logarithm of REER (DlREER). As a reminder, these differentiated variables are stationary and were included in our ECM.

Table A12 in annex shows the results of various VAR specification tests and of the regression model. On the VAR specification, the Granger causality test [see Table A10 in annex] says that REER variable cause trade balance variable, and table A11 indicates that the optimal
delay is of one lag. Table A6 presents the results of estimating the VAR with the optimal delay (1). These results show that trade balance negatively depends on REER: the elasticity coefficient equal $-0.36$. The Student test says that this coefficient is significant since the absolute value of the Student statistic is greater than 1.96. Table A7, dealing with variance decomposition, indicates that REER explains about 30% of the variation in trade balance. The following figure 6 that we have extracted represents the impulse response of trade balance to a shock (depreciation) on REER.

Figure 5: Impulse response of trade balance to a shock on REER

We found that depreciation of REER causes firstly a deterioration of the trade balance on a horizon of two periods. Secondly, trade balance improves on a horizon of two periods. Beyond, the effect of the shock on REER wears off and fails to set right definitely the trade balance. On the basis of these results, we invalidate the theory of J-curve for Senegalese case.

Economic policy recommendations
The analysis of trade balance determinants for the Case of Senegalese economy gives results whose interpretations can be of major interest for the orientation of international macroeconomic policy. A first interesting result of our study deals with the negative short run relationship between trade balance and domestic demand. The analysis of the structure of domestic demand reveals a large more important proportion of consumption of goods and services compared to gross fixed capital formation (GFCF) which represents on average only 22% of GDP. Indeed, it is clear that increasing pressures on final demand of consumption of

---

14 See value in Brackets and marked in asterix on table A12.
goods and services exert negative effect on trade balance in the short term. Several reasons explain this phenomenon:

- National productive sector is exposed to supply constraints that limit its ability to satisfy increasing short-term pressures of social demand;
- Then, this so-called social demand requires more standards about quality level of final consumption products that local producers, most of the time, are in incapacity of taking them into account;
- Weakness of investment rate (GFCF as a percentage of GDP) which is justified by the absence [or, in case they do exist, inefficiency] of incentive policies to increase domestic savings.

Faced with this situation, pressures of increasing domestic demand can be remedied by only recourse to imports. This explains the strong dependence of exterior of the national economy. *Any macroeconomic policy aiming to correct this imbalance should then be directed to a resolution of supply constraints faced by Senegalese productive sector.*

This could be achieved by a policy of encouraging increased savings whose purpose is to increase the investment rate and hence the productive capacity of the economy; the adoption of import substitution policies accompanied this time by a funding mechanism to improve the quality of locally produced goods [which would ultimately increase the ability of local producers to meet domestic demand and produce goods and services that meet international quality standards].

The second major finding of our study is the negative long-run relationship between trade balance and REER. This result means that competitive devaluation policy is not the solution to the trade balance structural deficit. Statistics show that the 1994 devaluation of the CFA Franc led to huge gains macroeconomic competitiveness for Senegal via REER depreciation without allowing a rebalancing of trade balance. The impulse response of trade balance to shocks in REER indicates a brief improvement in the ratio of import cover in the early periods after real depreciation of REER index. This result can be explained by the favorable inflation differential enjoyed by Senegal vis-à-vis its trading partners because of a good control of inflation which has a positive effect on the relative price of exports [Conversely, Shahbaz and Al. (2012) partly justify the widening Pakistani trade deficit following the depreciation of
REER with the problem of inflation, which absorbs the potential positive impact of downward REER changes on prices.

REFERENCES


**Rapports**


**Sites Internet**
Appendix:

Annex 1: Unit Root Tests.

Table A1: Stationarity tests: KPSS and Philip Perron (1988)

<table>
<thead>
<tr>
<th>Variable</th>
<th>KPSS</th>
<th>Philipp Perron</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LM.Stat.</td>
<td>p. value at a 5% threshold =0.146000</td>
</tr>
<tr>
<td>D(XM)</td>
<td>0.052699</td>
<td>0.0001</td>
</tr>
<tr>
<td>D(LDD)</td>
<td>0.070780</td>
<td>0.0108</td>
</tr>
<tr>
<td>D(LMS)</td>
<td>0.105481</td>
<td>0.0001</td>
</tr>
<tr>
<td>D(LREER)</td>
<td>0.079471</td>
<td>0.0048</td>
</tr>
</tbody>
</table>

Source: authors

Annex 2: Jarque-Bera normality test

Table A2: Jarque-Bera test results.

<table>
<thead>
<tr>
<th></th>
<th>XM</th>
<th>DD</th>
<th>LDD</th>
<th>MS</th>
<th>LMS</th>
<th>REER</th>
<th>LREER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jarque-Bera</td>
<td>0.949316</td>
<td>3.849916</td>
<td>3.003909</td>
<td>7.114305</td>
<td>2.491812</td>
<td>5.075381</td>
<td>4.635527</td>
</tr>
<tr>
<td>Probability</td>
<td>0.622098</td>
<td>0.145882</td>
<td>0.222694</td>
<td>0.028520</td>
<td>0.287680</td>
<td>0.079049</td>
<td>0.098494</td>
</tr>
<tr>
<td>N.of obs.</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
</tr>
</tbody>
</table>

(****) probability> 5%


Table A3: Results of Johansen cointegration test

Date: 08/12/13 Time: 5:11 p.m.
Sample (adjusted): 1982-2010
Included observations: 29 after adjustments
hypothesis trend: No deterministic trend (restricted constant)
Series: XM LDD LMS LREER
Lags interval (in first differences): 1-1

Unrestricted Cointegration Rank Test (Trace)
Assumed Trace 0.05
Number of CE (s) Eigenvalue Statistical Critical value Prob. **
None * 0.730820 76.24051 54.07904 0.0002
More than 1 * 0.542292 38.18168 35.19275 0.0231
At most 2 0.361857 15.51751 20.26184 0.1982
At most 3 0.082308 2.490903 9.164546 0.6793

Trace test indicates 2 cointegrating equation (s) at the 0.05 level
* Denotes rejection of the hypothesis at the 0.05 level
** MacKinnon-Haug-Michelis (1999) p-values

Figure A 1: Cusum test and Cusum square

Annex 4: Trade balance /REER VAR results.

Table 4: Granger causality test

Pairwise Granger Causality Tests
Date: 12/03/14 Time: 18:34
Sample: 1980-2010
Lags: 1
Null Hypothesis: Obs F-Statistic Prob.
DLREER does not Granger Cause DXM 29 14.6820 0.0007
**Table A5 : Choice of Number of optimal lag**

**VAR Lag Order Selection Criteria**
Endogenous variables: DXM DLREER
Exogenous variables: C
Date: 12/03/14  Time: 18:49
Sample: 1980 2010
Included observations: 26

<table>
<thead>
<tr>
<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>62.32903</td>
<td>NA</td>
<td>3.31e-05</td>
<td>-4.640695</td>
<td>-4.543918</td>
<td>-4.612827</td>
</tr>
<tr>
<td>1</td>
<td><strong>70.77149</strong></td>
<td>14.93665*</td>
<td><strong>2.36e-05</strong></td>
<td><strong>-4.982422</strong></td>
<td><strong>-4.692092</strong></td>
<td><strong>-4.898818</strong></td>
</tr>
<tr>
<td>2</td>
<td>72.63967</td>
<td>3.017830</td>
<td>2.80e-05</td>
<td>-4.818436</td>
<td>-4.334553</td>
<td>-4.679095</td>
</tr>
<tr>
<td>3</td>
<td>76.01659</td>
<td>4.935494</td>
<td>2.99e-05</td>
<td>-4.770507</td>
<td>-4.093070</td>
<td>-4.575429</td>
</tr>
<tr>
<td>4</td>
<td>76.81495</td>
<td>1.044013</td>
<td>3.95e-05</td>
<td>-4.524227</td>
<td>-3.653237</td>
<td>-4.273413</td>
</tr>
</tbody>
</table>

* indicates lag order selected by the criterion
We choose four lags for the estimation.

---

**Tableau A6: VAR estimation results with optimal lag.**

Vector Autoregression Estimates
Date: 12/03/14  Time: 18:55
Sample (adjusted): 1982 2010
Included observations: 29 after adjustments
Standard errors in ( ) & t-statistics in [ ]

<table>
<thead>
<tr>
<th></th>
<th>DXM</th>
<th>DIREER</th>
</tr>
</thead>
<tbody>
<tr>
<td>DXM(-1)</td>
<td>-0.042301</td>
<td>-0.111722</td>
</tr>
<tr>
<td></td>
<td>(0.16014)</td>
<td>(0.33451)</td>
</tr>
<tr>
<td></td>
<td>[-0.26414]</td>
<td>[-0.33399]</td>
</tr>
<tr>
<td>DLREER(-1)</td>
<td><strong>-0.360682</strong></td>
<td>0.141171</td>
</tr>
<tr>
<td></td>
<td>(0.09413)</td>
<td>(0.19662)</td>
</tr>
<tr>
<td></td>
<td>[<strong>-3.83170</strong>]**</td>
<td>[0.71798]</td>
</tr>
<tr>
<td>C</td>
<td>-0.003202</td>
<td>-0.003794</td>
</tr>
<tr>
<td></td>
<td>(0.00893)</td>
<td>(0.01866)</td>
</tr>
<tr>
<td></td>
<td>[-0.35853]</td>
<td>[-0.20336]</td>
</tr>
</tbody>
</table>

R-squared 0.384743 0.020394
Adj. R-squared 0.337416 -0.054960
Sum sq. resid 0.059850 0.261130
S.E. equation 0.047978 0.100217
F-statistic 8.129389 0.270648
Log likelihood 48.50736 27.14623
Akaike AIC -3.138439 -1.665257
Schwarz SC -2.996994 -1.523813
Mean dependent -0.000674 -0.004567
S.D. dependent 0.058942 0.097572

Determinant resid covariance (dof adj.) 1.91E-05
Determinant resid covariance 1.53E-05
Table A7: Variance decomposition for 10 periods.

<table>
<thead>
<tr>
<th>Variance Decomposition of DXM:</th>
<th>Period</th>
<th>S.E.</th>
<th>DXM</th>
<th>DLREER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>0.047978</td>
<td>100.000</td>
<td>0.00000</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.060612</td>
<td>70.62444</td>
<td>29.37556</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.060701</td>
<td>70.42446</td>
<td>29.57554</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.060734</td>
<td>70.36412</td>
<td>29.63796</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.060735</td>
<td>70.36204</td>
<td>29.63823</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0.060735</td>
<td>70.36177</td>
<td>29.63823</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0.060735</td>
<td>70.36177</td>
<td>29.63823</td>
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<td>8</td>
<td>0.060735</td>
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<td>29.63823</td>
</tr>
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<td></td>
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<td>0.060735</td>
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<td>29.63823</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>0.060735</td>
<td>70.36177</td>
<td>29.63823</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variance Decomposition of DLREER:</th>
<th>Period</th>
<th>S.E.</th>
<th>DXM</th>
<th>DLREER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>0.100217</td>
<td>17.40181</td>
<td>82.59819</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.101040</td>
<td>17.12238</td>
<td>82.87762</td>
</tr>
<tr>
<td></td>
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<td>0.101208</td>
<td>17.10406</td>
<td>82.89594</td>
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<tr>
<td></td>
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<td>0.101215</td>
<td>17.10229</td>
<td>82.89771</td>
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<tr>
<td></td>
<td>5</td>
<td>0.101216</td>
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<td>0.101216</td>
<td>17.10216</td>
<td>82.89784</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0.101216</td>
<td>17.10216</td>
<td>82.89784</td>
</tr>
<tr>
<td></td>
<td>8</td>
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<td>17.10216</td>
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<tr>
<td></td>
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<tr>
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<td>10</td>
<td>0.101216</td>
<td>17.10216</td>
<td>82.89784</td>
</tr>
</tbody>
</table>

CholeskyOrdering: DXM DLREER

Figure A 2: Impulsive responses