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Money Neutrality: Rethinking the Myth

Summary: Considered as an axiomatic basis of classical, neoclassical, and monetarist theories, the long-run money neutrality assumption does not always seem to be verified. Indeed, in our view, the money, in the sense of M2, can constitute a long-run channel of growth transmission. Thus, this paper examines the long-term relationship among money supply (M2), income (GDP), and prices (CPI). The subprime crisis in 2007 has shown that the demand for money does not only meet motives of transaction, precaution, and speculation but also of fictional or quasi-fictional future demands due to the fact that they are created without real counterparts. The capacity of production systems in developed countries to respond to increases in money supply by creating more wealth, involves the assumption of money neutrality in the long-run. However, in developing countries, the excess of money supply may lead to inflation trends. The present study has confirmed the long-term non-neutrality of money supply in the USA, and its neutrality in Gabon and Morocco.

Key words: Money neutrality, Developed countries, Developing countries, SVEC model.

JEL: E41, E42, E51, E52.

Economists have long been discussing the long-term effect of money on economic growth, yet no consensus has been reached. The neoclassical and monetarist theories assert the neutrality effect of money on real variables while acknowledging its effect on nominal variables. According to Keynes, the neutrality of money is assessed only in the long-term. However, this type of specification seems more linked to developed countries and has very few connotations with the reality of developing countries where monetary policy transmitted through bank loans has contributed to the growth of these countries.

The monetarist theory as conceptualized in developed countries (USA, UK and France) has focused even more on the characteristics of these countries than those of developing ones. Moreover, developed countries are more sensitive to transmission mechanisms (interest rates, credit supply, exchange rates and real money) of monetary policy than those in developing countries for various reasons. Individual rationality, availability, and abundance of information and its symmetrical or nearly symmetrical nature, as well as the development of financial markets are all factors allowing economic agents to anticipate and act at appropriate times in accordance with their present and future interests. However, in developing countries, because of scarcity and informational deficiency, the response of individuals seems

limited. Likewise, identified market indicators do not seem to be effective adjustment mechanisms. Even worse, impact perception cannot be immediate and may be delayed, which can cause a shift in the behavior of economic agents.

Hence, the present paper aims mainly to study the long-term effect of money supply shock on production through a comparative study of two developing countries (Morocco and Gabon) and a developed country (USA). In particular, it aims to identify behavior heterogeneity between the two groups of countries. The overall aim of this study is to enrich the literature which focuses on the relationship among the variables of money, price, and income (GDP) in developing countries. To this end, Section 1 describes the characteristics of monetary behavior in developing countries. Section 2 presents the literature review of the relationship between the variables of the present study. Section 3 presents the methodology and data. Section 4 analyzes the results while the last section concludes the paper.

1. The Specifics of Monetary Behavior in Developing Countries

## 1.1 A More and Less Risky Long-Term Endogenous Money Supply

In developing countries, money supply is not often exogenous because central banks generally resort to money supply (sometimes in a massive way) as a possible means to partially fund the budgetary deficit. Figures 1, 2 and 3 give us more details.

The three figures illustrate two fundamental patterns. First, they point to the active role played by the banking sector in creating money supply through the credit channel (Morocco and Gabon are illustrative cases). This is manifested by the strong correlation between domestic credit share provided by the banking sector (% of GDP) and that of M2 (% of GDP). Second, we note the significant discrepancy between money growth rate (as defined in M2) and income growth rate (GDP), which leads us to identify three phases.
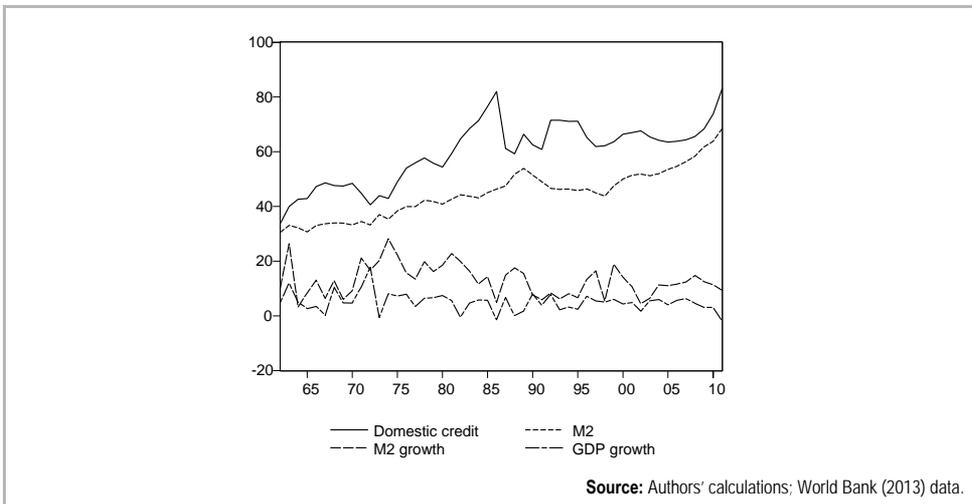

Source: Authors' calculations; World Bank (2013) data[1].
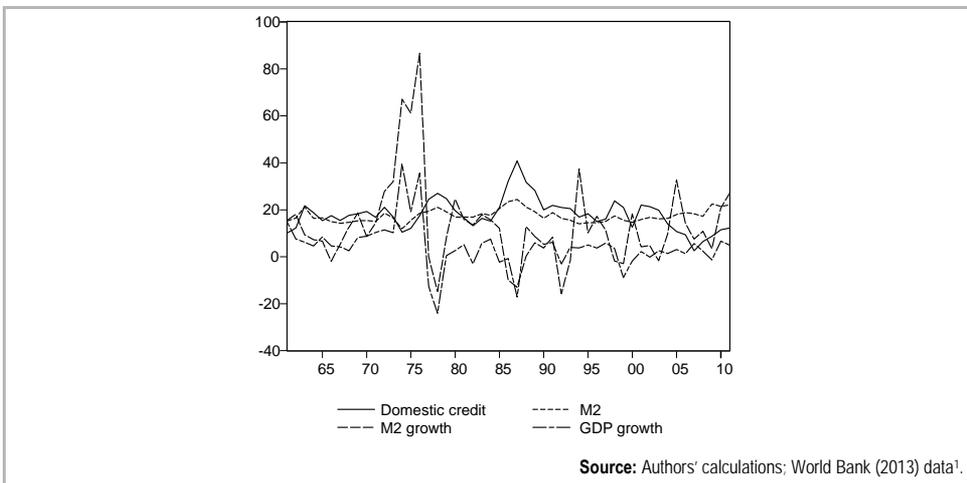
Figure 1 Evolution of Some Real and Monetary Indicators in Gabon (1961-2011)

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[1] **World Bank.** 2013. Indicators. http://data.worldbank.org/indicator (accessed March 8, 2013).

Source: Authors' calculations; World Bank (2013) data.
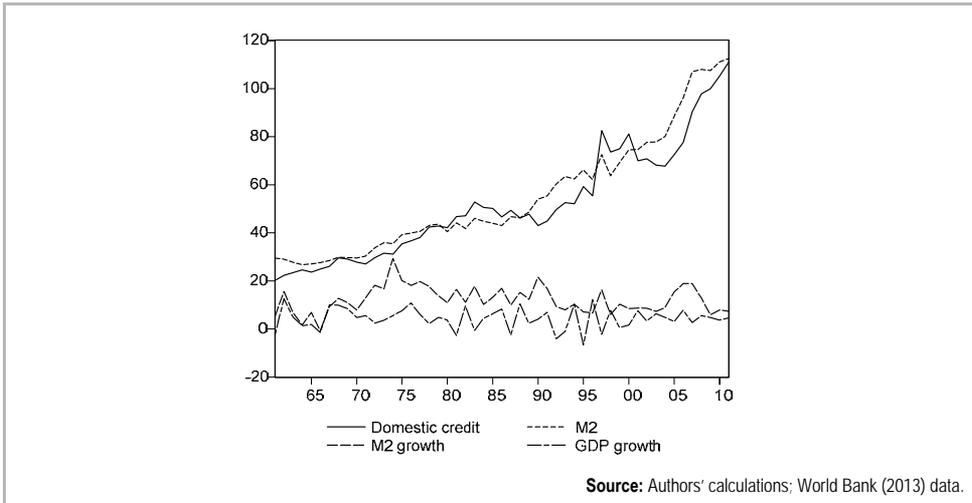
Figure 2 Evolution of Some Real and Monetary Indicators in Morocco (1961-2011)

Source: Authors' calculations; World Bank (2013) data.

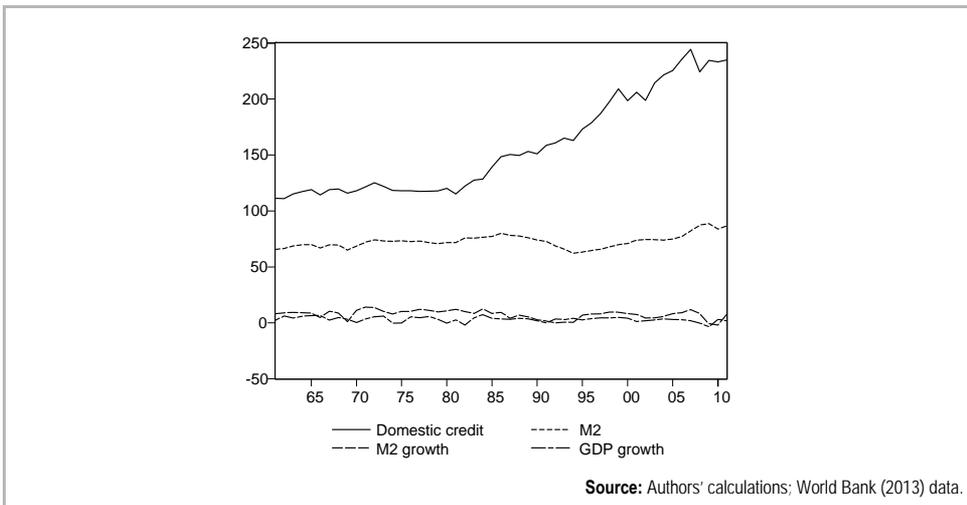**Figure 3** Evolution of Some Real and Monetary Indicators in Tunisia (1962-2011)

In the first phase, which covers the 1960-1975 period, the difference was very small or even almost zero (the case of Morocco). In the second phase, which goes from 1976 to 1990, the rate of money growth largely exceeded that of income growth. This is due to many reasons, especially the 1973 and 1979 oil shocks which increased the commodity prices (oil, phosphates, etc.), hence allowing these countries to replenish their budgets by additional financial resources.

The development models adopted focused on strengthening the social economy. For example, in 1973, Tunisia created a general compensation fund, while Morocco created a wide-scope public sector to address issues of social economy.

In Gabon and Tunisia, there were wage increases (for six consecutive years in Tunisia). This situation forced the governments, to support a more and more burdensome spending on public finance, to resort first to external debt and second to money supply.

During the 1980s, there were changes in behavior. In the case of Morocco, which has undergone structural adjustment since 1983, the gap (which refers to the difference between growth series) has weakened significantly compared with the situation back in the 1970s. In the case of Tunisia, the gap did not decrease until 1986 when the country has signed a structural adjustment agreement with the International Monetary Fund. The case of Gabon is specific due to huge fluctuations of money supply. Indeed, it all depends on fluctuations of commodity prices that the country exported.

In the third phase, between 1991 and 2011, the gap decreased (except for Gabon). Economic openness, and its requirements in terms of competitiveness, certainly required central banks to be more rational and able to control money supply to guard against possible inflationary trends. However, in developed countries, the evolution of real and monetary variables is governed by a different rational as shown in Figures 4 and 5.

Source: Authors' calculations; World Bank (2013) data.

Figure 4 Evolution of Some Real and Monetary Indicators in the USA (1961-2011)

Compared with developing countries, the difference between money growth rate and income growth rate is very small, especially in the case of the USA. One can also note that the use of indirect financing is very high.

At this stage, an important question arises: why do economic agents still borrow from the banking sector even in the case of developed financial markets? To answer this question, one should recall that the percentage of loans to private sector relative to the GDP ratio in 2011 represented only 15% in Algeria, 41% in Bolivia, 20% in Burkina Faso and 38% in Qatar, against 186% in the UK, 194% in the USA, 127% in Australia, 92% in Belgium and 116% in France.
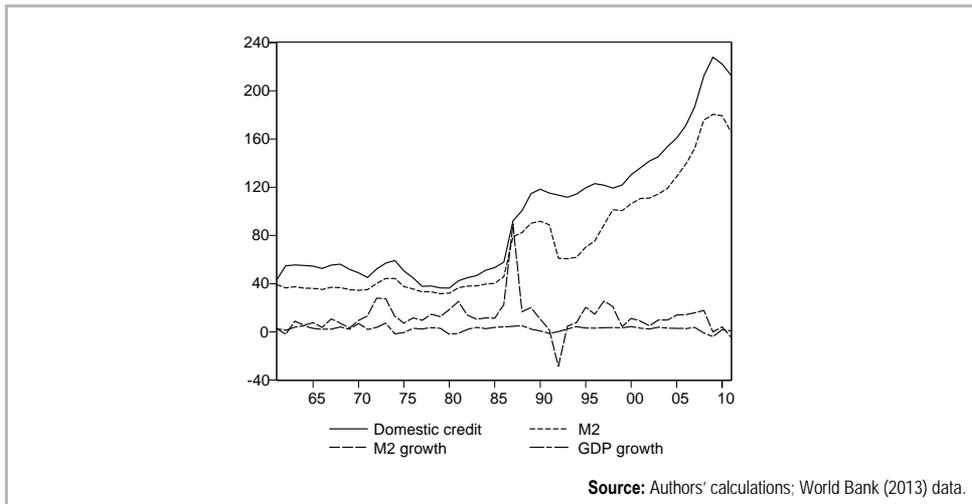
Figure 5 Evolution of Some Real and Monetary Indicators in the UK (1961-2011)

Intuitively, we may say that the monetary policy in developed countries is different from that of developing ones in so far as the huge volumes of credits reveal an almost unique reality. This reality highlights the willingness of bankers to help individuals to buy, at present, the goods and services planned for the future.

Indeed, the 2007 subprime crisis revealed that in moments of socio-economic optimism, bankers do not fund present or future transactions on the basis of the borrowers' current capacity to pay, but rather on their capacity to repay. Thus, a new market is created: that of the future market of goods and services (covering goods and services that people hope to purchase in the future and which became possible, thanks to the opportunity of unsecured credits offered by their banks).

In such financing structures, can one still assert the long-run neutrality (LRN) of money? *A priori*, the answer is negative at least in developed countries. Such a funding scheme (present/future) may substitute the short- and medium-run funding, by the long- and very long-run funding. This behavior creates a sort of fictitious demand for goods and services in the present (normally to be revealed in the near, distant, or very distant future) which adds to real demand (revealed in the present). The demand for goods and services will lead to the increase of present and future income (near and distant), as long as optimism and trust reign. At the time (t), the monetary authorities must respond to two requests. The first demand meets the needs of transaction, funding and caution expressed by economic agents. The second type (called unreal or fictitious) is defined as a money demand expressed by economic agents who can enjoy credits without having the necessary guarantees.

This can be explained by the fact that at times of social and economic optimism, banks try to involve a large number of potential clients to have loans without guarantees. Such credits, which create an effective demand at time (t), should logically be part of future demand expressed in $(t + k)$. Thus, the demand for goods and services at time (t) includes two types of demands: a present demand and a future one. Hence, future economy competes with the current economy. The more the fu-

ture economy goes away from the current, the more it creates demand without injecting a proportional real compensation into the real economy. Only the decrease in trust and social pessimism can lead to the disappearance of future markets.

Money demand (in terms of M2), which is revealed in the present, covers the Keynesian motives of precaution and transaction $M_t(Y_t)$ and a future demand M_f that depends on expected revenues (expected and granted) by the banking sector (without real compensation in the present) $M_f(Y_{t+s}^a)$. Formally, aggregate money demand (present and future) is equal to $M^0 = M_t(Y_t) + M_f(Y_{t+s}^a)$. Facing an important volume of income created by new loans, the economic system should adjust itself to such a situation. However, production systems do not systematically and proportionally respond to new demand funded by new money supply. To do so, producers who become aware that there is additional demand for goods and services will be encouraged to mobilize more resources and to review their production and investment strategies to increase their production level. Thus, to meet extra demand, supply increases in its turn, but this increase is proportionally lower than the demand for money (money growth rate is still higher than production growth rate).

Thus, at present, we will create a present and future income (Y_{tf}) higher than the income that should have been created (all things being equal $Y_{tf} \geq Y_{tt}$. The supplement income ΔY represents all future transactions that are converted in the present. Accordingly, the present growth rate $g_t = g_n + g_f > g_n$ where g_t is the growth rate at time (t), g_n is the growth rate occurring at time (t), if banks do not offer high-risk credits (without consideration); g_f is the growth rate, which cannot normally take place in the future but becomes possible when banks fund bad loans.

When the basis of trust collapses, g_f is canceled out, while g_n falls immediately and the economy begins to re-balance time frames and to penalize the bad and unfair income investors already created.

1.2 A Money Demand Oriented to Real Demands and Much Less to Speculative Demands

One can logically state that whenever economic structures are weak, demand for money tends to incline rather towards actual motives related to basic needs (the economic theory asserts the assumption of the positivity and the decrease in the marginal efficiency of money as well as the long-term decrease in the marginal propensity to consume) and towards the most productive uses. In other words, the growth of these countries (Tunisia, Morocco, Egypt, etc.), to a large extent, and for decades, was exclusively financed by public or private banking systems (due to the lack of financial markets or their low-level of development).

Note that the Keynesian argument that the role of consumption exclusively depends on available income does not seem to be solid. Indeed, part of household consumption is funded and planned in terms of expected and anticipated incomes (bank credits, for example). This means that a tiny proportion of the created money (*via* credit channel) is transformed into actual present and future consumption. Thus, it seems that the creation of money through bank loans affects real activity and allows for an increase in aggregate demand. In addition, the market of goods and ser-

vices is not independent from the money market whenever money supply (as defined in M2) is added to aggregate demand (aggregate consumption and investment), at least in the behavior of economic agents.

Since the 1980s, we have witnessed new forms of commercial banks whose customers belong mainly to the poor class, as shown by the experience of Mohamed Younes who created the Grameen Bank in Bangladesh or the Tunisian Solidarity Bank (TSB). The relative success of these experiments and their generalizations in almost all countries (developed and developing) leads us to pose a question, again, about the possible effect of long-term money growth. This is due to the fact that this type of credits, aimed at fighting poverty, takes the form of a socio-productive investment that could affect economic growth, in the short- and long-term.

However, in developed countries, the credit marginal efficiency is logically and relatively low given that these countries are richer (high wage level, unemployment allowance, high level of human development index, etc.). Hence, the subsequent uses of these loans serve more the prestigious and unproductive speculative spending.

1.3 Sensitivity of the Hypotheses of Quantity Theory of Money

On the other hand, in developing countries, the quantity theory of money (QTM) faces many problems. First, this theory intrinsically makes heterogeneous values, which are not determined by the same measurement scales, equal. The monetary value of transactions (T) is obvious as market prices are visible. However, money stock is not always easy to determine as it is a result of the heterogeneous behavior of individual economic agents. This means that it is partly a balance between consumption and monetary and non-monetary savings approved by economic agents.

Accordingly, money stock accounted, at a given point, may give us information about the money stock of an earlier period rather than that of the current period (as some monetary flows were not recorded). As for the fast flow of money, it is important to note that it is the most difficult variable to quantify. In other words, it seems that the determination (*ex-ante*) of its value is impossible. The fact that its speed depends to a large extent on socio-economic pessimism (or optimism), its valuation can be considered a complex task. The speed, determined *ex-post*, is intended as a forced theoretical quotient ($V = PT/M$). Consequently, as a simple identity, the QTM will always be verified even though there is no evidence of this very equality.

The gap between the theoretical and actual value of money speed can be explained by the time gap between the onset of any economic problem and the moment at which economic agents perceive this very problem. This makes economic agents unable to react efficiently especially if the time difference is high. Hence, their reaction (expressed at time (t)) to hold or to dispose of their liquidity does not reflect the real situation of the economy, which may, at this moment, return to the initial equilibrium.

As a result, the real speed that should have been made (theoretical velocity) will be distorted by another speed that reflects the past time and does not take into consideration the fact that there is an economic return to equilibrium.

Indeed, to achieve velocity that reflects the reality of the economy and therefore allows for achieving equality for both parts of QTM equation, a multitude of hypotheses should be verified. First of all, the perfection and asymmetry of information that enables economic agents to conduct perfect forecasts. Second, the homogeneity of the behavior of economic agents towards their future optimization programs allows them to adopt the same reactions when managing their level of consumption, saving and liquidity. However, this hypothesis is not always true because in moment of economic crisis, the economic agents can adopt divergent scenarios (e.g. when they anticipate inflation, some agents sell their cash to buy goods and services, while others keep it under the assumption that expected inflation is very short-term). Third, economic agents must react instantly when they expect some money velocity increase (or decrease). In addition, this kind of behavior is not always possible even in times of crisis; because some spending cannot be performed immediately (e.g. some precautionary reserves may be spent only in case of risk).

Henceforth, in our view, it is hardly conceivable to admit the similarity of the reaction of both groups of countries facing monetary shocks and also to recognize that the dynamics of neutrality follow a single time path.

2. Literature Review

2.1 Money Neutrality

Note that money neutrality is one of the most important results of the physiocratic, classical, and neoclassical theories, which attributed to the money, the simple function of transaction. From then on, what can make the money in an economy characterized by full employment? *A priori* nothing, in a world governed by the benevolence of Smith's invisible hand. This thesis has generated thereafter, a continuum of theoretical debates that can be divided into three categories. The first category recognized the absolute neutrality of money in all time horizons. The second, less conservative than the first, has recognized the neutrality of money in the long-run only. The third category, although its supporters have not developed a theory which affirms or reverses the non-neutrality of money, converged, following the stylized facts and empirical studies, to the reality confirming that money cannot be neutral even in the long period.

The classical and neoclassical monetary thought, admits that money is a veil that hides the reality of real activity. In other words, as long as supply created its own demand (law of markets), the presence of currency, can have only one role: substitute barter by the monetary exchange. For Walras, neutrality of money is a fundamental assumption in his theoretical developments. He considered money a commodity like any other goods, and where its price is the reference price of all other goods (equal to unity). Thus, he developed his famous law stating that in a market economy governed by the pure and perfect and where prices are flexible competition, all markets are cleared instantly (market goods and services and market factors). This equilibrium is established by simply adjusting their prices to equilibrium levels.

For Keynes, the money neutrality idea cannot have any sense in a situation of full employment. However, in underemployment situations, the expansionary mone-

tary policy may therefore be effective in the short-term given that it increases the level of income and decreases the level of interest rates (moving the *LM* curve to the right). For Friedman and Schwartz, in the short-term, the money has an effect on real variables while in the long-term, it affects only nominal variables (Milton Friedman and Anna J. Schwartz 2008).

Robert E. Lucas (1996) showed that monetary shocks can have real effects because of the imperfection on price information. In other words, only unexpected monetary shocks can lead to real effects. He explained this idea by showing that when expected money increases, it also increases inflation and interest rate simultaneously, but they have no effects on real variables (production and employment). However, when unexpected money increases, it can affect the production level positively given that the price increases can incite investors, in the short-run, to produce more. Robert J. Barro (2013) showed that only the unanticipated increases in money affect production.

In the last three decades, several studies by economists have tried to test the effects of money on real variables even in the long-run.

Sang-Kun Bae, Mark J. Jensen, and Scott G. Murdock (2005) have shown that long-run neutrality is confirmed in all countries of the sample except Sweden. The authors noted that, even when money has no lasting long-run impact on real output, it exists positive monetary shocks having a significant and persistent positive effect on the level of output.

H. Sonmez Atesoglu and Jamie Emerson (2009) have tried to test the long-run monetary neutrality employing cointegration and vector error correction modeling (VECM) methodology. The estimation of the long-run relationships among money supply and output and other key macroeconomic variables have shown that it exist a doubts about the long-run monetary neutrality proposition.

Chin-Hong Puah, Muzafar Shah Habibullah, and Shazali Abu Mansor (2008) have tested the LRN and long-run super neutrality (LRSN) hypothesis using annual observation from 10 member countries of the South East Asian Central Banks (SEACEN) Research and Training Centre. The authors noted that empirical results reveal that LRN can be deviated from the case of Asian developing economies. They showed that monetary expansion seems to have long-run positive effect on real output in the economies of Indonesia, Taiwan and Thailand. However, LRSN is neither fail or not addressable in our study.

Mehdi Farahani and Marjan Deh Abadi (2012) have tried to evaluate money neutrality in Iran's economy. They noted that, "according to rational expectations hypothesis and flexibility of prices (equilibrium in markets) in macroeconomy, only unanticipated changes of volume of money influence real production". Also, the authors have found that "empirical results indicate that anticipated money is neutral while unanticipated money is not (over the short-run)".

2.2 Empirical Literature

The literature review on the relationship among money (M2), income (GDP), and prices (CPI) is not so abundant. Besides, most of the works did not attempt to test the hypothesis of non-neutrality of money in the long-term. In most cases, this hypothe-

sis was theoretically considered false. Studies on the money topic focused on two objectives. The first is to study its effects on economic and monetary variables, while the second is to check the time frames in which such effects take place.

Using a vector autoregression (VAR) model, Ryuzo Miyao (2002) has studied the effects of monetary policy on macroeconomic variables (interest rates, money supply, price vector and production) during the previous two decades in Japan. The author concluded that monetary shock affects, in the long-run, the actual production.

Robert G. King and Mark W. Watson (1997) have concluded that "the USA post-war data confirmed the neutrality of money and a vertical long-run Phillips curve". Also the authors noted that the "sign of the estimated effect of money growth on output depends on the particular identifying assumption used".

Gary L. Shelley and Frederick H. Wallace (2004) used the methodology of Fisher-Seater (Mark E. Fisher and John J. Seater 1993) and tried to test the LRN of money in Mexico for the period 1932-2001. They found that the political behavior was non-neutral in the long-term on real variables. However, the authors noted that over the period 1932-1981, the currency had confirmed its long-run neutrality. This means that from the early 1980s, the currency has begun to influence the real economy.

Bae and Ronald A. Ratti (2000) attempted to test the neutrality of money in the case of Argentina (1884-1996) and of Brazil (1912-1995). They found that money is neutral in the long-term but is not super neutral with respect to actual production. The increase in money supply is followed, in the short-term, by a decline in production: an opposite effect to the Tobin effect.

Shyh-Wei Chen (2007) tried to test the neutrality of money in the short- and long-term in South Korea and Taiwan. The empirical studies have shown that in the long-term, money was neutral in the case of South Korea and non-neutral in the case of Taiwan.

Seher N. Sulku (2011) tried to test the long-run money neutrality in the case of Turkey (Q1 of 1987 to Q3 of 2006). The author concluded that the LRN of money is confirmed for the various monetary aggregates M1, M2 and M3.

Puah, Habibullah, and Kian-Ping Lim (2006) have shown the LRN of money in the Malaysian stock market for the period 1978-1999. This means that when the money supply varies, then stock returns have remained unchanged.

Mario Forni and Luca Gambetti (2010) used a factorial VAR on 112 monthly macroeconomic series to study the effects of a monetary shock. The authors have identified the shock by two restrictions imposing a zero effect on prices and industrial production. The authors have concluded that prices fell after an initial zero effect. Moreover, monetary policy has a significant effect on the nominal and real variable dynamics.

Gábor Pellényi (2012) used a factorial VAR to analyze the sectorial heterogeneity role on the monetary policy impact in Hungary. The author identified monetary shocks through restrictions of sign. Assessment of the model showed that sectors responded differently to monetary shocks. The largest impact of the monetary shock on the real variables (production impulse response) was in the construction, industry, and trade sectors. However, the manufacturing sector, which produces sustainable

goods, responded much more to monetary expansion. In addition, the authors concluded that the sectors that depended on external funding benefited more from monetary expansion. Finally, they showed that the reaction of production and prices correlated negatively with the shock.

Analyzing the American, French and German cases, Catherine Bruno (1997) tried to evaluate the impact of a monetary shock on production, interest rate, prices and on actual monetary stock. Using a VAR model, the author concluded that the flexible exchange rate regime is more appropriate in terms of efficiency to the French and German cases while the fixed exchange rate regime is more effective in the case of USA. The author also concluded that actual monetary stock is the channel through which monetary policy is transmitted to this group of countries and that money is an important source of production fluctuation in both cases (flexible regime and fixed exchange rate regime).

Bruno and Olivier de Bandt (1999) examined the importance and limitations of a structural VAR (SVAR) model while referring to an analysis of monetary policy shocks in France over the period from Q1 of 1972 to Q2 of 1995. The authors have concluded that the restrictive monetary shock affects the economic activity negatively, which decreases in the six quarters post-shock. Right after this period, the negative shock effects disappear gradually.

Elsheikh M. Ahmed and Suliman Zakaria (2011) studied the case of Sudan using time series. The authors found no causal effect between money and income (GDP) while they confirmed two unidirectional causal relationships: from income (GDP) to price and from money to price. Kalbe Abbas (1991) studied East Asian countries (Malaysia, Pakistan and Thailand) to detect a causal relationship between money supply and income. The author concluded that there is a bidirectional causal relationship.

Hamad S. Al-Bazai (1999) examined the relationship among income (log GDP excluding oil), money supply (log M1), and consumer price index (CPI) in Kingdom of Saudi Arabia (KSA) using quarterly data from 1971:Q1 to 1995:Q4. The main results point to the presence of a bidirectional relationship between money and income, a unidirectional relationship from money to prices, and a unidirectional one between income and prices.

Mohamed A. R. Salih (2013) examined the relationship among three macroeconomic variables: money (M3), income (GDP) and prices (CPI) in Saudi Arabia during 1968-2011. Using cointegration, bivariate and trivariate VAR and Granger causality test, the author concluded that the causal relationship between income and money is bidirectional. Besides, the author indicated that a unidirectional causality from income to price and from money to price is validated. A money supply shock affects both prices and income in medium-term time horizons.

3. Methodology and Data

3.1 Methodology

As mentioned above, the present work studies the dynamic effect of a long-term impact of money supply on real activity. As it became customary to use the neoclassical assumption of money neutrality in the long-term as an unquestionable assumption

within structural multivariate models, we believe that this hypothesis should be tested with more vigilance. It is all the more confirmed that the effect of a money supply shock on production is different in developed countries and developing countries. Using a structural vector error correction (SVEC) model, we suggest studying this issue through a comparative study between the USA on the one hand, and Morocco and Gabon on the other.

3.1.1 The SVAR Approach

Structural VAR methodology, introduced by Christopher A. Sims (1980), Ben S. Bernanke (1986), Olivier J. Blanchard and Watson (1986) and Blanchard and Danny Quah (1989), seeks to specify a framework that is economically interpretable. This interpretation is made in the VAR framework by studying causality between variables and forecast error variance decomposition and impulse response functions (IRF). The pioneering work of these authors was to overcome standard VAR models limitations and to enable tracing the transmission of an economic policy impulse to the economy. In this regard, note that SVAR methodology considerably succeeded in two major areas of research: the interpretation of business cycle fluctuations of macroeconomic variables and the identification of the effects and transmission mechanisms of economic policies.

   This methodology attempts to detect a set of independent shocks by imposing few short- and/or long-term identification restrictions using economic fundamentals. These restrictions are considered short-term when they express lack of instantaneous responses of some variables to some structural impulses.

   However, when some impulses have no lasting effect on some components of the system, the restrictions are long-term. This second type of restrictions implies non-stationarity of one or more series. These results from the fact that impulses extend over a long period and that permanent shocks continue to accumulate. The SVAR model is expressed as follows:

$$B_0 Y_t = \sum_{i=1}^{p} B_i\, Y_{t-i} + w_t, \tag{1}$$

where the matrix B_0 of $(N \times N)$ dimension contains terms equal to the uniton the main diagonal that expresses the simultaneity relationship between the variables constituting Y_t. The squared matrix B_i, for $i = 1, \dots, p$ contain the structural parameters of the model and the vector $w_t = (w_{it}, \dots, w_{nt})'$ contains N structural innovations (shocks).

   The SVAR model admits the reduced form (VAR standard):

$$Y_t = \sum_{i=1}^{p} B_0^{-1} B_i Y_{t-i} + B_0^{-1} w_t$$
$$= \sum_{i=1}^{p} A_i\, Y_{t-1} + \varepsilon_t. \tag{2}$$

   The squared matrix A_i, for $i = 1, \dots, p$ related to lagged vectors Y_{t-i} for lag order p, contain the model parameters. The vector $\varepsilon_{1t} = (\varepsilon_{1t}, \dots, \varepsilon_{Nt})$ contains the N canonical innovations. The variance-covariance matrix $\sum \varepsilon$ is asymmetric $(N \times N)$ matrix describing the stochastic interdependence structure of canonical innovations

ε_t. The SVAR parameters are recovered by assuming that the vector of canonical innovations ε_t is a linear combination of structural innovations w_t of the same date $\varepsilon_t = B_0^{-1} w_t$.

Thus, to identify the SVAR model, we should determine the matrix B_0. Because matrix B_0 is unknown, then we should first estimate the standard VAR model, assuming that $v(w) = \Omega = I$. To properly identify parameters of B_0^{-1} (or of B_0), we generally suppose that $v(w) = \Omega = I$. This condition implies that innovations w_t from the structural form are uncorrelated and their variances are unitary. We may write $\sum_\varepsilon = B_0^{-1}(B_0^{-1})'$ or still $B_0 \sum_\varepsilon B_0' = \Omega = I$. The latter condition tells us about the number of restrictions needed to determine B_0 and identify the structural form. Given that the variance-covariance matrix is symmetric, $\frac{N(N+1)}{2}$ restrictions are provided by the model. However, B_0 contains N^2 unknown elements. Then, at least $\frac{N(N-1)}{2}$ additional restrictions remain to identify the structural form.

3.1.2 Cointegration and Structural VECM

The identification and estimation of the structural form of a VAR model assume the existence of a vector moving average (VMA) form of the model. Because the existence of the VMA representation is determined by the stability of the VAR process in question, the two approaches above for identifying the SVAR model were applied to stable models in level or in difference. When a VAR model contains components $I(1)$ (when a series is said to be integrated of order d, denoted $I(d)$, it should be differentiated d times to make it stationary - a stationary series is described as $I(0)$), its VMA representation exists only after having differentiated the non-stationary series. However, this transformation is not appropriate when there are cointegration relationships between variables. Then a VECM should be specified.

When econometric tests reveal the presence of cointegration relationships between the variables, the VAR model presented by Equation (2) should be transformed into a VECM representation. This VECM form is an intermediate representation between the stationary VAR process in level and that indifference when there is no cointegration. The economic peculiarity of a dynamic representation like VECM lies in its flexibility to model adjustments that lead to a long-term equilibrium.

The pioneering researches of Clive W. J. Granger (1981), Robert F. Engle and Granger (1987) and Granger and Andrew A. Weiss (2001) have defined cointegrated variables as "variables that have at least one $I(0)$ linear combination".

Cointegration relationships between $I(1)$ series are long-term equilibrium relationships, which could lead, to some extent, to compensating the non-stationary series. In other words, $I(1)$ series are considered divergent in the short-term because they are not stationary, but can move together in the long-term. If we assume that the number of series constituting Y_t at the VAR Equation (2) is $N = 3$ and that these three series are $I(1)$ and are co-integrated of order $(1,1)$ the VAR model should be expressed in the form of a VECM as follows:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-1} + \varepsilon_t = \pi Y_{t-1} + \sum_{i=1}^{n-1} \Gamma_i \Delta Y_{t-1} + \varepsilon_t \qquad (3)$$

with $\Gamma_i = -(A_{i+1} + \cdots + A_p)$ for $i = 1,\ldots, p-1$, the rank of $\pi = -(I_n - A_t - \cdots - A_p)$ is equal to $r < 3$ (which amounts to considering that $r = 1$, because all three series are co-integrated of order (1,1)), and α (the weight matrix) and β (the cointegration matrix) are of dimension (3,1) and of a rank equal to $r = 1$; Δ is the first difference operator.

In addition, it is necessary to reverse the VECM to deduce the VMA form. At this level, deducing the VMA form is a critical step in studying impulse response functions and forecast error variance decomposition. Like Helmut Lütkepohl and Hans-Eggert Reimers (1992a, b), Anders Warne (1993) and Søren Johansen (1995), we used the common trend representation to reverse the VECM. The common trend representation is an alternative representation to a co-integrated system derived from the Granger representation theorem.

The common trend representation to consider is that if the rank of a cointegration vector $Y_t \sim CI(1, 1)$ is $r = 1$, then this implies that r stochastic trends are eliminated and there are only $k = N - r = 2$ trends, which become common to the N components of Y_t. Indeed, the long-term co-movement of co-integrated series is governed by a common trend, which reduces the number of stochastic trends consequently.

With reference to the Granger representation theorem and respecting the following conditions: (i) the number of unit root of non-stationary series is exactly equal to $N - r$ and (ii) α and β are (N, r) matrices and rank $(\alpha) = rank(\beta) = r$, the VECM Equation (3) can be rewritten as the VMA form of Beveridge-Nelson decomposition of Y_t as follows:

$$Y_t = Y_0^* + + \Xi^*(L)\varepsilon_t + \Xi\sum_{i=1}^{t} \varepsilon_i . \qquad (4)$$

Y_0^* contains the initial value of the series, $\Xi^*(L)\varepsilon_t = \sum_{j=0}^{\infty} \Xi_j^* \varepsilon_{t-j}$ is the stationary component of Y_t and $\Xi = \beta_\perp[\alpha_\perp'(I_N - \sum_{i=1}^{p-1} \Gamma_i)\beta_\perp]^{-1}\alpha_\perp'$ (where $P_\beta = \beta(\beta'\beta)^{-1}\beta'$ the projector on the co-integrating space which is of dimension r and $P_{\beta\perp} = \beta_\perp(\beta_\perp'\beta_\perp)^{-1}\beta_\perp'$, the projector on the orthogonal space to the co-integrating space, of dimension k, such that $\beta'\beta_\perp = 0$ and $P_\beta + P_{\beta\perp} = I_N.\beta_\perp$ of dimension (N,k), is a basis of k vectors orthogonal to β).

This representation decomposes the process Y_t into two parts: $I(0)$ and $I(1). Y_t$ is thus governed by r components $I(0)$ represented by $\Xi^*(L)\varepsilon_t = \sum_{j=0}^{\infty} \Xi_j^* \varepsilon_{t-j}$ and $K = N - r$ components $I(1)$ represented by $\Xi\sum_{i=1}^{t} \varepsilon_i$. The stationarity of the r transitory components of Y_t implies absolute summability of matrices Ξ_j^* capturing the short run impact of shocks and the non-stationary component of Y_t consists of N random walks multiplied by the matrix Ξ of rank $k = N - r$ capturing the long run effects. This amounts to considering that these matrices converge to zero as j tends to ∞. This amounts to considering that if the N structural innovations w_t, deduced from the expression $\varepsilon_t = B_0^{-1}w_t$, are identified, we may consider that only r

of them to have short-term effects. The first k non-stationary components, known also as common trends of Y_t drive the system in its long-term trajectory. The r transitory components that remain describe the short-term behavior of the process. Substituting $\varepsilon_t = B_0^{-1} w_t$ in the expression of common trend gives $\Xi B_0^{-1} \sum_{i=1}^{t} \varepsilon_i$. It follows then that the long term effects of structural shocks w_t are given by the matrix ΞB_0^{-1}. The fact that the rank of the matrix ΞB_0^{-1} is equal to $N - r$ implies that it contains atmost r columns of zeros. This amounts to considering that among the structural innovations of the model, only r innovations should have short run effects and the rest of them $(k = N - r)$ are expected to have long run effects.

Given that the just identification of the structural model requires the imposition of $\frac{N(N-1)}{2}$ additional restrictions, $\frac{1}{2}r(r - 1)$ restrictions are needed to identify transitory shocks and $\frac{1}{2}k(k - 1)$ restrictions are needed to identify permanent shocks. This amounts to a total of $\frac{1}{2}r(r - 1) + \frac{1}{2}k(k - 1) = \frac{1}{2}N(N - 1) - rk$ restrictions to identify the structural innovations associated with structural vector error correction (SVECM). It should be noted in this respect that the fewer number of restrictions compared to a SVAR model is due to the fact that in the framework of a SVECM cointegration properties of the variables lead to long-term restrictions provided by the data.

Therefore, we will need, in a case similar to our model where the vector Y_t consists of three $I(1)$ series cointegrated of order $(1, 1)$, $\frac{1}{2}r(r - 1) = 0$ additional restriction to identify temporary shocks and $\frac{1}{2}k(k - 1) = 1$ additional restriction to identify permanent shocks. This identification scheme assumes that the structural innovations vector w_t has three shocks: two permanent shocks and a transitory shock. Placing the two permanent shocks as the first components of the vector w_t and assuming that the second long term shock exerts no permanent effect on the first variable, we may write the restrictions as follows:

$$\Xi B_0^{-1} = \begin{bmatrix} * & 0 & 0 \\ * & * & 0 \\ * & * & 0 \end{bmatrix} \text{ and } B_0^{-1} = \begin{bmatrix} * & * & * \\ * & * & * \\ * & * & * \end{bmatrix}. \qquad (5)$$

The asterisks represent the unrestricted elements to estimate.
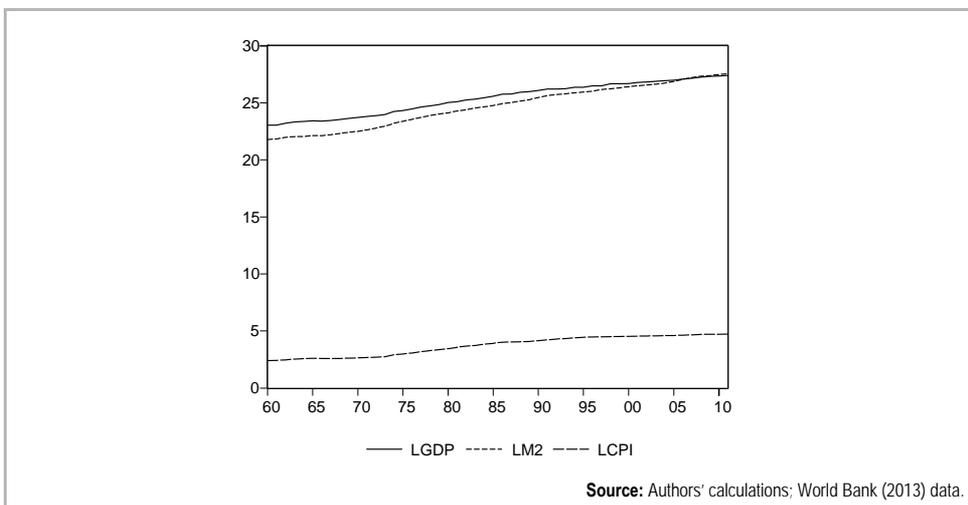
3.2 Data

The adapted model in our study is a trivariate model containing GDP, money supply (M2) and consumer price index (CPI). The series of GDP (current local currency unit (LCU)), M2 (current LCU), and CPI (2005 = 100) are obtained from the World Bank. Data are annual and spread over the 1960-2011 period for the USA and Morocco and the 1962-2011 period for Gabon. Given the 50-year span of the data, the possibility of some structural break cannot be ignored. Nevertheless, in our research, we need not worry about it for two reasons. First, the monetary behavior of central banks has not changed significantly in the countries considered in our sample. Second, because the monetary policies in those countries have not known deep struc-

tural changes especially in Morocco and Gabon. Indeed, in those countries, the monetary markets are yet submitted to the control of central banks and their liberalizations are partial.
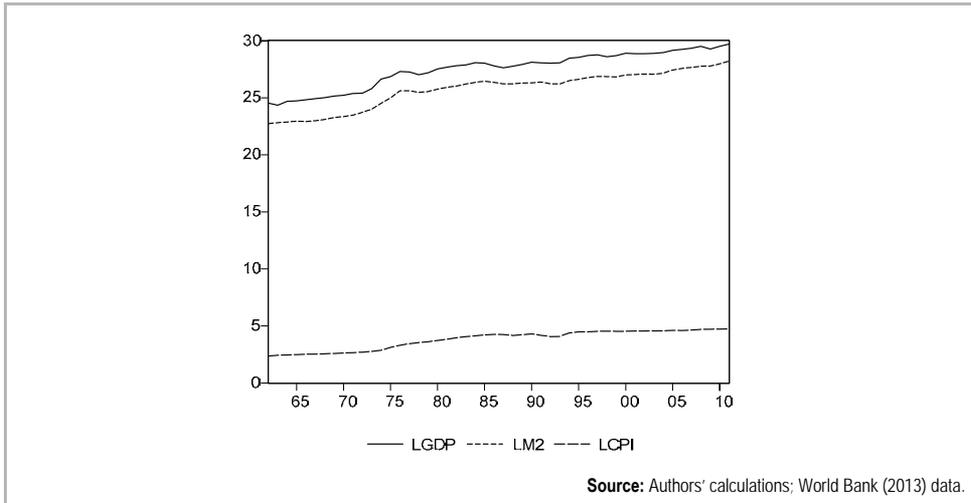
The results of the usual unit root tests (Augmented Dickey-Fuller (ADF) and Phillips Perron (PP)) indicate that the logarithms of GDP, M2 and CPI are $I(1)$ (see Table 1). The adapted ADF and PP test regressions had a constant and no trend. The three series seem to grow and to move together in the same direction (see Figures 6, 7 and 8). Then we suspect the eventual existence of a cointegration relationship among the three series. We used Johansen procedure to test for the eventual existence of cointegration (Johansen 1995).

Source: Authors' calculations; World Bank (2013) data.
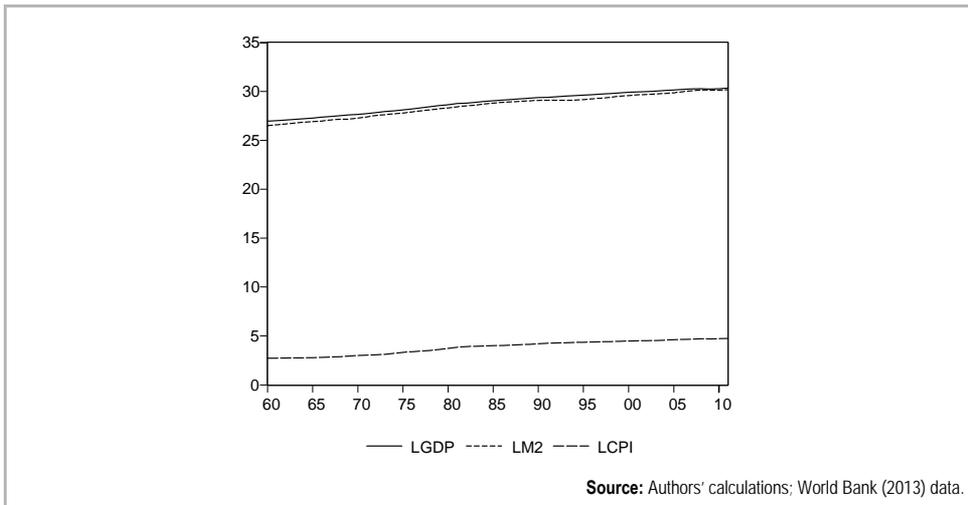
Figure 6 Evolution of the Logarithms of GDP, M2 and CPI during 1960-2011 (USA)

Source: Authors' calculations; World Bank (2013) data.

Figure 7 Evolution of the Logarithms of GDP, M2 and CPI during 1960-2011 (Morocco)

Source: Authors' calculations; World Bank (2013) data.

Figure 8 Evolution of the Logarithms of GDP, M2 and CPI during 1962-2011 (Gabon)

However, applying Johansen procedure intrinsically depends on the type of specification that we want to test. According to this specification, we can argue whether cointegration and VECM contain a constant or not and/or has a trend. This choice is crucial because it has a direct influence on likelihood ratio tests (trace test statistic and maximum eigenvalue test) and the critical values derived from these tests. We will use in our analysis the trace test statistic, which is the most used in the econometric literature.

In our model, the retained specification is that which supposes absence of trend in the cointegration relationship and the presence of a constant in the VECM. Two reasons motivate our choice. The first, which is economic, considers that in a long-term equilibrium situation, the relationship among income, CPI and money supply has no trend. The second, associated with the presence of a constant in the VECM, considers a fact that our three logarithmic series have an upward linear trend.

Table 2 summarizes the results of the trace test statistics done through the Johansen procedure for the three countries considered. The calculated values of the trace statistics for the USA, Morocco and Gabon are 39.18, 40.01 and 36.07, respectively. These values are respectively higher than the critical value at a 5% risk level (35.07 for the three models). Therefore, we reject the null hypothesis of no cointegration for all three countries. However, we accept the null hypothesis according to which there is, at most, one cointegration relationship (12.22 < 20.16, 17.17 < 20.16, 15.31 < 20.16) at a 5% risk level. It follows then that the trace test procedure should be stopped at the cointegration rank $r = 1$. We conclude with the existence of one cointegration relationship between the logarithms of GDP, M2 and CPI ($r = 1$) for the three countries under consideration.

Table 1 Results of ADF and PP Tests

Country	Variable	ADF		PP	
		Level	First diff.	Level	First diff.
USA	GDP	-2.194	-3.461	-2.869	-3.433
	M2	-1.683	-3.549	-2.171	-3.546
	CPI	-1.555	-3.011	-1.085	-3.357
	5% critical values	-2.921	-2.921	-2.919	-2.921
Morocco	GDP	-1.794	-3.455	-1.154	-7.791
	M2	-0.725	-4.147	-0.282	-4.225
	CPI	-1.452	-3.004	-1.107	-3.066
	5% critical values	-2.921	-2.923	-2.919	-2.921
Gabon	GDP	-1.379	-5.780	-1.358	-5.772
	M2	-1.052	-3.868	-1.119	-3.736
	CPI	-1.678	-4.153	-1.619	-4.127
	5% critical values	-2.922	-2.923	-2.922	-2.923

Source: Authors' calculations.

Table 2 Johansen Cointegration Test

Country	Number of cointegration vector	Trace statistic	5% critical value	Rank r
USA	None	39.18	35.07	0
	At most 1	12.22	20.16	1
	At most 2	4.38	9.14	2
Morocco	None	40.01	35.07	0
	At most 1	17.17	20.16	1
	At most 2	3.47	9.14	2
Gabon	None	36.07	35.07	0
	At most 1	15.31	20.16	1
	At most 2	2.91	9.14	2

Source: Authors' calculations.

We should therefore retain the multivariate VECM specification as the one appropriate for the USA, Morocco and Gabon. The choice of the VECM order is based on the Akaike information criterion (AIC) selection criterion. We retained a number of lags in our VECM equal to 2 for the USA, 4 for Morocco and 1 for Gabon.

After estimating the VECM models of the three countries, deducing the structural form of each model requires the identification of the matrix ΞB_0^{-1}. As our model is trivariate with a single cointegration relationship, the just identification of each of the three SVECM models therefore requires only one long term additional restriction $\frac{1}{2}r(r-1) = 0$ and $\frac{1}{2}k(k-1) = 1$. This restriction is derived from neoclassic theory which assumes the long-run neutrality of a monetary shock on production. The structural innovations vector w_t contains three shocks: two permanent shocks (a real shock and a monetary shock) and a transitory shock (a nominal shock) (real, monetary and nominal shocks represent respectively shocks emanating from production, M2 and prices). Respecting this order of shocks at the level of vector w_t, the restriction takes the form described by Equation (3).

4. Economic Analysis of the Results

4.1 The Long-Term Effect of a Real Shock

4.1.1 The Effect of a Real Shock on GDP

As noted above, our sample is composed of three countries (USA, Gabon and Morocco). The choice of this sample can be explained by two factors. The first one is that Gabon and Morocco can represent the majority of developing countries in which the monetary authorities continue to control the offer and the affectation of credits to some specific uses. The second is that the USA canal so represent, in our view, all the developed countries, in which the money-debt systems are expanded.

We did not take into account intermediate cases (such as those of Southeast-Asian or South-America) due to the fact that we wanted to focus only on extreme cases (represented by two opposite monetary systems) to study their effects on the long-run money neutrality.

Despite difficulty to generalize the results of this study because of the small number of countries considered, we believe that the results can give us an idea on the long-term money effects on growth in the majority of the country in each case. Moreover, despite the criticality of the special status of the USA, on its own, it does not represent the developed countries properly; however, we can confirm that the monetary behavior of the USA is similar to other developed countries (e.g. Canada, France, UK, Japan) especially concerning the way of money creation through the money-debt system and credit liberalization.

In general, the different countries in our sample respond similarly to a real shock (Figures 9, 10 and 11), despite the difference in the reaction rate of production systems in developing countries (Morocco and Gabon) compared with developed countries (USA). Indeed, unanimously, we find that a positive real shock (exogenous innovation) contributes in the short- and medium-term to GDP growth. However, the difference between the two groups of countries lies in the reaction and response times for each group. Specifically, the positive and growing impact in Morocco and Gabon is explained by the fact that exogenous innovation promotes and accelerates growth. It is also a source of long-term growth.

In developing countries where companies are generally labour-oriented, any structural innovation is a major source of capitalist productivity gains. In other words, faced with new innovations, companies (through a low capital intensity hypothesis) benefit from new technology especially because its marginal effect is very high.

However, in the USA, the shock effects appear, significantly, only after ten years. This allows us to conclude that the growth of developed countries is not bound directly to structural innovations simply because where companies are capital-intensive (relative capital abundance), the marginal effect of any new innovation is very low.

In conclusion, the exogenous technological innovation shocks contribute most to economic growth in developing countries, while in developed countries, the contribution of such shocks is weak and dependent on endogenous shocks affecting human capital, organization, and incentive schemes.

### 4.1.2 The Effect of a Real Shock on Money Stock

By examining all IRF (Figures 9, 10 and 11, in the middle), we note that the trend of the effect of a real shock on money is similar to that of the real shock on GDP. This confirms to some extent the assumption that when GDP increases, then there will be a greater need for cash that should be supplied by issuing additional money. The function of money as a medium of exchange is confirmed.

4.1.3 The Effect of a Real Shock on Inflation

Following a real shock, prices showed an increase in all countries (the bottom of Figures 9, 10 and 11). This seems logical because as income increases, demand rises, hence, increasing price.

Source: Authors.
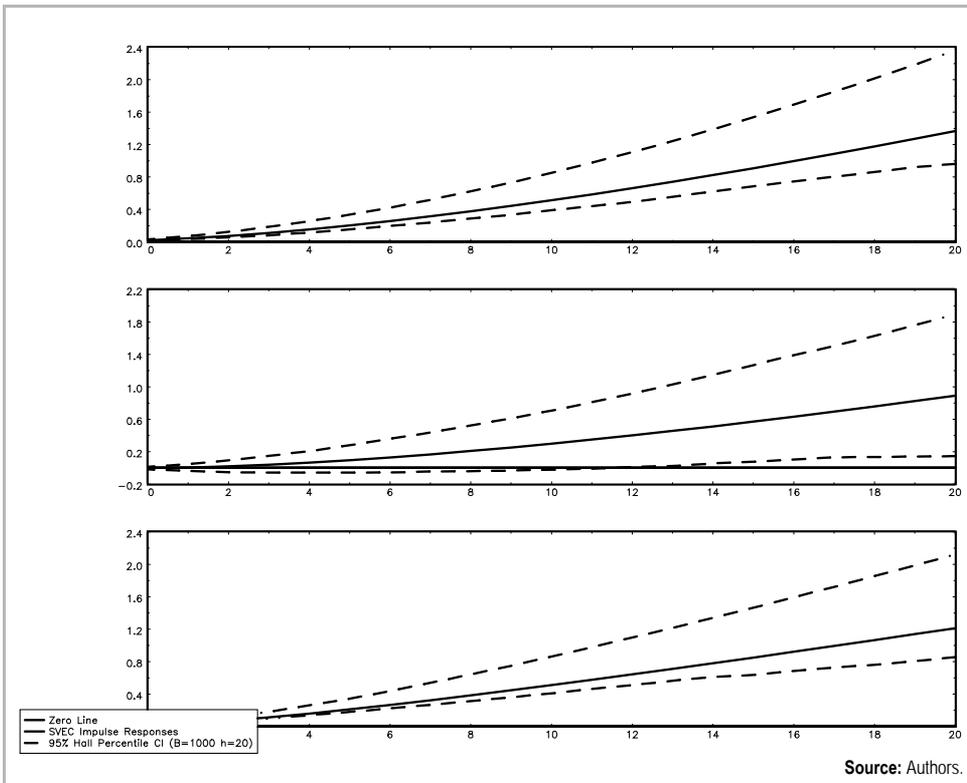
Figure 9 Responses of GDP, M2 and CPI (Top to Bottom) to a Real Shock (the First Long-Term Shock) with 95% Hall Percentile Bootstrap Confidence Interval Based on 1000 Bootstrap Replications (USA)

Source: Authors.
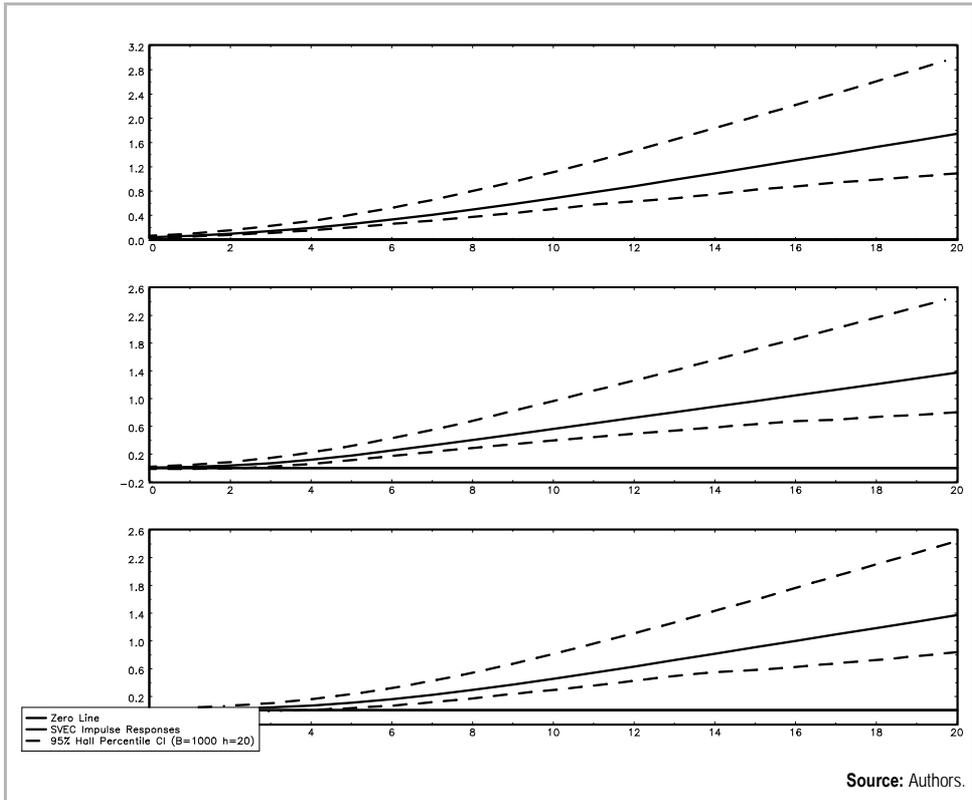
Figure 10 Responses of GDP, M2 and CPI (Top to Bottom) to a Real Shock (the First Long-Term Shock) with 95% Hall Percentile Bootstrap Confidence Interval Based on 1000 Bootstrap Replications (Morocco)

Source: Authors.
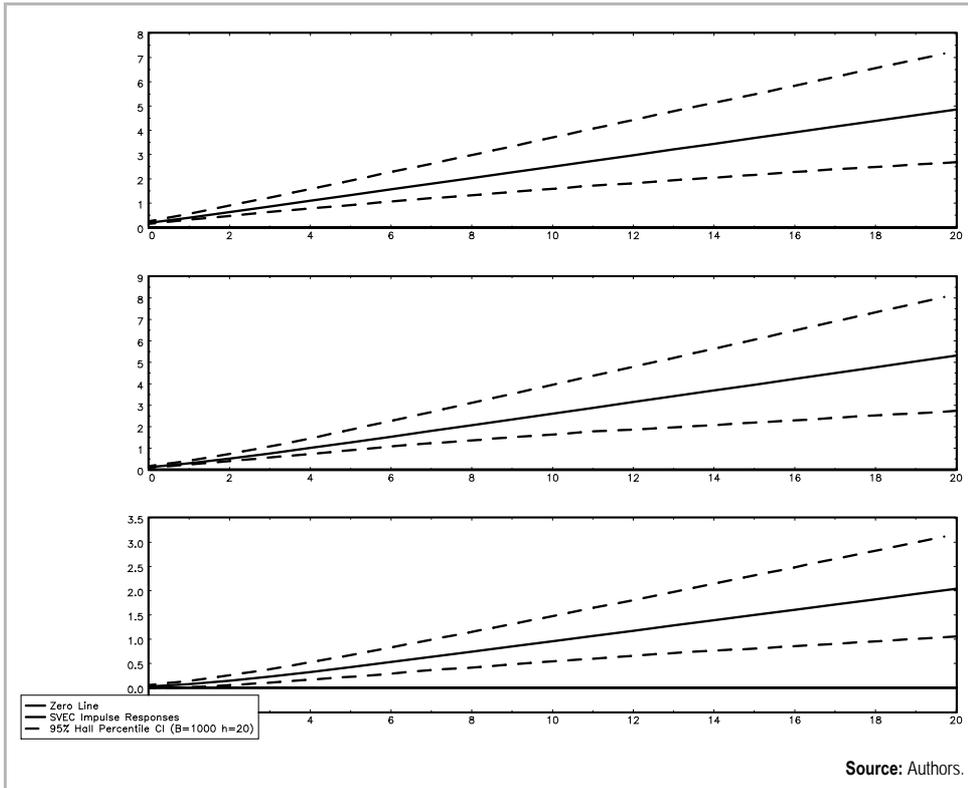
Figure 11 Responses of GDP, M2 and CPI (Top to Bottom) to a Real Shock (the First Long-Term Shock) with 95% Hall Percentile Bootstrap Confidence Interval Based on 1000 Bootstrap Replications (Gabon)

4.2 The Long-Term Effect of a Monetary Shock

4.2.1 The Effect of a Monetary Shock on GDP

Examining the various IRF (the top of Figures 12, 13 and 14), we can note that the long-term monetary effects of shocks on GDP is confirmed for the American case. This calls into question the assumption of money neutrality. However, in Morocco and Gabon, the long-term money effect is negative but low (near zero). The money neutrality thesis is confirmed at least for the M2 aggregate, which reflects real economy, better than the other monetary aggregates (M3 and M4).

### 4.2.2 The Effect of a Monetary Shock on Money Stock

The effect of monetary shock on money (Figures 12, 13 and 14, in the middle) is positive and increasing for all countries of the sample. This is understandable, for the simple reason that central banks' strategy for the money supply (M2) is based on constant progress determined *ex-post* for most countries.

4.2.3 The Effect of a Monetary Shock on Prices

The effect of the long-term monetary shock on prices is positive and increasing in the USA, and negative and decreasing in Gabon and Morocco. This seems to be the result of the effect of a monetary shock on GDP. Thus, as long as the effect of a monetary shock on GDP is positive and increasing in the USA, then it would be plausible to claim that the monetary growth yields a long-term price increase. However, in Morocco and Gabon, the monetary shock has a negative impact on prices in the long-term. This may be due to the fact that in these countries, central banks opt for credit management and exert a massive control on money emission sometimes lower than production growth (see Figures 1 and 2).

Source: Authors.
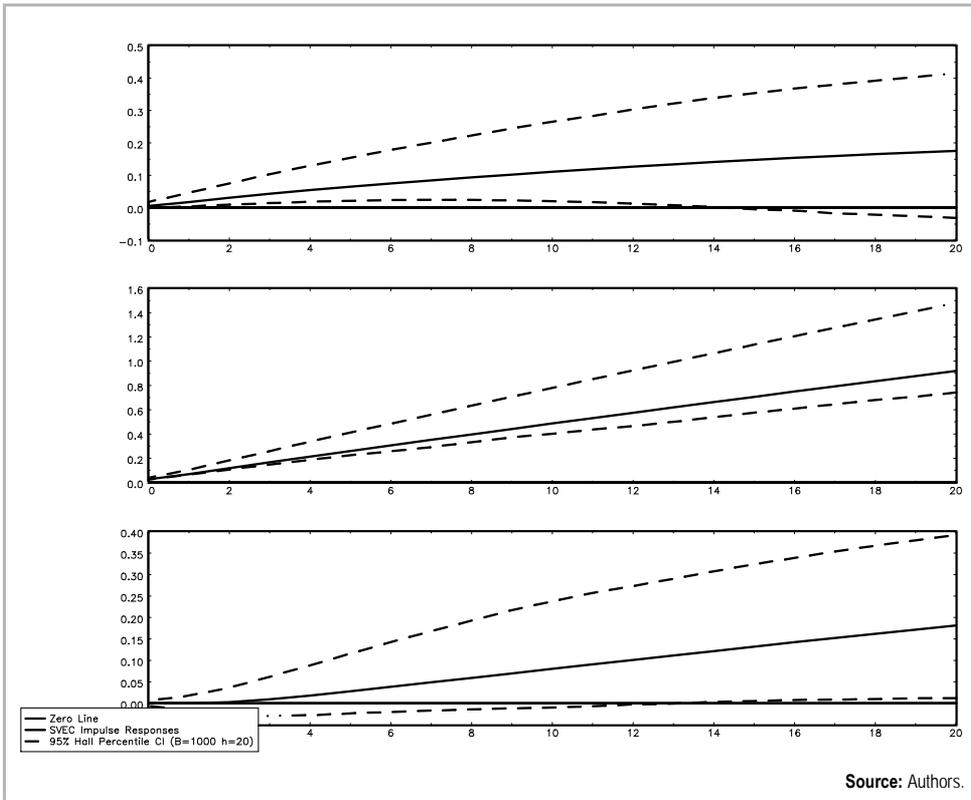
Figure 12   Responses of GDP, M2 and CPI (Top to Bottom) to a Monetary Shock (the Second Long-Term Shock) with 95% Hall Percentile Bootstrap Confidence Interval Based on 1000 Bootstrap Replications (USA)
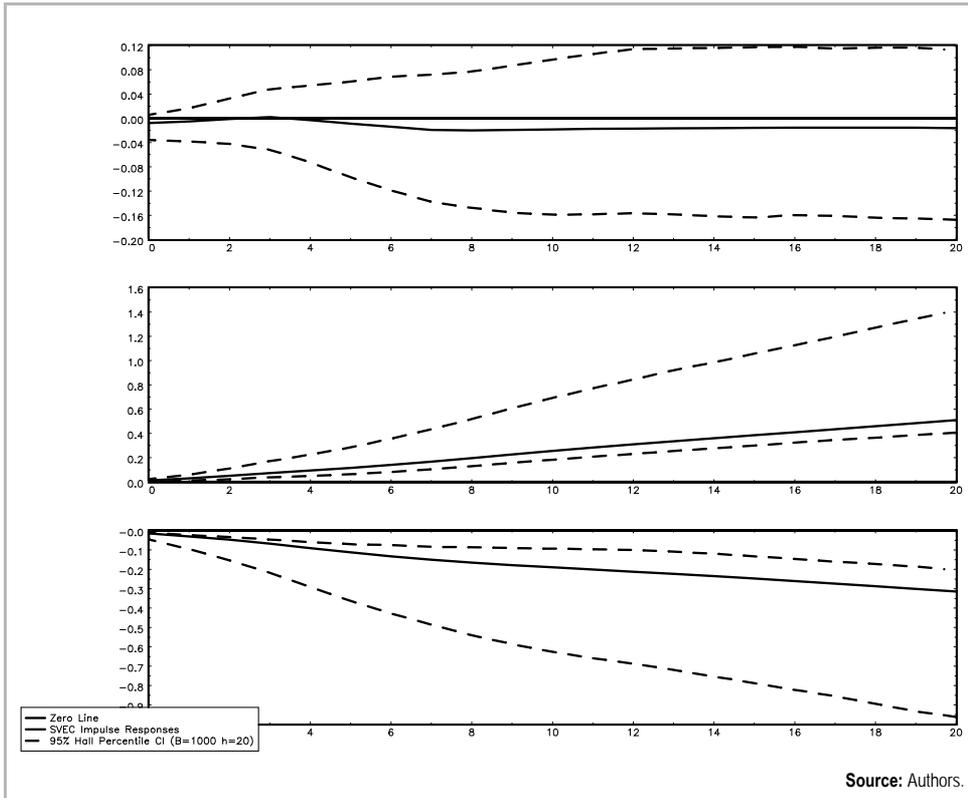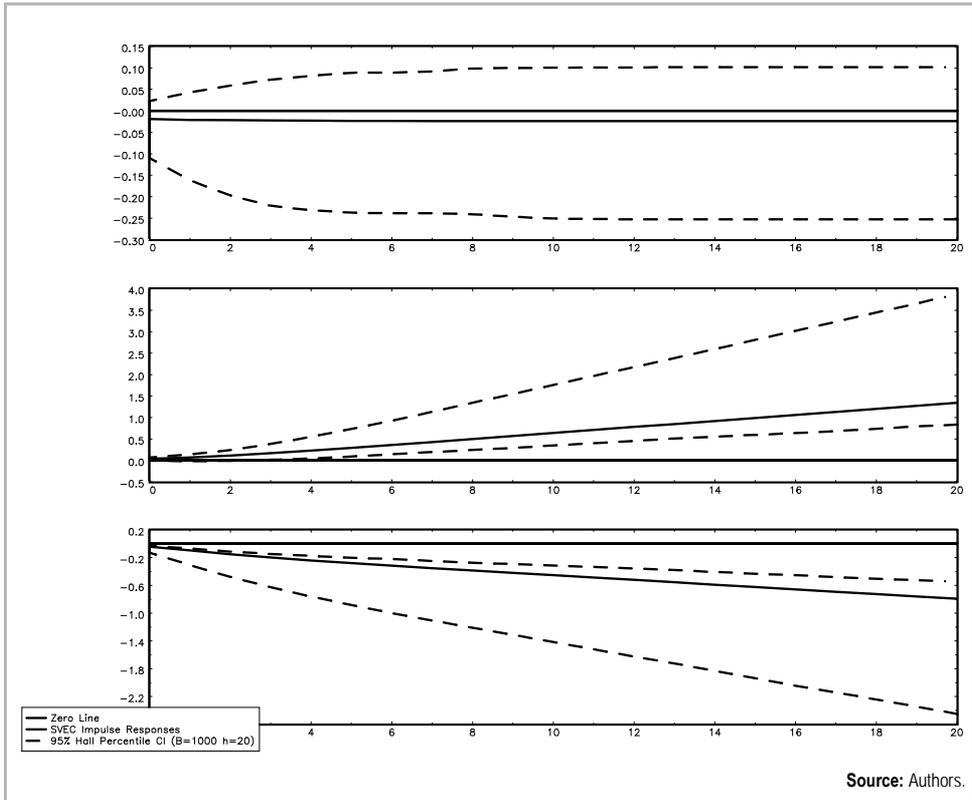
Figure 13 Responses of GDP, M2 and CPI (Top to Bottom) to a Monetary Shock (the Second Long-Term Shock) with 95% Hall Percentile Bootstrap Confidence Interval Based on 1000 Bootstrap Replications (Morocco)

4.3 The Short-Term Effect of a Nominal Shock

4.3.1 The Effect of a Nominal Shock on GDP

Examining the various IRF (the top of Figures 15, 16 and 17), we note that the effect of a nominal shock on GDP is positive and decreasing in Gabon and Morocco while it is negative in the USA. Although it is difficult to explain such a trend, we may claim that this may be due to the fact that in developing countries, a nominal shock on prices does not have a negative effect on production. This is simply because the shock does not affect the entire vector of goods but only secondary or superior goods. The basic necessities are immune from a shock because they are funded. Henceforth, the increase in prices of some categories of goods partially affects aggregate demand and may in the short-term encourage companies to produce more. In the long-term, the effect of nominal shock on production is zero because prices will be adjusted to their true natural values.

However, in the USA, the effect of a nominal shock on prices is negative, which means that the increase in prices directly affects aggregate demand that decreases and hardly returns to its initial levels.

Figure 14 Responses of GDP, M2 and CPI (Top to Bottom) to a Monetary Shock (the Second Long-Term Shock) with 95% Hall Percentile Bootstrap Confidence Interval Based on 1000 Bootstrap Replications (Gabon)

4.3.2 The Effect of a Nominal Shock on Money Stock

The effect of a nominal shock on money (Figures 15, 16 and 17, in the middle) is positive and decreasing in Morocco and Gabon, and negative in the USA. Indeed, while the increase in prices in developing countries causes a fall in real balances, it encourages economic agents to ask for more money to offset their loss of purchasing power. As the nominal shock phases out, the new demand for money decreases in its turn. However, in the USA, lowering money supply after a nominal shock simply results from lower production recorded after the nominal shock. Indeed, when production decreases, less cash is needed to guard against possible inflation.

4.3.3 The Effect of a Nominal Shock on Prices

The effect of a nominal shock on prices (the bottom of Figures 15, 16 and 17) is positive and decreasing in Morocco and Gabon, and negative in the USA. Indeed, in developing countries, the increase in prices after a shock recovers relatively to its initial levels. However, in the USA, a positive nominal shock is followed by a negative nominal shock, which leads us to assume that anticipating prices is cyclical. In other

words, the decrease in prices after a positive nominal shock pushes prices downward, below their pre-shock values.

Source: Authors.
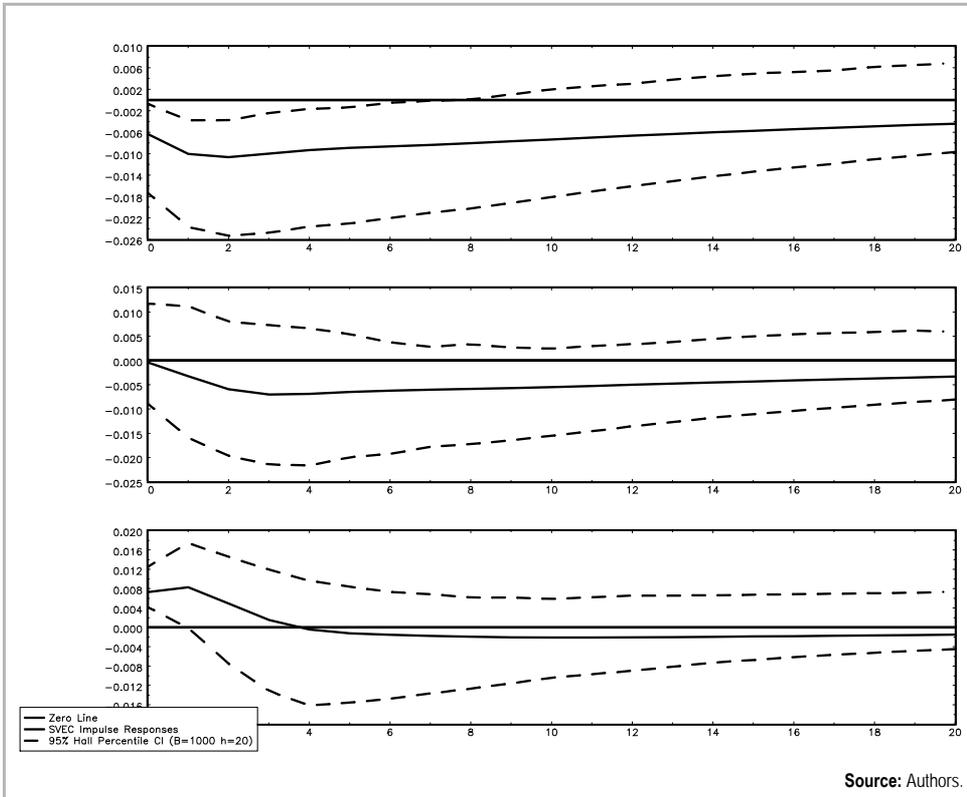
Figure 15 Responses of GDP, M2 and CPI (Top to Bottom) to a Nominal Shock (the Short-Term Shock) with 95% Hall Percentile Bootstrap Confidence Interval Based on 1000 Bootstrap Replications (USA)

Source: Authors.
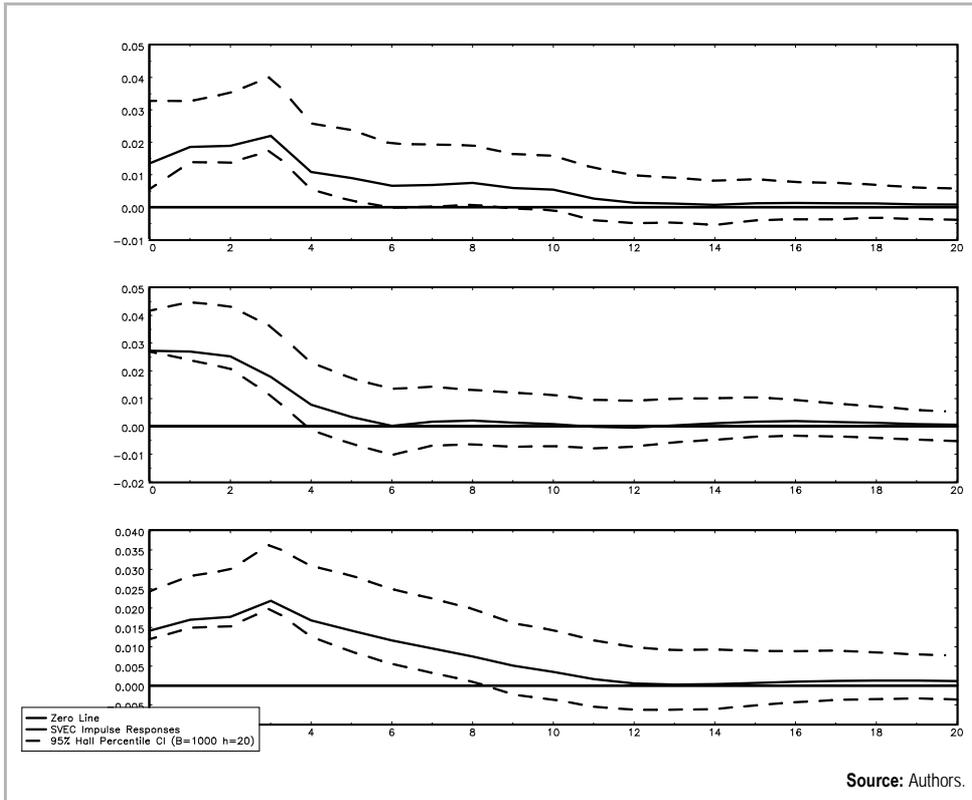
Figure 16 Responses of GDP, M2 and CPI (Top to Bottom) to a Nominal Shock (the Short-Term Shock) with 95% Hall Percentile Bootstrap Confidence Interval Based on 1000 Bootstrap Replications (Morocco)
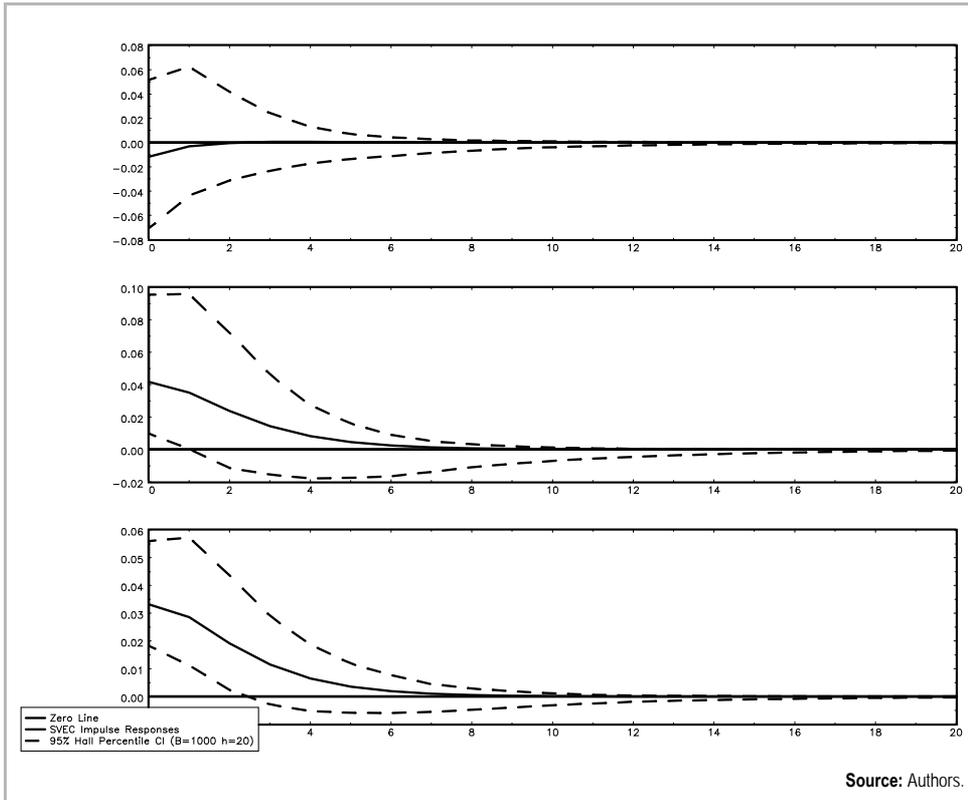
Figure 17   Responses of GDP, M2 and CPI (Top to Bottom) to a Nominal Shock (the Short-Term Shock) with 95% Hall Percentile Bootstrap Confidence Interval Based on 1000 Bootstrap Replications (Gabon)

4.4 Forecast Error Variance Decomposition (USA)

When analyzing Figure 15, we note that in the case of the USA, the GDP shock is essentially inherent to the components constituting the GDP (investment, savings, expectations, etc.). In other words, it is the economic structure that explains most economic shocks. Therefore, the price or currency has limited impact on the growth effects given that the growth shock can only be structurally explained. Thus, in the case of a large country (USA), the structural is largely explained by the structural (it should be noted that for all figures relating to forecast error variance decomposition, the real shock is represented by the dark area, the monetary shock by the hatched area, and the nominal shock by the white area).

As for the monetary shock, during the first periods, it is explained by monetary shock but it gradually transforms itself into a shock resulting from real variables (income). *A priori*, production plays the part of absorber of monetary shocks which, in the long-run, are not monetary anymore. More specifically, production is adjusted with money supply. Hence, we can deduce the non-neutrality of money. In addition, to a large extent, the price shocks are explained by the income, which proves once again that the USA shocks are inherently real.
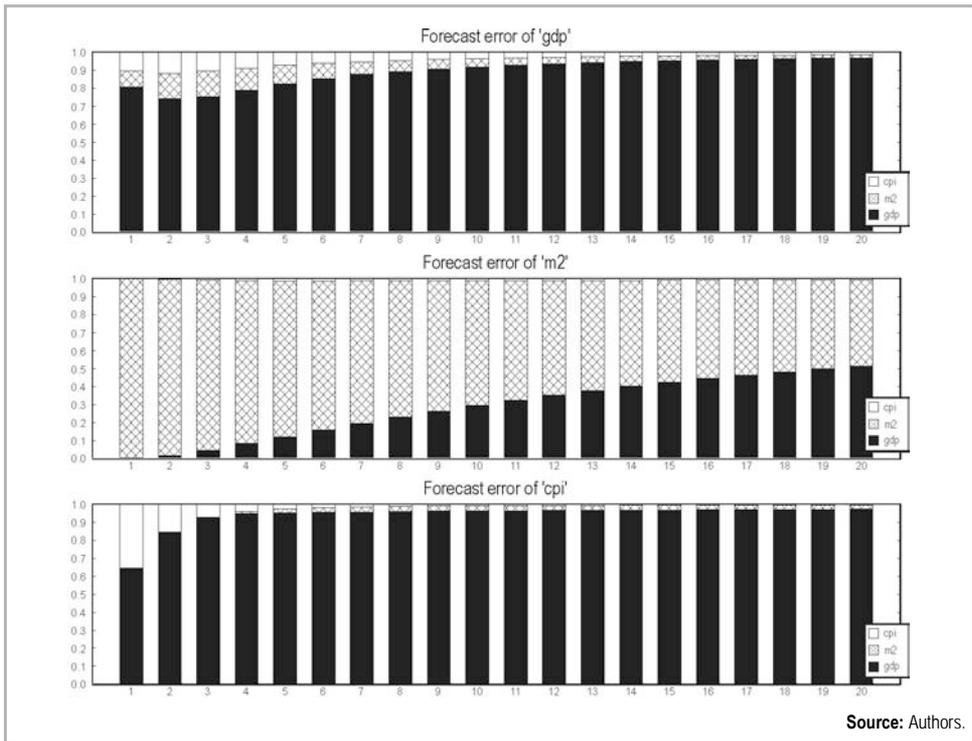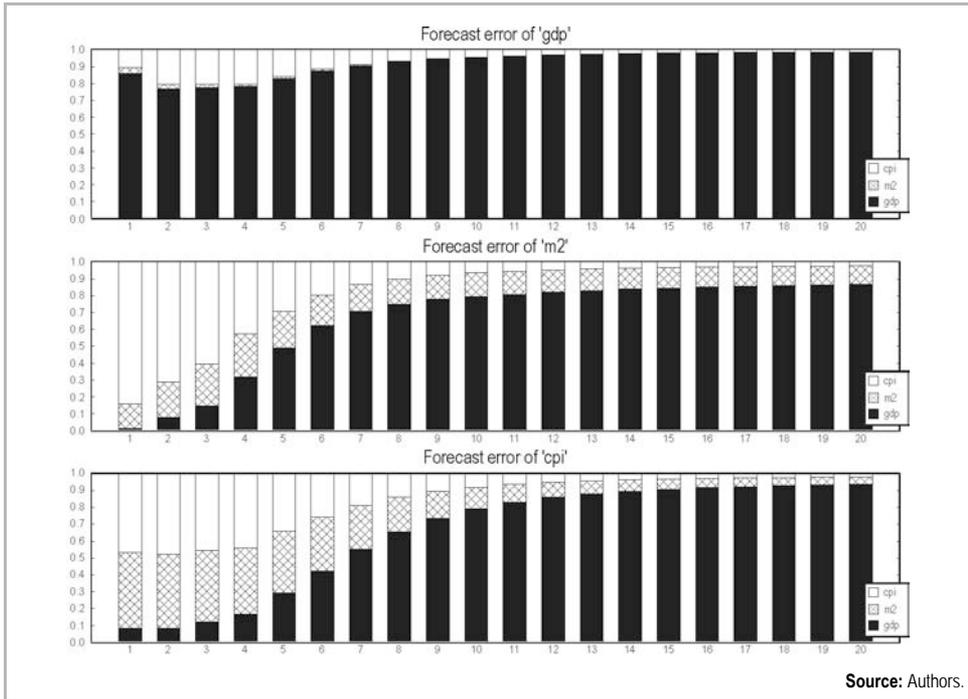
Source: Authors.

Figure 18 Forecast Error Variance Decomposition of GDP, M2 and CPI (USA) with Relative Contributions of Real Shock, Monetary Shock and Nominal Shock

4.5 Forecast Error Variance Decomposition (Morocco)

In the Moroccan case, we note that the income shock is mainly due to real economic variables (investment, savings, productivity, etc.). However, part of this is linked to the price shock. In the long-run, the real shock is entirely explained by the real variables.

The currency shock is due, in the short- and medium-run, to the variable price that seems to target monetary authorities to adjust the money supply. However, the price effect weakens in the long period and that, as and when, the production system is developed and creating more supply of goods and services allowing the money supply, within the meaning of M2, its role as a means of transaction.

As for the price shock, we note that it is due to, in large part, the price and the money supply in the short- and medium-run. In other words, the short- and medium-term price fluctuations are purely monetary phenomena. In contrast, long-term price shocks fit mainly to the supply of goods and services.

Source: Authors.

Figure 19 Forecast Error Variance Decomposition of GDP, M2 and CPI (Morocco) with Relative Contributions of Real Shock, Monetary Shock and Nominal Shock

4.6 Forecast Error Variance Decomposition (Gabon)

We note that GDP shocks and currency shocks are mainly due to the GDP in Gabon. This implies the neutrality of money. However, the price is explained mainly by the currency and prices in short-run, but in the medium- and long-run, production will become the sole explanatory component of prices.

Source: Authors.
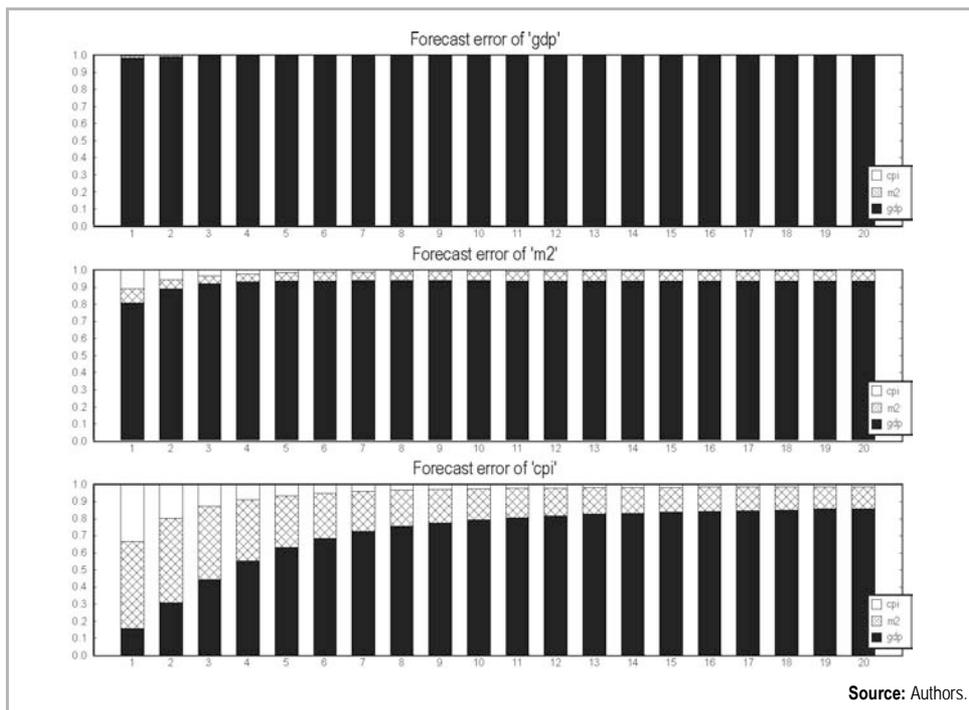
Figure 20 Forecast Error Variance Decomposition of GDP, M2 and CPI (Gabon) with Relative Contributions of Real Shock, Monetary Shock and Nominal Shock

4.7 Recommendations

Based on the findings of the present study, one may claim that money supply may positively influence income growth (long-term GDP) provided that the growth rate does not significantly exceed production growth rate (USA). However, when the difference is huge, money seems to have a long-term negative effect, though very low (near zero). In fact, everything depends on the strategies and rationality of central banks. Facing a real shock, the Gabonese authorities opted for infinitely increasing M2 (Figure 12), which reflects a strange trend confirmed and well explained in Figure 1 where increases in GDP are followed by increases more than proportional to M2. However, in the USA, (top and middle of Figure 10), a positive real shock (in which the effect on GDP is late) affected money supply positively. Again, the claim that in the USA any future transaction (innovation, which increases future production) is converted into money, whose immediate effect is an increase in the current demand, is confirmed.

5. Conclusion

The present study has two objectives. The first is to test the long-run money neutrality hypothesis. Money neutrality is often accepted theoretically without being empirically confirmed or disproved, especially in developing countries where money and

monetary policy do not have the same objectives as in developed countries. The second is to detect a relationship among money supply (M2), income (GDP), and the prices (CPI). The main findings of this paper are three-fold.

The first is that the short-term effect of a monetary shock on GDP is positive and decreasing, thus, confirming the Keynesian assumption that money may positively affect economic activity. However, the long-term effect of this very shock is not systematically zero. We indicated that it is zero in Gabon while positive, decreasing, and at lower rates in Morocco and the USA. The money neutrality thesis is not confirmed at least for M2, which better reflects real economy than the other monetary aggregates (M3 and M4).

The second result is that positive real shocks increase M2 in the long-term.

The third result is that nominal shocks have positive and decreasing effects on money in the short-term and zero effects in the long-term.

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