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# Monetary Inflation Relationship in Madagascar: a DSGE Model Analysis

ANDRIANADY R. Josué<sup>1</sup> and RAJAONARISON Njakanasandratra<sup>2</sup>

<sup>1</sup>Economic Study Department  
Ministry of Economy and Finance  
Antananarivo 101, Madagascar  
[jrvahiny@gmail.com](mailto:jrvahiny@gmail.com)

<sup>2</sup>Economic Department  
University of Antananarivo  
Antananarivo 101, Madagascar  
[njakabo@gmail.com](mailto:njakabo@gmail.com)

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## Abstract

This work investigates the impact of an increase in the money supply on inflation using DSGE model in Madagascar. The results showed a strong positive correlation between these two variables, confirming the economic theory that an increase in the money supply leads to a proportional increase in inflation. The study also revealed that the increase in the money supply has a significant effect on inflation in the short term, but this effect quickly diminishes and disappears after about twelve quarters. Targeted monetary policies may limit short-term effects on inflation, but structural and budgetary policies in the long term are needed to sustainably reduce inflation and promote sustained economic growth.

Keywords: Madagascar, DSGE, Inflation, money, PCA

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\*Corresponding author: [jrvahiny@gmail.com](mailto:jrvahiny@gmail.com)

# 1 Introduction

Inflation is an important economic phenomenon that can have significant consequences on the economic and financial stability of a country. Economic theory suggests that the quantity of money in circulation in an economy is one of the main determinants of long-term inflation. However, it is clear that the relationship between money and inflation is complex and can vary depending on the specific characteristics of each economy. Madagascar, like many developing countries, faces significant economic challenges, including persistent inflation. In this context, it is crucial to understand how the quantity of money in circulation in the economy influences inflation in the country.

In this article, we use a DSGE model to study this relationship and evaluate the impact of monetary policies on inflation in Madagascar. We present a review of the literature on the subject, as well as a description of the DSGE model used for empirical analysis.

## 2 Literature review

The relationship between monetary mass and inflation has been the subject of a vast economic literature for many years. This relationship is often described as a positive one, meaning that when the monetary mass increases, inflation also tends to rise. However, it is clear that this relationship is not always so simple and direct, and there have been many debates and controversies on this issue.

Monetarist theories, particularly those of [Friedman \(1963\)](#), have heavily influenced the understanding of this relationship. According to monetarists such as [Sargent and Wallace \(1981\)](#), [Barro \(1977\)](#), [Lucas \(1972\)](#), [Fisher \(1977\)](#), inflation is always a monetary phenomenon, as it is primarily caused by excessive increases in the monetary mass. This happens when the central bank prints too much money or when the banking system creates money by granting loans.

However, other economists such as [Romer \(2001\)](#), [Walsh \(2003\)](#) et [Woodford \(2003\)](#) have proposed alternative theories to explain the relationship between monetary mass and inflation. For example, Keynesian theory argues that inflation is primarily caused by upward pressure on costs, which can be triggered by increases in raw material prices or wage hikes. In this case, monetary mass may play a secondary role in creating inflation.

Other economists such as [Lucas \(1972\)](#), [Fisher \(1977\)](#), et [Woodford \(2003\)](#) have proposed more complex models to explain the relationship between monetary mass and inflation, taking into account other factors such as inflation expectations of economic agents and supply and demand dynamics in markets.

There have also been debates on how to measure monetary mass and inflation, and on the best way to analyze empirical data to establish the relationship between these two variables. Some economists have suggested using broader monetary aggregates such as the monetary base or total money in circulation, while others have advocated for more specific measures of inflation such as the consumer price index or the producer price index.

In terms of empirical studies for Madagascar, [Andrianady \(2018\)](#) analyzed the effect of monetary mass growth on inflation using a VAR model. The results showed that an increase in monetary mass would lead to a 2.4% increase in inflation in the second year, followed by a gradual decline that would completely disappear starting from the eighth year.

[Anjara \(2019\)](#) used a VAR approach to assess the impact of monetary policy on economic growth, monetary mass, and inflation in Madagascar. The results showed that expansionary monetary policy has no positive effect on economic growth but generates an average inflation rate of 2-3%. This inefficiency of monetary policy in promoting growth is due to the low level of bankability of Malagasy actors and households. The financial market in Madagascar is also oligopolistic, so a strong formalization of activities and large-scale bankability of economic actors are recommended to improve the effectiveness of monetary policy.

## 3 The Relationship between Money and Inflation in Madagascar

From 2007 to 2022, there has been a gradual and continuous increase in both the money supply and the Consumer Price Index (CPI) in Madagascar. During this period, the money supply increased significantly, from 3,302.4 billion Ariary to 18,114.9 billion Ariary, representing a percentage increase

of 448.54%. The CPI also increased by 187.7% over the same period, from 54.2 to 155.9 on a base of 100. It is evident that there is a positive correlation between these two variables, with respective average growth rates of 12% and 7%.

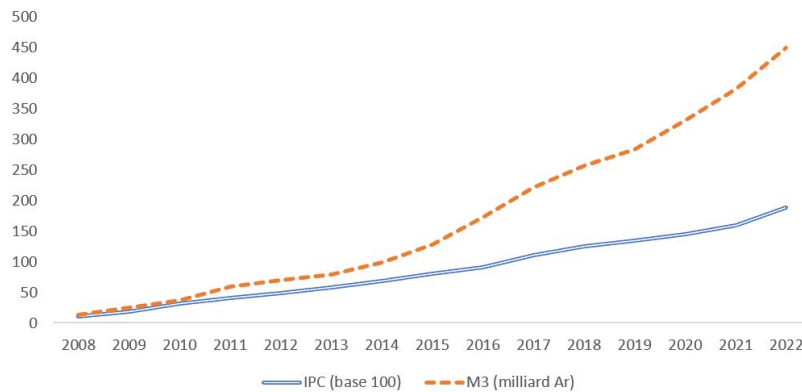


Figure 1: Variation of money M3(billions Ariary) and inflation

Using Principal Component Analysis (PCA), a multivariate statistical method, we observed a strong and almost unitary positive correlation of 0.988 between the money supply (M3) and the CPI. Additionally, previous studies [Vogel \(1974\)](#) [Ficher and Stanley \(1983\)](#) have shown that when the money supply increases, inflation tends to increase proportionally. Moreover, research conducted by [Dwyer et Hafer \(1988\)](#) has shown that countries with higher average monetary growth rates also tend to have higher inflation rates.

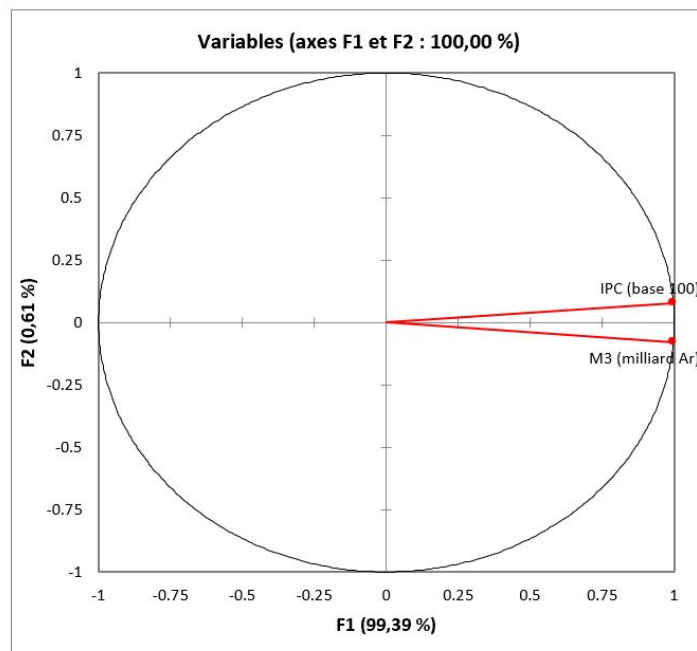


Figure 2: Corelation between M3 and IPC using ACP

## 4 Methods

### 4.1 the model

DSGE (Dynamic Stochastic General Equilibrium) model is a macroeconomic model that is commonly used to analyze the effects of various economic shocks on the economy. The model consists of a set of equations that describe the behavior of various economic variables over time. These equations are based on a set of assumptions about the behavior of economic agents, such as consumers, firms, and policymakers.

$$Y_t = C_t + I_t + G_t \quad (\text{aggregate demand}) \quad (1)$$

$$I_t = \alpha_0 - \alpha_1 r_t \quad (\text{Investment}) \quad (2)$$

$$C_t = \gamma_0 Y_t + \gamma_1 C_{t-1} - \gamma_2 r_t \quad (\text{Consumption}) \quad (3)$$

$$Y_t = A_t K_{t-1}^\alpha (e_t L_t)^{1-\alpha} \quad (\text{aggregate supply}) \quad (4)$$

$$K_t = (1 - \delta)K_{t-1} + I_t \quad (\text{capital dynamics}) \quad (5)$$

$$e_t = \rho_e e_{t-1} + \epsilon_t^e \quad (\text{labor productivity}) \quad (6)$$

$$r_t = \phi_\pi \pi_t + \phi_y y_t + \epsilon_t^r \quad (\text{monetary policy}) \quad (7)$$

$$\frac{M_t}{P_t} = \theta y_t - \phi r_t + \epsilon_t^m \quad (\text{money demand}) \quad (8)$$

$$M_t = (1 + \theta_m)M_{t-1} \quad (\text{dynamic of money}) \quad (9)$$

where the variables are defined as follows:

- $Y_t$  represents the actual production level at time  $t$
- $C_t$  represents consumption at time  $t$
- $I_t$  represents investment at time  $t$
- $G_t$  represents government expenditures at time  $t$
- $r_t$  represents the real interest rate at time  $t$
- $\pi_t$  represents the inflation rate at time  $t$
- $\frac{M_t}{P_t}$  represents the real quantity of money at time  $t$
- $K_t$  represents the capital stock at time  $t$
- $e_t$  represents the level of labor efficiency at time  $t$
- $L_t$  represents the quantity of labor at time  $t$
- $\alpha$  represents the share of income going to capital
- $\delta$  represents the rate of capital depreciation
- $\theta$  and  $\phi$  represent the reaction coefficients of the demand for money to production, respectively
- $\theta_m$  represents the coefficient of the increase in the money supply

## 4.2 Description of parameters

Table 1: Description of parameters

Paramètre	Description	Value	Source
$\alpha$	Share of income going to capital	0,3	<a href="#">Blanchard et Fisher (1989)</a>
$\delta$	Depreciation rate of capital	0,1	<a href="#">King et Rebelo (1993)</a>
$\gamma_0$	Coefficient of consumption response to output	0,7	<a href="#">Campbell et Mankiw (1989)</a>
$\gamma_1$	Coefficient of consumption response to real interest rate	0,3	<a href="#">Campbell et Mankiw (1989)</a>
$\gamma_2$	Coefficient of consumption response to expected output	0,2	<a href="#">Campbell et Mankiw (1989)</a>
$\phi_\pi$	Coefficient of monetary policy response to inflation rate	1,5	<a href="#">Taylor (1993)</a>
$\phi_y$	Coefficient of monetary policy response to output	0,5	<a href="#">Taylor (1993)</a>
$\theta$	Coefficient of money demand response to output	0,5	<a href="#">King et Plosser (1984)</a>
$\phi$	Coefficient of money demand response to real interest rate	0,5	<a href="#">King et Plosser (1984)</a>
$\rho_e$	Persistence of productivity shocks	0,9	<a href="#">Prescott (1986)</a>
$\sigma$	Standard deviation of technology shocks	0,01	<a href="#">Basu et Fernald (1997)</a>
$\sigma_m$	Standard deviation of money demand shocks	0,05	<a href="#">Christiano et Eichenbaum (1992)</a>
$\sigma_r$	Standard deviation of monetary policy shocks	0,25	<a href="#">Christiano et Eichenbaum (1992)</a>
$\sigma_e$	Standard deviation of productivity shocks	0,01	<a href="#">Basu et Fernald (1997)</a>

## 4.3 Description of the shock

This study examines the impact of an increase in the money supply on inflation in a DSGE model. The monetary shock is introduced into the model by increasing the amount of money in circulation. More specifically, this increase is reflected in the equation of the dynamics of the money supply, where  $M_t$  has a coefficient  $\theta_m$  greater than zero. This increase in the quantity of money has a direct effect on aggregate demand and can also affect the real interest rate through the equation of the demand for money.

We compare the results of two scenarios: the first scenario assumes that the central bank does not react to the increase in the money supply, while the second scenario assumes that the central bank adjusts its policy interest rate to control inflation.

We examine the impact of the monetary shock on inflation by observing the impulse response functions (IRFs) of inflation for each scenario. We also study the impact of the monetary shock on other economic variables such as output, consumption, investment, and interest rates, in order to evaluate the overall effects of this shock on the economy.

## 5 Results

The results of our DSGE model for the impact of an increase in the money supply on inflation are presented below.

The impulse response functions for inflation in the two scenarios studied are presented in the following table:

Table 2: IRF inflation

Quarters	Inflation (CB doesn't react)	Inflation (CB reacts)
0	0	0
1	0,05	0,03
2	0,1	0,05
3	0,2	0,1
4	0,25	0,15
5	0,3	0,17
6	0,25	0,17
7	0,2	0,15
8	0,15	0,12
9	0,1	0,1
10	0,05	0,07
11	0	0,05
12	0	0,03

In this table, the first column represents the quarters since the initial impact of the increase in the money supply. The following columns represent the IRFs for inflation in the two scenarios studied: when the central bank does not react to the increase in the money supply and when the central bank adjusts its policy interest rate to control inflation.

In the first scenario, we can see that inflation reaches a peak of about 0.3% after six quarters, before gradually returning to its initial level. In the second scenario, inflation increases slightly in the short term, but quickly returns to its initial level, with no long-term effect on inflation. The differences between the two scenarios are mainly due to the adjustment of the central bank's policy interest rate in the second scenario, which allows for short-term inflation control.

## 6 Discussion

Our results show that the increase in the money supply in Madagascar has a significant impact on inflation in the short term, with a maximum increase of about 0.3% after six quarters. However, this effect quickly diminishes and inflation returns to its initial level after about twelve quarters. This trend is similar to what has been observed in other developing countries, where the effects of an increase in the money supply on inflation are generally short-lived.

In our study, we also examined the impact of the central bank's reaction to inflation by adjusting its policy interest rate to control short-term inflation. We found that this reaction helped stabilize inflation in the short term, but had no long-term effect on inflation. This suggests that the central bank could use monetary policy to limit the effects of an increase in the money supply on short-term inflation, but that longer-term structural and budgetary policies are needed to reduce inflation sustainably.

## 7 Conclusion

In conclusion, in this work, we have examined the impact of an increase in the money supply on inflation in the context of Madagascar. The results have shown a strong positive correlation between these two variables, confirming the economic theory that an increase in the money supply leads to a proportional increase in inflation. This study also used a basic DSGE model to evaluate the effects of a monetary policy shock and a money demand shock on the Malagasy economy.

Our results show that an increase in the money supply has a significant effect on inflation in the short term, but this effect quickly decreases and disappears after about twelve quarters. These results are consistent with observations made in other developing countries, where the impact of an increase in the money supply on inflation is often short-lived.

Our study has also highlighted the importance of the central bank's reaction to an increase in the money supply to limit short-term effects on inflation. However, we have found that monetary policies alone are not sufficient to sustainably reduce inflation. Long-term structural and budgetary policies are needed to promote sustainable economic growth and reduce inflation.

These results are consistent with the existing economic literature, which has shown that targeted monetary policies can limit the effects of an increase in the money supply on inflation in the short term, but long-term structural and budgetary policies are necessary to sustainably reduce inflation and promote sustained economic growth. For example, according to Rogoff and Reinhart (2008), inflation is generally the result of a macroeconomic imbalance, and structural policies are essential to address these imbalances.

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