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Analysis of the effectiveness of the transmission of BCEAO monetary policy in WAEMU countries through the interest rate channel: an empirical study in Panel VAR

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Abstract: The paper describes an empirical analysis of the effectiveness of monetary policy in the West African Economic and Monetary Union (WAEMU). The data were subjected to a stationarity test to determine the time series trend. The results showed that the consumer price index is integrated of order 1, while the Gap and MMR data series have a constant trend. The results of the panel VAR model estimation showed that the policy interest rate does not significantly influence inflation or economic activity. The response functions also showed that monetary policy does not have a direct impact on economic activity in the WAEMU. These results can be explained by the weak connection between the banking sector and the real sector, the low level of financial development, the excess liquidity of banks and the lack of competition in the banking market.
Keywords: WAEMU, monetary policy, panel VAR model, stationarity test, effectiveness of monetary policy.

I. Introduction

Analysing the effects of monetary policies on economic growth in a monetary union is a complex process that requires a thorough understanding of the different macroeconomic factors at play. It is important to take into account the heterogeneous economic structures of the countries in the monetary union, as well as the effectiveness of the policies adopted.

At the most basic level, monetary policies aim to stabilise prices and promote economic growth. To do this, a central bank can either increase or decrease the supply of money in the economy. It is important to note, however, that these policies may have different effects on each of the countries in the union, as the economies of these countries are not all identical.

For example, if an increase in the money supply leads to higher inflation in one country, but lower inflation in another, the effects of the policy may be unevenly distributed. In addition, the effectiveness of a monetary policy may depend on the general economic conditions in the union, such as the level of economic integration and the degree of cross-border coordination.

In addition, it is also important to take into account the potential externalities of these policies. For example, a change in the money supply may have an effect on the exchange rate, capital flows and international reserves. It is therefore essential to assess the macroeconomic factors that influence monetary policy decisions in the union countries in order to understand the heterogeneous effects of policy.

Finally, it is also important to analyse potential shocks to monetary policies, such as the economic impact of the COVID-19 pandemic or fluctuations in oil prices, financial crises. This will help policy makers to design better policies that will ensure greater economic stability in the region.

When approaching the issue of heterogeneous economic unions through the prism of monetary policy and economic growth, there are many authors to consider. These include David Romer[1] , Philippe Martin, Emi Nakamura, Pete Klenow, Pierre-Olivier Gourinchas and Maurice Obstfeld, whose work examines the consequences of this policy on all members of heterogeneous economic unions.

David Romer is one of the leading authors on the effects of monetary policy and economic growth in heterogeneous economic unions. In his 1999 paper "Introducing a common currency: Implications for low-income countries", he explores the potential effects on economic growth and monetary policy in the presence of income disparities among union members. In particular, it shows that the presence of a common currency can have beneficial effects on economic growth, especially for low-income countries.

Philippe Martin is another author who has addressed this issue. In his 2015 article entitled "Monetary policy and economic growth in heterogeneous economic unions", he looks at the potential consequences of monetary policy and economic growth in heterogeneous economic unions. In particular, he shows that, in such cases, the implementation of differentiated monetary policies among member countries can be more effective than a single monetary policy.

[1]David Romer's articles that uses panel VAR (vector autoregression) models is "The Macroeconomic Effects of Increased Government Spending," which was published in the Journal of Political Economy in 1992.

Emi Nakamura and Pete Klenow (2019)[2] are also interested in the impact of monetary policy and economic growth in heterogeneous economic unions. In their 2011 paper "International Prices, Markups and Exchange Rates", they examine the effects of the introduction of a common currency on prices and exchange rates across member countries. In particular, they show that the presence of a common currency can have beneficial effects on exchange rates and the general price level.

Pierre-Olivier Gourinchas and Maurice Obstfeld are also interested in monetary policy and economic growth in a heterogeneous economic union. In their 1999 paper "The Macroeconomics of Monetary Union", they study the consequences of the introduction of a common currency on monetary and fiscal policies in the member countries of the union. In particular, they show that monetary policies need to be coordinated and harmonised to cope with fluctuations in interest rates and international capital flows.

In conclusion, the work of these authors provides a better understanding of the effects of monetary policy and economic growth in a heterogeneous economic union. In particular, they show that the presence of a common currency can have beneficial effects on economic growth, prices and exchange rates, and that monetary and fiscal policies need to be coordinated to cope with fluctuations in interest rates and international capital flows.

To better understand the heterogeneous effects of monetary policy on economic growth in the West African Economic and Monetary Union (WAEMU), it is important to take into account the different economic structures of the countries in the region. This implies analysing the types of monetary policies implemented in each country, the effectiveness of these policies and their impacts on the economic performance of the countries in question.

According to data from the International Monetary Fund (IMF), in 2020, economic growth in the WAEMU was on average -0.2%. However, this average hides significant disparities between countries, with growth ranging from -4.3% for Togo to +2.3% for Burkina Faso.

In 2020, inflation in the WAEMU averaged 2.7%. However, inflation varied considerably from one country to another, ranging from 0.2% for Benin to 5.3% for Togo.

The interest rates set by the BCEAO for refinancing operations have been maintained at 2.5% in 2020. However, interest rates on loans granted by commercial banks vary considerably from one country to another. For example, the average interest rate on business loans was 7.9% in Senegal in 2020, compared to 12.6% in Benin.

These figures show that the heterogeneity of the BCEAO's monetary policy can have different effects on economic growth and inflation in each WAEMU country. Differences in interest rates can also have important consequences for businesses and consumers in each country.

It is appropriate to ask about the heterogeneity of the monetary policy responses of the BCEAO in the WAEMU economies.

Is the monetary policy conducted by the monetary authorities not a factor of non-convergence of the economies that make up the WAEMU zone?

Through the PVAR model, which has been widely used to analyse the effect of monetary policy on the economic performance of countries within a monetary union. We rely on this model in the case of this paper. Indeed, the model can be used to examine the impact of various monetary policies implemented by different countries within the union on the economic growth of each country. In addition, the PVAR model can also be used to assess the transmission of these shocks between countries in the union.

Given the heterogeneity of the economic performance of the member countries of the West African Economic and Monetary Union (WAEMU), the question arises as to whether the monetary policy conducted by the Central Bank of West African States (BCEAO) is a factor of non-convergence. A central question to this issue could be: To what extent does the monetary policy conducted by the BCEAO contribute to the non-convergence of the WAEMU economies, in particular with regard to economic growth, inflation and interest rates?

According to some authors , monetary policy heterogeneity may have different effects on economic growth and inflation in each WAEMU country . For example , Bénassy-Quéré et al (2018) pointed out that interest rate differences between member countries can lead to different real interest rate effects, which can affect firms' competitiveness and economic growth.

In this context, the use of the PVAR model can help analyse the impact of monetary policy on the economic performance of countries within the WAEMU. The model will help to better understand the effects of monetary policy heterogeneity on the region's economies and to suggest ways to improve economic convergence.

[2]"Monetary Policy in the Data and Model Age" in 2019.

II. Review of Literature

Many authors have used the panel vector autoregression (panel VAR) model to analyse the effects of monetary policy on business cycles and cross-sectional heterogeneity. In particular, researchers such as Blanchard et al (2010), Dutt et al (2003), and Bhattarai et al (2009) have used this model to analyse the impacts of fiscal and monetary policies on macroeconomic outcomes, with a particular focus on cross-country differences.

Dutt et al (2003) used the panel VAR model to analyse the effects of monetary policy on economic fluctuations in the euro area countries. They found that expansionary monetary policy had a positive effect on economic growth in the short and long term. They also found that the effects of monetary policy on economic growth were stronger in countries with greater economic and financial integration.

Bhattarai et al (2009) used the Panel VAR model to analyse the effects of fiscal and monetary policies on economic fluctuations in EU countries. They found that fiscal policy has a positive effect on economic growth in the short run and a negative effect in the long run. They also found that the effects of fiscal and monetary policies were stronger in countries with greater economic and financial integration.

Overall, these researchers found that the panel vector autoregression (Panel VAR) model can be used to analyse the effect of fiscal and monetary policies on business cycles and cross- sectional heterogeneity. Furthermore, they found that the effects of fiscal and monetary policies are stronger in countries with greater economic and financial integration.

Several authors have addressed the issue of monetary policy heterogeneity in the franc zone by using the panel vector autoregression (VAR) model to analyse the effects of monetary policy on business cycles and cross-sectional heterogeneity within the franc zone.

Adenikinju et al (2014); Gbadamosi et al (2010); Adenikinju et al (2014); Raschke et al (2015); Kaneko et al (2008); Ueda et al (2014) also used the Panel VAR model to analyse the effects of fiscal and monetary policy on business cycles in the WAEMU. They found that fiscal and monetary policy had a positive effect on economic growth in the short run, but a negative effect in the long run. Furthermore, they found that the effects of fiscal and monetary policy were stronger in countries with a more rigid exchange rate regime.

Overall, these authors found that the Vector Auto-Regressive (VAR) model can be used to analyse the effects of monetary policy on business cycles and cross-sectional heterogeneity. Furthermore, they found that the effects of fiscal and monetary policy are stronger in countries with a more rigid exchange rate regime.

However, it is worth noting the existence of alternative models such as DSGE (Dynamic Stochastic General Equilibrium) and structural VARs on panel data. However, several authors such as Canova and Ciccarelli (2013) indicate that DSGE models impose many restrictions by construction. For example, the policy recommendations they provide are embedded in the model assumptions. Like DSGE models, structural VAR models on panel data are subject to the standard critique of structural VARs (Cooley and Dweyer 1998, Canova and Pina, 2005, Chari et al, 2008) and therefore should be viewed with caution.

Since the pioneering work of Sims (1980), VAR models have been widely used in empirical studies. One of the advantages of these models compared to structural models is their ability to analyse the interactions between several variables, without any a priori distinction. Beyond time series, several studies use VAR models on panel data.

The economic literature shows that the introduction of VAR models on panel data is not recent. Indeed, the pioneering work dates back to Holtz-Eakin et al (1988). Recent studies using panel data VAR models are numerous. For example, Carstensen et al (2009) analysed the effects of institutional factors on the transmission of monetary policy in a mortgage market in OECD.

countries. Furthermore, Beetsma and Giuliadori (2011) and Lane and Benetrix (2010) used a panel VAR model to analyse the transmission of government spending shocks.

According to Canova and Ciccarelli (2013), panel VARs are constructed with the same logic as standard VARs. However, unlike standard VARs, the inclusion of the cross-sectional dimension increases the power of panel VAR models in explaining economic phenomena. Indeed, these models are able to capture both static and dynamic interdependencies. Also, they can deal with the links between units without any a priori restrictions, etc. Moreover, they are particularly suited to the analysis of the transmission of shocks between units over time.

In practical terms, the estimation method varies according to the nature of the data, and each case is specific and requires in-depth analysis. Indeed, assuming the existence of dynamic homogeneity in the data generation process, conditional on the initial values of the endogenous variables on the one hand, and the presence of fixed effect on the other hand, the classical parameter estimation method becomes appropriate. However, when T is fixed, the estimators are biased and the use of the GMM Method of Arellano and Bonds (1991) allows to correct the bias even when T is small (Canova and Ciccarelli, 2013).

However, when T is large, the estimation can be done on a per unit basis. Pesaran and Smith (1995) point out that the estimator derived from the means is more efficient than the panel estimator. In the following, all these considerations are taken into account by the Fisher probability test.

Before estimating the VAR panel, a number of precautions are taken with regard to the panel data and the VAR models. Firstly, the stationarity of the variables is examined by the IPS test. This test is preferred to the others because Hurlin and Mignon (2005) show that it is convergent when T is low (T less than 30).

Moreover, as with standard VARs, the estimation of the VAR panel requires the determination of the optimal lag before the specification of the model. To do this, several criteria are used in the literature. In some studies, such as Boubtane et al (2010) and Carstensen et al (2009), the optimal lag is determined using the LM test. Others, however, use the Akaike and Schwarz criteria to determine the optimal delay as in standard VARs (Miller et al, 2011). Based on the literature, the AIC and Schawrz criteria are used to determine the optimal delay.

FélixAyadi, (2019); Adama Sow, (2014); Eric Akoboua (2015) found that monetary policy is an effective tool for stimulating economic growth, but that its impact varies according to the structural characteristics of each country.

These studies have contributed to the understanding of the impact of monetary policy on economic growth in the WAEMU countries and have highlighted the importance of taking into account the structural characteristics of each country in the analysis.

III. Methodology

In this section we first present the empirical specification adopted and then outline the data used.

3. Model specification.

3.1. PVAR model verification test

When working with a panel VAR model, the most appropriate stationarity tests for variables such as the monthly average money market rate, the consumer price index and the output gap depend on the type of dependence present between the observations in the panel. In general, stationarity tests for panel data include:

- Breusch-Pagan-Godfrey (BPG) test: This test examines the presence of heteroscedasticity within the panel and determines whether it is statistically significant.
- Hausman homoscedasticity test: This test compares the results of fixed and random effects models to determine whether homoscedasticity is present in the panel.
- Pooling test: This test examines whether the covariance between the errors of the individual regressions in the panel is zero. If the covariance is zero, it means that the pooling model is appropriate.
- Levin, Lin and Chu (LLC) test: This test examines the presence of a unit root in individual time series, and determines whether it is statistically significant.

It may also be necessary to test variables for absolute stationarity using tests such as the Dickey-Fuller test or the KPSS test.

In this paper, we use the Levin, Lin and Chu (LLC) test, as this is the most commonly used test for testing a VAR (Vector Autoregressive) model for panel data. This test examines the presence of a unit root in the individual time series, which may affect the stability of the causal relationship between the variables in the VAR model. If the unit root is present, it means that the variables in the model are cointegrated, which can lead to errors in the predictions and conclusions of the model. The LLC test helps to determine whether the unit root is statistically significant and whether further adjustments should be made to the model to improve its performance.

The Levin Lin Chu unit root test (LLC) is a useful tool for determining whether a panel data set is stationary or has a unit root. To perform the LLC test, we first assume the null hypothesis that the panel has unit roots (Ho). The alternative assumption (Ha) is that the panel is stationary. Next, we enter the number of panels and periods, then determine the parameter AR and whether or not a time trend is included. The next step is to run the ADF regression, which must have a lag.

The results of the LLC unit root test are then given in terms of the unadjusted T-statistic and the adjusted T*-statistic, together with the associated p-value. The p-value is used to determinewhether the null hypothesis should be accepted or rejected. If the p-value is less than 0.05, then the null hypothesis can be rejected and the panel data is considered stationary.

3.2. The VAR panel model

Monetary policy has a profound impact on the economic performance of countries. In particular, changes in monetary policy can have important consequences for inflation, output and exchange rates. Therefore, it is important to understand the effects of monetary policy on economic variables.

The panel VAR model is an extension of the traditional vector autoregression (VAR) model. It is based on the pooled VAR approach, in which the panel data consists of multiple VARs estimated on different subsets of the data. However, rather than estimating the model separately for each country in the panel, the model allows the estimation of a single equation that captures the common dynamics of the variables across the different countries.

The panel VAR model is estimated by the least squares method. It is based on an equation with a single dependent variable and several explanatory variables. The coefficients of the equation are estimated using pooled estimation, which takes into account the interdependence of variables across countries. Pooled estimation allows for more accurate estimates of the effects of monetary policy shocks.

The model can also be used to estimate the effects of monetary policy on different countries within a monetary union. This is done by aggregating the individual country VARs into a single panel VAR. By aggregating individual estimates, the PVAR model allows for a more accurate and robust estimation of the effects of monetary policy.

Application to monetary policy

The PVAR model has been widely used in the field of monetary economics, particularly in the context of currency unions. The model has been used to analyse the effect of monetary policy on macroeconomic variables, such as inflation, output and exchange rates. The model can also be used to assess the transmission of monetary policy shocks between different countries in a monetary union.

For example, the PVAR can be used to analyse the effect of an expansionary monetary policy implemented by a central bank in one country on inflation and output in other countries of the union. The model can also be used to assess the effectiveness of monetary policy over different time horizons, such as the short, medium and long term.

The PVAR model is a powerful tool for analysing dynamic relationships between economic variables, especially in the context of currency unions. The model can be used to analyse the effect of monetary policy shocks on macroeconomic variables, as well as the transmission of these shocks between countries in the union. The PVAR model is an important tool forunderstanding the effects of monetary policy and its implications for economic performance in a currency union.

3.3. Study framework

In this section, we try to go further in our analysis by trying to identify the transmission channels of the BCEAO's monetary policy through a panel VAR. Thus, we take both the time dimension and the country dimension. This choice is first justified by the fact that monetary policy is in a monetary area , with common objectives, is conducted by a single Central Bank . The uniquenesśof the objectives and convergence criteria make it necessary to take into account in a study of the zone, the different characteristics as a whole, because the WAEMU constitutes, despite everything, a common monetary market. Moreover, technically, the addition of the individual dimension makes it possible to increase the number of data (and therefore the degree of freedom) by including information relating to different countries and thus to conduct a multi-country analysis (C. Hurlin and V. Mignon, 2007). Secondly, it allows to control for individual heterogeneity of member countries, and to identify effects that cannot be detected by a simple time series or cross-sectional data.

Our model combining the VAR and panel approaches is written as follows:

$$\boldsymbol{Y_{it}} = \sum_{\boldsymbol{s=1}}^{\boldsymbol{p}} \boldsymbol{A_s Y_{i,t-s}} + \boldsymbol{u_{it}} + \boldsymbol{f_i} + \boldsymbol{d_t}$$

(Y_{it}) represents a vector of variables (monthly average money market rate; the consumer priceindex and the output gap), $f_i$represents the country fixed effect and $\boldsymbol{d_t}$random effect) ; $\boldsymbol{u_{it}}$ the error term.

The data concern the eight (8) WAEMU countries and cover the period April 1995-December 2019.

3.3.1. The Panel data model has a number of advantages, including

- the double dimension of the data (individual and temporal) makes it possible to account simultaneously for the dynamics of behaviours and their possible heterogeneity, which is an advantage over other types of data such as time series and cross-sections. In addition to these advantages, there are other advantages linked to the very large number of data and their variability (Sevestre, 2002). Heterogeneity is subdivided into

observed and unobserved heterogeneity. The former can be controlled through the explanatory variables while unobserved heterogeneity can be controlled through cross-sectional and time series analysis. Ignoring unobserved heterogeneity would lead to inefficient Ordinary Least Squares estimators, i.e. a biased estimator;

- The other advantage is the increase in the sample size, which leads to an increase in the number of degrees of freedom and a reduction in collinearity between the explanatory variables, thereby improving the estimates of the results obtained on the basis of econometric tests (Hurlin and Mignon, 2007);
- With the two-dimensional nature of the panel data, this makes it easy to interpret the results. Indeed, the difference between individuals creates inter-individual variability. The latter can be decomposed into temporal intra-individual variability proposed to each individual and inter-individual variability.
- In the case of our study, the panel VAR model is appropriate because it does not make any a priori restriction on the exogeneity and endogeneity of the variables. Moreover, it allows us to identify the existence or not of a bidirectional or unidirectional relationship. Furthermore, it allows to capture both static and dynamic interdependencies.

IV. Interpretation of Results

The results of the stationarity test show that the Gap and TMM data series have a constant trend (stationary in level) and do not show a tendency to change over time. In addition, the CPI data series is integrated of order 1, which means that it is likely to change consistently over time, but that these changes are limited and do not exceed a certain limit.

The estimation results of the panel VAR model are presented in the following table 2. It can be seen that the key interest rate does not significantly influence inflation, let alone economic activity. Indeed, the reaction of economic activity to a monetary shock is not significant. This result is not surprising in view of our previous analyses concerning the lack of intensive connection between the monetary sector and the real sector.

Figure 1 shows the response functions and the 5% error bands generated by the Monte Carlo simulation. These response functions present the maximum variation as a function of time of each endogenous variable following a one standard deviation shock to the exogenous variable. Figure 1 thus presents the shock of the variable in column j on the variable in column i, with the order for the Cholesky decomposition.

However, Graph 1 shows us that the simulation of an interest rate shock would have a quasi- linear negative impact on inflation represented by the consumer price index. The economic activity represented by the output gap reacts quite significantly following a shock to the interest rate. Following a shock to the consumer price index, economic activity also responds significantly. On the other hand, the results of the impulse response functions show that the classic transmission pattern (monetary instrument (policy rate), intermediate objective (price level), final objective (economic activity)) is not respected in the WAEMU. This result confirms the idea that the effectiveness of monetary policy is far from being achieved. Indeed, the actions of the BCEAO do not have a direct impact on economic activity. This result could be explained by the fact that in the WAEMU, there is a weak connection between the banking sector and the real sector. This fact could reduce or delay the impact of monetary policy on prices and, moreover, on economic activity. In addition, the low level of financial development, the excess liquidity of banks and the lack of competition (oligopolistic banking market) could also be factors in this lack of efficiency.

V. Conclusion

In this paper, we empirically try to estimate the impacts of the transmission of the BCEAO monetary policy through the interest rate channel by means of a panel VAR model. Thus, we take both the time dimension and the country dimension. The data concern the eight (8) WAEMU countries and cover the period April 1995-December 2019, in monthly dimensions for each year.

Studies by different authors on the issue of monetary policy heterogeneity in franc zone countries show that expansionary monetary policy has a positive effect on economic activity and inflation in the short term, and that the effects of fiscal and monetary policies are stronger in countries with a more rigid exchange rate regime.

The results of our study show that the Gap and MMR data series have a constant trend and that the CPI data series changes consistently over time but within defined limits. The estimation results of the panel VAR model show that the policy interest rate has no significant influence on inflation or economic activity. Figure 1 shows that the interest rate shock would have a linear negative impact on inflation, but economic activity responds significantly following a shock to the interest rate or the consumer price index. The result of the response functions shows that the classical transmission pattern is not respected in the WAEMU, indicating that the effectiveness of monetary policy is limited. Factors that could explain this include the weak connection between the banking sector and the real sector, the low level of financial development, the excess liquidity of banks and the lack of competition in the banking market.

On the basis of these results, the following recommendations could be made:

Strengthen the connection between the banking sector and the real sector to improve the transmission of monetary policy.

Improve financial development in the WAEMU through increased access to finance for the private sector and increased competition in the banking market.

Address excess liquidity in the banking sector to increase the effectiveness of monetary policy.

It is important to note that these recommendations must be considered in conjunction with other economic and structural factors that may affect the effectiveness of monetary policy in the WAEMU.

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VII. Annex

Tableau 1 : Teste de stationnarité

```
. xtunitrootllc gap

Levin-Lin-Chu unit-root test for gap
----------------------------------
Ho: Panels contain unit roots          Number of panels =      8
Ha: Panels are stationary              Number of periods =    297

AR parameter: Common                   Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 21.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                 Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t      -16.2955
 Adjusted t*       -8.6165       0.0000

. xtunitrootllc t4m

Levin-Lin-Chu unit-root test for t4m
----------------------------------
Ho: Panels contain unit roots          Number of panels =      8
Ha: Panels are stationary              Number of periods =    273

AR parameter: Common                   Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 21.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                 Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t      -7.7038
 Adjusted t*       -6.1989       0.0000

. xtunitrootllcipc

Levin-Lin-Chu unit-root test for ipc
----------------------------------
Ho: Panels contain unit roots          Number of panels =      8
Ha: Panels are stationary              Number of periods =    297
```

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 21.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-4.2208	
Adjusted t*	-0.4953	0.3102

. gen dipc=d.ipc
(8 missing values generated)

. xtunitrootllcdipc

Levin-Lin-Chu unit-root test for dipc

Ho: Panels contain unit roots Number of panels = 8
Ha: Panels are stationary Number of periods = 296

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 21.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-33.9696	
Adjusted t*	-33.3974	0.0000

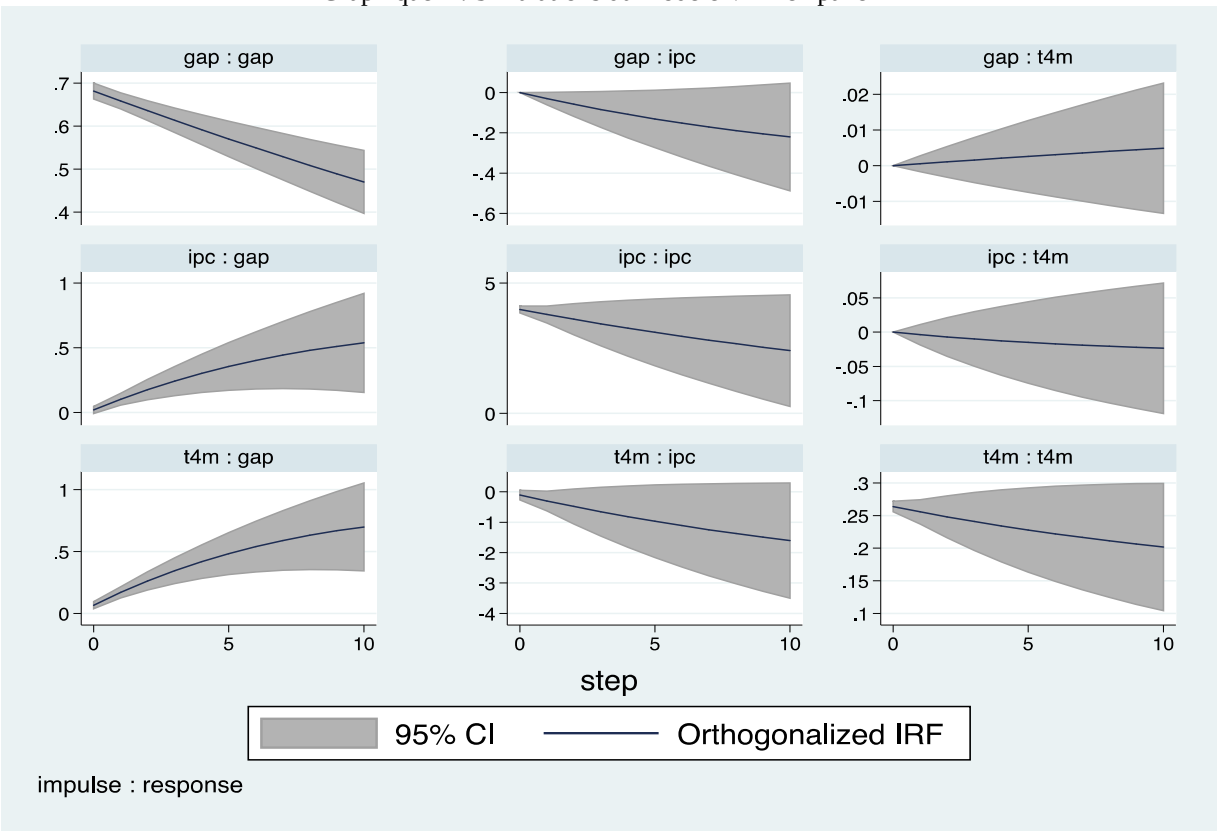
Tableau 2 : Panel Vector Autoregresssion
. pvar t4m ipc ga
GMM Estimation
Final GMM Criterion Q(b) = 5.94e-32
Initial weight matrix: Identity
GMM weight matrix: Robust
No. of obs = 2128
No. of panels = 8
Ave. no. of T = 266.000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
t4m |						
t4m |						
L1. |	. 9685118	. 0341405	28.37	0.000	. 9015976	1.035426
|						
ipc |						

```
        L1.|  -.0009276   . 001986   -0.47 0.640   -.0048201   . 0029649
           |
        gap |
        L1. |   . 0007826   . 0016828 0.47 0.642   -.0025158   . 0040809
------------+----------------------------------------------------------------
ipc         |
        t4m |
        L1.|  -.7394809   . 5453579   -1.36 0.175   -1.808363   . 3294009
           |
ipc |
        L1. |   . 9523227   . 0355449 26.79 0.000   . 882656 1.021989
           |
        gap |
        L1.|  -.0441744   . 0223929   -1.97 0.049   -.0880637   -.0002852
------------+----------------------------------------------------------------
gap         |
        t4m |
        L1.|   . 4097922   . 0760959 5.39 0.000   . 260647   . 5589374
           |
ipc |
        L1. |   . 0209179   . 0054439 3.84 0.000   . 0102481   . 0315877
           |
        gap |
        L1. |   . 9661402   . 0070203 137.62 0.000   . 9523807   . 9798997
------------------------------------------------------------------------------
```

Instruments : l(1/1).(t4m ipc gap)

Graphique 1 : Simulations du modèle VAR en panel



Source: auteur