# How relevant is monetary policy to explain Mexican unemployment fluctuations?

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# How Relevant is Monetary Policy to Explain Mexican Unemployment Fluctuations?

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Abstract:

In this paper we analyze the effects of a monetary policy shock on Mexican unemployment rates. Unlike previous studies we re-estimate unemployment rates so that these alternative rates are comparable to those of the OECD member countries. We find that in response to tightening monetary policy, unemployment increases with a characteristic hump-shaped pattern found in other studies. Our empirical results indicate that unemployment elasticity is low and yet the velocity of adjustment to return to the initial point is rather high. We interpret these findings as being the result of two characteristics of Mexico's labor market: (i) high labor regulation (which includes labor intervention in hiring-firing decisions), and (ii) the existence of a large informal sector and low enforcement of labor regulation.

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## 1. *Introduction.*

By all accounts Mexico's monetary policy for the last 25 years has been successful in achieving price stability. In effect, inflation has declined from a monthly average rate of 4.3% during the 80s to 1.5% during the 90s to 0.4% during the first seven years of the new millennium. The prevailing view is that price stabilization is a necessary condition for expanding production, fostering the development of financial markets, and improving both public finances and income distribution.[1]

To pursue price stability, Mexico's monetary authorities have used different monetary instruments going from exchange rate control to base money control to inflation targeting. The latter two were implemented after the crisis of December 1994. To achieve its inflationary targets, Mexico's central bank maintained a policy of controlling the amount of money available to commercial banks through their reserves, which resulted in increases of the domestic interest rates. Higher interest rates, in turn, resulted in contractions of the aggregate demand that lowered domestic inflation. In an open economy, with high capital mobility and flexible exchange rates, higher domestic interest rates further lower the inflation rate through the appreciation of the domestic currency: an appreciated domestic currency not only restrains exports, but also lowers the domestic price of the imported goods.

Even though it has been recognized the impact of Mexico's tight monetary policy on production, up to now there has not been a thorough discussion about how the former has affected labor market performance. This is a major shortcoming in the current research agenda in Mexico because it overlooks the cost of achieving such price stability in terms of workers' welfare. Even if one were to recognize that price stability is a necessary condition for economic growth in the long run, we should not overlook the short and medium run costs on workers´ wellbeing.

[1] For example, Banxico (2002) and Grier and Grier (2006) analyze the costs of inflation on Mexico's economic growth.
http://www.banxico.org.mx/documents/%7B15AA921B-8C80-3651-02F2-B0AE5A7BB9E6%7D.pdf

Nevertheless, there are several studies that have measured the impact of output changes on employment (or unemployment) in less industrialized countries. For example, Loboguerrero and Panizza (2009) find that, compared to industrialized countries, Latin American economies transmit their macroeconomic instability to their labor markets more through fluctuations in real wages than through fluctuations in employment.[2] Loboguerrero and Panizza's conclusions are similar to those of Gonzalez-Anaya (2002) in the sense that in Latin America, changes in output has been absorbed more through changes in real wages than through changes in employment (or unemployment). He also finds that within Latin American countries, Mexico presents one of the highest wage elasticity while exhibiting one the lowest unemployment elasticity.[3] The estimates of output elasticity of unemployment for Mexico's are less conclusive however. Chavarin (2001) finds that a one percentage point of Mexico's output decline is associated with a 0.416 increase in unemployment, whereas Loria and Ramos (2007), using a different estimation technique, also find that output elasticity of unemployment is about 0.481. Compared to the rest of Latin American economies, these estimates are larger than most of Latin American economies.[4]

We explore further the question of how responsive unemployment rate is to macroeconomic shocks in Mexico, a country that began its successful price stabilization program during the second half of the 1980s. We depart from the studies already mentioned in that we consider that much of the output shocks were caused by the anti-inflationary policy that Mexico's government has implemented since the late eighties. However, monetary policy is not exogenous, but rather depends on inflationary expectations.

The theoretical model used to carry out the empirical analysis rests on the assumption that money is non-neutral; that is, we argue that changes in unemployment rates can be partly explained by monetary policy implemented to control inflation. Our central argument is that by affecting output, monetary policy has some impact on unemployment rates. Our analysis involves the estimation of a Structural VAR model (SVAR). Variance

[2] Macroeconomic instability measured by output volatility.
[3] However, there is some evidence that countries that engaged in price stabilization, and to the extent that achieved lower inflation, showed declining wage elasticity at the expense of higher unemployment elasticity; that is, there is some evidence that those elasticities might be declining.
[4] Table 2B in Loria et al (2007).

decomposition shows which shocks have caused movements in the variables during the sample period, while the impulse response functions contain information about the magnitude and duration of the effect of a specific structural shock.

An additional difference with previous studies about unemployment is that the empirical analysis considers both the official unemployment rate and an alternative one following the definition used by the CPS of the US Bureau of Labor Statistics. The latter as a response to some criticisms made to the official unemployment rates.

Our results indicate that when using the alternative unemployment rate, tightening monetary policy increases unemployment rates with a characteristic hump-shaped pattern found in Alexius and Holmlund (2007) and Ravn and Simonelli (2008). The unemployment rate reaches its maximum level after the second quarter at a level 0.26 points above its original level, and then it slowly reverts back to its original level. Error variance decomposition results indicate that the monetary policy shock accounts for 3 to 27 percent of the fluctuation in unemployment. When we use the official unemployment rate however, monetary policy shocks do not have much impact on unemployment rates.

The paper is organized as follows. Section 2 presents a short summary of the main ideas of the Keynesian argument about the relationship between monetary policy and unemployment. Section 3 reviews the monetary policies followed by Mexican authorities during the period of analysis. Section 4 presents some key characteristics of the Mexican labor market, and introduces an alternative indicator of unemployment rates. Section 5 discusses the model specification and describes the data. Section 6 presents the main empirical results, while section 7 concludes.

## 2. *Is money neutral?*

Discussions about money non-neutrality can be traced back to Cantillon's Essay published in the first half of the 1700s[5]. His argument was that under the gold standard increases in the money supply would encourage higher spending, which in turn would stimulate production. This positive effect on production however is short lived for higher

[5] Cantillon (1730) "Essay on the nature of the commerce in general".

demand would also induce higher prices which in turn would have a negative impact on production. We find the same argument in Hume's (1752) paper about money. His view was later retaken by Newcomb (1885) and Fisher (1911) and became what now is known as the Quantitative Theory of Money.

Money's non-neutrality, on the other hand, is a key feature in Keynesian economics. Keynes's view about the impact of money on real variables is found in his General Theory of Employment, Interest and Money. Central to the argument is the role played by domestic interest rates in inducing changes to aggregate demand. Interest rate in the Keynesian framework is the reward for getting ride-off of liquidity. To the extent that the interest rate affects the marginal efficiency of capital which, in turn, determines investment, changes in the quantity of money would affect output and employment.[6] In Keynes' view interest rate partly depends on the state of liquidity preference and partly on the quantity of money so that changes in the quantity of money would induce changes in the interest rates, ceteris paribus. Chick (1983), in turn, argues that interest rates would be affected by open market operations or by variations in banks' reserves or reserve requirements designed to affect liquidity and or the supply of credit.

Thus, within the Keynesian perspective there is a consensus that increases (decreases) in the interest rates induce reductions (increases) in the aggregate demand which would, in turn, result in reductions (increases) in output and employment. Given the capacity of interest rates to affect output and unemployment, the government can use the monetary policy to induce changes in the domestic interest rates to achieve some specific goals. It is precisely money's non neutrality which allows the government to achieve some specific goals. If inflation is assumed to be caused by an excess demand, then higher interest rates can be used to control inflation through the restrain of aggregate demand. Furthermore, in an open economy with high capital mobility, higher interest rates would induce appreciation of the domestic currency. This in turn would induce not only lower price increase but also a further contraction of aggregate demand. In sort, a policy prescription from this framework to reduce inflation is to increase domestic interest rate; thus squeezing aggregate demand which, in turn, would reduce output and increase unemployment.

[6] The overall impact on aggregate demand is further strengthened by the responsiveness of consumption to changes on investment.

Lipsey (1960) and Samuelson and Solow (1960) formalized Phillips' (1958) initial findings about unemployment rates and wage inflation and contended that there was a stable trade-off between inflation and unemployment rates. However, the notion of a stable Phillips curve was criticized by Friedman (1968; 1976) for not introducing workers' reaction to higher price levels into the model. Friedman further argued that inflation would persist as long as unemployment was below its natural rate and inflation expectations were positive.

Lucas (1973), for example, did not find evidence of a tradeoff between output and inflation for a sample of 15 countries.

The analysis of inflation stabilization has led various strand of research. One of them involves discussions about its impact on output volatility (Taylor, 1994). In effect, Taylor suggested that monetary authority's efforts to keep prices stable may cause production to fluctuate more, while attempts to smooth production cycle may induce higher price volatility. Another one entails discussions on the existence of the Phillips curve. Be this the Traditional Phillips Curve (TPC) based on adaptive expectations or the New Phillips Curve (NPC) based on forward looking agents.[7]

A conclusion we can draw from this review is that theoretically there strong arguments to expect some impact of monetary policy on unemployment; at least, in the short and medium term. A related question is how strong the effect on unemployment is, given the characteristics of Mexico's labor market. Furthermore, to the extent that a reduction of inflation expectations is a key factor for successful price stabilization, economic policies also involve control of fiscal deficits. In section 5 we present the econometric model that summarizes the main ideas presented here.

### *3.- Mexico's Monetary and Fiscal Policies.*

Since the late fifties and early sixties, inflation has become one of the major concerns of both industrialized and emerging economies. Friedman (1976) illustrated the negative impact of both high inflation and inflation volatility on economic performance. High inflation, for example, could reduce political cohesiveness since it overruns institutional arrangements and

[7] See for example the special issue on the Phillips Curve of the Journal of Monetary Economics (1999), Vol. 44, No 2.

financial contracts based on a "normal," long term price level. Higher price volatility, on the other hand, by increasing uncertainty lowers economic efficiency and renders market prices a less efficient system for coordinating economic activity. For all these negative effects on economic growth, governments have considered inflation to be the most important problem to solve.

The empirical evidence against the negative impact of inflation on growth is mixed. For example, a recent study by Grier and Grier (2006) found that inflation uncertainty have a negative and significant effect on Mexico's growth; moreover, higher average inflation rates induces higher inflation uncertainty which further affects growth. However, Risso and Sanchez (2009) argued that inflation has a positive impact of growth as long as it does not reach its threshold level of 9 percent. Inflation rates greater that this threshold level have negative effect of growth.

Our analysis begins in 1987[8], in the aftermath of a period characterized by high macroeconomic instability. That particular year, inflation reached a historical high of 140% annually. To face this situation, the Mexican authorities designed a stabilization program centered on a temporary freeze of wages and administered prices in the context of an Economic Solidarity Pact. However, a few weeks after the launching of the program, in early March 1988, the nominal exchange rate was fixed and became the main anchor of the anti-inflationary effort.

As most of the prices and wages control were gradually lifted, the anti-inflationary program evolved into a more orthodox strategy in which fiscal adjustment and exchange rate anchor became the main policy elements. Between 1988 and 1994 the Mexican authorities made several modifications to the exchange rate system, moving first to a regime based on a preannounced rate of devaluation (where the rate of devaluation was set below the rate of inflation). In November 1991, Mexico's Central Bank implemented a narrow exchange rate band with a sliding ceiling.

Throughout most of this period, Mexico's managed exchange rate regime was supported by prudent fiscal and monetary policy. Between 1992 and October 1993 the nominal exchange rate was remarkably stable. After 18 months, all these policies provided

[8] This section draws heavily in Messmacher and Werner (2002) and Sanchez (2005).

their expected results: inflation fell drastically to less than 20 percent. But from then on, the pace of disinflation became sluggish.

In December of 1994, Mexico faced a serious balance of payment and financial crisis, when under severe pressure in the foreign exchange market, the Central Bank was no longer able to defend the predetermined US Dollar-Peso parity and let the peso float. As the peso was left to float, it depreciated immediately and domestic prices increased steadily at a monthly rate of 3.6% throughout 1995. The interbank interest rate increased from 17 percent in the third week of August 1994 to 110 percent in the third week of March 1995, which induced a severe slump of the real economy.

The new anti-inflationary program adopted in early in 1995 stabilized relatively quickly nominal variables. Despite this rebound, output and employment suffered considerably: output fell by 6.2 per cent, whereas open unemployment went up to 7.6 percent by the mid 1995.

The evolution of monetary policy since the adoption of the floating exchange rate regime has included the following main elements. First, adoption of quantitative objectives based on aggregates such as the monetary base. This was predominant during 1995-1997. Second, in early 1998 the central bank announced a change in its strategy: it began inflation targeting. In particular, the 1999 monetary program set an annual inflation goal of no more than 13% for the National Consumer Price Index and proposed, as commitment for the next five years, a gradual approximation to the inflation rate of the country's main trading partners. In 2001, the monetary policy's goal was to stabilize the National Consumer Price Index at 3 percent. However, by mid 2002 the Central Bank announced that this commitment would have a margin of tolerance of $\pm$ 1 percentage point.

Gaytán and Gonzalez (2006) found that there has been a change in the transmission mechanisms of monetary policy as a result of the change in monetary policy (the use of inflation targeting).

### *4.- The Mexican Labor Market*

The purpose of this section is twofold. First, to describe some characteristics of Mexico's labor market so that we have a better understanding about its employment

dynamics and how unemployment might respond to policy shocks. Second, in light to some criticisms made to the official unemployment rate, we estimate an alternative unemployment rate.

### *4.1 About the nature of Mexico's labor market*

There are two contrasting views about the nature of Mexican labor market. On the one hand, there is the idea that Mexico's labor market is heavily regulated by laws that impede employment creation (Heckman and Pagés, 2001; Gill et al, 2001). In this case, output growth would not translate into employment growth but rather into real wage changes. It is argued that job security provisions (which includes severance payments) increases dismissal costs to the firms. These costs discourage firms to fire workers whenever there is a negative shock and reduce job creation in expansions. Heckman and Pagés (2001) found that Mexico exhibits one of the highest indexes of job security within Latin American countries which implies that it has one of the most regulated markets in the region.

Employment rigidity can also be increased by the existence of labor unions. Maloney (2009), for example, argues that Mexican unions value more employment over wages so that output fluctuations affect more wage rates than employment. This can be explained for several reasons. First, Mexico has no unemployment insurance; hence, workers value more employment stability over wages. Second, since the early twenty century, major unions have had a long-standing and close relationship with the government and have cooperated in implementing policies to reduce inflationary pressures. In particular, since the late 1980s unions have settled, on average, for nominal wage growth below inflation rates. Third, during the late 1980s and early 1990s job growth was slow relative to population growth. These elements explain why output fluctuations are more correlated with real wage fluctuations than with employment changes. They might also explain Alcaraz's conclusion that real wages do not depend on unemployment in the formal sector (Alcaraz, 2009).

On the other side of the debate, there is the notion that even though Mexico's labor market is heavily regulated by labor laws, in practice the compliance to such laws is very low. Moreover, since the late 1980s there have been introduced a number of schemes that have added employment flexibility (Marshall, 2004). Among these schemes we find the increased

use of short term contracts to avoid job stability. This is particularly true for the in-bound and service sectors, the fastest growing sectors within the Mexican economy since the late 1980s.

Furthermore, Alcaraz, et al (2008) contend that the employment share of the services sector has increased at the expense of Mexico's manufacturing employment since 2000. According to these authors, this employment re-composition has implied not only an increase of the service sector's employment share but an increase of the informal sector as well. The upward trend of employment in the informal sector has occurred despite the existing wage differential between formal and informal employment. They also found evidence that the transition rate between formal and informal employment is higher than the one existing between manufactures and services sectors. Alcaraz et al (2008) point out that higher mobility between formal and informal sectors (and vice-versa) would indicate the existence of institutional labor market rigidities in Mexico's formal sector.

The existence of a large informal sector[9] somewhat offsets employment rigidities that arise due to labor regulations in the formal sector. The question is whether or not this offsetting force is strong enough so that we can characterize Mexican labor market as being fairly flexible.

In short, within Mexico's labor market coexist two types of factors. On the one hand, there are some labor market institutions that add employment rigidity while adding real wage flexibility; namely, labor regulation and unions. On the opposite side, we find elements that offset the negative effect of the latter on employment flexibility. Among these we find the low enforcement of labor regulations and the informal sector. A priori we do not know which of these two types of factors have a stronger effect on employment flexibility.

### *4.2 How accurate is Mexico's unemployment rate?*

For an outsider, Mexico's low official unemployment rates represent a puzzle. How could a country with such low rates of unemployment grow so little? In effect, Mexico's unemployment rate for the last twenty years or so has been on average one of the lowest among OECD members, about 3.5%, only Luxembourg and South Korea present lower

[9] Alcaraz (2009) argues that it can be as large as 40% of the Mexican labor force.

unemployment rates.[10] Yet its average annual growth rate of per capita GDP has been 1.2%, a much lower rate of growth than South Korea's 5.8%, a country with similar unemployment rates. [11]

Several authors have argued that Mexico's low official unemployment rates can be explained by a combination of several elements; namely, (i) the lack of unemployment benefits, (ii) the existence of a fairly remunerated, and large, informal sector, (iii) the existence of high rates of labor migration to the United States, and (iv) the exclusion of rural areas in estimating unemployment rates where unemployment is higher than in urban areas.

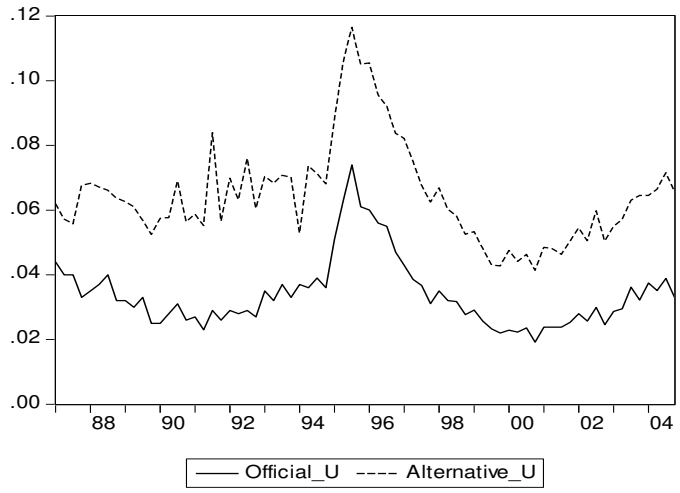
We argue however that although some of these factors might explain partially the low rates, a significant explanation is found on some methodological issues relating the estimation of unemployment rates. Fleck and Sorentino (1994) and Martin (2000), for example, argue that when following the concepts and methodology used by the US labor Statistics, Mexican unemployment rates increase between 40 and 70 percent. Revenga and Riboud (1993), on the other hand, reach to the same conclusion though for a different reason: the official statistics do not take into account temporary unemployed, or unemployed who were not included in the surveys.[12]

To tackle one the main criticisms to official statistics we re-estimate Mexico's unemployment rate. We use the quarterly National Survey of Urban Employment and followed the CPS criteria. First, we consider only workers between the age of 16 and 75 years.[13] Second, to obtain the overall unemployment rate, we utilize the original 16 cities included in the ENEU only. Third, we do not consider as employed, people who are on strike, unemployed for shortage of working capital, raw materials or lack of repairs. We also exclude people working without pay up to fifteen hours a week. That is, they are not included as part of the Economically Active Population (EAP) or as employed. The resulting

[10] During 1987-2004 OECD members had an average rate of 5.93% (http://stats.oecd.org).
[11] Between 1987 and 2004, Mexico's total real GDP grew at an annual average rate of 3.01, while population grew at an annual average of 1.8%. South Korea, on the other hand, grew at an annual rate of 6.2% and its population growth was 0.33% during the same period (Data on output comes from OECD web page, http://stats.oecd.org; whereas data on population growth comes from United Nations World Population Propsects: 2006 revision – Table A.8).
[12] This is particularly relevant when a person is out of job and not looking for one in one survey but before the next survey is carried out, he or she finds a job and thus appears as employed.
[13] Previous to 2005, Mexican statistics considered people working form the age of 12. In 2005 and as a response to criticisms, the lower age limit was raised to 14.

series allows a direct comparison between Mexico's unemployment rates to the OECD countries.

Figure 1: Mexico: Official and Alternative Unemployment




Source: INEGI (ENEU, several years)

The evolution of official and alternative unemployment rates are displayed in figure 1. Compared to the official rates, the alternative measure is about 100% higher, i.e., the average rate of unemployment for the period 1987 - 2004 goes up from 3.4 percent to 6.4 percent. The overall behavior of both series however, is somewhat similar. The main difference occurs during the period previous to the 1995 crisis. During the early 90s both series show a slight upward trend which reaches its highest value by the end of 1995. In 1996 begins a period where the unemployment rate declines rapidly, so that by the end of 2000 had reached their respective low rates of unemployment. This recovery of the unemployment rate is short lived however, for in the next year unemployment begins a new upward trend. Both unemployment series exhibit large cyclical fluctuations as well as short run variations.

We now turn to the specification of the econometric model and its estimation.

## *5. Model Specification.*

We use a structural vector autorregresion model (SVAR) to analyze the dynamic impact of monetary policy on unemployment[14]. The analysis is complemented by the estimation of the impulse response function and variance decomposition.

Thus,

$$AX_t = B(L)X_{t-1} + \varepsilon_t \qquad (1)$$

where $X_t$ is a *(nx1)* vector of endogenous variables, A is a *(nxn)* matrix of coefficients describing the contemporaneous correlation among the variables; B(L) is a *(nxn)* matrix of polynomials in the lag operator, L; and $\varepsilon_t$ is a *(nx1)* vector of structural shocks. Thus, each of the system's variables can be influenced by its own idiosyncratic shocks and by shocks from the other variables. The matrices A and B(L) determine how shocks to each variable are transmitted through the system, both contemporaneously and in subsequent periods. The reduced form of the SVAR can be expressed by

$$X_t = A^{-1}B(L)X_{t-1} + A^{-1}\varepsilon_t = C(L)X_{t-1} + e_t \qquad (2)$$

where $e_t = A^{-1}\varepsilon_t$ describes the relationship between the model's reduced and structural shocks. In fact, the model's reduced shocks are linear combinations of the pure structural shocks.

A necessary condition for establishing the relationships between the reduced and structural shocks is that the system be identified. As is well known, to identify the structural model from an estimated VAR, it is necessary to impose $(n^2 - n)/2$ restrictions on the structural model.

Several different methods of identification are available in the literature. Blanchard and Diamond (1989) used a priori assumptions about the signs of structural parameters to identify the range of values of matrix A, consistent with the data. Shapiro and Watson (1988) and Blanchard and Quah (1989) used assumptions about long run multipliers to achieve

[14] Another way to perform the analysis is through the use of a Markov-switching vector autoregression model. However, the degrees of freedom are quickly eroded due the number of observations in our sample.

identification. Blanchard and Quah (1989) start with orthogonal shocks. In a two variable model, one is assumed to represent a supply shock and the other one a demand shock. For example, productivity shocks are separated from demand shocks by assuming that demand shocks do not affect real output in the long run while productivity shocks do. On the other hand, Sims (1980) argues that identification is achieved using short run restrictions on the timing of the effects of shocks only, i. e., monetary policy shocks are frequently identified by assuming that changes in the interest rate does not affect inflation in the same period since prices are sticky and respond with a delay. In our analysis we will use a combination of the two approaches to identify our model.

### *5.1.- Definition of variables and data*

Our SVAR model includes three endogenous variables: unemployment (both the official and the alternative rates), an indicator of the monetary policy and output gap. We include the latter since labor demand is a derived demand that depends on output's fluctuations. The estimation also includes three exogenous variables that are thought to affect unemployment: the US output, an indicator of fiscal policy and labor productivity[15].

In this work we use available quarterly data from the first quarter of 1987 to the fourth quarter of 2004, a total of 74 observations. The Mexican output gap is estimated from the real GDP (collected from INEGI), whereas the US output gap is calculated from the US real GDP (taken from OECD's main economic indicators). The indicator of Mexico's fiscal policy is measured by the fiscal surplus while labor productivity is measured by output per worker.

It should be noted that both unemployment series were seasonally adjusted using Tramo/Seats. By the same token, the Mexican and foreign output gap were obtained using the Hodrick-Prescott filter with $\lambda$ =1600 after seasonally adjusted using Tramo/Seats. We now discuss in more detail the variables included in the SVAR model.

[15] That these three variables are exogenous was proved following Hyeon-Seung H.(2005). $\chi^2(48) = 37.007[0.87]$. Values in parentheses refer to the degree of freedom and those in square brackets are the marginal significance levels of the test.

*5.1.1 Indicator of monetary policy*

As argued in section 3, our sample period covers both fixed and floating exchange rate regimes; thus we need a single time series that captures the effects of monetary policy on the economy in both regimes. To solve this problem, we use the Monetary Condition Index (MCI) that captures the total effect (direct and indirect) of the exchange rate and the interest rate on domestic output.

MCI is typically measured as the weighted sum of the change in the short term interest rate and exchange rate relative to a base period, with the weights being generally derived from empirical econometric models reflecting estimated impact of these variables on output or inflation[16]. Thus, MCI encapsulates the extent of internal and external influences on the overall monetary conditions of a country. Higher weight of the exchange rate relative to that of the interest rate in the MCI would indicate greater importance of the exchange rate relative to the interest rate in influencing aggregate demand or prices.

MCI can be used for monetary policy in different ways; as an operational target, as a monetary policy rule or as an indicator of policy stance. In our work we use MCI as an indicator of policy stance. For instance, MCI calculated relative to a base period indicates whether policy has become "tighter" or "easier" relative to that base period. In this construct, the absolute value of the MCI does not offer any meaningful interpretation; rather it is the direction of the movements which reveals the change in policy stance.

Using the estimated coefficients of interest rate and exchange rate variables in the cointegration vector of aggregated output system, the ratio or weight of the MCI index turn out to be 1:4.2 which indicates that the exchange rate affects into aggregate output is stronger than interest rate effects.[17] This is consistent with the high degree of openness (measured by

[16] We derived the relative weights of interest rate and exchange rate for MCI from aggregate demand equation. The literature has suggested three approaches To estimate the relative weights: (i) single equation approach by estimating either output or price equation; (ii) trade share approach by estimating long-rung exports to GDP ratio equation and (iii) multiple equation approach by estimating the system of equations through cointegration. We used Vector Autoregressive (VAR) and Johansen cointegration models to avoid omitted variable bias, dynamic exogeneity and feedback problems. The contegration approach takes care of these problems.

[17] It should be noted that recent empirical studies have shown that there has been a change in the transmission mechanism of monetary policy since 2001 as a consequence of the new anti-inflationary strategy based on inflation targeting. Gaytán and González (2006) argue that output and inflation have become more sensitive to interest rates whereas real exchange rate has become less important.

the value of trade as proportion of GDP) that Mexican economy shows during our period of analysis. Monitoring MCI is one possible way of incorporating the exchange rate directly into the framework of monetary policy; therefore, the greater the openness of an economy, the higher the weight of the exchange rate relative to that of interest rate.

*5.1.2 The domestic output gap*

In our analysis, the gap between aggregated demand and potential output[18], is a key driving variable in our dynamic analysis. Understanding where the economy is going requires a good idea of where the starting point is. The basic problem is that potential output and hence the output gap are not directly observable. We consider that potential output is best characterized as being driven by a stochastic process and is obtained using the Hodrick-Prescott (H-P) filter. The rationale for using the H-P filter is that it can help decompose the observed shock into a permanent (supply) and temporary (demand) component[19]. Thus the domestic output gap, $\tilde{y}$, is estimated as $\tilde{y} = (y - y*)$, where $y*$ is the permanent component of output, estimated through the HP filter, $y$ is observed real GDP.

*5.1.3 The index of Fiscal Policy.*

We noted previously that Mexico's stabilization program included the reduction of fiscal deficits. To control for the impact of fiscal policy on unemployment, we introduce the primary structural surplus. The primary structural surplus is calculated as the difference between the budgetary income and expenses, adjusting the fiscal component of the budgetary income. Following the work of Villagómez and Pastor (2007) we adjust the indicator of fiscal policy for business cycle fluctuations and seasonal patterns[20]. This adjustment is made

[18] Potential output is defined as the maximum level of output that can be produced without creating pressure for inflation to accelerate.

[19] Choosing a large $\lambda$ in the H-P filter imposes the view that supply shocks are deterministic and that variations in output come almost entirely from demand shocks. Choosing $\lambda$ to be very small imposes the view that most variation in output is also variations in potential or trend output and hence is driven by supply shocks.

[20] According to Hayford (2005) "the logic behind structural measures is that one problem in identifying the effect of fiscal policy is that government revenues and transfer payments respond to fluctuations in economic

by multiplying income from taxes by the ratio of potential GDP to actual GDP, raised to the power of the tax-income elasticity with respect to actual GDP. To construct the primary structural surplus, budgetary data was used and collected from Secretaria de Hacienda y Crédito Público (SHCP).

*5.1.4 US output*

Several studies have shown the degree to which the Mexican business cycles are highly co-dependent of the US business cycles. This result is more than evident given that more than 90% exports goes to the US economy. To control for such an impact on unemployment we include the US output gap, $\tilde{q}$, as the indicator of foreign demand in our model. Thus, $\tilde{q} = (q - q*)$, where $q*$ is the potential US output, estimated through the HP filter, $q$ is the observed US output.

*5.1.5 Labor productivity*

It has been argued that labor saving technical change can affect unemployment rates; thus, to control for such changes in technical efficiency we introduce labor productivity in our model as an exogenous variable. Labor productivity is measured by the output per employed worker.

## *6. Empirical analysis*[21]

*6.1 Identification*

In this section we first justify some of the assumptions made to obtain the estimated parameters. Our SVAR model includes three endogenous variables: *Monetary Policy (MCI),*

activity as well as potentially caused fluctuation in economic activity. One way to deal with this problem is to control for the effect of cyclical fluctuations by using cyclical adjusted or structural measures of fiscal policy.

[21] We also included a one lag inflation rate as a proxy for expected inflation. While the one lag inflation rate variable is statistically significant only in the MCI equation, including this variable does not have any qualitative effect on the rest of the results (see Table A1 at the appendix). Therefore, we use a parsimonious model without expected inflation.

*Domestic output gap* ($\tilde{y}$) and *Unemployment* ($u$), and three exogenous variables: *US output gap* ($\tilde{q}$), *Productivity* ($p$) *and Fiscal policy* ($g$). The order of the matrix $\mathbf{A}$ is as follows. First we include monetary policy, we place excess domestic demand second and then the unemployment rate.

Monetary policy is identified by assuming that changes in interest rate do not affect the excess demand in the same period since prices are sticky and respond with a delay. This implies that $a_{21} = 0$. In section 4.1 we presented some stylized facts about Mexico labor market. Given the existence of a large informal sector and the high degree of transition between formal and informal employment, unemployment rates would not necessary change as output changes. Output fluctuations would induce flows between the formal and informal sectors so that unemployment rate would remain somewhat rigid. This translates into $a_{32} = 0$. The third restriction is derived from the fact that the monetary policy does not depend on unemployment, i.e., $a_{13} = 0$.

*6.2 SVAR estimation.*

Given that both unemployment series (the official and alternative ones) are non stationary[22] over the sample period; and since we want to determine the persistence of monetary policy shocks rather than assume that the effects are permanent, we added a deterministic time trend to the model to yield a stationary SVAR and also stationary unemployment rate.

Before estimating our SVAR model we tested the identification restrictions ($a_{21} = a_{32} = a_{13} = 0$), the likelihood ratio test is 0.003 and is not significant when contrasted with critical values of the chi-square distribution with three degree of freedom, and the joint hypothesis cannot be rejected. The optimal lag length was derived using the AIC and BIC criteria, leading to a choice of 2 lags. When using the official unemployment rates, the estimated SVAR coefficients were either statistically insignificant or had the wrong signs.

[22] Due to space constraints we do not include the unit root tests, but they are available from the corresponding author.

In fact, the initial impact of a monetary shock was a reduction of unemployment rate, clearly a result that is contrary to economic theory.[23]

Table 1: SVAR estimates
(p-values in parenthesis)

| | *Unemployment Ln (u)* | *Domestic demand (y-y*)* | *Monetary Policy (MCI)* |
|---|---|---|---|
| *Ln (u)* | 0.759 | -0.351 | 0.516 |
| | (0.000) | (0.081) | (0.398) |
| *(y-y*)* | -0.061 | 0.568 | 0.351 |
| | (0.090) | (0.000) | (0.263) |
| *L(MCI)* | 0.024 | -0.067 | 0.582 |
| | (0.064) | (0.007) | (0.000) |
| *US output (q-q*)* | -0.183 | 0.293 | 0.315 |
| | (0.014) | (0.036) | (0.457) |
| *Productivity (t)* | -0.017 | 1.809 | 5.175 |
| | (0.943) | (0.000) | (0.000) |
| *Fiscal Surplus (g)* | 0.153 | -2.711 | -7.690 |
| | (0.758) | (0.005) | (0.009) |
| *Time trend* | 0.0008 | -0.038 | -0.011 |
| | (0.884) | (0.001) | (0.744) |
| *Dummy95* | 1.766 | -3.138 | 35.167 |
| | (0.012) | (0.018) | (0.000) |
| *Adjusted ($R^2$)* | 0.834 | 0.811 | 0.837 |
| Log Likelihood -339.93 | | | |
| Portmanteau(12) 105.1633 (0.1311) | | | |

Source: own estimates.
Note: The Table contains the sum of the coefficients on the two lags of each variable. Wald test for joint significance of both lags of each variable. Wald test for joint significance of both lags of each variable. The Portmanteau joint test for white noise residuals is showed.

The estimated SVAR coefficients using the alternative unemployment series are reported in Table 1. As we can see there are no signs of misspecification in any of the equations. Table 1 contains the sum of coefficients on the two lags of each variable and the Wald test for their joint significance; p-values are in parenthesis. Results are as expected; a tight monetary policy increases unemployment and decreases the domestic demand. Higher domestic demand decreases unemployment. Fiscal surplus decreases the domestic demand and the impact on unemployment has the right sign but is not significant. Shocks on the US

[23] In the Appendix we compare results of the impulse response functions for the two unemployment rates.

output decreases unemployment and increases domestic demand, while productivity shocks increase domestic demand.

*6.3 Impulse response functions.*

Since we are particularly interested in the effects of monetary policy shocks on the unemployment rate; we show in Figure 2 the dynamic response of unemployment and excess domestic demand to an exogenous tightening of monetary policy. The results show that unemployment responds positively to positive shocks of monetary policy. This result indicates that an exogenous tightening of monetary policy of one percent induces an increase of 0.26 percentage points of unemployment after two quarters. After five years, unemployment is still 0.06 percentage points higher than it would have been without the shock. In response to the tight monetary policy, unemployment increases with a characteristic hump-shaped pattern as the one found in other studies[24]. It reaches its maximum effect after three quarters at a level 0.61 points above its original level, and then it slowly reverts back to its original level.

Our results indicate that Mexico's labor market adjusts quicker than Sweden's since in Alexius and Holmlund (2008)'s study the estimate of a monetary policy shock reaches its maximum effect on unemployment after nine quarters. In a study evaluating the impact of a monetary policy shock on unemployment for the US economy, Ravn and Simonelli (2008) found that half of the maximum effect of a monetary policy shock on unemployment had disappeared after ten quarters and none remained after ten years.

Hence, an exogenous tightening of monetary policy has less persistent effect on unemployment in Mexico than in Sweden and somewhat similar to the one found in the US economy. The reason for the velocity to adjust can be explained by the existence of a large informal sector and the existence of a number of schemes that have added some employment flexibility despite the heavy regulation that there is in the Mexican formal labor market. Labor regulation and labor unions, on the other hand, might explain the low employment elasticity to policy shocks.

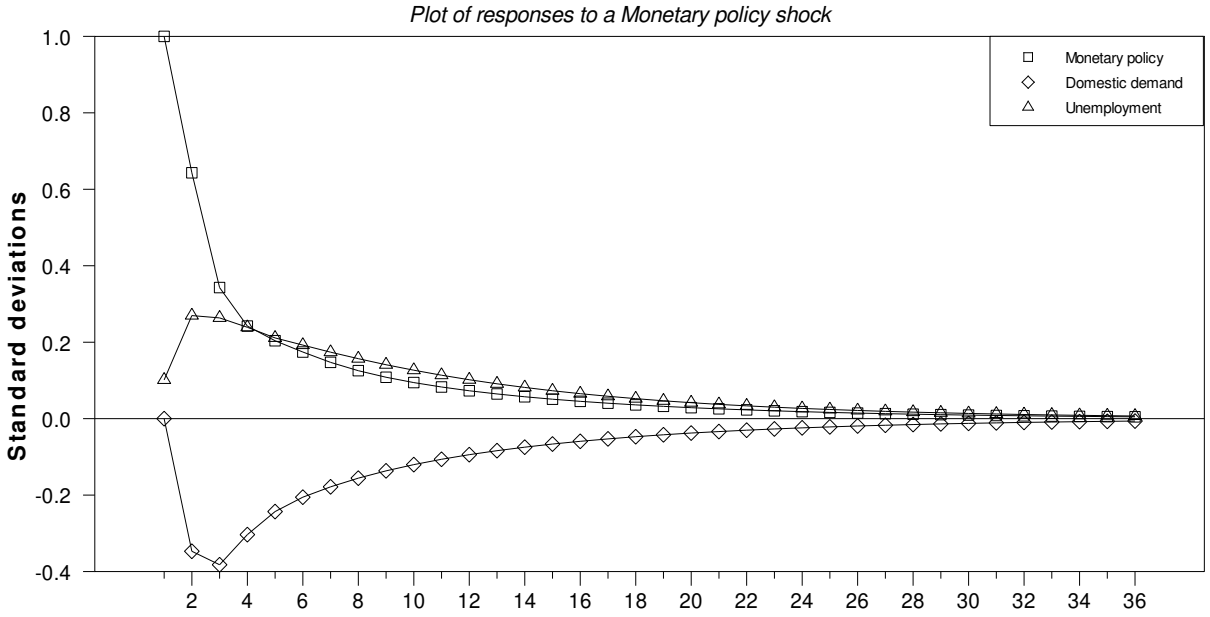
[24] See, for example, Alexius and Holmlund (2008) and Ravn and Simonelli (2008).

In short, our results are consistent with previous findings encountered in Latin America.[25] Unlike those studies however, we argue that the existence of a large informal sector and a growing service sector could explain the velocity of adjustment we just found.

Figure 2 also shows that a contractionary monetary shock has a negative effect on the excess domestic demand. The maximum effect occurs after the first quarter, compared to the second quarter for unemployment. Half of the maximum effect disappears after the seventh quarter. As in unemployment, the estimated impulse response of the domestic excess demand reverts back to zero after six years. This result indicates that when the monetary policy is restrictive, output falls, which is logical since real interest rates affect the cost of capital and thus consumption and investment.

In short, the results indicate that an exogenous tightening of monetary policy will increase unemployment while contracting output below its potential level. Our results do not necessarily contradict other studies. Mendoza (2003), for example, found that Mexico does not have long run volatility trade-off between output and inflation so that monetary policy only affects prices in the long run.

Figure 2: Responses of unemployment and domestic demand




[25] See for example Loboguerrero and Panizza (2007) and Gonzalez (2002).

*6.4 Variance decomposition.*

Next, we examine the forecast error variance. The forecast error variance decomposition tells us the proportion of the movement in a sequence due to its own shocks versus shocks to the other variables. Table 2 reports the forecast error variance decomposition at the 1, 10, 20 and 30 quarter horizon. We are interested in the share of movements in unemployment that is due to monetary policy shocks and to domestic demand (first row). Results indicate that the monetary policy shock accounts for 1 to 26 percent of the fluctuation in unemployment depending on the time horizon. Domestic excess demand shocks account for about 5 percent in the short run, while the share falls to 4 percent at longer horizon. We can observe that in the short run, unemployment is explained by its own innovation in about 93 percent, while the share falls to 69 percent at longer horizon.

Table 2. Variance decomposition

| | *Ln u* | | | | $\tilde{y}$ | | | | *MCI* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 10 | 20 | 30 | 1 | 10 | 20 | 30 | 1 | 10 | 20 | 30 |
| *Ln u* | 93.35 | 71.71 | 69.71 | 69.50 | 5.47 | 4.28 | 4.40 | 4.42 | 1.17 | 23.99 | 25.80 | 26.07 |
| $\tilde{y}$ | 0.00 | 9.07 | 11.17 | 11.40 | 100 | 59.34 | 56.08 | 55.73 | 0.00 | 31.57 | 32.71 | 32.85 |
| *MCI* | 0.00 | 5.02 | 6.92 | 6.88 | 0.72 | 4.94 | 5.04 | 5.04 | 99.27 | 90.02 | 88.26 | 88.06 |

Source: own estimates
Figures in the second row are horizons (i,e. quarters); all others figures are estimates rounded to two decimal places, so rounding errors may sometimes prevent perfect percentage decomposition.

*6.5 Robustness.*

Given that the SVAR is estimated on a number of specific assumptions, we investigate the robustness of our results to variation in these assumptions. Model 1 constitutes our Baseline model already reported. Model 2 includes as a measure of monetary policy an MCI with derivation of relative weights of interest rate and exchange rate from trade share approach by estimating long-rung exports to GDP ratio equation. Based on the AIC and BIC

criteria there are arguments in favor of two or three lags so that in our baseline model we settled for the more parsimonious model specification, i.e., two lags; hence, model 3 is a SVAR model with three lags. Given that two of the three restrictions we needed to identify our SVAR were not theoretically justified, we include in Model 4 the restriction that monetary policy does not respond contemporaneously to neither excess demand or unemployment ($a_{12} = a_{13} = 0$), in addition to the assumption that monetary shocks do not affect excess demand contemporaneously ($a_{21}$). Models 1 through 4 are estimated using the alternative unemployment rate. Model 5 is the baseline model with the official rate of open unemployment.

Figure 3 shows the impulse response function of unemployment to monetary policy shocks in our five SVAR specifications. Except for model five, results are quite robust; the effects reach their maximum after two quarters. The magnitude of the maximum effect varies between 0.26 and 0.50 percentage points where the response is calculated for a monetary policy shock of one standard deviation. As already noted, estimated coefficients when using the official unemployment rate are not consistent with economic theory.

Another interesting feature of this comparative analysis is that five years after the initial shock, unemployment would be between 0.004 and 0.12 percentage point higher that it would have been without the shock. The highest estimated persistence belongs to Model 4, where we imposed the restriction that monetary policy will not respond contemporaneously to the economy; while the model with the lowest estimated persistence is the model with three lags (Model 3).

Figure 3: Impulse Response function

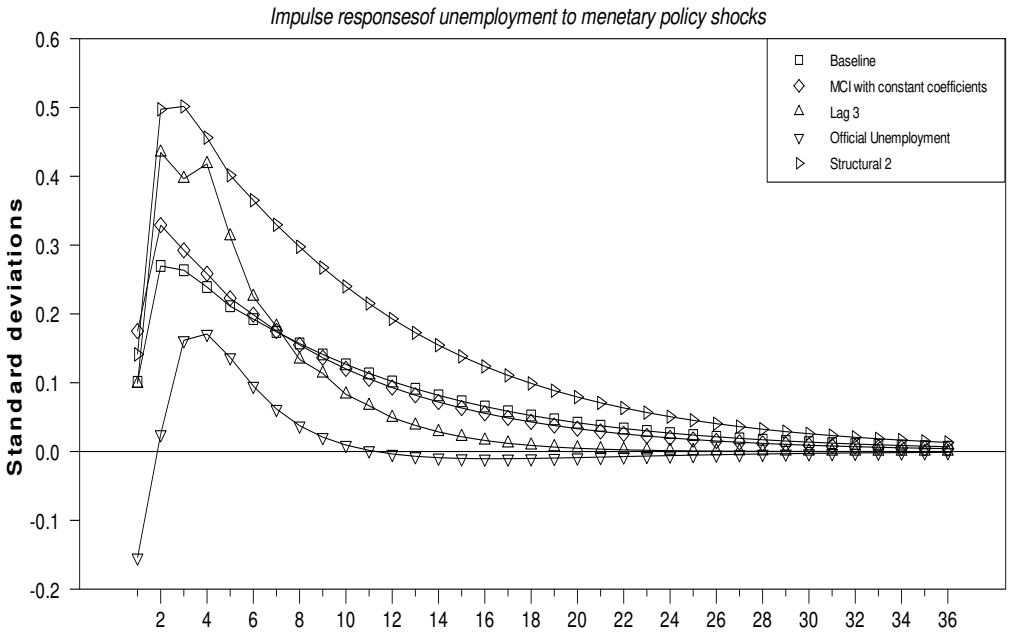



Table 3 reports the forecast error variance decomposition at 1, 10, 20 and 30 quarter horizon. As we can observe, the share of monetary policy shocks in the variance decomposition of unemployment are quite robust at 10, 20 and 30 quarter horizon for models 1 to 4. Results indicate that the monetary policy shocks account for 21 percent at the longer horizon in model with three lags while in our base line model accounts for 26 percent.

Model 5, the one based on the official rate of unemployment deserves special attention. Results indicate that an exogenous tightening of monetary policy (shock) of one percentage point results in 0.15 percentage point drop of unemployment contemporaneously; and then reaches its maximum effect of 0.18 percentage point higher unemployment after four quarters. The estimated impulse response returns to zero after two and a half years. The variance decomposition analysis indicates that official unemployment rates are exogenous with respect to monetary policy shocks.

Table 3: Unemployment variance decomposition

| | *Ln u* | | | | $\tilde{y}$ | | | | *MCI* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *1* | *10* | *20* | *30* | *1* | *10* | *20* | *30* | *1* | *10* | *20* | *30* |
| *Model 1* | 93.35 | 71.71 | 69.71 | 69.50 | 5.47 | 4.28 | 4.40 | 4.42 | 1.17 | 23.99 | 25.80 | 26.07 |
| *Model 2* | 90.45 | 67.35 | 65.63 | 65.05 | 5.88 | 6.10 | 6.92 | 6.95 | 3.65 | 26.03 | 27.43 | 27.54 |
| *Model 3* | 97.87 | 74.45 | 74.55 | 74.55 | 1.21 | 3.61 | 3.99 | 3.99 | 0.95 | 21.93 | 21.45 | 21.44 |
| *Model 4* | 38.88 | 28.82 | 27.58 | 27.45 | 60.33 | 48.60 | 48.08 | 48.03 | 0.77 | 22.57 | 24.32 | 24.50 |
| *Model 5* | 88.61 | 92.14 | 92.51 | 92.51 | 9.28 | 5.54 | 5.31 | 5.30 | 2.10 | 2.29 | 2.17 | 2.17 |

Source: own estimates
Figures in the first column are the models while figures in the second row are horizons (i,e. quarters); all others figures are estimates rounded to two decimal places, so rounding errors may sometimes prevent perfect percentage decomposition.

*7. Conclusions*

We estimated the impact of macroeconomic stabilization policies on Mexican unemployment rates. The analysis is carried out for two unemployment series, -the official rate and an alternative rate estimated following the methodology used by the CPS of the US Bureau of Labor Statistics-, and for different model specifications.

When using the official unemployment rates, the impulse response function indicates that monetary policy shocks induces an initial drop in unemployment rate of about 0.15 percentage points. However, it quickly increases up to 0.18 percentage point by the fourth quarter. But, then unemployment returns to its initial level by the 10$^{th}$ quarter; that is, official unemployment rates suggest that Mexican labor market is very fluid.

When using the alternative unemployment rate, our results indicate that monetary policy is no neutral in the short and medium terms. The impulse response function suggests that the impact of a monetary policy shock on unemployment varies from 0.26 to 0.50 percentage points under different sets of assumptions. Another important result is that after 5 years of the initial shock, unemployment would be between 0.004 and 0.12 percentage points higher than it would have been without the shock.

Variance decomposition analysis complements the impulse response function findings. In effect, while the models based on our alternative measure of unemployment suggest that monetary policy can explain up to 27 percent of overall variance, the model based on the

official unemployment rate indicates that monetary policy can only explain up to 2.2 percent of total variations in unemployment!. Obviously, these results represent a puzzle that needs further investigation.

Our estimates of the unemployment elasticity to monetary shocks suggest that its effect on the former is rather low. However, the velocity of adjustment to such shocks is relatively higher than found in European countries, for example. The low impact of monetary policy can be explained by the existence of some institutional rigidity; namely, the existence of intrusive labor regulation and labor unions. These rigidities impede a fuller adjustment to policy shocks. However, there are other elements within the labor market that allows, over time, a relatively quick adjustment to such shocks. Among these elements we consider the existence of a large informal sector and a growing service sector where much of labor legislation is not enforced.

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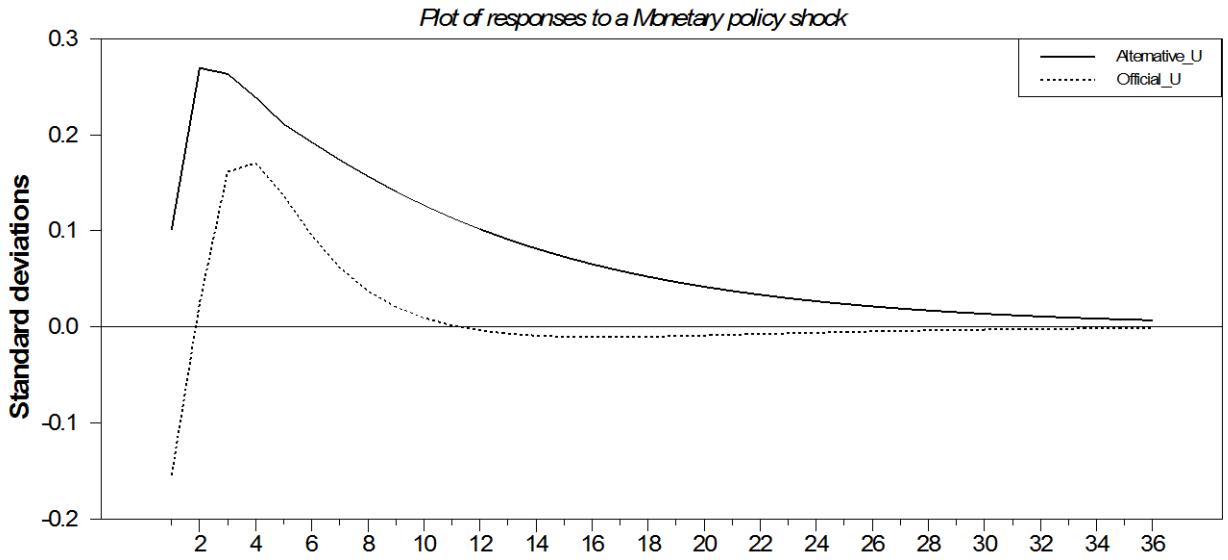
## Appendix

Table A1: SVAR estimates
(p-values in parenthesis)

| | *Unemployment Ln (u)* | *Domestic demand (y-y*)* | *Monetary Policy (MCI)* |
|---|---|---|---|
| *Ln (u)* | 0.761 | -0.369 | 0.837 |
| | (0.000) | (0.072) | (0.133) |
| *(y-y*)* | -0.005 | 0.562 | 0.246 |
| | (0.919) | (0.000) | (0.382) |
| *L(MCI)* | 0.025 | -0.073 | 0.689 |
| | (0.081) | (0.007) | (0.000) |
| *US output (q-q*)* | -0.184 | 0.300 | 0.188 |
| | (0.015) | (0.036) | (0.621) |
| *Productivity (t)* | -0.026 | 1.894 | 3.645 |
| | (0.918) | (0.000) | (0.008) |
| *Fiscal Surplus (g)* | 0.105 | -3.149 | -15.615 |
| | (0.869) | (0.011) | (0.000) |
| *Lag_inf* | -0.0005 | 0.004 | -0.084 |
| | (0.905) | (0.563) | (0.000) |
| *Time trend* | 0.0009 | -0.037 | -0.021 |
| | (0.878) | (0.002) | (0.498) |
| *Dummy95* | 1.763 | -3.107 | 34.596 |
| | (0.013) | (0.020) | (0.000) |
| *Adjusted ($R^2$)* | 0.831 | 0.809 | 0.869 |
| Log Likelihood -331.18 | | | |
| Portmanteau(12) 107.1656 (0.1411) | | | |

Source: own estimates.
Note: The Table contains the sum of the coefficients on the two lags of each variable. Wald test for joint significance of both lags of each variable. Wald test for joint significance of both lags of each variable. The Portmanteau joint test for white noise residuals is showed.

Figure A1. Impulse response function of a monetary shock




Source: own estimates

Impulse responses of alternative and official unemployment from a one standard deviation shock to monetary policy