DISINFLATION, OUTPUT AND UNEMPLOYMENT: THE CASE OF SPAIN

Javier Andrés, Ignacio Hernando
and J. David López-Salido

Banco de España - Servicio de Estudios
Documento de Trabajo nº 9806

DISINFLATION, OUTPUT AND UNEMPLOYMENT: THE CASE OF SPAIN (*)

Javier Andrés (**), Ignacio Hernando (***)
and J. David López-Salido (***)

(*) We thank José Viñals for asking questions that helped prompt us to study this topic. We would like to thank Juan Ayuso, Rafael Doménech, Fernando Restoy, Javier Vallés and José Viñals for valuable comments and suggestions and Francisco de Castro for excellent research assistance.
(**) Research Department, Banco de España and University of Valencia.
(***) Research Department, Banco de España.

Banco de España - Servicio de Estudios
Documento de Trabajo nº 9806

In publishing this series the Banco de España seeks to disseminate studies of interest that will help acquaint readers better with the Spanish economy.

The analyses, opinions and findings of these papers represent the views of their authors; they are not necessarily those of the Banco de España.

The Banco de España is disseminating some of its principal reports via INTERNET and INFOVÍA.

The respective WWW server addresses are: http://www.bde.es and http://www.bde.inf.

ISSN: 0213-2710
ISBN: 84-7793-595-5
Depósito legal: M. 9784-1998
Imprenta del Banco de España

Abstract

Taking into account two salient Spanish stylized facts, namely, a persistent disinflationary process and hysteresis in the unemployment, this paper tries to answer the following question: Is a nominal permanent disinflation compatible with short-run unemployment costs but also with long-run output benefits?. The answer to this question crucially depends on the way we identify such nominal shocks. When monetary shocks are identified as those that do not generate a long-run trade-off between inflation and unemployment (and inflation in the long-run is primarily, although not exclusively, a monetary phenomenon), the answer to the question is **yes**. The reason is that, although in the data there exists a permanent trade-off between inflation and unemployment, its origin is real.

1. Introduction.

Spain, along with most countries in the European Union, has been involved in a process of steady disinflation so as to approach a situation of price stability. The aim has been thus not only to reduce inflation but to set the stage for a lasting period of price stability. This process is by no means costless for countries with high and persistent unemployment. Yet, the conventional wisdom among monetary policymakers is that although reducing inflation may entail output costs in the short run insofar as prices and wages are sticky and/or disinflation policies are not fully credible, it pays-off in terms of higher per capita income over the medium to long-run. Although there is some international evidence in favour of this view, the literature on the effects of disinflation has followed two seemingly unrelated strands which differ in too many respects so that a straightforward comparison is not possible. On the one hand, many authors have estimated a positive sacrifice ratio following a disinflation (Ball, 1994). On the other hand, the empirical growth literature has found a negative long-run cross-country correlation between inflation and per capita income (Barro (1995) and Andrés and Hernando (1997)). These results need not be inconsistent, but the evidence is far from conclusive. In particular, while many economists argue that the costs of disinflation might be large in the short run (or even permanent in presence of hysteresis in unemployment), the existing evidence in favour of long run benefits of disinflation is weak, and is most so at low levels of inflation.

This paper contributes to piece together the different bits of the empirical disinflation literature. In particular we want to identify the dynamic path followed by unemployment and output after a monetary policy shock to see whether it fits in with the conventional wisdom. In this paper we focus in the case of Spain, which is characterized by medium-high, but steadily subsiding, inflation over the sample period (1976 to 1996), as well as by a very high and persistent unemployment. There is some evidence available as for the long run effect of disinflation in Spain. Thus, Dolado, López-Salido and Vega (1997) find that the sacrifice ratio might be permanent and non-negligible, while Bullard and Keating (1995) reach a similar conclusion and estimate that the long run response of output to a permanent inflation shock is positive. On the other hand, Dolado, González-Páramo and Viñals (1997) add up all the costs (mainly unemployment) and benefits (mostly reducing tax distortions) of disinflation and conclude that reducing inflation leads to a net welfare gain over the long run.

As noted before, the aim of the paper is to uncover the dynamic response of output and unemployment following a permanent nominal shock to the inflation rate. While the theoretical explanation of the short-run sacrifice ratio relies on concepts like informational errors, nominal and real inertias, and so on, the long run effect of inflation operates through the so-called investment or efficiency channels, i.e. undermining the accumulation rate or the efficiency with which productive factors are used. Thus, the task of encompassing, within a unified theoretical framework, the channels through which monetary policy operates in the short run and in the long run is beyond the scope of this paper.[1]

While waiting for theory, our approach is mostly empirical. We pay special attention to identify shocks based on "reasonable" economic theory. In particular, we focus on the identification of nominal (monetary) shocks affecting inflation permanently, and then we look at how the effects of these shocks are propagated over time. Building upon the work of Balmaseda, Dolado and López-Salido (1996, 1997) and Bullard and Keating (1995), we have chosen to approach the relationship among inflation, output and unemployment at different time horizons within the framework of a structural vector autoregressive model (say, SVAR). For such a purpose we mainly invoke alternative long-run restrictions usually considered in the SVAR literature. In this way, we follow the seminal works by Blanchard and Quah

[1] Actually, as recently stated by Solow (1997): "One major weakness in the core of macroeconomics... is the lack of real coupling between the short-run picture and the long-run picture".

(1989) and Shapiro and Watson (1988). Moreover, as a matter of robustness we present different identification exercises combining long and short run restrictions as developed in Galí (1992) and Bean (1992).

Two assumptions turn out to be of crucial importance for the characterization of the shocks: first, the extreme monetarist claim that *inflation is just a monetary phenomenon in the long run*; and second, the belief that *monetary shocks do not generate a long-run trade-off between inflation and unemployment*. These assumptions are jointly rejected by the Spanish data. When monetary shocks are identified as those that do not generate a long-run trade-off between inflation and unemployment, and while inflation in the long run is characterized as being primarily but not exclusively a monetary phenomenon, our main conclusion is the following: although a monetary policy induced disinflation may have long-lasting -or even permanent- effects on unemployment, the efficiency gains outweigh the standard sacrifice ratio like losses, leading to a higher level of income over the long run.

The economic and econometric setups are presented in section 2. In section 3 we estimate and discuss at length the effect of disinflation on output under alternative identification schemes. Finally, section 4 concludes with the interpretation of the results and some additional remarks.

2. Theoretical and empirical framework.

2.1. Economic Issues.

Growth Literature. In the context of models of economic growth, the effects of disinflation have been related to an increase in per capita income as the outcome of capital accumulation and the improvement in the efficiency in the use of productive factors.[2] Thus, the uncertainty associated to a high and volatile unanticipated inflation has been found to be one of the main determinants of the rate of return of capital and investment (Bruno (1993), Pindyck and Solimano (1993)). Other authors argue that even fully anticipated inflation may reduce the rate of return of capital because of the non-neutralities built-in most industrialized countries tax systems (Jones and Manuelli (1995), Feldstein (1996)) or because the way bank regulations interact with monetary policies (Roubini and Sala-i-Martín (1995) and Chari, Jones and Manuelli (1995)). Besides, a high and volatile inflation undermines the confidence of foreign investors over the future course of monetary policy. Inflation, thus, may affect the accumulation of capital as well as other determinants of growth such as human capital or investment in R+D; this channel of influence constitutes what is known as the *accumulation or investment effect* of inflation on growth. But inflation also worsens the long-run macroeconomic performance of market economies by reducing the efficiency with which productive factors are used. This is known as the *efficiency channel* and is harder to formalize in a theoretical model, although its importance within the transmission mechanism from inflation towards lower growth cannot be denied[3]. A high level of inflation induces frequent changes in prices which may be costly for firms (*menu costs*) and reduces the optimal level of cash-holdings by consumers (*shoe-leather costs*). It also leads to bigger forecast errors by distorting the information contents of prices. This encourages economic agents to spend more time and resources in gathering information and protecting themselves against the damages caused by price instability, endangering the efficient allocation of resources.

The empirical validity of these theories has been obtained through convergence-type-cross-country regressions relating inflation and output. Barro

[2] See, for instance, Orphanides and Solow (1990), De Gregorio (1993) and Gylfasson and Herbertson (1996).

[3] As Briault (1995) has rightly pointed out it is very difficult to derive a significant effect of inflation on factor productivity in frictionless general equilibrium competitive models.

(1995) and Andrés and Hernando (1997) use large samples of countries and estimate a negative effect of inflation on the level of per capita income once plausible instruments are accounted for in their statistical analyses. This negative correlation may be used as indicating that it could exist an opportunity for monetary policy to influence growth rates. Nevertheless, the problem with this interpretation comes from the fact that both inflation and output are endogenous variables. So, given this endogeneity, the previously found negative correlation could reflect non-monetary shocks, for instance technology shocks, affecting both variables. That is, the sign of this correlation may be negative because high growth tend to generate low inflation as a result of (exogenous) technological progress (see, for instance, Kocherlakota (1996) and Sims (1996)).

Business Cycle Literature. Most of the existing business cycle literature generates a negative correlation among inflation and unemployment that can be explained in a number of ways on the grounds of nominal price or wage rigidities, relative price misperceptions, credit rationing and the like. In this framework, deliberate monetary policy actions, undertaken with the aim of reducing the inflation rate, are almost always costly, resulting in significant short-run increases in unemployment and output losses. The combination of continuous market clearing and rational expectations in macroeconomic models reduces the significance of the trade-off between inflation and unemployment to the short-run. But, in a country like Spain, the performance of the labor market may play an special role relating business cycle fluctuations with long-run growth. In particular, the hysteresis theory of unemployment explains the dependence of the long-run growth from the short-run movements in the activity. More formally, in some models (see Blanchard and Summers (1986) and Layard, Nickell and Jackman (1991)), where such a *hysteresis mechanisms* play an important role in explaining unemployment dynamics, such a disinflationary strategy may have long-lasting effects on output.(4)

(4) Although this is an important issue for the European economy, it is particularly so for Spain (see, for instance, Blanchard and Jimeno (1995) and Blanchard *et al.* (1995)).

Keeping these theoretical considerations in mind, in this paper we take an empirical approximation to the joint analysis of the short and long-run real effects of disinflationary processes. To summarise, we do so for two reasons. First, because it is by no means easy to portray all these long-run and short-run features in a simple dynamic macroeconomic model which captures what we consider the most salient feature of a process of disinflation: the changing pattern from the short-run negative correlation between inflation and unemployment to the long-run negative one between inflation and output[(5)]. Second, because if one succeeds in constructing a general equilibrium model displaying such a pattern, it would hardly consider more than a few out the many channels through which inflation is related to unemployment and output.

2.2. The Empirical Strategy.

In order to keep the dimension at a minimum, we specify our model as a 3 variables VAR in stationary representations of unemployment (u), inflation (π) and the log of output (y) or of observed labour productivity (y-n). There are several advantages of this parsimonious representation. First, in a structural VAR model all variables involved are endogenous, as inflation, unemployment and output are in any macroeconomic model. This is most important for our purposes, since equations relating inflation and growth have been often criticized on the grounds of the endogeneity of inflation. Second, the analysis of the relation among inflation and growth is often blamed by not discriminating among different types of shocks behind inflation. Inflation and output being endogenous variables, the correlation among them must differ depending on the type of shocks (i.e. demand or supply) that dominate at each point in time. The SVAR methodology enables us to estimate

(5) Some authors have explored the long run effects of monetary policies in models with learning-by-doing (Stadler (1990) and Pelloni (1997)). These models are not useful for our purposes since they extend to the long-run (i.e. to output) the short run effect of monetary policies upon unemployment, whereas we want to allow for a changing sign in this effect as time goes by.

different structural shocks driving the variables during the sample period. Thus, we can look for the correlation among a nominal demand shock (monetary policy) and output, which is our primary interest. Third, since we do not derive our econometric setup from any particular theoretical model we want to be careful as to which theoretical restrictions are imposed on the data. The SVAR methodology has the advantage of making explicit the identifying assumptions. In particular we shall work with the minimal set of restrictions needed to identify the model, which can be justified on the grounds of a variety of theoretical models. These refer mainly to the long run correlation among the variables in the model. Thus, we shall emphasize the importance of long run restrictions resorting to the short run ones just to check the robustness of the results when necessary. Similarly, the SVAR approach permits a clear distinction among short run and long run responses to particular shocks. This is most important since the timing of the response to disinflation is what we are mainly interested in. In particular, the most likely pattern is one in which the negative effect of disinflation comes first, whereas the benefits take much longer to show up.

For the Spanish case, we consider that a stationary representation of inflation, output and unemployment is one in which these variables appear in first differences[6]. Notice, that this means that the rate of growth of output is stationary, and hence it cannot change permanently in response to inflation shocks. Thus, the long run real effect of inflation would, if any, produce a permanent change in the level of output but not a permanent change in its rate of growth[7]. The representation for the unemployment rate deserves a more thorough discussion. Although the conclusions that one can draw from Spanish labour market studies differ somewhat, they tend to share a common issue: the evidence suggests that the

[6] See Appendix 1 where we present the available sample period and variables' definition, and the unit root tests for these variables.

[7] Although the literature of growth often looks for a correlation among growth and inflation, what it finds is most properly a level effect (see Andrés and Hernando (1997) for a detailed discussion of this issue).

role of persistence, and thus the history of shocks, is crucial in explaining such a high structural unemployment[8]. Thus, the superiority of the first difference stationary representation for the unemployment rate can hardly be disputed and, since we want to look at correlations at a very long time horizon, we shall impose it in our empirical model. Nevertheless, which particular structural shocks account for the unit root in unemployment matters for the choice of the appropriate identification scheme. The fact that unemployment has a non-stationary representation has been sometimes considered as a sign of *full hysteresis* and hence of a permanent trade-off among inflation and unemployment. But this does not need to be the case. A simple model of the labor market in Appendix 2 makes clear under what circumstances the unit root of the unemployment rate can have a nominal component. This is of crucial importance for our purposes because models in which the unit root has not a nominal component suggest an additional long run restrictions in the SVAR model. In order to check the robustness of our results, we shall present results pertaining to both representations.[9]

3. Results

Let us consider a 3-variables VAR model, in which the vector X is defined as $\{\Delta\pi, \Delta z, \Delta u\}$. The variable z will represent either labour productivity or the level of output as described in each case. The system is driven by three orthogonal shocks that will be labeled in a way that enable us to use some well known theoretical relationships in the identification process: nominal (ε^{π}), productivity or supply (ε^{z}, i.e $\varepsilon^{(y-n)}$ or ε^{y}) and natural rate of unemployment shock (ε^{u}). These shocks are loosely defined and they might be compounded of a larger set of innovations. However, what

---

[8] See, for instance, Andrés (1993), Bentolila and Dolado (1994), Blanchard *et al.* (1995), Blanchard and Jimeno (1995), Dolado and López-Salido (1996), Dolado, López-Salido and Vega (1997), and the references therein.

[9] In the Appendix 3 we formally discuss the econometric set-up and the identification issues of the SVAR literature used in this paper.

is crucial for our purposes is the ability of the model to isolate the nominal shock, whose long-run real effect is what we are interested in. Since the structural innovations are by definition orthogonal, purely nominal shocks (i.e. shocks to monetary growth) may pertain to either of these ε's but only to one of them. Thus, a more precise definition of ε^u and ε^z is not neccessary, over and above what is neccessary to isolate the nominal shock behind inflation. The structural model in matrix form can be represented as (see Appendix 3):

$$\begin{bmatrix} \Delta\pi \\ \Delta z \\ \Delta u \end{bmatrix} = \begin{bmatrix} c_{11}(1) & c_{12}(1) & c_{13}(1) \\ c_{21}(1) & c_{22}(1) & c_{23}(1) \\ c_{31}(1) & c_{32}(1) & c_{33}(1) \end{bmatrix} \begin{bmatrix} \epsilon^{\pi} \\ \epsilon^{z} \\ \epsilon^{u} \end{bmatrix} \qquad [1]$$

In order to identify the model, we can invoke three well-known economic restrictions usually considered in the literature. First, the extreme monetarist assumption of inflation being in the long run a monetary phenomenon. This assumption means that the unit root of inflation is just money growth and it provides two restrictions in the matrix of long run multipliers; i.e. $c_{12}(1)=c_{13}(1)=0$. Second, the assumption that monetary shocks do not generate a long-run trade-off between inflation and unemployment ($c_{31}(1)=0$). Finally, according to most theories of the natural rate (Layard, Nickell and Jackman, 1991), productivity (output) shocks cannot explain the unit root of unemployment, i.e. $c_{32}(1)=0$.

Notice that, this set of assumptions provides four identifying restrictions and, consequently, the model is overidentified.[10] Using Spanish quarterly data for the period 1976:3-1996:3, these theoretically appealing restrictions are jointly rejected[11]. The reason is that the observed long-run non-zero correlation between inflation and unemployment cannot be explained by models generated by those

---

[10] This is so because we also impose the assumption of orthogonality of the ε's in the SVAR. See Appendix 3 for details.

[11] The test of the overidentifying restriction (distributed χ^2 with one degree of freedom) was 37.96 (when productivity was considered in the SVAR) and 23.33 (for output). See Roberts (1993) for a description of this test.

restrictions, because the sources of inflation and unemployment fluctuations in the long-run are imposed to be orthogonal. In other words, while inflation is explained only by nominal shocks, these shocks do not contribute to explain the observed upward trend in the Spanish unemployment. In fact, all models imposing $c_{12}(1)=c_{13}(1)=c_{31}(1)=0$ are rejected by data, regardless of whether the model is enlarged with additional long-run (i.e. $c_{32}(1)=0$) or short run restrictions.[12]

In order to reconcile the model with the facts, we can consider two alternative sets of identification schemes. First, if our identification strategy relies on the monetarist assumption but allowing for a long-run negatively sloped Phillips curve (i.e. removing $c_{31}(1)=0$), the nominal ε^{π} shocks are the only responsible of the common trend between inflation and unemployment. Alternatively, we can assume a long-run vertical Phillips curve but considering the possibility of more than one shock driving the process of inflation in the long-run (i.e. removing $c_{12}(1)=0$, $c_{13}(1)=0$, or both). In such a case, low frequency relationship between inflation and unemployment is due to real shocks. In what follows, we discuss the results for both sets of identification schemes.

3.1. Inflation is just a monetary phenomenon in the long-run.

The extreme monetarist assumption of inflation being in the long run just a monetary phenomenon was first proposed, in the SVAR literature, by Roberts (1993) and subsequently exploited by Bullard and Keating (1995) in their study on the relationship among inflation and output[13]. In our model, this assumption accounts

[12] This result is in line with those presented by Dolado, López-Salido and Vega (1997) and Dolado, González-Páramo and Viñals (1997).

[13] These latter authors set up a 2 variables SVAR model and assume that whereas output and inflation are driven by two orthogonal shocks (ε^{π}, ε^{y}) only one of them is allowed to have permanent effects on inflation. The results of a similar exercise for our sample period are depicted in Figure 1a (90% confidence intervals

for two long run restrictions in $C(1)$: $c_{12}(1)=c_{13}(1)=0$. As a third restriction, we consider that productivity shocks do not explain the unit root of unemployment, i.e. $c_{32}(1)=0$[14]. This set of restrictions leaves $c_{31}(1)$ unrestricted, thus allowing for a permanent unemployment effect of purely nominal shocks. We shall, rather loosely, call this identifying scheme *monetarist-full hysteresis*, meaning that part of the observed upward trend of unemployment might have a nominal origin (as in model [2] in Section 2.2) and can be represented as follows:

$$\begin{bmatrix}\Delta\pi\\ \Delta z\\ \Delta u\end{bmatrix}=\begin{bmatrix}c_{11}(1) & 0 & 0\\ c_{21}(1) & c_{22}(1) & c_{23}(1)\\ c_{31}(1) & 0 & c_{33}(1)\end{bmatrix}\begin{bmatrix}\epsilon^{\pi}\\ \epsilon^{z}\\ \epsilon^{u}\end{bmatrix} \qquad [2]$$

The main results in terms of impulse-response functions and forecast variance decomposition of this model are depicted in Figure 2a and 2b and in Table 1. A permanent positive shock to the natural rate of unemployment ($\varepsilon^{u}>0$) induces a temporary increase in inflation, a permanent increase in the level of output per worker and an output fall. On the other hand, ε^{y} or $\varepsilon^{(y-n)}$ are well identified as supply shocks. They lead to a permanent increase in output or productivity while their (temporary) effect on inflation is countercyclical[15]. Permanent inflation shocks (ε^{π}) display a negative effect on unemployment at all frequencies. In this specification, the existence of a long run unemployment-inflation trade-off cannot be

---

based on 250 boostrap replications are also reported in the Figures). The real shock is well identified as a supply shock, which increases output forever alongside with a temporary reduction of inflation. The long run response of output to a permanent change in inflation (ε^{π}) is positive, meaning that disinflation is costly also in the long run. Interestingly enough, when productivity enters the model instead of output, the sign of the long run correlation with permanent inflation changes (Figure 1b).

[14] Holding the hypothesis that inflation is determined in the long-run by nominal shocks, we proceeded to relax the hypothesis that $c_{32}(1)=0$. In general, other identification schemes ($c_{12}(1)=c_{13}(1)=0$, plus one short-run restriction) produce extremely similar results so they will not be discussed here.

[15] Somewhat surprisingly though, they contribute very little to explain the behaviour of output at long horizons. We shall discuss this latter.

denied. In fact, nominal shocks contribute to explain over a third of the unit root of unemployment even at long horizons[16] (Table 1).

Turning to the main hypothesis of interest, permanent inflation shocks induces a positive effect on output at all frequencies, which is consistent with the results obtained by Bullard and Keating (1995) and by Dolado and López-Salido (1996). This is a bit puzzling though, since it casts some doubts on the rationale of the increasing attention paid by monetary authorities to the goal of price stability or low inflation. In recent years, based on the strong belief that low inflation pays-off in terms of higher income in the future, most central banks have explicitly adopted a monetary strategy aimed primarily at keeping inflation under control. If inflation were harmless in the long run, the prospects for monetary policy would be gloomy. Since the central bank would have little interest in preventing inflation from rising, an economy could fall very quickly into a high and persistent inflation trap, whose reduction would require massive output losses.

Whereas the long run response of output to inflationary shocks is positive the response of labour productivity is negative. There are two interpretations for these results. On the one hand, a permanent disinflation might move the economy to a higher production function but with a lower level of employment. Thus, disinflation may enhance productivity as the empirical literature of growth predicts, but the permanent increase in unemployment more than compensates the efficiency gains leading to a net fall in output. Alternatively, the economy might simply move to a lower level of activity along an unchanged production function. In such case the increase in observed productivity is a mere consequence of the fall in employment in a model with decreasing returns to scale. Notice that the policy implications of these two explanations are very different. According to the former, permanent disinflations would still be beneficial although their advantages would only accrue if supported by labour market policies which succeed in reducing the level of

---

[16] From 27% in the model with output up to a 39% in the model with productivity.

unemployment persistence. However, if the latter were true the benefits of disinflation would be nil.

Summing up, on the one hand, the *extreme monetarist-non-hysteresis* identifying schemes (those that do not allow for a permanent trade-off between inflation and unemployment driven by nominal shocks) were rejected by the data. The reason was that they are unable to explain the observed long-run non-zero correlation between inflation and unemployment because the sources of inflation and unemployment fluctuations in the long-run are imposed to be orthogonal. On the other hand, the *extreme monetarist-full hysteresis* identification schemes we have been working with have an unpleasant feature: the only thing that the unit root of inflation and that of unemployment have in common is the so-called nominal shock ε^{π}. But, even among those economists that admit a strong persistence in Spanish unemployment, not many would accept that a monetary surprise may exert a permanent effect on unemployment. The only way in which a long-run vertical Phillips curve might be imposed on the data, while still giving the correlation among inflation and unemployment a chance, is if we consider the possibility of more than one shock driving the process of inflation in the long run (see for instance, Evans (1994)).

3.2. Inflation might result from various shocks.

How can a non-monetary source of long-run inflation be rationalized? Although differences in money growth must account for most of the cross-country differences in inflation, many authors argue that the influence of other, non-monetary, factors cannot be denied. A strand of the literature of international trade suggests that relative inflation is partially explained by structural differences both on the demand and on the supply side of the economy.[17] The argument relies in the

[17] See, among others, Balassa (1964), Samuelson (1964) or, more recently, De Gregorio, Giovannini and Wolf (1994) and Campillo and Miron (1996).

different pricing behaviour of firms in sectors exposed to the international competition as compared with that of firms specialized in the production of non tradeable goods. If the productivity in the tradables sector grows faster than that in the non-tradables, the productivity gain leads to higher wages and labour demand. This in turn produces an across-the-board increase in wages that is translated into higher prices in those sectors with monopolistic power. Similar effects can result from increases in public spending[18]. An alternative approach is represented by Ball and Mankiw (1995) who show that if the distribution of relative prices present skewness, due to menu costs, real shocks may have an effect upon the general price level. What these real theories of inflation have in common is that shocks which do not have a monetary origin might exert a lasting influence on the inflation rate[19].

The existence of a non-monetary source of inflation may be also rationalized making use of the equation of exchange which in first differences relates inflation (π, say changes in the price level) to changes in money (m), output (y) and velocity (v):[20]

$$\pi = \Delta m + \Delta v - \Delta y \qquad [3]$$

the assumption of two shocks (monetary and non-monetary) driving inflation may be interpreted in terms of equation [3]. In this general set-up, since v is usually taken as a residual, the non-monetary shock might be considered as a shock to this component that, while affecting inflation pennanently does lead neither to a long-run shift in the growth rate of the economy nor to changes on money growth. More precisely, the shocks considered by most real theories of inflation operate through

---

[18] See Rogoff (1992) and Martín Moreno (1996).

[19] Balke and Wynne (1996) show how inflation may occur even without money growth, merely as a consequence of real shocks.

[20] As it stands, equation [3] is nothing more than an identity - a relationship that it is true by definition -. Further assumptions about the velocity behavior transform this equation in the *quantity theory of money*.

stochastic movements in this residual, thus exerting a long-lasting influence on inflation and output.

All in all, most economist would argue that over and above these real shocks, persistent inflation requires monetary accomodation[21]. If this is so, all models are monetarist and there is not a relevant distinction among real and monetarist theories of inflation in the very long run. Despite this ambiguity, there are reasons to allow for more than one source of long-run inflation movements (i.e. to remove either $c_{13}(1)=0$ or $c_{13}(1)=0$). First, from an econometric perspective, the time horizon at which money can be considered fully accomodated, and thus the only source of inflation, may be very long. If this is the case, extreme monetarism is an infinite horizon property, and as argued by Faust and Leaper (1994) it may be wise not imposing it as a long run restriction at finite horizons. Second, although allowing for more than one source of inflation is controversial, since it is by no means easy to give a precise interpretation to all of them, the orthogonality of shocks ensures that only one of these contains the nominal component (i.e. monetary growth), the one whose effect we are interested in. Third, removing this restriction makes the model less restricted so we have the chance of testing whether inflation in Spain has had a substantial non-monetary component.

There are many identification schemes in which inflation is allowed to be influenced by real shocks also over the long run, all of which are characterized by the long-run multipliers $c_{13}(1)$ and $c_{12}(1)$ not being zero at the same time. Our empirical model is identified under the assumption that inflation might be affected in the long-run by two shocks. In order to stick to the SVAR approach we need one long run restriction to compensate for the zero that has been removed. The only sensible long run restriction available is that $c_{31}(1)=0$. Thus, we assume that the low frequency movements in unemployment are only determined by natural rate shocks (say, ε^u). Notice also that, in this case we are not allowing for nominal variables to

[21] See, for instance, Ball (1993) for a discussion of this issue.

have permanent effects on the unemployment level. This assumption turns out to be very important and we discuss it more thoroughly at the end of this section. According to this, we are left with two sets of long run identifying restrictions: $R1=\{c_{31}(1)=c_{32}(1)=c_{12}(1)=0\}$ and $R2=\{c_{31}(1)=c_{32}(1)=c_{13}(1)=0\}$. We do not consider the identification scheme R2, because it imposes that there is not a common trend for inflation and unemployment. Then, we shall first discuss the results of the model identified under the restriction set *R1* and next we shall asses their robustness by means of alternative identification schemes combining short run and long run restrictions.

The results corresponding to *R1* are summarized in Figure 3 and Table 2. Both ε^{y} and $\varepsilon^{(y-n)}$ are well identified as supply shocks, with a short run influence on unemployment. Their short run effect on inflation is, as expected, countercyclical and neither of them contribute to the forecast variance decomposition of inflation at any time horizon. Again, the contribution of supply shocks to explain the unit root of output is surprisingly low (from 27% in the short-run to 9% in the long-run) as compared with the contribution of ε^{u}. This may reflect the importance of unemployment persistence in Spain in shaping the course of output and the fact that the restriction of demand shocks having no effect on long run output is difficult to maintain(22). Notice that our identification scheme does not restrict this effect to zero and the response of output or productivity to ε^{u} shocks is strong and significant over the long run. Finally, ε^{u} shocks are mostly real demand shocks, since they are associated with a permanent fall in inflation and in output.

The assumption of two shocks driving inflation seems well accepted by the data. As can be seen from Table 2, positive one-period impulses to ε^{π} and ε^{u} produce permanent changes in inflation. Even assuming that there are several forces of long-run inflation, to what extent does our identification scheme succeeds in allocating nominal and real components to ε^{π} and ε^{u} respectively?. We interpret ε^{u} as an

(22) See, for instance, Dolado and López-Salido (1996), Andrés, Mestre and Vallés (1997) and Dolado, López-Salido and Vega (1997).

inflation shock that has a real component with permanent effects upon the natural rate of unemployment, whereas ε^{π} can be interpreted as a nominal shock. Notice that ε^{u} explains most of unemployment and a great deal of output too, which makes it hard to consider it a nominal shock. On the other hand ε^{π} behaves as a nominal demand shock. It is demand since the short run correlation with unemployment displays a Phillips curve pattern: the increase in inflation leads to a rapid, although not very pronounced, fall in unemployment in the short run. As inflation reaches its steady-state level, unemployment subsides slowly returning to its previous level in about 20 quarters. Several results indicate that ε^{π} must collect the nominal determinants of inflation. First, although our identification scheme allows for non-monetary determinants of inflation, money is still expected to be the most important one, and ε^{π} accounts for most of the variance of the forecast error of inflation over the long run (70%). Second, although the long run impact of both inflation shocks upon output is left free, the contribution of ε^{π} to the forecast variance decomposition of output and productivity is virtually nil (below 1%).

Turning now to our main hypothesis of interest, we find, as it was the case under the extreme monetarist identification scheme, that both stochastic components of inflation have a negative effect on productivity over the long run. Also, the response of output to normalized impulses in ε^{u} is positive but, unlike we found under the monetarist-full-hysteresis identification, now the response of output to impulses in ε^{π} is negative and strongly significant, specially in the long run. Thus, conditioned on our characterization of ε^{π} being adequate, we have identified a negative effect of a nominal demand driven disinflation on long term income, which is of the same sign to that found in the literature of growth. It is true that the other shock driving inflation (ε^{u}) displays a positive correlation with income, but this by no means, contradicts the claim that disinflation with a monetary origin generates beneficial effects in the long run.[(23)]

---

(23) Notice that the growth literature acknowledges that inflation is not expected to have the same effect upon income regardless of its causes. Fischer (1993) and Andrés and Hernando (1997) split the sample period to compare the output-inflation

From these results, the main message coming from the different bits of the disinflation literature is confirmed: even for a high unemployment country like Spain, permanent disinflations achieved through a permanent fall in monetary growth might have significant short run unemployment costs, but end up having net beneficial permanent effects on output. Furthermore, the path following a permanent disinflation is one of a initial increase in unemployment with a fall or modest increase in output followed by a long run stronger positive output effect. This path is consistent with the previous results in the literature. The main cost of disinflation comes first, due to nominal rigidities. When all prices adjust, and the level of unemployment gets back to its previous level, output increases rapidly to achieve its new long run level. Additionally, our results show that the way disinflation is pursued matters. In particular, non-monetary disinflations, i.e. those that are achieved through permanent cuts in real demand, impose upon the economy a permanent cost. What happens in this case is just that the way in which disinflation proceeds is not through a pure nominal disinflation, hence the unemployment effects are long lasting and outweigh the efficiency gains.

Two additional issues are relevant at this point. On the one hand, we want to check the robustness of this result within the family of non extreme monetarist identification schemes. With that purpose, we have tried many other identification schemes, substituting out in *R1* or *R2* one or two long-run identification restrictions by short run ones.[24] According to the results summarized in Table 3, the pattern obtained with *R1* as regards the negative long run output effect of impulses to ε^{π} is clearly predominant (in 70% of the cases).

---

correlation across periods in which the predominant shocks behind inflation have changed. In a way, our approach here can be considered as a step ahead in that direction. Instead of identifying the predominant shocks in such a crude manner, the SVAR methodology allows for a better identification of the shocks driving inflation.

[24] Note that once we substitute in R2 one long-run identification restriction by a short-run one, the sources of inflation and unemployment fluctuations are no longer orthogonal.

On the other hand, notice also that the *R1* (or *R2*) identification scheme differs from the extreme monetarist-full-hysteresis one not only in relaxing the restriction on $c_{13}(1)$ (or $c_{12}(1)$) but also in that it imposes $c_{31}(1)=0$ (i.e. the absence of long-run co-movements between inflation and unemployment due to nominal shocks). Thus, the role played by the assumption of no permanent influence of ε^{π} on unemployment must be carefully assessed. One way to do so is by comparing the non extreme monetarist identification schemes that leave the long run impact of nominal shocks upon unemployment free (i.e. *non extreme monetarist-full hysteresis*), with those that set it to zero (*non extreme monetarist-non hysteresis*). As can be seen in Table 3, the long run response of output to nominal permanent inflation shocks is less robust to changes in the identification scheme, among the former. More precisely, when the model converges, the negative long run effect of ε^{π} on output it is obtained just in about a half of these cases (non dashed rows). Conversely, among those identification schemes that impose $c_{31}(1)=0$ (dashed rows), the pattern of a negative long run effect of shocks of the ε^{π} type upon output (and hence of significant benefits of disinflation) is overwhelmingly obtained (15 out of 16 of the cases).

4. Concluding remarks.

In this paper we have analyzed the short-run and the long-run response of both unemployment and output following a permanent shock to the inflation rate in the Spanish economy. For that purpose, the identification of the sources of permanent fluctuations in the inflation rate is of crucial importance and the SVAR is the best of the bunch among the suitable methodologies. Thus, our results turn out to be dependent on the set of assumptions invoked to identify nominal (i.e. monetary) shocks, in particular to two of these. The first one is the extreme monetarist claim that *inflation is just a monetary phenomenon in the long-run*, so that only shocks to the money supply can explain the unit root of inflation. The second one is common to most theories of the business cycle and simply argues that *monetary shocks do not generate a long-run trade-off between inflation and unemployment.* These theoretical restrictions are clearly at odds with the recent Spanish experience and are jointly rejected by the data. The main reason behind this result is a simple one: the existence of a long-run non-zero correlation between inflation and unemployment cannot be explained by models generated by those restrictions, because the sources of inflation and unemployment fluctuations in the long-run are imposed to be orthogonal.

In order to reconcile the model with the facts either of those assumptions has to be removed. First, to identify nominal shocks we can invoke the extreme monetarist assumption, so inflation is just a monetary phenomenon, but allowing for a long run negatively sloped Phillips curve. This means that money is behind both inflation and unemployment, which sets some common grounds among the unit root of these two variables, thus accounting for their observed long-run correlation. Following this avenue the main result is that inflation does not produce a permanent harm to the economy. In fact, disinflation is costly, mainly because it produces a permanent increase in unemployment. At face value this result seems to contradict the most widely shared belief among central bankers according to which no matter how costly disinflation could be in the short run it must lead to higher output and welfare in the future. But this combination of the monetarist assumption with the extreme keynesian one (i.e. full hysteresis) is neither very appealing nor the only way to reconcile the SVAR with the facts.

Second, and alternatively, we can assume that what the unit roots of inflation and unemployment have in common is something real. This means that a long-run vertical Phillips curve must be restored, imposing that money does not account for the long run behaviour of unemployment. What is more debatable though is that this identification scheme gets rid of the extreme monetarist assumption allowing two or more shocks to shape the inflation path even in the long run. The results in this case differ from the ones obtained under the extreme monetarist scheme. Inflation is mostly, but not only, a monetary phenomenon and a nominal disinflation leads to a long run increase in both output and productivity. Thus a process of permanent disinflation, engineered by the monetary authority, might lead to a temporary increase in unemployment (along a short-run Phillips curve trade-off). However, once unemployment is back to its (unchanged) natural rate, the economy reaches a new long run equilibrium with both higher productivity and output.

In other words, if inflation were 'always and everywhere only a monetary phenomenon' we should conclude that inflation is costless, and that disinflation imposes upon the economy a permanent cost. However, if inflation has also a non monetary component, although reducing inflation working through the real bit (using non-monetary demand policies) is painful, reducing the monetary component is not so. The cause is that although both disinflation strategies do rise productivity, the rise in unemployment associated to the former leads to a net real output loss whereas this increase is low or nil following a purely monetary shock and the productivity gains predominate over the long run. Since the output gain is permanent its present value outweighs that of the increased unemployment at a zero discount rate, and thus moving towards price stability by appropiate monetary policies is justified on economic grounds.

TABLE 1. FORECAST ERROR VARIANCE DECOMPOSITION
Inflation is money in the long-run
(Model Equation [2])

Model with Productivity		ε_π	ε_u	ε_{y-n}
Inflation	1	62(9)	37(9)	1(0)
	4	83(4)	16(4)	1(0)
	8	90(2)	9(2)	0(0)
	12	93(2)	7(2)	0(0)
	40	98(1)	2(1)	0(0)
Unemployment	1	32(11)	60(11)	8(2)
	4	40(11)	59(11)	1(0)
	8	41(11)	59(11)	0(0)
	12	40(11)	60(11)	0(0)
	40	39(11)	61(11)	0(0)
Productivity	1	3(5)	2(5)	95(6)
	4	22(9)	11(8)	68(8)
	8	29(10)	20(10)	51(8)
	12	32(10)	24(11)	44(8)
	40	35(11)	32(11)	33(7)

Model with output		ε_π	ε_u	ε_y
Inflation	1	63(9)	37(9)	0(0)
	4	77(6)	22(6)	1(0)
	8	87(3)	12(3)	1(0)
	12	90(2)	9(2)	1(0)
	40	97(1)	3(1)	0(0)
Unemployment	1	21(8)	33(11)	47(10)
	4	33(9)	49(9)	18(4)
	8	34(9)	60(9)	5(1)
	12	30(9)	66(9)	2(1)
	40	27(9)	72(9)	0(0)
Output	1	10(8)	63(8)	27(6)
	4	14(8)	70(8)	16(4)
	8	16(8)	71(8)	12(3)
	12	16(8)	73(8)	11(2)
	40	16(8)	75(8)	9(2)

TABLE 2. FORECAST ERROR VARIANCE DECOMPOSITION
Inflation is not only money in the long-run
$R1=\{c_{31}(1)=c_{32}(1)=c_{12}(1)=0\}$

Model with Productivity		ε_u	ε_π	ε_{y-n}
Unemployment	1	92(2)	0(0)	8(2)
	4	99(0)	0(0)	1(0)
	8	100(0)	0(0)	0(0)
	12	100(0)	0(0)	0(0)
	40	100(0)	0(0)	0(0)
Inflation	1	0(2)	99(2)	1(0)
	4	9(6)	91(6)	1(0)
	8	23(9)	76(9)	0(0)
	12	26(10)	74(10)	0(0)
	40	35(11)	65(11)	0(0)
Productivity	1	5(5)	0(3)	95(6)
	4	30(9)	3(4)	68(8)
	8	47(9)	2(4)	51(8)
	12	54(9)	2(3)	44(8)
	40	66(7)	1(2)	33(7)

Model with output		ε_u	ε_π	ε_y
Unemployment	1	53(11)	1(3)	47(10)
	4	81(5)	2(2)	18(4)
	8	94(2)	1(1)	5(1)
	12	97(1)	1(0)	2(1)
	40	100(0)	0(0)	0(0)
Inflation	1	1(3)	99(3)	0(0)
	4	2(2)	97(2)	1(0)
	8	12(6)	87(6)	1(0)
	12	15(7)	84(7)	1(0)
	40	22(9)	77(9)	0(0)
Output	1	71(6)	2(2)	27(6)
	4	82(4)	1(2)	16(4)
	8	87(3)	1(1)	12(3)
	12	88(3)	1(1)	11(2)
	40	90(2)	1(1)	9(2)

TABLE 3. SENSITIVITY TO ALTERNATIVE IDENTIFICATION SCHEMES

A. MODELS WITH TWO SOURCES OF INFLATION IN THE LONG RUN

IDENTIFICATION SCHEME (1)	SOURCE OF DISINFLATION (2)						LONG RUN FORECAST ERROR VARIANCE DECOMPOSITION OF π (k=40)					
	ε^u		ε^π		$\varepsilon^y/\varepsilon^{y-n}$		Model with y-n			Model with y		
	y-n	y	y-n	y	y-n	y	ε^u	ε^π	ε^{y-n}	ε^u	ε^π	ε^y
$C_{12}(1) = C_{31}(1) = C_{32}(1) = 0$	(+) [66]	(-) [90]	(+) [1]	(+) [1]	(+) [33]	(+) [9]	35	65	0	22	77	0
$C_{13}(1) = C_{31}(1) = 0;\ C_{31}(0) = 0$	(-) [48]	(+) [27]	(+) [4]	(+) [0]	(+) [48]	(-) [73]	0	64	36	1	75	24
$C_{13}(1) = C_{31}(1) = 0;\ C_{32}(0) = 0$ (3)												
$C_{13}(1) = C_{31}(1) = 0;\ C_{12}(0) = 0$ (3)												
$C_{13}(1) = C_{31}(1) = 0;\ C_{21}(0) = 0$	(+) [28]	(+) [44]	(+) [1]	(+) [0]	(+) [71]	(-) [56]	0	65	35	1	72	27
$C_{12}(1) = C_{31}(1) = 0;\ C_{31}(0) = 0$	(+) [48]	(-) [73]	(+) [4]	(+) [0]	(-) [48]	(+) [27]	36	64	0	24	75	1
$C_{12}(1) = C_{31}(1) = 0;\ C_{12}(0) = 0$	(+) [53]	(-) [91]	(+) [3]	(+) [1]	(¿?) [47]	(+) [8]	35	65	0	22	78	0
$C_{12}(1) = C_{31}(1) = 0;\ C_{32}(0) = 0$	(+) [88]	(-) [26]	(-) [0]	(-) [0]	(+) [12]	(+) [74]	38	61	1	43	55	2
$C_{12}(1) = C_{31}(1) = 0;\ C_{21}(0) = 0$	(+) [71]	(-) [56]	(+) [1]	(+) [0]	(+) [28]	(+) [44]	35	65	0	27	72	1
$C_{13}(1) = C_{32}(1) = 0;\ C_{31}(0) = 0$ (3)												
$C_{13}(1) = C_{32}(1) = 0;\ C_{32}(0) = 0$	(-) [48]	(+) 27	(+) [48]	(-) 73	(+) [4]	(+) 0	0	36	64	1	24	75
$C_{13}(1) = C_{32}(1) = 0;\ C_{12}(0) = 0$	(-) [27]	(+) 76	(+) [42]	(-) 15	(-) [31]	(+) 9	2	97	1	3	97	0
$C_{13}(1) = C_{32}(1) = 0;\ C_{21}(0) = 0$ (3)												
$C_{12}(1) = C_{32}(1) = 0;\ C_{31}(0) = 0$	(+) [65]	(-) 86	(+) 2	(+) 5	(-) 33	(+) 9	30	69	0	33	67	0
$C_{12}(1) = C_{32}(1) = 0;\ C_{32}(0) = 0$ (3)												
$C_{12}(1) = C_{32}(1) = 0;\ C_{12}(0) = 0$ (3)												

IDENTIFICATION SCHEME (1)	SOURCE OF DISINFLATION (2)						LONG RUN FORECAST ERROR VARIANCE DECOMPOSITION OF π (k=40)					
	ε^{u}		ε^{π}		$\varepsilon^{y}/\varepsilon^{y-n}$		Model with y-n			Model with y		
	y-n	y	y-n	y	y-n	y	ε^{u}	ε^{π}	ε^{y-n}	ε^{u}	ε^{π}	ε^{y}
$C_{12}(1) = C_{32}(1) = 0;\ C_{21}(0) = 0$	(+) 67	(-) 91	(-)0	(-) 0	(+) 33	(+) 9	55	45	0	12	88	0
$C_{13}(1) = 0;\ C_{31}(0) = C_{32}(0) = 0$ (3)												
$C_{13}(1) = 0;\ C_{12}(0) = C_{31}(0) = 0$	(¿?) 43	(+) 11	(+) 3	(+)4	(+) 54	(-) 85	0	66	34	0	68	31
$C_{33}(1) = 0;\ C_{21}(0) = C_{31}(0) = 0$	(+)26	(+) 36	(+) 2	(+) 0	(+) 72	(-) 64	0	71	29	1	77	21
$C_{13}(1) = 0;\ C_{12}(0) = C_{32}(0) = 0$	(-)42	(+) 27	(+) 49	(-) 0	(-) 9	(-) 73	2	92	6	1	84	15
$C_{13}(1) = 0;\ C_{21}(0) = C_{32}(0) = 0$	(-) 50	(+) 84	(+) 46	(-) 5	(+) 4	(-) 10	0	37	63	3	21	76
$C_{13}(1) = 0;\ C_{12}(0) = C_{21}(0) = 0$	(-)9	(+) 38	(+) 21	(-) 2	(+) 71	(-) 61	2	95	3	2	88	11
$C_{12}(1) = 0;\ C_{31}(0) = C_{32}(0) = 0$	(+) 87	(-) 22	(+) 1	(-) 4	(+) 12	(+) 74	28	71	1	18	79	3
$C_{12}(1) = 0;\ C_{12}(0) = C_{31}(0) = 0$	(+) 52	(-) 86	(+) 4	(+) 6	(+) 44	(+) 8	34	66	0	34	66	0
$C_{12}(1) = 0;\ C_{21}(0) = C_{31}(0) = 0$	(+) 72	(-) 64	(+) 2	(+) 0	(+) 26	(+) 36	29	71	0	21	77	1
$C_{12}(1) = 0;\ C_{12}(0) = C_{32}(0) = 0$ (3)												
$C_{12}(1) = 0;\ C_{21}(0) = C_{32}(0) = 0$	(+) 78	(-) 23	(+) 10	(+) 3	(+) 12	(+) 74	10	89	1	84	13	3
$C_{12}(1) = 0;\ C_{12}(0) = C_{21}(0) = 0$	(+) 22	(-) 92	(+) 34	(-) 0	(+) 44	(+) 8	95	5	0	11	88	0

B. MODELS WITH THREE SOURCES OF INFLATION IN THE LONG RUN

IDENTIFICATION SCHEMES (1)	SOURCE OF DISINFLATION (2)						LONG RUN FORECAST ERROR VARIANCE DECOMPOSITION OF π (k=40)					
	ε^m		ε^π		$\varepsilon^y/\varepsilon^{y-n}$		Model with y-n			Model with y		
	y-n	y	y-n	y	y-n	y	ε^m	ε^π	ε^{y-n}	ε^m	ε^π	ε^y
$C_{21}(1) = C_{32}(1) = 0; C_{31}(0) = 0$	(+) [64]	(-) [90]	(+) [4]	(+) [0]	(-)[30]	(+)[10]	35	64	1	22	75	3
$C_{21}(1) = C_{32}(1) = 0; C_{31}(0) = 0$	(+) [66]	(-) [90]	(-) [30]	(+) [10]	(+) [4]	(+) [0]	35	1	64	22	3	75
$C_{31}(1) = C_{32}(1) = 0; C_{12}(0) = 0$	(+) [66]	(-) [90]	(+) [3]	(+) [1]	(-) [31]	(+) [9]	35	65	0	22	78	0
$C_{31}(1) = C_{32}(1) = 0; C_{21}(0) = 0$	(+) [66]	(-) [90]	(+) [1]	(+)[0]	(+) [33]	(+) [10]	35	65	0	22	72	6
$C_{31}(1) = 0; C_{31}(0) = C_{32}(0) = 0$	(+) [87]	(-) [22]	(+) [4]	(+) [0]	(-) [9]	(-) [78]	28	64	8	18	75	6
$C_{31}(1) = 0; C_{12}(0) = C_{31}(0) = 0$	(-) [3]	(-) [67]	(+) [4]	(+) [0]	(+) [93]	(-) [33]	12	64	24	4	75	21
$C_{31}(1) = 0; C_{21}(0) = C_{31}(0) = 0$ (3)												
$C_{31}(1) = 0; C_{12}(0) = C_{32}(0) = 0$	(+) [87]	(-) [25]	(+) [3]	(+) [2]	(-) [9]	(-) [73]	29	65	6	8	77	15
$C_{31}(1) = 0; C_{21}(0) = C_{32}(0) = 0$	(+) [88]	(-) [22]	(+) [1]	(+) [0]	(-) [11]	(-) [78]	33	65	2	25	72	4
$C_{31}(1) = 0; C_{12}(0) = C_{21}(0) = 0$	(+) [45]	(+) [44]	(+) [1]	(+) [0]	(+) [54]	(-) [56]	1	65	34	1	72	27
$C_{32}(1) = 0; C_{31}(0) = C_{32}(0) = 0$	(+) 87	(-) 22	(-) 9	(+) 78	(+) 4	(+) 0	28	8	64	18	6	75
$C_{32}(1) = 0; C_{12}(0) = C_{31}(0) = 0$	(+) 66	(-) 85	(+) 4	(+) 6	(-) 31	(+) 9	34	66	0	34	66	0
$C_{32}(1) = 0; C_{21}(0) = C_{31}(0) = 0$	(+) 64	(-) 90	(+) 2	(+) 0	(+) 34	(+) 10	29	71	0	19	77	4
$C_{32}(1) = 0; C_{12}(0) = C_{32}(0) = 0$ (3)												
$C_{32}(1) = 0; C_{21}(0) = C_{32}(0) = 0$	(+) 51	(-) 94	(+) 45	(-) 0	(+) 4	(+) 6	0	36	64	12	13	75
$C_{32}(1) = 0; C_{12}(0) = C_{21}(0) = 0$	(+) 58	(-) 91	(-) 11	(-) 0	(-) 31	(¿?) 9	88	11	1	11	88	0

NOTES:

(1) $C_{ij}(1) = 0$: long run restriction;
$C_{ij}(0) = 0$: short run restriction.

(2) This shows the long run forecast error variance decomposition of productivity (output) and the sign of the long run responses of productivity (output) to the different shocks.

(3) Convergence not achieved after 2000 iterations.

FIGURE 1.A (IMPULSE-RESPONSE FUNCTIONS FOR OUTPUT)

Inflation is money in the long-run (Bullard-Keating)

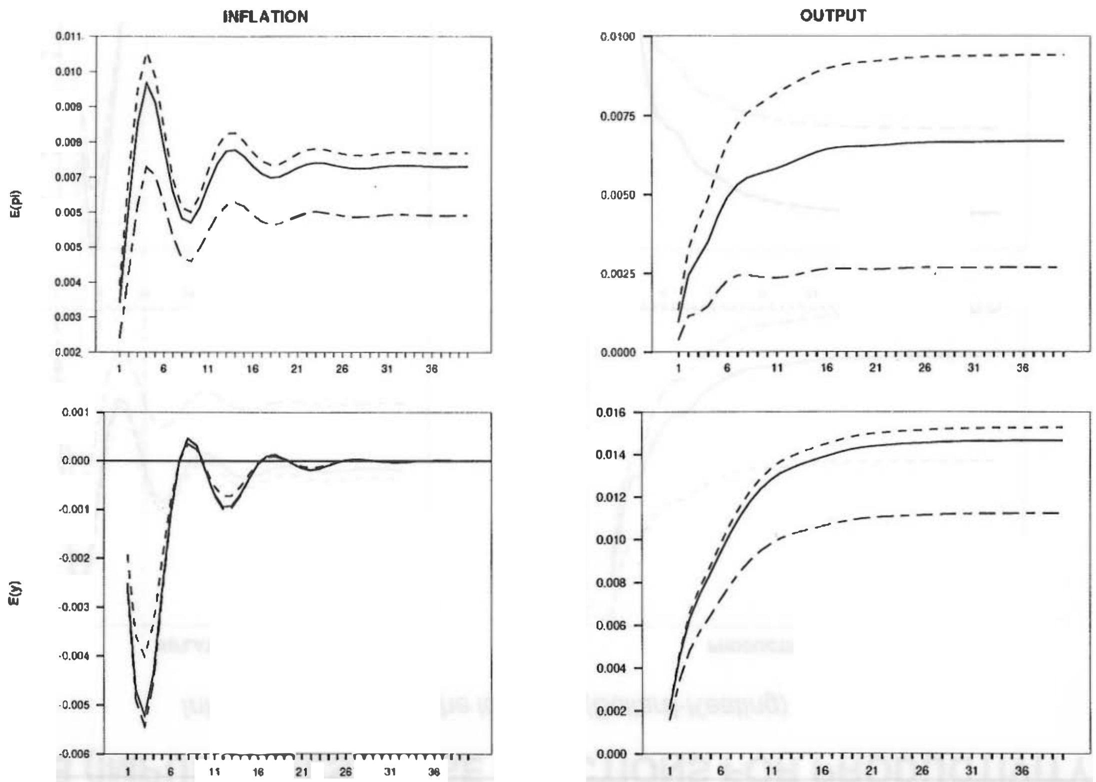


FIGURE 1.B (IMPULSE-RESPONSE FUNCTIONS FOR PRODUCTIVITY)

Inflation is money in the long-run (Bullard-Keating)

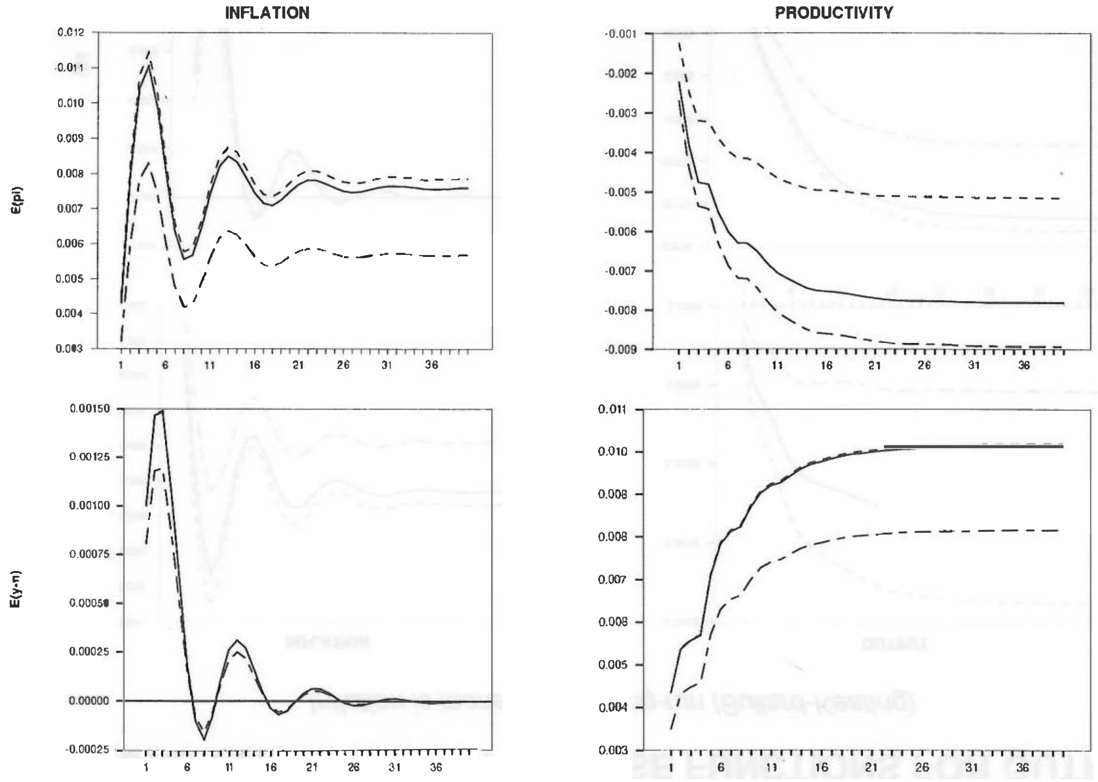


FIGURE 2.A (IMPULSE-RESPONSE FUNCTIONS FOR OUTPUT)

Inflation is money in the long-run

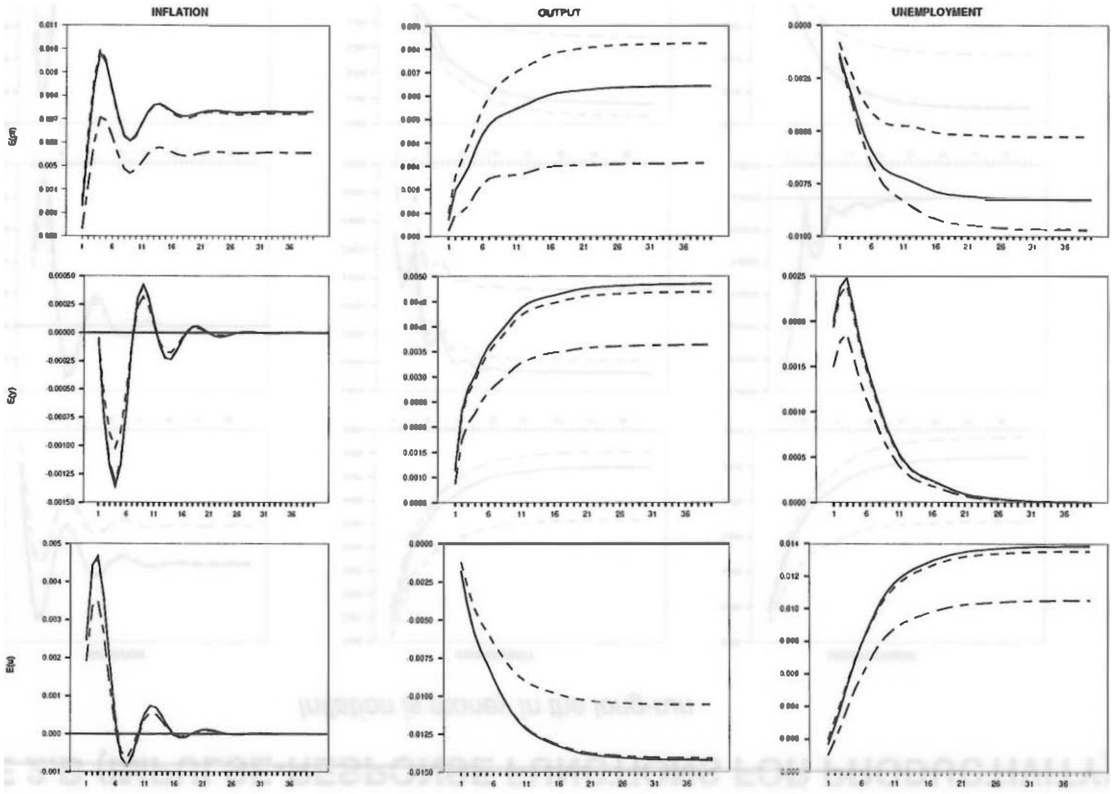


FIGURE 2.B (IMPULSE-RESPONSE FUNCTIONS FOR PRODUCTIVITY)

Inflation is money in the long-run

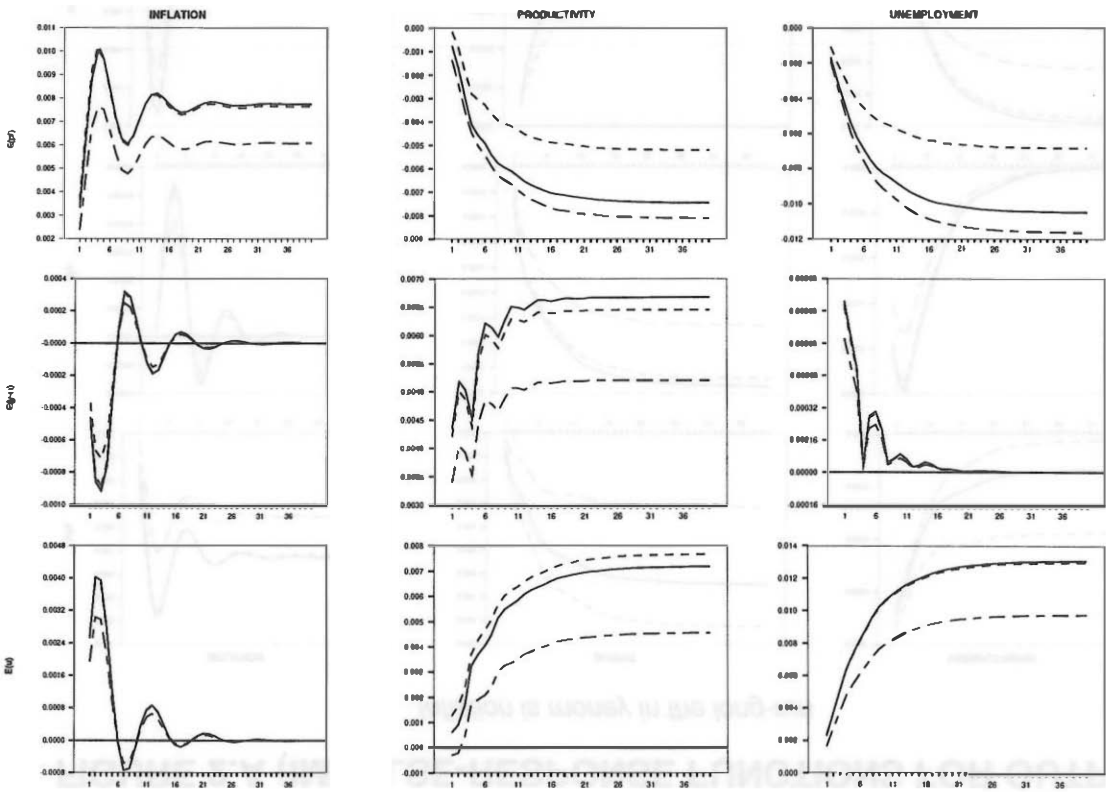


FIGURE 3.A (IMPULSE-RESPONSE FUNCTIONS FOR OUTPUT)

Inflation is not only money in the long-run

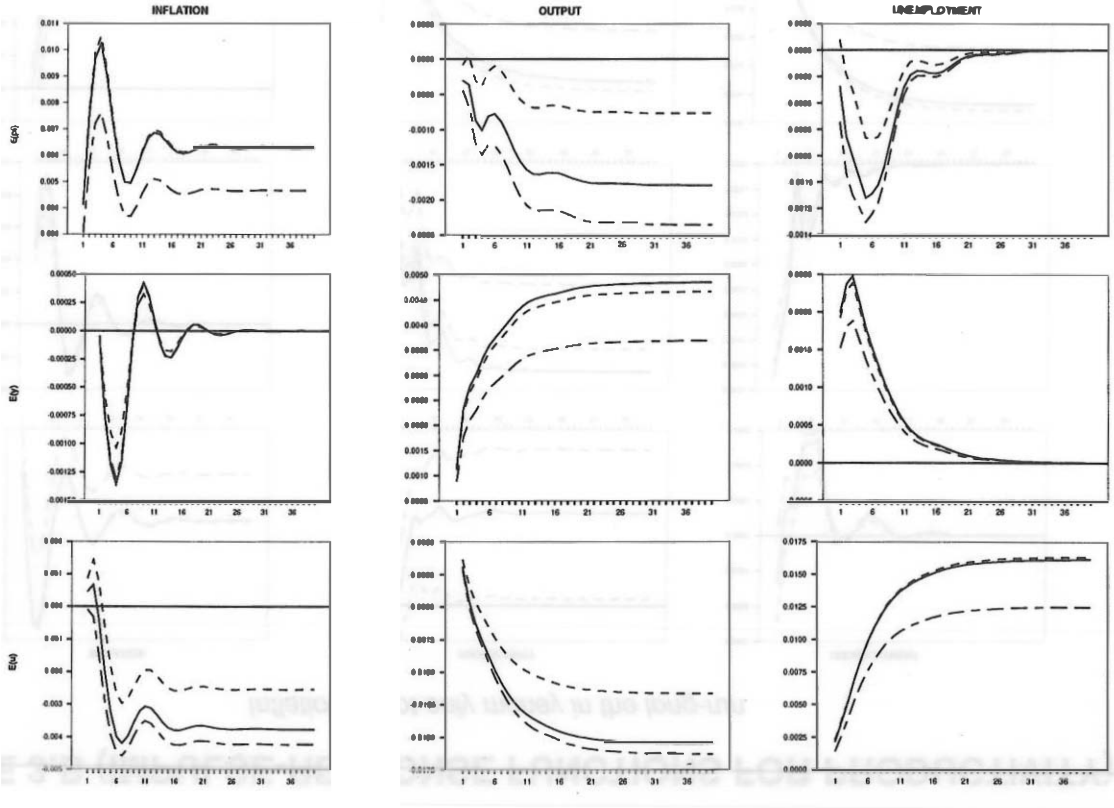
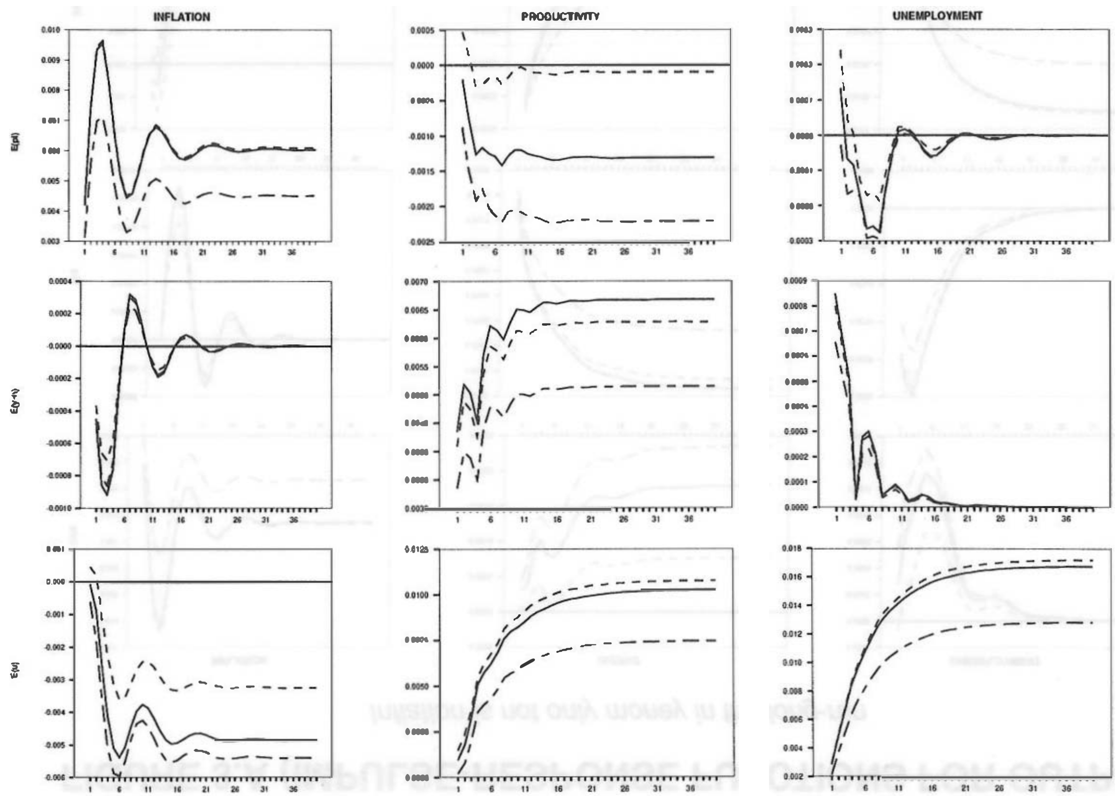


FIGURE 3.B (IMPULSE-RESPONSE FUNCTIONS FOR PRODUCTIVITY)

Inflation is not only money in the long-run



APPENDIX 1
UNIVARIATE ANALYSIS OF THE VARIABLES
(Unit root tests)

Variables Definition: Output (Y) defined as GDP expressed in 1986 prices and GDP implicit price deflator (P) are from Quarterly National Accounts (*Instituto Nacional de Estadística)*. Annual inflation rate is defined as $\pi_t = \Delta_4 \log P_t$. Employment (N) defined as the total employment and rate of total unemployment (u) are from *Instituto Nacional de Estadística* (*Encuesta de Población Activa -EPA-*). Sample Period: From 1976.III to 1996.IV.

Unit Root Tests: See Table.

We estimate all the VAR containing four lags, a constant term and seasonal dummies. The results are extremely robust to use inflation defined as CPI annual rate.

UNIT ROOT TESTS (Augmented Dickey-Fuller; $H_0 \gamma = 0$)

$$\Delta X_t = \alpha + \beta t + \gamma X_{t-1} + \sum_{j=1}^{p} \delta_j \Delta X_{t-j} + \epsilon_t$$

ΔX		α≠0, β≠0			α≠0, β=0		α=0, β=0
	p	α	β	γ	α	γ	γ
Δy	6	0.49 (2.9)	$2 \cdot 10^{-3}$ (2.94)	-0.03 (-2.89)	0.003 (0.08)	$-1 \cdot 10^{-4}$ (-0.06)	$5.4 \cdot 10^{-3}$ (1.68)
$\Delta (y-n)$	6	0.11 (0.49)	$2.8 \cdot 10^{-5}$ (0.13)	-0.02 (-0.46)	0.08 (2.30)	-0.01 (-2.21)	$4.9 \cdot 10^{-4}$ (2.22)
$\Delta \pi$	3	1.21 (2.06)	-0.01 (-1.99)	-0.08 (-2.46)	0.06 0.54	-0.02 (-1.66)	-0.01 * (-2.67)
Δu	6	0.48 (2.44)	0.004 (0.95)	-0.03 (-1.96)	0.42 (2.25)	-0.02 (-2.04)	0.001 (0.42)

$$\Delta X_t = \alpha + \beta t + \gamma X_{t-1} + \sum_{j=1}^{p} \delta_j \Delta X_{t-j} + \sum_{i=1}^{3} S_i Q_i + \epsilon_t$$

ΔX		α≠0, β≠0			α≠0, β=0		α=0, β=0
	p	α	β	γ	α	γ	γ
Δy	3	0.38 (2.60)	$1.6 \cdot 10^{-4}$ (2.60)	-0.02 (-2.59)	0.009 (0.28)	$-4.8 \cdot 10^{-4}$ (-0.23)	$1.1 \cdot 10^{-4}$ (2.48)
$\Delta (y-n)$	4	0.22 (1.04)	$1.5 \cdot 10^{-4}$ (0.73)	-0.03 (-1.03)	0.07 (2.04)	-0.01 (-2.08)	$-1.7 \cdot 10^{-4}$ (-0.66)
$\Delta \pi$	5	1.64 (2.54)	-0.02 (-2.40)	-0.11 (-3.02)	0.13 0.86	-0.03 (-2.18)	-0.02 ** (-2.25)
Δu	5	-0.13 (-0.69)	0.005 (1.49)	-0.04 (-2.75)	-0.21 (-1.08)	-0.02*** (-2.61)	-0.03* (-5.71)

*** Significant at 1%**
**** Significant at 5%**
***** Significant at 10%**

APPENDIX 2
A STYLIZED MODEL OF THE LABOR MARKET

Let us consider the following simple version of the *insiders-outsiders* model of the labour market. The expressions for the supply (n^s) and demand (n^d) for labour are:

$$n_t^s = g_0 + g_1 (w_t - p_t) \quad [2.1]$$

$$n_t^d = g_2 - g_3 (w_t - p_t - a_t) \quad [2.2]$$

where all *g's* are positive, *w-p* and *a* represent the real wage and total factor productivity. Workers set the nominal wage before the realization of current variables is known, as to achieve the highest real wage compatible with a given employment target (n^I):

$$w_t^I = p_t^e + a_t + \frac{g_2}{g_3} - \frac{n_t^I}{g_3} \quad [2.3]$$

Thus the unemployment rate behaves according to:

$$U_t \approx n_t^s - n_t^d = (n_{t-1}^s - n_t^I) - g_3 (p_t - p_t^e) + \Delta n_t^s \quad [2.4]$$

Let us assume the following general expression for n^I:

$$n_t^I = (1-\gamma) n_t^s + \gamma n_{t-1} - Z_t \quad [2.5]$$

The employment target of the insiders is a weighted average of the current labour supply and past employment. Also this employment target is lower the higher the distortions induced by some labour market institutions captured by *Z* (unemployment benefit duration, minimum wages, etc.). The parameter γ (which lies between *0* and *1*) captures the power of *insiders* (employment protection legislation, hiring and firing costs and the like), such that the higher that power the higher γ.

Thus, the Phillips curve can be written (adding and subtracting p_{t-1} as:

$$U_t = \gamma U_{t-1} - g_3 (\pi_t - \pi_t^e) + \lambda Z_t + \gamma \Delta n_t^s \quad [2.6]$$

Notice that when γ is strictly lower than *1* the unit root of unemployment is purely real and should be explained by the presence of non stationary components in *Z*. When γ is equal to *1*, the nominal surprise enters in the unit root of unemployment (along with other real components):

$$U_t = U_{t-1} - g_3(\pi_t - \pi_t^e) + \lambda Z_t + \Delta n_t^s \qquad [2.7]$$

APPENDIX 3
ECONOMETRIC SETUP

Let us assume that $X=\{\Delta\pi, \Delta z, \Delta u\}$ is a covariance stationary vector that can be represented as a moving average of current and past serially uncorrelated structural shocks ε's. The variable z will represent either labour productivity or the level of output as described in each case. In matrix form (in Gali's (1992) notation) the structural model can be represented as follows:

$$X_t = C(L)\epsilon_t \qquad [3.1]$$

where $C(0)=I$. Let us also assume that X_t admits the following reduced form moving average representation:

$$X_t = E(L)\nu_t \qquad [3.2]$$

where the ν's are the innovations in the elements of X, that are correlated with variance-covariance matrix,

$$\Sigma = E\nu\nu' \qquad [3.3]$$

The autoregressive representation of the reduced-form is:

$$B(L)X_t = \nu_t \qquad [3.4]$$

where $B(0)=I$, $B(L)=E(L)^{-1}$. A crucial assumption is that the vector of innovations, ν_t, can be written as linear combination of the vector structural disturbances, say ε_t:

$$\nu = S\epsilon \qquad [3.5]$$

which means

$$C(L) = E(L)S \qquad [3.6]$$

Under these assumptions, the autoregressive representation of the structural model is given by,

$$A(L)X_t = \epsilon_t \qquad [3.7]$$

where $A(0)=S^{-1}$.

The purpose of the exercise is to obtain an estimate of *C(L)* and ε, so that the dynamics of *X* in response to structural disturbances can be traced out. Estimates of *B(L)*, *v* and the variance-covariance matrix of *v* can be obtained by OLS from the reduced-form autoregressive representation (expression [3.4]). Then, *E(L)* is obtained inverting *B(L)*. We need an estimate of *S* in order to obtain *C(L)* and ε. Notice that under the assumption of orthogonality of the ε's, and under the appropriate normalisation, *E*εε'=*I*. Thus the following relationship holds:

$$\Sigma = Evv' = E[S\epsilon\epsilon' S'] = SE[\epsilon\epsilon']S' = SS' \qquad [3.8]$$

Since there are 6 different elements on the estimated variance-covariance matrix of *v*'s we have 6 non linear equations involving the elements of *S* of the form:

$$\sum_{k=1}^{n} S_{ik} S_{kj} = \sigma_{ij} \qquad [3.9]$$

Thus, we still need 3 restrictions to estimate the 9 elements on *S*. These ought to be obtained imposing additional restrictions in the model. For that purpose we proceed making use of the relations suggested by economic theory. In particular, we will mainly impose long-run restrictions -i.e. restrictions upon *C(1)*-, and, in some cases, we will combine long and short-run restrictions -i.e restrictions both upon *C(1)* and *S*, respectively-.

REFERENCES

Andrés, J. (1993): "La persistencia del desempleo agregado: Una panorámica", Moneda y Crédito, 197, 91-127.

Andrés, J. and Hernando, I. (1997): "Does inflation harm economic growth? Evidence for the OECD", NBER Working Paper 6062.

Andrés, J., Mestre, R. and Vallés, J. (1997): ""A structural model for the analysis of the monetary transmission mechanism", Forthcoming in Monetary Policy and Inflation in Spain, McMillan.

Balassa, B. (1964): "The purchasing power parity doctrine: a reappraisal", Journal of Political Economy, 72, 584-596.

Balke, N. and Wynne, M. (1996): "Supply shocks and the distribution of price changes", Federal Reserve Bank of Dallas, Economic Review, First quarter, 10-18.

Ball, L. (1993): "What causes inflation?", Federal Reserve Bank of Philadelphia Business Review, March/April, 3-12.

Ball, L. (1994): "What determines the sacrifice ratio?", in Monetary Policy, Mankiw, G. (ed.), University of Chicago Press.

Ball, L. and Mankiw, G. (1995): "Relative price changes as aggregate supply shocks", Quarterly Journal of Economics, February, 161-193.

Balmaseda. M., Dolado, J. and López-Salido, D. (1996): "Hysteresis and the source of shocks: a cross-country analysis", CEMFI Working paper n. 9614.

Balmaseda, M., Dolado, J. and López-Salido, D. (1997): "The dynamic effect of disturbances and the cyclical behavior of wages: a comment", mimeo.

Barro, R. (1995): "Inflation and economic growth". Bank of England Economic Bulletin, 1-11.

Bean, C. (1992): "Identifying the causes of British unemployment", mimeo LSE, August.

Bentolila, S. and Dolado, J.J. (1994): "Labour flexibility and wages: Lessons from Spain", Economic Policy, 18, 53-99.

Blanchard, O. and Summers, L. (1986): "Hysteresis and the european unemployment problem", NBER Macroeconomic Annual, 15-78

Blanchard, O. and Quah, D. (1989): "The dynamic effects of aggregate demand and supply disturbances", American Economic Review, 79, 656-673.

Blanchard, O. and Jimeno, J.F. (1995): "Structural unemployment: Spain versus Portugal", American Economic Review Papers and Proceedings, 85(2), 212-18.

Blanchard, O. *et al.* (1995), Spanish Unemployment: Is there a Solution?, CEPR London.

Briault, C. (1995): "The costs of inflation", Bank of England Economic Bulletin, 33-45.

Bruno, M. (1993): "Inflation and growth in an integrated approach", NBER Working Paper 4422.

Bullard, J. and Keating, J. (1995): "The long-run relationship between inflation and output in postwar economies", Journal of Monetary Economics, 36, 477-496.

Campillo, M. and Miron, J. (1996): "Why does inflation differ across countries?", NBER Working paper n. 5540.

Chari, V. V., Jones, L. and Manuelli, R. (1995): "The growth effects of monetary policy", Federal Reserve Bank of Minneapolis Quarterly Review, 18-32.

De Gregorio, J. (1993): "Inflation, taxation, and long-run growth", Journal of Monetary Economics, 31, 271-298.

De Gregorio, J., Giovannini, A. and Wolf, H. (1994): "International evidence on tradeables and nontradeables inflation", European Economic Review, 38, 1225-1244.

Dolado, J. and López-Salido, D. (1996): "Histéresis y fluctuaciones económicas (España 1970-1994)", Moneda y Crédito, 202, 117-149.

Dolado, J., González-Páramo, J. M. and Viñals, J. (1997): "A cost-benefit analysis of going from low inflation to price stability in Spain", Banco de España, mimeo.

Dolado, J., López-Salido, D. and Vega, J. L. (1997): "Spanish unemployment and inflation persistence: Are there Phillips trade-offs?", mimeo Bank of Spain, updated version of the CEPR Discussion Paper n. 1 483.

Evans, Ch. (1994): "The post-war U.S. Phillips curve. A comment", Carnegie-Rochester Conference Series on Public Policy, 41, 221-230.

Faust, J. and Leeper, E. (1994): "When do long-run identifying restrictions give reliable results?, Federal Reserve Bank of Atlanta, Working Paper 94-2.

Feldstein, M. (1996): "The costs and benefits of going from low inflation to price stability", NBER working paper 5469.

Fischer, S. (1993): "The role of macroeconomic factors in growth", Journal of Monetary Economics, 32, 485-512.

Galí, J. (1992): "How well the IS-LM model fit postwar U.S data", Quarterly Journal of Economics, 107, 709-738.

Gylfason, T. and Herbertsson, T. (1996): "Does inflation matter for growth?", Center for Economic Policy Research, Discussion Paper 1503.

Jones, L. and Manuelli, R. (1995): "Growth and the effects of inflation", Journal of Economic Dynamics and Control, 19, 1405-1428.

Kocherlakota, N. (1996): "Inflation and Growth: Comentary", Federal Reserve Bank of St. Louis Review, May/June 1996, 170-172.

Layard, R., Nickell, S. and Jackman, R. (1991): Unemployment. Macroeconomic performance and the labour market, Oxford University Press.

Martín Moreno, J.M. (1996): "Consumo público e inflación dual", Instituto Complutense de Análisis Económico, Documento de Trabajo 9605.

Orphanides, A. and Solow, R. (1990): "Money, inflation and growth", en B. M. Friedman and F. Hahn (eds.), Handbook of Monetary Economics, vol. I.

Pelloni, A. (1997): "Nominal shocks, endogenous growth and the business cycle", Economic Journal, 107, 467-474.

Pindyck, R. and Solimano, A. (1993): "Economic instability and aggregate investment", NBER working paper 4380.

Roberts, J. (1993): "The sources of business cycles: a monetarist interpretation", International Economic Review, 34, 923-934.

Rogoff, K. (1992): "Traded goods consumption smoothing and the random walk behaviour of the real exchange rate", Bank of Japan, Monetary and Economic Studies, 10, 2, 1-29.

Roubini, N. and Sala-i-Martin, X. (1995): "A growth model of inflation, tax evasion and financial repression", Journal of Monetary Economics, 35, pp. 275-301.

Samuelson, P. (1964): "Theoretical notes on trade problems", Review of Economics and Statistics, 46, pp. 145-154.

Shapiro, M. and Watson, M. (1988): "Sources of Business Cycle Fluctuations", NBER Macroeconomic Annual 1988, 111-148.

Sims, C.(1996): "Inflation and Growth: Comentary", Federal Reserve Bank of St. Louis Review, May/June 1996, 173-178.

Stadler, G. (1990): "Business cycle models with endogenous technology", American Economic Review, 80, 763-777.

WORKING PAPERS (1)

9708 **Jeffrey Franks:** Labor market policies and unemployment dynamics in Spain.

9709 **José Ramón Martínez Resano:** Los mercados de derivados y el euro.

9710 **Juan Ayuso and J. David López-Salido:** Are *ex-post* real interest rates a good proxy for *ex-ante* real rates? An international comparison within a CCAPM framework.

9711 **Ana Buisán y Miguel Pérez:** Un indicador de gasto en construcción para la economía española.

9712 **Juan J. Dolado, J. David López-Salido and Juan Luis Vega:** Spanish unemployment and inflation persistence: Are there phillips trade-offs?

9713 **José M. González Mínguez:** The balance-sheet transmission channel of monetary policy: The cases of Germany and Spain.

9714 **Olympia Bover:** Cambios en la composición del empleo y actividad laboral femenina.

9715 **Francisco de Castro and Alfonso Novales:** The joint dynamics of spot and forward exchange rates.

9716 **Juan Carlos Caballero, Jorge Martínez y M.ª Teresa Sastre:** La utilización de los índices de condiciones monetarias desde la perspectiva de un banco central.

9717 **José Viñals y Juan F. Jimeno:** El mercado de trabajo español y la Unión Económica y Monetaria Europea.

9718 **Samuel Bentolila:** La inmovilidad del trabajo en las regiones españolas.

9719 **Enrique Alberola, Juan Ayuso and J. David López-Salido:** When may peseta depreciations fuel inflation?

9720 **José M. González Mínguez:** The back calculation of nominal historical series after the introduction of the european currency (An application to the GDP).

9721 **Una-Louise Bell:** A Comparative Analysis of the Aggregate Matching Process in France, Great Britain and Spain.

9722 **Francisco Alonso Sánchez, Juan Ayuso Huertas y Jorge Martínez Pagés:** El poder predictivo de los tipos de interés sobre la tasa de inflación española.

9723 **Isabel Argimón, Concha Artola y José Manuel González-Páramo:** Empresa pública y empresa privada: titularidad y eficiencia relativa.

9724 **Enrique Alberola and Pierfederico Asdrubali:** How do countries smooth regional disturbances? Risksharing in Spain: 1973-1993.

9725 **Enrique Alberola, José Manuel Marqués and Alicia Sanchís:** Unemployment persistence, Central Bank independence and inflation performance in the OECD countries. (The Spanish original of this publication has the same number.)

9726 **Francisco Alonso, Juan Ayuso and Jorge Martínez Pagés:** How informative are financial asset prices in Spain?

9727 **Javier Andrés, Ricardo Mestre and Javier Vallés:** Monetary policy and exchange rate dynamics in the Spanish economy.

9728 **Juan J. Dolado, José M. González-Páramo y José Viñals:** A cost-benefit analysis of going from low inflation to price stability in Spain.

9801 **Ángel Estrada, Pilar García Perea, Alberto Urtasun y Jesús Briones:** Indicadores de precios, costes y márgenes en las diversas ramas productivas.

9802 **Pilar Álvarez Canal:** Evolución de la banca extranjera en el período 1992-1996.

9803 **Ángel Estrada y Alberto Urtasun:** Cuantificación de expectativas a partir de las encuestas de opinión.

9804 **Soyoung Kim:** Monetary Policy Rules and Business Cycles.

9805 **Víctor Gómez and Agustín Maravall:** Guide for using the programs TRAMO and SEATS.

9806 **Javier Andrés, Ignacio Hernando and J. David López-Salido:** Disinflation, output and unemployment: the case of Spain.

(1) Previously published Working Papers are listed in the Banco de España publications catalogue.

Queries should be addressed to: Banco de España
Sección de Publicaciones. Negociado de Distribución y Gestión
Telephone: 338 51 80
Alcalá, 50. 28014 Madrid