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ABSTRACT

In this paper we consider that the relationship between nominal exchange rate and prices depends on the nature of the shocks impacting the economy. In order to identify the sources of nominal exchange rate and relative price fluctuations in Spain we impose long-run restrictions on the dynamics of these variables through a 2-variable and 3-variable SVAR, respectively. According to our results, supply and real demand shocks move nominal exchange rates and relative prices in opposite directions. Nominal shocks, however, move both variables in the same direction. Thus, only under nominal shocks, which account for half the variability of the nominal exchange rate, may peseta depreciations fuel inflation.

1. INTRODUCTION

Exchange rates are closely monitored because they are thought to have important effects on other economic variables. Conventional wisdom welcomes nominal exchange rate depreciations or devaluations because they improve competitiveness, but they are also feared because they may bring about inflation so dampening the initial competitive gains. In this work we address this second issue.

The transmission of exchange rate movements to domestic prices has been extensively analysed in many theoretical and empirical papers. This exchange rate pass-through literature has focused on how domestic prices react to nominal exchange rate movements.[1] In particular,it tries to estimate the effect of exchange rate movements on subsequent domestic price movements.

This view, however, may be misguiding because both the exchange rate and prices respond to the shocks impinging on the economy, so that both variables are simultaneously determined. In principle, neither can be considered weakly exogenous. The reason is that the relationship between nominal exchange rate and domestic inflation depends on the nature of the shocks hitting the system. Only when shock-induced exchange rate movements have additional -or second round- effects on inflation, through import prices and inflation expectations, can the exchange rate pass-through be properly identified. Moreover, if different shocks (i.e. monetary, fiscal, productivity...) dominate in different periods, the usual pass-through analysis would probably provide rather unstable results.

In this paper we explore, as an alternative but complementary route, whether the peseta nominal exchange rate may have actually acted as an important transmission channel from shocks to prices. We do that by identifying the sources of exchange rate and relative price fluctuations in Spain through a Vector Autoregressive (VAR) decomposition. We start with the simplest framework: a bivariate Structural VAR (SVAR) model including real exchange rates and relative

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[1] See Krugman (1979), Dornbusch (1987) and Hooper and Mann (1989) for theoretical and empirical underpinnings, and Menon (1995) for a survey on the empirical literature. Escrivá and Petit (1994) and Gordo and Sánchez-Carretero (1996) are recent applications of this literature to the Spanish case.

prices which allows us to capture (country-specific) nominal and real shocks to the economy. Next, we distinguish between aggregate supply and fiscal shocks and assimilate nominal shocks to monetary and financial conditions in a three-variable SVAR.

The results of both exercises coincide: real (supply or demand) shocks which produce nominal exchange rate depreciations also cause relative prices to fall; on the contrary, nominal shocks bring about both nominal exchange rate depreciations and relative price increases. Note that in the first case, it does not make sense to think of a depreciation as potentially feeding into inflationary pressures, because it is accompanied by relative price deflations. Thus, only when nominal disturbances are at the source of the exchange rate movements is the exchange rate channel for inflation potentially relevant. In fact, since nominal shocks are found to account for around half of nominal exchange rate movements, and all but explain changes in relative prices at any horizon, we infer that nominal exchange rate depreciations may in practice have fuelled relative price increases. However, our methodology is not able to discriminate between first-round and second-round effects.

The paper is organised as follows. After this Introduction, Section 2 discusses our main analytical framework and Section 3 describes the empirical results. In Section 4, we extend and complement our approach. Finally, Section 5 summarises the main conclusions of the paper.

2. THE SIMPLEST ANALYTICAL FRAMEWORK

We are interested in revealing the sources of fluctuation of (log) nominal exchange rates (e) , defined here as units of domestic currency per unit of foreign currency, and relative (log) prices (p) . We can do that through the analysis of (log) real exchange rate (q) fluctuations.

Thus, the real exchange rate defined as:

$$q = e - p \qquad [1]$$

allows us to capture nominal and real shocks. Real shocks (ϵ_r) will be defined as those which affect real variables -in this case q - in the long run; we can think either of a supply (i.e. technological) shock or of a real demand (i.e. to the IS curve) shock. Nominal shocks (ϵ_n) will only affect nominal variables - e and p - in the long run, that is, they capture monetary or financial disturbances (LM shocks).[2]

In order to understand how this identification outline works, let us first consider a domestic monetary expansion (i.e. a positive nominal shock). If prices are sticky, the nominal exchange rate would initially depreciate overshooting its long run equilibrium level. In the long run, the eventual increase in prices would return the real exchange rate to its unmodified long run equilibrium level. Table 1 sums up the short and long-run responses of the variables to the nominal shock.[3]

Let us consider now a domestic positive supply shock. This leads to a real exchange rate depreciation to offset the excess supply and to a reduction in relative prices, both in the short and in the long run. However, its effects on the nominal exchange rate at any horizon are ambiguous, because q and p move in the opposite direction. Similarly, in the case of a positive real demand shock, the excess demand is accommodated by a real exchange rate appreciation and the effects on the nominal exchange rate are again uncertain, because relative prices increase. Thus, the joint consideration of supply and demand real shocks prevents us from identifying the responses of the variables to these real shocks, as observed in table 1.

To assess empirically the effects of both shocks on the nominal exchange rate and relative prices, and their respective significance, we first consider the simplest approach. In particular, we will look at the comovement of the real exchange rate and relative prices, for which we have predictions from Table 1. One

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[2] Notice that, such an identifying restriction rules out the possibility of full hysteresis effects of nominal shocks on the trade balance and so on te real exchange rate. This possibility has been considered, for example, by Baldwin and Krugman (1986).

[3] There is a longstanding tradition in the literature building on these identification outlines. For instance, Dornbusch (1976) sticky price model in which nominal shocks cause nominal exchange rate overshooting and sluggish price adjustment, and the real exchange rate moves in the short but not in the long run. On the other hand, Balassa (1964) and more recently Obstfeld (1985) and Stockman (1988) stress the effects of real fluctuations on the long-run behaviour of prices and nominal and real exchange rates.

useful way of describing the dynamics of these variables is in terms of estimated impulse responses to two types of orthogonal innovations. The orthogonalization that we will use is in the spirit of Blanchard and Quah (1989).[4] We will estimate a SVAR model for the real exchange rate and relative prices, imposing the long-run restriction that nominal shocks do not affect the real exchange rate. We can write this long-run system in a compact (matrix) form for the stationary transformation of the non-stationary variables as follows:

$$\begin{pmatrix} \Delta q \\ \Delta p \end{pmatrix} = \begin{pmatrix} c_{11}(1) & 0 \\ c_{21}(1) & c_{22}(1) \end{pmatrix} \begin{pmatrix} \epsilon_r \\ \epsilon_n \end{pmatrix} \qquad [2]$$

Notice that in [2] it is assumed that one innovation (the 'permanent shock' or the real shock ϵ_r) has permanent effects *on the level* of the real exchange rate, while the other (the 'temporary shock' or the nominal shock, ϵ_n) does not affect real exchange rates in the long run. Contrary to the Blanchard and Quah (1989) analysis we cannot call the permanent shock a 'supply shock'. The reason, as stressed by Clarida and Gali (1994), is that the long run behaviour of the real exchange rate could be affected by real demand shocks, such as, for instance, a real government expenditure shock. In section 4 we will analyse several ways of decomposing these real shocks into fiscal and supply-side shocks.

3. EMPIRICAL RESULTS

Before estimating our 2-variable SVAR, we have to decide on the type of exchange rate to use: the multilateral or any bilateral exchange rate. First of all, the above-mentioned models characterise small open economies against the rest of the world, thus implying the use of multilateral exchange rates. Moreover, we can easily think that the inflationary effects of a Peseta (ESP) depreciation against the Deutschemark (DEM) are not the same if accompanied by a simultaneous appreciation against the US Dollar. This is quite relevant in the context of the ERM, since US Dollar depreciations have usually put upward pressure on the DEM. There is still a third argument supporting the use of the multilateral exchange rate, which has to do with

[4] Details on how such a long-run orthogonalization is carried out are provided in an econometric Appendix.

potential short-run manipulation of the nominal exchange rate. Since our exercise only makes sense in a context of (roughly) floating exchange rates, if we choose the Peseta-Deutschemark (ESP/DEM) as our bilateral exchange rate we would observe that it has been a heavily intervened variable since the mid-eighties; on the contrary, interventions are less effective in manipulating multilateral rates. Chart 1 illustrates this point: the profile of the multilateral rate is much more stable in the whole period than the bilateral ESP/DEM rate, although we can observe a lower variability in the latter during the ERM period. Therefore, we decide to use multilateral exchange rates and test in Section 4 the implications of using a different sample and a bilateral exchange rate.

Multilateral real and nominal exchange rates indices are obtained from the Banco de España database. They are constructed as a weighted average of bilateral exchange rates, where the weights are given by the bilateral shares in the overall Spanish trade. Given these indices, we construct a relative price index using expression [1]. We use quarterly data covering the period 1971:1-1996:3, for which the stationarity hypothesis is rejected (see, for instance, Pérez-Jurado and Vega, 1994) thus requiring the specification in differences which we adopted in [2].[5]

Regarding the estimates of our 2-variable SVAR, Chart 2 displays the estimated impulse-response functions, with approximate 90% bootstrap confidence intervals as recommended by Runkle (1987), that is, the dynamic adjustment of the variables to a real and a nominal shock, respectively. We can observe that 'positive' real shocks appreciate the real exchange rate and increase relative prices. At the moment we cannot identify whether positive real demand shocks or negative supply shocks are behind this result. The resulting effect on the nominal exchange rate is an appreciation, with negligible overshooting on its long-run level. The effects of the nominal shock are consistent with the theory: an initial depreciation of the real exchange rate (peaking around the first year); a subsequent appreciation until returning to its initial level -as the long-run restriction implies; a sluggish increase in prices to their long-run level and consequently a depreciation of the nominal

[5] The non-stationarity of the real exchange rate holds for the Consumer Price Indices (CPIs), but this is not the case for the relative price of tradable goods. Notwithstanding, given the aim pursued in this paper we have to consider the real exchange rate as defined by the nominal exchange rate and the relative CPI.

exchange rate with a slight overshooting after one year[6].

The impulse responses to ϵ_n reveals the potential inflationary effect of depreciations caused by this type of shock: a positive nominal shock depreciates the nominal exchange rate and increases relative prices, so that the aforementioned second-round effects may have fed into inflationary pressures. Our analysis, however, is unable to ascertain to what extent these second-round effects have been relevant. As to the effects of real shocks which were undetermined beforehand, a real shock provoking a depreciation causes relative prices to fall. Thus, nominal exchange rate movements induced by real shocks cannot provoke inflationary pressures in the economy.

Once the potential source of inflationary pressures from exchange rate depreciations has been identified, the next step is to measure how important the nominal shocks are in the observed behaviour of our variables, in particular the nominal exchange rate. Table 2 displays the variance decomposition of the series. Notice that nominal shocks explain more than 90% of relative price variations at any time and more than 50% of nominal exchange rate variability after four quarters, while they only explain up to 20% of real exchange rate variability. The fact that nominal shocks explain around half of the nominal exchange rate variability underscores the scope of the nominal exchange rate as a potential transmission channel from nominal shocks to relative prices.

In order to quantify our results, Chart 3 shows the effects of a nominal shock leading to a 10% depreciation (and a 10% relative price increase) in the long run. Our variance decompositions imply that around half of the variability of the nominal exchange rate responds to this mechanism.

We first observe that the whole exchange rate depreciation actually takes place in the first quarters, and there is even a small overshooting after one year.

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[6] The confidence intervals confirm that all these effects are significant. Intervals corresponding to e have been obtained running a 2-variable SVAR for Δq and Δe .

Relative prices adjust sluggishly, although after one year they have already increased 6%. As a result, the inflation differential reaches a peak of 1% after 5 quarters and decreases smoothly thereafter[7].

To conclude with this section, it should be noted that the above-mentioned results are still subject to at least two potential objections. First, our analysis does not distinguish between the pre-ERM or free-floating period and the ERM or partially-pegged period. Second, as we have already observed, the 2-variable SVAR does not allow us to discriminate between supply and real demand shocks; the aggregated real shock we capture moves the nominal exchange rate and relative prices in opposite directions but, within the current framework, we cannot identify what type of shock (real demand or supply) underlies this behaviour. In the following section we address these issues.

4. SOME ADDITIONAL CONSIDERATIONS

In this section we extend and complement the 2-variable SVAR model in two directions. First, we analyse to what extent our results might be affected by the joint consideration of the pre-ERM (free-floating) and the ERM (partially-pegged) periods. Second, we add greater depth to our identification outline by discriminating between supply and real demand shocks.

As to the first issue, the peseta joined the ERM in 1989 and that meant a semi-fixed exchange rate against substantial portion of the currencies which make up the multilateral exchange rate. In order to check the robustness of our results to the inclusion in our analysis of data corresponding to the ERM period, Chart 4 shows the impulse responses corresponding to the full sample and to the pre-ERM periods. As can be observed, the impulse responses do not significatively change when we consider the pre-ERM period alone (1971:I-1989:II), which is labelled as a free-floating subsample in the figure. Moreover, this robustness result is clearly reinforced when we look at Chart 5, where the same check has been applied to the bilateral ESP/DEM nominal exchange rate. We can observe that the impulse response of the ESP/DEM to a real shock is significatively different when the ERM period is

[7] Notice that relative inflation is a stationary variable. Shocks can only cause transitory deviations from its long-run average.

considered, thus suggesting a structural change that does not arise when we look at the multilateral exchange rate.[8]

Second, disentangling supply, or ϵ_{AS} , and real demand, or ϵ_{IS} , shocks is important because, although the former seems to be dominated by the latter, ϵ_{AS} might move relative prices and the nominal exchange rate in the same direction. To address empirically such an issue our 2-variable SVAR must be extended to incorporate another variable which could provide additional information. The first obvious candidate is relative output $-y-$ since, contrary to supply shocks, demand shocks can be considered be thought to have no long-run effect on output. This is the approach adopted by Clarida and Galí (1994) who merge Dornbusch's and Obstfeld's models. They envisage the existence of supply shocks and demand shocks, the latter having transitory as well as permanent components. The existence of a transitory component in the real demand shock is important in this model because if only a permanent component is allowed for, real demand shocks would not have a long-run effect on prices. However, the real exchange rate still appreciates in the long-run, implying a long-run nominal exchange rate appreciation.

Therefore, we can consider two alternative SVAR specifications. The first, and more general one admits permanent and transitory components in the real demand disturbance:

$$\begin{pmatrix} \Delta y \\ \Delta q \\ \Delta p \end{pmatrix} = \begin{pmatrix} c_{11}(1) & 0 & 0 \\ c_{21}(1) & c_{22}(1) & 0 \\ c_{31}(1) & c_{32}(1) & c_{33}(1) \end{pmatrix} \begin{pmatrix} \epsilon_{AS} \\ \epsilon_{IS} \\ \epsilon_{n} \end{pmatrix} \qquad [3]$$

The second specification assumes no transitory component in the real demand shock, requiring the substitution of the nominal exchange rate for prices. Otherwise, the SVAR would be overidentified[9]:

[8] As an additional stability analysis, we have also intervened the large depreciation of the Peseta in 1977:3 and have considered a small sample ending in 1992:2, before the ERM crises. Our qualitative results do not change in any case.

[9] See Clarida and Galí (1994) for a more detailed discussion on this issue.

$$\begin{pmatrix}\Delta y\\ \Delta q\\ \Delta e\end{pmatrix} = \begin{pmatrix}c_{11}(1) & 0 & 0\\ c_{21}(1) & c_{22}(1) & 0\\ c_{31}(1) & c_{32}(1) & c_{33}(1)\end{pmatrix} \begin{pmatrix}\epsilon_{AS}\\ \epsilon_{IS}\\ \epsilon_{n}\end{pmatrix} \qquad [4]$$

Table 3 summarises the short and long-run effects of the different shocks in the new framework. It distinguishes supply and demand shock, and considers permanent plus transitory or only permanent components in the latter.

Charts 6 and 7 display the impulse responses corresponding to the 3-variable SVARs in [3] and [4][10]. While the profiles of the nominal shocks are very similar to the bivariate case and the short-run effect on output is positive as expected, the negative effect of a positive real demand shock on output and the appreciation of q afier a supply shock are inconsistent with the theory in both cases[11]. The underlying reason is that this outline is unable to pick up correctly the type of underlying shocks. We could, for instance, consider that real demand shocks in the form of public investment to have contributed to increasing output in the long run.

The failure to decompose correctly the shocks in this well-established theoretical framework does not prevent us from exploring alternative, less standard routes, provided that the impulse responses behave consistently. Hence, we propose dropping y and incorporating a neat fiscal variable in the specification: public

[10] In both cases, rest-of-the-world output growth has been obtained as a weighted average of domestic growths, using the same weighting implicit in the multilateral exchange rate indexes.

[11] This agrees with the analysis in Canzoneri et al. (1996) for the bilateral ESP/DEM case. As a consequence these authors have propose an alternative SVAR in output, public consumption and nominal exchange rates; under this scheme AS shocks; under this identification scheme AS shocks have long run effects on all variables, FS shocks have long run effects on public consumption and the nominal exchange rate and nominal shocks have only long-run effects on the nominal exchange rate.

expenditure $-g-$ [12]. The identification strategy is straightforward. That is, the long-run movements of such a variable are driven only by fiscal (ϵ_{FS}) shocks. Notice that these fiscal shocks were included in the previous IS (ϵ_{IS}) shocks, so the new long-run identification outline can be written as follows:

$$\begin{pmatrix} \Delta g \\ \Delta q \\ \Delta p \end{pmatrix} = \begin{pmatrix} c_{11}(1) & 0 & 0 \\ c_{21}(1) & c_{22}(1) & 0 \\ c_{31}(1) & c_{32}(1) & c_{33}(1) \end{pmatrix} \begin{pmatrix} \epsilon_{FS} \\ \epsilon_{AS} \\ \epsilon_{n} \end{pmatrix} \qquad [5]$$

As Table 4 shows, short-run expected responses of g are only determined in the case of fiscal shocks. Neither nominal nor supply shocks have defined effects on g, but quite interestingly, the short-run responses on these variables can inform us on the policy mix implied in the data. In particular, Chart 8 shows that positive monetary shocks are accompanied by fiscal tightening. But the important point of these impulse responses is that they are consistent with the theory. Thus, we can confidently return to our main point of interest.

We see from Chart 8 that both supply and fiscal shocks move relative prices and the exchange rate in different directions. In other words, the picture obtained in this extended SVAR does not add new insights to our previous conclusions: it is only through nominal disturbances that the movements in the exchange rate may generate inflationary pressures. The impulse-responses to nominal shocks in Chart 8 mimic those presented in Chart 2. As a consequence, the effect of a positive nominal shock on relative prices and the nominal exchange rate are the same as in the 2-variable SVAR. Finally, the variance decomposition in Table 5, shows that the explanatory role of nominal shocks is indeed extremely similar to that obtained in the bivariate SVAR.

An additional point of interest is to analyse whether the shocks we are identifying correspond to the conventional wisdom on Spanish economic events.

[12] Proxied by public consumption and obtained in the same way as output in SVARs [3] and [4]. See footnote 6.

Chart 9 shows the pattern of the three structural shocks hitting the system.[13] Our model captures important (asymmetric) positive nominal shocks in 1976-1977, which probably reflect the well-documented accommodative Spanish monetary policy in response to the oil shocks in the seventies. On the contrary, the period 1986-1990 can be characterized as one dominated by negative nominal demand shocks. This is in accordance with the disinflationary strategy pursued by monetary policy during such an expansionary episode. In the nineties, however, there is no evidence of major nominal shocks, while since 1992 negative fiscal shocks seem to have been dominant. This contrasts sharply with the expansionary tone of the fiscal policy detected from 1989 to 1992 (dominant positive fiscal shocks). This change in the patterns of our estimated fical shocks may be thought to reflect a progressive process of fiscal consolidation in Spain.[14]

Are these results consistent with similar studies? Table 6 compares our result with the other papers we have mentioned. Clarida and Galí (1994), and Astley and Garrat (1996) use the 3-variable SVARs in output, real exchange rates and prices, which appeared in expression [3]. Both papers, referring respectively to the bilateral exchange rates of the US dollar and Sterling with several major currencies, uncover the dominance of real demand shocks in explaining real and nominal exchange rate movements[15]. However, amentioned, this identifying framework has proved inadequate for the Peseta, hence the alternative schemes proposed by Canzoneri *et al.*(1996) -see footnote 9 and ourselves. As we observe in the table, the only basis for comparison is the behaviour of the nominal exchange rates and our results broadly concur with theirs. First, nominal disturbances explain half of Peseta movements, although in the short run, in Canzoneri *et al.*(1996) the dominance of nominal shocks is overwhelming (90% vs. 40% in our model); second, our scheme reveals a larger importance of supply shocks in explaining the movements of nominal exchange rates.

[13] These shocks have, by construction, unit variance and zero covariance between them.

[14] As noted in the Introduction, these changes in the nature of the dominant shocks may have implications for the results of the standard pass-through analysis.

[15] Clarida and Gali (1994) only report variance decompositions for the real exchange rate.

All in all, our 3-variable-SVAR[5] results are consistent with similar approaches to the Spanish case, but they are inconsistent with altemative schemes of identification, suggesting that the Spanish case shows some particular features.

5. CONCLUSIONS

We have stressed in this work that what really matters in assessing the potential inflationary impact of exchange rate depreciations is the nature of the shocks behind exchange rate and relative price movements.

According to our results for the Spanish peseta, supply and real demand shocks move nominal exchange rates and relative prices in opposite directions. Nominal shocks, however, move both variables in the same direction. Moreover, almost half the variability of the nominal multilateral peseta exchange rate is explained by nominal shocks which also account for almost all the variability of Spanish relative prices against the rest of the world.

Thus, only under nominal shocks, which are indeed an important source of nominal exchange rate variability, may peseta depreciations fuel inflation.

Table 1. Short and long-run expected responses of variables to shocks in the 2-variable SVAR

Type of shock	Variable					
	q		p		e	
	S	L	S	L	S	L
NOMINAL (ϵ_n)	+	0	+	+	+	+
REAL (ϵ_r)	?	?	?	?	?	?

Notes: - S, L = short and long-run expected responses, respectively.
- The sign indicates the expected effects of positive shocks. A "+" sign referring to *e* or *q* means an exchange rate depreciation.

Table 2. Variance decomposition. 2-variable SVAR [2]

Horizon (quarters)	% of variance explained by nominal shocks		
	q	p	e
1	12 [2]	91 [10]	38 [7]
4	21 [4]	93 [9]	52 [9]
8	15 [3]	93 [9]	54 [9]
12	11 [2]	93 [9]	54 [9]
16	8 [2]	93 [9]	54 [9]
40	3 [1]	93 [9]	56 [10]

Notes: Bootstrap standard errors in brackets (250 draws).

Table 3. Short and long-run responses of variables to shocks in [3] and [4]

		Variable							
		q		**p**		**e**		**y**	
Type of shock		S	L	S	L	S	L	S	L
NOMINAL (ϵ_n)		+	0	+	+	+	+	+	0
SUPPLY (ϵ_{AS})		+	+	-	-	?	?	+	+
REAL DEMAND	T+P	+	-	-	-	?	?	+	0
(ϵ_{IS})	P	-	-	+	0	?	-	+	0

Notes: - S, L = short and long-run expected responses, respectively.
- T, P = transitory and permanent components.
- The sign indicates the expected effects of positive shocks. A "+" sign referring to *e* or *q* means an exchange rate depreciation.

Table 4. Short and long-run responses of variables to shocks in [5]

	Variable							
	q		**p**		**e**		**g**	
Type of shock	S	L	S	L	S	L	S	L
NOMINAL (ϵ_n)	+	0	+	+	+	+	?	0
SUPPLY (ϵ_{AS})	+	+	-	-	?	?	?	0
FISCAL (ϵ_{FS})	-	-	+	+	?	?	+	+

Notes: - S, L = short and long-run expected responses, respectively.
- The sign indicates the expected effects of positive shocks. A "+" sign referring to *e* or *q* means an exchange rate depreciation.

Table 5. Variance decomposition. 3-variable SVAR [5]

	% of variance explained by shocks							
	g		q		p		e	
H	FS	n	FS	n	FS	n	FS	n
1	74	10	13	13	2	91	8	40
	[6]	[3]	[7]	[2]	[5]	[11]	[6]	[7]
4	87	6	15	22	2	93	9	52
	[3]	[2]	[8]	[4]	[4]	[10]	[6]	[9]
8	92	5	21	16	4	92	10	55
	[2]	[1]	[8]	[3]	[6]	[11]	[6]	[9]
12	94	4	25	12	5	91	11	56
	[1]	[1]	[9]	[2]	[6]	[11]	[6]	[9]
16	96	3	27	9	5	90	11	56
	[1]	[1]	[9]	[2]	[7]	[11]	[6]	[9]
40	98	1	33	3	7	88	11	57
	[0]	[0]	[9]	[1]	[7]	[12]	[7]	[9]

Notes: Bootstrap standard errors in brackets (250 draws).

Table 6. Comparison of Variance decompositions with similar studies

	Clarida & Galí (US Dollar)		Astley & Garrat (Sterling)	
	S	L	S	L
q	IS (>50%)	IS (>80%)	IS (<75%)	IS (>75%)
y	?	?	AS (>75%)	AS (100%)
p	?	?	n (>50%)	n (>60%)
e	?	?	IS (>60%) n (<35%)	IS (>65%) n (<28%)

Table 6. Comparison of Variance decompositions with similar studies (Cont.)

	Canzoneri, Vallés & Viñals (Peseta)		Alberola, Ayuso & López (Peseta)	
	S	L	S	L
q	-	-	AS (74%)	AS (64%) FS (33%)
y	AS (75%)	AS (94%)	-	-
p	-	-	n (91%)	n (88%)
e	n (90%)	n (59%) IS (26%)	n (40%) AS (42%)	n (57%) AS (32%)

Notes: - The cells indicate the type of shock predominating. In brackets, the percentage of the variance they explain.
- S, L = short and long-run horizons, respectively.
- '?' stands for unreported; and '-' stands for not applicable.

Chart 1. Peseta's nominal exchange rate dynamics

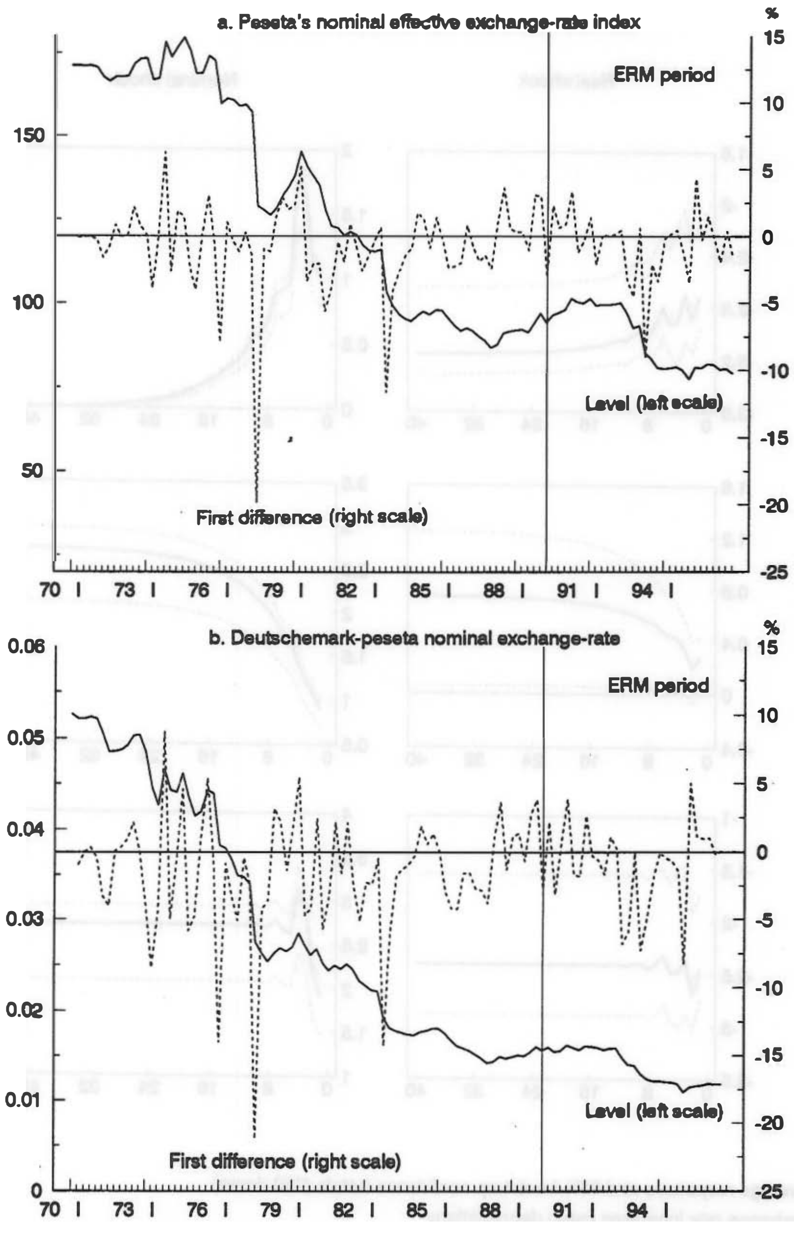
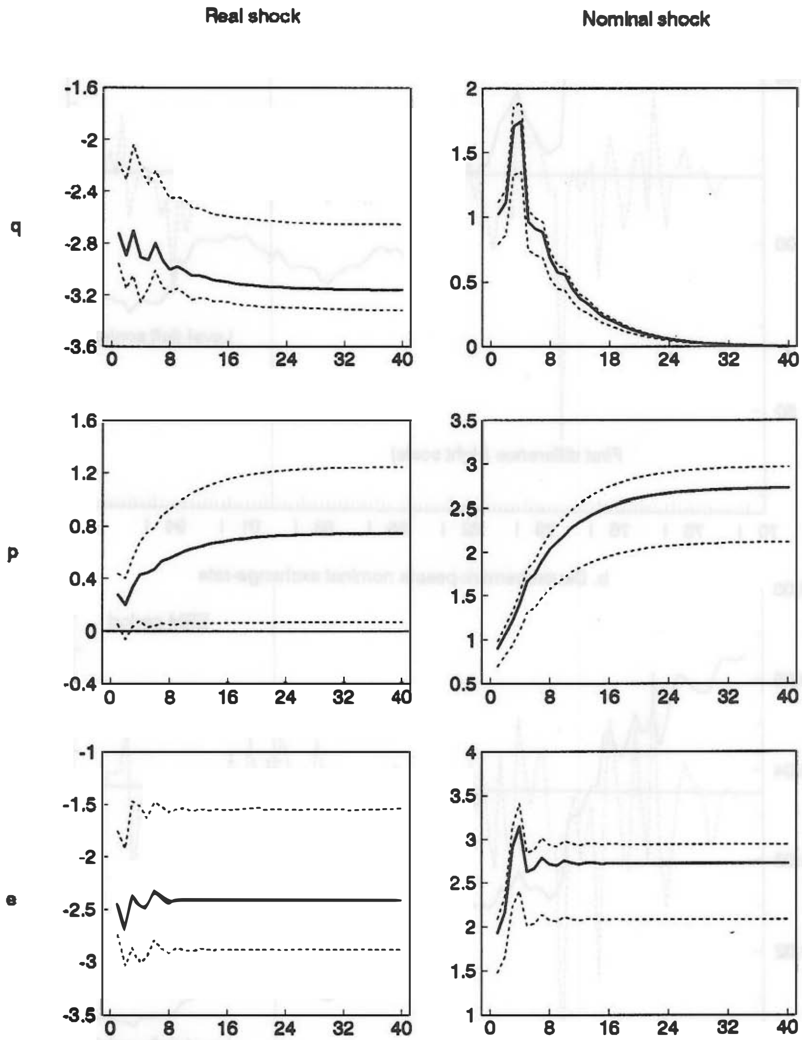


Chart 2. Impulse responses. 2-variable SVAR [2]



Average responses and 90% bootstrap confidence bands (250 draws)
Exchange rate increases mean depreciations

Chart 3. Effects of a nominal shock which causes a 10% nominal depreciation

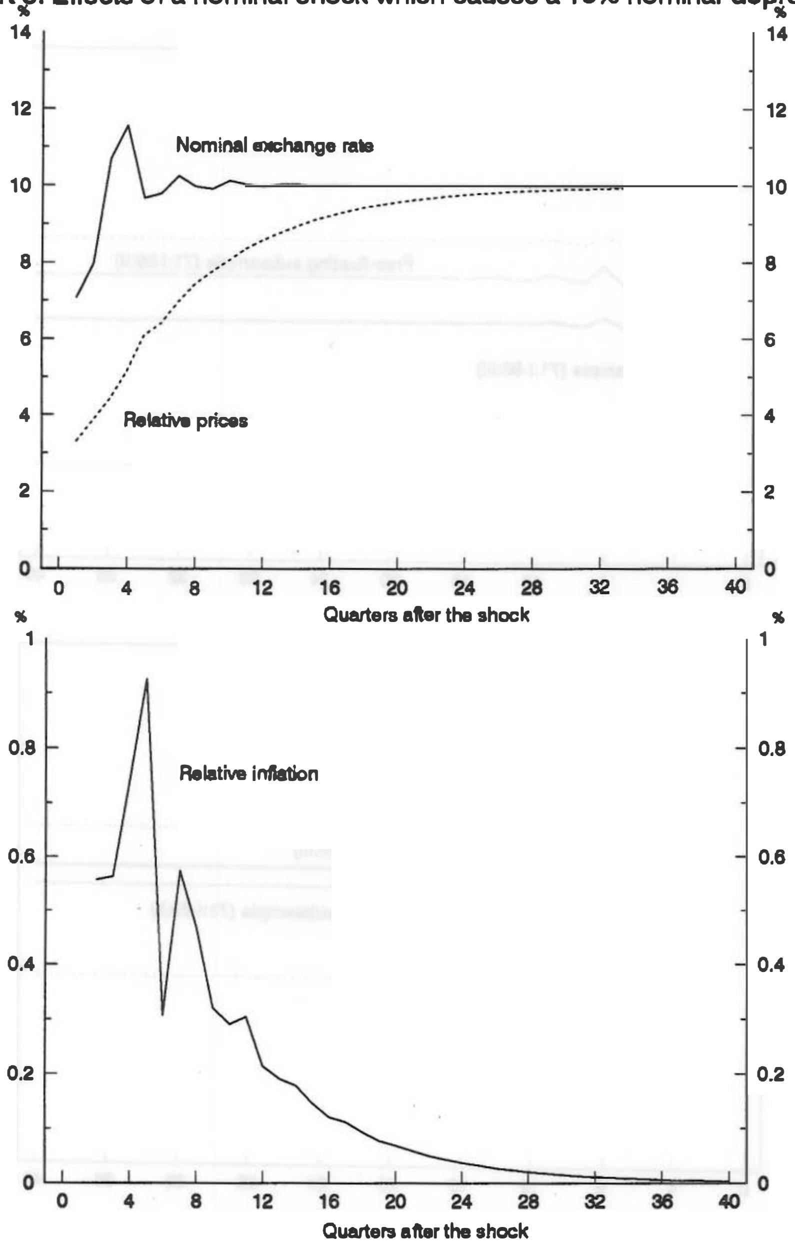
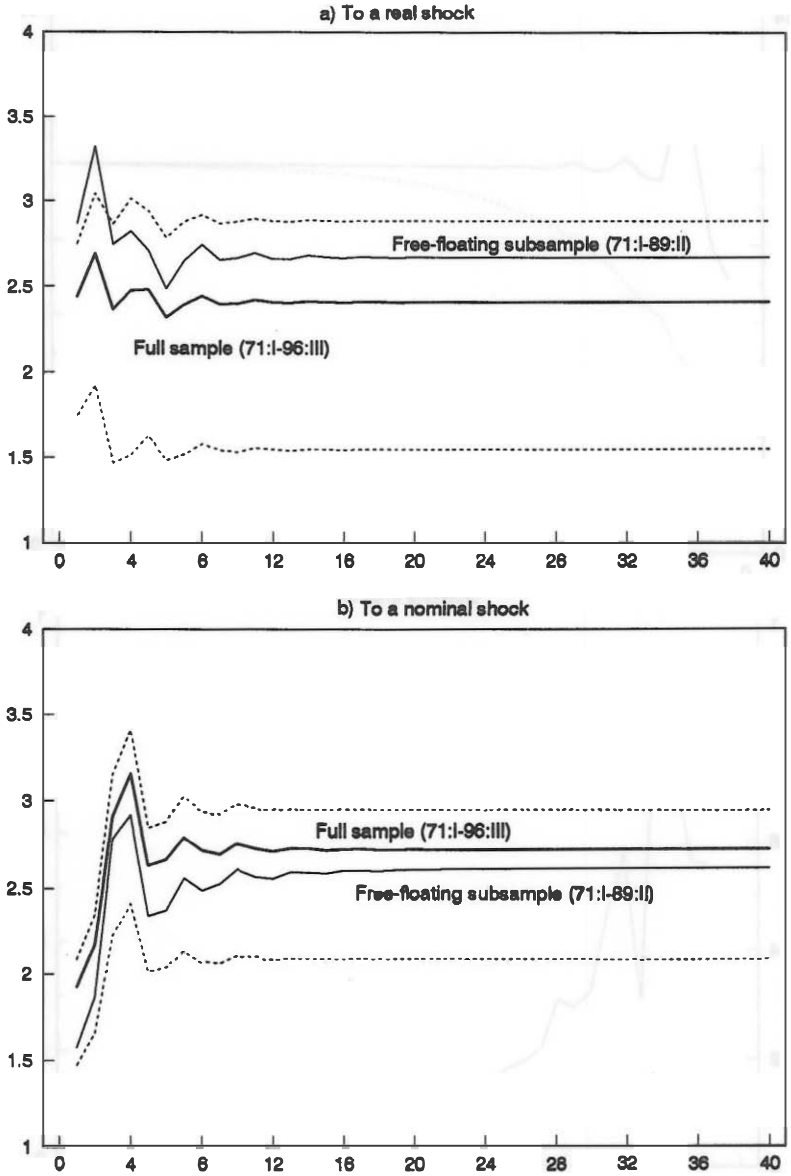
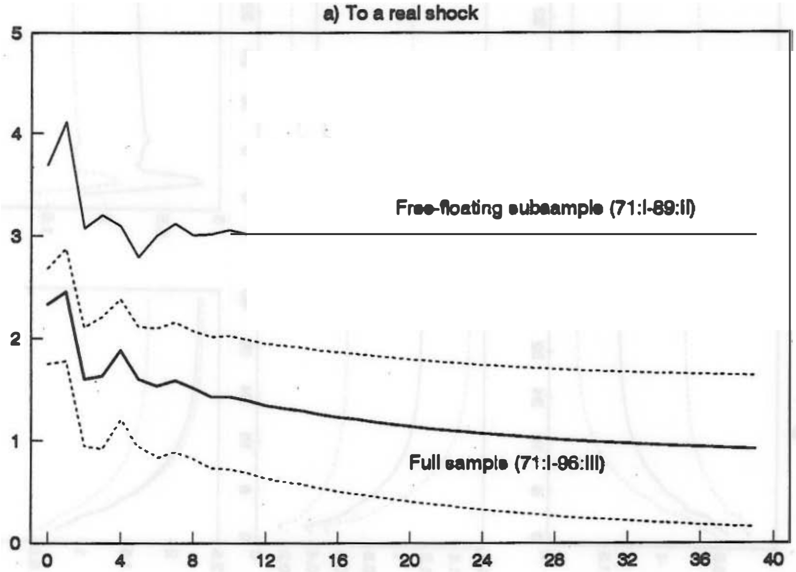


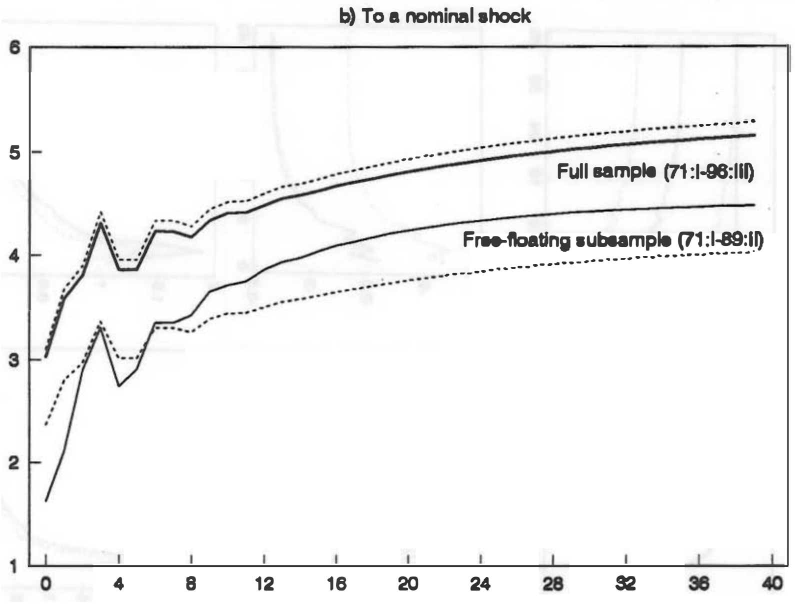
Chart 4. Impulse responses of the peseta's nominal effective exchange rate



Exchange rate increases=depreciations. 90% bands for the full sample point estimates

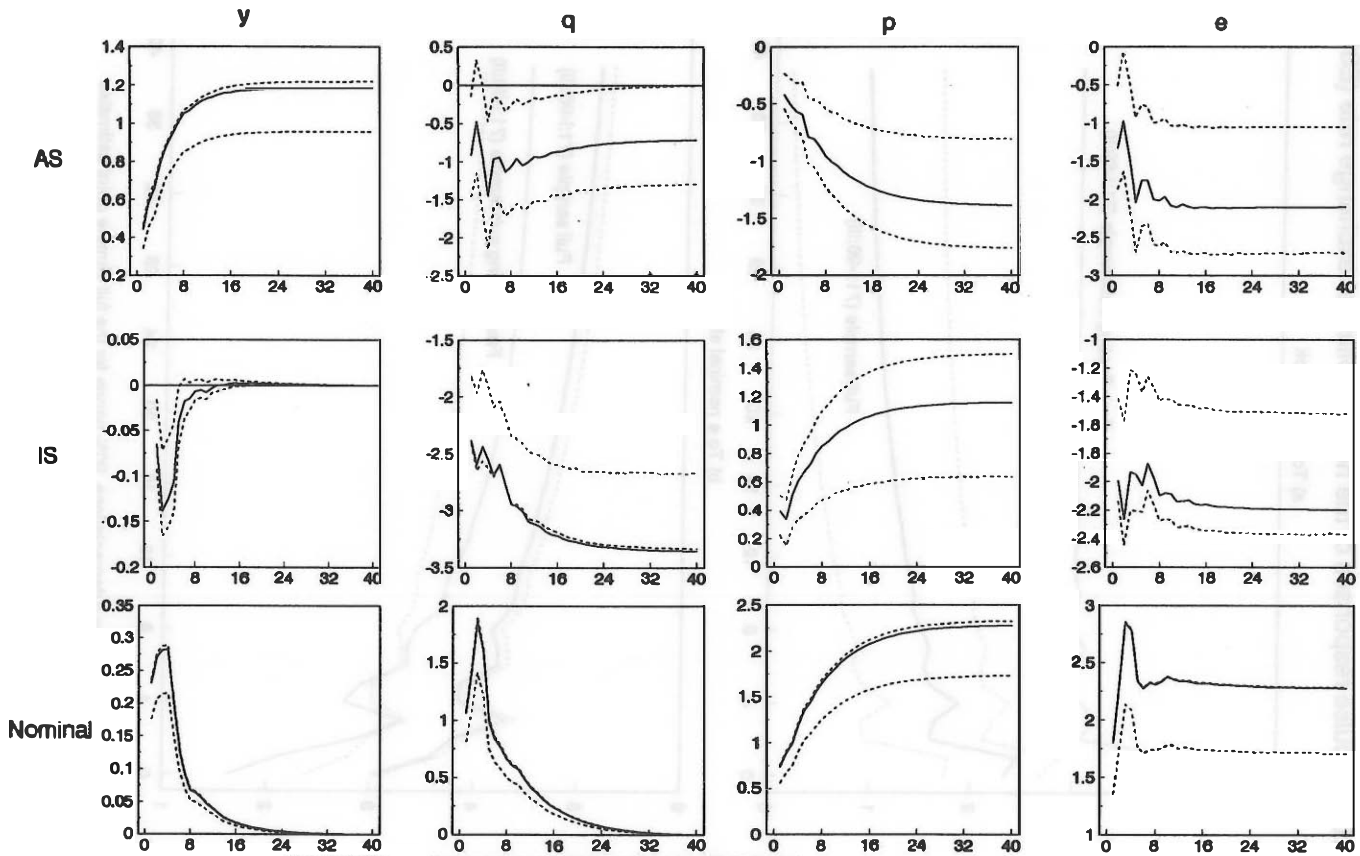
Chart 5. Impulse responses of the nominal bilateral exchange rate (ESP/DEM)





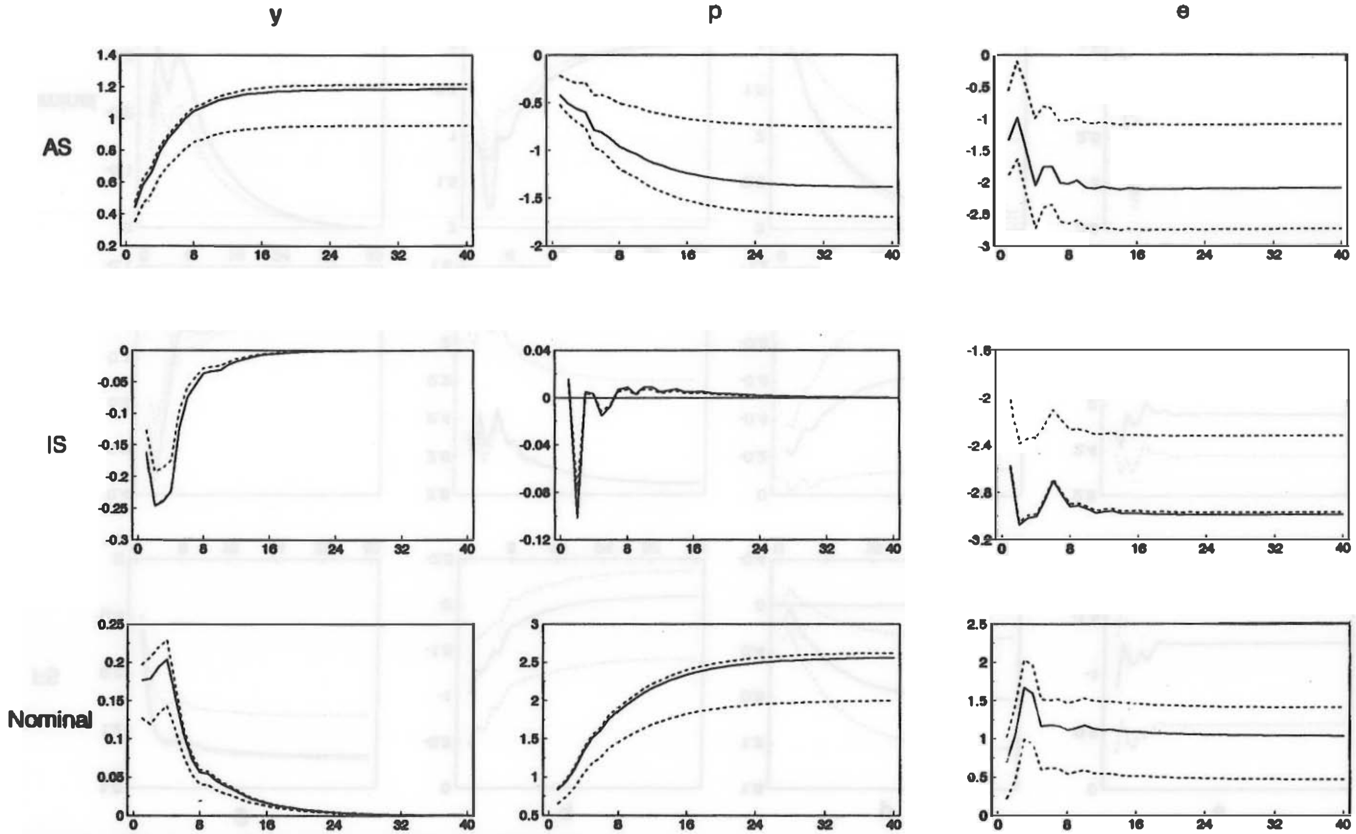
Exchange rate increases = depreciations. 90% bands for the full sample point estimates

Chart 6. Impulse responses. 3-variable SVAR [3]



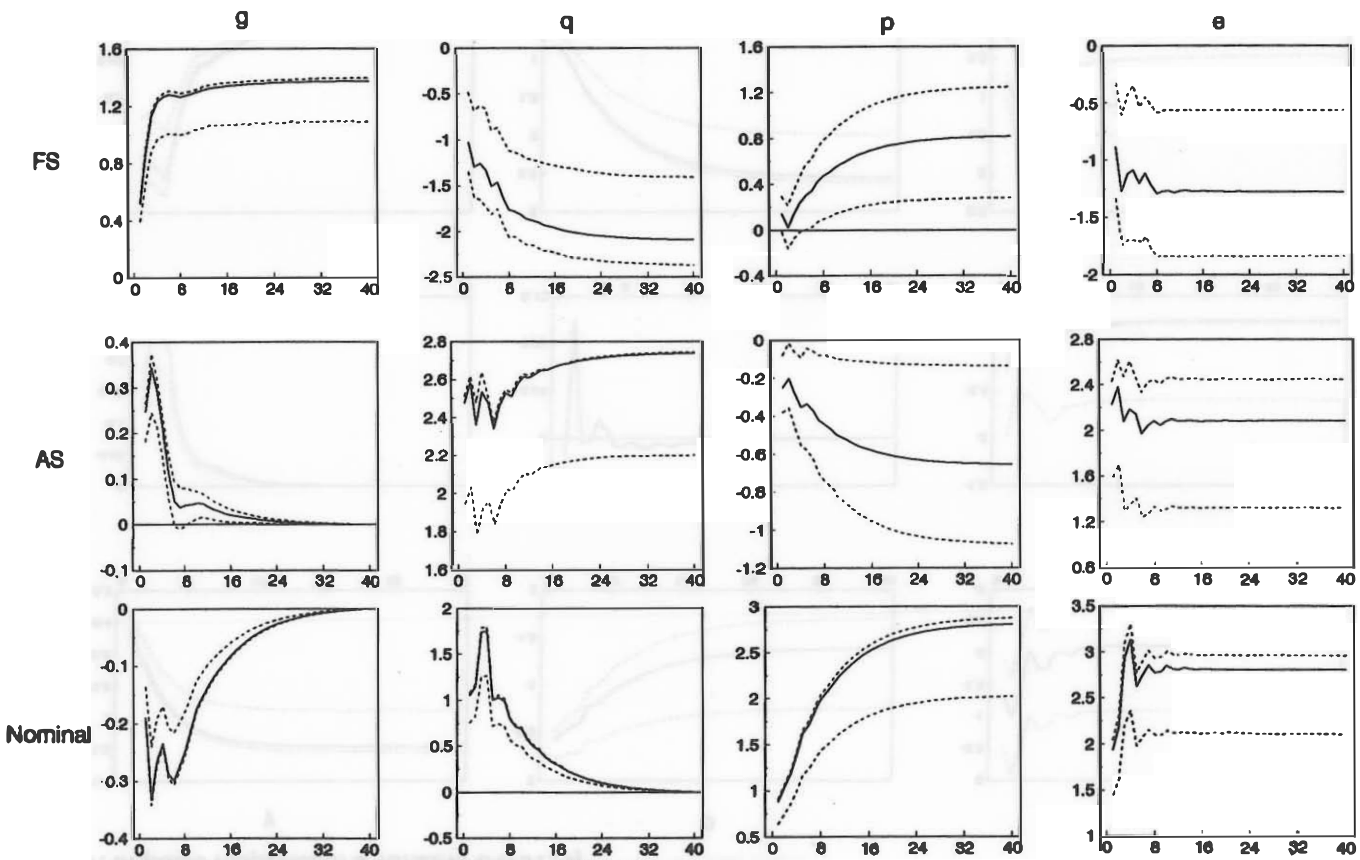
Exchange rate increases mean depreciations. 90% bootstrap confidence bands (250 draws)

Chart 7. Impulse responses. 3-variable SVAR [4]



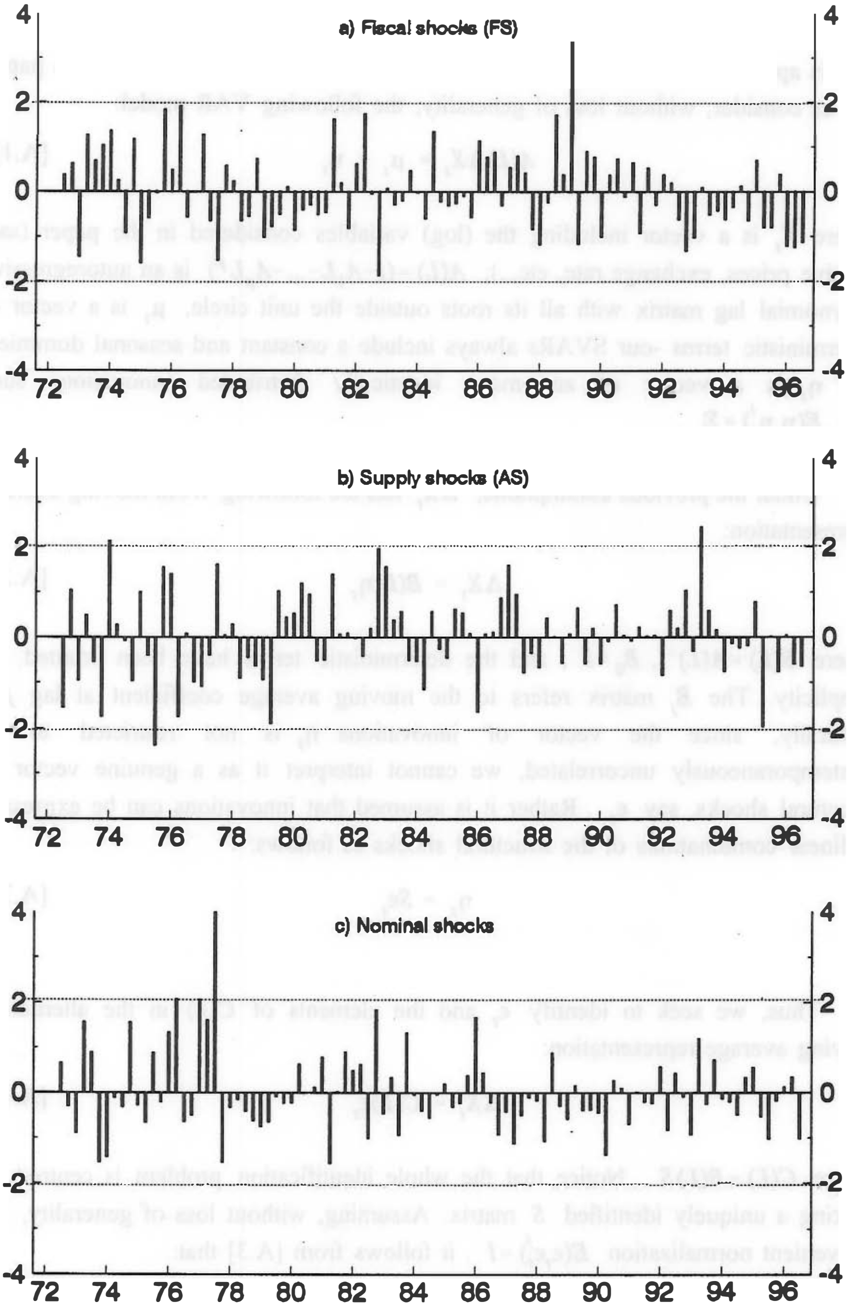
Exchange rate increases mean depreciations. 90% bootstrap confidence bands (250 draws)

Chart 8. Impulse responses. 3-variable SVAR [5]



Exchange rate increases mean depreciations. 90% bootstrap confidence bands (250 draws)

Chart 9. Shocks from 3-variable SVAR [5]



APPENDIX
LONG-RUN CHOLESKY IDENTIFICATION IN SVAR MODELS

In this appendix we summarize the SVAR identification outline used in this paper. Let us consider, without loss of generality, the following VAR model:

$$A(L)\Delta X_t = \mu_t + \eta_t \qquad [A.1]$$

where X_t is a vector including the (log) variables considered in the paper (say, relative prices, exchange rate, etc...); $A(L) = (I - A_1 L - ... - A_p L^p)$ is an autoregressive polynomial lag matrix with all its roots outside the unit circle, μ_t is a vector of deterministic terms -our SVARs always include a constant and seasonal dummies- and η_t is a vector of zero-mean identically distributed innovations such that $E(\eta_t \eta_t^{\prime}) = \Sigma$.

Under the previous assumptions, ΔX_t has the following Wold moving average representation:

$$\Delta X_t = B(L)\eta_t \qquad [A.2]$$

where $B(L) = A(L)^{-1}$, $B_0 = I$, and the deterministic terms have been omitted for simplicity. The B_j matrix refers to the moving average coefficient at lag j . Naturally, since the vector of innovations η_t is not restricted to be contemporaneously uncorrelated, we cannot interpret it as a genuine vector of structural shocks, say ϵ_t . Rather it is assumed that innovations can be expressed as linear combinations of the structural shocks as follows:

$$\eta_t = S\epsilon_t \qquad [A.3]$$

Thus, we seek to identify ϵ_t and the elements of $C(L)$ in the alternative moving average representation:

$$\Delta X_t = C(L)\epsilon_t \qquad [A.4]$$

where $C(L) = B(L)S$. Notice that the whole identification problem is centred on picking a uniquely identified S matrix. Assuming, without loss of generality, the convenient normalization $E(\epsilon_t \epsilon_t^{\prime}) = I$, it follows from [A.3] that:

$$\Sigma = SS' \qquad [A.5]$$

To choose such a unique S matrix, note that $C_0 = S$ and $B(1)S = C(1)$. Consequently,it holds that:

$$B(1)\Sigma B(1)' = B(1)SS'B(1)' = C(1)C(1)' \qquad [A.6]$$

Expression [A.6] is very useful since, assuming that $C(1)$ is a *lower triangular matrix* (as is the case in our theoretical models), it tells us that $C(1)$ is the unique Cholesky lower triangular factor of the matrix $B(1)\,\Sigma\,B(1)$, say F . Thus, S can be easily obtained as follows:

$$S = B(1)^{-1}F \qquad [A.7]$$

which uniquely determines ϵ_t and $C(L)$ in [A.4]. Notice that, as recalled by Clarida and Galí (1994), the simplicity of this identification outline lies upon the lower triangular property of the long-run restrictions.

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