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INFLATION AND MONETARY POLICY IN ITALY: SOME RECENT EVIDENCE

by Eugenio Gaiotti[*], Andrea Gavosto[**] and Giuseppe Grande [*]

Abstract

The empirical literature on the transmission of monetary policy to inflation in Italy has stressed the importance of the exchange rate and, to some extent, of the demand channel; recently, the roles of inflation expectations and the fiscal situation have been emphasized. This paper uses vector auto-regression to address the issue. The results suggest that inflation expectations do matter as determinants of inflation, along with the exchange rate and demand. Expectations on the sustainability of the public debt are found to have a significant effect on the exchange rate, but only a moderate effect on inflation, thus rejecting the assumption of "fiscal dominance". The VAR confirms that the two episodes of sharp exchange rate depreciation (in 1992 and 1995) made a major contribution to inflationary tensions, but also shows that demand shocks and the expectational climate played an important role.

Contents

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The issue of the channels of transmission of monetary policy to inflation in Italy is far from being settled. On the one hand, the importance of the exchange rate and, to a more limited extent, of demand has been emphasized in the empirical literature; on the other hand, the recent debate has centered on the roles of inflation expectations and the fiscal situation. This paper[1] addresses the issue by estimating a vector auto-regression (VAR), after discussing, in Section 1, the strategy of monetary policy after the exit from the exchange rate mechanism of the EMS and surveying, in Section 2, the existing empirical evidence on the different channels of monetary transmission in Italy.

1. Monetary policy and inflation in the 1990s

In 1992, the lira left the exchange rate agreement of the EMS, which was an important element of the monetary strategy in the 1980s. In the same period, concern about the sustainability of the fiscal situation came to the fore in policy discussion. The conduct of monetary policy was affected by the diminished role of the exchange rate as a nominal anchor, by institutional changes, such as the 1992 and 1993 agreements on labour costs, which abolished wage indexation, and by the high volatility recorded in the currency and securities

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[1] The authors thank Filippo Altissimo, Ignazio Angeloni, Riccardo Cristadoro, Salvatore Rossi, Paolo Sestito, Guido Tabellini, Daniele Terlizzese, Ignazio Visco and the participants at a CEPR seminar in Perugia for their useful comments and discussion on a previous version of this paper. The usual disclaimer applies.

markets, reflecting uncertainty about the process of budgetary adjustment.

In this period the lira suffered rapid and dramatic depreciation, as in September 1992, soon after the exit from the ERM, and in February and March 1995, prompted by fears about the prospects for the adjustment of the public finances. The depreciation, which involved the risk of a price-exchange rate spiral, was finally reversed in 1996. GDP growth turned negative in 1993, recovered in 1994 and in 1995, weakened again in 1996. Consumer price inflation, which was still about 6.4 per cent in January 1992, rapidly (and to some extent unexpectedly) decreased throughout 1993, reaching a minimum (4.0 percent) in December. Strong inflationary pressures reappeared in mid-1994 and lasted through most of 1995; they began to subside in the second half of that year. At the end of 1996 twelve-month inflation was down to 2.6 percent. Against the background of these developments, there was a sharp tightening of monetary policy in the summer of 1992 during the currency crisis, a gradual but substantial easing in 1993 and the first half of 1994, followed by a renewed tightening from June 1994 to the end of 1995.

In the same period, the debate on monetary policy centered on two main issues. As regards the strategy, the need for a nominal anchor to replace the exchange rate suggested more direct reference to inflation, not only as a final target but also as a guide to actual policy implementation. This view is found both in the debate in the profession and in public statements by the Bank of Italy, although usually with different emphasis. Many observers argued in favour of direct inflation targeting. For its part, the Bank of Italy did not adopt a formal

scheme of this kind, but it repeatedly stressed that monetary policy was oriented to the final objective of curbing inflation; the management of policy rates was often linked to inflationary developments and the anti inflationary objective was couched in more precise quantitative terms by the Governor on several occasions.[2]

In the new floating exchange rate regime, the transmission mechanism of monetary policy to inflation received greater attention. A number of factors were considered in the discussion. In the preceding decade the interpretation of inflation had been based mainly on the effects of exogenous shocks to costs (wages, the exchange rate) and, although to a lesser extent, on the pressure of aggregate demand. In recent interpretations these channels were again emphasized: for instance, the rapid fall in inflation after 1992 was attributed by the Bank of Italy to wage restraint and the weakness in domestic demand, while the moderation in raw materials prices and the pricing policies of foreign producers dampened the effect of the currency depreciation.[3] The subsequent worsening in inflation was also interpreted as a consequence of a rapid recovery in demand pressure and of the new fall of the exchange rate.

However, growing emphasis was also placed on the role of inflation expectations in monetary policy transmission. Many observers highlighted the importance of both the effect of monetary policy on expected inflation and that of expected on actual inflation and

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[2] See, for example, the analyses in various issues of the *Economic Bulletin* of the Bank of Italy and Governor Fazio's "Concluding Remarks" in 1994, 1995 and 1996.

[3] See, for example, *Economic Bulletin*, No. 16, 1993, p. 22.

consequently advocated greater transparency of monetary policy targets and procedures.[4] The Bank of Italy also stressed the "announcement" effects of its policy actions and the link of monetary policy to inflation expectations. Immediately after the exit from the ERM, monetary policy was assigned the task of anchoring inflation expectations and avoiding a resurgence in inflation. It was thought that both compliance with the wage agreement and the return of the exchange rate towards an equilibrium value were conditional on the stabilization of inflation expectations. The monetary policy aim of curbing inflation expectations was repeatedly confirmed in the following years.[5]

Given the large fiscal imbalances accumulated in Italy over the last decade, it is hardly surprising that the link between inflation expectations, the exchange rate and the prospects of public debt sustainability should also have been a central issue in the debate on monetary policy's effectiveness. According to most interpretations, the weakening of the exchange rate, particularly in 1994-95, was mostly an effect of the persisting uncertainty about the outlook for budget consolidation.[6] However, some argued that the emphasis put on the fiscal constraints to monetary policy effectiveness was excessive; according to this view, in

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4 For instance CER (1995a, 1995b), Spaventa (1995), Fratianni (1995), Sarcinelli (1995), Griffiths, Lane and Prati (1995), Tabellini (1995).

5 *Economic Bullettin*, No. 16 and No. 17, 1993, and No. 18, 1994.

6 See, for example, *Economic Bullettin*, No. 19, 1994, p. 62; *Economic Bullettin*, No. 21, 1995, p. 61. This is also the view in Visco (1995).

some instances a more resolutely anti-inflationary monetary policy would have been necessary.[7]

2. The channels of monetary policy transmission in Italy: the existing evidence

In this discussion, the channels of monetary policy transmission to inflation include: the *exchange rate*, which affects the cost of imported inputs and the competitive pressure on domestic firms in setting prices; *aggregate demand*, which affects, with different lags, both wage bargaining and profit margins;[8] *inflation expectations*, which play a role in wage determination, influence the speed of adjustment of profit margins and may feed back on exchange rate expectations; the *interaction between fiscal and monetary policy*, which may affect inflation expectations and the exchange rate, since an unsustainable fiscal position may induce market participants to believe that monetary policy will eventually have to weaken its anti-inflationary commitment.

The relative importance of each channel has to be considered in determining the optimal response of monetary policy to inflation in terms of size, timing and degree of visibility. The overall transmission lags of

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[7] See Gros (1995) and Fratianni (1995). See also Spaventa (1995).

[8] Monetary policy may affect aggregate demand in different ways (direct interest rate effects, wealth effects, the credit channel), whose analysis goes beyond the scope of this paper. See Nicoletti Altimari et al. (1995); on the credit channel in Italy, see Angeloni et al. (1995). For recent work on the transmission mechanism, see Taylor (1995) and Mishkin (1996).

monetary policy also have implications for the optimal monetary strategy.[9]

Most empirical evidence on monetary policy transmission in Italy comes from different versions of the Bank of Italy quarterly econometric model of the Italian economy;[10] recently, there have also been other studies. Overall, most results agree on the importance of the exchange rate and of aggregate demand; in contrast, the evidence on inflation expectations and on the fiscal constraint is still preliminary and somewhat tentative.

2.1 *The exchange rate*

In the 1980s control of the exchange rate was the centerpiece of the monetary policy strategy.[11] However, after September 1992 the lira's sharp depreciation led to a much smaller increase in inflation than had been feared. Several papers have addressed the issue (Siviero and Terlizzese, 1997; Ford and Krueger, 1995; Locarno and Rossi, 1995). Although there is no strong evidence of a structural break after 1992, Siviero and Terlizzese conclude that the speed of the impact of the exchange

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9 As it is well known, the longer the lags, the more stable and forward looking should monetary policy be, as too large and fast a reaction could be destabilizing (the original references are Friedman, 1968; Holbrook, 1972; Brainard, 1967). In contrast, when transmission takes place via expectations, monetary policy should react as soon as possible to inflation and take pains to communicate its strategy to the market. When fiscal policy interferes with monetary policy effectiveness (as in Sargent and Wallace, 1981), close coordination between fiscal and monetary policy is needed to stabilize inflation expectations.

10 See Banca d'Italia (1986), Terlizzese (1994).

11 Gressani, Guiso and Visco (1988) summarize the prevailing view for that period.

rate on consumer prices varies according to demand conditions, as foreign exporters may accept a temporary reduction of profit margins during recessions in order to defend their market share. There is substantial agreement on the long-run elasticity of domestic prices to the exchange rate (for given wages), which is estimated at around 0.15-0.20 (approximately the weight of imported goods in total output).

2.2 *Demand*

In the quarterly model of the Bank of Italy, demand affects prices via wage bargaining and the determination of firms' profit margins. In the case of the first channel,[12] a one-point increase in unemployment determines a reduction in the quarterly growth of wages of about 0.1 percentage points, a rather moderate effect, although statistically significant.[13] There is also empirical evidence that demand affects prices through profit margins.[14]

According to the simulations of the quarterly model conducted by Gavosto and Siviero (1995), if the

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[12] A survey of the literature on the link between unemployment and the determination of wages in Italy is to be found in Sestito (1994).

[13] The Phillips curve is estimated through 1994. It also includes an effect of capacity utilization, as firms may be more willing to grant pay rises in an expansion; the effect is sizable in the current quarter, but disappears within one year. A somewhat larger effect of unemployment is found by Ford and Krueger (1995), where a one percentage point deviation of the unemployment rate[13] from its trend affects wages by 0.5 percentage points each quarter.

[14] The evidence is much less clear-cut in other industrialized countries, as shown by Bean (1994).

output gap[15] is exogenously increased by one percentage point, consumer price inflation increases rapidly, reaching a maximum in the second year (0.6 percentage points). However, potential output reacts to the increase in capacity utilization, thereby closing the gap. A 1 percentage point increase in aggregate demand, with a given exchange rate, thus leads to a more moderate increase in inflation (initially 0.1 percentage points, while in the second year the inflation rate is 0.30 percentage points above the baseline).[16]

2.3 *Inflation expectations*

Research on monetary policy's effects on inflation expectations in Italy is still at a preliminary stage. Most work on expectations has been done using survey-based measures, such as Forum ME, Isco, Consensus. Nicoletti Altimari (1997) and Gaiotti and Nicoletti Altimari (1996) estimate a model describing the formation of price expectations (measured in the Forum-ME survey[17]) that includes changes in the discount rate among the explanatory variables:[18] a one percentage point increase

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15 Gavosto and Siviero (1995) analyze different measures of the output gap, and conclude that the best one is the index of capacity utilization in the manufacturing sector computed by Marchetti (1995) (based on Wharton and the Isco survey).

16 In this case, the inflationary effect dies out within four years: in the end, the price level is 0.4 percentage points higher. Other authors have found evidence of an effect of aggregate demand on prices in Italy: Padoa-Schioppa Kostoris (1990), Ford and Krueger (1995), Gavosto, Sabbatini e Sestito (1994).

17 The survey is conducted quarterly; its respondents are individuals from business, finance, universities and research centres. An analysis of the characteristics of the survey is to be found in Visco (1987) and Nicoletti Altimari (1997).

18 The variables are those included in the wage-price block of the quarterly model: lagged inflation, the change in the

in the discount rate reduces inflation expectations in the same quarter by 0.36 percentage points on an annual basis.[19] Long-term interest rates show some correlation with the above-mentioned survey measures, as shown by Gaiotti and Nicoletti Altimari (1996).

The overall effect of expectations on prices in the quarterly model is neither very large nor very direct. Price expectations affect wages, although only to a limited extent. Wage increases feed back to the GDP deflator and then consumer prices. In the Phillips curve the average elasticity of wage changes to expected inflation, over the period 1971-1994, is about 0.3 (the equation is homogeneous in prices, since the elasticity to past inflation is 0.7; see Siviero and Terlizzese, 1997). The results obtained by these two authors do not seem to support the assumption that the overall elasticity has permanently increased since the abolition of wage indexation, although the number of available observations is still limited.

The hypothesis that inflation expectations affect firms' price-setting behaviour in Italy is advanced in CER (1995a), where it is argued that the overall influence of expectations on prices has increased. Gavosto, Sabbatini and Sestito (1994) find that inflation expectations speed up the transmission to prices of changes in unit labour costs and input prices, although

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exchange rate, capacity utilization, the unemployment rate, foreign inflation, the change in energy prices (see Nicoletti Altimari, 1997).

[19] Giovannini and Polinari (1992) also found an effect - although a moderate one - of discount rate changes on price expectations based on the Isco survey on Italian households (price forecasts over the following 12 months) between 1982 and 1990.

in industry only the interaction between expected inflation and unit labour cost is statistically significant.[20] Cipollone and Sabbatini (1997) also find that the expectational climate accelerates the upward adjustment of output prices.

2.4 *The fiscal constraint*

It is well known from the literature that an unsustainable fiscal position may worsen inflationary expectations and diminish the effectiveness of monetary policy;[21] in the Italian case, the interaction with the weakening of the exchange rate reinforces this result. Fiscal imbalances may affect inflationary expectations and the exchange rate on two accounts: they may raise the chances of a government default, thus causing a sudden depreciation; they may lead to more inflation in the future as the Central Bank will eventually turn more permissive.

Visco (1995) maintains that monetary policy, although necessary, may not be sufficient to curb inflationary expectations, fueled by fiscal imbalances. He points to the coincidence of movements in the slope of the yield curve since 1992 (a measure of expected inflation) with adverse fiscal news. The correlation

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[20] The idea is that firms will more readily transfer changes in costs when they expect their competitors to do the same. However, in general equilibrium the expected price level (or the expected inflation rate) must coincide with the actual one; hence a permanent effect of price expectations on profit margins is inconsistent with the RE hypothesis as it would imply systematic forecast errors on the part of the agents.

[21] The original reference is of course Sargent and Wallace (1981). See also the surveys in Haliassos and Tobin (1990), Lane and Prati (1995).

between fiscal (more generally, political) news and fluctuations in the exchange rate are confirmed both by casual graphic observation, as in OECD (1997), and by econometric analysis, as in Tivegna (1996). Lane and Prati (1995) directly address the link between fiscal and monetary policy in Italy over a longer period (1978-1995), using a VAR.[22] They reject the assumption of monetary policy ineffectiveness (inflation decreases after a discount rate shock) and of "fiscal dominance" (they find a positive response of the primary surplus to a shock on the discount rate, although with long lags).

2.5 *Summary*

Overall, there is still uncertainty about the channels of transmission of monetary policy that operated in Italy in recent years. Most of the existing literature agrees on the importance of the exchange rate and demand channels; however, the size of these effects has recently been questioned. The effect of expectations is considered in a few recent papers and in the quarterly model, but its quantitative importance is usually limited. This is even more true for the role of the fiscal constraint in determining monetary policy effectiveness: a central theme in the policy debate, but on which there is still little empirical backing, apart from casual observation.

Overall, the transmission lags of monetary policy to prices vary; in the quarterly model, the size and speed of this effect depend crucially on the determination of the exchange rate and on the way

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[22] The VAR includes two fiscal variables (deficit and debt), the discount rate, GDP and the inflation rate.

expectations are determined. With the exchange rate kept exogenous, an increase in interest rates affects inflation, through demand, only after 4-5 years, as shown in Nicoletti Altimari et al. (1995). Transmission lags are much shorter and the effect greater when a monetary policy effect on the exchange rate is included in the quarterly model, as in Nicoletti Altimari et al. (1995) (where rational expectations are used) and in Gaiotti and Nicoletti Altimari (1996) (who estimate a mechanism for the formation of of exchange rate and inflation expectations based on survey observations). The simulations of the Fed's *Multi Country Model* (Tryon, 1995) relative to Italy (rational expectations are again assumed) also point to a rapid effect of monetary policy. In general, the introduction of rational expectations speeds up the effect of monetary policy on inflation (it takes place within the first year). Estimates based on VAR, by contrast, show transmission lags of about two years and rather strong effects (Gerlach and Smets, 1995; Lane and Prati, 1995).

3. A VAR approach

We estimate a vector auto-regression (VAR) in order to assess the importance of the channels of transmission described above. The use of a VAR avoids imposing strong identification assumptions, which would be hard to justify given the present state of knowledge in some areas, particularly as regards the effect of expectations and of fiscal uncertainty.[23]

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[23] There is a large literature and an ongoing debate on the estimation of monetary policy effects through VARs. For a recent contribution that also discusses most of the existing empirical literature, see Leeper, Sims and Zha (1996).

3.1 *Specification and estimation*

The basic version of the VAR includes seven variables: a measure of the output gap, inflation expectations based on survey data, the exchange rate, consumer prices, a short-term interest rate, wages and import prices. The output gap, inflation expectations and the exchange rate measure three of the channels discussed so far. The short-term rate is taken as a measure of the monetary stance, consistently with most of the empirical literature. Wages are included to control for their effect on actual inflation and inflation expectations and to avoid that the estimated expectations shocks pick up wage shocks. Import prices have a twofold role: they measure exogenous shocks originating from foreign prices and permit a gradual transmission of the exchange rate to lira-denominated prices on the domestic market (pass-through), a major issue in the recent discussion on Italian inflation. In a second VAR we also included a proxy of the default risk on public debt, to measure the effect of the fiscal position; since this effect was not found to be very significant, it is not included in the basic version.

Consumer prices are measured as the log of the seasonally adjusted cost-of-living index; gross contractual wages, the nominal effective exchange rate vis-à-vis the main trading partners and the import deflator are all also taken in logs. The interest rate is the three-month rate on the interbank market.[24] Inflation

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[24] A shorter-term (e.g. the overnight) rate is in principle a better measure of monetary policy; however, the volatility of this rate was previously quite substantial, owing to the thinness of the overnight market and the absence of reserve

expectations (over a three-month horizon) are taken from the Forum-Mondo Economico survey (the measure used by Visco, 1987 and Nicoletti Altimari, 1997); as a measure of the output gap, we use the composite index of capacity utilization (Wharton-Isco).[25] An exogenous variable measuring the effect of changes in indirect taxes on consumer prices is also included.[26] [27]

An unconstrained VAR is estimated in levels.[28] The estimates are based on monthly data for the period 1985-1996.[29] A lag lenght of 4 was selected, as suggested by

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averaging provisions (see Gaiotti, 1992; a similar choice is made by Angeloni et al., 1995).

[25] The index, constructed by Marchetti (1995), is a simple average of the Wharton and Isco indexes of capacity utilization; the first is constructed interpolating peaks in seasonally adjusted industrial production, the second is taken from the ISCO survey of industrial firms.

[26] This is the change in the log-difference between the (seasonally adjusted) consumer price index gross and net of indirect taxes (see *Economic Bullettin*, No. 22, 1994, pp. 30-31). This variable controls for the effect of changes in indirect taxes that would otherwise be captured by the expectations variable.

[27] In other versions of the VAR we also included a dummy with a value of 1 in 1992, to consider the pronounced deceleration in contractual wages in that year due to the abolition of wage indexation. This dummy has some effect on the impulse responses of wages, not much on the other results.

[28] Although ADF tests indicate that all series are non stationary, there is no need to difference them to conduct hypothesis testing (Sims, Stock and Watson, 1990); moreover, differencing would induce a bias in the estimation if the series were cointegrated, since it would ignore the ECM term in the VAR. We have chosen not to proceed from a VAR in levels to an ECM form with cointegrating relations, owing to the difficulty of properly identify the cointegrating relations in the relatively short sample period. Estimation of a VAR in levels, without imposing cointegrating restrictions, yields consistent parameters (Lutkepohl, 1991, p. 369).

[29] Two of the variables (inflation expectations and the output gap) are originally quarterly; we constructed monthly series, based on the monthly profile of households' expectations from the qualitative Isco survey and industrial production. The Isco index of households' expectations is computed as the monthly share of households that expect a "larger" increase in

likelihood ratio tests; diagnostic tests indicated that this would yield non-autocorrelated residuals (Table 1). The results proved to be robust to a longer lag lenght.[30]

Stability tests indicated signs of a break around 1992 and, to a minor extent, 1995. This is due to the exchange rate equation, which, not surprisingly, reflects the two major depreciation shocks. However, the need to preserve a sufficient number of degrees of freedom rules out running the estimates over the sub-sample starting in 1992.

3.2 *Structural Analysis*

To use the estimated VAR for policy analysis, identifying restrictions must be imposed, that make it possible to transform the estimated (reduced form) system:

$$y_t = C(L)y_{t-1} + u_t$$

(where C(L) is a matrix-polynomial in the lag operator, y is the vector of endogenous variables and u is the vector of reduced-form errors) into the structural form:

$$A_0 y_t = A(L)y_{t-1} + \varepsilon_t$$

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consumer prices in the following twelve months. Since 1995:2 expectations in the Forum survey refer to the subsequent twelve months, rather than the subsequent quarter; these are reported on a quarterly basis.

[30] Table 1 shows some diagnostics statistics for the VAR residuals. The model shows no sign of autocorrelation or heteroschedasticity. However, normality is rejected for some equations (mostly the interest rate and the exchange rate equation), due to outliers after 1992.

DIAGNOSTIC TESTS

Autocorrelation:

Output gap	: AR 1-4 F(4,109) =	1.4436	[0.2245]
Wages	: AR 1-4 F(4,109) =	0.43194	[0.7853]
Prices	: AR 1-4 F(4,109) =	0.33285	[0.8553]
Exchange rate	: AR 1-4 F(4,109) =	1.7067	[0.1537]
Three-month rate	: AR 1-4 F(4,109) =	1.8052	[0.1330]
Import prices	: AR 1-4 F(4,109) =	0.21916	[0.9273]
Inflation expectations	: AR 1-4 F(4,109) =	0.35017	[0.8434]
Vector	: AR 1-4 F(196,550)=	1.042	[0.3560]

Normality:

Output gap	: $Chi^2(2)$=	10.577	[0.0050]	**
Wages	: $Chi^2(2)$=	12.54	[0.0019]	**
Prices	: $Chi^2(2)$=	1.574	[0.4552]	
Exchange rate	: $Chi^2(2)$=	59.216	[0.0000]	**
Three-month rate	: $Chi^2(2)$=	28.792	[0.0000]	**
Import prices	: $Chi^2(2)$=	0.035557	[0.9824]	
Inflation expectations	: $Chi^2(2)$=	1.0075	[0.6043]	
Vector	: $Chi^2(14)$=	103.27	[0.0000]	**

Heteroschedasticity:

Output gap	: ARCH 7 F(7, 99) =	0.41024	[0.8940]
Wages	: ARCH 7 F(7, 99) =	1.29	[0.2631]
Prices	: ARCH 7 F(7, 99) =	1.0405	[0.4080]
Exchange rate	: ARCH 7 F(7, 99) =	0.29407	[0.9548]
Three-month rate	: ARCH 7 F(7, 99) =	2.3941	[0.0264] *
Import prices	: ARCH 7 F(7, 99) =	0.55461	[0.7909]
Inflation expectations	: ARCH 7 F(7, 99) =	1.1635	[0.3307]

with $A(L) \equiv A_0 C(L); \quad \varepsilon_t \equiv A_0 u_t$

As is usual in the VAR literature, the first set of restrictions is that the covariance matrix of the structural disturbances (ε) is diagonal.[31] The remaining restrictions are imposed by assuming that some of the elements of A_0 are zero; this implies making assumptions about the links of simultaneous causality among the endogenous variables. We assumed a recursive scheme of simultaneous causality, as shown below; the variables are ordered as follows: the output gap (g), wages (w), consumer prices (p), the exchange rate (e), import prices (p*), the interest rate (r) and inflation expectations (p^e).

$$y_t = \begin{pmatrix} g \\ w \\ p \\ e \\ p^* \\ r \\ p^e \end{pmatrix} \qquad A_0 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix}$$

Most of the assumptions in this ordering are quite standard. The output gap, wages and consumer prices are assumed not to be affected by simultaneous shocks to either monetary policy or the other variables; the gap is allowed to have a simultaneous impact on wages and prices. The choice of identification assumptions in the second block of variables is less straightforward. The

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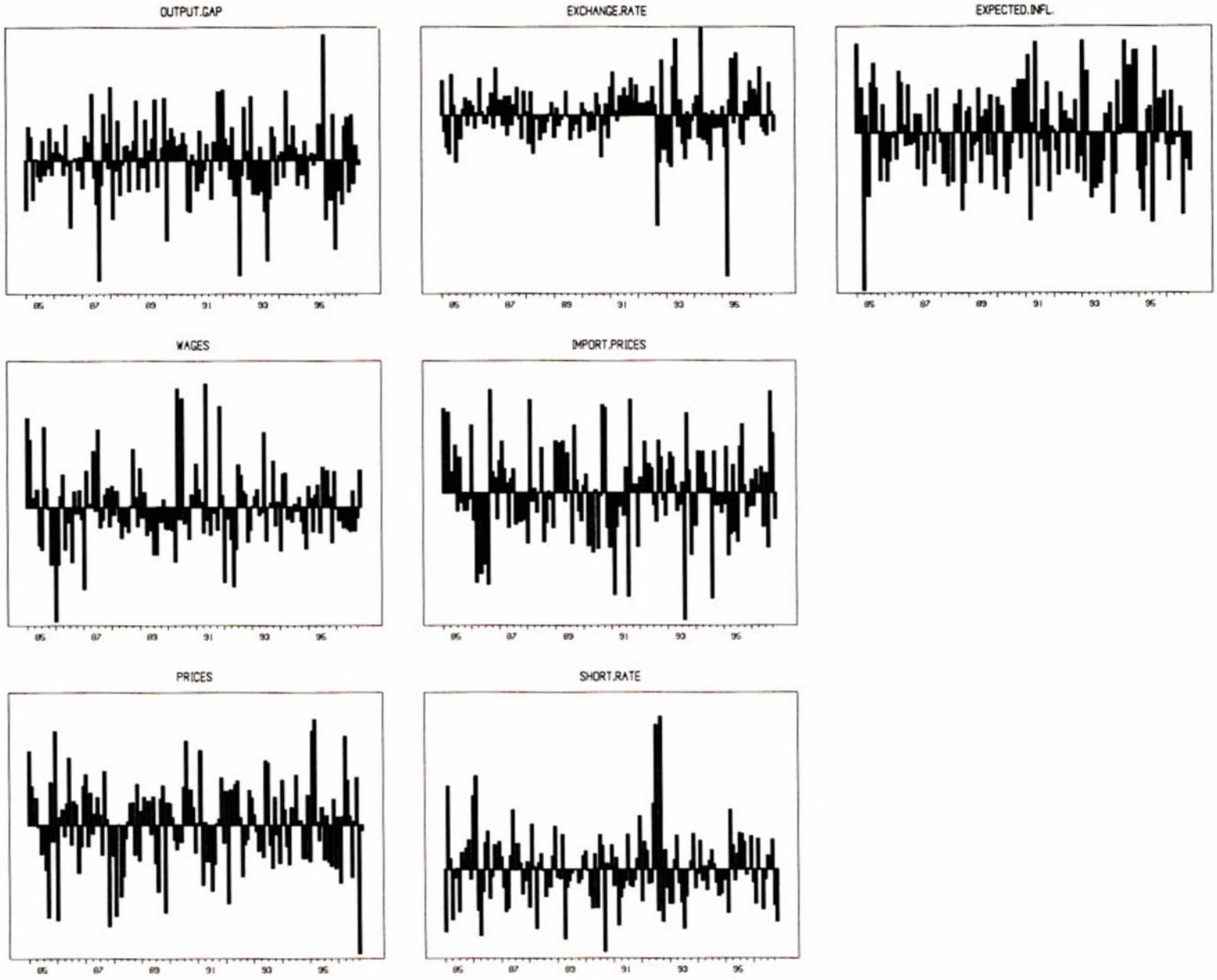
[31] Leeper, Sims and Zha (1996) justify this assumption arguing that a well-specified model should account for all the correlations among the variables, so that the disturbances have a diagonal covariance matrix.

STRUCTURAL SHOCKS

Figure 1



ordering we chose implies that neither the interest rate nor the exchange rate react to simultaneous movements of inflation expectations and that the simultaneous correlation of the exchange rate and the interest rate is driven by the reaction function of the central bank. The latter assumption is indeed very strong; we felt justified in imposing it by the robustness of the results. More generally, the results are quite robust to the choice of different orderings for the lower 4x4 block.[32] Import prices are ordered after the exchange rate since they have an endogenous component, being affected by movements of the exchange rate (with speed depending on the pass-through).

The estimated shocks are shown in Figure 1. Their pattern is generally consistent with anecdotal evidence on the period. Negative shocks to the output gap in the second half of 1992 coincide with a substantial fall in demand; positive shocks to the interest rate in June and September 1992 and again in February 1995 coincide with two major episodes of monetary tightening; major shocks to the exchange rate in the summer of 1992 and, later, in the first months of 1995 coincide with the two depreciation episodes.

Overall, the VAR yields plausible results: responses of consumer prices (Figure 2) and inflation (Figure 3) to different shocks have the expected sign[33].

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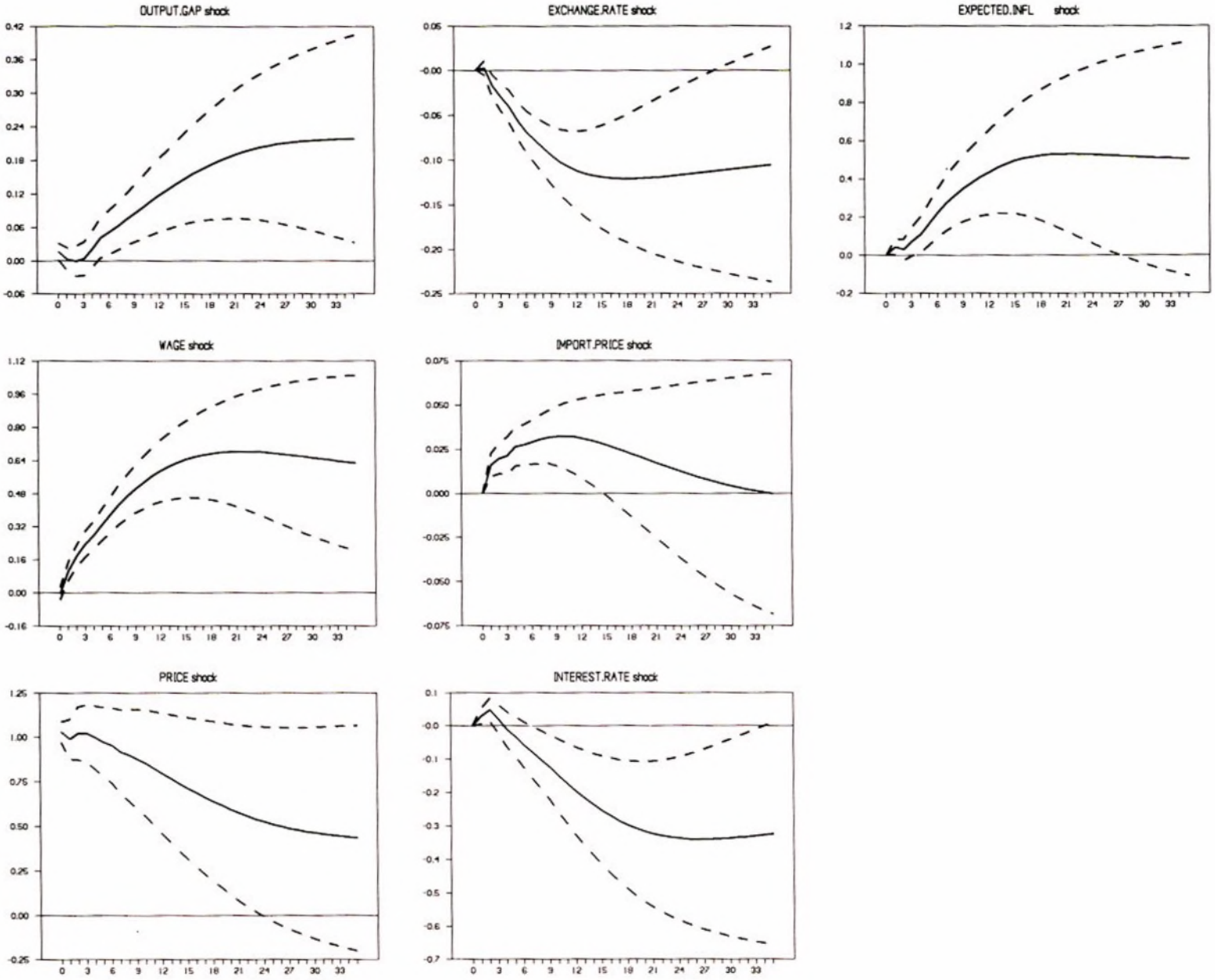
[32] More accurate ways to identify monetary policy shocks in systems including the exchange rate are discussed by Smets (1997) and Kumah (1996); usually, they imply introducing some other international variable (e.g, a foreign interest rate or foreign GDP) in the system. For the purposes of this paper, the implementation of such a strategy does not appear necessary.

[33] The responses and the (unit) shocks are measured as percentage deviations from the baseline (absolute deviations for the

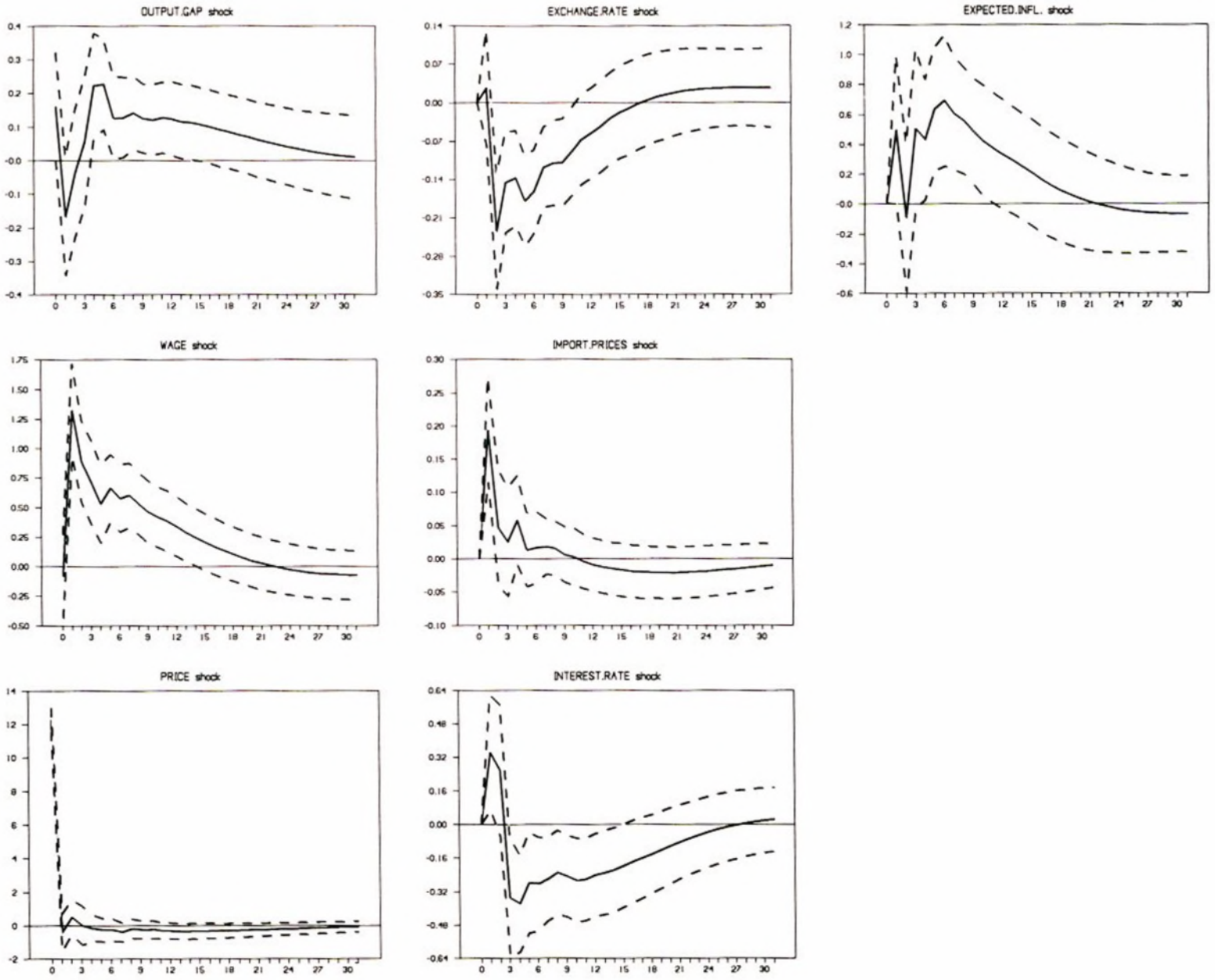
RESPONSES OF CONSUMER PRICES

Figure 2



RESPONSES OF ONE-MONTH INFLATION

Figure 3



Prices react positively to shocks on wages, expectations and the output gap; they respond negatively to exchange rate shocks (appreciations). The effect of inflation expectations on prices is larger than found elsewhere. This is the main difference compared with the earlier results discussed in Section 2.

The response of inflation to an output gap shock is persistent, declining slowly in the following eighteen months; the response to an inflation expectations shock reaches a maximum after a few months and then decreases. An exchange rate shock has an impact on the price level and inflation that is distributed over the following year.[34]

Monetary policy affects inflation: the response of prices to an interest rate shock has the expected sign (negative); its dynamics are similar to existing evidence either based on VARs or using an endogenous determination of the exchange rate (e.g., Gerlach and Smets, 1995[35] and Gaiotti and Nicoletti Altimari, 1996). However, the confidence bands are large.

The absence of a "price puzzle" (a positive response of prices to an interest rate shock) is worth noting. In the US literature the "price puzzle" has been

---

output gap, the interest rate and expected inflation). In Fig. 3 inflation is measured as the annualized one-month log-change in the price level. Confidence intervals are computed with Monte Carlo simulations; they refer to one-standard-deviation bands.

[34] The response to a direct shock on import prices is similar. As is shown in Figure 7 below, an exchange rate shock does not immediately have a one-to-one impact on import prices (pass-through).

[35] They estimate a VAR using an identification approach based on both short- and long-run identifying assumptions.

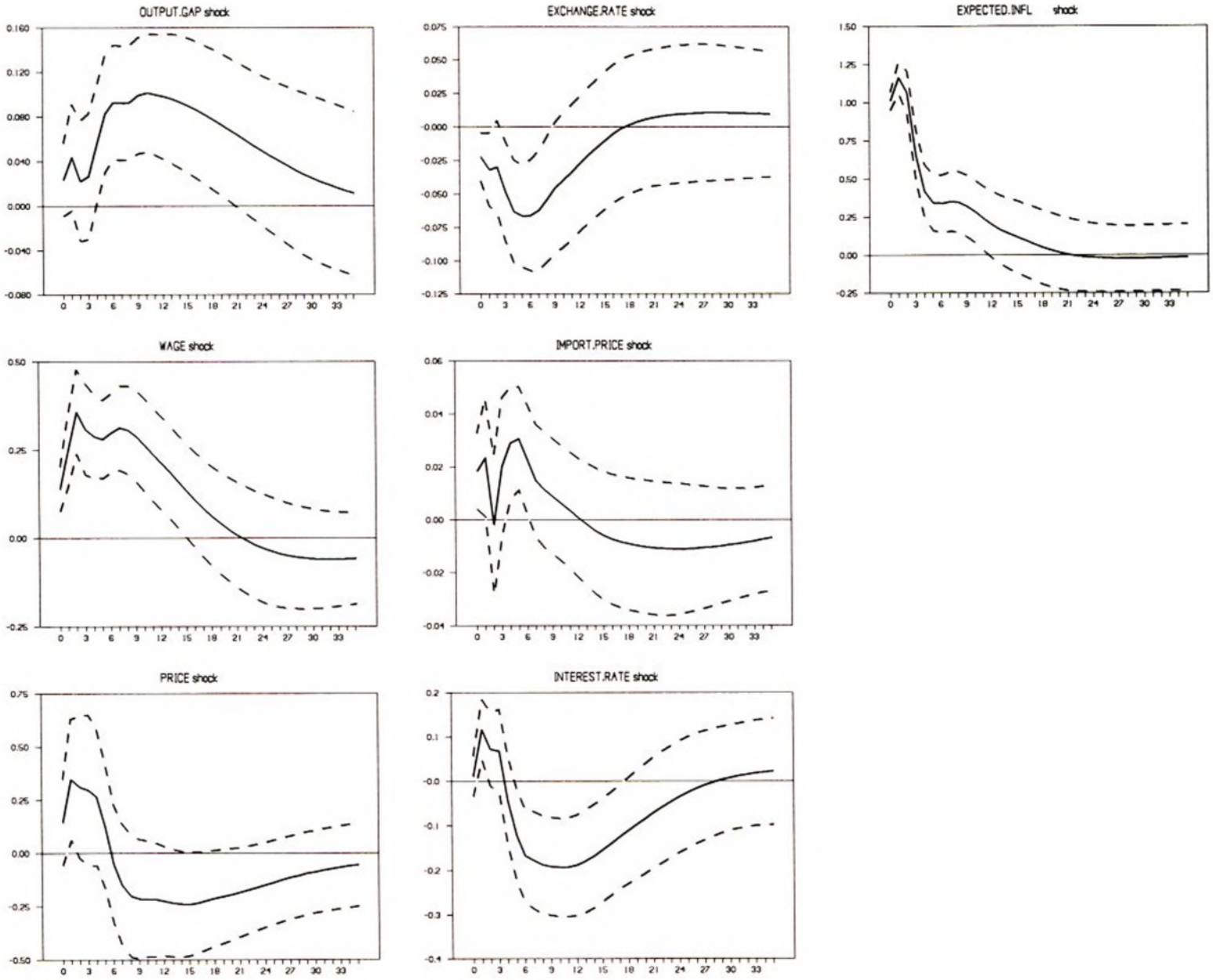
interpreted as a spurious correlation due to the effect of omitted variables on both prices and monetary policy, and solved by including commodity prices in the VAR (for a survey, Leeper, Sims and Zha, 1996). Consistently with this interpretation, a sensitivity analysis showed that in the VAR a "price puzzle" appears if both import prices and inflation expectations are excluded: shocks to these variables affect both prices and interest rates (since they are taken into consideration by the central bank, as it is confirmed by the impulse responses for the interest rate, discussed below).

Inflation expectations (Figure 4) increase following shocks on demand, wages, the exchange rate, import prices; they are affected by the interest rate (a monetary tightening induces a downward revision of expectations). The responses of inflation expectations are consistent with the responses of actual inflation: as Figure 5 shows, expectations errors (defined as the difference between the responses of expectations and the responses of inflation), although in some cases significantly non-zero in the short run, rapidly return to zero (long-run consistency and short-run bias are common results when using survey data on expectations: for a recent example, Ball and Croushore, 1995).

Monetary policy is largely endogenous, as it responds to the behavior of all the variables in the system. Figure 6 shows that interest rates react positively to output gap and price shocks; this behavior, characterizing most of the industrial countries since the beginning of the eighties, has recently been discussed

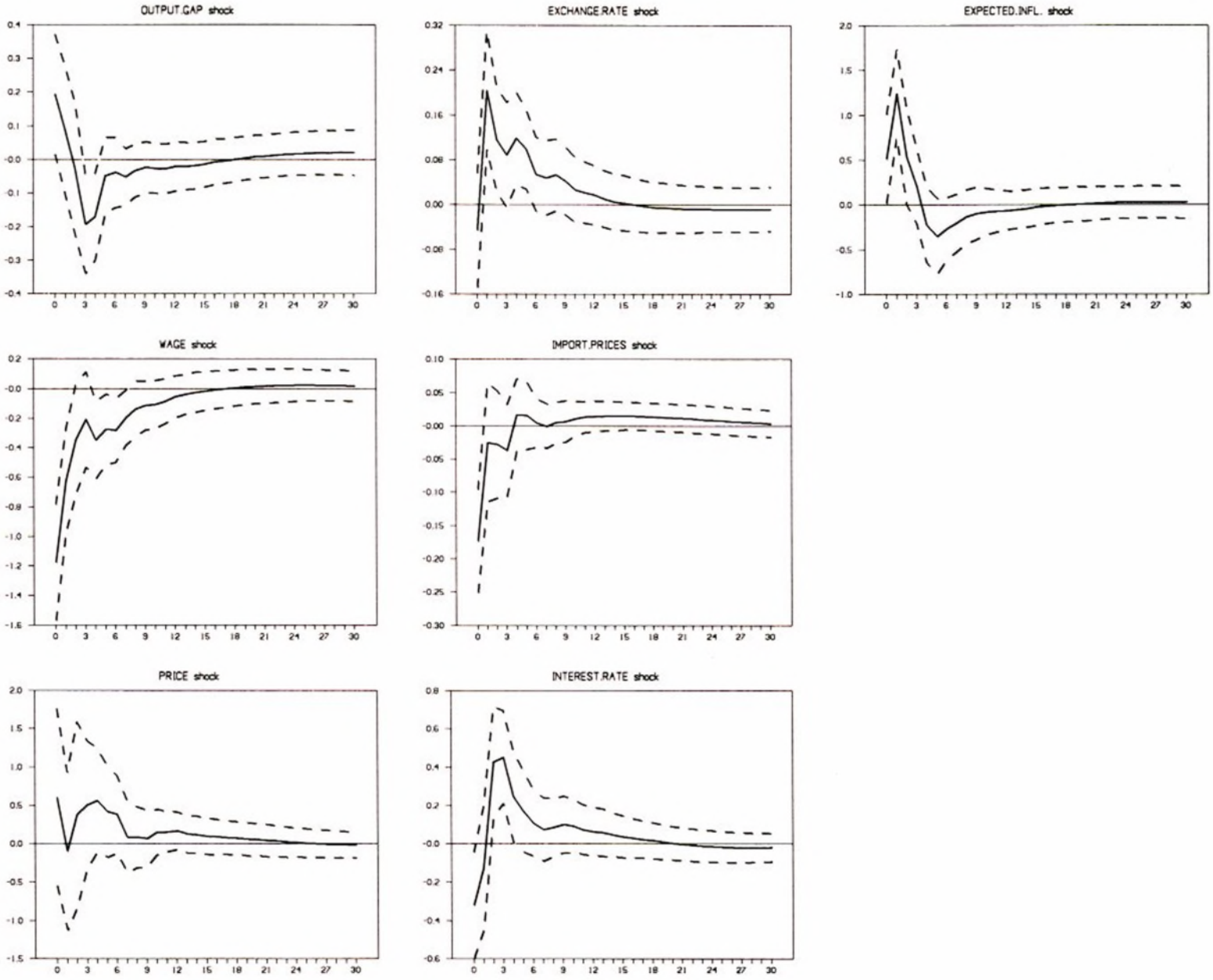
RESPONSES OF INFLATION EXPECTATIONS

Figure 4



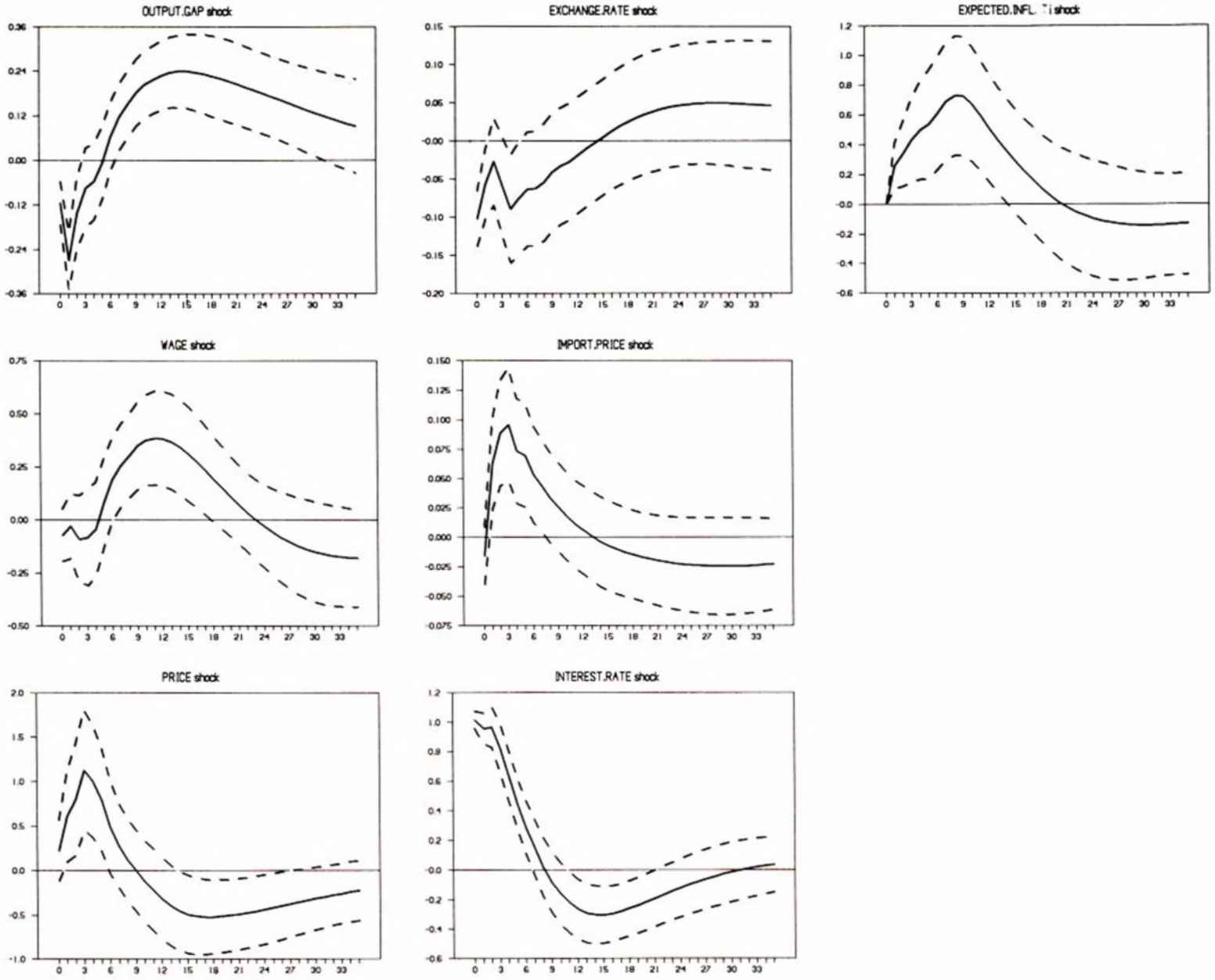
EXPECTATIONS ERRORS

Figure 5



RESPONSES OF THE INTEREST RATE

Figure 6



within the framework of a "Taylor rule".[36] However, in the VAR the most significant response is to inflation expectations and to costs (wages, import prices, exchange rate), suggesting that a Taylor rule is too simple a framework to fully capture monetary policy.[37]

In order to estimate the response of inflation to shifts in fiscal expectations, we estimated a different version of the VAR, which also included a proxy of default risk on the public debt, as perceived by financial markets; in the recent literature, this variable is usually measured as the spread between the yield on long-term (usually ten-year) government bonds (BTPs) and a low-risk security (e.g., swap rates), compared with the same spread for DM yields. However, these series do not exist before 1991; in order to obtain a continuous time series, we used the spread between the average yield on BTPs and the average yield on lira-denominated bonds issued by international institutions quoted on the Milan Stock Exchange.[38] Strictly speaking, inflation expectations should be related to the (less easily observable) risk of debt monetization rather than to that of debt default; our assumption is that the two measures are closely correlated, since they both signal the perception of fiscal imbalances.

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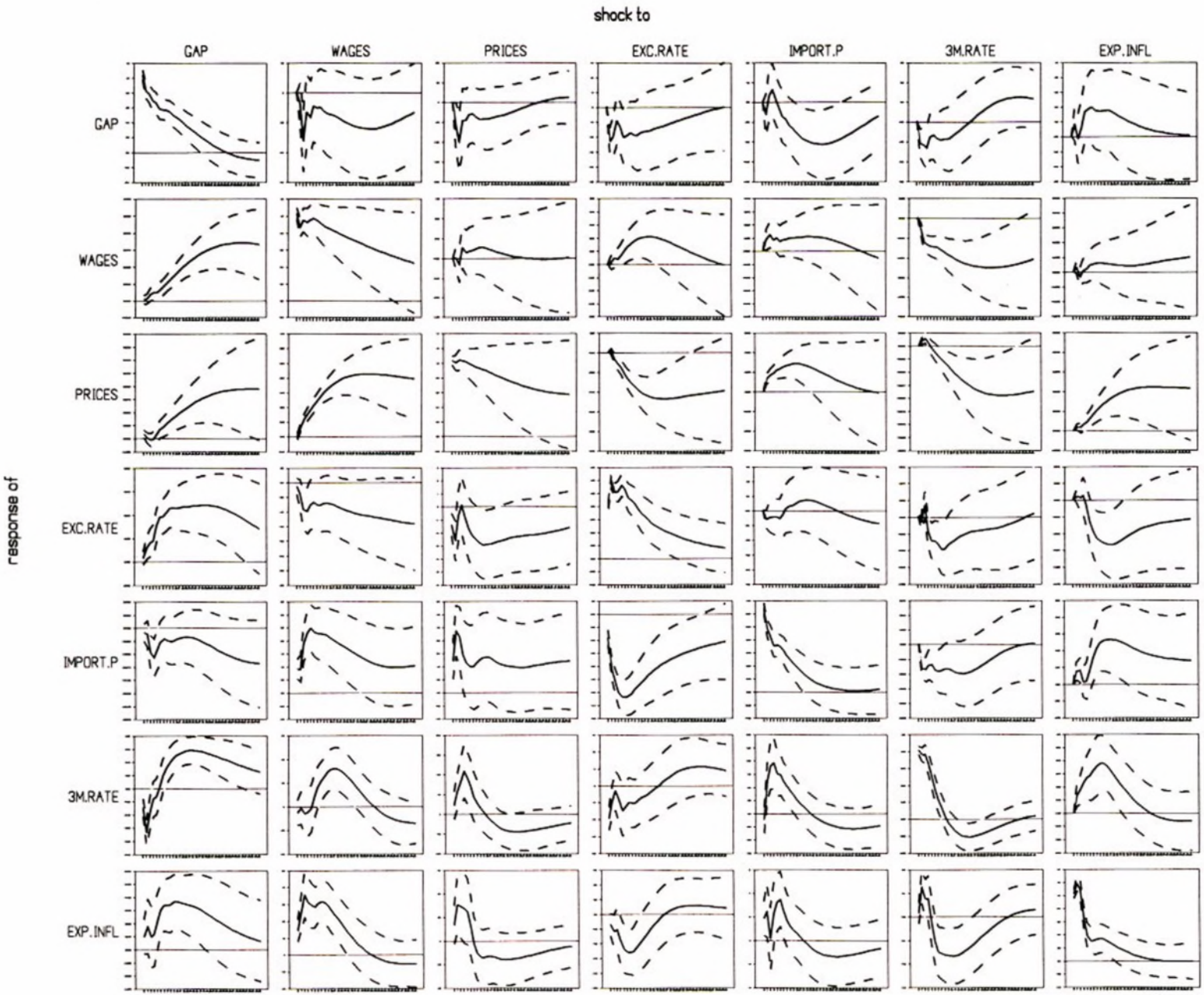
[36] See Taylor (1993). A Taylor rule links real interest rate movements to the output gap and inflation, with predetermined coefficients (0.5 in Taylor's original proposal for the US; the fit of a Taylor rule to the monetary policy of the Bundesbank is discussed in Clarida and Gertler, 1996).

[37] The whole set of impulse-responses is reported in Figure 7.

[38] Comparison between the two variables in the overlapping period suggests they follow a quite similar pattern. On the BTP-swap spread, see various issues of the *Economic Bulletin* of the Bank of Italy and Favero, Giavazzi and Spaventa (1996).

THE 7-VARIABLE VAR

Figure 7



The results are shown in Figures 8 and 9. To identify the shock, we assume that simultaneous causality runs from the default premium to the exchange rate and accordingly order the former before the latter. A shock to the default premium has a significant effect on the exchange rate, which depreciates; to some extent, the opposite effect also holds; a shock to the exchange rate is temporarily followed by a higher default premium. This is consistent with the fiscal interpretation of the turbulence on the currency market. However, the assumption of "fiscal dominance" would also imply a positive response of prices to the shock, but this is not the case: the response is rather weak and statistically not significant.

3.3 *A decomposition of inflation, 1992-96*

The properties of the VAR can be better evaluated by examining the contribution of the different exogenous shocks to the pattern of inflation in 1992-96.[39]

The VAR

$$\mathbf{y}_t = \sum_{s=1}^{L} \mathbf{C}_s \mathbf{y}_{t-s} + \mathbf{C}_0 \boldsymbol{\varepsilon}_t$$

(where ε is an n-dimensional vector of structural disturbances) may be written as:

$$\mathbf{y}_t = \sum_{s=0}^{\infty} \mathbf{B}_s \boldsymbol{\varepsilon}_{t-s}$$

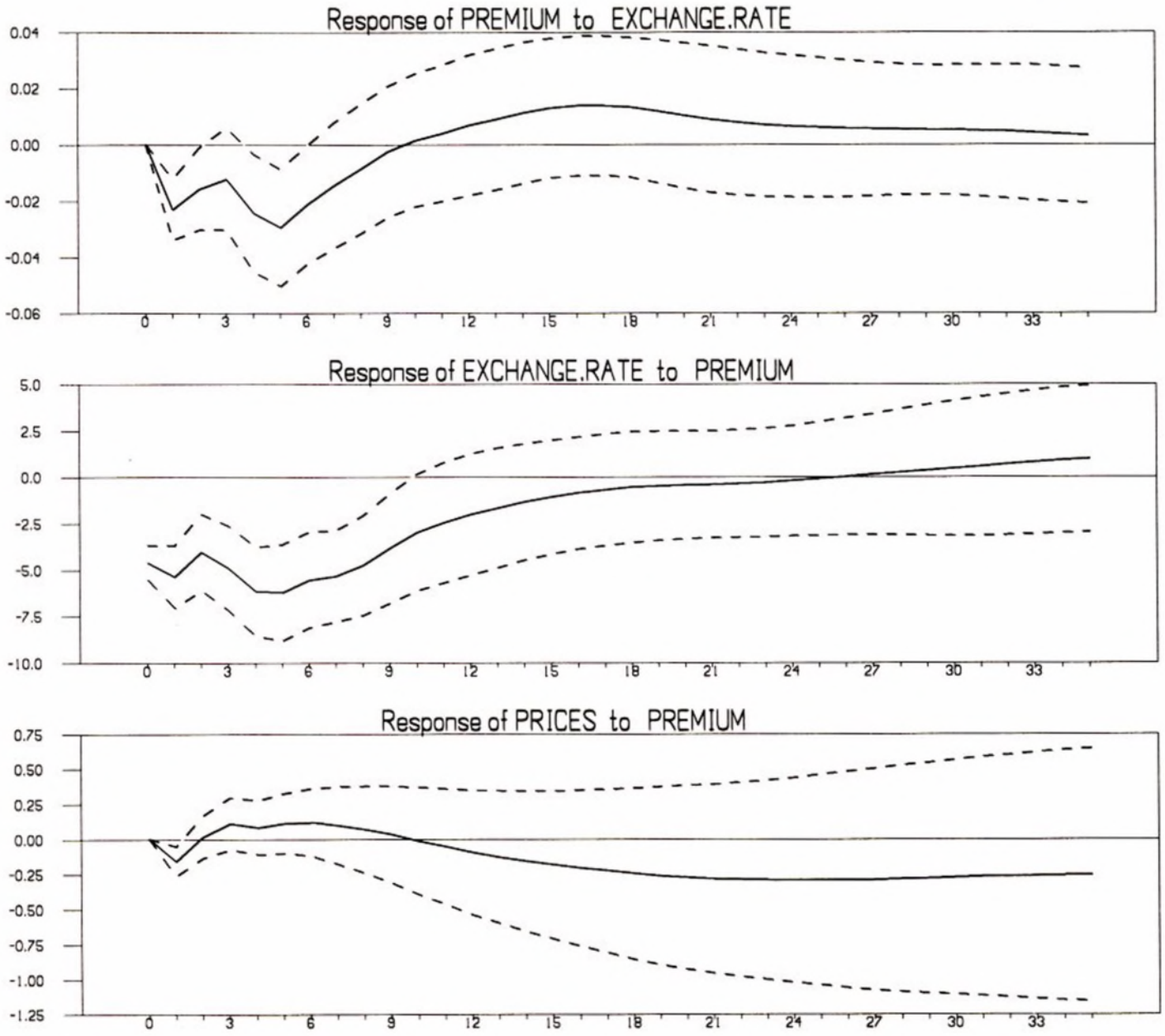
$$(1) \qquad y_{i,t} = \sum_{s=0}^{\infty} b_{s,1i} \varepsilon_{1,t-s} + \ldots + \sum_{s=0}^{\infty} b_{s,ni} \varepsilon_{n,t-s}$$

---

[39] See Doan (1992). For a recent application, see Gerlach and Smets (1995).

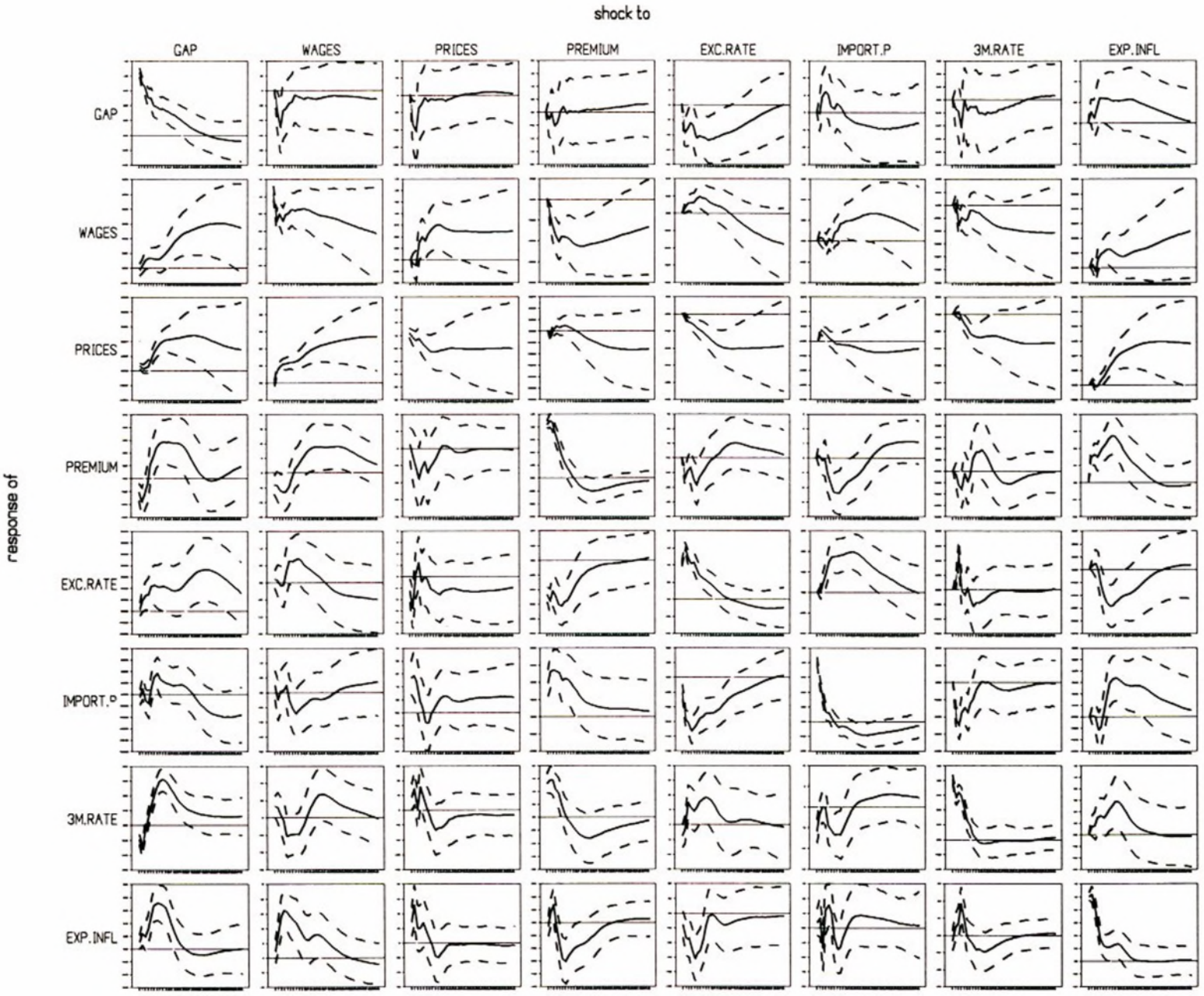
THE RISK PREMIUM ON PUBLIC SECURITIES, THE EXCHANGE RATE AND CONSUMER PRICES

Figure 8



THE 8-VARIABLE VAR

Figure 9



where $y_{i,t}$ is an element of y. Each $y_{i,t}$ is the sum of n terms, each representing the cumulated effect of the past history of structural shocks to one equation. The historical decomposition of inflation in 1992-96 was obtained taking twelve-month differences on both sides of the last equation, with $y_{i,t}$ defined as the consumer price log-level.[40]

In each panel in Figure 10, the straight line is the component of twelve-month consumer price inflation attributable to one of the shocks; the dotted line is the sum of these components (that is, actual inflation net of the deterministic mean, in percentage points). Three main periods may be observed.

Between 1992 and mid-1994 inflation decreases. In the first part of 1992, wage shocks contribute to the slowing of inflation; starting late in that year, a further contribution comes from the effect of negative output gap shocks; in the first part of 1993, the lagged effect of the interest rate shocks (the tightening in the summer of 1992) begins to emerge. The fall in the exchange rate after the exit from the EMS has effects of the opposite sign.

A resurgence in inflation starts in mid-1994, due to different factors. There is a major contribution of the exchange rate, peaking in mid-1995; inflation expectations start to have a positive effect in the summer of the same year, that peaks in the early part of 1995; the increase in capacity utilization begins to

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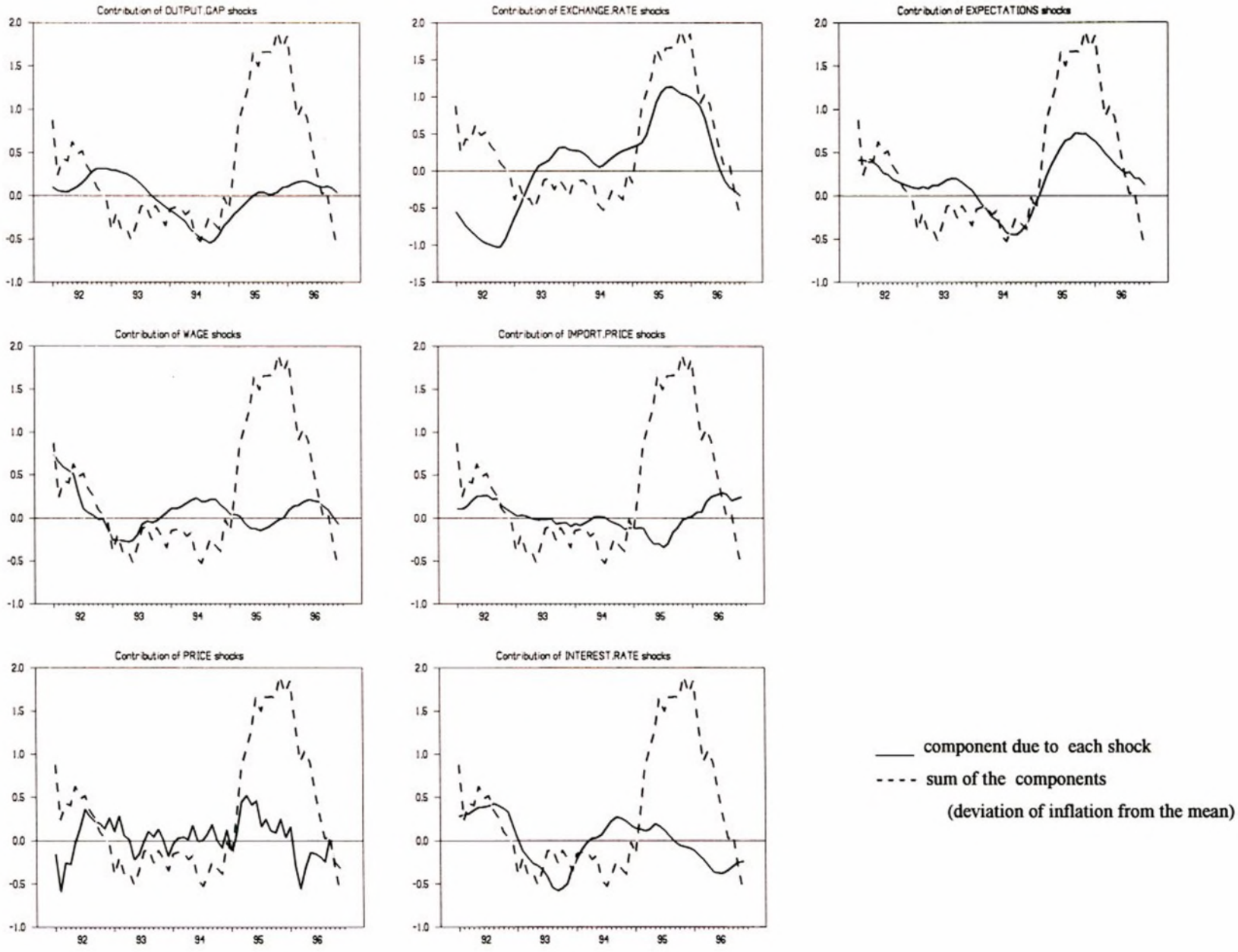
[40] The backward summation of the lagged shocks was truncated at 1986:1. This leaves out a term, that converges to the deterministic component of inflation in the VAR.

DECOMPOSITION OF TWELVE-MONTH INFLATION

Figure 10



dampen the downward pressure on prices in mid-1994. The monetary easing that took place in 1993 has the effect of increasing inflation from end-1994 onwards.

In the second half of 1995 the trend in inflation is reversed, due to the appreciation of the exchange rate, from the summer onwards, to the gradual waning of adverse expectations and to the effects of the monetary restriction initiated in June 1994, which begins to show up in inflation in the second half of 1995.

4. Conclusions

Our results suggest that inflation expectations do matter as determinants of inflation in Italy. The results also show a larger effect of demand shocks on prices than previously found. Fiscal expectations shocks, by contrast, affect the exchange rate, but not the inflation rate: the assumption of "fiscal dominance" is rejected.

The interpretation of the effect of inflation expectations warrants further research. It may reflect an effect of the expectational climate on firms' price-setting policies, which would be consistent with the trasmission mechanism assumed in most of the recent literature on monetary policy credibility. It may also capture the effect of omitted variables, although the VAR controls for the main ones (wages, import prices, indirect taxes; it is also robust to the inclusion of output prices). Survey expectations may reflect "diffused" information among economic agents, coming from a number of micro-variables; in this case, although expectations would not be causing inflation, their observation would still be important for policy-making.

Expectations may also matter because they affect the speed of transmission of exchange rate movements to prices, by determining their perceived persistence; this interpretation is consistent with some of the evidence discussed in Section 2.3.

The decomposition of recent Italian inflation shows that the two episodes of sharp depreciation, in 1992 and in 1995, were a major source of inflationary pressures, but not the only factor. Demand shocks were the main determinant of the decrease in inflation from the end of 1992 onwards, more than offsetting the effect of the devaluation of the lira. Demand recovery also played a role in the inflationary episode in 1994-95, together with the worsening of inflation expectations.

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