

Chart 4

Inflation and Real Output Growth: No Correlation

Average Annual Rates of Growth in Consumer Prices
and in Nominal Gross Domestic Product, Deflated by Consumer Prices
During 1960–90 in 110 Countries

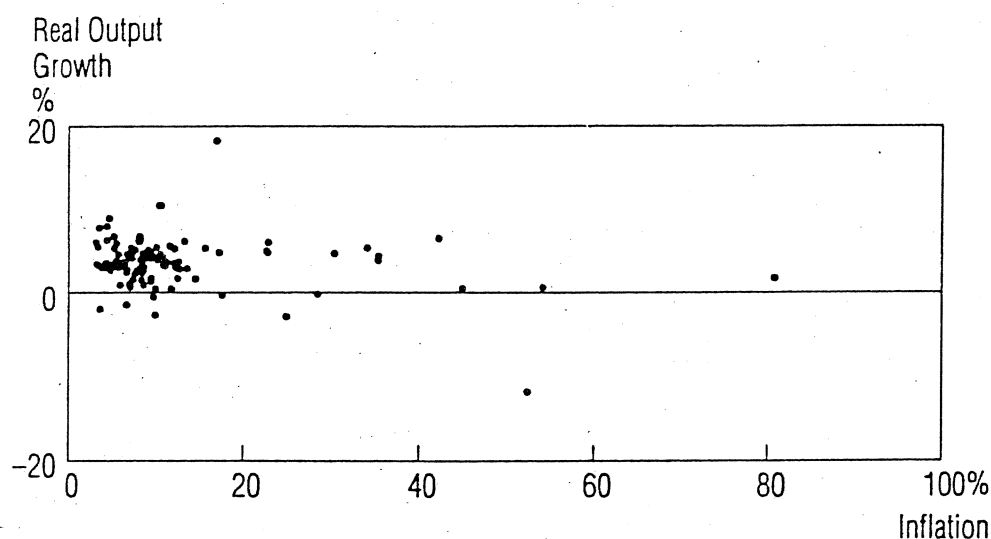


Table 5

Correlation Coefficients for Inflation
and Real Output Growth*

Based on Data From 1960 to 1990

Sample	Coefficient With Outlier**	
	Included	Excluded
All 110 Countries	-.243	-.101
Subsamples		
21 OECD Countries	.390	.390
14 Latin American Countries	—	-.342

*Inflation is defined as changes in a measure of consumer prices. Real output growth is calculated by subtracting those inflation rates from changes in nominal gross domestic product.

**The outlier is Nicaragua.

Source of basic data: International Monetary Fund

Table 3.2
Alternative specifications for inflation in growth regressions

Independent variable	(1)	(2)	(3)	(4)
Log(GDP)	-.0260 (.0031)	-.0261 (.0031)	-.0261 (.0031)	-.0262 (.0031)
Male schooling	.0116 (.0024)	.0114 (.0024)	.0111 (.0025)	.0110 (.0025)
Log(life expectancy)	.0421 (.0137)	.0419 (.0137)	.0418 (.0139)	.0427 (.0139)
Log(GDP) * male schooling	-.0057 (.0016)	-.0057 (.0016)	-.0052 (.0017)	-.0052 (.0017)
Log(fertility rate)	-.0166 (.0053)	-.0167 (.0053)	-.0170 (.0054)	-.0167 (.0054)
Government consumption ratio	-.138 (.026)	-.140 (.026)	-.137 (.026)	-.140 (.026)
Rule of law index	.0310 (.0053)	.0310 (.0053)	.0315 (.0054)	.0317 (.0054)
Terms of trade change	.137 (.030)	.137 (.030)	.139 (.030)	.139 (.030)
Democracy index	.091 (.026)	.091 (.026)	.104 (.026)	.103 (.026)
Democracy index squared	-.088 (.023)	-.088 (.023)	-.099 (.023)	-.097 (.023)
Inflation rate	-.0293 (.0043)	-.0317 (.0080)	-.0261 (.0054)	-.0314 (.0113)
Standard deviation of inflation rate		.0030 (.0089)		.0071 (.0150)
R ²	.56, .51, .50	.56, .51, .50	.55, .49, .51	.55, .50, .50
No. of observations	80, 87, 84	80, 87, 84	80, 87, 84	80, 87, 84

Notes: The systems correspond to those shown in table 1.1 except for the inflation variables. In columns 1 and 2, the actual inflation rate over each period is included on the instrument list. Columns 3 and 4 include lagged inflation (for 1960-1965, 1970-1975, and 1980-1985, respectively) and its square, but not contemporaneous inflation, with the instruments. Columns 2 and 4 add the standard deviation of the inflation rate for 1965-1975, 1975-1985, and 1985-1990, respectively. Column 2 includes this standard deviation on the instrument list. Column 4 includes only the lagged standard deviation (for 1960-1965, 1970-1975, and 1980-1985) with the instruments.

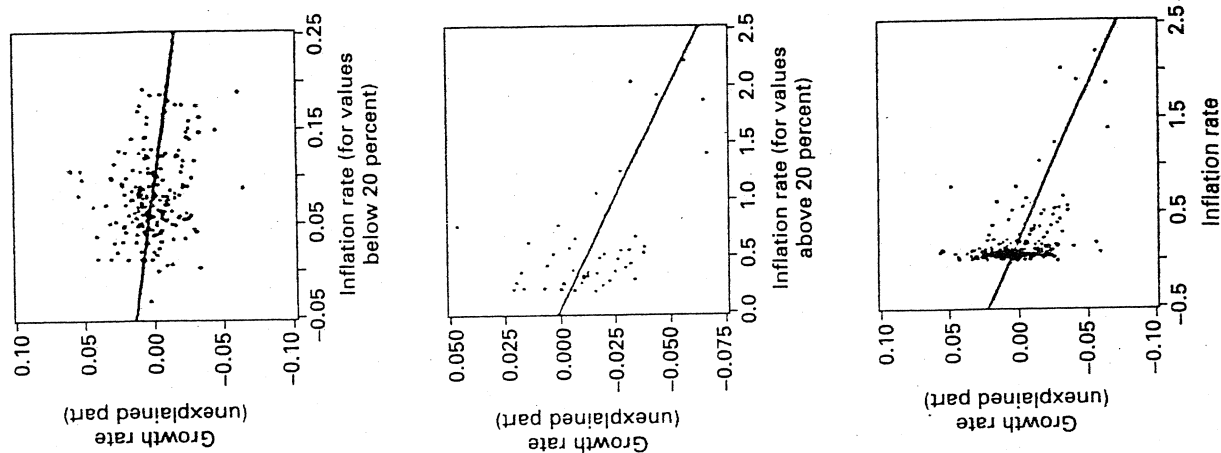


Figure 3.3
Growth rate versus inflation rate

Table 2
Growth before and after inflation crises of 40% and above, 1961-1994* (t-statistics in parentheses)

	No. of annual observations	Inflation rate (%) ^b	Per capita growth ^b	Per capita growth, deviations from world average, robustness checks				
				Per capita growth, deviation from world average	Sample excluding growth deviations > 10% and < -10%	Sample prior to 1978	Sample excluding hyperinflationary countries ^c	Sample excluding war years ^d
Before first inflation crises	518	11% (24.46)	1.3% (4.91)	-0.8% (-3.25)	-0.5% (-2.60)	-0.5% (-1.58)	-0.9 (-3.20)	-0.5% (-1.83)
During inflation crises	269	151% (17.22)	-1.1% (-3.23)	-2.1% (-6.49)	-1.4% (-5.66)	-2.8% (-4.26)	-1.7% (-5.43)	-2.0% (-6.01)
After inflation crises	176	17% (24.11)	2.2% (8.18)	1.4% (5.81)	1.6% (7.65)	1.8% (3.02)	1.3% (5.81)	1.5% (5.94)
t-stat for H ₀ : equality of means during-before		15.17	-5.57	-3.11	-3.04	-3.24	-2.36	-3.67
t-stat for H ₀ : equality of means after-during		-14.12	7.64	8.68	9.24	5.17	7.81	8.37
t-stat for H ₀ : equality of means after-before		6.70	2.42	6.37	7.46	3.40	6.33	5.46

*There were 41 high inflation crises in 31 countries, with a median crisis length of 6 years (see Appendix for listing).

^bGDP per capita growth from World Bank Economic and Social Database (BESD), inflation from International Financial Statistics (CPI December over December); averages are geometric averages.

^cCountries that had hyperinflation: Argentina, Bolivia, Brazil, Nicaragua, Peru, Yugoslavia, Zaire (hyperinflation defined as > 1000%.

^dWars taking place on national territory as listed in Sivard (1993), updated to 1994 from Center for Defense Information, 1995.

Table 7.1
Cyclical Behavior of the U.S. Economy: Deviations from Trend of Key Variables, 1954:I-1991:II

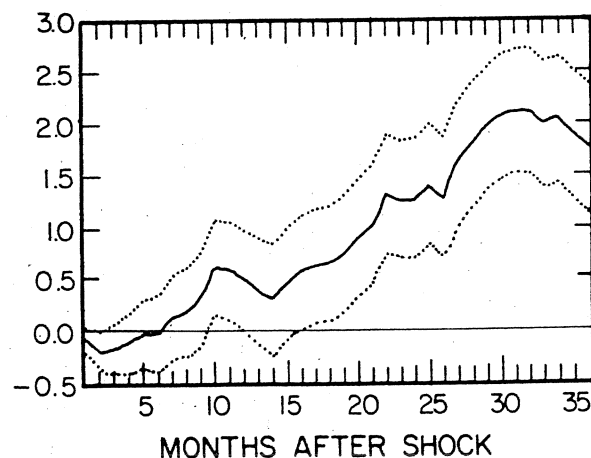
Variable	SD%	Cross-Correlation of Output with:											Correlation with M1 Growth
		x(-5)	x(-4)	x(-3)	x(-2)	x(-1)	x	x(+1)	x(+2)	x(+3)	x(+4)	x(+5)	
Output component													
GNP	1.72	-.02	.16	.38	.63	.85	1.0	.85	.63	.38	.16	-.02	-.12
Consumption Expenditures													
CNDS	0.86	.22	.40	.55	.68	.78	.77	.64	.47	.27	.06	-.11	.02
CD	4.96	.24	.37	.49	.65	.75	.78	.61	.38	.11	-.13	-.31	.07
Investment													
INV	8.24	.04	.19	.38	.59	.79	.91	.76	.50	.22	-.04	-.24	-.18
Ch.INVENT	17.3	-.03	.07	.22	.38	.53	.67	.51	.27	.04	-.15	-.30	-.34
Labor input based on Household Survey													
HSHOURS	1.59	-.06	.09	.30	.53	.74	.86	.82	.69	.52	.32	.11	-.15
Prices													
GNPDEF	0.88	-.52	-.63	-.69	-.70	-.65	-.57	-.44	-.31	-.17	-.04	.08	-.16
CPI	1.43	-.57	-.66	-.71	-.72	-.65	-.52	-.35	-.17	.02	.19	.34	-.22
INFLATION	0.57	-.32	-.23	-.10	.01	.19	.34	.43	.44	.47	.43	.34	-.29
Monetary Aggregates													
MB	0.84	.22	.33	.39	.42	.37	.30	.21	.15	.07	.03	.02	.18
M1	1.52	.16	.24	.33	.41	.39	.33	.21	.12	.05	.03	.02	.25
M2	1.46	.51	.58	.62	.62	.50	.33	.10	-.08	-.21	-.29	-.37	.37
Velocity of money													
M1V	1.94	-.38	-.33	-.24	-.08	.15	.37	.39	.33	.22	.09	0.0	.01
Interest rates													
GB10YR	0.66	-.51	-.46	-.39	-.26	-.09	.10	.08	.11	.10	.08	.07	-.37
TB1MO	1.29	-.55	-.41	-.27	-.03	.20	.40	.42	.44	.36	.32	.25	-.27

Note: GNP—real GNP, 1982\$; CNDS—consumption of nondurables and services, 1982\$; CD—consumption of durables, 1982\$; INV—gross private domestic investment, 1982\$; Ch.INVENT—change in inventories, 1982\$; HSHOURS—total hours of work (Household Survey); GNPDEF—implicit GNP deflator; CPI—Consumer Price Index, all items; INFLATION— $\Delta \text{LN}(\text{CPI})$; MB—monetary base; M1—Money Supply 1; M2—Money Supply 2; M1V—velocity for M1; GB10YR—10-year government bond yield; TB1MO—1-month Treasury bill rate.

$$y_t = a_0 + \sum_{i=1}^{11} a_i M_{it} + \sum_{j=1}^{24} b_j y_{t-j} + \sum_{k=0}^{36} c_k D_{t-k}, \quad (1)$$

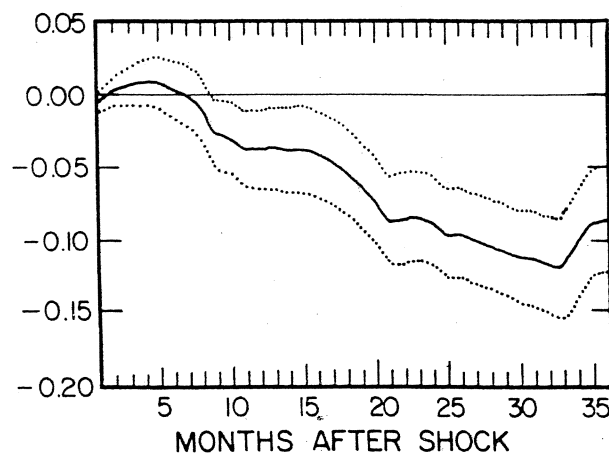
where y is either the change in log industrial production or the level of the unemployment rate, M is a set of monthly dummy variables, and D is the dummy variable for contractionary monetary shocks. For the unemployment equation a simple linear time trend is also included. The regressions are run over the period 1948–87.

Figure 5 IMPULSE RESPONSE FUNCTION FOR BASIC UNEMPLOYMENT REGRESSION.



Notes: The impulse response function shows the impact of a unit shock to the monetary dummy variable on the level of the unemployment rate (expressed in percentage points). The coefficient estimates used to generate the impulse response function are given in Table 2. The dashed lines show the one standard error bands.

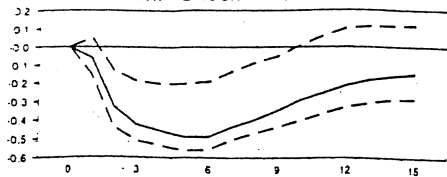
Figure 4 IMPULSE RESPONSE FUNCTION FOR BASIC INDUSTRIAL PRODUCTION REGRESSION



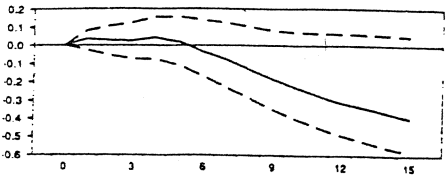
Notes: The impulse response function shows the impact of a unit shock to the monetary dummy variable. The impulse responses for the change in industrial production have been cumulated to reflect

Figure 2

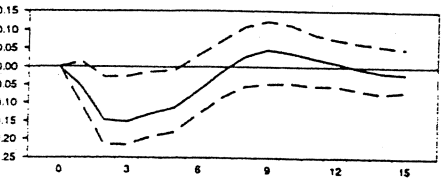
Fed Funds Model with M1
MP Shock => Y



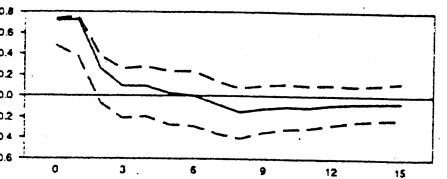
MP Shock => Price



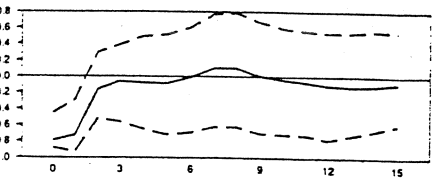
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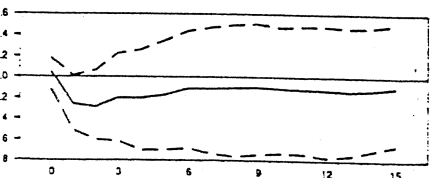
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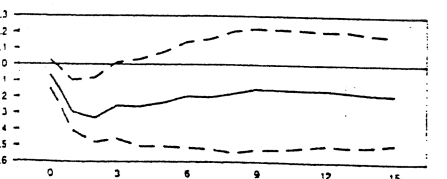
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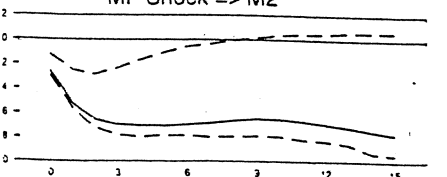
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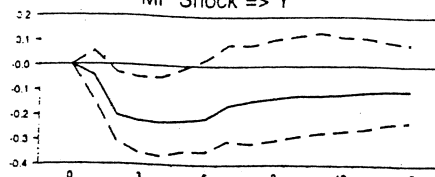
MP Shock => M1



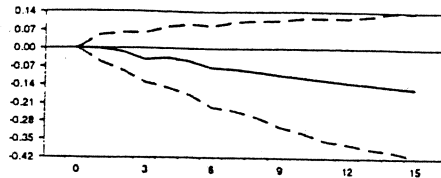
Fed Funds Model with M2
MP Shock => M2



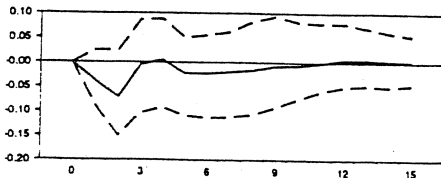
NBR Model with M1
MP Shock => Y



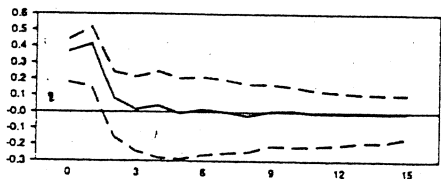
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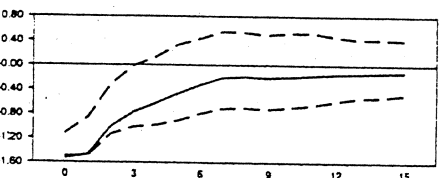
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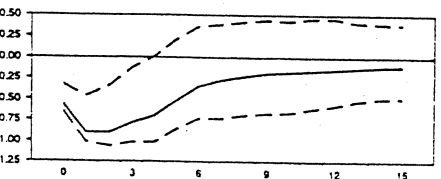
MP Shock => FF



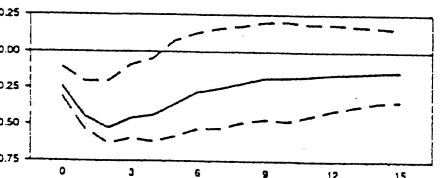
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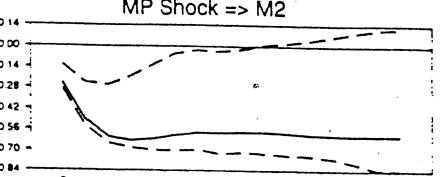
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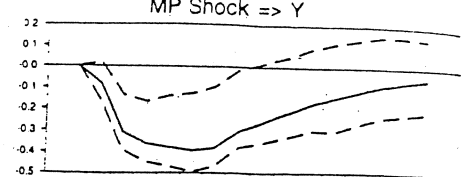
MP Shock => M1



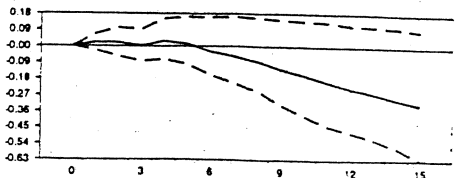
NBR Model with M2
MP Shock => M2



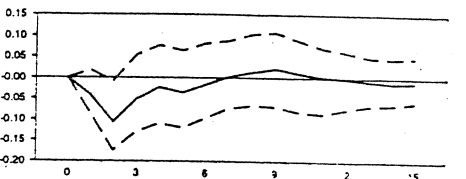
NBR/TR Model with M1
MP Shock => Y



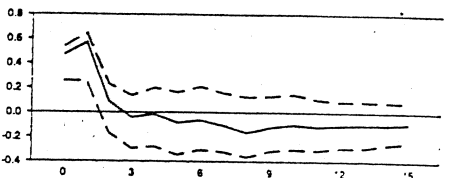
MP Shock => Price



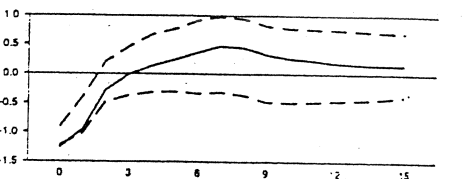
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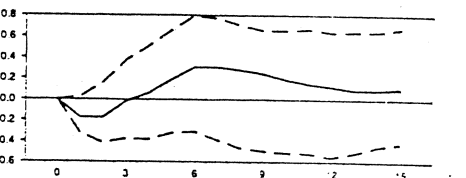
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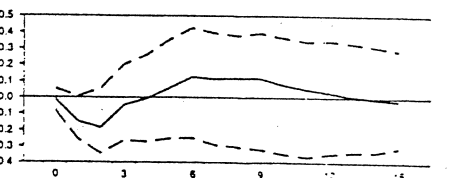
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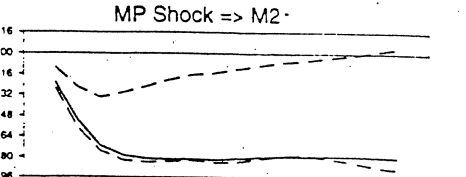
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MP Shock => M1



NBR/TR Model with M2
MP Shock => M2



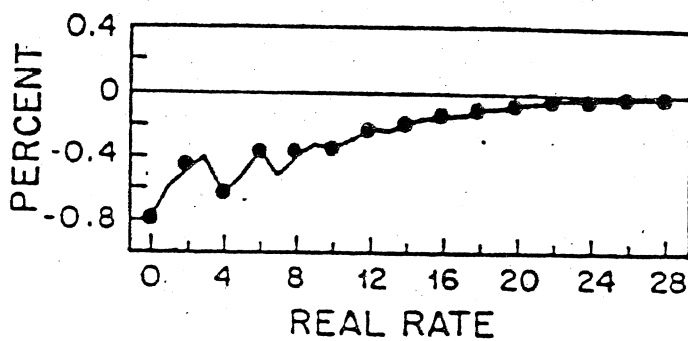
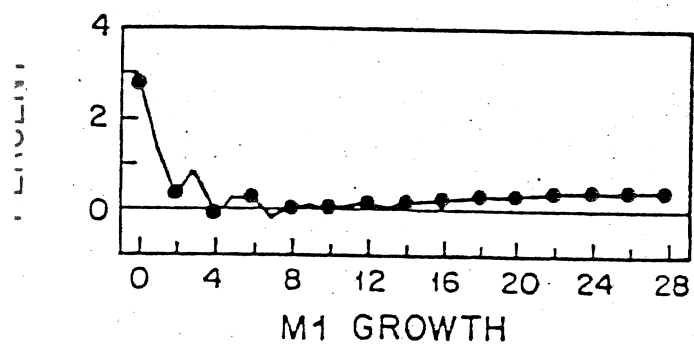
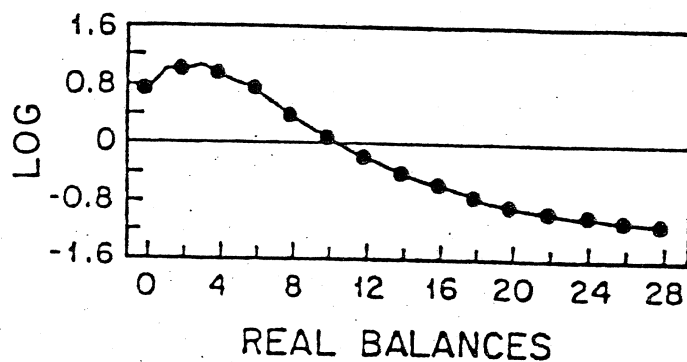
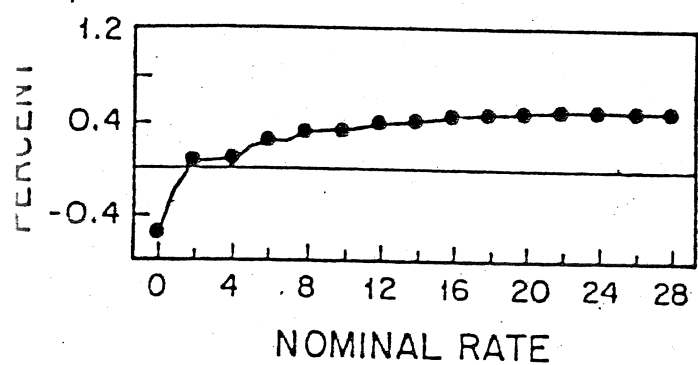
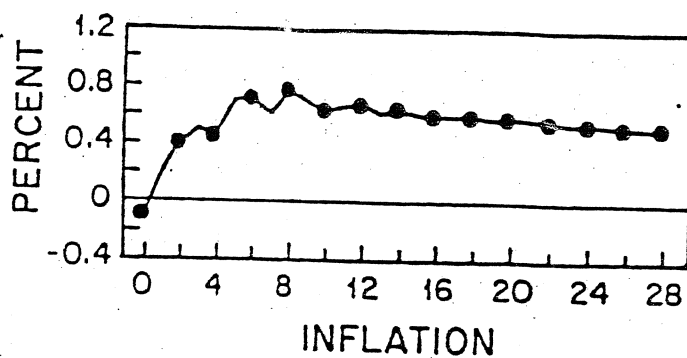
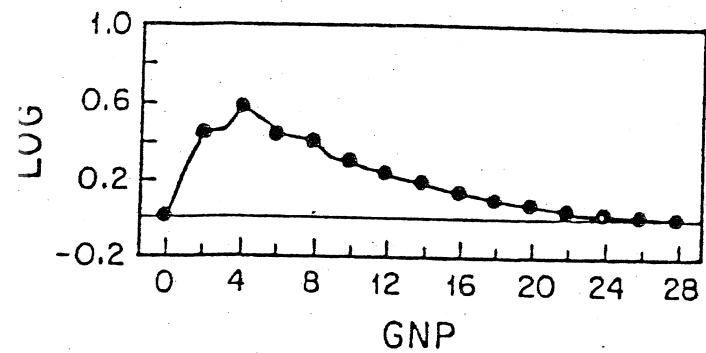


FIGURE II
Dynamic Response to a Money Supply Shock

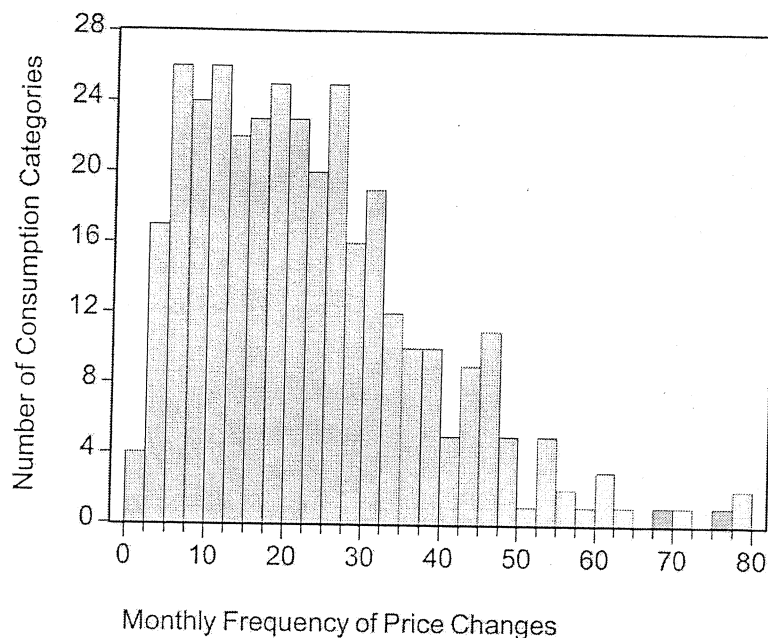


FIG. 1

STICKY PRICES

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TABLE 1
MONTHLY FREQUENCY OF PRICE CHANGES BY YEAR,
1995-2002

Year	Median Frequency (%)	Median Duration (Months)
1995	21.3	4.2
1996	20.8	4.3
1997	19.9	4.5
1998	21.2	4.2
1999	21.4	4.1
2000	21.7	4.1
2001-2	22.0	4.0

SOURCE.—U.S. Department of Labor, Commodities and Services Substitution Rate Table, various years.

NOTE.—2001-2 refers to the 15-month period from January 2001 through March 2002.

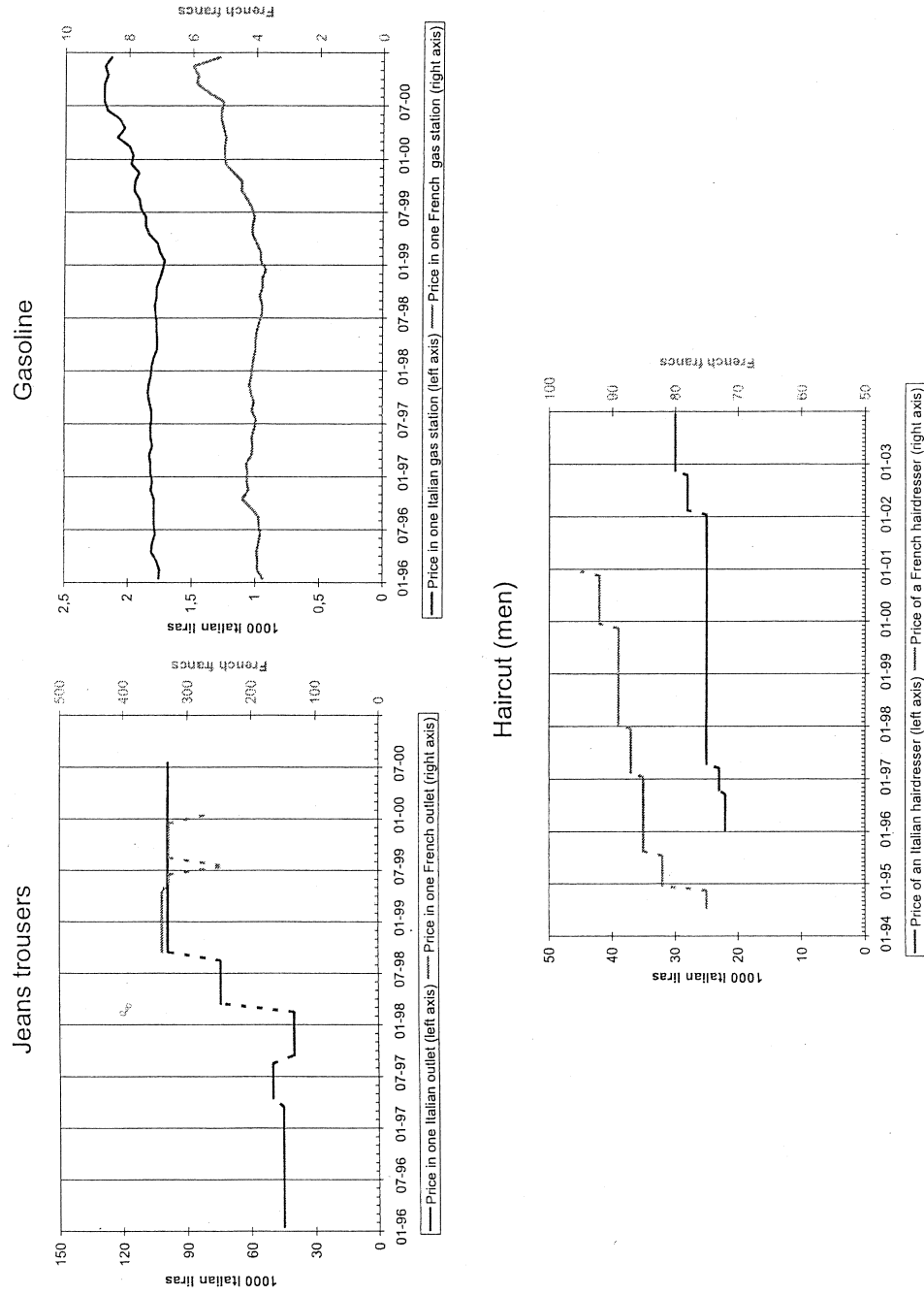
TABLE 2
MONTHLY FREQUENCY OF PRICE CHANGES FOR SELECTED CATEGORIES

	Price Quotes with Price Changes (%) (1)	Price Quotes with Price Changes, Excluding Observations with Item Substitutions (%) (2)
All goods and services	26.1 (1.0)	23.6 (1.0)
Durable goods	29.8 (2.5)	23.6 (2.5)
Nondurable goods	29.9 (1.5)	27.5 (1.5)
Services	20.7 (1.5)	19.3 (1.6)
Food	25.3 (1.8)	24.1 (1.9)
Home furnishings	26.4 (1.8)	24.2 (1.8)
Apparel	29.2 (3.0)	22.7 (3.1)
Transportation	39.4 (1.8)	35.8 (1.9)
Medical care	9.4 (3.2)	8.3 (3.3)
Entertainment	11.3 (3.5)	8.5 (3.6)
Other	11.0 (3.3)	10.0 (3.3)
Raw goods	54.3 (1.9)	53.7 (1.7)
Processed goods	20.5 (.8)	17.6 (.7)

SOURCE.—U.S. Department of Labor (1997).

NOTE.—Frequencies are weighted means of category components. Standard errors are in parentheses. Durables, nondurables, and services coincide with U.S. NIPA classifications. Housing (reduced to home furnishings in our data), apparel, transportation, medical care, entertainment, and other are BLS major groups for the CPI.

Figure 1 - Examples of individual price trajectories (French and Italian CPI data)



Note : Actual examples of trajectories, extracted from the French and Italian CPI databases. The databases are described in Baudry *et al.* (2004) and Veronese *et al.* (2005). Prices are in levels, denominated in French Francs and Italian Lira respectively. The dotted lines indicate events of price changes.

Table 2 - Frequency of price changes and average price duration
in the Euro area and the US

	Euro area	US
Frequency of price changes		
50 product sample	15.1 p.c.	24.8 p.c.
Larger sample	15.3 p.c.	26.1 p.c.
Trimmed mean	16.9 p.c.	
Average duration		
Based on frequencies at the euro area product category level	13.0 months	6.7 months
Based on frequencies at the country-product category level	15.1 months	
Inverting the aggregate frequency of price changes	6.6 months	3.8 months
Median price duration	10.6 months	4.6 months

Sources: authors calculations based on NSIs data, and Bils and Klenow (2004). Median duration for the US relies on full CPI. Figures are weighted using CPI and country weights.

Table 3 – Frequency of price change by product type⁽¹⁾

	Unprocessed food	Processed food	Energy (oil products)	Non energy industrial goods	Services	Total ⁽²⁾ country weights	Total ⁽³⁾ Euro area weights
Austria (AT)	37.5	15.5	72.3	8.4	7.1	15.4	17.1
Belgium (BE)	31.5	19.1	81.6	5.9	3.0	17.6	15.6
Germany (DE)	25.2	8.9	91.4	5.4	4.3	13.5	15.0
Spain (ES) ⁴	50.9	17.7	n.a.	6.1	4.6	13.3	11.5
Finland (FI)	52.7	12.8	89.3	18.1	11.6	20.3	-
France (FR)	24.7	20.3	76.9	18.0	7.4	20.9	20.4
Italy (IT)	19.3	9.4	61.6	5.8	4.6	10.0	12.0
Luxembourg (LU)	54.6	10.5	73.9	14.5	4.8	23.0	19.2
Netherlands (NL)	30.8	17.3	72.6	14.2	7.9	16.2	19.0
Portugal (PT)	55.3	24.5	15.9	14.3	13.6	21.1	18.7
Euro area	28.3	13.7	78.0	9.2	5.6	15.1	15.8
US	47.7	27.1	74.1	22.4	15.0	24.8	-

Sources: NCBs calculations on NSIs data

(1) Figures presented in this table are computed on the basis of the 50 product sample, with the only exception of Finland for which figures derived from the entire CPI are presented. Figures based on a larger coverage of the CPI for each individual country, when available, are presented in their respective national paper mentioned in Table 1.

(2) The total is calculated using country specific weights for each item.

(3) The total is calculated using common euro area weights for each sub-index. No figures are provided for Finland because of lack of comparability of the sample of products used in this country.

(4) In the Spanish database no energy products are included, which biases downwards the aggregate frequency.