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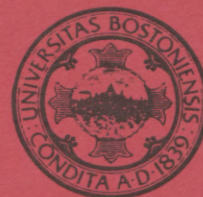
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INFLATION IN PERU: 1980-1984

by

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## Inflation in Peru: 1980-1985

### 1. Introduction

In 1980, one of the main objectives of the government of Peru was to control inflation. Inflation was thought to be the result of demand pull and expectations. Demand pressures in turn were supposed to come from two sources: The fiscal deficit and the accumulation of international reserves due to the price boom of primary exports during 1979-80. According to this diagnosis, the anti-inflationary policy implemented comprised the main following measures:<sup>1/</sup>

a) Control of the fiscal deficit. This included, among other measures, the elimination of subsidies on the goods and services provided by the government. Price controls on these goods were thought to have artificially repressed inflation. Furthermore, there was the conviction that the price adjustments would produce a once and for all corrective increase of prices.

b) Contractionary monetary policy via increase in interest rates and control of money supply. Higher interest rates were supposed to increase savings, thus lowering demand pressures.

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<sup>1/</sup> See for example: Central Bank, "La Lucha contra la Inflación", February 1982.

c) Import liberalization. It comprised the elimination of prohibitions, the reduction of tariff rates mainly on final goods and the establishment of a crawling peg. Additional imports would reduce the accumulation of reserves and provide more competition for domestic production. The exchange rate would be adjusted according to the difference between domestic and world inflation, to maintain traded sectors' competitiveness.

d) Initiation of a wage and price tripartite agreement between government, entrepreneurs and workers to reduce expectations and cost push pressures.

However, the outcome of these anti-inflationary measures was the persistence and even acceleration of inflation (See Table 1.1). This paper tries to show that the diagnosis of the causes of inflation in 1980 was questionable. Evidence suggests that during the period under study, excess domestic demand did not exist. An alternative explanation of inflation, to be tested in this paper, is that the causes of inflation were mainly the exchange rate policy and adjustments of the controlled prices, through costs and expectations. The paper is organized as follows: In Section 2, the notion of excess demand as cause of inflation is discussed. Section 3 is an overview of the inflation trends of the main components of the Consumer Price Index (CPI). A model on the price formation mechanism for different types of goods and services during the period is

Table 1.1

Peru: Annual Rates of Inflation  
December/December

Year	Inflation Rate % (Consumer Price Index)
1975	24.0
1976	44.7
1977	32.4
1978	73.3
1979	66.7
1980	60.8
1981	72.7
1982	72.9
1983	125.1
1984	111.5

Source: National Institute of Statistics.

presented in Section 4, and Section 5 contains the empirical estimates of this model. Finally, in Section 6 the conclusions of the paper are presented.

## 2. Demand Pull and Inflation

As noted above, inflation was thought to be caused mainly by demand pressures. These pressures were in turn assumed to be the result from the fiscal deficit and monetary expansion..

It is usually postulated that fiscal deficit increases domestic demand and therefore promotes inflation. This conclusion is derived by assuming that the fiscal deficit represents a net injection to the economy and that the aggregate supply curve is inelastic.

However, both assumptions do not necessarily hold. The relationship between a fiscal deficit and a net injection is not very straightforward, since it will depend both on the structure of the fiscal expenditures and on the source of deficit financing. Government expenditures in foreign currency are not "injections" to the economy but rather "leakages" from it, thus, if a particular fiscal deficit results exclusively from "excess" expenditures in foreign currency, no net injection and therefore

no excess domestic aggregate demand would occur.

Similarly, the source of deficit financing affects the relationship between fiscal deficit and aggregate domestic demand. A domestic expenditure financed by credit creation represents an injection to the economy, whereas by contrast, a domestic expenditure financed by crowding out domestic private credit, may not. Therefore, whether a fiscal deficit constitutes a net injection to the economy will depend on the combined effects of fiscal expenditures and deficit financing. The final effect on inflation however, will still depend on the inelasticity of domestic supply, since a net expansion of aggregate demand could be absorbed by an increase in output and/or imports for traded goods, and not necessarily in prices.

In the Peruvian case, during the period 1980-1984, the fiscal deficit as a percentage of GDP ranged from 4.7% to 12% (See Table 2.1). However, the structure of expenditures and the deficit financing suggest that during this period the fiscal deficit did not produce a net injection into the economy.

Since it was not possible to determine the degree of crowding-out of the domestic credit used to finance fiscal deficit, estimates of the "effective" fiscal deficit (net injections) were made for 1980-1983, considering two polar situations:

Table 2.1

Consolidated Public Sector Deficit  
(millions of intis)

	1980	1981	1982	1983
Current Revenues	2700	4108	7022	13991
Current Expenditures	2549	4059	7031	14707
Current Balance	151	49	-9	-716
Capital Income	32	72	202	273
Capital Expenditures	418	838	1508	2744
Overall Deficit	-235	-717	-1315	-3187
(As percentage of GDP)	(-4.7)	(-8.4)	(-9.3)	(-12.1)
Financing	235	717	1315	3187
Foreign	100	223	1033	1809
Domestic	135	494	282	1378

Source: Central Bank, Memoria 1984.

No crowding out of private credit (case 1) and 100% crowding out of private credit (case 2). Results of Table 2.2 show that only for years 1982 and 1983, for the case of zero crowding-out of the domestic credit to the public sector, a negligible injection is obtained. This implies that fiscal deficit was not a source of excess demand during the period under study.

Other evidence against the inflationary impact of demand increases on prices is the existence of excess capacity. Table 2.3 shows for example a widespread excess capacity across manufacturing sectors.

Monetary variables do not provide a strong evidence for explaining the dynamics of inflation during this period. Money supply, defined as money plus quasi-money in domestic currency, shows a growth rate above the inflation rate for 1980 and 1981 and a lower rate than inflation for 1982-1984, the years precisely with the highest rate of inflation (See Table 2.4).<sup>1/</sup>

These observations suggest the need to look for other explanatory variables for the inflationary process experienced by Peru during 1980-1984. In the next section we look at the behavior of prices of different goods and of other variable which

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<sup>1/</sup> Deposits in foreign currency could also be included. However, a significant share of these deposits were considered hoarding.

Table 2.2

Estimates of the Effective Domestic Fiscal Deficit  
(millions of intis)

	1980		1981		1982		1983	
	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2
Total Injections (1)	2967	2967	4897	4897	8539	8539	17451	17451
Total Leakages								
-Revenues (2)	2731	2731	4180	4180	7224	7224	14264	14264
-Expenditures in								
Foreign Exchange (3)	513	513	791	791	1289	1289	3106	3106
Domestic Credit Financing	135	---	494	---	282	--	1378	--
Net Injections (leakages)	(412)	(277)	(568)	(74)	(256)	26	(1297)	81
Effective Deficit (Superavit) as % of GDP	(8.3%)	(1.7%)	(6.6%)	(0.9%)	(1.8%)	0.2%	(4.9%)	0.3%

Case 1. Assumes total crowding out of domestic private credit.

Case 2. Assumes no crowding out of domestic private credit.

(1) Total expenditures (From Table 2.1)

(2) From Table 2.1.

(3) Estimate. It includes interest payments on foreign public debt (Central Government) and imports of the public sector.

Table 2.3

Rates of Capacity of Utilization in Some  
Selected Industrial Sectors, 1981

ISIC	Percentage of Use of Capacity
3111 Meat Processing	60
3113 Fruits & Vegetables Processing	50
3115 Oils and Fats	90
3116 Flour Products	66
3117 Pasta	60
3119 Chocolates	60
3214 Carpets and Rugs	50
3231 Leather	65
3240 Leather Footwear	60
3521 Paints and Barnices	60
3528 Candles	40
3559 Rubber Products	70
3610 Porcelain Products	80
3620 Glass	85

Source: Ministry of Industry, Tourism and In-  
tegration. "Utilización de la Capaci-  
dad Instalada en el Sector Industrial",  
1981

Table 2.4

Money and Quasi Money in Domestic Currency  
Growth Rates

	Money + Quasi Money	Inflation
1980	77.8%	60.8%
1981	78.1%	72.7%
1982	57.6%	72.9%
1983	74.2%	125.1%
1984	102.4%	111.5%

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Source: Central Bank; Memoria, various years.

could play an important role in the price formation mechanism, mainly through costs and expectations.

### 3. Price Structure and Price Trends: An Overview

#### a) Price Structure.

Variations in the consumer price index (CPI) are the result of changes in the prices of its components. Insofar as each of these components has a different price formation mechanism, it is useful to distinguish them as different groups of goods and services of the CPI (See Table 3.1).

In terms of government intervention in the determination of prices, two main categories of goods and services can be distinguished: Prices which are directly controlled by the government and prices which respond to the market mechanism. Measured by expenditures shares, around 22% of the CPI is made up by goods whose prices are controlled by the government, while the remaining 78% are non-controlled. This distinction is important because the changes in the controlled prices are exogenous, whereas the changes in the rest are not, as will be seen in more detail later.

The non-controlled prices can be divided as well into two

Table 3.1  
Structure of the CPI

	Share (%)
General Index	100.00
1- Controlled Prices	21.97
-Food	9.92
-Oil	4.31
-Transport	5.64
-Other Public Services	2.10
2- Non-Controlled Prices	78.03
2.1 Traded	31.69
Food	12.97
Textiles and Footwear	7.20
Electric Appliances	2.46
Other traded	9.06
2.2 Non Traded	46.34
Food	13.44
Eating Out	8.69
Services	4.42
Rent	10.87
Other	8.92

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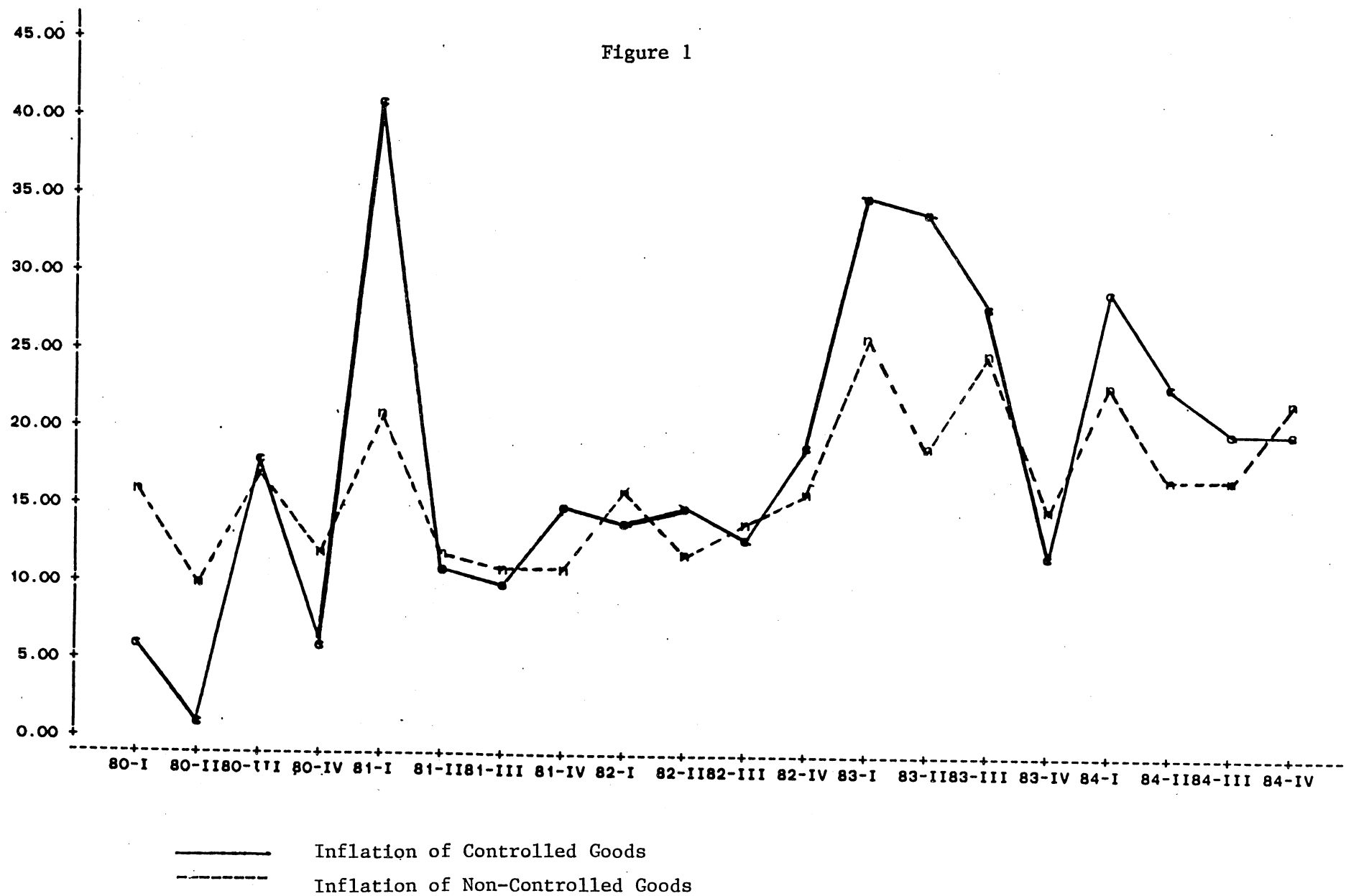
Source: Central Bank, Reseña Económica, several issues, 1981-1984.

groups: prices of traded and prices of non-traded goods and services. This distinction is particularly relevant during the period 1980-1984, when import prohibitions were eliminated and when "water in the tariffs" was presumably non-existent. In this case, traded goods are either imports, import-competing consumer goods or final exportable goods, and therefore, domestic prices are determined by international prices, the exchange rate and tariffs. Prices of non-traded, on the other hand, are determined by domestic supply and demand conditions.

#### b) Price Trends.

Figure 1 shows the pattern of quarterly variation of controlled and non-controlled prices for the period 1980-1984. It can be observed that, in most of the period, the increase in controlled prices has been greater than the increase of the non-controlled prices. This reflects the explicit fiscal policy implemented during that period aimed at reducing the fiscal deficit by reducing subsidies. Furthermore, variations of the controlled prices are more abrupt than the changes of the non-controlled prices. It can be seen that the first quarters usually register large jumps in controlled prices (the so-called "desembalses"), whereas observation 83-IV corresponds to a period where controlled prices were adjusted at lower rates. Variations of the uncontrolled prices are smoother but follow somehow the pattern of controlled prices, suggesting some relationship

Figure 1



Source: Central Bank, "Memoria" and "Reseña Económica," several issues.

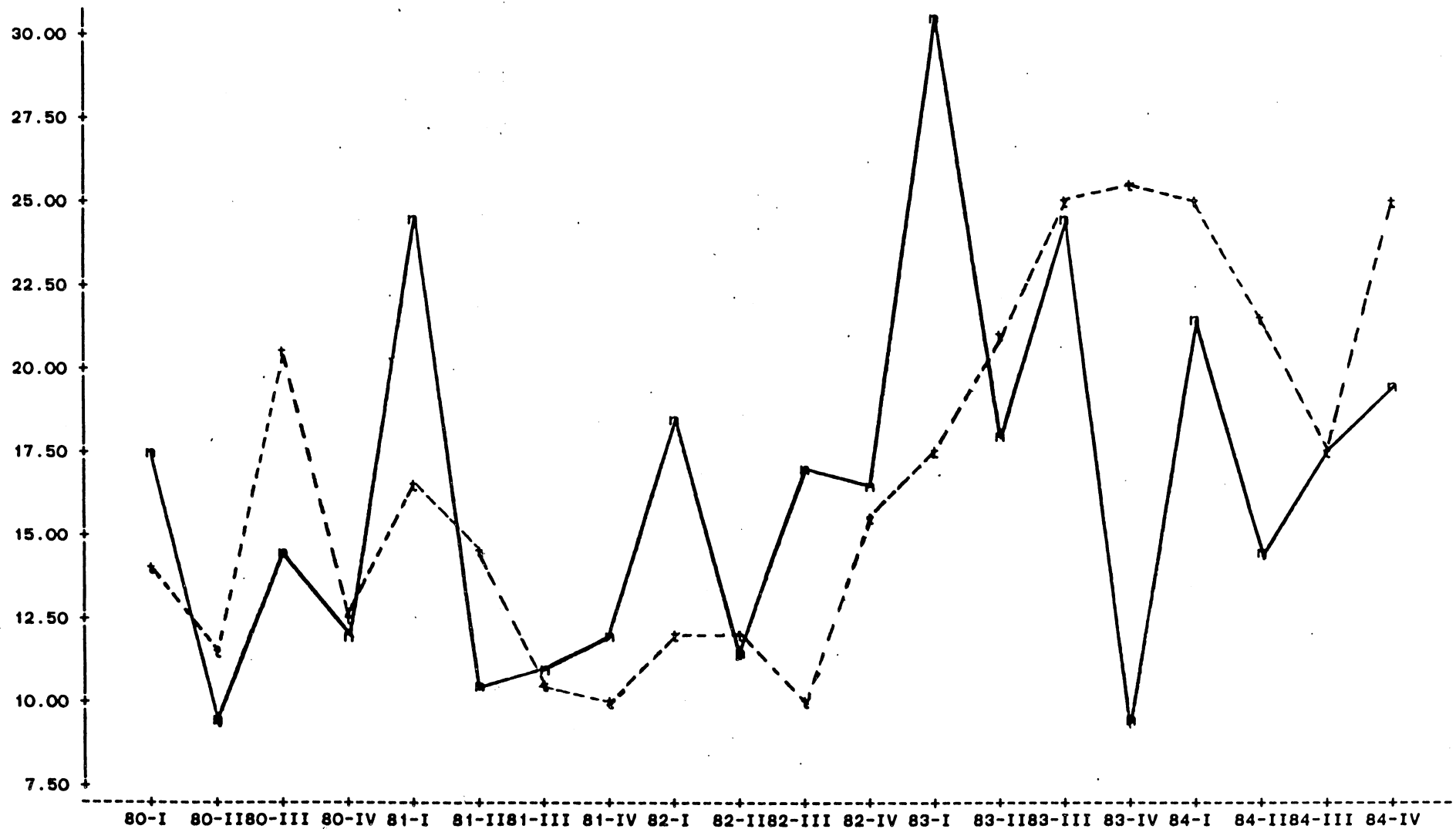
between uncontrolled and controlled prices, which will be explored later.

Figure 2 shows the comparative behavior between the prices of non-controlled traded and non-traded goods and services. Three sub-periods can be identified in this case: increases of prices of traded goods have been in general above those of the non-traded goods until the quarter 80-IV, at the early stages of import liberalization, from period 80-IV to period 83-I the inflation of traded goods lags behind the inflation of non-traded sectors; and, finally from the quarter 83-II on, prices of traded goods recover, during a period of a much higher devaluation rate after the short period of implementation of the pre-announced exchange rate (the so-called "tablita").

Figure 3 depicts the relationship between inflation of traded goods and devaluation. There is similarity between both trends from period 80-I to 83-III. However, from quarter 80-I to 81-IV the inflation of traded goods was above the rate of devaluation, whereas from period 82-II to 83-III it was below. During the two first quarters of 1984, inflation of traded sectors is fairly constant in spite of the lower devaluation rate. This corresponds to the period when a pre-announced exchange rate was instituted.

Regarding the prices of non-traded goods, they do not follow

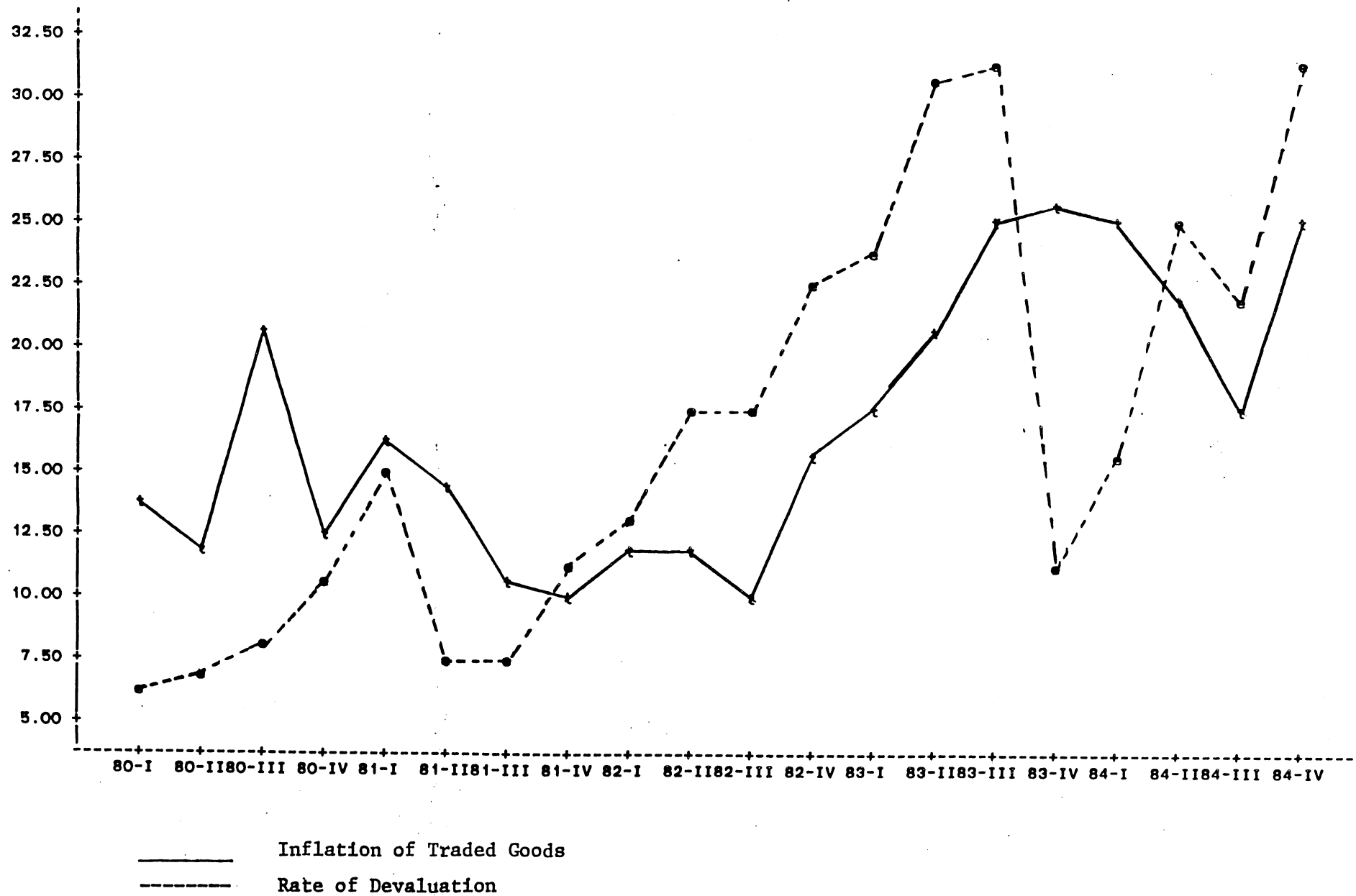
Figure 2



\_\_\_\_\_ Inflation of Non-Traded Goods  
 - - - - - Inflation of Traded Goods

Source: Central Bank, "Memoria" and "Reseña Económica," several issues.

Figure 3



Source: Central Bank, "Memoria" and "Reseña Económica," several issues.

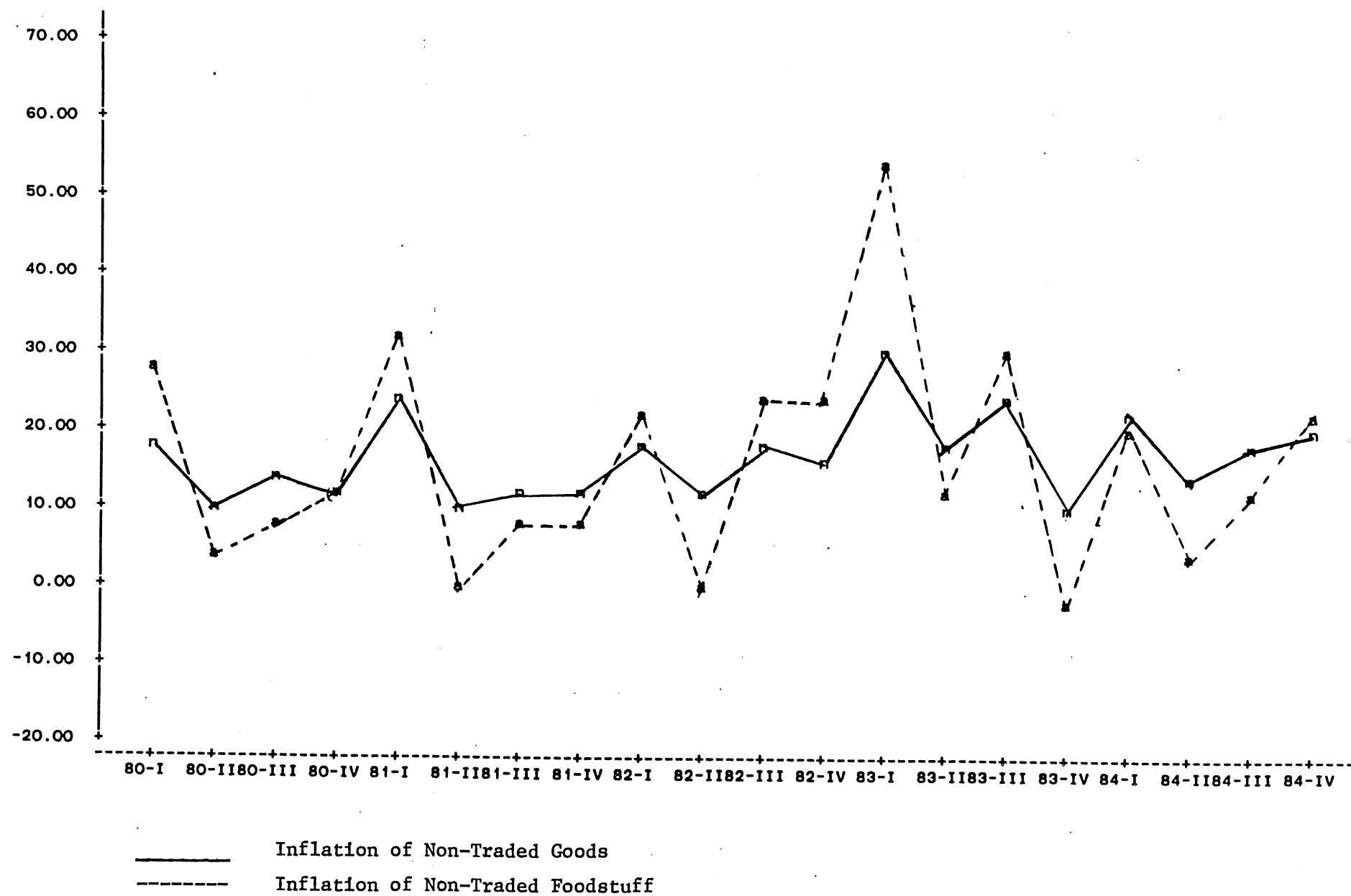
the same pattern. Non-traded food, for example, is subject to agricultural seasonality which is not the case of other non-traded goods (See Figure 4).

Figure 5 shows the trends during the period, for labor costs and prices of non-traded goods. It can be seen that, particularly before 1983, there are long lags (two quarters, in general) in the changes of one variable which could be perceived as reactions to changes from the other variable, as well as more drastic changes in the case of labor costs. The lags can be explained by the labor negotiating process, by which wage adjustments to price variations are very slow. Moreover, even if the prices of non-traded goods and services may partially respond to changes in labor costs, it will be shown below that there are other variables with probably more significance in the explanation of inflation of these goods, during the period under study.

Figure 6 shows the output growth of non-traded goods and services and their inflation rate. If output in this sector is assumed to be determined mainly by demand, the figure suggests that there has not been a clear relationship between both variables in 1980-1984. This type of hypothesis will be analyzed in more detailed below.

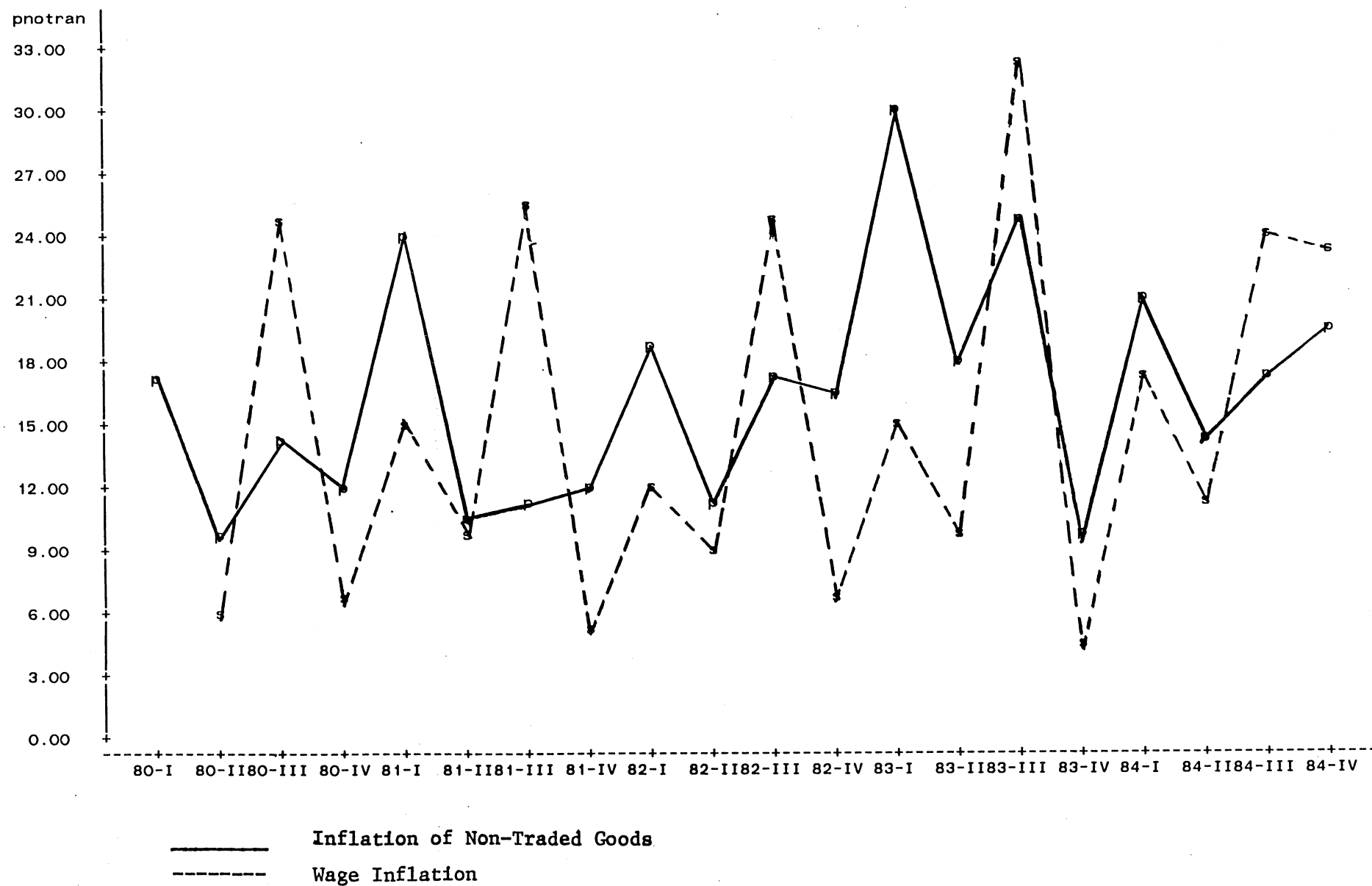
Figure 7 shows the relationship between the rate of devaluation and the increase of non-traded prices. Here some relation-

Figure 4



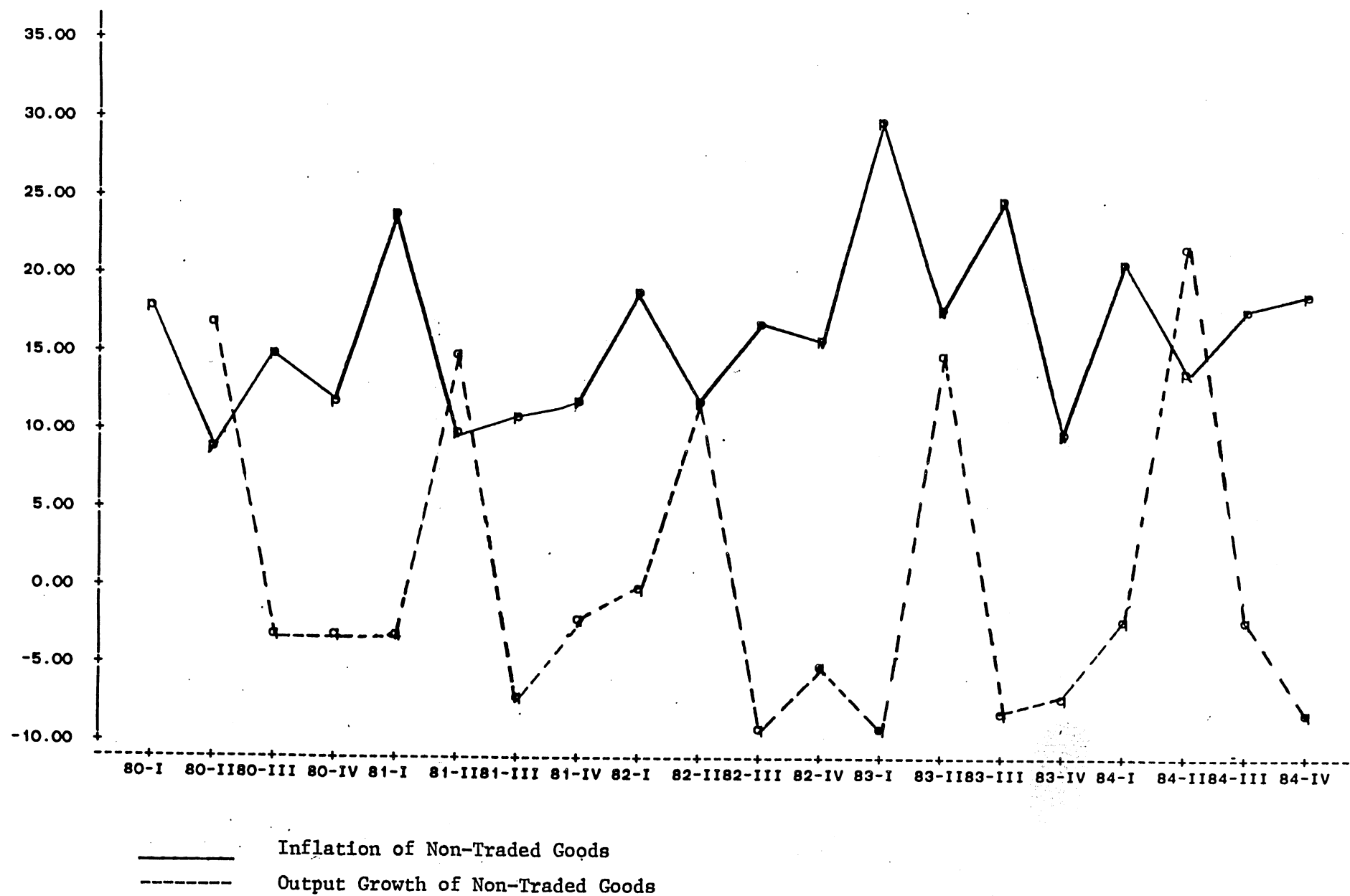
Source: Central Bank, "Memoria" and "Reseña Económica," several issues.

Figure 5



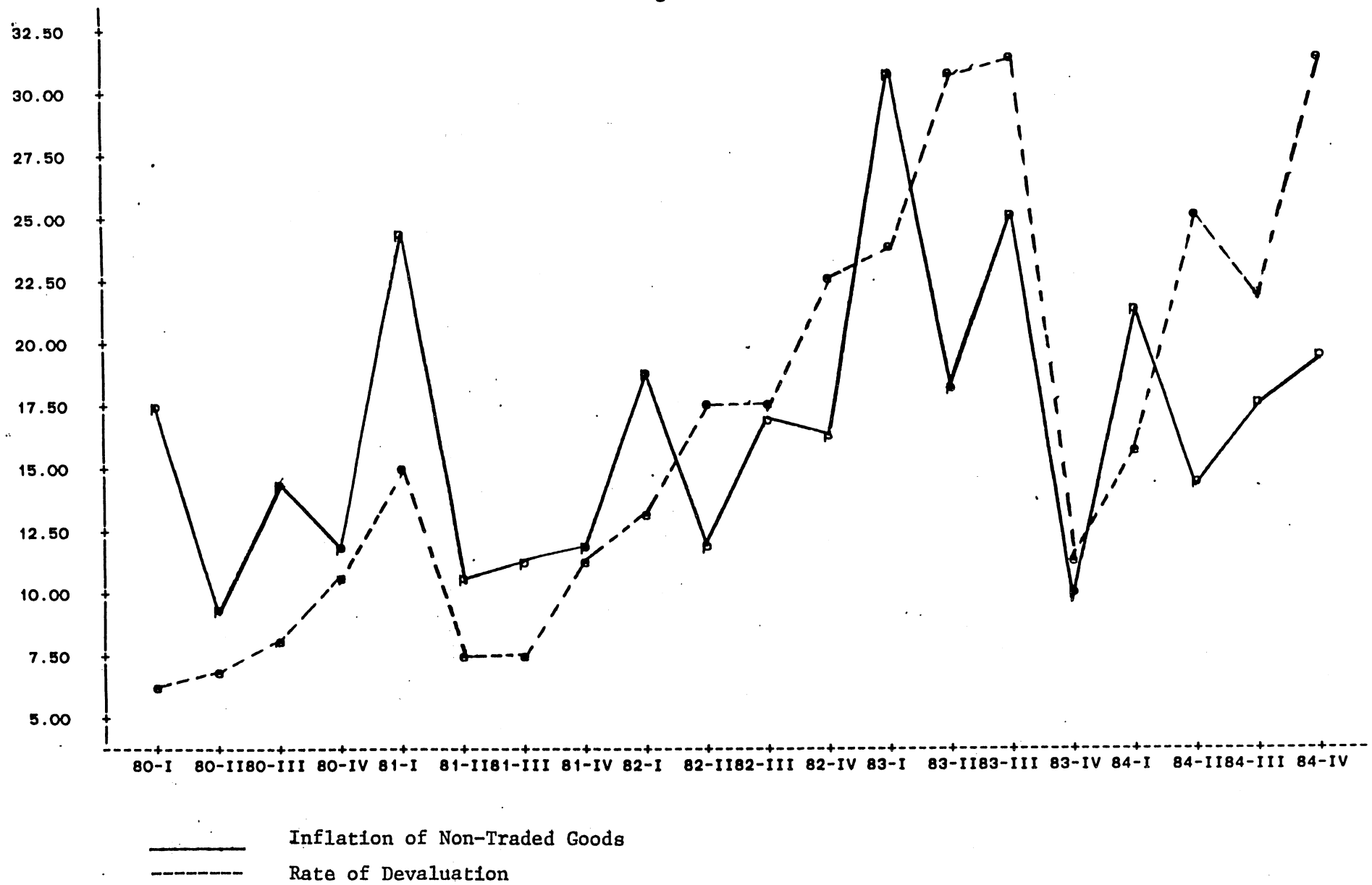
Source: Central Bank, "Memoria" and "Reseña Económica," several issues.

Figure 6



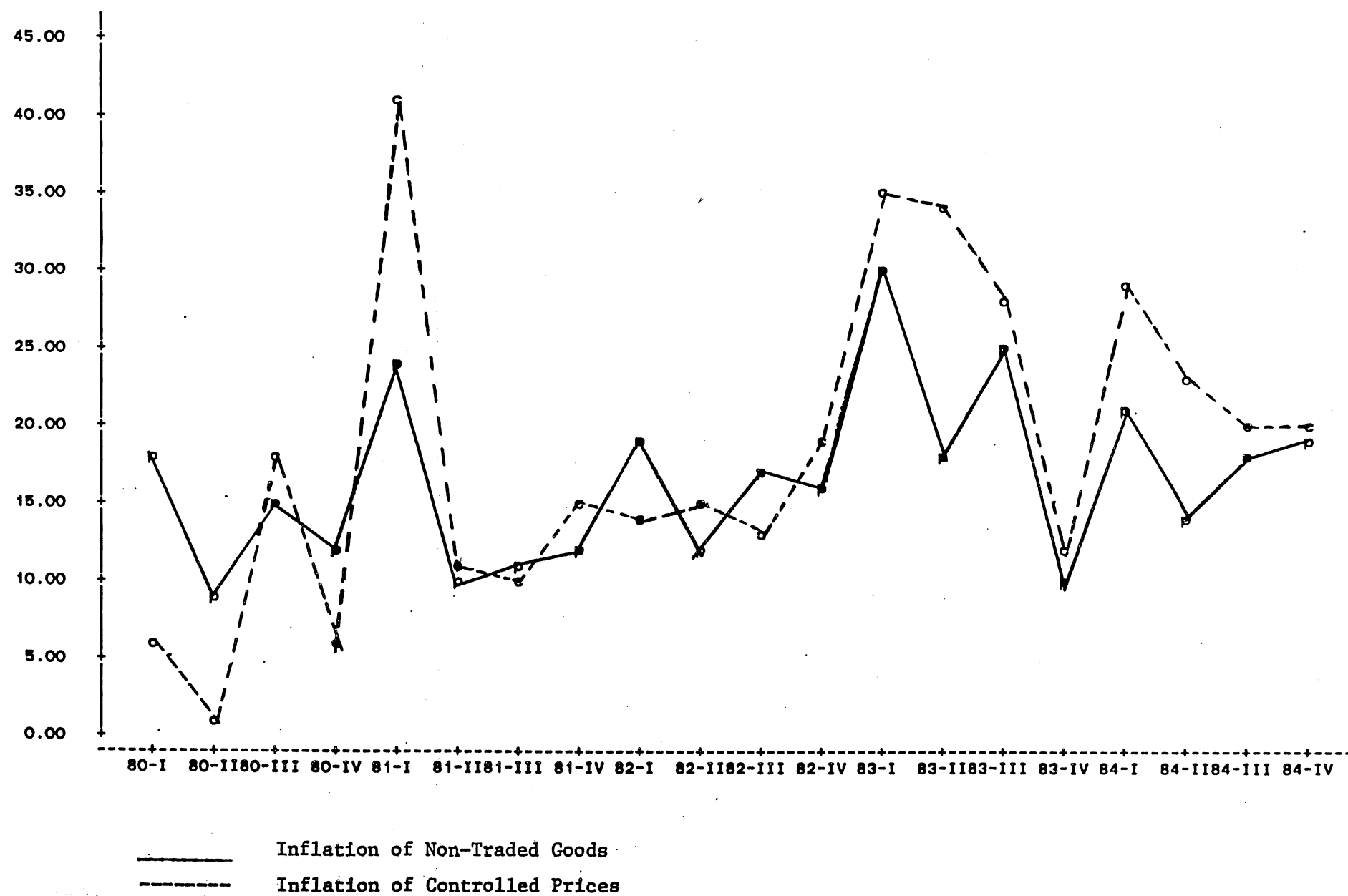
Source: Central Bank, "Memoria" and "Reseña Económica," several issues.

Figure 7



Source: Central Bank, "Memoria" and "Reseña Económica," several issues.

Figure 8



Source: Central Bank, "Memoria" and "Reseña Económica," Several issues.

ship between both trends is observed, although devaluations are smoother than the changes in the prices of non-traded goods. In addition, in Figure 8 there is also similarity in the trends of controlled prices and increase of non-traded prices. This suggests some relationship between prices of non-traded, devaluation and controlled prices adjustments.

#### 4. The Model

In this section we present a model of price formation aimed at testing the hypotheses previously formulated, in particular, the importance of controlled price inflation and devaluation rates in the price adjustment mechanism, and the lack of significance of demand growth as an explanatory variable for inflation during this period.

A basic feature of the model is the disaggregation of the general inflation rate into different price components with different behavioral equations. As in the Scandinavian models and their applications to the study of inflation in developing countries (see, e.g. Corbo, 1984), the difference between traded and non-traded goods is taken into account. However, an additional distinction is made here, between goods which have non-controlled prices and goods which are subject to price

controls. Regarding the determination of non-controlled prices of non-traded goods, a mark-up over unit costs is assumed, as is usually done in the Scandinavian models, but other variables are incorporated here as well, such as demand growth and inflationary expectations, in a formulation resembling works by Bruno (1978 and 1979) and Maccini (1978).

Inflation ( $p$ ) is divided into inflation of controlled prices ( $p^c$ ) and of non-controlled prices ( $p^{nc}$ ), based upon their direct weight in the general price index ( $F$ ):

$$p = F \cdot p^c + (1-F) \cdot p^{nc} \quad (1)$$

We will show that, even though "F" can be directly observed as the weight of controlled prices (0.22 in the CPI), when indirect effects are incorporated, the total effect of  $p^c$  in  $p$  can be substantially higher for a given period. This takes place through adjustments in other variables which in turn affect  $p^{nc}$ , such as expectations, wages and the exchange rate.

$p^c$  is exogenously determined by the government:

$$p^c = \bar{p}^c \quad (2)$$

With regard to prices of non-controlled goods and services,

two sub-sectors can be defined, namely traded and non-traded:

$$p^{NC} = F^T P^T + (1-F^T) p^{NT} \quad (3)$$

The prices of pure traded goods, facing competition from abroad particularly after the trade liberalization policies of 1980, and having a weight equal to  $F^T$  in the non-controlled price index, are determined mainly by world prices expressed in domestic terms, including their tariff rates:

$$P^T = R \cdot P^W \cdot (1 + T) \quad (4)$$

Where:

$P^T$  = Domestic Price of traded goods,

$R$  = Nominal exchange rate,

$P^W$  = World price of traded goods, in foreign currency,

$T$  = Rate of Tariffs/Subsidies

Expressing (4) in growth rates (identified here as lower-case letters):

$$p^T = r + p^W + t \quad (4')$$

Where  $t$  = growth of  $(1 + T)$

However, it is assumed that  $t=0$ , since the period of the estimations of this model starts right after tariffs were reduced as part of the trade liberalization policy, remaining relatively constant afterwards. The variable  $p_m$  is also approximated to zero, since there were few changes in the relevant world inflation during the period under study.

Therefore:

$$p^T = r_{\perp}^1 \quad (4'')$$

Firms producing non-traded goods and services are assumed to determine the prices for their products by applying a constant mark-up rate over their costs:

$$P_{NT} = M \cdot C \quad (5)$$

Where:

$P_{NT}$  = Price level of a typical non-traded good or service,

$C$  = Total costs per unit of output, and

$M$  = Mark-up rate from average costs to final prices,  $>1$

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<sup>1/</sup> This formulation will be expanded later, since not all traded goods follow this form of price determination.

The following average costs function will be used:<sup>1/</sup>

$$C = Q^{C_0} W^{C_1} P_r^{C_2} \quad (6)$$

Where:

$Q$  = Quantity of output of the non-traded good,

$W$  = Wage rate

$P_r$  = Prices of intermediate inputs used in the production of non-traded output.

Parameters  $C_0$ ,  $C_1$ , and  $C_2$  (assumed greater than or equal to zero) are therefore the "cost elasticities" of output, labor and input payments, respectively.<sup>2/</sup> From (5) and (6), we obtain, in terms of growth rates:

$$p^{NT} = C_0 \cdot q + C_1 \cdot w + C_2 \cdot p_r \quad (5')$$

Assuming cost elasticities,  $w$ , and  $p_r$  to be known by firms, the only variable that remains to be determined before setting the prices is the output growth  $q$ . Since firms do not know the exact demand reaction to their prices, we assume that they set

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<sup>1/</sup> One way of obtaining this type of cost function is by starting from a separable production function, homogeneous of degree one for labor and inputs (see Bruno, 1978).

<sup>2/</sup> Note that when there are increasing returns,  $C_0$  could have a negative value.

them according to an expected demand behavior for a marketing period in which transactions will actually take place at the given prices. If the "production plan" of the firm, compatible with the price finally set, is different from actual sales, expectations will be revised for future exercises.<sup>1/</sup>

The quantity that the typical firm expects to sell ( $Q^*$ ) will depend on the expected behavior of the aggregate economic activity ( $Y^*$ ) during the period at stake, and the relationship between its own price ( $P^{NT}$ ) and that of its competitors, to be approximated as the expected general price level ( $P^*$ ). Assuming that income and price elasticities (positive "a" and negative "b", respectively) are known by the firms, we have:

$$Q^{NT*} = Y^{*a} (P^{NT}/P^*)^b \quad (7)$$

Which, translated into growth terms, is:

$$q^{NT*} = a \cdot y^* + b(p^{NT} - p^*) \quad (7')$$

Replacing (7') for  $q$  in equation (5'), we obtain a price growth equation for the non-traded goods and services sector, depending on the growth of costs, expectations on inflation and

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<sup>1/</sup> This type of behavior has been assumed by Bushaw and Clower (1957), Clower (1965), Benassy (1976) and Bruno (1978 and 1979). Our equations will again be similar to Bruno's formulations.

income growth: 1/

$$p^{NT} = \left( \frac{1}{1 - C_0 b} \right) [C_1 \cdot w + C_2 \cdot p_r + C_0 \cdot a \cdot y^* - C_0 \cdot b \cdot p^*] \quad (5'')$$

Keeping in mind that  $b$  is negative, all variables included in equation (5'') have a positive effect in the price growth of non-traded goods and services.

Notice that when  $C_0 = 0$ , in equation (5''), we have a pure cost-push formulation, with expectations playing no role in the explanation of the inflation rates; however, even if there are constant returns, expectations could be incorporated in the model by allowing for a variable mark-up. 2/

In order to endogenize the expectations variables appearing in the model, namely expected real income growth ( $y^*$ ) and expected inflation ( $p^*$ ), we assume that the economic agents have a model similar to the one postulated here. In this sense, this could be presented as an approximation to the rational expect

1/ Given the type of costs and demand functions used here, in which the average costs growth is equal to the marginal costs growth, and the demand growth defined in terms of  $p$  is equal to the marginal costs growth, the final price growth equation obtained here may correspond to different type of behavior and not exclusively to the mark-up case. In fact, the same solution would be reached if we assume a profit maximizing monopoly (see e.g. Bruno, 1978).

2/ If  $C_0$  is negative, i.e. there are decreasing costs,  $y^*$  and  $p^*$  would have a negative effect if  $C_0 \cdot b < 1$ , whereas  $w$  and  $p_r$  would have a negative effect if  $C_0 \cdot b > 1$

tations hypothesis; however, it is also assumed here that these agents do not have complete information at the moment of making their decisions. Therefore, they have to base their expectations of inflation on the available information, such as the controlled prices and the exchange rate, together with what they have learned from experience. They will then end up with an intuitive reduced form of our model, in which in fact these two variables prove to be most important:<sup>1/</sup>

$$p^* = z_1 \cdot p^c + z_2 \cdot r \quad (8)$$

With regard to the expected growth in real income ( $y^*$ ), we assume it to be equal to the one predicted from our model:

The growth in real income ( $y$ ) in turn will be estimated from a dynamic version of an IS-LM type of model <sup>2/</sup>, depending upon several variables which, for the definition of  $y^*$ , we will assume known by the economic agents, at least in real terms:

$$y = d_0 + d_1 \cdot m_r + d_2 \cdot g_r + d_3 \cdot w_r + d_4 \cdot r_r \quad (9)$$

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<sup>1/</sup> We assume here that expectations adjust rapidly, so that no lags are included in equation (8) in a quarterly basis.

<sup>2/</sup> See for example, R. Dornbusch and S. Fischer "Budget Deficits and Inflation", Academic Press, 1981.

Where:

$d_0$  = Intercept, corresponding to exogenous growth, particularly the production of some primary goods,

$m_r$  = real money growth,

$g_r$  = real growth in government expenditures,

$w_r$  = real growth in wages

$$= w - p,$$

$r_r$  = real growth in the exchange rate

$$= r + p^w - p$$

The cost of intermediate inputs ( $p_i$ ) can be disaggregated into a traded component (mainly complementary imported inputs), a non-traded component, and a component including inputs with controlled prices:

$$p_i = g_0 p^T + g_1 p^{NT} + g_2 p^C \quad (10)$$

An additional element to be incorporated into the determination of  $p^{NT}$  refers to the seasonal price growth observed for non-traded foodstuffs during the first quarter of each year, as shown in section 3 b). A "dummy" variable for the intercept is therefore included (DE); it will reflect the increase in the inflation rates observed during these quarters for reasons other than the changes in the other variables included in the equation. This variable will have a zero value

in general and a value of one for each first quarter of our series. Thus, after all the changes are incorporated, i.e., the variable DE and the substitution of  $p_1$  and  $p^*$  (from equations (8) and (10)) in equation (5''), we obtain:

$$p^{NT} = n_0 \cdot y + n_1 \cdot p^C + n_2 \cdot r + n_3 \cdot w + n_4 \cdot DE \quad (5''')$$

As was clear from the discussion above, a distinction must be made for the period of the so-called "tablita", in which the devaluation policies experienced a change aimed at slowing down the rates of devaluations of the sol and the inflationary expectations of the public. During this short-lived period, the devaluation rates were announced for the whole quarter. Therefore, a "dummy" variable (TABL) is incorporated into the traded goods pricing equation (4'') in order to assess the effects of this policy in the price formation mechanism for traded goods, assumed by policymakers to respond with lower price growth to lower devaluation growth. As seen before, prices did not respond to this policy as rapidly as expected, reflecting some downward inflexibility and suggesting the existence of explanatory factors other than those already mentioned, at least for some activities included in the CPI.

It is also important to note that final traded goods do not include only products facing competition from abroad but also,

particularly during the recent liberalization experience, some activities with monopoly power over the domestic sales of this type of products. Therefore effects of expected demand were incorporated in the price growth equation for traded goods (4'').

With all these changes, equation (4'') has been reformulated as follows:

$$p^T = t_0 \cdot y + t_1 \cdot p^e + t_2 \cdot r + t_3 \cdot \text{TABL} \quad (4''')$$

We can now endogeneize the rest of the explanatory variables used in the price equations.

Regarding wage inflation ( $w$ ), which is found in the general equation (5''') for the inflation of non-traded goods and services, it is possible to write an equation incorporating variables representing effects of changes in the economic activity ( $y$ ), and some type of indexation rule related to inflation rates observed in previous periods.

The system of wage adjustments observed in Peru is not continuous, and it is difficult to be formulated in a simple equation. Different labor unions negotiate annual wage adjustments at different times of the year. Moreover, the wages of

workers not subject to collective bargaining are adjusted by the government from time to time without a pre-established pattern. Therefore, the price lag effect on wages is difficult to assess and it would have to include longer periods. However, the adjustment process takes into account to some extent past inflation, particularly the behavior of controlled prices, since this type of goods plays a significant role in the consumption basket of the wage earners:

$$w = w_0 + w_1 \cdot y + w_2 \cdot p^{e-1} + w_3 \cdot p^{e-2} \quad (11)$$

Where  $w_1$ ,  $w_2$ , and  $w_3$  are positive.

In order to determine the devaluation rates ( $r$ ) affecting  $p^T$  directly and, as explained in the preceding paragraph,  $p^{NT}$  indirectly, we consider the balance of payments situation ( $\bar{B}$ ), and the need to keep a purchasing power parity in terms of domestic versus world prices.

$$r = r_0 + r_1 \bar{B} + r_2 (p_{-1} - p^{w-1}) + r_3 \text{TABL} \quad (12)$$

$r_1$  is expected to be negative, whereas  $r_2$  should be positive and close to one;  $r_3$  should be negative, since the devaluation policies were slowed down during the implementation of the "tabli ta", regardless of  $\bar{B}$  and  $p_{-1}$ .

The system of equations to be estimated in the next section will consist then of equations (5'''), (4'''), (9), (11), and (12), considering the identities for general price indices and real wages and exchange rates.

The recursive nature of this system of equations can be observed by replacing "r" and "w" from equations (11) and (12) into the rest of the equations (for a given "y" and ignoring  $p^w$  and the "dummy" variables):

$$p = \sum_{i=0}^{\infty} Z^i L^i [A + B \cdot y + C \cdot p^c + D \cdot p^c_{-1} + E \cdot p^c_{-2}] \quad (13)$$

Where:

$L$  = Lag operator,

$Z = (1 - F)r_2 [F^T t_2 + (1 - F^T) n_2],$

$A = B (1 - F)r_1 [F^T t_2 + (1 - F^T) n_2] + (1 - F) [(1 - F^T) n_3 w_0 + n_2 r_0 + F^T t_2 r_0],$

$B = (1 - F) [F^T t_0 + (1 - F^T) (n_0 + n_3 w_1)],$

$C = F + (1 - F) [F^T t_1 + (1 - F^T) n_1],$

$D = (1 - F)(1 - F^T) n_3 w_2, \text{ and}$

$E = (1 - F)(1 - F^T) n_3 w_3.$

In equation (13) the recursive nature of the system is given by the indexation of the exchange rates ( $r_2$ ) affecting through

the prices of non-controlled goods (see parameter "z"). It is also clear that the price inflation of controlled goods will have a longer-lasting effect on total inflation much higher than "F", and acting through the prices of non-controlled goods (see parameter "C"). The indexation of wages to controlled prices (parameters "D" and "E") adds more delayed effects from these prices to inflation. Thus, through the indexation of the exchange rate and labor costs to previous inflation, an element of inertia is introduced into the dynamics of the inflationary process.

##### 5. Empirical Estimates of the Model

The model formulated in the previous section was estimated for Peru during the period 1980-1984, using the quarterly data on inflation and related variables already analyzed in the first sections.

The econometric method used was the Three Stage Least Squares estimator, obtaining a weighted  $R^2$  for the system of 0.94. The equation on inflation of non-traded goods and services shows the following estimates (t-tests in parentheses):

$$p^{NT} = 0.28 y + 0.23 p^c + 0.56 r + 0.11 w + 7.5 DE \quad (5''')$$

1.0)      (2.1)      (5.0)      (1.3)      (4.4)

Even though all parameters show the expected positive sign, the growth in real income and nominal wages are the least significant variables. As expected, the seasonality adjustment is very important, since inflation is pushed up in the first quarter due to the seasonality of non-traded food production. Once the seasonality "dummy" DE is considered, the most relevant variables are the inflation of controlled prices ( $p^c$ ) and the devaluation rates ( $r$ ). It is important to keep in mind that both of these parameters incorporate several different effects: In the case of the inflation of controlled prices ( $p^c$ ), we know that they affect directly the cost of non-traded goods and also indirectly, via changes in the cost of the traded inputs used to produce non-traded goods, and on expectations of inflation. In the case of the devaluation rate ( $r$ ), its effects work through the cost of traded inputs and the inflationary expectations, thus reflecting as well the degree of "dollarization" of the economy.

The estimates for the equation on inflation of traded goods and services are as follows:

$$p^T = .27 y + .16 p^c + .69 r + 12.1 TABL \quad (4''')$$

(1.0)      (2.1)      (7.6)      (5.4)

As expected, devaluations play a crucial role in the price formation mechanism of traded goods. The estimates show as well an upward shift in the equation when the "tablita" was implemented: the effects of lower devaluations on inflation were nullified during that period, because economic agents did not believe that the new exchange policy would last. Moreover, the inflation of controlled prices proves to be significant. This reflects some role of expectations in the determination of prices of traded goods, and that some of the activities included in these sectors do not behave in a competitive way.

With regards to the endogenization of the wages, the best econometric results are reported in the following equation:

$$w = 10.3 + .75 y - .02 p_{-1} + .35 p_{-2} \quad (11)$$

(-1.9)    (.9)       (.1)       (2.0)

Notice that the wage indexation to previous price changes is very slow and that is relevant only when a two-lag period (i.e. between three and six months) is considered. This is probably due to the labor negotiation system used in Peru, which we mentioned before. The estimates are even less significant when the CPI inflation is used as explanatory variable, instead of the controlled prices.

With respect to devaluation, the estimates are as follows:

$$r = 6.2 - .001 \bar{B} + .73 p_{-1} - 6.2 \text{ TABL} \quad (12)$$

(1.3)      (-.1)      (2.8)      (-1.4)

Estimates of equation (9) show an effect of the lagged inflation rate. Since world inflation was very low and stable throughout this period, compared to the Peruvian rates, it was not included in these estimates. The "dummy" TABL reflects the shift in the policies of devaluations, since they became slower during the period of implementation of the "tablita". The parameter for  $\bar{B}$ , i.e., on the balance of payments effects shows no significance at all, despite having the expected negative sign.

The equation for growth in demand or economic activity ( $y$ ) shows the following estimates:

$$y = 1.9 - .004 m_r + .1 g_r + .1 w_r - .37 r_r \quad (9)$$

(1.6)      (.06)      (2.6)      (2.0)      (-2.6)

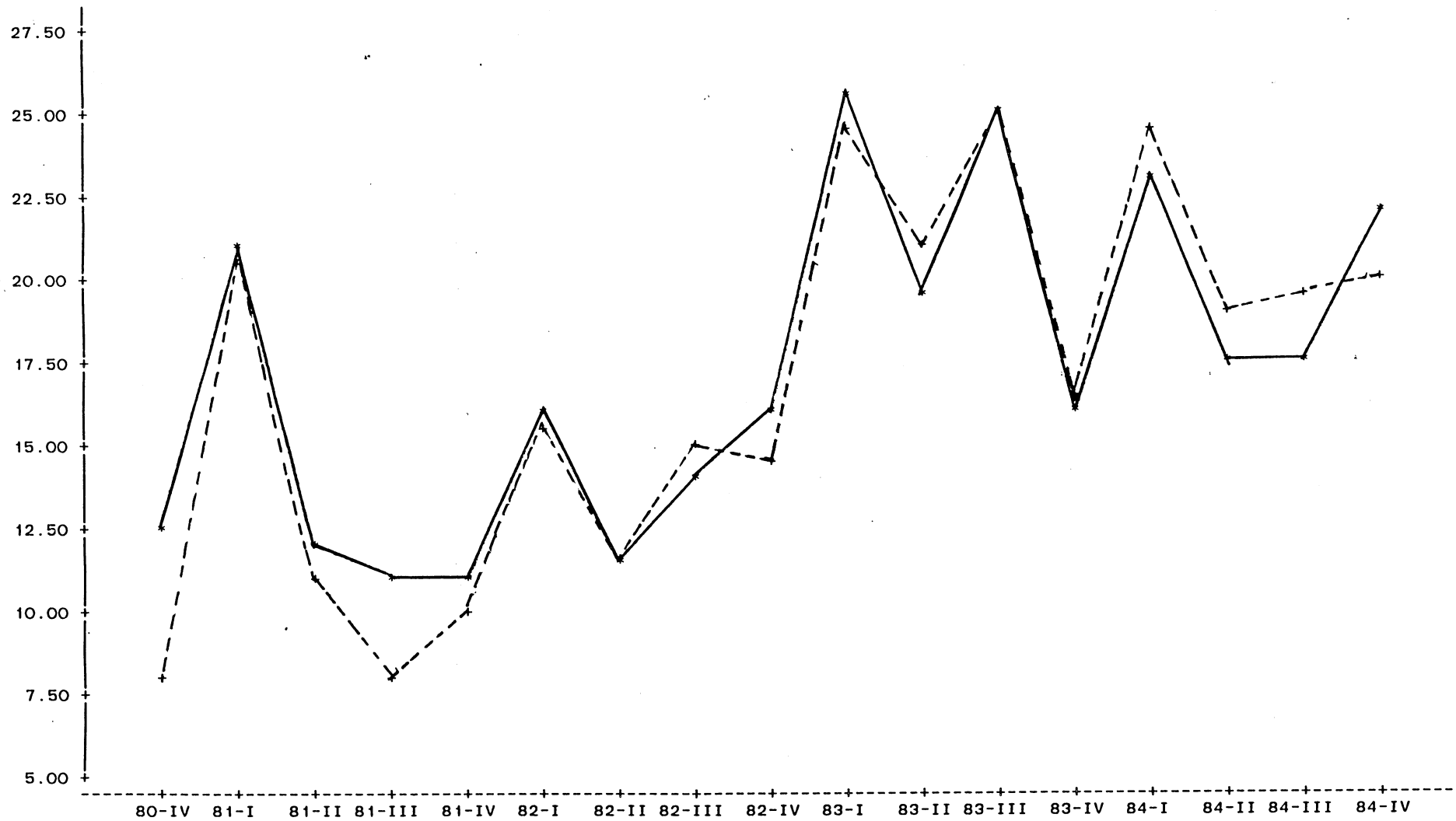
Notice that, in statistical terms, the most significant variables are the real growth in government expenditures, wages and exchange rate. The latter shows a negative sign, suggesting the existence of contractionary effects of devaluations.

The quality of the fit can be appreciated not only through

the analysis of the econometric results reported above, but also by simply comparing the predicted values of the endogenous variables of the model during the period under study, and those actually observed. This is shown in Figure 9, where the fitted and actual trends of the endogenous part of the inflation rates (i.e. that of non-controlled prices) are plotted for the period under study.

Inserting the estimates obtained for the different parameters of the model into the parameter "C" of equation (13), we see that the effect of controlled prices in the inflation rate for each quarter goes from the direct effect of .22 to a total effect of .38. This shows that approximately an additional .16 is explained by the indirect effects of controlled prices into the prices of non-controlled goods. The parameter "Z" in equation (13) is also high, reflecting an important lag effect (.35 in the first lagged period), working mainly through the indexation of the exchange rate. The lagged effect of controlled prices directly via wages proves to be less significant (parameters "D" and "E" from equation (13)). Therefore, it is mainly the indexation of the exchange rate to prices what provides the "inertial" elements into the process of inflation in Peru during the period under study.

Figure 9



— Inflation of Non-Controlled Goods (Actual)

- - - Inflation of Non-Controlled Goods (Fitted)

Source: Central Bank, "Memoria" and "Reseña Económica", several issues.

## 6. Conclusion

The stabilization policies implemented in Peru during the period 1980-1984 did not help reducing the high inflation rates observed in that country since the late seventies. These policies were based on the hypothesis that inflation was a result of demand pressures, coming mainly from the fiscal deficit and the growth in money supply. Inflationary expectations and cost increases were to be controlled by a wage and price tripartite agreement.

The evidence suggests that inflation during this period was not a result of excess demand: a very high share of the government expenditures was in foreign exchange, which does not necessarily generate an increase in domestic demand. The growth in money supply showed no relationship with the inflation rates observed during this period; and there was also strong evidence of the existence of excess capacity.

Our empirical analysis shows that expectations and cost push, particularly coming from the periodical adjustments of controlled prices and the exchange rate, played a significant role in the high inflation rates observed in Peru during this period.

Since explaining inflation at an aggregate level may result

in misinterpretations regarding its real causes, we considered important to disaggregate the inflation rate into different components, according to the different types of price determination mechanisms observed in the economy. In the case of Peru, it seems relevant to distinguish at least two categories for the period 1980-1984: the behavior of prices of controlled and non-controlled goods and services. Within the non-controlled sectors, an additional distinction is made between traded and non-traded goods and services.

The controlled prices, which are by definition determined by the government, experienced very high growth rates during the period under study, particularly in the two instances of the so-called "desembalses". This policy was aimed at reducing the excess demand pressures from these markets, eliminating their "repressed inflation" and setting relative prices right. In the case of public enterprises, this would contribute to the reduction of their losses and, therefore, of the overall fiscal deficit. Little attention was given to the possible effects of these measures on costs and expectations, which could put new inflationary pressures in the economy, offsetting the intended effects of these policies.

An important part of these counterproductive effects was observed in the prices of non-controlled goods and services: In

the case of non-traded goods, controlled prices induced additional inflation via cost push and expectations effects; for some traded goods whose markets are under monopoly power, controlled prices had an effect mainly through expectations.

In the case of non-controlled prices, the exchange rate policies also played a significant role. For traded goods, devaluations would either immediately be translated into price increases or work through expectations. For non-traded goods and services, devaluations would have an impact on the costs of imported inputs and expectations. The crawling peg system of devaluations is also crucial in providing a recursive nature to the inflation spiral by indexing the exchange rate to the price changes observed in previous periods, providing the system with an inertial element.

Under these conditions, a tripartite agreement could not be successfully implemented together with such a policy of inflationary increases of controlled prices and the exchange rate.

It is important to notice that, although a higher devaluation rate and a higher rate of increases in controlled prices accelerate inflation, the opposite, i.e. lower growth in the exchange rate and in controlled prices, does not necessarily

bring lower inflation rates. As it was seen above, a very important element in explaining the inflationary process is the reaction of economic agents to the different economic policies, particularly those who determine the prices of non-controlled goods since they enjoy some degree of monopoly power. For instance, it was shown that, during the short period of pre-announcement of exchange rates (the "tablita"), the expectations of entrepreneurs regarding the behavior of the exchange rate and prices were different from those of the policymakers and, even though the rates of devaluation were lowered during that period, the inflation rate did not come down accordingly, suggesting the existence of inertial inflation through expectations. This would justify the implementation of additional policies such as price and wage controls temporarily applied throughout the economy, and/or the tripartite agreements, such as the one that was attempted during this period.

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