RELATIVE PRICE AND INFLATION UNCERTAINTY IN COLOMBIA: A CASE OF CHRONIC MODERATE INFLATION 1970-1990

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Resumen: Este trabajo estudia dos aspectos de la inflación crónica moderada experimentada en Colombia durante 1970-1990. Con base en análisis de series de tiempo, se sugiere que la política de aumentar los precios relativos de los productos energéticos se complementen con mecanismos que reduzcan gasto, para evitar así la validación de las presiones por precios altos originados en otros sectores. También, recomienda esfuerzos para eliminar mecanismos de indexación, ya que dificultan la reducción de la inflación.

Abstract: This study explores two aspects of Colombian chronic but moderate inflation experience during the period 1970-1990. Based on time series analysis, the study suggests that the policy to increase relative price of energy products be complemented with expenditure reducing mechanisms to avoid the validation of higher price pressures stemming from other sectors. Moreover, it recommends efforts to dismantle indexation mechanisms, which make it difficult to reduce inflation.

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Introduction

While commenting a paper on "extreme cases" of inflation (i.e. sustained 15-20% a month), Fischer (1990, pp. 67-68) raised crucial questions regarding deflationary policy packages:

> (...) Is there any point at which extreme inflation becomes inevitable? Is Colombia, with its stable 20% annual inflation, destined to hyperinflate? I don't know. (...) Why don't gradualist stabilizations work? (...) Those who argue that it might be wise to wait for hyperinflation before stabilizing are –or should be– making a political and not an economic argument. The point is not that relative prices are more likely to be right when inflation rate is higher but that politicians are unlikely to move until the public is fully persuaded that the costs of inflation outweigh the costs of stabilizing (...).[1]

The same topics were being addressed by Colombian economists when inflation began to accelerate again in early 1989, passing from 24% annually, in early 1988, to almost 30%. After the corresponding four years in office, the Barco administration was to finish its task in August of 1990, so several anti-inflationary packages began to be proposed to attack the three-decade chronic moderate inflation (Hommes, 1989; Calderón y Herrera, 1990; Clavijo, 1990a,b; Ocampo, 1990).

In general, there existed consensus that the governmental package of economic modernization, particularly the trade liberalization program launched at the end of the previous administration, had as its corner-stone the price stabilization principle. However, such packages represented different views regarding the timing and blending (if any) of orthodox and heterodox policy instruments, where the new

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Meeting of the Econometric Society, Tucuman, 1993. Responsibility for remaining errors rests with the author and do not necessarily represent the points of view of those institutions.

[1] Similar concerns were pointed out by Bruno (1990) regarding the deflationary package of mid-1980s adopted in Israel. For arguments against the use of income policies due, among other factors, to the delay they might represent in adjusting certain relative prices, see Kiguel and Liviatan (1990). However, in their previous paper (1988) a policy combination alternative was not totally discarded.

buzzwords were the novelty in the discussions –e.g., optimal frequency of price and wage adjustments, full indexation, credibility, time (in)consistency, reputation (Clavijo, 1989a; Calderón, 1990).[2]

Given the chronic but moderate state of inflation in Colombia, a gradual package of orthodox instruments was finally adopted, where income policies were timidly addressed under a "Pacto Social" lingo that intended to implant a scheme of forward-looking expectations in anchor variables (eg. the nominal rate of the peso depreciation against the dollar, which has been managed by a crawling peg-rule since 1967).

Once such a package has been implanted and its macroeconomic aspects debated at length; it is interesting to review two micro-economic issues of inflation: a) The relative price effect of some administered prices, such as fuels and electricity, from a cost-push perspective; and the relative price effect of wages, from an aggregate demand perspective; and b) the inflation variability effect, which, for simplicity, we will identified as the price uncertainty effect.

The working hypotheses, widely known in the economic literature (Fischer, 1981; Taylor, 1981; Dornbusch, 1990), are: First, that changes in key relative prices (induced either by policy or "nature" actions) could generate inter-sectorial price reactions that, when not accompanied by real structural changes, end-up accelerating the rate of inflation; and, secondly, that higher price variability tends to induce higher inflation levels, for example, via an increase of the frequencies of wage and prices adjustments.

1. Relative Prices and State Intervention

The studies of relative prices effects on inflation, in Colombia, have focused on agricultural goods. For instance, Londoño (1985) and, more recently, Correa and Escobar (1990) have emphasized the key

[2] The issues, however, were not new to the Latin Americans in general (Hirschman, 1985) or the Colombians in particular: "One of the main consequences of indexation, as a mechanism of inflation propagation, is that it turns rather inefficient orthodox policies of aggregate demand control..." [our translation] (Jaramillo and Montenegro, 1984 pp. 31-32).

role played by agricultural goods both directly, as final consumption goods which account for nearly 50% of the CPI index, and indirectly, as inputs for the industrial sector.[3]

The evolution of food relative prices is usually highlighted in short-run analysis, even in those stemming from the Central Bank (Banco de la República, 1988). Furthermore, Calderón and Herrera (1990) came to the conclusion that even if food relative prices did not exhibit any (statistical) long-run equilibrium during 1950-1990, the years 1973 and 1985 did operate as important references for the corresponding decades.

Our interest, however, is to analyze the relative price effect of goods and services (different from food) which are subject to State intervention (e.g., fuels and electricity). To focus on this type of price-administered goods has the advantage of permitting to address the possible effects of some policy actions directed towards increasing those relative prices, particularly before launching an stabilization package. In the absence of close substitutes for gasoline and electricity power, most governments could end-up accelerating inflation by recurring to these kind of policies and, afterwards, would have to confront higher levels of inflation, where long-run relative energy prices were not possible to alter.

In short, price elasticities of demand for such goods need to be carefully assessed and, complementarily, real sector policies adopted in order to increase the supply of close substitutes; all these before adopting policies that could easily backfire on the stabilization package.

1.1. *Relative Prices of Fuels, Electric Power and Wages*

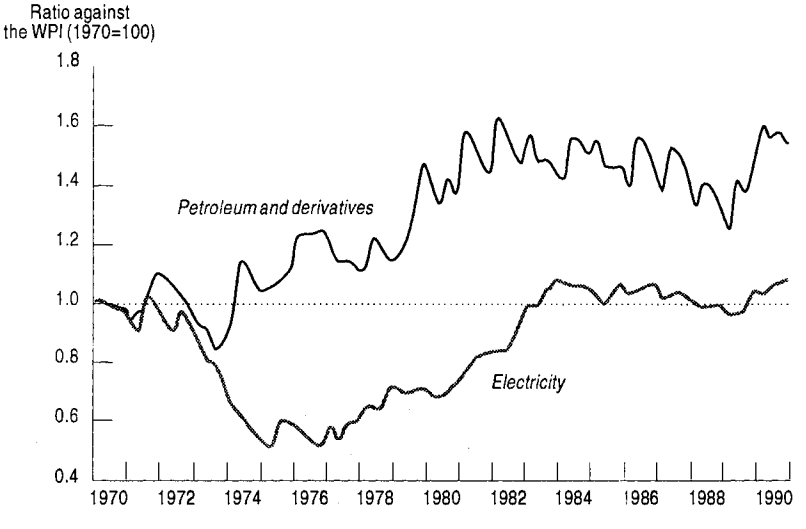
Since the construction of the first price indexes and the analysis of the social consequences of its variations during 1845-1862 in Great Britain (Jevons, 1863), it has been clear that such movements not only do not compensate each other (ie. inflation can occur), but that certain goods prices could increase more rapidly than others for relatively long periods.

[3] The income distribution effects of relative prices in Colombia has also been studied (Jaramillo and Montenegro, 1984), but will not be addressed here.

The case of prices of energy has been particularly interesting to analyze since the OPEC crises of 1973, which has also awaken the world conscience for environmental protection. We now proceed to analyze the cases of petroleum (including its derivations) and that of electric power in Colombia.

Petroleum aud Its Derivations. Graph 1 highlights the evolution of oil and similar in Colombia during 1970-1990. Note that it took almost 8 years (i.e. 1973-1981) to increase their relative price to 1.6 times the ratio that prevailed in the early 1970s. Nevertheless, it fell to only 1.2 times during 1982-1988. Not surprisingly, the price of gasoline sold in U.S.A. turned out to be 2.5 times that of Colombia at the end of the 1980s. The Italian/Colombian gasoline price ratio was 10 times. Only in Saudi Arabia, Ecuador and Venezuela was gasoline cheaper than in Colombia (Montes, 1990).

Graph 1
Colombia
Relative Prices of Petroleum and Electricity
(Measured against the wholesale price index)



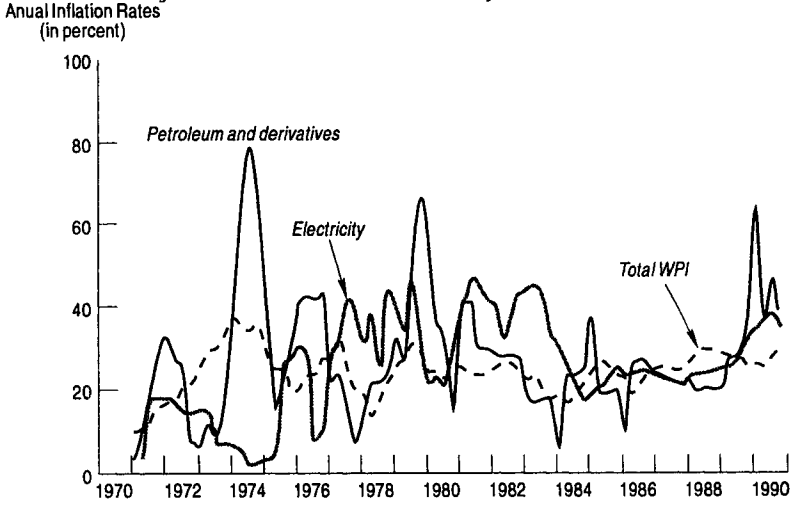
During the last year of the Barco Administration and since Gaviria took office (August of 1990), a policy directed towards in-

creasing the relative prices of petroleum related goods was again adopted, which so far has placed its price ratio back to the peak of 1.6, once held in 1981. Such policy has implied annual increases of nearly 60% in the last year (i.e. more than twice the long-run annual inflation rate), only comparable to those of 1973 (80%) and 1979 (60 percent).

Although the *direct* inflation effect of such price policy has been estimated to be rather low –i.e. an increase of 50% in the gasoline price would only generate a 1.5 percentage point increase in the annual inflation rate (Correa and Escobar, 1990)–, the *indirect* effects could well surpass the direct ones. In the following section we will attempt to quantify both direct and indirect effects on the overall rate of inflation.

Electric Power. Graph 1 also illustrates the case of electric energy relative price, which, in contrast to that of petroleum related goods, became 40% cheaper in 1973-1975. The 1978-1983 policy of real value adjustment in the tariff structure only represented a recovery of the level attained in early 1970s; nevertheless, it implied successive increases surrounding the 40% per-year, which were again adopted in 1989-1990 (see graph 2).

Graph 2
Colombia
Inflation in Petroleum, Electricity and Total WPI



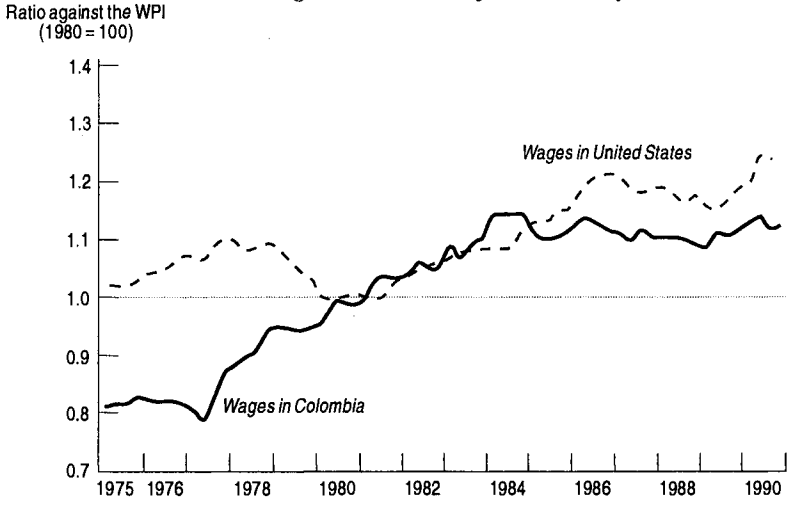
Wages. From an aggregate demand perspective, the relative price of wages play a crucial role in determining the level of inflation. Although this is not a case of a variable totally determined by State intervention, the governmental wage policy influences the rest of the economy directly, via the fiscal budget, and indirectly, by signalling to the private sector the desired rate of wage increases.

To some sectors of the Colombian economy, the annual rate of increase in the minimum wage operates as an anchor regarding level and, eventually, frequencies of price and wage readjustments (Clavijo, 1989a). Furthermore, the level of wages determine not only optimal capital-labor combinations domestically, but directly affect the level of equilibrium of the long-run real exchange rate (Clavijo, 1990c).

Graph **3** shows the path followed both by Colombian and USA's relative nominal wages. In the former case, wages experienced a loss during 1975-1977 and a recovery during 1978-1984, concluding with a gain of nearly 10% with respect to 1980 = 100. In the latter case wages gained 10% during 1975-1978, but rapidly decreased by the same amount during 1979-1980. However, such recovery did not

Graph 3

Relative Prices of Wages in Colombia and in United States
(Measured against total WPI of each country)

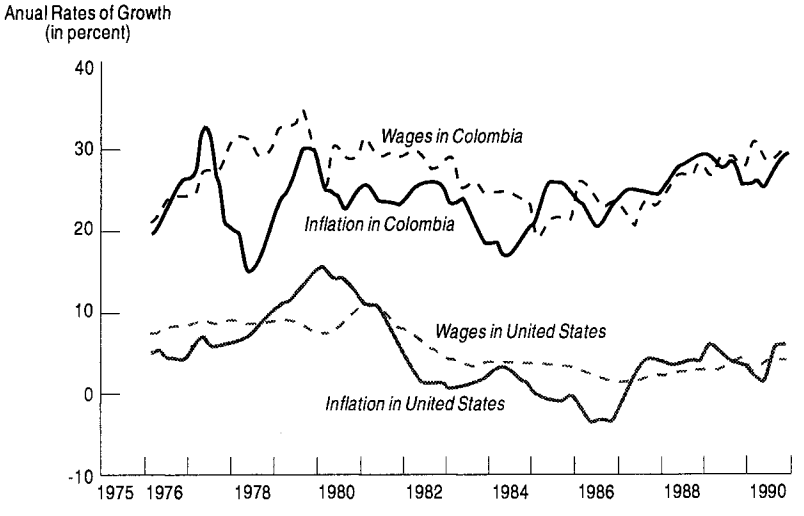


stop there, as occurred in Colombia, but continued until recently, when the relative price of wages reached a peak of 1.3 times the overall price level.

This path partially explains the net gain registered in the real exchange rate of Colombia against her main trade partners, where it is clear that wage readjustments pressed inflation upward during 1980-1984, but mitigated price increases during 1985-1987 (see graph 4), when an orthodox stabilization package was implanted. Wage pressures rebuilt in 1989, but have recently been placed under control.

Graph 4

Rates of Growth of Wages and Inflation in Colombia and United States



1.2. Measuring the Impact of (Induced) Relative Price Changes on Inflation: An Econometric Analysis

We mentioned previously that governments should assess the existence of good energy substitutes before launching a policy direct to rationalize consumption by increasing (administratively) their relative price. If relative prices were induced to change and the long-run level of inflation was not altered, then one could infer that there existed good substitutes.

With the intention of testing the impact of relative price changes on Colombian inflation, we adopted an ARIMAX((p, d, q)) estimation procedure for the whole-sale price index (WPI), where "X" represents the deterministic components of the right hand side variables (Box and Jenkins, 1976). In this case, the "X" components are given by the rate of inflation registered in fuels and electric power (1970-1990, quarterly data).[4] The idea is that the portions of the general inflation not explained by the ARIMA constitute "surprises", which, ceteris paribus, could be accounted for by changes in relative prices of energy-related goods.

The results of this exercise are reported in Table 1, where the fuels and electricity components of inflation turn out to be statistically significant in explaining inflation surprises of the period 1971-1990. The coefficients permit to infer that inflation surprises (i.e. the levels that differ from the 23% long-run inflation rate, adjusted by the moving-average components) have an elasticity of 11% and 10% to price increases in fuels and electricity power, respectively.[5]

Accordingly, the 40% price increases recently observed in those items should (statistically speaking) be accompanied by an increase of 8 percentage points of the overall inflation rate. In fact, the 1990 inflation rate of 32% could be explained basically by the direct and indirect effects of relative price changes in energy related goods and services (i.e. 23% + 8% = 31 percent).

This type of exercise was also extended to the relative price effect of wages, although it should be clear that State actions in this area only affect less than 50% of the government employees and its signal effects are limited to those contracts indexed to the minimum wage rate of readjustment. Table 2 shows that the elasticity of inflation surprises to (industrial) wage nominal adjustments is around 35%. Given that those wages increased by 27.7% during 1989, one should

[4] After applying Schwartz Bayesian Information Criteria (SBIC) for model selection (Judge *et al.*, 1985), we found that the Colombian series of WPI reported the best estimations under $p = 0$, $d = 1$ and $q = 3$. The "q" component was selected in the space 1 to 8 lags, finding that positions 1, 2 and 3 were optimal.

[5] Since the direct effect of recent gasoline price increase has been estimated in only 1.5 percentage points (Correa and Escobar, 1990), it could be said that nearly 2.5 points, out of the 4 points here assigned to fuels, correspond to indirect effects.

expect the inflation rate to be 9 points above the long-run rate (i.e. 23% + 9% = 32%), as in fact occurred.[6]

Table 1

Energy Relative Price Effects on the Inflation Rate: Colombia 1970-1990 (80 Quarterly Observations)

Independent Variables	*Dependent Variable: (Logarithm) of the Whole Sale Price Index (WPI)*	
Annual Growth Rates of the WPI Components:	*Estimation: ARIMAX (0, 1, 3)*	
	(1)	*(2)*
Fuels		0.110*
		(2.24)
Electricity		0.105*
		(3.18)
(Constant)	0.227*	0.173*
	(21.9)	(10.9)
Fitness Indicators		
$\overline{R}^2$	0.715	0.757
Degrees of Freedom	77	74
RMSE	0.029	0.027
SBIC	−2.493	−2.589
DW	1.347	1.519
Q	0.400	0.924

Note: The (*) indicates significance at least at the 95% confidence level; and (**) at 90% level. Absolute *t*-statistic values appear in parenthesis. RMSE: Root of the Mean Square Error. SBIC: Schwarts's Bayesian Information Criteria. Q: Ljung-Box statistics level of rejection of the hypothesis that the errors are not "white noise".

Synthesis. From the above results one should not conclude immediately that the adoption of policies directed to increase the relative prices of energy were a mistake, since they conducted to accelerate inflation recendy. No, our interpretation is that the lack of good substitutes for gasoline and electricity –e.g., natural gas is being developed only now as a viable alternative for Colombia– incited price reactions in other sectors as to avoid the cost-push caused by

[6] Results of this type can also be drawn from VAR models; see Carrasquilla (1990), Reinhart and Reinhart (1991), and Ramírez (1991).

this State policy, which partially retarded the energy consumption rationalization.

Table 2

Wages Relative Price Effects on the Inflation Rate: Colombia (1976-1990) (60 Quarterly Observations)

	Dependent Variable: (Logarithm) of the Whole Sale Price Index (WPI)	
	Estimation: ARIMAX (0, 1, 3)	
Independent Variables	*(1)*	*(2)*
Annual Growth Rates of the Nominal Industrial Wage		0.351*
		(2.77)
(Constant)	0.227*	0.141*
	(21.9)	(4.21)
Fitness Indicators		
$\overline{R}^2$	0.663	0.694
Degrees of Freedom	56	55
RMSE	0.022	0.020
SBIC	−3.364	−3.412
DW	1.625	1.704
Q	0.701	0.570

Note: The (*) indicates significance at least at the 95% confidence level; and (**) at 90% level. Absolute *t*-statistic values appear in parenthesis. RMSE: Root of the Mean Square Error. SBIC: Schwarts's Bayesian Information Criteria. Q: Ljung-Box statistics level of rejection of the hypothesis that the errors are not "white noise".

However, the relative price of energy related goods has remained higher than in the mid-1970s and this should propel future explorations of new alternatives or even generate fresh resources to enhance the proven reserves of oil and alike. In order to comply with the need for reducing inflation in the short-run, a less aggressive policy could be adopted, but without loosing the historical perspective, particularly in the electrical sector.[7]

[7] Price increases should go hand in hand with the availability of good substitutes or else the effect would only be a higher rate of inflation. Here is relevant to make the analogy with an active management of the nominal rate of depreciation: Gains in the real exchange rate will not occur if the acceleration of the nominal rate of

The elasticity of inflation surprises to nominal wages was found to be 35%, which, not startlingly, is higher than the 10% elasticity found for the sectorial effects of energy related goods.

2. Variability, Uncertainty and the Level of Inflation

Our second working hypothesis is that increases in price variation (ie. uncertainty) could lead to accelerate inflation if economic agents feel that it is better to "insure" against inflation surprises in the near future by means of readjusting upward prices today.

Graph 5 illustrates the positive relation that tended to exist between the standard deviation of inflation and the level of inflation in developed economies (e.g., US, Great Britain and Japan) between the 1960s and 1970s (Taylor, 1981). This type of relation implicitly supposes that indexation mechanism have not been developed yet to the point of having built-in insurance against inflation surprises.

Where agile indexation mechanism tended to develop, one should expect this relation to weaken. In fact, graph 5 reveals this to be the case of Colombia: Average inflation increased from 11% to 24.5% between the periods 1960-1972 and 1973-1990, but its standard deviation reduced from 6.5 to 5.4 points. Countries with moderate and high chronic inflation rates tend to develop quick indexation mechanism to counterbalance inflation surprises, but, paradoxically, the latter becomes one of the main obstacles to return to one digit inflation patterns, as has occurred in Colombia (Jaramillo and Montenegro, 1984; Clavijo, 1989a; Calderón, 1990).

With the intention of quantifying the incidence of price variability on inflation, beyond simple correlations, we performed some dynamic forecasting simulations of Colombian inflation by means of introducing some variations to the Beveridge and Nelson's (1981) technique.[8]

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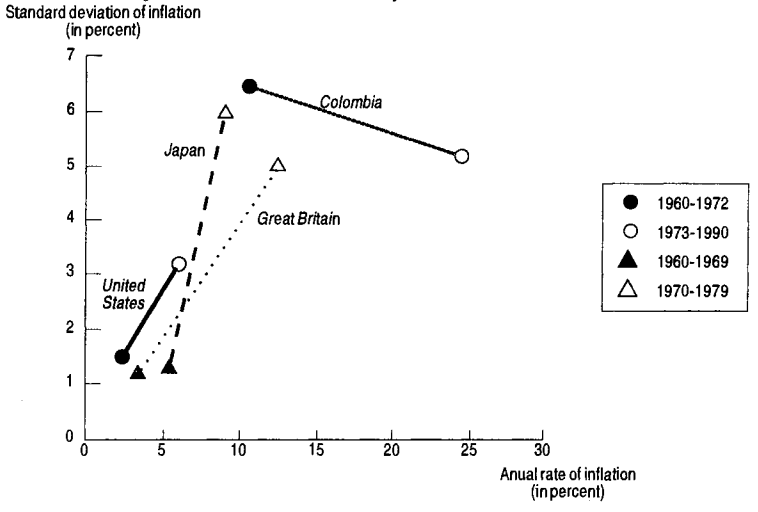
depreciation results inconsistent with fundamental macroeconomic variables (e.g., the fiscal deficit).

[8] The simulation procedure is explained in detail in Clavijo (1989b, 1989c), where it was pointed out how the variance of the forecasting introduced sensitivity to the final results.

Graph 5

Inflation and Uncertainty in Selected Countries



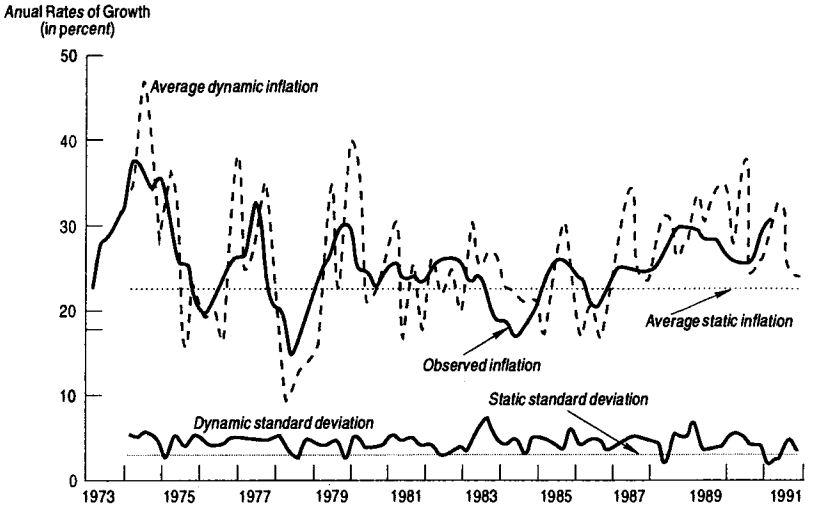
The mean values of the dynamic forecasting simulations, where random shocks were entered according to the sample variance, are depicted in graph 6. Note that dynamic forecasting values of inflation fluctuate more than the observed ones due the presence of random shocks. The variance of those forecasting, obtained while replicating 100 times each point of the forecast, will be here interpreted as the "uncertainty" faced by any "rational economic agent" that intended to foresee inflation within a year horizon. The one year ahead forecast horizon was fixed according to the characteristics of the basic model, which appears in the first column of Table 1.

The standard deviation of such dynamic forecasting are also shown in the lower part of graph 6, which almost always surpass the "static" error of the forecasts, as measured by the Root of the Mean Square Error (RMSE = 2.9%).[9] As points of high inflation uncertainty,

[9] An econometric alternative consists of using ARCH-models (Engle, 1982). However, from a theoretical point of view, the best alternative might be to direcdy compute the variance from inflation surveys, as the one conducted by J. Livingston for U.S.A. (Holland, 1984). Unfortunately, the latter is not a feasible way to be followed for the Colombian case.

when inflation was accelerating, it is worth to note the years of 1977, 1980 and 1989. In contrast, as points of high inflation uncertainty, but when inflation was reducing, we have the years of 1978, 1983 and 1991 (estimated).

Graph 6
Colombia
Inflation and Uncertainty
(Static and dynamic)



Our simulations indicate that, in early 1990, inflation experienced upward surprises, which coincided with a period of higher uncertainty (see graph 6). However, by the end of that year uncertainty had reduced, but a higher rate of inflation was already consolidating (around 30% a year). The dynamic forecasting exercise also reveals that inflation could be reduced in the second term of 1991, with the 25% annual figure as the most probable outcome. Note also that the standard deviation of inflation would eventually come down to 3 percentage points (i.e. the "static" uncertainty).

Effects of Uncertainty on the Level of Inflation. From the analysis given above, one could intuitively conclude that effects of price variability on inflation have not been important in Colombia, given

the creation of agile indexation mechanisms. With the intention of testing econometrically this hypothesis, we fitted again an ARIMAX model for the WPI, similar to the one reported in column one of Table 1, but this time we included in the right hand side the standard deviation of the dynamic forecasts of inflation, in the form of a second degree polynomial –i.e. using the Almond technique, Judge *et al.* (1985).

The results appear in Table 3, but they should be interpreted with caution, given that some problems of serial correlation remained. The coefficients imply that uncertainty effects on inflation are not always positive. In fact, the unravel lagged structure of the uncertainty components are: $t_0 = -0.83$; $t_{-1} = -0.24$; $t_{-2} = 0.17$; $t_{-3} = 0.40$; $t_{-4} = 0.45$, indicating that price variations generated a year ago tend to increase inflation, but the one generated recently tends to counterbalance such effect. As mentioned before, this null effect of higher price variation on inflation might be explained by the continuous development of indexation mechanisms in Colombia.

3. Conclusions

Stabilization packages almost always include an stage of relative price alignment. What is hard to assess is both the timing and the spectrum of prices that should be included in such policies. For example, there is no doubt that the alignment of the real exchange rate is crucial, but it is less clear if some administered prices (e.g., those of food, fuels or electric power) should also be moved at once in order to induce consumption rationalization and alleviation of the fiscal budget, when those goods and services are provided by the State.

In the absence of substitutes for these basic goods and services, the risk exits of having an stabilization package that will, in the aftermath, spur inflation. A simple lesson regarding this topic is then that careful evaluations should be made when deciding which relative prices of the economy should be affected –i.e. avoid goods which (potential) price elasticities are rather low.

As estimated in this paper, the elasticity of inflation surprises to price increases of fuels and electric power in Colombia was around 10% (each) during 1970-1990. This means that in spite of the achieve-

ments in consumption rationalization and alleviation of the budget, some inflation was induced by policies directed to increase the relative price of energy related goods.

Table 3
Uncertainty Effects on the Level of the Inflation Rate: Colombia 1975-1990

Independent Variables	*Dependent Variable: (Logarithm) of the Whole Sale Price Index (WPI)*	
	Estimation: ARIMAX (0, 1, 3)	
Standard Deviation of the Dynamic Forecast of Inflation (Second Degree Polinomial)	*(1)*	*(2)*
First Component		−0.833*
		(2.38)
Second Component		0.685*
		(2.20)
Third Component		−0.092**
		(1.80)
(Constant)	0.256*	0.208*
	(28.9)	(3.56)
Fitness Indicators		
$\overline{R}^2$	0.654	0.694
Degrees of Freedom	60	57
RMSE	0.022	0.021
SBIC	−3.287	−3.171
DW	1.795	1.553
Q	0.459	0.060

Note: The (*) indicates significance at least at the 95% confidence level; and (**) at 90% level. Absolute *t*-statistic values appear in parenthesis. RMSE: Root of the Mean Square Error. SBIC: Schwarts's Bayesian Information Criteria. Q: Ljung-Box statistics level of rejection of the hypothesis that the errors are not "white noise".

For the future, this outcome means that more substitutes of these kind of goods should be generated in order to maintained the current relative price structure. The short run anti-inflation policies, however, dictate the convenience of moderating the readjustments of gasoline and electric tariffs as to comply with the Pacto Social that is attempting to have inflation expectations look-forward. The recent negotia-

tions regarding public wages and the minimum wage constitute important elements that should help to consolidate a return to the long-run inflation rate of 23% a year.

Regarding price variability in Colombia, we found that uncertainty did not spur inflation, as happened in some developed economies. The main explanation for this phenomena might have to do with the development of agile indexation mechanism, which, paradoxically, implies that stabilization packages should include devices to abolish such indexation clauses in order to recover the effectiveness of traditional aggregate demand policies.

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