PRICE SETTING IN THE ARGENTINE AND COLOMBIAN MANUFACTURING INDUSTRY

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1998 **No. 90**

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Price Setting in the Argentine and Colombian Manufacturing Industry

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June, 1997 - First draft

Abstract

A price-setting mechanism based on a markup over variable costs is studied for the quite different inflationary experiences of Argentina and Colombia. The paper pursues a twofold strategy: first, it tests the null hypothesis of a constant markup against the alternative of a variable one; second, it checks the sensitivity of the price setting mechanism to strong shifts in the macroeconomic environment. The model explains price setting during periods of moderate and high inflation in both countries. However, it is less powerful for the period of price stability in Argentina. Finally, markups seem to be constant for all types of inflationary experiences except hyperinflation. This stands in contrast to a body of literature that has found a negative relationship between markups and inflation for OECD countries. The estimations shed light on other interesting issues: productivity has become a crucial determinant of prices for Argentinian manufacturing firms during the period of stability and opening of the economy; in contrast, the results suggest a weak impact of the opening on Colombian firms.

*I am grateful to Rodolfo Maino and Daniel Merino of the Central Bank of Argentina for providing recent data for this country; also to participants in seminars at Banco de la República and Fedesarrollo for helpful comments; and to Marcela Eslava for her diligent and professional research assistance. The opinions expressed do not reflect those of the Banco de la República.

1. Introduction

The purpose of this paper is to test a model of price setting in the manufacturing industry in Argentina and Colombia. It is supposed that firms enjoy some degree of market power, which allows them to set a markup over variable costs. This assumption has been confirmed for these countries by Chica (1983) and Frenkel (1983). The testing of this model allows a discussion of two issues of interest: first, the variability of the markup under different inflationary regimes. Markup variability and its relationship with inflation has been studied for industrialized economies, and has received growing empirical and theoretical attention (Hall, 1986 and 1988; Bénabou, 1992; Bénabou and Gertner, 1993 Blanchard and Muet, 1993; Kaskarelis, 1993; Tommasi, 1994)[1]. This literature has focused on low inflation economies and on a particular method for testing markup variability.

Here the relationship is tested for two countries which have exhibited a variety of inflationary experiences over the last two decades. Argentina experienced high inflation (up to 300% per year) until 1989, after which it entered a period of hyperinflation, lasting until 1991. Since the Convertibility Plan of 1991 Argentina has undergone a thorough adjustment widely regarded as highly successful in

[1] A related, though separate topic, has received growing attention and deals with the countercyclical behavior of markups.

virtually eliminating inflation. This paper updates and broadens an econometric exercise performed by Echeverry and Villanueva (1990); at the time, Argentina was still in the midst of hyperinflation. Data for the full period of hyperinflation as well as a long span of price stability has since become available, and is used in the current work.

Colombia, on the other hand, presents an interesting contrast since it has exhibited a moderately high and stable rate of inflation (between 20% and 30%) during the last 25 years. Hence, one of the questions asked in this paper is whether a price setting behavior that proved to have explanatory power for the high and variable inflation in Argentina, would fit the moderate and stable inflationary pattern of Colombia.

Second, the contrast between the two countries is not restricted to different inflationary experiences; both Argentina and Colombia undertook an opening of their economies at the beginning of the nineties. It is to be expected that price setting behavior would change once the economy reduces tariffs and competes within an unrestricted environment with foreign products. Indeed, facing low tariffs and no quantitative restrictions, domestic producers cannot transmit variations in costs to final prices as is possible in a highly protected setting. Furthermore, it has been claimed that the opening triggered a microeconomic transformation

of the manufacturing industry in Argentina, promoting the improvement of soft and hard technologies in an important share of firms(Kosacoff, 1996; Bisang et al. 1996); in contrast, there is informal evidence that the depth of reforms was lower in Colombia. Thus, the tests performed shed light on a second hypothesis regarding wether the opening process in these two countries was truly effective in confronting domestic production with foreign competition.

Two approaches have been frequently used for computing markups: those which assume a constant markup, such as Hall (1986, 1988); and those that estimate short run markup fluctuations from the time series of an input-output equation. There are some theoretical justification for both types of empirical exercises (see Naish, 1990 and Bénabou, 1992).

Naish (1990) justifies a fairly constant markup in the short run that can be affected by major macroeconomic shocks, such as a change in the monetary regime, or, as is argued here, by a reform of the competitive environment, emerging from the opening of the economy. In this paper a twofold strategy is used to test the behavior of markups: first, the null hypothesis of a constant markup is tested against the alternative of a variable one; and second, the stability of such behavior with respect to strong shifts in the macroeconomic environment is checked.

The results indicate that the model helps in explaining price setting during

moderate as well as high inflations in both countries. It is less powerful, however, in characterizing the period of price stability in Argentina. The estimates show that markups were constant for all types of inflationary experiences except hyperinflation. This stands in contrast to the body of literature that has found a negative relationship between markups and inflation for OECD countries. The results also shed light in another direction: price setting has changed with the opening of the economy and the stabilization program in Argentina, making changes in productivity a crucial determinant of manufactures prices. Finally, the opening of the economy seems to have had little impact on price setting in Colombian firms, reflecting the limited depth of the structural reforms in this country.

The paper is organized as follows: the next section presents the methodology and results of Echeverry and Villanueva. Section three discusses the results for Argentina when the complete time series for hyperinflation is used, which at the time of the cited paper was only half complete. It also includes the estimates for the period of June 1992-June 1995, characterized by a negligible rate of inflation and an open economy. Section four focuses on Colombia during the 1980-1996 period, and explores whether there was a structural change in price setting practices after the opening of the economy in 1990. The fifth section concludes.

2. Method and Results of Echeverry and Villanueva

The main assumption regarding the price setting behavior of manufacturing firms was that they enjoyed of some degree of monopoly power in the local market and were dependent on imported inputs. Thus, it was assumed that prices were determined in the domestic market, with firms setting them as an ex-ante markup over expected prime costs. The markup was assumed to depend upon long run factors, so that it was constant in the short run. This methodology followed a successful exercise by Frenkel (1983) for the Argentine industry prior to 1982. The paper updated Frenkel´s exercise, and tested how hyperinflation affected the price setting mechanism.

The method for testing markup variability used differs from that of Hall (1986, 1988), Bénabou (1992), Blanchard and Muet (1993) and Kaskarelis (1993). These authors obtain the markup in a fashion similar to Solow´s famous residual; when the assumption of perfect competition is lifted, changes in output can be attributed to changes in inputs multiplied by the markup. The markup can then be estimated through regression methods. One possible criticism of that methodology, which is particularly relevant to the countries analyzed here, is the availability of reliable measures of inputs. Indeed, at least for Colombia, there are no good

measures of hours worked, intermediate inputs or capital. For this reason, and for coherence with the original works of Frenkel, and Echeverry and Villanueva, the estimation of markup variability was performed using price data.

The working hypothesis was that during hyperinflation the ex-post markup should be volatile due to the inaccuracy of the entrepreneurs´ costs predictions based on the history of the variables. These prediction errors were caused by a lack of reliable information about the future evolution of costs, and by the high rate of change of relative prices. It seemed plausible that under hyperinflation the history of the variables should no longer be relevant for prediction.

The second hypothesis was that in a highly uncertain environment, like hyperinflation, entrepreneurs should use the evolution of the parallel market exchange rate (PMER) as the best proxy for predicting the rate of change in their costs. The reason is that the PMER was the best macroeconomic variable that embodied relevant information about the evolution of prices, available on a daily basis and at a low cost.

The authors tested a short run markup model with adaptive expectations of costs, developed by Frenkel (1983). The empirical equation is (see the appendix

for a more detailed explanation of the model):

$$p_t = \beta\, p_{t-1} + a_w(1-\beta)\, c_{wt} + a_m(1-\beta)\, c_{mt} + a_\mu(1-\beta) \qquad (1)$$

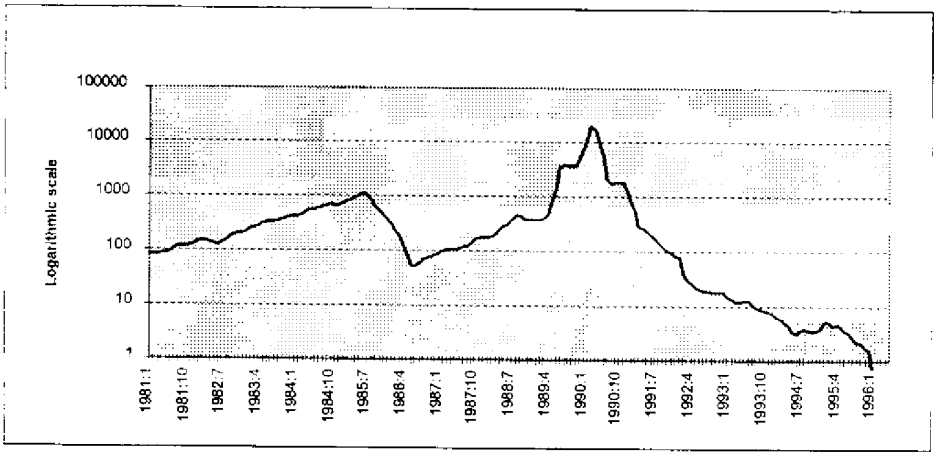
here the ex-post markup, μ, results from actual costs, C_t and final price, $P_t \equiv (1+\mu)C_t$; hence, in equation (1) p_t is the first difference in (the log of) prices; $a_\mu$is the rate of change of the price/total variable costs ratio ($1+\mu$, the markup); a_w is the share of labor costs; c_{wt} is the rate of change of labor costs (wages, adjusted by productivity); a_m is the share of the cost of (imported) inputs; c_{mt} is the increase in prices of (imported) inputs; and β represents the degree of inertia.

The conditions which guarantee the validity of the model are:

$a_w > 0,\ a_m > 0,\ a_w + a_m = 1,\ a_\mu = 0$ for a constant markup, and $a_\mu \neq 0$ for variable markup.

The period of estimation was 1982-1989, which was divided into two subperiods aimed at identifying the effects of hyperinflation on price setting decisions in this industry. Hyperinflation started in August 1988, and, at the time of the estimations, only data until November 1989 were available (15 months). Given the small number of observations for the hyperinflationary period, the strategy adopted was to compare the results of two regressions: one before hyperinflation

Figure 2.1: Argentinian Annual Inflation Rate 1981 - 1996



(1988:2-1988:8, see fig. 2.1), and another for the entire period, including hyperinflation (1988:2-1989:11). The differences in the value and significance of the coefficients were attributed to hyperinflation.

The model of constant markup (i.e. where the null, $a_\mu = 0$, could not be rejected) proved to be valid for the period 1982:1-1988:8, which was characterized

by highly fluctuating inflation, up to 300% yearly (see fig. 1 and table 1, col. 5)[2]. In contrast, when hyperinflation was included in the sample the results supported a *variable* markup, since the constant term became significantly different from zero (table 1, col. 6). The interpretation given to this finding was that uncertainty in forecasting the future evolution of costs led the firms to systematic errors in their predictions, and hence to variable ex-post markups. The theory developed by Bénabou (1988) and Bénabou and Gertner (1993) provides another explanation, according to which higher inflation may trigger search and reduce market power. Such an explanation depends on the cost of acquiring information.

[2]Two dummy variables were included in order to account for the biggest two policy shocks of this period: $d1$ for January 1984, the moment of change to a democratic government; and $d2$ for July 1985 for the implementation of the Plan Austral. The dummies were one for these months and zero for the rest of the sample.

Table 1. Price setting equation for Argentina[3]

	New Estimates				Echeverry-Villanueva	
	(1)	(2)	(3)	(4)	(5)	(6)
inflation	82:3-88:8 variable	88:9-91:3* hyper	82:3-91:3* var.-hyper	92:7-95:6 stable	82:1-88:8 variable	82:1-89:11 var.-hyper
constant	0.001	-0.04	-0.02	0.001	0.002	-0.35
	(0.17)	(-2.13)	(-3.09)	(0.9)	(0.29)	(-2.8)
$p_{(t-1)}$	0.33	0.07	0.09	0.2	0.37	0.114
	(5.17)	(1.28)	(3.05)	(1.08)	(6.19)	(2.7)
$c_{w(t)}$	0.24	0.64	0.55	-0.01	0.16	0.37
	(4.7)	(6.8)	(11.4)	(-0.07)	(4.5)	(5.2)
$c_{m(t)}$	0.46	0.49	0.52	0.13	0.47	0.71
	(10.5)	(7.3)	(14.4)	(1.95)	(10.8)	(13.9)
$d1_{(t)}$	-0.14		-0.12		-0.16	-0.17
	(4.6)		-1.76		(-5.1)	(-1.9)
$d2_{(t)}$	-0.16		-0.03		-0.19	-0.56
	(-4.3)		(-0.48)		(-4.95)	(-0.61)
R^2	0.91	0.95	0.95	0.16	0.902	0.905
F	137.4			2.1	134.8	165.01
DH	2.05	2,11	2.07	2.02	0.358	1.402
$\rho_{(t\ value)}$		(-2.08)	(-2.6)			
$a_w + a_m$	1.04	1.21	1.17	0.15	1.01	1.24

[3] An asterisk means that the regression was corrected for autocorrelation (HILU method), therefore the F-statistic is not reported. t-statistic in parenthesis below the coefficients.

Echeverry and Villanueva pursued a related investigation, since the finding of markup variability was assumed to be associated with the costs of acquiring information. However, the question posed was of a different type, namely, that facing an uncertain environment, entrepreneurs chose to peg their prices to the evolution of the variable which embodied relevant information in the economy at a daily basis and low cost: the PMER. Granger causality tests supported this prediction. Indeed, prices were found *not* to Granger-cause the PMER in either the period before the hyperinflation, or in the whole period including the hyperinflation, at significance level of 1%. In contrast, Granger causality was found from the PMER to the prices, but only for the period *including* hyperinflation.

The main implications drawn from such results were: **i.** a hyperinflationary process breaks down the *information system* underlying the price setting decisions of the industry. In such an environment it is easy to make costly mistakes when predicting the relevant variables for the firms; **ii.** this leads to a shift in the information structure used by the entrepreneurs to construct their expectations, favoring variables which embody most of the relevant information, readily available and at a low cost; and **iii.** the PMER played such role.

3. Estimates for the Hyperinflation and Stable Prices Periods (1988:9 - 1995:6)

Two types of evidence can be used now that were not available at the time of the cited paper: first, estimation for the whole period of hyperinflation can be undertaken independently. Second, the model can be tested for the period of price stability, 1992-1995. The results of these new tests appear in table 1. The estimates for hyperinflation (August 1989 to February 1991) appear in column 2. The major difference with Echeverry and Villanueva (col. 6)[4] is that the coefficient of the lagged dependent variable is not significant; the other results are quite similar: the markup is variable (i.e. the constant is significantly different from zero), the cost coefficients are positive and significant, the R^2 is higher than 0.9, and the sum of the share of wages and imported inputs (a_w+a_m) is close to the one obtained previously, and slightly higher than one. The warning regarding the interpretation of the a_w and a_m estimates made in the previous work is still valid: expectations during hyperinflation were formed using other type of information, not included in the information set considered by the model; this tends to increase

[4]It should be noted that results of the new estimations for the period 1982-1988 differ from those of Echeverry and Villanueva due to the fact that a number of series used in that paper were not available for recent years.

the value of these coefficients. Altogether, these results validate the approach of Echeverry-Villanueva (1991) and confirm the conclusions drawn for hyperinflation.

The results for the period of stable inflation are less satisfactory (1992:7-1995:6)[5] since the model performs poorly, indicating a whole new environment and suggesting a new price setting mechanism. Column 4 of table 1 shows that the R^2 drops to 0.16 and the sum of input shares is only 0.15. The coefficients are not significant and the sign of wage increases is negative. The only promising indication that emerges from the estimation is that imported inputs seem still to be part of the explanation of prices (the significance of the t-statistic is 6%).

Since the major problem is in wage costs, a similar regression was run separating the two components of this variable, increases in nominal wages and productivity, aiming to identify if either of them was responsible for the change in the model. The results appear in Table 2 in what is called the "labor cost participation equation". Notice that this regression cannot be interpreted in the same way as those in table 1. Here $(a_w + a_m)$ does not have the same meaning as before, and the intercept cannot be interpreted as the markup. Nevertheless, the purpose

[5]In the period of stability the regressions were run starting in 1992:7, because the period between 1991:4 and 1992: 6 appears to be characterized by an adjustment process. For instance, including this period in the price stability span, the markup appears to be variable. A plausible explanation can be that agents were still adjusting to the new environment and the economic policy was gaining credibility. The special character of this period is confirmed by the account of the post-stabilization period given by Bisang et al (1996, p.196)

is to shed light on the origin of the break in the model documented in table 1. Column 1 of table 2 shows that the results are almost identical to those of column. 1 of table 1; the only difference is that here the labor cost component is split between changes in wages and in productivity. The coefficient and significance of the $\Delta w(t)$ variable is the same as the one for $c_w(t)$ for the same period, which indicates that changes in wages and not in productivity were crucial for determining prices for the period of high and variable inflation. A similar conclusion carries to the period of hyperinflation (col. 2).

The main difference emerges in estimating the model for the period of price stability. Column 4 of table 2 shows that the lagged dependent variable is not significant, indicating the absence of inertial factors, which were important before hyperinflation; $c_m(t)$ is significant and has the right sign, confirming that this still is a determinant of prices, although the coefficient is half of that obtained before hyperinflation. The most important piece of evidence is the non-significance of nominal wage increases, and the significance of the shifts in productivity. As expected an improvement in productivity negatively affects prices. Finally, The R^2 more than doubles that of column. 4 in table 1 indicating that separating out productivity increases the explanatory power of the regression.

Summing up, the model presented apparently provides a flawed explanation for

price setting during the period of price stability. However, a transformed version partly indicates the source of the problem: under the new environment changes in wages cannot be transmitted to prices; whereas productivity shifts, non-significant before hyperinflation, become a crucial determinant during price stability. This observation is coherent with the fact that the Argentine economy was opened to international competition during the nineties. Hence, the story can be that firms which previously enjoyed protection from outside competition, and which therefore could ask for prices higher than those prevailing in the international economy, faced a new environment in which they could no longer transmit wage increases into prices, and had to depend on productivity gains for competitiveness.

Table 2. **Labor cost participation equation for Argentina**[6]

	(1) 82:3 - 88:8	(2) 88:9 - 91:3*	(3) 82:3 - 91:3*	(4) 92:7 - 95:6
inflation	**variable**	**hyper**	**variable- hyper**	**stable**
Constant	0.05	-0.44	-0.14	011
	(0.55)	(-1.04)	(-1.06)	(3.35)
$p_{(t-1)}$	0.32	0.06	0.09	0.03
	(5.1)	(1.25)	(3.05)	(0.17)
$c_{m(t)}$	0.45	0.50	0.52	0.21
	(10.3)	(7.4)	(14.5)	(3.3)
$\Delta w_{(t)}$	0.24	0.64	0.55	0.06
	(4.6)	(6.8)	(11.5)	(0.31)
Δ $productivity_{(t)}$	-4.8	38.78	11.26	-10.13
	(-0.57)	.092	(0.86)	(-3.3)
$d1_{(t)}$	-0.14		-0.12	
	(4.6)		-1.74	
$d2_{(t)}$	-0.17		-0.02	
	(-4.3)		(-0.32)	
R^2	0.91	0.95	0.95	0.38
F	113.4			4.8
DW	2.05	2,14	2.08	2.19
$\rho(t\ value)$		(-2.27)	(-2.7)	

[6] An asterisk means that the regression was corrected for autocorrelation (HILU method), therefore the F-statistic is not reported. Columns 1 to 5 have the t-statistic in parenthesis below the coefficients.

4. Price Setting in Colombia´s Manufacturing Industry

The model estimated for Argentina was used for Colombia taking into consideration that a similar industrial organization holds for manufacturing in Colombia, at least until the beginning of the nineties; namely, some degree of market power and a protectionist environment. The sample (1980:1-1996:8) was split in September 1989, the start of the opening process[7]. In terms of inflation, the two periods do not differ greatly, since the pattern of fluctuations within a 20% - 30% band characterizes both of them, and is still in place (see fig. 4.1).

Table 3 shows the model´s estimates. The first indication of trouble is given by the R^2 and $(a_w + a_m)$ term; in particular the sum of the shares of inputs is much lower than one, indicating that some inputs are left out. Another fact that emerges is that the coefficients of c_w and c_m seem to be independently and jointly significant for the period after 1989:9, whereas the opposite occurs for 1980:1-1989:8.

[7] A consensus favoring the opening of the economy had been gained during the term period of president Barco (1986-1990). During 1989 policy-makers implemented a faster pace of nominal devaluation, aimed at temporarily compensating for tariff reductions. The goal was to prevent a drastic impact on domestic production and exports. This policy was continued during the Gaviria presidency (1990-94). The exchange rate regime in place between 1967 and 1991 was a crawling peg, after which a target zone was implemented for the nominal exchange rate.

Figure 4.1: Colombian Annual Inflation Rate 1970 - 1996

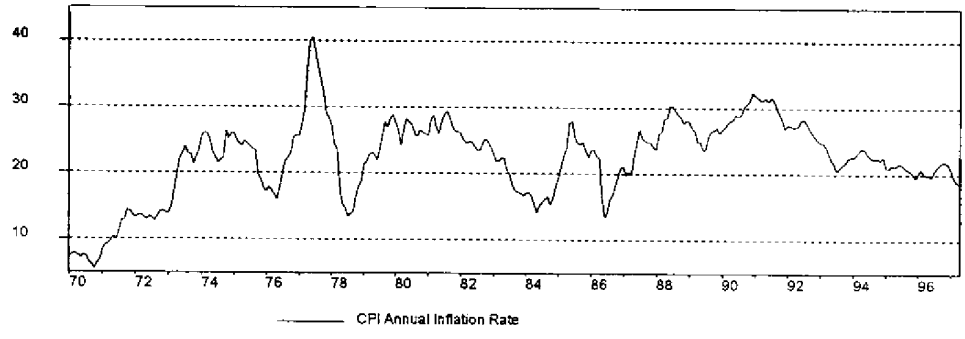


Table 3. **Price setting equation for Colombia**

Imported inputs ($c_{m(t)}$)

	(1) **80:1 - 96:8**	**(2)** **80:1 - 89:8**	**(3)** **89:9 - 96:8**
Constant	0.01	0.01	0.01
	(4.4)	(3.3)	(3.05)
$p_{(t-1)}$	0.23	0.21	0.21
	(3.4)	(2.2)	(2.1)
$c_{m(t)}$	0.34	0.16	0.51
	(4.6)	(1.18)	(4.7)
$c_{w(t)}$	0.01	0.01	0.02
	(2.03)	(0.79)	(2.3)
R^2	0.17	0.05	0.34
F	13.57	2.03	13.08
DW	1.94	1.94	1.67
$a_w + a_m$	0.45	0.22	0.67

The model was reestimated replacing imported with total inputs, in order to improve the fit; the component of intermediate goods of the Producer Price Index (PPI) was used as proxy of total inputs. The results of these estimations appear in table 4, and show that the R^2 of all regressions rise, and the $(a_w + a_m)$ term is close to one indicating the appropriateness of this choice and the good behavior of the model. In contrast to table 3, here the markup is constant for all regressions. The main change lies in the significance of labor costs, which do not help explaining prices before 1989:8, but do following the opening of the economy. In sum, the model fits the data for the period of opening of the economy, but it does so less successfully for the previous period. It is interesting that the mark up is constant in both periods.

Table 4.	**Price setting equation for Colombia** **Total inputs ($c_{T(t)}$)**		
	(1) 80:1 - 96:8	**(2) 80:1 - 89:8**	**(3) 89:9 - 96:8**
Constant	0.002	0.001	0.001
	(1.43)	(0.73)	(1.21)
$p_{(t-1)}$	0.17	0.17	0.17
	(3.6)	(2.5)	(2.6)
$c_{T(t)}$	0.79	0.82	0.76
	(15.7)	(10.2)	(10.3)
$c_{w(t)}$	0.01	0.001	0.02
	(1.7)	(0.89)	(2.63)
R^2	0.597	0.507	0.71
F	95.9	37.8	63.3
DW	1.96	1.93	1.81
$a_w + a_m$	0.96	0.99	0.94

A final exercise was performed using the labor cost equation already utilized for Argentina, aimed at identifying if either the wages or productivity components of labor costs were separately significant. According to table 5 the result is completely different to that of Argentina; in Colombia neither wages nor productivity are significant when taken separately. Colombia´s manufacturing prices seem not to have been affected by a shift in productivity after the opening of

the economy. Since this is considered to be one of the major impacts of opening domestic production to foreign competition, its lack of significance is interpreted as an indication that the opening strategy was timid, with little effect on labor productivity in the manufacturing industry.

This statements needs to be qualified. Price setting did change after the trade opening, and the shift was related to the labor component. However, it was the *relationship* between the evolution of wages vis-a-vis that of productivity, rather than productivity itself, what started to affect prices. Both components have the right sign, but neither of them enters significantly in the regression.

Table 5.	Labor cost participation equation for Colombia		
	(1) **80:1 - 96:8**	**(2)** **80:1 - 89:8**	**(3)** **89:9 - 96:8**
Constant	0.002 (1.38)	0.002 (0.82)	0.002 (1.14)
$p_{(t-1)}$	0.19 (3.8)	0.21 (2.8)	0.18 (2.4)
$c_{m(t)}$	0.79 (15.58)	0.8 (9.79)	0.76 (12.2)
$\Delta w_{(t)}$	-0.003 (-0.31)	-0.02 (-1.09)	0.02 (0.72)
Δ *productivity*$_{(t)}$	-0.02 (-1.81)	-0.02 (-1.2)	-0.02 (-1.47)
R^2	0.6	0.51	0.71
F	72.4	28.9	46.97
DW	2.01	1.98	1.83

5. Conclusions

The results obtained indicate that except under the extreme conditions of hyperinflation, markups were constant. This was the case even for Argentina under high and variable inflation rates. For Colombia, under moderately high and stable inflation they also appear to be constant. If ex-post markups are variable because firms make mistakes when predicting variable costs, such an effect is only clear un-

der the extreme inflationary conditions . Otherwise, price and costs expectations are less vulnerable to inflation than is normally thought.

This result stands in contrast to a body of literature that has identified variable markups for countries with low rates of inflation. Indeed, Bénabou (1992) Blanchard and Muet (1993) and Kaskarelis (1993) have obtained that upward changes in inflation, in low inflation countries, may lead to a reduction in markups, and therefore to an increase in welfare. However, given the findings reported here it is hard to maintain that for Argentina hyperinflation was welfare improving because it led to markup reductions. And for Colombia, markups seem not to have changed at all.

In the determination of prices, changes in wages and not in productivity were crucial in Argentina for the period of high and variable inflation. The model presented apparently provides a flawed explanation for price setting during the period of price stability after the convertibility reform of 1991. However, a transformed version indicates a plausible source of the problem: in an environment of competition with foreign products and price stability, wage costs cannot be transferred to prices, whereas productivity shifts, non-significant before hyperinflation, become a crucial determinant. Hence, the story may be that firms, which previously enjoyed protection from outside competition, and which therefore could ask

for prices higher than those prevailing in the international economy, faced a new environment after 1992, in which they could no longer transmit wage increases to prices. They were forced to depend on productivity gains for competitiveness. A new microeconomic behavior appears to be in place after the opening of the economy in the nineties.

For Colombia total inputs replaced imported ones in the price setting equation in order to obtain a good fit of the model. The opening of the economy did not lead to the behavior identified in Argentina. Productivity gains seem not to be a separate force behind prices during the nineties. Wages and productivity together are part of the price setting mechanism; this result leads to the conclusion that Colombia´s opening of the economy lacked depth, at least in comparison with Argentina´s.

REFERENCES

Bénabou, Roland (1992), "Inflation and Markups, Theories and Evidence from the Retail Trade Sector", *European Economic Review*, Vol. 36, 566-574.

Bénabou, Roland and Robert Gertner (1993), "Search with Learning from Prices: Does Increased Inflationary Uncertainty Lead to Higher Markups", *Review of Economic Studies*, Vol. 60, 69-94.

Bisang, Roberto, Carlos Bonvecchi, Bernardo Kosacoff and Adrian Ramos (1996), "La Transformación Industrial en los Noventa. Un Proceso con Final Abierto", *Desarrollo Económico*, número especial, Vol.. 36, verano, 1987-216.

Blanchard, Jean Oliver and Pierre Alain Muet (1993), "Competitiveness through Disinflation: an Assessment of French Macroeconomic Strategy", *Economic Policy*, April, 11-56.

Chica, Ricardo (1983), "La Dinámica de los Precios en la Industria Manufacturera colombiana, 1958-1980", *Revista de Planeación y Desarrollo*, Jan.-Apr., 33-70.

Echeverry, Juan Carlos and Juan Paulo Villanueva (1990), "Price Setting in the Manufacturing Industry Under Hyperinflationary Conditions, the Case of Argentina ", Working Paper, Kiel Institute of World Economics, May. Published in Spanish in *Desarrollo Económico* (Buenos Aires), Vol. 31, No. 121, Apr.-Jun. 1991, 73-89.

Frenkel, Roberto (1983), *La Dinámica de los Precios Industriales en la Argentina 1966-1982, un Estudio Econométrico*, CEDES, Buenos Aires.

Hall, Robert E. (1986), "Market Structure and Macroeconomic Fluctuations", *Brookings Papers on Economic Activity*, No. 2, 285-322.

Hall, Robert E. (1988), "The Relation between Price and Marginal Cost in U.S. Industry", *Journal of Political Economy*, Vol. 96, No. 5, 921-947.

Kaskarelis, Ioannis A. (1993), "Inflation and the Mark-up in UK Manufacturing Industry", *Oxford Bulletin of Economics and Statistics*, Vol. 55, No. 4, 391-408.

Kosacoff, Bernardo (1996), "Estrategias empresariales en la Transformación Industrial Argentina", separata, *Boletín Informativo Techint*, No. 288, octubre-diciembre, 25-47.

Naish, Howard F. (1990), "The Near Optimality of Markup Pricing", *Economic Inquiry*, Vol. XXVIII, 555-585.

Tommasi, Mariano (1994), "The Consequences of Price Instability on Search Markets: Towards Understanding the Effects of Inflation", *The American Economic Review*, Vol. 84, No. 5, Dec., 1385-1396.

A. Appendix 1

Here the model of Frenkel (1983), as used by Echeverry and Villanueva (1990) is presented. Prices, P_t, are modeled as an ex-ante markup, μ^*, over the expected cost, C_t^e:

$$P_t = (1 + \mu^*)C_t^e \tag{A1}$$

the ex-post markup, μ, results from actual costs, C_t:

$$P_t \equiv (1 + \mu)C_t$$

Cost expectations are formed adaptively, and the discrepancy between actual and expected costs is ε_t, the error the entrepreneur makes when estimating costs. Prices are set taking into consideration the main components of firm costs, namely, labor costs and intermediate (domestic and/or foreign, avoiding time subscripts):

$$P = (1 + \mu)\left[W\left(\frac{L}{Q}\right) + P_m\left(\frac{M}{Q}\right)\right] \tag{A2}$$

Where P is the price in the manufacturing sector, μ is the markup rate, W is the nominal wage, L/Q is the unit labor requirement, M is the quantity of the imported input and P_m its price expressed in terms of the domestic currency. Differentiating (A2) with respect to time and dividing it by P the following ex-

pression is obtained:

$$\hat{P} = p = a_\mu + a_m \left[\hat{P_m} + \hat{M/Q}\right] + a_w \left[\hat{W} + \hat{L/Q}\right] \tag{A3}$$

where a hat over a variable represents its rate of change; $a_\mu = d\mu/(1+\mu)$ is the rate of growth of $(1+\mu)$ and represents the rate of change of the ratio of price to total variable costs (markup),

$a_w = \frac{W(L/Q)}{[W(L/Q)+P_m(M/Q)]}$, is the share of wages costs in total costs,

$a_m = \frac{P_m(M/Q)}{[W(L/Q)+P_m(M/Q)]}$, the share of the cost of (imported) inputs.

In the short run it is assumed that (M/Q) is constant. Thus, $c_m = \hat{P_m}$; also $c_w = \hat{W} + \hat{L/Q}$, c_w being the rate of change of wages, adjusted by productivity. Hence, the price setting equation is:

$$p = a_m c_m + a_w c_w + a_\mu \tag{A4}$$

Since the evolution of the cost variables is uncertain, prices are set taking into consideration expected values:

$$p = a_m E c_m + a_w E c_w + a_\mu + \varepsilon \tag{A5}$$

where E is the expectations operator, and a disturbance ε is included to allow

for an accidental over- or undershooting in the achievement of the price target. Expectations of a variable X are formed as a weighted average of its current and past realizations:

$$EX = (1-\beta)\sum_{j=0}^{\infty}\beta^{j}X_{t-j} \qquad \text{(A6)}$$

where β represents the degree of inertia. Through a Koyck Transformation equation (A6) becomes the empirical equation to be estimated, equation (1) in the text (including time subscripts):

$$p_t = \beta\, p_{t-1} + a_w(1-\beta)\, c_{wt} + a_m(1-\beta)\, c_{mt} + a_\mu(1-\beta) + \varepsilon_t \qquad \text{(A7)}$$