The Relationship between Wages and Prices in Colombia

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Abstract

Due to the fact that many reliable indicators of further in‡ationary pressures do not seem to work any more, …nding whether or not wages Granger cause prices is an important concern for policy making. However, international evidence on the relationship between wages and prices does not show strong evidence in favor of causation in the direction of prices. The results presented here for Colombian data point to the same direction. This paper di¤ers from previous ones published in Colombia in two aspects. First, we include the Unit Labor Cost (productivity adjusted wages) as a more sensible measure of wages. Second, we base our analysis on a price markup expectations augmented Phillips curve in which we include indicators of aggregate demand and supply shocks, thus avoiding omitted variables bias in our inferences. We worked under alternative stationary / non stationary VAR models. We found evidence in favor of Granger causality from prices to wages but no evidence of Granger causality in the direction of prices. This results hold only whe unit labor cost is used as the wage indicator and under alternative measures of aggregate demand and under di¤erent assumptions on the integration properties of the series. The policy implication of these results point the very careful use of wages as leading indicator of in‡ation.

1 Introduction.

Central banks need to pay close attention to signals of in‡ationary pressures. In order to do so, authorities usually keep track of di¤erent variables that may contain information about the future evolution of prices. One of such variables is the nominal wage. Analyst and authorities look at wages as an indicator of cost pressures that may anticipate future changes in the rate of in‡ation.

However, from a theoretical point of view, it is not always clear why wages may be used as a leading indicator of in‡ation. Depending on the theoretical approach, causality may arise in any direction and not necessarily from wages to prices. Thus, the wage - price relationship becomes an issue that have to be confronted on empirical grounds.

Since 1980, some research has been done using American data which focuses on the relationship between this two variables and tries to establish weather causality runs in one specific direction or there is a feedback relationship. Working with different price and wage definitions and using different statistical techniques, the majority of works have found no enough empirical evidence that supports the view that the rate of change in wages contains information to anticipate the future path of inflation. Although many of this works find a cointegrating relationship between the series of prices and wages, they only find causality running from prices to wages at most.

Working on similar basis, this paper finds mixed evidence that supports the findings of the international literature on this topic. Using Colombian data, our main results show evidence of Granger-causality from prices to wages but no evidence of causality from wages to prices. This findings contradicts some previous results obtain for similar data, as we will point later. The second section of this paper brings a short review of some of the literature on this topic using American and Colombian data, the third section clarifies some of the theoretical basis that lies underneath the empirical relationship between prices and wages, the fourth presents the empirical results and finally we report the main conclusions.

2 Some International and Colombian Evidence

One of the most influential papers in the last two decades has been the one by Gordon (1988). In his paper, the author clearly establishes the link between wages and prices from a theoretical point of view. This link is derived from traditional price and wage equations and allow the author to obtain two new equations: an inflation equation in which lagged changes in the labor's share determine the rate of inflation, and one equation for the wage variable. As the price variable, this paper considers a Fixed Weight Deflator and employs the Unit Labor Cost instead of the nominal wages. Previous papers had employed the nominal wages directly; however as Gordon correctly points, this decision did not take into account the fact that a rise in the rate of change of the nominal wage do not pass-through to a higher inflation rate if it is joined by an increasing labor productivity. By definition, unit labor cost corresponds to wages adjusted by labor productivity.

Using standard regression techniques, Gordon finds that the labor's variable is statistically insignificant, which can be interpreted as the rate of change of wages being irrelevant to explain inflation. Results also show that price changes do not help to explain wage changes. However, at this point, the author recognizes that this last conclusion is less supported by the empirical evidence.

Working on a similar line of research but explicitly testing for Granger-causality, Mehra (1991) offers new evidence on the wage - price relationship. The price variable is specified as the log of the fixed-weight GNP deflator and the wage variable as the log of unit labor costs of the non-farm business sector (i.e.: the productivity-adjusted wage). The author questions the implicit assumption on deterministic trend component of the series used by Gordon and other works. A misspecification of the trend like the one mentioned before, may lead to incorrect tests of hypothesis, which can drawn wrong conclusions about the direction of causality between prices and wages. According to Mehra, rates of growth of wages and prices for the American case do not contain a deterministic trend but they share a common stochastic trend, which technically means that the variables are cointegrated. Thus, long run movements in the rate of change of prices and wages are correlated over time, and this is due to Granger- causality from the growth rate of prices to the growth rate of wages and not the other way around. In other words, past inflation determines the growth rate of wages only.

A not very different result is obtained by Huh and Trehan (1995), who estimate a VEC model containing wages, prices and productivity to look at the dynamic relationship among these variables. This methodology allows them to examine the long-run relationship between wages and prices and specifically the nature of the long-run adjustments between these variables. Having found that wages and prices are cointegrated, they show that it is the level of wages, and not the level of prices, that adjusts to maintain the cointegrating relationship in the model. Thus, as in Mehra (1991), Huh et al. also conclude that prices Granger cause wages but that wages do not Granger cause prices.

A more general and recent work by Emery and Chang (1996) supports most of the results found by previous works and offers some additional insight into the relationship between the two series. In their paper, unit labor costs are taken as the wage variable and CPI and core CPI as two alternative price indicators. Granger test are applied for a longer period spanning from 1960 to 1996 and for two sub-periods: from 1960 to 1980 and from 1980 to 1996. The breaking point (1980) is found using standard stability tests developed by Stock and Watson (1993). Along the longer period, the results show again that inflation always Granger causes the wage growth, regardless of the choices of the price series. Similarly, wage growth Granger causes core CPI inflation, however no enough evidence was found that wage growth Granger causes CPI inflation.

When analysis is performed on the sub-periods, the authors conclude that the series behavior is different. In particular, the Granger causality from wage growth to core CPI inflation found above, can only be assured for the period before 1980. After this year, the data do not support these findings. Anyway, the data consistently shows no Granger causality from wage growth to CPI inflation in any sub-period, but still shows Granger causality from CPI and core CPI inflation to wage growth for both.

Finally, taking a farther step, Emery et al. perform out-of-sample forecasts of inflation using wages in an error-correction model in order to offer a more definitive clue of the roll labor costs play on future inflation. This exercise show no evidence that wage growth contributes to any reduction in forecast errors compared with univariate autorregresive models of inflation. This means again, that wages are of little help to predict inflation.

As opposed to the American evidence, the Colombian evidence is far less numerous, clear and conclusive. Montenegro (1994) examines the relationship between the minimum wage and the CPI, performing Granger causality test for them. As for the American data, he finds causality running from prices to wages. This results, however, are subject to many criticisms due, mainly, to the nature of the wage variable used. In fact, in Colombia, minimum wage is an indexed-staggered variable which does not originate from a free interaction between labor demand and supply. This sets serious doubts about the right connection between this variable and prices from a theoretical point of view.

In part as a response to this analytical weakness, Misas and Oliveros (1994) study the relationship between different price and wage indicators. In their work, the authors use industrial wages in addition to the minimum wage as wage indicators and the CPI and CPI without food prices (CPIF) and CPI excluding food, transportation and utility prices (CPIB) as price indicators. Working on a monthly frequency and performing standard Granger causality tests on the series for the 1982-1994 period, they find a feedback Granger-causal relationship between industrial wages and CPI, CPIF and CPIB. Similarly, results show a feedback relationship between minimum wage and CPI.

One of the main problems with the previous works for Colombian data has to do with the utilization of wages without adjusting by productivity gains. As it has been clear with most of the literature on this topic, an increase in wages do not necessarily imply higher unit costs of production if it happens to be similar to that in labor productivity. Thus, in order to check the existence of inflation generated by wage pressures a variable such as productivity adjusted wages or unit labor costs has to be used to avoid misleading results. By the same token, not taking into account demand variables may lead to problems because of the omitted variable bias, and the few works on Colombian data fail to consider this fact too.

3 What Theory Has to Say?

Economic literature offer two basic approaches to understand the wage - price relationship: the demand-pull and the cost-push models. The demand-pull model derives from monetarists arguments which see inflation as demand determined. In a particular economy, the rate of change of all prices depends on the demand for real balances. More precisely, changes in prices and wages are both directly related to monetary policy and are not exogenous. The price that matters to the labor market is the real wage, therefore nominal wages are the ones that respond to price changes so as to preserve its initial level. By increasing the rate of money growth, the monetary authority may induce a rise in production and employment in the short run as long as people are expecting price stability in the near future. However, higher production requires that prices increase faster than costs do, in particular labor costs. This allows firms to temporarily profit more from their business. But if prices go up, wages will have to go up too in order to drive real wages back to its equilibrium level. This will occur since, according to monetarist assumptions, wages are fully flexible; but it will happen at a slower pace than price increases because initial workers´ expectations are wrong. Thus, from this point of view it is possible to see a sequence of price increases followed by nominal wage increases which would mean that prices may offer information to anticipate future changes in wages but not the other way around.

On the other side, the so called cost-pushed model is rooted in a Keynesian type of model. Thus, this approach is based on the assumption that prices are set as a mark up on labor costs (Stein 1979). In this case, nominal wage is set in the labor market as in the demand-pull model. Once its level has been establish by the market, firms add a fixed mark-up on wages to define prices, which guaranties them a fixed profit margins. To keep this margins constant, a rise in wages relative to productivity (a rise in unit labor costs) has to be transfered to prices. When monetary authorities increase the growth rate of money, firms´ first response is to increase production and not prices. More production, however, leads to a higher labor demand pushing nominal wages up. Only then, prices will rise as a respond to higher labor costs. Thus, changes in wages over productivity gains precede changes in prices implying that the rate of change of wages have information to predict future inflation rates.

As Gordon (1982) showed, a more formal view of the wage-inflation relationship can be obtain from an explicit model which considers a Phillips curve type of adjustment. In this case, the nominal wage rate adjust to gradually close the gap between the labor supply and demand. Adding a mark-up price hypothesis, it is possible to derive equations (1) to (4), which are the basic relations underlying augmented Phillips curve models .

$$p_t = a_0 + a_1 ulc_t + a_2 d_t + a_3 Sp_t \tag{1}$$

$$ulc_t = b_0 + b_1 p^e_t + b_2 d_t + b_3 Sw_t \tag{2}$$

$$ulc_t = w_t - \frac{1}{\mu_t} \tag{3}$$

$$p^e_t = \alpha(L) p_{t-1} \tag{4}$$

In this set of equations all variables are in natural logarithms and lower case letters correspond to rates of change. p is the price level; ulc corresponds to the unit labor costs and it is defined as the rate of change of wages divided by the gains in productivity ; p^e is the expected price level; d represents cyclical demand and S represents different supply shocks. Equation 1 is the price mark-up equation while equation 2 corresponds to what is known in the literature as the wage equation.

The model presented above shows how wages and prices are connected , and suggests that a feedback causal relationship between both variables is thinkable, at least from a theoretical point of view. In fact, from equations 2 and 4 it is clear that past prices affect future wages and, after a little algebra, from equations 1, 2 and 4 it can be seen how past wages may affect future prices. Thus, theory does not help much in clarifying the direction of the causal relationship between this two variables, and this issue has to necessarily be solved on empirical grounds for the Colombian data as it has been done for American data.

4 Empirical Evidence

4.1 The Data

Our data base contains quarterly measures of the annual growth rate of the geometric average of the consumer price index, DCPI4, the unit labor cost, DULC4, the industrial nominal wages, DW4, and a measure of supply shocks, S, defined as the centered difference between the CPI inflation without food, CPIF, and the CPI inflation. The output gap, YG, is the deviation of output with respect to a linear trend as concluded by Julio and Gomez (1999), and our measure of unemployment gap, UG, is the deviation of the unemployment with respect to a constant as was concluded by Gomez and Julio (2000).

Figure 1 displays the data used in the analysis. The upper left figure shows the inflation rate with and without food, and the lower left panel

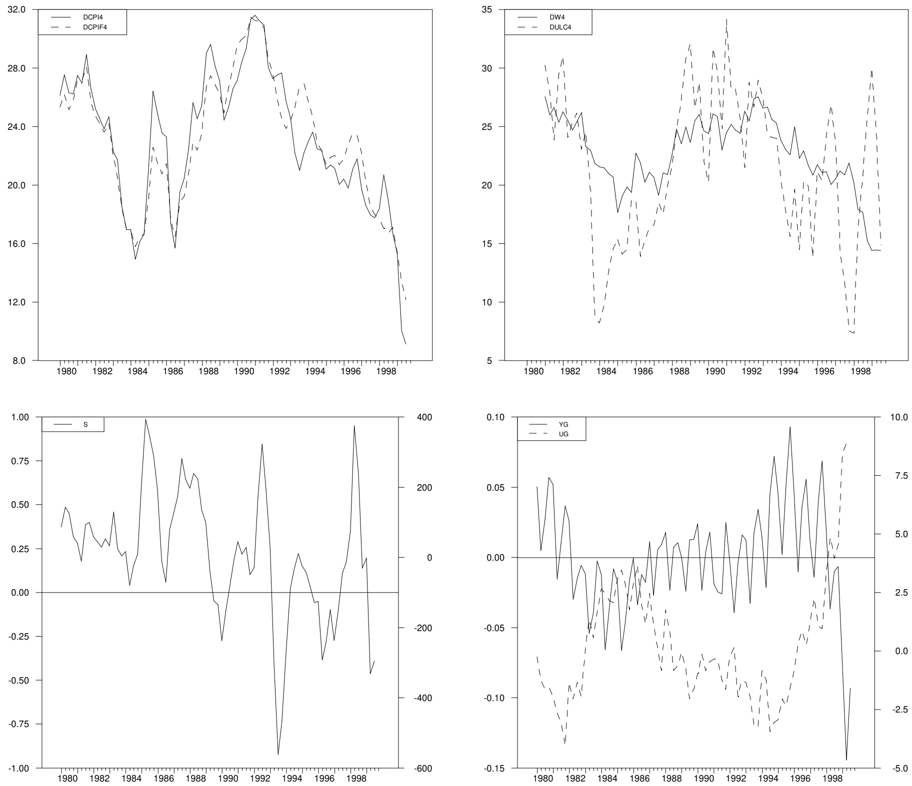

Figure 1: Original Data

shows our measure of supply shocks suggested by King and Watson (1994, footnote 18). The upper right panel contains the annual growth of the wages indicators, and the lower right panel contains the unemployment and output gaps, which clearly satisfy the Okun's law.

Figure 2 Displays the CPI in‡ation rate and the annual growth of the wage indicators. Although the ..gures show the expected form of relationship between wages and prices, it looks closer for the case of nominal wages and CPI in‡ation. Moreover, and from the peaks and througs of the series it seems that prices anticipate nominal wages. However, for the case of the ULC it is not clear from this ..gure the direction of the causality.

4.2 Results

Table 1 contains the results of the augmented Dickey - Fuller and KPSS tests for unit root on the original variables. A number without stars indicates non

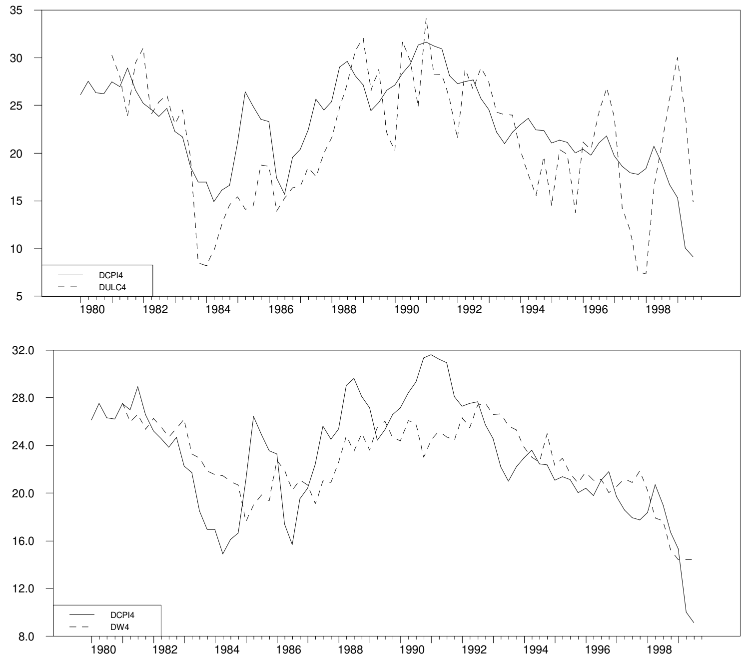

Figure 2: Wages and Prices

rejection of the null, a star indicates rejection at 5% and two stars indicates rejection at 1% or less. The results of this tests contradict each other. While Dickey - Fuller tests tend to indicate the existence of a unit root in all variables, the KPSS tests indicate that all variables are stationary[1]. In the spirit of Kiwatowski, Phillips, Schmidt and Shin (1992, page 165), this result help us conclude that the series are not very informative the existence of unit roots. The only exception to this result is that of DULC4, in which both tests (marginally the Dickey - Fuller) agree on the non stationarity and S in which both tests (marginally the KPSS) agree on non stationarity.

The results of the ADF test is particularly striking for the case of the unemployment and output gaps and the measure of supply shocks, which are expected to have no unit roots althoug they may be somewhat persistent.

Since agreement between these results are marginal at the signicance level 10%, we conclude that there is no strong evidence about whether or not there is a unit root in all our series.

[1]This is clearly a border case since the test statistic is 0.347 and the critical value 0.346 .

	LEVELS		DIFFERENCES	
Variable	ADF	KPSS	ADF	KPSS
CRIT (5%)	-2.890	0.347	-1.950	0.347
DW4	-0.451	1.480	-10.740^{**}	0.141
DCPI4	-0.911	0.283	-5.853^{**}	0.124
DULC4	-3.143^{*}	0.450	-6.117^{**}	0.047
UG	-0.789	0.318	-1.392	0.300
YP	-2.386	0.093	-2.494^{*}	0.092
S	-2.711	0.346^{*}	-4.824^{**}	0.054

Table 1: Unit Root Tests

4.2.1 Choosing Between two Evils.

Whether or not the series used in this analysis have a unit root is a matter of great practical importance, particularly for the CPI inflation, and the unemployment and output gaps. If these series have unit roots, for instance, our current estimates of the Phillips curve should likely be specified as cointegration models instead of standard regressions. However, if these series do not have unit roots conventional linear regression would do the job.

For the case of the two indicators of wages, DW4 and DULC4, and the CPI inflation, DCPI4, we could make a case for stationarity reasoning as follows:
Let Y_t be the any of the wages and prices variables in levels. Let $y_t = \log(Y_t)$, be its logarithm, and assume that the yearly growth of the series $D_4Y_t = (Y_t/Y_{t-4} - 1)$ differ from $\Delta^4 y_t = (y_t - y_{t-4})$ by a negligible amount. Let us further assume that $y_t \sim I(1)$, as has been shown extensively in the Colombian literature, that is $z_t = \Delta y_t \sim I(0)$.
Under this assumptions

$$\begin{aligned} (y_t - y_{t-4}) &= \Delta y_t + \Delta y_{t-1} + \Delta y_{t-2} + \Delta y_{t-3} \\ &= z_t + z_{t-1} + z_{t-2} + z_{t-3} \end{aligned} \quad (5)$$

is clearly a stationary variable. Which means that the yearly growth of Y_t, $z_t = D_4Y_t$ is a stationary variable.

In order for the yearly growth of the variables to have a unit root, it is required that the logarithm of Y_t has an additional seasonal root. For instance, if $y_t \sim I(1,4)$; which means that $\Delta\Delta^4 Y_t$ is a stationary variable but $z_t = \Delta y_t$ and $x_t = \Delta^4 y_t$ are nonstationary.

Variables	FPE	AIC	HQ	SW
DW4-DCPI4-UG	2	13	2	1
DULC4-DCPI4-UG	5	13	1	1
DW4-DCPI4-YG	6	13	2	1
DULC4-DCPI4-YG	6	6	6	1

Table 2: Estimated Lag Coefficients for Trivariate VARs

The existence of seasonal unit roots in our time series is unknown. The phenomenon of seasonal roots appears correspopnds to slowly evolving seasonal effects, the type of variations that can be identified only with a fair amount of sample information. Moreover, even if we had the required sample size and time span to perform the test for seasonal unit roots, its results are plaged with the same power difficulties of any unit root test, which leaves us with the same level of uncertainty we already have.

Since our only attempt is to find a good representation of the sample data at hand, and our sample span is short for identifying slowly evolving seasonal effects, we argue that a stationary representation fits more parsimoniously our data. However, since we are not sure about the non existence of a seasonal unit root, we will present the results for Granger causality under both assumptions.

4.2.1.1 **The Stationary Case.** Table 2 presents the estimated lag coefficients in trivariate VAR models of inflation, wages and the corresponding gap measure in which the supply shocks indicator is exogenous. As expected the Akaike Information Criteria, AIC, presents an overestimated number of lags, followed by the Final Prediction Error, FPE, and the more consistent Hannan - Quinn and Schwartz Bayesian criteria, which both present the smaller estimate.

Table 3 presents the results of the Granger causality tests for the same VAR models. The results are very clear. The null of no Granger causality form prices to both indicators of wages is rejected in all cases, but the null of non Granger causality from the indicators of wages to prices is not rejected. This results is robust to the choice of aggregate demand and wages indicators.

However, the significance levels of the Granger causality test in the direction of prices greatly differ depending on the wage indicator considered. In the case of nominal wages we can easily reject the null of no causality

Direction	VAR WITH	LAGS	F	® = p-value	Autocorrel Sign. level
DCPI4 ! DW4	UG	2	5:420	0:006	0:934
DW4 ! DCPI4	UG	2	2:284	0:087	0:307
DCPI4 ! DULC4	UG	5	3:909	0:004	0:848
DULC4 ! DCPI4	UG	5	1:045	0:407	0:450
DCPI4 ! DW4	YG	2	6:113	0:003	0:936
DW4 ! DCPI4	YG	2	2:222	0:094	0:298
DCPI4 ! DULC4	YG	6	2:972	0:015	0:687
DULC4 ! DCPI4	YG	6	1:203	0:319	0:375

Table 3: Granger Causality Tests

Variables	Normality	®	Autoc	DF	®
DW4-DCPI4-UG	5.258	0.261	25.552	24	0.318
DULC4-DCPI4-UG	4.711	0.318	10.780	12	0.547
DW4-DCPI4-YG	5.783	0.215	28.283	24	0.248
DULC4-DCPI4-YG	1.918	0.750	14.100	8	00791

Table 4: Multivariate Resudual Tests

at a 10% level as found in Misas and Oliveros(1991). The higher p-value in the case of the Unit Labor Cost assures that at any reasonable signi..cance level the null of non causality from wages to prices is not rejected as found in the most signi..cant studies on american data. Since nominal wages may be the result of changes in labor productivity, the ..rst variable may yield wrong conclussions on the prices and labor costs relationship. This problem is avoided by the use of unit labor cost in the analysis.

Table 4 contains the multivariate residual tests for each of the trivariate systems. From this table we conclude that residual normality and no autocorrelation are supported by the data, which validates our results.

4.2.1.2 The Non-Stationary Case. Using the same lag parameter estimates from Table 3 we conduct cointegration tests for each of the trivariate

ENDO VAR	EXOG VAR	WEAK EXOG VAR	α	NULL HIP	TRACE STAT	CRIT(10%)
DW4	S	UG	0.19	R=0	25.17	21.38
		DCPI4		R=1	7.27	10.35
DULC4	S	UG	0.33	R=0	20.44	21.58
		DCPI4		R=1	1.75	10.35
DW4	S	YG	0.59	R=0	34.59	31.88
		DCPI4		R=1	13.71	17.79
DULC4	S	DCPI4	0.25	R=0	47.36	31.88
YG				R=1	16.68	17.79

Table 5: Cointegration Tests

systems using Johansen's (1991) maximum likelihood methodology. Table 5 presents the results of the Johansen test for cointegration in the last three columns, and the result of the weak exogeneity tests on the fourth column. In general the results of the tests show cointegration, except for the VAR that includes DULC4, DCPI4, UG and S in which the null of no cointegration is not rejected[2].

From this table we can observe that regardless of the aggregate demand and wages indicators the inflation rate is weakly exogenous. This means that in the equation of the acceleration of prices the lagged cointegrating error does not appear, hence the relevant equations of the model become

$$\begin{aligned}
\Delta w_t &= \alpha_{0,1} + \alpha_1 Z_{t-1} + \sum_{i=1}^{p} \theta_{i,1} \Delta \pi_{t-i} + \sum_{i=1}^{p} \delta_{i,1} \Delta w_{t-i} + \text{lags of other variables} + \varepsilon_t^w \qquad (6)\\
\Delta \pi_t &= \alpha_{0,2} + \sum_{i=1}^{p} \theta_{i,2} \Delta \pi_{t-i} + \sum_{i=1}^{p} \delta_{i,2} \Delta w_{t-i} + \text{lags of other variables} + \varepsilon_t^\pi \\
Z_t &= \beta_0 + \beta_1 \pi_t + \beta_2 w_t + \beta_3 d_t + \beta_3 s_t
\end{aligned}$$

where w_t is the annual growth of the wages indicator, d_t is the aggregate demand variable, s_t is the supply shocks indicator, the β_i's are the cointegrating coefficients and Z_t is the cointegrating error.

[2]However, since the power of cointegration tests is low, the probability of falling into an error of type II could be high. Moreover, since the trace statistic is close to the critical value, we can assume that the cointegrating rank is 1.

DCPI4 WITH	RESIDUAL ANALYSIS NORMALITY		AUCTOC	
	T^*	α	Q	α
DW4-UG	7.444	0.28	11.259	0.26
DULC4-UG	3.950	0.68	10.452	0.32
DW4-YG	4.106	0.66	8.086	0.53
DULC4-YG	1.911	0.93	8.359	0.50

Table 6: Residual Analysis

The null of no Granger causality from π_t to w_t corresponds to $\alpha_1 = \theta_{i;1} = 0$ for all i, and the null of no cointegration from w_t to π_t corresponds to $\delta_{i;2} = 0$ for $i = 1;2;3;4$:.

Table 6 displays the results of the multivariate normality and non autocorrelation tests for the residuals of each of the VAR models, and the appendix A shows the results of the cointegrating space stability tests. From here we can conclude that the assumptions on the residuals are supported by the data, and that the long run relationship between wages and prices is stable. These validates our results of cointegration and weak exogeneity tests.

As shown by Mehra (1996), since our cointegrating coefficients estimators are consistent and asymptotically unbiased, we can readily estimate the error correction representation of the model by linear regression. Under the assumption of known cointegration coefficients the standard errors and tests are valid.

Table 7 contains the Wald Tests for the hypothesis of non causality in the short run parameters in equation6[3]. Since the lagged cointegrating error does not appearin the equation of the acceleration of prices, non rejection of the null implies no Granger causality. However, since the lagged cointegrating error appear in the equation of wages acceleration, non rejection of the null does not indicate non Granger causality. In this case causality could be transmitted through the lagged cointegration error.

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From this table we can conclude that there is no causality from unit

[3] $H_0 : \delta_i = 0 \;\; \forall i$ in the equation of prices in 6, and $H_0 : \theta_i = 0 \;\; \forall i$ in the equation of wages in 6.

Direction	VAR WITH	DF	T^*	α = p-value
DCPI4 → DW4	UG	1	1.234	0.266
DW4 → DCPI4	UG	1	3.518	0.060
DCPI4 → DULC4	UG	4	0.736	0.946
DULC4 → DCPI4	UG	4	0.897	0.924
DCPI4 → DW4	YG	1	0.837	0.360
DW4 → DCPI4	YG	1	3.492	0.061
DCPI4 → DULC4	YG	5	0.403	0.525
DULC4 → DCPI4	YG	5	1.243	0.264

Table 7: Granger Causality on Short Run Parameters

labor costs to prices either in the long or the short run. However, there seems to be Granger causality from wages to prices running through the short run adjustment paramenters. Moreover, we can observe that the short run coefficients in the equation of wages (eq. 6) do not seem different from zero. However, since prices are weakly exogenous, the lagged cointegrating error appears in the equation of wages implying Granger causality in the direction of wages. This finding also accords with some results for american data. Once more, by using wages as indicator of labor costs we could be getting misleading results on Granger causality tests.

5 Conclusions.

In this paper we studied the relationship between wages and prices for Colombia using quarterly data from 1980:1 to 1999:3. This study differs from previous studies in Colombia in two aspects; First, we use the unit labor cost as a measure of wages. And second, we avoid the omitted variables bias by introducing in the specification a measure of supply shocks and a measure of economic activity. That is, we base our analysis on equations derived from a Phillips curve as presented by Gordon(1982).

We show that there is no evidence to conclude on the existence of a unit root in the series used in our analysis. If we assume that the series are stationary, causality runs exclusively from prices to wages regardless of the indicator of wages or economic activity. If we assume that there are unit roots, we find a stable long run relationship between the variables analyzed, and prices become weakly exogenous. That is, the error correction term does not appear on the prices equation, which means that the causality from wages to prices should transmit through the short run coe¢ cients. By testing the null that these parameters are jointly zero we can not reject the null of non causality from wages to prices, but the evidence is weak when we use the nominal wage indicator.

On the other hand, although there is no evidence that the short term parameters of prices are di¤erent from zero in the equation of wages, the fact that the error correction term appears in this equation allows us to conclude that there is Granger causality running from wages to prices through the error correction term, no matter which indicator is used.

As we have pointed out, when using nominal wages the results seem to be less conclusive and could support some of the …ndgs obtained by previous work done on Colombian data. However, by introducing unit labor costs, the results show causality running from wages to prices and not the other way around, as it has been found for American data. Since unit labor costs takes into to account productivity adjusments, it is a more adequate variable to study the wages-pices relationship than nominal wages. Hence the results presented here are more reliable.

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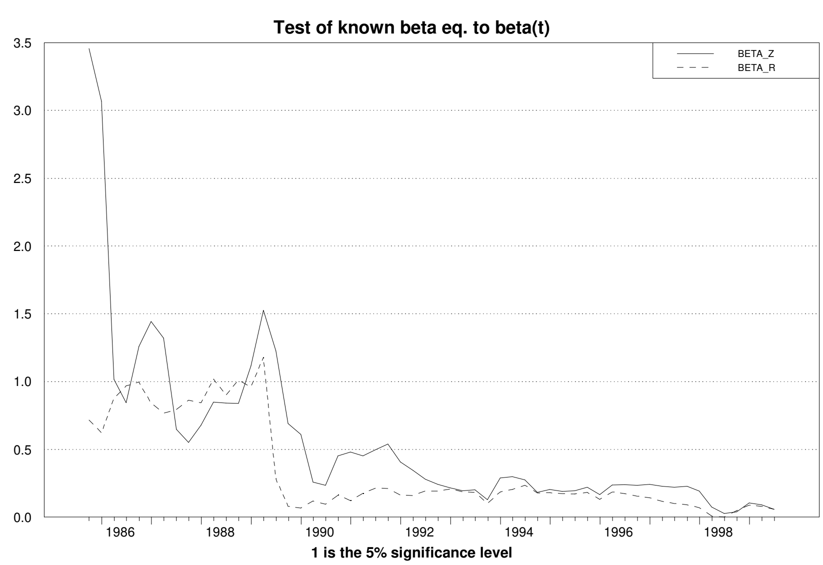
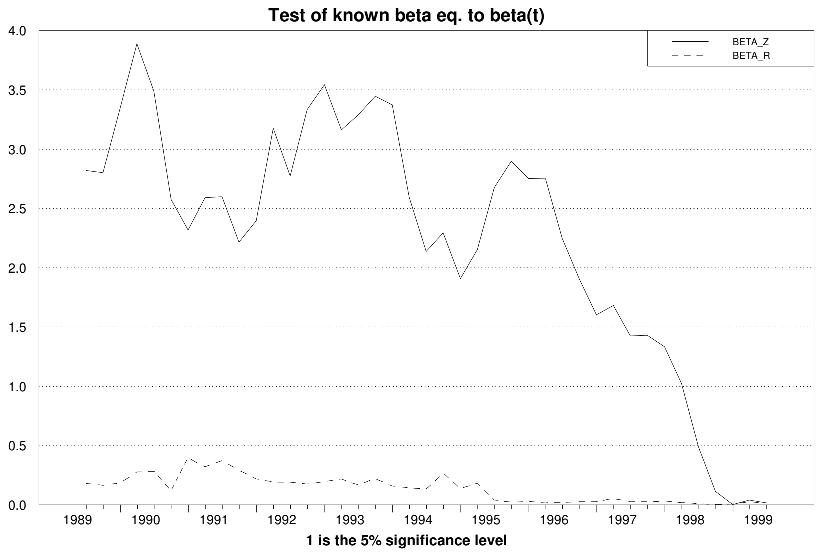
Apendix A: Figures of Cointegration Space Stability Tests.

Figures A1 to A4 show the results of the cointegrating space stability test. Each graph contains two lines, both for the same hypothesis of stability. The dashed line is the tests statistic for the R representation from Johansen (1991) and correspond to the test statistic when the short run parameters are kept constant along the sample. The continuous line corresponds to the Z representation in which the constancy of the short run parameters is dropped. The horizontal line at height one corresponds to the 5% critical value for stability. The ..rst quarter of each ..gure is not worth analyzing since the sample size is small.

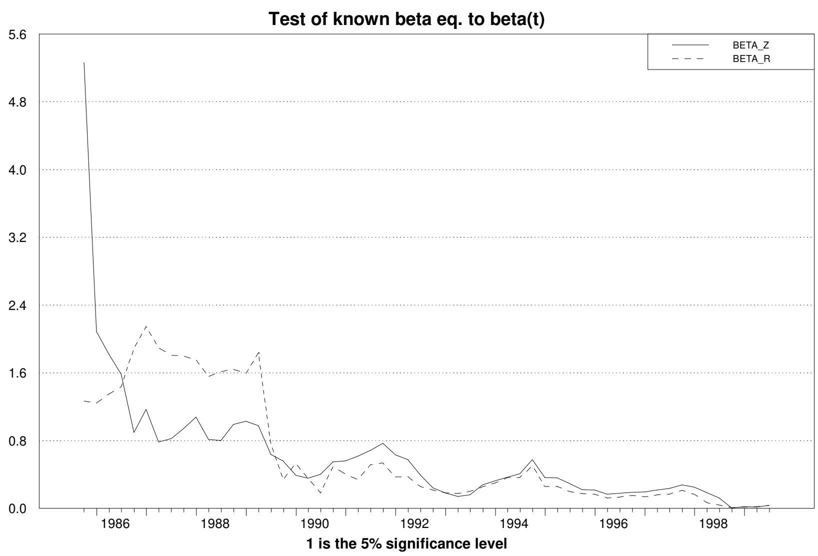
From this ..gures we can observe that the dashed line lies consistently below the critical value, which indicates stability of the cointegrating space. The continuous line is almost always below the critical value for three of the VAR models, but for the VAR that includes DULC4 and UG it lies well above the critical value. The contradicting result for this later model implies that some of the estimated short run parameters are highly correlated with some long run ones and that the system as a whole is not stable. However, we can not conclude that the long run relationship is not stable. All we can say on this respect is that the sample data is not informative on the long run relationship stability except if we strongly believe that the short run parameters are stable. In such a case we could conclude that the long run relationship is stable as indicated by the dashed line.



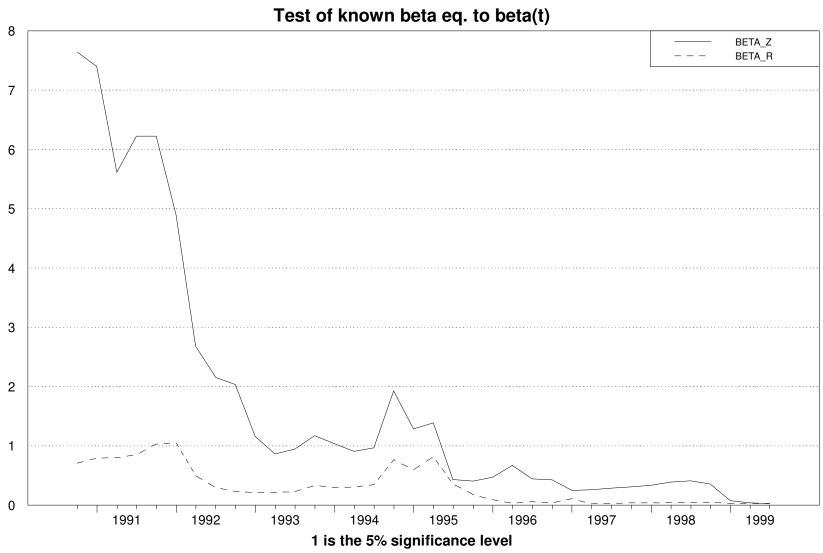
Coint. Space Stability Tests for DW4, CPI and UG.



Coint. Space Stability Tests for DULC4, CPI and UG.



Coint. Space Stability Tests for DW4, CPI and YG.



Coint. Space Stability Tests for DULC4, CPI and YG.