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El grado de transmisión de la tasa de cambio a los precios internos: el caso de Colombia

Peter Rowland*

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Resumen

Este artículo utiliza un contexto econométrico basado en un modelo de vectores autorregresivos no restringidos (VAR), para estudiar el grado de transmisión de la tasa de cambio a los precios de las importaciones, del productor y del consumidor en Colombia. El grado de transmisiones parece ser incompleto. Los precios de las importaciones, sin embargo, responden rápidamente a una variación en la tasa de cambio, donde cerca del 80% de dicha variación se traspasa a los precios de las importaciones en 12 meses. La cifra correspondiente a los precios del productor es del 28%, y la de los precios al consumidor es del 8%. Por lo tanto, podemos concluir que el grado de transmisión de la tasa de cambio a los precios del productor es moderado, y a los precios del consumidor es bastante limitado. De esta forma, un choque a la tasa de cambio solo tiene un impacto limitado sobre la inflación del consumidor.

Clasificación JEL: E31, F31.

Palabras clave: *grado de transmisión de la tasa de cambio, índices de precios, funciones impulso-respuesta.*

Exchange Rate Pass-Through to Domestic Prices: the Case of Colombia

Peter Rowland *

This study uses an econometric framework based on an unrestricted vector autoregressive (VAR) model to study exchange rate pass-through to import, producer and consumer prices in Colombia. Exchange rate pass-through is shown to be incomplete. Import prices, nevertheless, respond quickly to an exchange rate change, where some 80 percent of such a change is passed onto prices of imports within 12 months. The corresponding figure for producer prices is 28 percent and for consumer prices 8 percent. We can, consequently, conclude that pass-through is modest for producer prices and very limited for consumer prices. An exchange rate shock does, therefore, only have limited impact on consumer price inflation.

The opinions expressed here are those of the author and not necessarily of the Banco de la República, the Colombian Central Bank, nor of its Board of Directors. I express my thanks to Luis Eduardo Arango, Javier Gómez, Luis Fernando Melo, Hernán Rincón and Hernando Vargas for helpful comments and suggestions. Any remaining errors are my own.

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I. INTRODUCTION

The relatively large depreciation of the Colombian peso to the US dollar during 2002 has posed a challenge for Colombian monetary policy. From end-2001 to end-2002 the USD/COP rate of exchange depreciated by some 20.0 percent,¹ while consumer prices during the same period increased by 7.0 percent and producer prices by 9.3 percent. If not countered by the right monetary policies, such a rate of depreciation could easily transform into higher inflation.

Many monetary models of the exchange rate as well as of the balance of payments assume purchasing power parity and, thus, a one-to-one relationship between exchange rate changes and changes in domestic prices. Studies on exchange rate pass-through have almost unanimously rejected this assumption, particularly in the short run. If significant lags exist in the transmission of exchange rate changes to domestic prices, exchange-rate depreciation would only have limited impact on the rate of domestic inflation. A low degree of exchange rate pass-through would, furthermore make it possible for trade flows to remain relatively insensitive to changes in the exchange rate, despite demand being highly elastic. If prices respond sluggishly to changes in the exchange rate, and if trade flows respond slowly to the relative price change, then the overall balance-of-payments adjustment process could be severely held back.

The degree of exchange rate pass-through, consequently, have important implications for the design of monetary policy to counteract the inflationary as well as trade implications of an exchange rate shock. However, up to now the impact and dynamics of exchange rate changes on domestic prices in Colombia has not been fully quantified. Rincón (2000) is the only previous study on Colombian exchange rate pass-through. It reveals some important results regarding the long-term impact of an exchange rate change onto domestic prices, as well as some general short-term results. However, little is known about the dynamics of exchange rate pass-through in Colombia and its short-term properties.

¹ This could be compared with a depreciation of 2.7 percent for the previous 12 month period, i.e. from end-2000 to end-2001.

This study aims to fill that gap. We will use an econometric framework based on an unrestricted vector autoregressive (VAR) model. Impulse-response functions are used to analyse the dynamics of the exchange rate pass-through. We will use 20 years of monthly data from January 1983 up until October 2002. We will, furthermore, use the nominal USD/COP rate² of exchange to study its effect on the different stages of the distribution chain, i.e. on import, producer and consumer prices.

Exchange rate pass-through in Colombia is shown to be incomplete, which is in line with most other studies. Import prices respond relatively quickly to an exchange rate change. After three months, 47 percent of a change in the exchange rate has been passed onto import prices, and after 12 months, the pass-through is as much as 80 percent. Producer prices respond much more sluggishly, with only around 7 percent pass-through after three months. However, after one year the exchange rate pass-through to producer prices reaches 28 percent. The response of consumer prices to exchange rate changes is relatively limited. The short-term response (after three months) of the consumer price index to an exchange rate change is very limited at just above 1 percent, while the pass-through to consumer prices reaches 8 percent after 12 months.

The paper is organised as follows: Exchange rate pass-through is defined and the theoretical concept discussed in section II. This section also includes a review of the relevant empirical literature. Section III continues by introducing the data set. In section IV the analysis and the results of the study are presented, and section V concludes the paper.

II. EXCHANGE RATE PASS-THROUGH

Empirical studies have shown that domestic prices do not respond one-for-one to an exchange rate change, particularly not in the short run. The degree of exchange rate pass-through to domestic prices, then, becomes a very important variable when designing monetary policies. The concept of exchange rate pass-through is defined in section II. A., and section II. B continues by reviewing the empirical literature on the subject.

² The USD/COP rate of exchange is in fact the exchange rate expressed as Colombian pesos per US dollar, in accordance with classical exchange rate terminology. We will stick to this terminology throughout this paper, even if it is all but logical.

A. DEFINITION

“The textbook definition of exchange rate pass-through is the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries”.³ Changes in import prices are, nevertheless, to some extent passed on to producer and consumer prices. We are, therefore, in this paper using a broader definition of exchange rate pass-through, which is seen as the change in domestic prices that can be attributed to a prior change in the nominal exchange rate.⁴

Balance-of-payments models normally assume a one-for-one response of import prices to exchange rates, which is known as *complete* exchange rate pass-through. For this to be the case, two conditions need to be fulfilled. First, mark-ups of price over cost have to be constant, and second, marginal costs have to be constant. If these conditions are fulfilled, the response of the trade balance to exchange rate changes is driven by the elasticity of demand for imports in the respective countries.⁵

Exchange rate pass-through is, however, in reality far from complete. According to Goldberg and Knetter (1997), only around 60 percent of exchange rate changes are passed on to import prices in the United States,⁶ even if this figure varies significantly across industries. The main explanation for this phenomenon is that many importing and exporting firms choose to hold their prices constant and simply reduce or increase the mark-up on prices, when the exchange rate is changing. Such behaviour is referred to as *pricing-to-market*.⁷ Many firms might, consequently, choose to make temporary losses on their revenue not to loose market share to competition. Empirical studies have found the extent of pricing-to-market to be positively correlated with market concentration. Pricing-to-market, thus, tend to be more present within competitive industries.⁸

³ Goldberg and Knetter (1997), p. 1248.

⁴ See Kahn (1987), Menon (1995), and Goldberg and Knetter (1997) for an extensive discussion on exchange rate pass-through.

⁵ Textbook models normally assume perfectly competitive industries and mark-ups of price over cost to be constant at zero. See Goldberg and Knetter (1997), p. 1248.

⁶ Pass-through estimates of many studies seem to be centered around this figure. See Goldberg and Knetter (1997), p. 1250.

⁷ See Krugman (1987), and Dornbusch (1987).

⁸ See Goldberg and Knetter (1997), p. 1252 ff.

B. REVIEW OF THE LITERATURE

A literature search on exchange rate pass-through quickly reveals that the majority of the studies made in the area are industry or product specific studies.⁹ These studies analyse the pass-through to import prices of different products or industries on the micro level rather than focusing on the effects of aggregate price measures. The study undertaken in this paper does, however, look at the economy at the macro level, and we will, therefore, concentrate this literature survey mainly on such aggregate studies.

Menon (1995) is probably the most comprehensive survey of the literature on exchange rate pass-through up to date. He presents an overview of 43 empirical studies on industrialised economies, of which the most often studied is the United States. The majority of these studies conclude that exchange rate pass-through is incomplete, indeed. The degree of pass-through does, however, vary significantly across different countries. The main factors that influence the degree of pass-through across countries is the size and the openness of the individual economies.

Menon (1995), furthermore, reports that pass-through relationships have remained largely stable over time.¹⁰ Different results for a country stem primarily from the use of different methodologies, model specifications and variable selections rather than from different time periods studied. In particular there is an aggregation problem, whereby the choice of price aggregate has a potentially large impact on the result.¹¹ Some studies have also found pass-through to be asymmetric, which implies that the rate of pass-through is different during exchange rate appreciations and depreciations.¹²

⁹ Examples of recent such studies include Bernhofen and Xu (2000), Kardasz and Stollery (2001), Olivei (2002), and Takagi and Yoshida (2001).

¹⁰ See also Parsley (1993). Some studies have, nevertheless, challenged this result. See, for example, Taylor (2000), and Gagnon and Ihrig (2001).

¹¹ Not only is there a large difference between the results using, for example, a producer price index and a consumer price index, which is shown in this study, but different definitions of, for example, a consumer price index might yield different results. This implies that caution needs to be applied when comparing the results of different studies from different countries.

¹² Such studies include Mann (1986), Kreinin, Martin and Sheehey (1987), and Marston (1990). However, some other studies have found no evidence for such an asymmetry, including Lawrence (1990) and Athukorala (1991).

All but one of the studies reviewed by Menon (1995) use models based on an OLS estimation technique. These do not properly account for the time-series properties of the data, particularly the non-stationarity. Kim (1991) is the only study to apply a vector autoregressive (VAR) framework. The majority of the more recent studies use VAR frameworks to investigate exchange rate pass-through.

McCarthy (2000) presents a comprehensive study of exchange rate pass-through on the aggregate level for a number of industrialised countries. He estimates a VAR model using import, producer and consumer-price data from 1976 up until 1998. In most of the countries analysed, the exchange rate pass-through to consumer prices is found to be modest. The rate of pass-through is, furthermore, shown to be positively correlated with the openness of the country and with the persistence of the exchange rate change, and negatively correlated with the volatility of the exchange rate.

Kim (1998) investigates exchange rate pass-through in the United States using a framework of multivariate cointegration. This study relates changes in producer prices to changes in the trade weighted nominal effective exchange rate, money supply, aggregate income and interest rates. The exchange rate is found to contribute significantly to producer prices.

Goldfajn and Werlang (2000) present a study of 71 countries, where exchange rate pass-through onto consumer prices is investigated using panel estimation methods on data from 1980 up until 1998. Both developed and emerging market economies are included. They report that the pass-through effects on consumer prices increase over time and reach a maximum after 12 months. The degree of pass-through is, furthermore, found to be substantially higher in emerging market economies than in developed economies.

Rincón (2000) is the only aggregate study made on exchange rate pass-through in Colombia. This study uses the Johansen framework to estimate the pass-through effect. It uses monthly data for the period 1980 to 1998. Exchange rate pass-through is found to be incomplete. The estimated long-term elasticities of import and export prices to a change in the exchange rate are 0.84 and 0.61, respectively. The direct long-term effect of the exchange rate on the consumer prices is found to be 0.48.

Feinberg (2000) studies exchange rate pass-through in Colombia, Korea and Morocco using industry-level data and an OLS regression technique. The sample

for Colombia consists of pooled annual data for 25 industries over eight years, 1980 to 1987. The study reports a long-term effect of the real effective exchange rate on pooled wage adjusted producer prices to be 0.51. The exchange rate pass-through is, thus, found to be incomplete. However, the price and exchange rate indices used make it difficult to compare the results with other studies.¹³ The time period studied is, furthermore, too short to draw any definite conclusions of the long-term relationship.

We will in this paper use an unrestricted VAR framework, in line with McCarthy (2000). This has the advantage of being simple by only including the exchange rate and the price indices.

III. DATA

This section presents the data used in the econometric analysis. The data set is defined in section III. A. Section III. B. discusses the different exchange rate regimes in place in Colombia. This is relevant when determining the causality between the exchange rate and the domestic prices.

A. THE DATA SET

For the empirical analysis we use 20 years of monthly data from January 1983 until October 2002. We use the USD/COP rate of exchange to represent the exchange rate.¹⁴ We, furthermore, include all stages of the distribution chain, i.e.

¹³ The study uses the real effective exchange rate, real gross domestic product, and industry specific producer price indices that have been deflated by an economy-wide wage index. The results of the study are, therefore, not directly comparable to the results of most other studies that use the nominal exchange rate together with the (nominal) producer price index.

¹⁴ A trade-weighted nominal effective exchange rate index was initially used in the analysis. However, the estimation residuals never passed the test for normality. The time series for the USD/COP exchange rate did not experience these problems, and was, therefore, used instead. United States is by far Colombia's largest trading partner (with some 49.1 percent of exports and 35.9 percent of imports in 1999) followed by Venezuela at a distant second place (8.0 percent of exports and 8.1 percent of imports). A large majority of exports and imports are, furthermore, priced in US dollars, so the USD/COP exchange rate may, in fact, be more appropriate than a trade weighted nominal effective exchange rate index. The measurement of the exchange rate can have a large impact on the result of pass-through studies, which has attracted some attention in the literature. See, for example, Athukorala and Menon (1994), Citrin (1989), Feinberg (1991), and Woo (1984).

import prices, producer prices and consumer prices. All the prices are in the form of price indices.¹⁵ The data source is Banco de la República for all the data. All the data, apart from the exchange rate data, is, furthermore, seasonally adjusted, and all the time series are in logarithmic form.

B. THE DIFFERENT EXCHANGE RATE REGIMES IN COLOMBIA

From 1967 and up until 1991, the exchange rate regime in Colombia was defined by a crawling peg. The Colombian peso was pegged to the U.S. dollar at a pre-specified exchange rate and was not allowed to depart significantly from this rate. This exchange rate was, furthermore, devalued daily at a pre-determined and continuous devaluation rate. The exchange rate regime was combined with a system of thorough capital controls, where all foreign exchange transactions had to be made through the Banco de la República.¹⁶

The crawling peg regime was abolished in June 1991, following a sharp fall in international coffee prices and a deterioration in the trade balance. A market for foreign exchange was created, where the exchange rate was freely determined.¹⁷ However, the Banco de la República continued to intervene in the market, and in practice the new exchange rate regime was a managed floating regime with many similarities to a crawling exchange rate band.

In January 1994, the central bank introduced an official crawling band regime. This was to regain control over monetary variables, after a period of very low real interest rates in combination with very large capital inflows. The exchange rate was allowed to fluctuate around a pre-determined central rate, which initially was to be continuously devalued at an annual rate of 11

¹⁵ The choice of price indices can, however, have a large impact on the results. The bias introduced into estimates of pass-through as a result of measurement errors contained in price proxies is highlighted by Alterman (1991), who compares the relatively different results obtained using an import price index versus import unit values.

¹⁶ For a thorough discussion on the Colombian exchange rate regimes, see Villar and Rincón (2000), as well as Cárdenas (1997). The discussion here draws heavily from Villar and Rincón (2000), as well as from Rowland (2003).

¹⁷ The market traded Exchange Rate Certificates (Certificados de Cambio) which were US dollar denominated interest bearing papers issued by the Banco de la República. See Villar and Rincón (2000), pp. 27ff.

percent. The actual exchange rate could depart with as much as 7 percent from the central rate. In many ways, the regime resembled a managed float, since the limits of the band were shifted several times, and since the band was relatively wide.¹⁸

In September 1999, the exchange rate band was dismantled, and the exchange rate was allowed to float freely. This followed a period of economic difficulties. Colombia was in a recession, the government was running a large fiscal deficit, and the credibility of the currency band system had rapidly been deteriorating. The floating regime, which has been in place since then, is close to a free float. The central bank can only intervene to reduce short-term exchange rate volatility, and has not done so until 2002.¹⁹

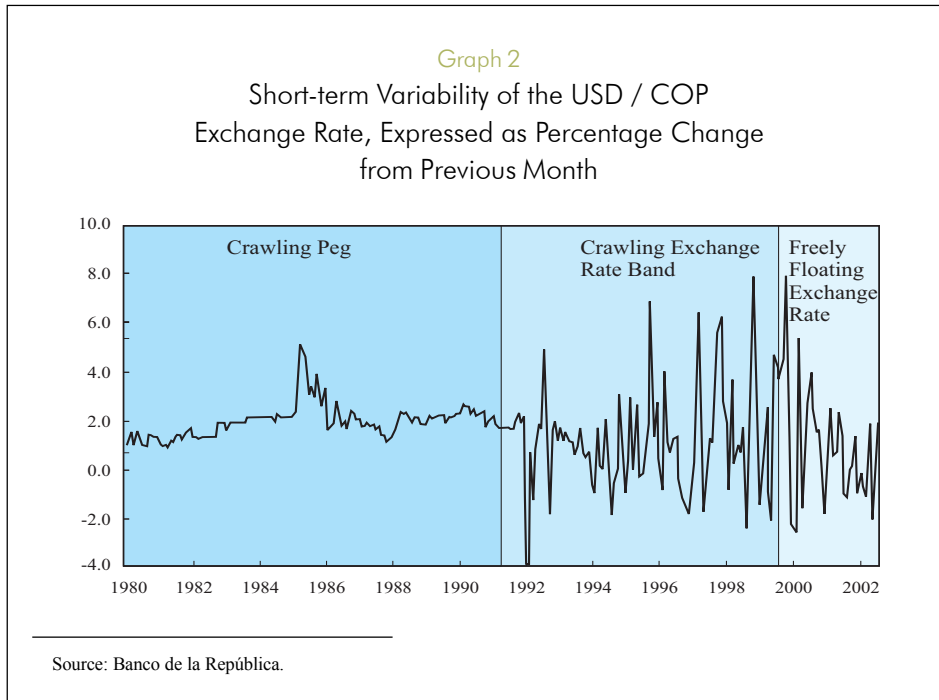
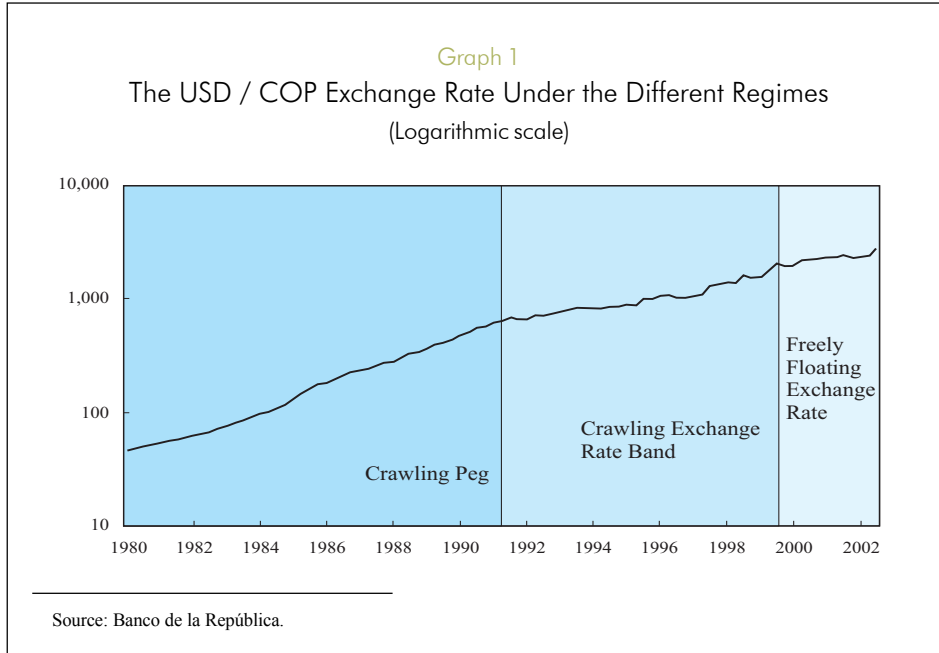
Graph 1 shows the exchange rate development since 1970, and Graph 2 shows the exchange rate variability. It is apparent from Graph 1 that the exchange rate left its path of a long-term stable depreciation rate in 1991, when the crawling peg was abandoned. As expected, the short-term variability of the exchange rate also increased significantly, as shown by Figure 3.2. However, there was no significant change in exchange rate variability between the crawling band regime and the floating regime, which was introduced in 1999. If we calculate the average absolute weekly change for the periods January 1994 to September 1999 and October 1999 to August 2002 we receive values of 0.72 percent and 0.68 percent, respectively.

We can, consequently, conclude that the time series data we are studying includes at least one significant structural break, generated by the abolishment of the crawling-band regime in June 1991. In the case of a pegged exchange rate, the causality between the nominal exchange rate and the price level should run from the former to the latter, while in the case of a freely floating exchange rate, the causality should run in the opposite direction.²⁰ A change in the exchange rate regime might thus influence the exchange rate pass-through in the economy. However, the time series for the floating rate period in Colombia are not long enough to investigate this.

¹⁸ Villar and Rincón (2000), p. 30.

¹⁹ The central bank can only intervene if the average exchange rate of a given day deviates more than 4 percent from its 20-day moving average.

²⁰ Empirical studies have, nevertheless, shown that this is not always the case. See Rincón (2000) for a discussion.



The assumption that causality runs from prices into the exchange rate under a floating exchange rate regime can, nevertheless, be discussed. A floating exchange rate is, in many cases, determined by other variables rather than by the relative price levels.²¹ This is particularly relevant for emerging market economies, where contagion and reoccurring crises have played a major part during recent years. This has generated exchange rate shocks, which have in various degrees been passed onto the domestic price levels.

We will in this paper study the pass-through for the whole 20-year period from 1983 up until 2002.

IV. IMPULSE-RESPONSE FUNCTIONS WITHIN A VAR FRAMEWORK

To investigate the pass-through of exchange rate fluctuations to domestic prices, we will use an unrestricted vector autoregressive (VAR) model, which is in line with McCarthy (2000). The VAR model is introduced in section IV. A. Section IV. B. continues with the estimation of the VAR, and in section IV. C., the impulse-response functions are studied.

A. THE VAR FRAMEWORK

We will in this section estimate an unrestricted VAR model, and study the impulse response functions generated from this model. The unrestricted VAR is defined by the following four equations:

$$(1) \quad \Delta s_t = \sum_{i=1}^k \gamma_{11}^i \Delta s_{t-i} + \sum_{i=1}^k \gamma_{12}^i \Delta imp_{t-i} + \sum_{i=1}^k \gamma_{13}^i \Delta ppi_{t-i} + \sum_{i=1}^k \gamma_{14}^i \Delta cpi_{t-i} + \varepsilon_{1t}$$

$$(2) \quad \Delta imp_t = \sum_{i=1}^k \gamma_{21}^i \Delta s_{t-i} + \sum_{i=1}^k \gamma_{22}^i \Delta imp_{t-i} + \sum_{i=1}^k \gamma_{23}^i \Delta ppi_{t-i} + \sum_{i=1}^k \gamma_{24}^i \Delta cpi_{t-i} + \varepsilon_{2t}$$

²¹ A classical example are the large and persistent deviations of the USD/DEM exchange rate during the 1980s and 1990s. See, for example, Isard (1995) for a discussion.

$$(3) \quad \Delta ppi_t = \sum_{i=1}^k \gamma_{31}^i \Delta s_{t-i} + \sum_{i=1}^k \gamma_{32}^i \Delta imp_{t-i} + \sum_{i=1}^k \gamma_{33}^i \Delta ppi_{t-i} + \sum_{i=1}^k \gamma_{34}^i \Delta cpi_{t-i} + \varepsilon_{3t}$$

$$(4) \quad \Delta cpi_t = \sum_{i=1}^k \gamma_{41}^i \Delta s_{t-i} + \sum_{i=1}^k \gamma_{42}^i \Delta imp_{t-i} + \sum_{i=1}^k \gamma_{43}^i \Delta ppi_{t-i} + \sum_{i=1}^k \gamma_{44}^i \Delta cpi_{t-i} + \varepsilon_{4t} \quad (4.4)$$

where γ_{nm}^i are parameters to be estimated, k is the maximum distributed lag length, Δ is the difference operator and ε_{nt} are independent and identically distributed error terms. The time series data used for the estimations consists of the exchange rate, s , the import price index (imp), the producer price index (ppi), and the consumer price index (cpi).

B. ESTIMATION OF THE VAR

The unrestricted VAR model defined by equation (1) to (4) is estimated using monthly data from January 1983 to October 2002. The maximum lag length, k , is chosen to be long enough for the error terms to be normally distributed and not serially correlated. As shown by Table 1, the residual tests for the model are all passed for a maximum lag length of 12.

C. THE IMPULSE-RESPONSE FUNCTIONS

In order to determine impulse-response functions, the variables need to be given a plausible ordering. We use the following ordering for the impulse-response analysis:

$$s \rightarrow imp \rightarrow ppi \rightarrow cpi$$

The exchange rate s is assumed to be exogenous. Table 2 displays the responses of domestic prices to a one-percent shock in the USD/COP exchange after 3, 6, 12 and 24 months. Graph 3 shows the impulse-responses.

It is apparent that import prices respond rapidly to an exchange rate shock. After three months, 47 percent of an exchange rate change has been passed onto import prices, and after 12 months, 80 percent has been passed on. Producer prices

Table 1
Residual Tests of the Unrestricted VAR Model
(Using Monthly Data from January 1983 to October 2002,
and a Maximum Lag Length $k = 12$)

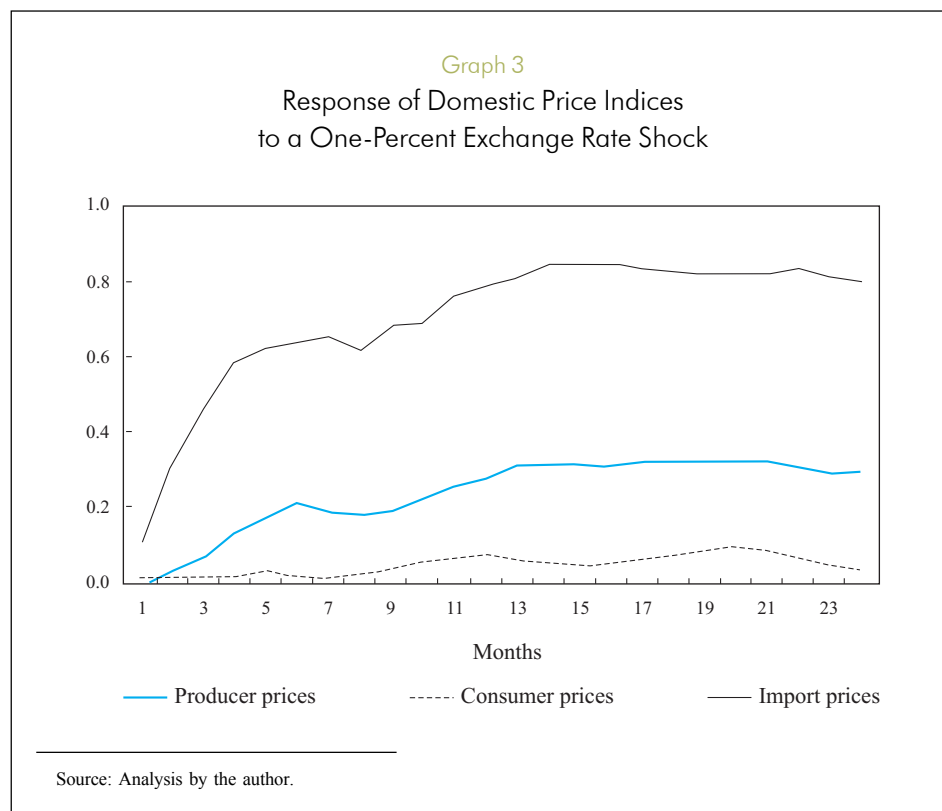
Test	Test Statistic	P-value
Multivariate Normality		
Lütkepohl test	$\chi^2(8) = 6.34$	0.609
Autocorrelation		
Portmanteau test	Port(60) = 770.4	0.468
LM test	LM(60) = 20.46	0.434
Unit Roots		
ADF test residual ε_1	ADF(0) = -14.47	
ADF test residual ε_2	ADF(0) = -15.86	
ADF test residual ε_3	ADF(0) = -14.73	
ADF test residual ε_4	ADF(0) = -14.64	

Source: Calculations by the author.

Table 2
Effects of Domestic Price Indices to a One-percent
Exchange Rate Shock

	After			
	3 months	6 months	12 months	24 months
Import prices	0.47	0.64	0.80	0.80
Producer prices	0.07	0.21	0.28	0.29
Consumer prices	0.01	0.02	0.08	0.03

Source: Calculations by the author.



respond considerably less. After 12 months only 28 percent of an exchange rate change has been passed onto producer prices. The response of consumer prices is only marginal. Less than ten percent of an exchange rate shock is passed onto consumer prices in the long run. In the short run, consumer prices hardly respond to exchange rate changes at all.

V. CONCLUSION

This study has analysed the exchange rate pass-through to domestic prices in Colombia. The degree of exchange rate pass-through is a very important variable when designing monetary policies, particularly in response to an exchange rate shock, like the large real depreciation of the USD/COP exchange rate during 2002.

The study used a framework based on an unrestricted VAR model. Impulse-response functions were used to study the dynamics of exchange rate pass-through.

In line with most empirical studies of exchange rate pass-through, this study concludes that pass-through in Colombia is incomplete. Import prices respond swiftly to an exchange rate change, with pass-through coefficients of 0.48 after three months and 0.80 after one year. Producer prices respond more sluggishly, with a pass-through coefficient of 0.28 after one year. For consumer prices, pass through is only limited, with a pass-through coefficient of 0.08 after one year.

A further point that should be made is that the confidence intervals for the estimates have not been estimated. These are potentially large, and the results should, therefore, be treated as approximations.

We can, consequently, conclude that even if import prices respond rapidly to an exchange rate change, with as much as 80 percent of the change in the exchange rate being passed on within a year, producer and consumer prices respond much more sluggishly. Exchange rate pass-through to producer prices is modest while the pass-through to consumer prices is very limited. The influence from an exchange-rate shock on consumer price inflation is, therefore, rather limited, with less than ten percent of an exchange rate change being passed onto consumer prices one year after the shock. This result is important for monetary policy makers when designing the right policy response to an exchange rate shock.

REFERENCES

- Alterman, W (1991). "Price Trends in US Trade: New Data, New Insights", in P. Hooper, and J. D. Richardson, eds., *International Economic Transactions: Issues in Measurement and Empirical Research*, University of Chicago Press, Chicago, pp. 109-139.
- Athukorala, Premachandra (1991). "Exchange Rate Pass-Through: The Case of Korean Exports of Manufactures", in *Economic Letters*, Vol. 35, No. 1, January, pp. 79-84.
- _____; Menon, Jayant (1994). "Pricing to Market Behaviour and Exchange Rate Pass-Through in Japanese Exports", in *Economic Journal*, Vol. 104, No. 423, March, pp. 271-281.
- Bernhofen, Daniel M.; Peng, Xu (2000). "Exchange Rates and Market Power: Evidence from the Petrochemical Industry", in *Journal of International Economics*, Vol. 52, No. 2, December, pp. 283-297.
- Cárdenas, Mauricio (1997). *La tasa de cambio en Colombia*, Fedesarrollo, Bogotá
- Citrin, Daniel (1989). "The Recent Behaviour of US Trade Prices", in *IMF Staff Papers*, Vol. 36, No. 4, December, pp. 934-949.
- Dornbusch, Rudiger (1987). "Exchange Rates and Prices", in *American Economic Review*, Vol. 77, No. 1, March, pp. 93-106.
- Feinberg, Robert M. (1991). "The Choice of Exchange Rate Index and Domestic Price Passthrough", in *Journal of Industrial Economics*, Vol. 39, No. 4, June, pp. 409-420.
- _____. (2000). "The Role of International Discipline in Three Developing Economies: Exchange Rate Effects on Domestic Prices in Colombia, Korea and Morocco", in *Review of International Economics*, Vol. 8, No. 1, pp. 126-133.
- Gagnon, Joseph E.; Ihrig, Jane (2001). "Monetary Policy and Exchange Rate Pass-Through", in Board of Governors of the Federal Reserve System, International Finance, Discussion Paper No. 704, Washington D. C.

- Goldberg, Pinelopi K.; Knetter, Michael M. (1997). "Goods Prices and Exchange Rates: What Have We Learned?", in *Journal of Economic Literature*, Vol. 35, No. 3, September, pp. 1243-1272.
- Goldfajn, Ilan; Ribeiro da Costa Werlang, Sérgio (2000). "The Pass-Through from Depreciation to Inflation: A Panel Study", in *Banco Central do Brasil*, Working Paper No. 5, Brasilia.
- Isard, Peter (1995). *Exchange Rate Economics*, Cambridge University Press, Cambridge.
- Kahn, George A. (1987). "Dollar Depreciation and Inflation", in *Federal Reserve Bank of Kansas City Economic Review*, Vol. 72, No. 9, November, pp. 32-49.
- Kardasz, Stanley W.; Stollery, Kenneth R. (2001). "Exchange Rate Pass-Through and Its Determinants in Canadian Manufacturing Industries", in *The Canadian Journal of Economics*, Vol. 34, No. 3, August, pp. 719-738.
- Kim, Yoonbai (1991). "External Adjustments and Exchange Rate Flexibility: Some Evidence from U.S. Data", in *The Review of Economics and Statistics*, Vol. 73, No. 1, February, pp. 176-81.
- Kim, Ki-Ho (1998). "US Inflation and the Dollar Exchange Rate: A Vector Error Correction Model", in *Applied Economics*, Vol. 30, No. 5, May, pp. 613-619.
- Kreinin, Mordechai; Martin, Stephen; Sheehey, Edmund J. (1987). "Differential Responses to U.S. Import Prices and Quantities to Exchange Rate Adjustments", in *Weltwirtschaftliches Archiv*, Vol. 123, No. 3, pp. 449-462.
- Krugman, Paul (1987). "Pricing to Market when the Exchange Rate Changes", in Sven W. Arndt, and J. David Richardson, *Real-financial linkages among open economics*, MIT Press, Cambridge, Massachusetts, pp. 49-70.
- Lawrence, Robert Z. (1990). "U. S. Current Account Adjustment: An Appraisal", in *Brookings Papers on Economic Activity*, No. 2, pp. 343-383.
- Mann, Catherine L. (1986). "Prices, Profit Margins and Exchange Rates", in *Federal Reserve Bulletin*, Vol. 72, No. 6, June, pp. 366-379.

- Marston, Richard C. (1990). "Pricing to Market in Japanese Manufacturing", in *Journal of International Economics*, Vol. 29, No. 3-4, November, pp. 217-236.
- McCarthy, Jonathan (2000). "Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies", in *Bank for International Settlements*, Working Paper, No. 79, Basel.
- Menon, Jayant (1995). "Exchange Rate Pass-Through", in *Journal of Economic Surveys*, Vol. 9, No. 2, June, pp. 197-231.
- Olivei, Giovanni P. (2002). "Exchange Rates and the Prices of Manufacturing Products Imported into the United States", in *New England Economic Review*, First Quarter, pp. 3-18.
- Parsley, David (1993). "Exchange Rate Pass-Through: Evidence from Aggregate Japanese Exports", in *Southern Economic Journal*, Vol. 60, No. 2, October, pp. 454-462.
- Rincón C., Hernán (2000). "Devaluación y precios agregados en Colombia, 1980-1998", in *Desarrollo y Sociedad*, Vol. 46, CEDE, Universidad de los Andes, Bogotá.
- Rowland, Peter (2003). "Uncovered Interest Parity and the USD/COP Exchange Rate", in Borradores de Economía, *Banco de la República*, No. 227, Bogotá.
- Takagi, Shinji; Yoshida, Yushi (2001). "Exchange Rate Movements and Tradable Goods Prices in East Asia: An Analysis Based on Japanese Customs Data, 1988-1999", in *IMF Staff Papers*, Vol. 48, No. 2, pp. 266-289.
- Taylor, John B. (2000). "Low Inflation, Pass-Through, and the Pricing Power of Firms", in *European Economic Review*, Vol. 44, No. 7, June, pp. 1389-1404.
- Villar, Leonardo; Rincón, Hernán (2000). "The Colombian Economy in the Nineties: Capital Flows and Foreign Exchange Regimes", in Borradores de Economía, *Banco de la República*, No. 149, Bogotá.

Woo, Wing T. (1984). "Exchange Rate Changes and the Prices of Non-Food, Non-Fuel Items", in *Brookings Papers on Economic Activity*, No. 2, pp. 511-530.