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**EXCHANGE RATE PASS-THROUGH INTO IMPORT
PRICES: THE CASE OF CHILE**

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Resumen

En este trabajo estimamos el traspaso de tipo de cambio a precios de importación a nivel desagregado y en frecuencia mensual. Trabajamos con precios de importación a nivel de puerto como al por mayor y nuestros resultados son coherentes con la idea de un traspaso alto –completo en el largo plazo— que no ha declinado en ambos niveles de fijación de precios. Sin embargo, en el corto plazo, los precios al por mayor resultan menos sensibles a variaciones del tipo de cambio. Esto puede indicar la existencia de un traspaso menos que perfecto en la cadena de distribución desde precios en puerto a su contraparte al por mayor. Asimismo, encontramos una débil evidencia de asimetría en el traspaso a nivel agregado de precios de importación. Finalmente, exploramos si el alto y no declinante traspaso está dado por la concentración de importaciones chilenas en productos de alto traspaso, hipótesis que no es validada por nuestros resultados.

Abstract

In this paper we estimate the exchange rate pass-through (ERPT) into disaggregated import price data at monthly frequency. We work with import prices both at the border and at the wholesale level, and our results are consistent with the idea of a high ERPT—complete in the long-run—which has not declined for both pricing levels. In the short-run, however, wholesale prices seem to be less sensitive to exchange rate variations. This may indicate the existence of a pass-through less than perfect in the distribution chain from prices at the border to its wholesale counterpart. In addition, we find weak evidence of asymmetric pass-through from appreciations versus depreciations for the aggregate import indexes. Finally, we also explore if the high and not declining ERPT is given by the fact that Chilean imports are concentrated in products with such ERPT, and our results support the view that this is not the case.

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I. Introduction

Pass-through issues play a central role in the design of appropriate monetary policies and exchange rate regime optimality. Few years ago, the main discussion in this topic was about the prevalence of producer currency- pricing (PCP) versus local currency pricing (LCP) of imports, and on whether exchange rate pass-through rates are endogenous to a country's inflation performance. Now, there is consensus that the pass-through is not complete. There is no one-to-one response of either consumer or import prices to changes in exchange rates. This evidence is, in general, quite robust for developed and developing countries (Campa and Goldberg, 2005).

Some recent research suggests that import prices in a number of industrialized nations may have become progressively less responsive to changes in exchange rates over the past decade or so. A decline in the exchange rate pass-through (ERPT) has obvious implications for stability of domestic prices and for the current account balance of the economy. In particular, on the former issue, a low ERPT may contribute to low rates of inflation since depreciations of the domestic currency will not create inflationary pressures related to increases of import prices. By contrast, a low ERPT may create difficulties in adjusting external balances when changes in import (or export prices) are needed to achieve corresponding changes in international trade. The degree of exchange rate pass-through, consequently, has important implications for the design of monetary policy to counteract the inflationary as well as trade implications of an exchange rate shock.

We study the ERPT using Chilean data of import prices for the period 1996-2007. The case of Chile is interesting for several reasons. First, there is not much empirical evidence on

exchange rate pass-through in developing countries. Some recent exceptions are Fuentes (2007) and Ca'Zorzi et al. (2007), but they only estimate aggregate pass-through. As we show in the next sections, we also estimate ERPT for different types of goods. This is useful for the discussion on the causes of declining pass-through in some economies. Second, Chile has successfully implemented a floating exchange rate regime since September 1999 within a context of lower inflation rates under an inflation targeting. As argued by Taylor (2000) the inflationary environment could be an important determinant of the magnitude of the ERPT coefficient.

The analysis of aggregate pass-through rates can be divided into two parts. The first part is a border phenomenon and addresses the extent to which there are changes in the pass-through rate at the level of import prices. The second addresses the extent to which these border price changes are transmitted to consumers or even offset by anticipated current or future monetary policy. By using information of both at the border and wholesale import prices, our analysis may contribute to determine how prices react to exchange rate movements at different stages of the marketing chain. Up to now the impact and dynamics of exchange rate changes on domestic prices in Chile has been extensively analyzed (García and Restrepo, 2003; Bravo, García, 2002; Noton, 2003; Morandé and Tapia, 2002; Edwards, 2007).¹ The pass-through from exchange rate changes to import prices, however, has received less attention, mainly due to lack of data at a disaggregated industry level.

We also estimate the pass-through coefficient for different types of goods. This is important considering the evidence by Campa and Goldberg (2005) and Marazzi and Sheets

¹ Appendix A presents a survey of previous contributions for Chile.

(2007) that reductions in the aggregate coefficient may reflect changes in the composition of imports or higher competition in some sectors.² The import price indexes of the Central Bank of Chile allow us to estimate pass-through for three types of goods classified by end use: (i) consumer goods, (ii) intermediate goods, and (iii) capital goods. In addition, we estimate ERPT for the subcomponents of these aggregate indexes using a unique database of unit values of imports for 40 products. In the case of imported goods at the wholesale level, we estimate ERPT for three sectors: (i) mining, (ii) agriculture, and (ii) industry.

The standard specifications, on which this paper is based, are typically derived from a partial equilibrium setup. They miss some of the structural elements of a more general equilibrium framework. For instance, the specifications lack explicit treatment of expectations as well as the conduct of monetary policy. However, exchange rate pass-through thus calculated can provide some insight into the likely underlying structural factors.

Our results indicate a high and not declining pass-through from exchange rate changes to import prices. The last result is in contrast with previous evidence for some other countries where ERPT has declined over time and opens interesting questions regarding why this not happening in Chile. In addition, our evidence shows important differences in pass-through along the marketing chain. In fact, short-run ERPT tends to be larger for goods at the border than for imported wholesale goods. In addition, we find weak evidence of asymmetric pass-through for the aggregate import indexes. There is some evidence of asymmetries for capital goods and agriculture, but they are specific to these products and

² In fact, Marazzi and Sheets (2007) find that part of the declining ERPT to import prices in the U.S. is due to higher competition from China.

they have not been reflected in the aggregate indexes. Finally, we do not find evidence that the large and not declining pass-through is given by the fact that Chilean imports are concentrated in products with high ERPT.

The remainder of this paper is divided into four sections. The second section presents a review of the related literature. The third section presents the empirical approach. The fourth section describes the data. In the fourth section we show and discuss the results. We conclude in the last section.

II. Brief Literature Review

Goldberg and Knetter (1997) summarize the extensive literature on pass-through and the law of one price and show why incomplete pass-through persists even as trade and economic integration increase. More recent developments which include macroeconomic explanations are summarized by Frankel, et al. (2005). They note that smaller countries, countries with a higher presence of foreign firms, and less developed countries generally tend to have higher pass-through of exchange rates into prices.

During the 1990s, many researchers observed that ERPT into prices were relatively mute in some countries.³ The literature has turned to the issue of the relatively widespread and ongoing decline in exchange-rate pass-through. These observations led to raise the hypothesis of a link between macroeconomic variables such as monetary policy and ERPT. Taylor (2000) attributes the decline in pass-through to the shift by those countries towards a low-inflation environment, mainly to the adoption of inflation targeting. Taylor argues that the exchange rate pass-through into import prices matters only when there are persistent

exchange rate changes. These tend to be muted in an environment where inflation is low and monetary policy is credible, because the pricing power of firms is diminished in a low inflation regime. His model introduces nominal rigidities and market imperfections into a dynamic general equilibrium to formalize the previous argument.

Taylor's hypothesis has strong implications for monetary policy. In the case that the decline in pass-through is an outcome of the low inflation environment of recent years, the gains in price stability can be fragile and potentially eliminated by adverse price shocks. Alternatively, if structural reasons are behind the decline in ERPT such as diminishing pricing power of firms, the regime of price stability may be more robust.

Campa and Goldberg (2005) conclude that the Taylor argument has some statistical merit, but it is not of first order importance for OECD countries. Far more important for overall pass-through rates are changes in the composition of industries in a country's import basket. In particular, the authors claim that the composition of imports with a larger concentration in manufactured products has been the primary driver behind the decline in pass-through changes into import prices. In fact, they conclude that it comes mainly from the decline in the import share of primary commodities such as raw materials and fuels. Otani et al. (2003, 2005) make the case for Japanese import prices, that the decline in ERPT is mostly attributable to the decrease in the exchange rate pass-through in each product category.

For the Euro Area, Campa, Goldberg and Mínguez (2005) analyze the transmission rates from exchange rates to import prices, across countries and product categories. They report significant heterogeneity across industries with a large pass-through in the short run.

³ Appendix A has a summary revision of previous contributions.

Moreover, they observe a lower ERPT into import prices in industries producing differentiated goods.

More recently, Ihrig et al. (2006) for import-price pass-through find that all G-7 countries experienced a decline in the responsiveness of import prices to exchange-rate movements; for nearly half of these countries the decline between 1975-1989 and 1990-2004 is statistically significant. They estimate that while a 10 percent depreciation in the local currency would have increased import prices by nearly 7 percent on average across these countries in the late 1970s and 1980s, it would have only increased import prices by 4 percent in the past 15 years.

Frankel et al. (2005) perform estimations for 76 countries and find empirical support for some of the factors that have been hypothesized in the literature. Significant determinants of the pass-through coefficient include per capita incomes, bilateral distance, tariffs, country size, wages, long-term inflation, and long-term exchange rate variability. Some of these factors changed during the 1990s. According to these authors, part of the downward trend in pass-through to imported goods prices can be explained by changes in the monetary environment.

For Chile, there some recent contributions exploring the ERPT into import prices. Ca'Zorzi, et al. (2007) perform estimations for 12 emerging markets, among them Chile, using quarterly data from the IMF's International Financial Statistics and the Central Bank of Chile, for the period 1980-2003. They report a high degree of pass-through into import prices. On the other hand, Edwards (2007) uses quarterly wholesale prices—that include domestic and imported goods—for the period 1980-2000, finding a long-run pass-through of

0.056 for the period with inflation targeting (and 0.257 for the pre-inflation-targeting period). Finally, Fuentes (2007), using information from the IFS-IMF for Argentina, Chile, Colombia and Brazil, reports a high but decreasing ERPT into import prices for Chile.⁴

There are some methodological differences between this work and these earlier studies. First, we use monthly instead of quarterly data. Second, we use import prices at two different stages of the marketing chain. Third, we study goods-specific differences in ERPT using classifications of goods by end use and industry.

II.1 Measuring ERPT: First and Second Stage

Exchange rate pass-through is usually defined as the responsiveness of prices—including consumer prices, producer prices, import prices, and sometimes the prices set by domestic exporters—to exchange rate movements. One standard way to estimate exchange rate pass-through is through the coefficient obtained from regressing changes in price indexes on movements in nominal effective exchange rates.

There are several reasons why prices could not be fully transmitted to consumers. For instance, Burstein et al. (2003) claim that, given that imported goods have to go through a distribution sector to reach consumers, incorporating local value added makes consumer prices less sensitive to exchange rate changes.⁵ Other authors have emphasized the idea that imports are intermediate goods. Bacchetta and Wincoop (2002) develop a model where these intermediate goods compete with domestic non-trade goods, and they show that if this sector is large enough, there could be a full pass-through to imports prices and no pass-

⁴ Note, however, that Fuentes (2007) characterizes the evidence of declining pass-through as “weak” for Chile.

through to consumer prices.

The distinction between first- and second-stage pass-through reflects different concerns for branches of the literature. In the academic literature of international economics or industrial organization, pass-through has often been calculated based on import prices or the prices set by domestic exporters, while pass-through to consumer prices has more recently come to the attention of researchers, especially within central banks. The distinction allows for different pricing behavior along a distribution chain. The pricing behavior of foreign exporters or domestic importers is thought to affect first-stage pass-through, and that of domestic distributors is thought to be relevant for second-stage pass-through. The difference in these pricing behaviors may lead to different development in each stage of pass-through.

First-stage pass-through can, in general, be derived from a first-order condition of a foreign monopolistic exporter's profit maximization in a static partial equilibrium model. The reduced expression relates import prices in domestic currency as the dependent variable to a set of independent variables that includes effective exchange rate—expressed in terms of units of domestic currency per unit of foreign currency—and other control variables such as commodity prices, output gap, and foreign costs, among others. In the next section we derive an explicit reduced form for the ERPT of the first stage.

The second-stage pass-through—which measures the effects of exchange rate fluctuations on consumer prices—is usually computed by estimating a backward-looking Phillips curve which relates domestic consumer prices to import prices and other control variables (Sekine, 2006).

⁵ They show that distribution costs account for more than 40% of retail prices in the U.S.

III. Empirical Approach

Since we are interested in the first-stage pass-through, let us consider import prices for any type of goods j , P_t^j , as a transformation of export prices of a country's trading partners,

XP_t^j :

$$P_t = E_t \cdot XP_t, \quad (1)$$

where E_t is the bilateral exchange rate (we omit subscript j). Using logs in definition (1), we obtain:

$$p_t = e_t + xp_t \quad (2)$$

Here, the export price consists of the exporters' marginal cost and a markup, which in logs gives the following expression:

$$xp_t = mc_t + mkup_t \quad (3)$$

Replacing for xp_t into equation (2):

$$p_t = e_t + mc_t + mkup_t \quad (4)$$

Using the previous expression, we may rationalize at least three effects on import prices which are associated to changes in the exchange rate: (1) the unity translation effects of the exchange rate movement; (2) the response of the markup in order to offset this translation effect; (3) the effect on the marginal cost that is attributable to exchange rate movements, such as the sensitivity of input prices to exchange rates. In this context, there is abundant literature explaining and formalizing why the pass-through from the exchange rate into import prices may be different from 1.

Markup responsiveness depends on the market share of domestic producers relative to foreign producers, the form of competition that takes place in the market for the industry, and the extent of price discrimination. Generally, a larger share of imports in total industry supply, higher degree of price discrimination or a larger share of imported inputs in the production process in the destination country leads to a higher predicted pass-through. ERPT may be higher if the ratio of exporters relative to local competitors is high (e.g. for commodities or oil), and lower if exporters compete for market shares (e.g. for manufactured goods), even if nominal exchange rate variability is high. Other factors affecting pass-through are the currency denomination of exports and the structure and importance of intermediate goods markets.

Exporters of a given product can choose to absorb some of the exchange rate variations instead of passing them through to the price in the importing country currency. If the pass-through is complete (producer-currency pricing), their markups will not respond to exchange rate fluctuations, thus leading to a pure currency translation. At the other extreme, they can decide not to vary the prices in the destination country's currency (local-currency pricing or pricing to market) and absorb the fluctuations within the markup. Thus, markups in an industry are assumed to consist of a component specific to the type of good, independent of the exchange rate and a reaction to exchange rate movements:

$$mkup_t = \alpha + \Omega e_t \quad (5)$$

Moreover, marginal costs are typically modeled as a function of demand conditions in the importing country (y_t), marginal costs of production (labor wages, fw_t) in the exporting country, and the commodity prices denominated in foreign currency ($fc p_t$):

$$mc_t = \rho_0 y_t + \rho_1 f w_t + \rho_2 e_t + \rho_3 f c p_t \quad (6)$$

Substituting (6) and (5) into (4), we obtain:

$$i p_t = \alpha + \underbrace{(1 + \Omega + \rho_2)}_{\beta} e_t + \rho_0 y_t + \rho_1 f w_t + \rho_3 f c p_t + \varepsilon_t, \quad (7)$$

where the coefficient β on the exchange rate e_t is the pass-through elasticity. In this approach we cannot identify Ω from ρ_2 . Thus, following Campa and Goldberg (2005) we assume that the term $\rho_0 y_t + \rho_1 f w_t + \rho_3 f c p_t$, which is independent of the exchange rate, is reflected in the world price of the product, $f p_t$, in the world currency (here taken to be the U.S. dollar). Thus, the final equation can be re-written as follows:

$$p_t = \alpha + \beta e_t + \gamma f p_t + \varepsilon_t \quad (8)$$

Equation (8) gives us the long-run relationship between the import price, the exchange rate and a measure of foreign price.

This equation expressed in first differences, including lagged exchange rate and foreign production costs to allow for a gradual adjustment of import prices, becomes:

$$\Delta \log P_t = \alpha + \sum \delta_i \Delta \log E_{t-i} + \sum \gamma_i \Delta X_t + \lambda \Delta Z_t + \varepsilon_t, \quad (9)$$

where P_t is an imports price index (measured in local currency), E_t is the nominal exchange rate, X_t is a vector of control variables for exporter costs, Z_t is a vector of other controls for the importer market characteristics, especially, economic activity, and ε_t is an error term with standard characteristics.⁶ The short- and long-run coefficients will be given

⁶ It should be noted that if the cointegrated equilibrium relationship were to exist, the equation to be estimated should contain an error correction term (ECT) as in Engle and Granger (1987). We estimate the equation with and without the ECT and the results are the same. In some cases, however, the ECT is not significant. Then, we only show results of equation (9).

by δ_0 and $\sum \delta_i$, respectively. Following previous work, we use lags up to one year (12 months in our case) and we only sum up the significant coefficients to calculate the long-run exchange rate pass-through.

IV. Data

We use a unique monthly dataset assembled by the National Accounts Department of the Central Bank of Chile which contains import unit value indexes (IUVI) distinguishing 40 categories according to the Central Product Classification (CPC), for the period January 1996 - May 2007. These categories account for around 80% of total Chilean imports. These products have been aggregated into three main subcomponents by end use: (i) consumer goods, (ii) intermediate goods, and (iii) capital goods.⁷ Table 1 shows the 40 categories organized according to the type of product. The number 1, 2 or 3 identifies goods that are in each category. For instance, for *meat products* (CPC code 14) we have information of import prices for consumer and intermediate goods.

The second source of information is the monthly survey of wholesale import prices carried out by the National Institute of Statistics (INE), which distinguishes imported goods from three sectors: (i) mining, (ii) agriculture, and (iii) industry. This data covers the period from January 1996 to May 2007.

⁷ Details regarding methodological aspects of the CPC are discussed in appendix A.

Table 1. Import prices: Central Product Classification

CPC Code	Products	CPC Code	Products
1	Agriculture and horticulture (3)	30	Leather Products (3)
2	Fruts, nuts, spices and plants (1) and (3)	31	Footwear (1) and (3)
3	Live animals (2) and (3)	32	Wooding products, cork and straw (1) and (3)
4	Forestry (3)	33	Pulp, paper and cardboard (1) and (3)
5	Fish and other fishing products (3)	34	Printing and Recording (1) and (3)
6	Hulla and lignito; turba (3)	35	Refined oil products, nuclear fuels (3)
9	Copper products (3)	36	Basic Chemical products (3)
14	Meat and meat products (1) and (3)	37	Other chemical products; textile manufacturing (3)
15	Prepared and canned fish (1) and (3)	38	Plastic products (1) and (3)
16	Prepared and canned fruts and vegetables (1) and (3)	39	Other plastic products (1) and (3)
17	Vegetable and animal oil (3)	40	Glass and other non metallic products (1) and (3)
19	Grinding and sifting products of wheat (1)	41	Manufacturing of other mineral non-metalic products (1) and (3)
21	Sugar and starch (3)	42	Iron and steel products (3)
22	Other nutritional food (1) and (3)	43	Metallurgic products (3)
23	Spirits (1) and (3)	44	Elaborated metalic producto ex-machinery and equipment (1) and (3)
24	Wine	45	Machinery and equipment (1), (2) and (3)
25	Malt beverages (1)	46	Machinery, electric and electronic products (1), (2) and (3)
27	Tobacco products (1)	47	Transportation products (1) and (3)
28	Textiles (1) and (3)	48	Furniture (1) and (3)
29	Clothing (1) and (3)	49	Other non-specific industry (1) and (3)

Source: Central Bank of Chile

Note: (1) Consumption goods; (2) capital goods and (3) Intermediate goods.

In our estimations we use two alternative definitions for the nominal exchange rate: U.S. dollar parity (Chilean peso/U.S. dollar) and multilateral nominal exchange rate from the IMF.⁸ The vector of control variables for exporter costs are those typically used in other studies (see Edwards, 2007, Campa and Goldberg, 2005). As a proxy for foreign prices, we use the external price index (EPI) calculated by the Central Bank. This index is a traded weighted average of producer price indexes of the main Chilean trading partners, which uses total trade (exports plus imports) as the weight of each country's price index.⁹ We recalculate the EPI using the weights of imports from each country instead of total trade.

We also control for changes in import prices associated to external shocks by including a commodities price index—minus fuel—obtained from the International Monetary Fund's International Financial Statistics. Changes in domestic economic activity are captured by the

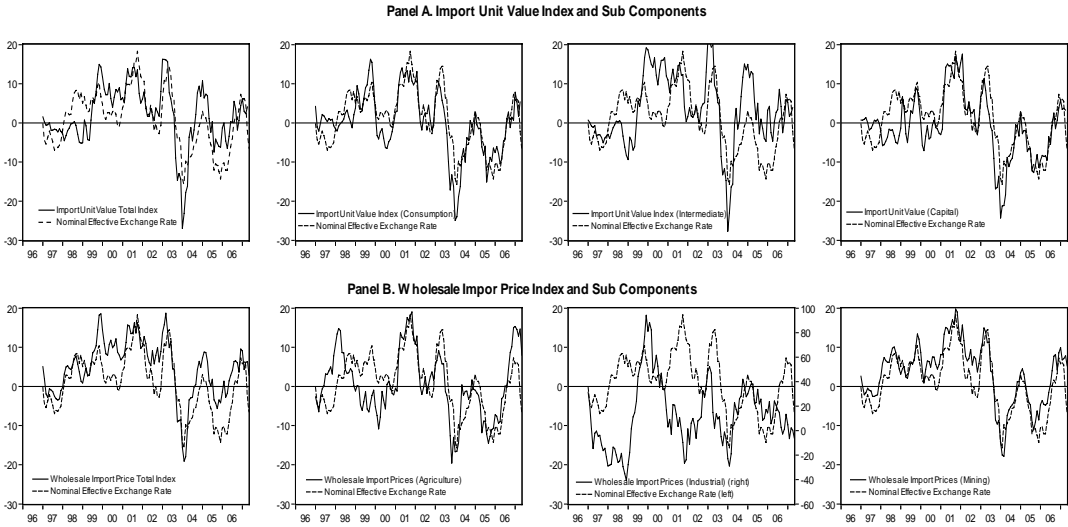
⁸ As both variables generate similar results, we present the estimations only using the nominal effective exchange rate.

⁹ In some cases, when producer price indexes are not available, consumer prices indexes are used. Available at http://si2.bcentral.cl/Basededatoseconomicos/951_713.ASP?cap=070.

monthly index of economic activity (IMACEC). All series are seasonally adjusted before performing the estimations.

Figure 1 presents the annual growth rates of import prices and exchange rates. It can be appreciated that, in general, changes in import prices are closely correlated with changes in the nominal exchange rate. The simple correlation coefficient between exchange rate and import prices is 0.69 for import unit values and 0.82 for wholesale import prices. This suggests an expected high ERPT into import prices. There are, however, some exceptions. Specifically, mining sector (third figure in panel b) shows several periods where movements in exchange rates were not accompanied by changes in import prices in the same direction. The simple correlation with exchange rate movements in this case is 0.04.¹⁰

Figure 1. Import Prices and the Exchange Rate
(Annual growth rates as log differences)



Source: Authors' elaboration.

¹⁰ For consumer, intermediate and capital goods it is 0.82, 0.52, and 0.80, respectively. For industry and agricultures is 0.92, and 0.66, respectively.

V. Estimations

In this section we present the results of our estimations. First, we summarize the results for the aggregate indexes, distinguishing at the border and wholesale import prices. Second, we analyze the existence of asymmetries in ERPT. Third, we show the results for individual time series estimations for the 40 categories detailed in Table 1.

V.1 Aggregate Results

The first estimation was done using aggregate import unit value indexes and the corresponding three subcomponents: (i) consumer goods, (ii) intermediate goods, and (iii) capital goods. Panel A of Table 2 depicts the results for the short- and long-run ERPT¹¹. We consider lag structures of one year (12 lags) of changes of the nominal exchange rate to calculate the long-run pass-through. Only significant coefficients are added to obtain the long-run ERPT. We test the hypothesis that the long-run pass-through is equal to 1.

The results show that the short-run coefficient is 0.83 for the aggregate index, greater for intermediate goods (0.89), and lower for consumer and capital goods (0.74 and 0.72, respectively). The only short-run coefficient for which the hypothesis that is equal to 1 cannot be rejected is that for intermediate goods. In the case of the long-run ERPT, the evidence is consistent with the idea of full adjustment of import prices to exchange rate movements for the aggregate price index and for each type of good. This is in line with most of the international evidence presented by Campa and Goldberg (2005) and for four Latin American countries in Fuentes (2007).

As has been discussed in previous sections, there is some international evidence suggesting that ERPT has been declining in the last decades. Although our information is for a short period of time, we look at potential changes in this parameter. Figure 2 shows the results for the short-run ERPT from recursive regressions. The evidence seems to suggest some decline in ERPT around 2001-2002, but an increase later on. In general, our results do not show a clear pattern of reduction in pass-through into import prices. If anything, there has been an increase over the past few years.

Table 2. ERPT to Import Prices

	Import Unit Values			
	Aggregate	Consumption	Intermediate	Capital
Short-run ERPT	0.830 [0.09]	0.739 [0.09]	0.888 * [0.11]	0.715 [0.09]
Long-run ERPT	0.816 * [0.12]	0.820 * [0.14]	0.886 * [0.22]	0.999 * [0.12]
	Wholesale Prices			
	Aggregate	Agriculture	Mining	Industrial
Short-run ERPT	0.521 [0.07]	0.384 [0.13]	0.448 [0.37]	0.521 [0.07]
Long-run ERPT	0.821 * [0.12]	0.577 [0.16]	1.152 * [0.43]	0.995 * [0.05]

Notes:

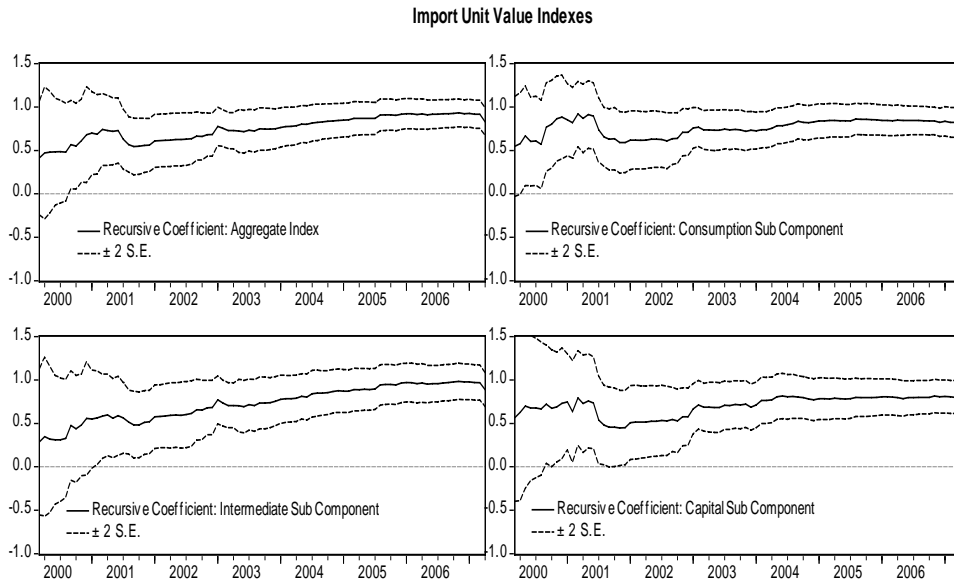
- Newey-West HAC Standard Errors & Covariance under Andrews (1991)'s method automatic lag truncation. Multilateral nominal exchange rate index considering weights by the main trading partners in total imports. Models estimated with 12 lags of the change in the exchange rate.

* The hypothesis that the long-run ERPT is equal to 1 is rejected at 5% significance level.

Source: Authors' calculations.

¹¹ The unit roots and cointegration analysis shows that the relevant series are I(1) with existence of at most one long run relationship. The econometrics approach internalizes these results and is concordant with the characteristics of previous international literature.

Figure 2. Stability of the Short-Run ERPT Coefficients



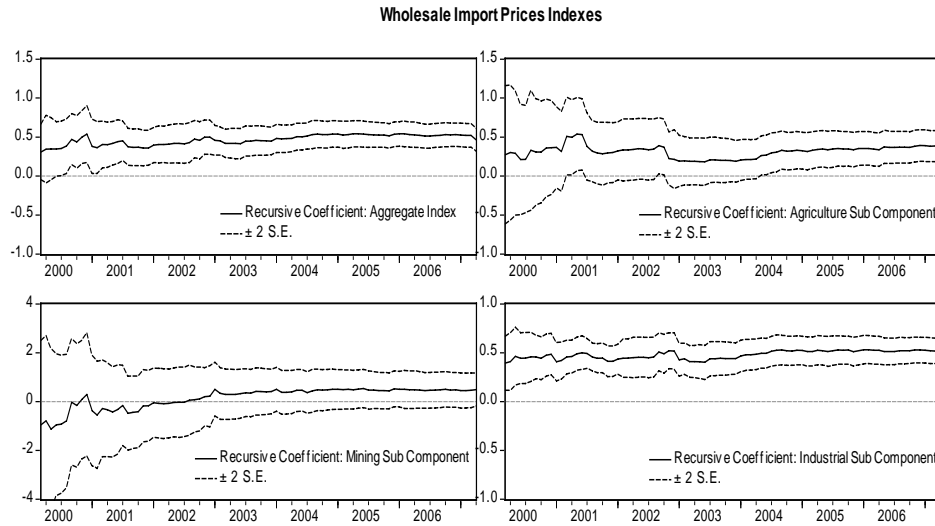
Source: Authors' calculations.

In the second panel of Table 2 we show the estimates using the wholesale import prices. Our results generally show a lower degree of ERPT in the short run compared to import unit values. Compare the ERPT for the aggregate index of 0.52 with the ERPT of 0.83 for goods at the border. For the aggregate index and for each of the sectors, we can reject the hypothesis that the pass-through is complete in the short run. Moreover, the coefficient is not different from zero for mining products.

The long-run ERPT is, in general, complete for the wholesale imported goods. The only exception is the agricultural sector. The coefficient is 0.58, and it is statistically different from zero, but different from 1.

In Figure 3, analogous to import unit values, we present the results of recursive regressions for the short-run pass-through coefficient. For the aggregate index and for the three sectors considered, the evidence suggests a not declining ERPT:

Figure 3. Stability of the Short-Run ERPT Coefficients



Source: Authors' calculations.

In sum, our results suggest that short-run ERPT for goods at the border is higher than for wholesale import prices. In the long-run—for both indexes—we find a complete pass-through from the exchange rate to import prices.

IV.2 Asymmetry in Short-Run ERPT: Appreciations and Depreciations

Various circumstances may generate asymmetry in the ERPT. In theory, an appreciation can lead to an either higher or lower rate of pass-through than depreciation. Thus, while prices may raise faster than they fall; they may also fall faster than they rise. Knetter (1994), for example, has argued that, if exporting firms face capacity constraints in their distribution networks, then an appreciation of the importing country's currency might cause a lower pass-through than exchange rate depreciation. The capacity constraints, because they limit potential sales, deter the lowering of the import price that an

appreciation might normally induce. Meanwhile, the capacity constraints do not affect the increase in the import price that depreciation might normally stimulate. Several earlier contributions have examined the behavior of prices under appreciations relative to depreciations, finding mixed results (See, for example, Feinberg, 1989, Athukorala, 1991, Gil-Pareja, 2000).

Following previous contributions, in this section we evaluate the role of positive and negative changes in the exchange rate in import prices. Equation (9) restricts pass-through to be identical regardless of whether the peso is appreciating or depreciating against foreign currencies. If pass-through is asymmetric with respect to the change in the exchange rate, then the estimates of pass-through from this specification are misleading.

To determine if pass-through is asymmetric with respect to the direction of the change in the exchange rate, two dummy variables are defined to identify months in which the dollar appreciated from those in which it depreciated. Specifically, let

$$A_t = 1 \text{ when } \Delta \ln ER_t < 0, \text{ and } 0 \text{ otherwise.}$$

$$D_t = 1 \text{ when } \Delta \ln ER_t > 0, \text{ and } 0 \text{ otherwise.}$$

Interacting these dummy variables with the exchange rate index and replacing $\alpha \Delta \ln ER$ in equation (9) for $\alpha_A (A_t \Delta \ln ER_t) + \alpha_D (D_t \Delta \ln ER_t)$, provides separate estimates for pass-through under appreciations and depreciations.

The results from this modified regression are shown in Table 3. First, consider the ERPT for import unit values. Overall, the coefficient for depreciations is larger than for appreciations, suggesting that devaluations of the Chilean peso are passed-through into import prices in a larger magnitude than appreciations of the local currency. Note, however,

that the null hypothesis that both coefficients are equal is not rejected—or only marginally (at 6 percent)—for capital goods.

Table 3. Short-run ERPT: Appreciations and Depreciations.

	Import Unit Values			
	Aggregate	Consumer	Intermediate	Capital
Depreciation	1.030 [0.127]	0.811 [0.178]	1.080 [0.179]	1.045 [0.182]
Appreciation	0.666 [0.171]	0.735 [0.146]	0.716 [0.209]	0.493 [0.156]
p-value: $\alpha_A = \alpha_D$	0.13	0.78	0.26	0.06
	Wholesale Prices			
	Aggregate	Agriculture	Mining	Industrial
Depreciation	0.588 [0.141]	0.858 [0.184]	-0.019 [0.711]	0.646 [0.098]
Appreciation	0.398 [0.146]	-0.213 [0.253]	0.752 [0.650]	0.368 [0.118]
p-value: $\alpha_A = \alpha_D$	0.41	0.00	0.49	0.13

Notes:

In parenthesis, Newey-West HAC Standard Errors & Covariance under Andrews (1991)'s method automatic lag truncation.

Source: Authors' calculations.

The evidence is similar for wholesale import prices. The ERPT for the aggregate index is larger for depreciations, but it is not statically different from the ERPT associated to appreciations. Interestingly, the results for agriculture suggest that only depreciations are

passed-through to import prices and the ERPT for appreciations is not different from zero. In the case of mining, neither coefficient is different from zero¹².

In sum, the evidence for asymmetric pass-through for the aggregate import indexes seems to be relatively weak. There is some evidence of asymmetries for capital goods and agriculture, but they are specific to these products and they have not been reflected in the aggregate.

V.3 Results by Products

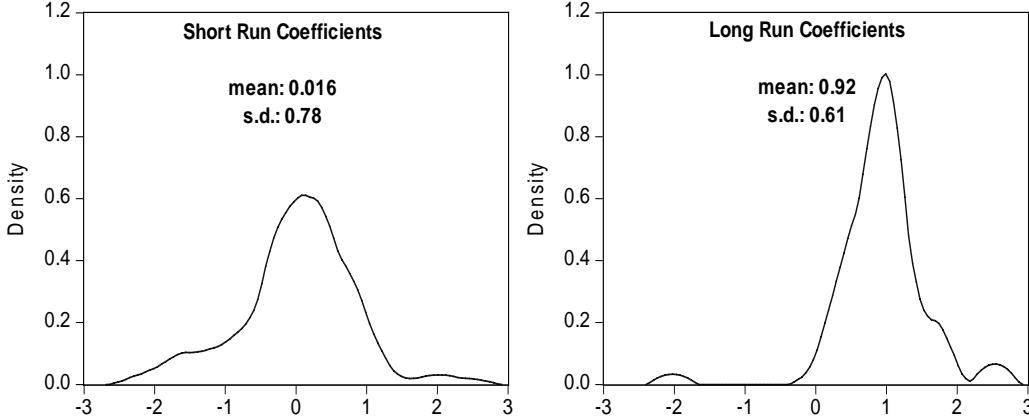
One problem with aggregate indexes is that they hide potential heterogeneity in the degree of pass-through for different components of the index. To analyze the heterogeneity of the ERPT coefficients, we make use of the import unit value indexes of the 40 categories described in Table 1, and we perform individual regression analysis using equation (9).

To have a simple interpretation of the individual regressions, we plot the empirical distribution of the short-run and long-run coefficients in Figure 4. Both distributions suggest significant heterogeneity in ERPT for individual products. Although the simple average of the short-run pass-through is 0.16, a significant mass of the distribution is on values greater than 1, and we even find some negative values. This can also be appreciated for the long-run coefficient. The simple average is 0.92, but its standard deviation is 0.61. In addition, we examine how product-specific ERPT's are associated to the share of the products in total imports. The idea is to explore whether the large and not declining pass-through is given by the fact that Chilean imports are concentrated in products with high

¹² These coefficients (appreciation/depreciation) are consistent with the estimations presented in table 2, for the short run exchange rate pass-through.

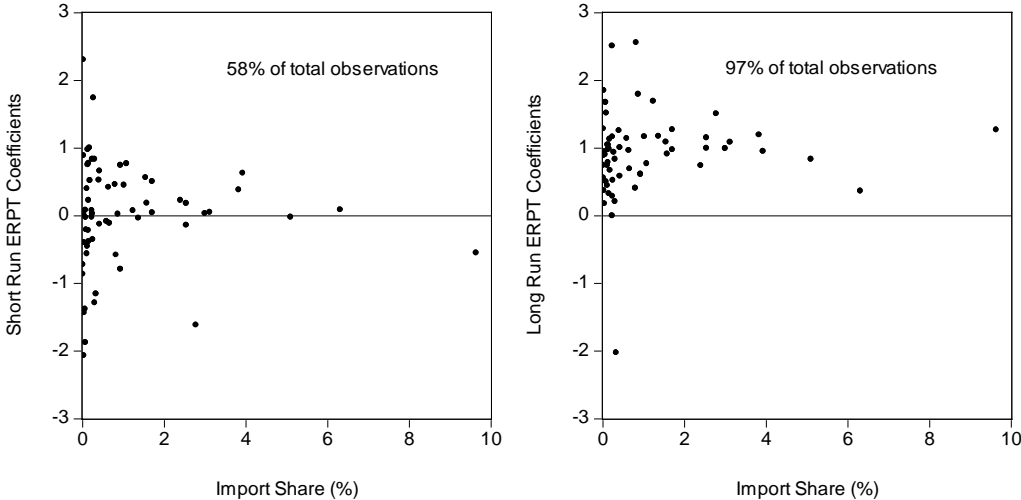
ERPT. The relationship between both variables is relatively weak (see Figure 5).

Figure 4. Empirical Distribution of ERPT Coefficients¹³



Source: Authors' elaboration.

Figure 5. ERPT Coefficients and Import Shares



Source: Authors' elaboration.

¹³ The empirical distribution was generated with an Epanechnikov kernel function with a number of grid points equal to 100 and linear binning as the evaluation method.

For the short-run and long-run coefficients there is no apparent relationship between ERPT and imports share.¹⁴ In sum, the evidence does not seem to suggest that our results are driven by a larger concentration of imports in those products with large ERPT.

VI. Concluding Remarks

We have estimated short- and long-run ERPT coefficients using different information sources. Using import prices at the border, we analyze how the pass-through differs in products classified according to end use. We have also estimated ERPT for the subcomponents of these aggregate goods using a unique database of unit values of imports for 40 products. We also performed estimations for prices of imported goods at the wholesale level considering three large sectors. To the best of our knowledge, no research has been done to measure ERPT into import prices at the level of desegregation used in this paper.

Our results are consistent with the idea of a high ERPT—complete in the long-run—which has not declined for either import prices at the border or at the wholesale level. In the short-run, however, wholesale prices seem to be less sensitive to exchange rate variations. This may indicate the existence of a less than perfect pass-through in the distribution chain from prices at the border to their wholesale counterparts.

We undertake some additional empirical exercises in order to understand other issues related to ERPT. First, we explore whether there are asymmetries in the pass-through associated to appreciation and depreciations of the local currency. The evidence for

asymmetric pass-through for the aggregate import indexes seems to be relatively weak. There is some evidence of asymmetries for capital goods and agriculture, but they are specific to these products and they have not been reflected in the aggregate indexes. Second, we explore if the large and not declining pass-through is given by the fact that Chilean imports are concentrated in products with high ERPT. Our results show that this not the case.

We conclude by noting that the evidence of a high and not declining ERPT into import prices—and decrease in the ERPT at the consumer level reported for Chile during the past few years—suggests that explanations for a muted response of domestic prices to exchange rate movements could be different to those in developed countries. In the case of the U.S., it has been suggested that increasing trade competition is one of the factors behind of this phenomenon. In the case of Chile, with an explicit inflation-targeting regime during most of the period analyzed, it seems that monetary policy could have played a significant role in this phenomenon.

¹⁴ In the short-run, a regression of ERPT on import share yields a negative coefficient of 0.008 with a t-statistic of -0.14. In the long-run, the coefficient is 0.03 with a t-statistic of 0.61.

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Appendix A

Previous Contributions on ERPT into Import Prices

Author	Data	Methodology	Main Results
Sekine (2006)	Industrial Countries. Period: 1974.1-2004.4	Time varying pass-through coefficients assuming no long-run relationship. First- and second-stage estimations.	Find a decrease in the ERPT for industrial countries in both first and second stage.
Campa and Goldberg (2005)	25 OECD countries. Period: 1975.1-1999.4	Time series estimation for each country assuming no long-run relationship.	60% pass-through in one quarter. Support the view of a change in trade composition in favor of goods with low ERPT instead of Taylor's hypothesis.
Marazzi and Sheets (2007)	USA. Period: 1978.1-2004.4. Exclude oil and computers.	Time series estimation. Authors examine the role of China by scatter plots with China's share in imports by industry and corresponding ERPT coefficients.	Significant decrease in ERPT into import prices -0.8 in 1980 to 0.2 during the 90s- caused by change in composition of imports and role of China.
Taylor (2000)	-	Microfounded model that links pricing power to persistence of shocks.	Taylor argues that the ERPT into import prices matters only when there are persistent exchange rate changes. These tend to be muted in an environment where inflation is low, because the pricing power of firms is diminished. The gains in price stability can be fragile and potentially eliminated by adverse price shocks. Alternatively, if structural reasons are behind the decline in ERPT such as declining pricing power of firms, the regime of price stability may be more robust.
Goldberg and Knetter (1997)	-	Survey on law of one price, price-to-market and sources of market segmentation.	Intermediate degrees of ERPT are observed under third degree of market discrimination. Market power and market segmentation would be open questions for further research.
Otani et al. (2006)	Japan. Period: 1980.1-2003.12.	Time series estimations by sector. Follow closely Campa and Goldberg (2004)	Authors disregard Campa and Goldberg's hypothesis (change in composition in favor of low ERPT goods) supporting a broad decrease in ERPT into import prices.
Campa, Goldberg and González-Mínguez (2005)	11 Euro countries. 9 Industries. Period: 1989.4-2004.5	Panel estimations. VECM models in case of finding a long-run relationship.	60% of ERPT in one quarter and 80% in one year. Authors find no significant changes due to the Euro Area in 1999.

McCarthy (2006)	9 developed economies. Period: 1976.1-1998.4	VAR estimation for each country (Producer Prices, Consumer prices, Import prices, Output gap and Exchange rate).	Impulse responses and variance decompositions indicate that these external factors have a modest effect on domestic price inflation over the post-Bretton Woods era. The pass-through is somewhat stronger in countries with a larger import share. A historical decomposition over 1996–98 indicates, however, that external factors have had a sizable disinflationary effect in most of the countries during the past couple of years. Estimating the model using post-1982 data has little effect on these conclusions.
Bouakez and Rebei (2005)	Canada. Period 1973.1-2004.4.	Estimation by Maximum likelihood of a DSGE model for Canada.	The adoption of Inflation Targeting in Canada is the main cause of the observed decrease in ERPT. Support Taylor's hypothesis.
Mumtaz et al. (2006)	UK. Import prices Using disaggregate data at the SITC-2 and SITC-3 digit level. Period: 1984.1-2004.1	Time series estimation by industry. Cointegrating analysis.	Evidence for significant heterogeneity among the estimated industry-specific pass-through rates. As for the Economy-wide ERPT the conclusion stands, possibly reflecting the relatively large weight of manufacturing goods in UK imports. Finally, they find a significant reduction in estimated ERPT rates since 1995 caused by increased stability of the UK economy over the past decade.

Appendix B

In this paper we use an international goods and services classification method: the Central Product Classification (CPC). This international standard is boosted by the United Nations and other international organizations relevant for the statistical processing of databases (National Accounts System 1993). In the case of Chile, the CPC considered around 11,000 products or goods of the Input-Output Matrix and the Harmonized System, where each item is assembled with the corresponding activity of the CIIU (rev3.). The CPC has the "aggregate" as order criteria and then classifies the goods as a function of industrial origin. So, the main focus is the product, not the industry.

The External Price Index (EPI) and the Broad Effective Nominal Exchange Rate (BNER) were modified from original versions calculated by the Central Bank of Chile. The current "Modified EPI" is weighted only for imports from the main trade partners. The next expression shows the principle in the modified EPI (see Caputo and Dominichetti, 2005):

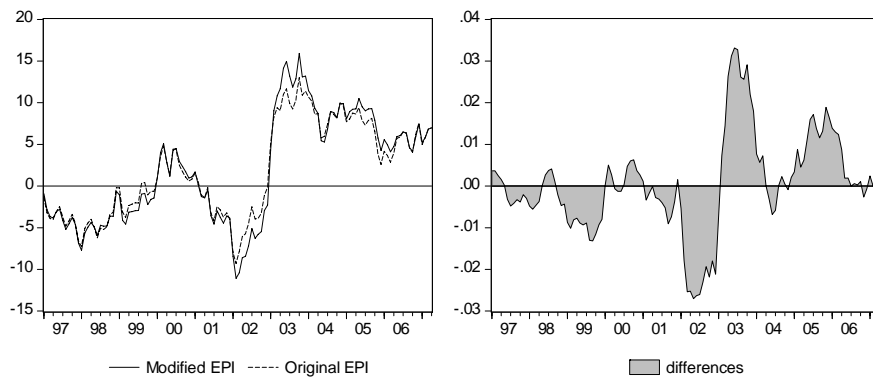
$$EPI = \prod_{i=1}^n \left(\frac{PPI_i}{NER_i} \right)^{\beta_i}$$

$$\ln(EPI) = \sum_{i=1}^n \beta_i \ln \left(\frac{PPI_i}{NER_i} \right)$$

$$1 + \Delta EPI = \exp \left[\sum_{i=1}^n \beta_i \ln \left(\frac{1 + \Delta PPI_i}{1 + \Delta NER_i} \right) \right]$$

where PPI_i is the producer price index or consumer price index and NER_i is the bilateral nominal exchange rate by country i , and β_i the participation in Chilean imports. The graphic differences between the series can be seen below:

Figure ??

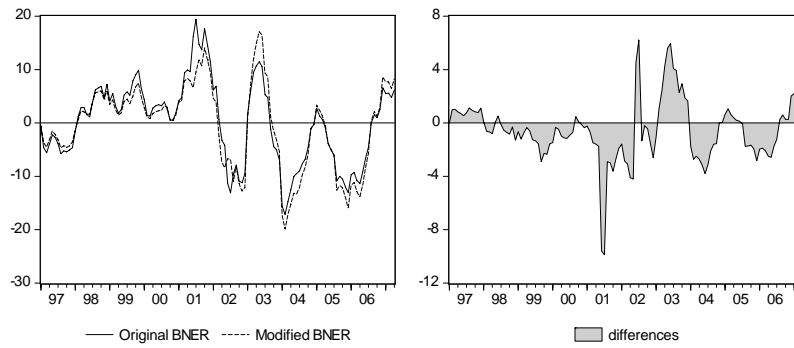


Source: Authors' Elaborations,

Alternatively, for BNER the relevant expression is:

$$1 + \Delta BNER = \prod_{i=1}^n (1 + \Delta NER_i)^{\beta_i}$$

The difference between our series and the official one can be seen below:



Source: Authors' elaboration.

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