Inflation Dynamics' Micro Foundations: How Important is Imperfect Competition Really?

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Abstract

This paper analyzes price formation and dynamics according to the industry structure. It divides manufacturing industries of Mexico into two groups: perfectly and imperfectly competitive. The results show that imperfectly competitive industries predominate. Then this classification is used to build consumer price sub indexes for the goods of both sectors. These sub indexes' inflation dynamics indicate that the exchange rate pass-through in the perfectly competitive sector is significantly higher than in the imperfectly competitive sector, while wage pass-through only affects the imperfectly competitive sector. Also, that inflation inertia is lower in the former than in the latter; adding up in more volatility of the perfectly competitive inflation rate. For policy makers an interesting feature of the perfectly competitive price index is that the evidence suggests that its variations precede those of the imperfectly competitive price index. For economic theorists these features validate recent macroeconomic models with heterogeneous price setting behavior.

Keywords: Panzar-Rosse, Industry Structure, Inflation, Price Dynamics, Price Indexes

JEL: L16, E31, E32, E52, and E58

[♦] Both authors are researchers at the Economic Studies Division of Banco de México. We thank the valuable suggestions of Manuel Ramos Francia, Daniel Garcés, Jose Luis Negrín and Alejandro Pérez-López, as well as the comments of the participants in Banco de México's Seminar. Meney De la Peza, Armando Martínez, Mishelle Seguí and Fernando Solano provided a very efficient research assistance at various stages of this project. All remaining errors are responsibility of the authors. The views expressed in this paper do not necessarily represent those of Banco de México.
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1. Introduction

Macroeconomic models that rely on the assumption of imperfect competition to explain the effectiveness of monetary policy, staggered prices, and inflation inertia are quite abundant in the literature and increasingly accepted in the economics profession (Blanchard and Fischer, 1989; Calvo, 1983, Mankiw, 2000). Calibrations of general equilibrium models that incorporate product or labor markets that are monopolistically competitive reproduce the dynamics of the United States key macroeconomic variables along the business cycle in a quite accurate manner (Chari, Kehoe and McGrattan, 2000; Christiano, Eichenbaum and Evans, 2001). Also, the merits of different stabilization strategies have been discussed with models elaborated upon these building blocks (Calvo and Vegh, 1999). However, with few exceptions like Hall (1988) or Basu and Fernald (1997) for the case of the United States, empirical evidence regarding the extent of imperfectly competitive markets is lacking. Evidence on whether inflation dynamics are substantially affected by this feature, based on equilibrium error correction models that produce estimates of the *price markups* and the *labor cost push*, is even more scant and mostly analyzed with aggregate data (De Brouwer and Ericsson, 1995; Mehra, 2000; Bertocco *et al*, 2002, Faruquee, 2004).[1] More recently, as the international flows of trade have deepened competition in several industries the question about the role of this process, in view of imperfectly competitive domestic markets, as a crucial factor behind several successful disinflation stories observed in the past 20 years has been raised by financial authorities (Rogoff, 2003). All these developments suggest that it is a good time to assess this fruitful micro foundation with the data and ask: is imperfect competition pervasive? If so, how does it affect price formation and dynamics?

In this paper we use the data of the Mexican economy to provide an answer to these two questions. First, we determine whether monopolistic competition is a common industry structure in the manufacturing sector. To this end, we use the method proposed by Panzar and Rosse (1987). Second, we build consumer price indexes of goods manufactured by

[1] Morisset and Revoredo (1995) constitutes an interesting exception within this literature because it estimates price adjustment in the industry, agriculture, services and commerce sectors of Argentina.

perfectly and imperfectly competitive industries and examine their respective dynamics. We do so by estimating error correction models that relate these prices to changes on labor and imported input costs.

Our estimations of the Panzar-Rosse statistic show that imperfect competition is a widespread market structure in the Mexican manufacturing sector. In the sample of 71 industries that we examine, which account for 47 percent of this sector's sales during the period 1994-2003 on average, this statistic suggests perfect competition in 12 industries and 69 imperfect competition industries. This group is divided into 27 monopolistically competitive industries and 29 industries with monopolies or very collusive oligopolies. The remaining 3 industries could be classified in either category (monopoly or monopolistic competition). The 71 classified industries have a weight of 69.7 per cent in the core merchandise price index, of which imperfect competitive industries account for almost half of the referred price index.

One of the main findings of the paper is that price adjustment to labor and foreign input cost shocks does differ across perfectly and imperfectly competitive industries in the theoretically predicted way: in the perfectly competitive sectors prices respond to changes on the exchange rate only, while prices of imperfectly competitive sectors respond to changes on the exchange rate and on wages. The adjustment to changes in the relevant variables is estimated to be faster in the former case than in the latter. In turn, this suggests that even though in the long run industries in which firms enjoy market power do not produce higher inflation, as cost push advocates assure, they do slow down prices' speed of convergence to a given target. This higher inertia of imperfectly competitive industries with respect to perfectly competitive ones, together with the exchange rate pass-through in the former being lower than in the latter, also implies that the inflation rate of perfectly competitive industries is more volatile than the inflation of imperfectly competitive industries.

Another interesting feature that the perfectly competitive manufactures price index exhibits is that its variations precede those of the imperfectly competitive price index. Hence, monitoring the evolution of these indexes might prove to be useful in order to identify inflationary pressures.

Because of the connection between imperfect competition and staggered prices, these findings relate very closely with recent contributions on the relevance of heterogeneous price setting behavior. For the United States, Ohanian, Stockman and Kilian (1995) explore the implications of monetary and real shocks in a business cycle model in which the degree of price stickiness differs across sectors. Nominal prices in the sticky-price sector are set one period in advance and output is determined by the quantity demanded (in accordance with monopolistic competition models), but in the flexible price sector trade occurs in a Walrasian fashion (in accordance with perfect competition). Following the work of Chari, Kehow and McGrattan (2000), Bils and Klenow (2002) sketch a general equilibrium sticky price model in which monopolistically competitive firms set price that are staggered with different duration periods across goods. Their empirical analysis linking the frequency of price changes with the degree of competition is the closest one to our work. They find a significant negative correlation between the frequency of price changes of the entry level items of the United States' consumer price index on one hand, and the four-firm concentration ratios, the wholesale markup, or the rate of product substitution in the other. Therefore, our findings are complementary to this research, providing evidence of its relevance for successful future modeling, as we will discuss later.

The rest of this paper is structured as follows. Section 2 is devoted to the classification of the manufacturing industries by their market structure. Section 3 delves on price formation and dynamics in perfectly competitive and imperfectly competitive industries. In section 4 we conclude with some policy implications of the different industry structures.

2. Classifying Perfectly and Imperfectly Competitive Industries

2.1 The Panzar-Rosse Statistic

Most econometric studies of market power focus on single market or industries (Bresnahan, 1989). The statistic proposed by Panzar and Rosse (1987) stands in the tradition of the New Empirical Industrial Organization. It is based on the comparative statics of a reduced form revenue equation. Although it is less powerful than structural models favored in single industry studies, it offers the advantage of less stringent data requirements and reduces the risk of model misspecifications. It is also regarded as a more powerful indicator of market structure and behavior than industry concentration ratios or markups measured with accounting data. These characteristics make it specially attractive for an analysis that comprises several industries. Moreover, in the analysis of Mexico's data this method to determine market power is preferable to the method based on the cycle properties of the Solow residual proposed by Hall (1988), as well as its extensions (Roeger, 1995).[2] The reason is twofold. On one hand, those methods crucially assume that price markups are constant during the analysis period, which is usually a long time series because the value added data required for estimations is reported in a quarterly basis by most countries. On the other hand, the effects on Mexican manufactures' trade on production after the adhering to the GATT in 1984 and to the NAFTA in 1994 raise serious doubts on the validity of this assumption.[3]

For the sake of completeness in the rest of this section we describe how the Panzar-Rosse statistic is built. We also explain the estimation method, the data and the industry structure classification.

Let y be a vector of decision variables which affect the firm's revenues so that $R=R(y, z)$ where z is a vector of exogenous variables that shift the firm's revenue function. The firm's cost function also depends on y, so that $C=C(y, w, t)$, where w is a vector of factor prices also taken as given by the firm and t is a vector of exogenous variables that shift the firm's cost curve. Then the firm's profit function is given by

$$\pi = R - C = \pi(y, z, w, t)$$

Let y^0 be the argument that maximizes this profit function and y^1 be the output quantity that maximizes $\pi(y, z, (1+h)w, t)$, where the scalar h is greater or equal to zero. Define R^0 as $R(y^0, z) \equiv R^*(z, w, t)$ and $R^1 = R(y^1, z) \equiv R^*(z, (1+h)w, t)$, where R^* is the firm's reduced form revenue function. It follows by definition that

$$R^1 - C(y^1, (1+h)w, t) \geq R^0 - C(y^0, (1+h)w, t)$$

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[2] Hall's method proposes that a pro-cyclical Solow residual is an indication of market power. It is used to examine the Mexican manufacturing sector by Castañeda (1988).

[3] In fact, Castañeda (2003) reports that pooled estimations a la Hall of Mexican manufacturing markups indicate a significant reduction in those sectors that experienced a strong liberalization process after the implementations of both GATT and NAFTA.

Using the fact that the cost function is linearly homogeneous in *w*, equation (2) can be rewritten as

$$R^1 - (1+h)C(y^1, w, t) \geq R^0 - (1+h)C(y^0, w, t) \tag{1}$$

Similarly, it must also be the case that

$$R^0 - C(y^0, w, t) \geq R^1 - C(y^1, w, t) \tag{2}$$

Multiplying both sides of (2) by *(1+h)* and adding the result to (1) yields

$$-h(R^1 - R^0) \geq 0 \tag{3}$$

Dividing both sides of (3) by $-h^2$ yields

$$(R^1 - R^0)/h = [R^*(z, (1+h)w, t) - R^*(z, w, t)]/h \leq 0 \tag{4}$$

This nonparametric result simply states that a proportional cost increase always results in a decrease in the firm's revenue. Assuming that the reduced form revenue function is differential, taking the limit of (4) as $h \to 0$ and then dividing the result by R^* yields

$$\psi^* \equiv \sum w_i \left(\partial R^* / \partial w_i\right) / R^* \leq 0$$

where the w_i are the components of the vector *w*, so that w_i denotes the price of the *ith* input factor. This expression describes a restriction imposed on a profit-maximizing monopoly. The sum of the factor price elasticities of the reduced-form revenue equation cannot be positive. Intuitively, the question that the test statistic ψ^* tries to answer is what is the percentage change in the firm's equilibrium revenue resulting from a one percent increase in all factor prices. An increase in factor prices shifts the average and marginal cost curves up. Consequently, the price charged by the monopolist goes up and the quantity decreases. Since the monopolist operates on the elastic portion of the demand curve, total revenue is lower. Hence ψ^* is non-positive for the monopolist case.[4] Panzar and Rosse cite two models of equilibrium consistent with a positive value for ψ^*:

$\psi^* = 1$	For firms observed in long-run competitive equilibrium the sum of elasticities of reduced form revenues with respect to factor prices equals

4 This case also is identified with a cartel or with an oligopoly with strong collusion.

unity. Because firms in a competitive industry are operating at the minimum average cost, a proportional increase in input cost will foster some firms to exit and revenues will go up for the surviving firms so that the equilibrium is reestablished at the minimum average cost.

$0 < \psi^* \leq 1$ In a symmetric Chamberlinian equilibrium of monopolistic competition, the sum of the elasticities of firm's reduced form revenues with respect to factor prices is positive and less than or equal to unity. This implies that a proportional increase of input costs increases the average and marginal cost curves inducing some firms to exit the industry until the equilibrium is reestablished.

It should be noted that in the competitive and monopolistically competitive model, the revenue function facing the firm depends on the action of potential or actual rivals, so the firm no longer acts in isolation. Also, the results of the models hinge upon the assumption that the observed firms are in a long-run equilibrium.

2.2 Estimation Method and Data

Applying the Panzar-Rosse test on industry structure requires a reduced form revenue equation. As Shaffer and Disalvo (1994) and Fischer and Kamerschen (2003), we estimate a log linear revenue equation given by

$$\ln(R) = a + b\ln(y) + \sum_{i=1}^{6} c_i \ln(w_i) \tag{5}$$

in which the vector of input prices includes the industry wage, the exchange rate, the price of gas, the price of electricity, and a domestic interest rate. This input choice obeys both to their common usage in the sector examined and to the need of preserving uniformity in the estimations. All variables are expressed in real terms and revenues, volumes and wages are calculated per hours worked. To take into account that output quantity is endogenous, equation (5) is estimated through two stage least squares (using a lag of output as instrumental variable).

The Monthly Industrial Survey (MIS) contains information about sales, volumes of output, remunerations, and employment of 205 manufactures (equivalent to the 6 digit aggregation level according to the Standard Industrial Classification).[5] Mexico's Consumer Price Index (CPI) contains 315 generic products and services, while the Core Merchandise Price Index has 191 generics. From these we found a reasonable match with 71 manufacturing industries, which we considered for our analysis.[6] For the period of January 1994 to December 2003, this sample covers an average of 47 percent of the manufacturing sector sales.

2.3 Results

Table 1 presents the estimations of the Panzar-Rosse statistic for the 71 manufactures of our sample. They take equation (5) as the initial specification, but input prices that are not significant are excluded to obtain the most parsimonious revenue equation. The value of the Panzar-Rosse statistics obtained suggest perfect competition in 12 industries; that is, the statistic does not reject the hypothesis of being equal to one. Other 56 industries do reject this hypothesis, which is consistent with imperfect competition. This group is divided into 43 monopolistically competitive industries, for which the hypothesis of being less than or equal to zero is rejected, and 13 industries with monopolies, for which this hypothesis is not rejected. There were 3 industries (knit underwear, shirts, and matches) in which none of the input prices considered resulted statistically significant from zero under any specification. Assuming that our input price list is complete, this result would be consistent with a monopoly or cartel. On the other hand, the present estimations do not show any industry with a statistic that is significantly larger than one, which in principle that may be consistent with either competitive or monopoly models not proposed in Panzar and Rosse (1987) and would require further scrutiny (probably with a structural model) to provide a definite classification.

[5] The Monthly Industrial Survey is produced by Mexico's National Institute of Statistics, Geography and Information (INEGI). It is available at INEGI's website (http//www.inegi.gob.mx).

[6] Price data is produced by Banco de México (http://www.banxico.org.mx). This is also the source of the exchange rate and interest rate data that we used. The exchange rate that we employ is the end of month fix peso-U.S. dollar exchange rate that Banco de México publishes to settle transactions in U. S. dollars, the interest rate is the ex post real interest rate of 28 day Treasury Bonds (CETES). The series of Consumer Price Index of the United States was extracted from the Federal Reserve Bank's website.

Hence, it seems fair too say that the imperfect competition is the most prevalent industry structure in this group of the Mexican manufacturing industries. During the period 1994-2001, the sales of the perfectly competitive industries account for 20.6 percent of all manufacturing sales, while those of imperfectly competitive industries for 26.7 percent, within which monopolistically competitive firms' participation is 13.9 percent and the one of monopolies or cartels is the remaining 12.8 percent. This finding grossly agree with the common belief that product differentiation is an extended business strategy in manufactures that increases demand's steepness and provides each producer with some degree of market power, as the Chamberlinian model of monopolistic competition suggests. In regard to the monopolies, it is important to keep in mind a limitation of the Panzar-Rosse test that its authors point out: the statistic must be nonpositive for all monopolies, *even those facing a perfectly elastic market demand curve*.[7] Hence, for the rest of our analysis we group these industries into "competitive" and "imperfectly competitive" ones.

Table 1
Estimates of the Panzar-Rosse Statistic for Mexican Manufacturing Industries

Industry	Panzar-Rosse Stat		Std. Error	t(coef=1)	Ho:PR=1*	t(coef=0)	Ho: PR<0**
311102 Fresh meat	0.78038	ab	0.32099	0.6842	perf comp	-2.43114	perf comp
311104 Canned meat and sausages	0.06593	ad	0.17622	5.30072	imperf comp	-0.37414	monop compet
311201 Milk	0.19418	ce	0.0567	14.21181	imperf comp	-3.42456	monop compet
311202 Cream, butter and cheese	0.19154	ac	0.02619	30.87512	imperf comp	-7.31468	monop compet
311203 Condensed, evaporated and powder milk	-0.82084	b	0.26177	6.95591	imperf comp	3.13575	monopoly
311301 Canned fruits and vegetables	0.48141	ae	0.13359	3.88208	imperf comp	-3.60373	monop compet
311303 Soups	0.22831	a	0.09157	8.42747	imperf comp	-2.49337	monop compet
311304 Fresh fish and seafood	1.41007	cd	0.45402	-0.90321	perf comp	-3.10577	perf comp
311305 Canned fish and seafood	0.34666	a	0.11429	5.71653	imperf comp	-3.03314	monop compet
311401 Rice	0.1051	a	0.06247	14.3249	imperf comp	-1.68227	monop compet
311403 Coffee	0.68031	ade	0.31442	1.01678	perf comp	-2.16369	perf comp
311404 Wheat milling	0.24959	ad	0.11254	6.66787	imperf comp	-2.21771	monop compet
311405 Corn flour	-0.54296	acde	0.34774	4.43713	imperf comp	1.56141	monopoly
311501 Cookies and pasta	-0.03316	ab	0.17496	5.90514	imperf comp	0.18955	monop compet
311503 Bakery and pastry	-0.00191	c	0.00056	1792.32379	imperf comp	3.41503	monopoly
311701 Cooking oil	0.28453	a	0.09102	7.86077	imperf comp	-3.12606	monop compet
311801 Sugar and cane residual products	-0.92983	d	0.36612	5.27098	imperf comp	2.53966	monopoly
311901 Cocoa and chocolate	1.48569	bd	0.78176	-0.62127	perf comp	-1.90043	perf comp
312110 Soluble coffee	0.28255	b	0.12608	5.69023	imperf comp	-2.24099	monop compet
312126 Powder gelatins, rich custard and desserts	0.11057	a	0.0655	13.57902	imperf comp	-1.68815	monop compet
312127 Snacks and other corn products	-0.2581	a	0.14036	8.96366	imperf comp	1.83892	monopoly
312129 Other nourishing products for human consumption	0.5697	ae	0.26289	1.63682	imperf comp	-2.16707	monop compet
313011 Tequila	0.99613	abe	0.74023	0.00523	perf comp	-1.34569	perf comp
313012 Rum	-0.4774	abcde	2.4746	0.59703	perf comp	0.19292	perf comp
313013 Grape spirits	-0.62441	b	0.21615	7.51513	imperf comp	2.88875	monopoly
313014 Other spirits	-0.26811	a	0.15774	8.0395	imperf comp	1.69975	monopoly
313031 Wine	0.00831	c	0.00348	285.13226	imperf comp	-2.38930	monop compet
313041 Beer	0.14102	a	0.04764	18.03142	imperf comp	-2.96022	monop compet
314002 Cigarettes	-0.17371	ae	0.21876	5.36529	imperf comp	0.79405	monop compet
321214 Cotton and bandages	-0.15566	a	0.06871	16.81842	imperf comp	2.26535	monopoly
321311 Sheets, bedspreads and table cloth	0.19673	a	0.09606	8.36212	imperf comp	-2.04793	monop compet
321401 Socks and stockings	0.42351	d	0.23053	2.50069	imperf comp	-1.83707	monop compet
321402 Sweaters	4.26264	abde	1.57371	-2.07321	perf comp	-2.70865	perf comp
321403 Knit underwear	0		0	--	--	--	--
322001 Outerwear for men	-1.23651	ade	0.71827	3.11373	imperf comp	1.72150	monopoly
322003 Outerwear for women	0.00379	ae	0.20446	4.87245	imperf comp	-0.01853	monop compet

[7] For more details, see Panzar and Rosse (1987) or Bresnahan (1989).

322005 Shirts	0		0	--	--	--	--
322006 Uniforms	-0.03753	ad	0.22288	4.65507	imperf comp	0.16837	monop compet
322009 Outerwear for kids	0.54143	a	0.21464	2.13651	imperf comp	-2.52257	monop compet
323003 Leather and rawhide products	0.11096	be	0.34703	2.56182	imperf comp	-0.31974	monop compet
324001 Footwear, mainly of leather	0.58806	acde	0.17045	2.41681	imperf comp	-3.45001	monop compet
332001 Furniture, mainly of wood	-0.09807	ade	0.33929	3.23638	imperf comp	0.28903	monop compet
332003 Mattresses	-0.24377	de	0.29794	4.17461	imperf comp	0.81820	monop compet
342001 Newspapers and magazines	0.48506	ae	0.15902	3.23832	imperf comp	-3.05035	monop compet
342002 Books	0.24351	a	0.12013	6.29747	imperf comp	-2.02712	monop compet
351222 Insecticide	-0.12289	ad	0.39341	2.85426	imperf comp	0.31237	monop compet
352100 Pharmaceutical products	1.00731	ade	0.42081	-0.01737	perf comp	-2.39373	perf comp
352221 Perfumes, cosmetics and similar	0.36721	d	0.12189	5.19154	imperf comp	-3.01272	monop compet
352222 Soaps, detergents and toothpastes	-0.16764	ab	0.19627	5.94928	imperf comp	0.85413	monop compet
352233 Matches	0		0	--	--	--	--
352234 Films, plates and photography paper	-0.78028	cd	0.15366	11.58618	imperf comp	5.07810	monopoly
352237 Cleaning and aromatic products	0.13632	abe	0.23754	3.63593	imperf comp	-0.57389	monop compet
354002 Car lubricants	0.20635	bc	0.08622	9.20507	imperf comp	-2.39330	monop compet
355001 Tires	-0.45113	a	0.23229	6.24705	imperf comp	1.94209	monopoly
356005 Household plastic articles	0.02078	a	0.13063	7.49639	imperf comp	-0.15906	monop compet
356011 Plastic toys	0.57632	a	0.31025	1.36561	imperf comp	-1.85763	monop compet
362022 Glass and refractory products	1.00016	ae	0.40119	-0.00041	perf comp	-2.49299	perf comp
383107 Batteries	0.62874	ab	0.32106	1.15635	perf comp	-1.95830	perf comp
383109 Electric materials and accessories	0.10206	bcd	0.28396	3.16219	imperf comp	-0.35942	monop compet
383110 Light bulbs, tubes and electric light bulbs	-0.48812	e	0.25752	5.77876	imperf comp	1.89551	monopoly
383204 Music players and televisions	0.57578	b	0.32654	1.29915	imperf comp	-1.76331	monop compet
383205 Music disks and tapes	0.21943	a	0.0718	10.87152	imperf comp	-3.05606	monop compet
383301 Stoves and ovens	0.59494	ac	0.19246	2.10471	imperf comp	-3.09128	monop compet
383302 Refrigerators and freezers	0.00681	c	0.00286	347.26993	imperf comp	-2.38042	monop compet
383303 Washing and drying machines	0.0068	c	0.00366	271.14278	imperf comp	-1.85749	monop compet
383304 Heating devices and house wares	0.10083	abe	0.33651	2.67205	imperf comp	-0.29964	monop compet
384110 Cars and trucks	0.95281	abe	0.30292	0.15577	perf comp	-3.14547	perf comp
384203 Motorcycles and bicycles	0.1838	bce	0.43343	1.88314	imperf comp	-0.42406	monop compet
385002 Dental equipment	-0.70722	e	0.22363	7.63408	imperf comp	3.16245	monopoly
385005 Eyeglasses	0.37131	ade	0.90546	0.69434	perf comp	-0.41008	perf comp
390001 Jewelry, gold and silver work	-0.01248	ace	0.35402	2.85996	imperf comp	0.03526	monop compet

a=wage is statistically significant at the 10% level, b=exchange rate is statistically significant at the 10% level, c=interest rate is statistically significant at the 10% level, d=price of electricity is statistically significant at the 10% level, e=price of gas is statistically significant at the 10% level

* Rejects the null hypothesis at the 10% level

** Rejects the null hypothesis at the 10% level

However, since some analysts may raise concerns regarding the fact that foreign competition is an important reality in manufactures which may not be well accounted for in the test we employ, in the next section we also distinguish imperfectly competitive industries taking into account the share of imports to domestic sales according to a threshold 30 percent.

3. Price Formation and Dynamics in Perfectly and Imperfectly Competitive Industries

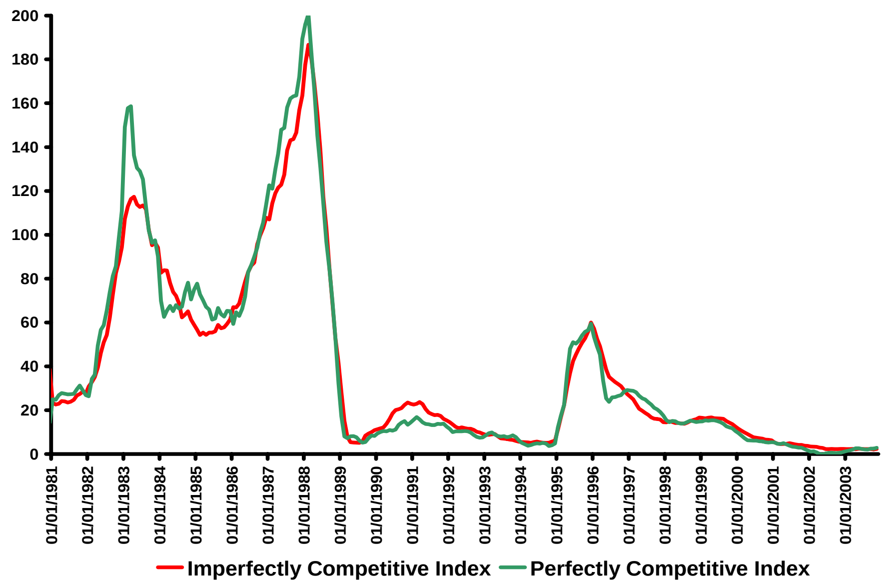
3.1 Price Indexes

With the Panzar-Rosse industry classification we built a price index for goods produced in perfectly and imperfectly competitive industries. The generics included in both indexes have a weight of 25.8 percent in the CPI and 69.68 percent of the core merchandise price index. The imperfectly competitive industries price index has a larger weight in the CPI than perfectly competitive industries; the former accounts for 18.7 percent and the latter for

7.1 percent. An additional feature of the perfectly competitive price index is that 3.3 percent of the weight corresponds to automobiles.

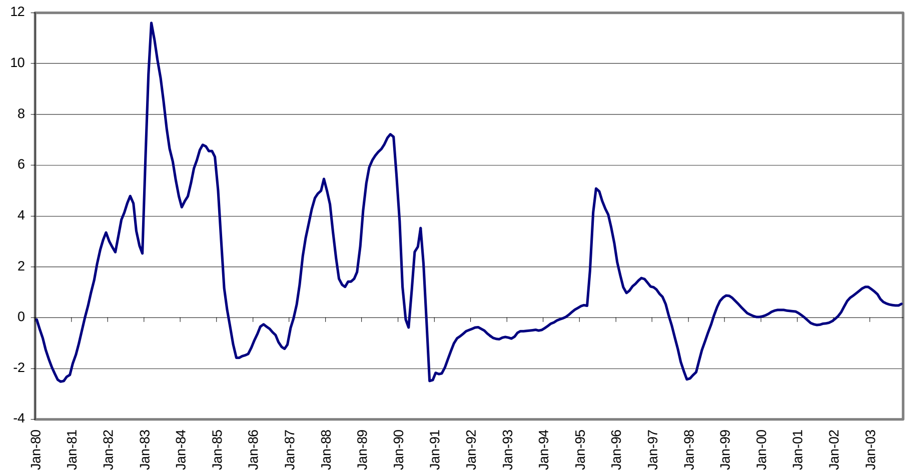
The evolution of the annual inflation of perfectly and imperfectly competitive price indexes, according to the Panzar-Rosse classification and the Panzar-Rosse augmented with imports, shows that there are episodes in which there is a wide gap between them. For instance, the inflation rate for perfectly competitive manufactures increased more and faster than the one for imperfectly competitive manufactures during 1982, 1987, 1995, and 1998 (Graph 1). The former also seems to decrease somewhat faster in the aftermath than the latter, specially in the 1982 and 1995 episodes. Also, the volatility of the perfectly competitive annual inflation rate is higher than that of imperfectly competitive manufactures (Graph 2).[8]

Graph 1
Annual Inflation Rate: Perfectly Competitive vs. Imperfectly Competitive Price Index, Panzar-Rosse Classification (percentage)



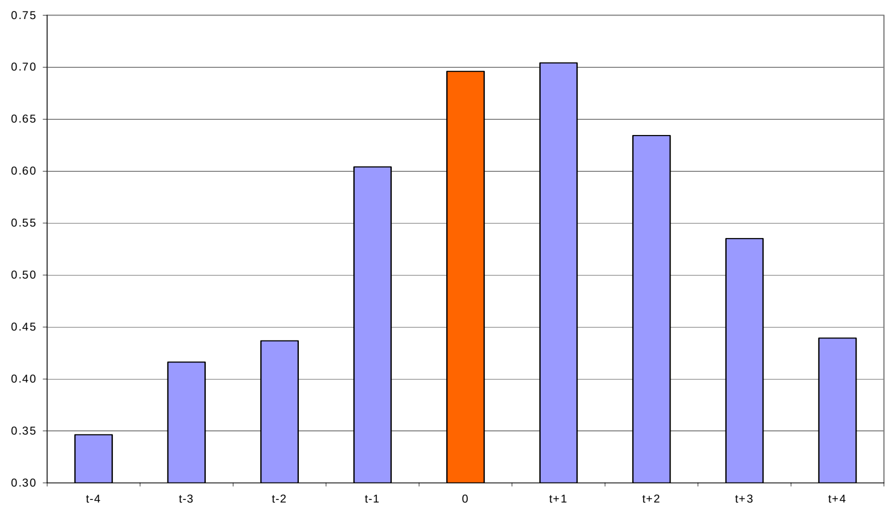
[8] A perfectly competitive price index which excludes automobiles shows similar features.

Graph 2
Rolling Variation Coefficient Gap of Perfectly and Imperfectly Competitive Annual Inflation (24 month window)



An interesting feature of perfectly competitive inflation is that its variations precede those of imperfectly competitive inflation. Graph 3 depicts the correlation coefficient of perfectly and imperfectly competitive inflation first differences according to the Panzar-Rosse classification in periods *t* and *t-i*, respectively; it is evident that it is skewed to the right. Hence, the perfectly competitive price index might be for policy makers a useful statistic to monitor future inflationary pressures.

Graph 3
Correlation Coefficient: First Difference of Perfectly Competitive Manufactures Inflation in *t* and Imperfectly Competitive Manufactures Inflation in *t-i*, January 1990 - November 2003



3.2 Price Formation and Dynamics

Error correction type equations are increasingly popular choices to model price behavior. Applying this technique for our analysis has the advantage of making our estimations comparable to previous work about Mexico's inflation dynamics (Garcés, 2001 and Baillieu *et al*, 2003). For each price index we estimate the following equation:

$$\Delta p_t = c_1 + c_2 w_{t-1} + c_3 e_{t-1} + c_4 p_{t-1} + c_5 \Delta p_{t-1} + c_6 \Delta w_t + c_7 \Delta e_t + u_t \qquad (6)$$

where p_t is the log price index, w_t is the log nominal wage cost, and e_t is log foreign input cost. To expand our sample period until 1985, in this section our wage measure is the average wage quotation of the Mexican Social Security Institute (IMSS). However, estimations with this variable are very similar to those that employ the wage indexes of competitive and imperfectly competitive manufactures constructed with the MIS data of Section 2 (see appendix).[9] The cost of foreign inputs is measured through the real exchange rate, constructed as the peso-dollar exchange rate times the consumer price index of the United States.

Notice that in equation 6, p_{t-1}, w_{t-1} and e_{t-1} constitute the error correction term, which depicts the long run relationship among the variables. This relationship can be derived from a unit cost inflation model that represents the price as a Cobb Douglass function of the wages and the exchange rate, $P = \mu W^{\lambda_w} E^{\lambda_e}$, where $\lambda_w>0$ and $\lambda_e>0$ are the respective long run elasticities and $\mu>0$ is a price mark up over costs (De Brouwer and Ericsson, 1998). It is straightforward to show that when linear homogeneity is imposed and this price equation is expressed in logarithms $\lambda_w=-c_2/c_4$, $\lambda_e=-c_3/c_4$. In the appendix we verify through the appropriate Johansen cointegration tests that this relationship satisfies the required stationarity conditions, which support the existence of a stable long run mark up.[10]

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9 These estimations are available from the authors upon petition.

10 Notice that we could have estimated the equation $\Delta p_t = c_1 + c_8 ect_t + c_5 \Delta p_{t-1} + c_6 \Delta w_t + c_7 \Delta e_t + u_t$, where $ect_t = p_t - \lambda_w w_t - \lambda_e e_t$ and satisfies stationarity, instead. But the specification we use has the advantage of suggesting a specific cointegration relationship at instances where there are more than one and the cointegration and exogeneity tests presented in the appendix indicate very similar results. In particular, the coefficient of the p_t and of ect_t has the expected sign and is statistically significant according to the applicable distribution of error correction tests for cointegration (Ericsson and MacKinnon, 1999), although in the former case that of the w_t and e_t is not properly assessed. Still, we prefer equation 6 for illustration purposes.

In Table 2 we report the estimations of equation 6 with the CPI, the core merchandise price index, the core services price index, and our industry structure price indexes. The first of them divides manufactures between perfectly and imperfectly competitive ones taking the baseline Panzar-Rosse threshold only and the second one combines the Panzar-Rosse index. In general, the coefficients of the error correction term variables, c_2, c_3 and c_4, have the expected sign and are significant at conventional levels: inflation rises as a response to either wage or exchange rate increases, but price disturbances have a transitory nature and converge to the long term equilibrium level; that is a negative coefficient associated to the lagged price level. For the CPI, the estimated coefficients largely coincide with the previous results of Garcés (2001) or Baillieu *et al* (2003). Moreover, if we take this equation as baseline, we appreciate a tendency in which the equations for price indexes of manufactures produced in imperfectly competitive industries to show smaller coefficients of lagged exchange rate and lagged price level and a larger coefficient associated to the lagged wage than those of manufactures from perfectly competitive. In fact, the wage coefficient of the perfectly competitive index is negative but not statistically significant. So for this index we also examined a version of equation 6 without the wage variable. This version yields a slightly lower coefficients for the exchange rate (0.044789) and the lagged price (-0.049121), both statistically significant, that those reported in the table. Since cointegration and exogeneity tests also resulted very similar across the two specifications, we only report those of the baseline equation.[11]

On the other hand, the coefficients of c_5, c_6 and c_7 that account for the short term effects also have the expected signs, but their statistical significance varies across regressions. Also, the adjusted-R^2 and the F-statistic respectively suggest that equation (6) has good data fit and overall statistical significance. Lastly, the recursive and rolling regression estimations show that the coefficients are stable (in the appendix we present the corresponding graphs for the error correction term coefficients).

[11] The rest of the tests are available from the authors upon petition.

Table 2
Estimation Results of Price Error Correction Models of Perfectly and Imperfectly Competitive Manufactures

Dependent Variable		c2	c3	c4	c5	c6	c7	Adj. R^2	F-stat.	Prob(F-stat)
CPI	Coeff..	0.0318	0.0414	-0.0727	0.6321	0.0230	0.0247	0.9007	120.5421	0
	Std. Error	0.0069	0.0059	0.0111	0.0828	0.0313	0.0284			
	t-Stat.	4.6250	6.9773	-6.5217	7.6318	0.7348	0.8676			
	Prob.	0.0000	0.0000	0.0000	0.0000	0.4633	0.3866			
CORE MERCHANDISE PRICE INDEX	Coeff..	0.0120	0.0303	-0.0432	0.7664	0.0719	0.0215	0.9195	151.5052	0
	Std. Error	0.0051	0.0080	0.0119	0.0695	0.0263	0.0159			
	t-Stat.	2.3520	3.8010	-3.6210	11.0275	2.7360	1.3480			
	Prob.	0.0196	0.0002	0.0004	0.0000	0.0068	0.1791			
CORE SERVICES PRICE INDEX	Coeff..	0.0177	0.0244	-0.0423	0.4903	0.0339	0.0103	0.8720	90.74364	0
	Std. Error	0.0088	0.0044	0.0106	0.0919	0.0395	0.0259			
	t-Stat.	2.0199	5.4702	-4.0436	5.3328	0.8587	0.3962			
	Prob.	0.0447	0	0.0001	0	0.3915	0.6924			
P of PERFECTLY COMPETITIVE MANUFACTURES	Coeff.	-0.00095	0.04738	-0.04999	0.62899	0.04959	0.06349	0.82071	61.31508	0
	Std. Error	0.00373	0.01440	0.01693	0.09483	0.03570	0.04055			
	t-Stat.	-0.25546	3.29045	-2.95284	6.63258	1.38881	1.56591			
	Prob.	0.79860	0.00120	0.00350	0.00000	0.16640	0.11890			
P of IMPERFECTLY COMPETITIVE MANUFACTURES	Coeff.	0.01350	0.03604	-0.05237	0.68805	0.11909	0.01400	0.90994	134.13810	0
	Std. Error	0.00401	0.00730	0.00990	0.07158	0.02639	0.00976			
	t-Stat.	3.36584	4.93997	-5.29289	9.61225	4.51227	1.43439			
	Prob.	0.00090	0.00000	0.00000	0.00000	0.00000	0.15300			
P of PERFECTLY COMPETITIVE MANUFACTURES OR WITH IMP. PEN. >30%	Coeff.	0.002975	0.030111	-0.035658	0.746559	0.052167	0.048703	0.89874	117.9492	0
	Std. Error	0.002833	0.010276	0.012602	0.077808	0.025739	0.02811			
	t-Stat.	1.050228	2.930103	-2.829653	9.594936	2.026749	1.73261			
	Prob.	0.2948	0.0038	0.0051	0	0.044	0.0847			
P of IMPERFECTLY COMPETITIVE MANUFACTURES WITH IMP. PEN < 30%	Coeff.	0.020218	0.052435	-0.075853	0.56548	0.149384	0.003489	0.865407	85.7224	0.0000
	Std. Error	0.005234	0.007237	0.010074	0.074954	0.036979	0.011005			
	t-Stat.	3.862994	7.245489	-7.529308	7.544315	4.039721	0.317049			
	Prob.	0.0001	0	0	0	0.0001	0.7515			

Method: Least Squares
Sample(adjusted): 1985:02 2003:10
Included observations: 225 after adjusting endpoints
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

One of the features in which inflation of perfectly and imperfectly competitive industries differ is on the degree of inertia. Price formation in perfectly competitive industries relies significantly less on past inflation than in imperfectly competitive industries. In the first case, the lagged inflation coefficient is 0.30 and in the second 0.76. In the other three cases the lagged inflation coefficient is somewhat larger for the perfectly competitive industries and somewhat lower for the imperfectly competitive ones. Due to the core services component and the fact that perfectly competitive manufactures have a low share in the merchandise component, the CPI's lagged inflation coefficient is closer to that of the imperfectly competitive inflation (0.63).

Next, in Table 3 we show the estimations of the long run pass-through coefficients λ_w and λ_e. As expected, given the values of c_2, c_3 and c_4 obtained, the coefficients' magnitudes in the CPI equation coincide with the previous studies: if the exchange rate depreciates by 10 percent then prices increases by 5.7 percent, while if wages costs increase by 10 percent prices increase by 4.4 percent. In the case of core merchandise inflation the exchange rate pass-through is 0.70, while the wage pass-through is 0.28. In contrast, pass-through coefficients for the inflation rate in the perfectly competitive industries differ significantly, since wage variations have a nil effect and price dynamics depend only on the exchange rate.[12] However, the results for imperfectly competitive industries inflation are closer to those of core services inflation (partly due to the weight they have on the index) with exchange rate and wage pass-through coefficients of 0.69 and 0.26, respectively, using the Panzar-Rosse classification. The pass-through coefficients are similar independently of the threshold of import to domestic sales that we use and for different specifications of the Panzar-Rosse revenue equation.

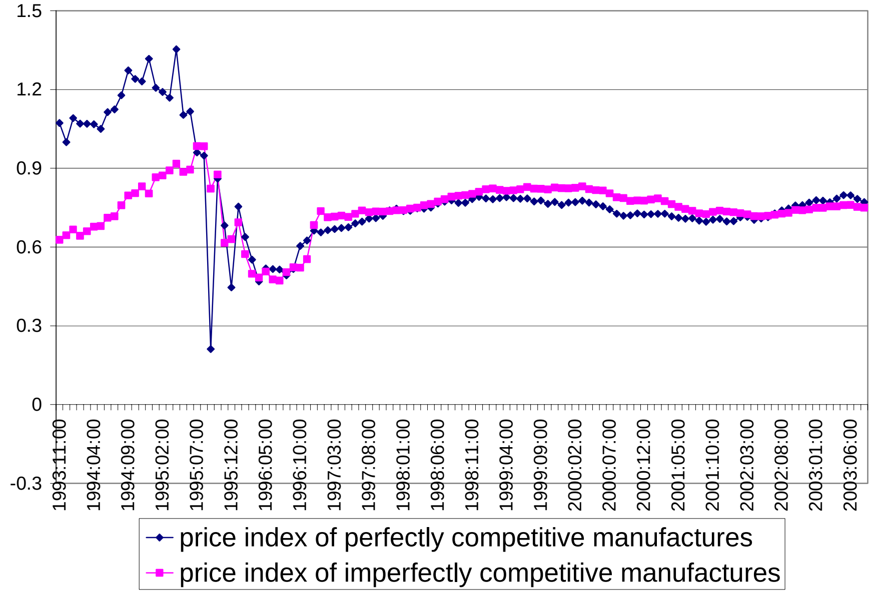
Table 3
Pass-Through Coefficients of Wage and Exchange Rate of Perfectly and Imperfectly Competitive Manufactures

Dependent Variable	λw	λe
CPI	0.4370	0.5690
CORE INFLATION MERCHANDISE	0.2771	0.7013
CORE INFLATION SERVICES	0.4150	0.5723
P of PERFECTLY COMPETITIVE MANUFACTURES	-0.0190	0.9478
P of IMPERFECTLY COMPETITIVE MANUFACTURES	0.2577	0.6881
P of PERFECTLY COMPETITIVE MANUFACTURES OR WITH IMP. PEN. >30%	0.0834	0.8444
P of IMPERFECTLY COMPETITIVE MANUFACTURES WITH IMP. PEN < 30%	0.2665	0.6913

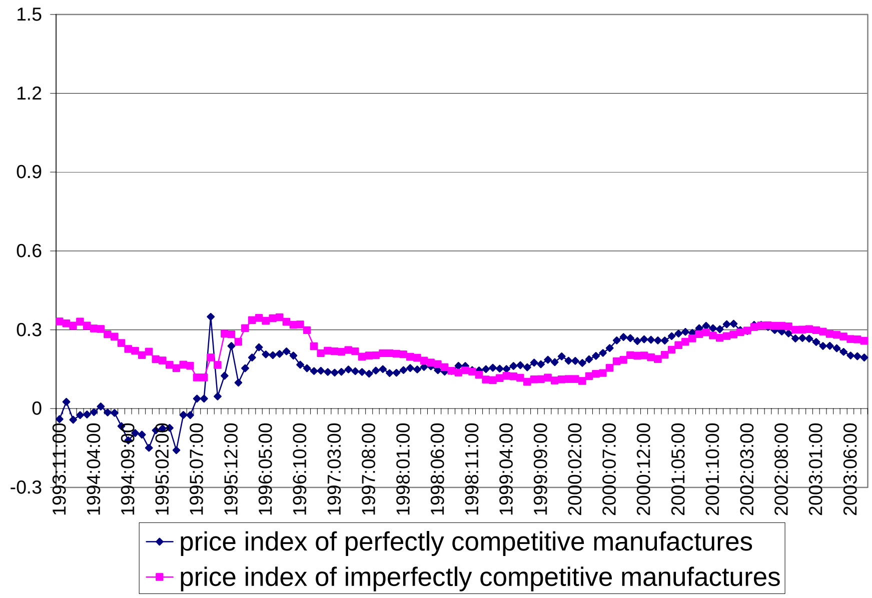
In addition, Graph 4 and 5 displays the pass-through coefficient dynamics with a rolling regression estimation. They provide an additional grasp of their stability through time, specially after 1996. For both wages and the exchange rate periods in which the prices of one sector show a higher pass-through than the other are observed. After 2002, it seems that the exchange rate pass through has been higher for the perfectly competitive index and lower for the imperfectly competitive index, while the wage pass through has had the opposite pattern.

[12] See note

Graph 4
Rolling Regression Estimates of the Exchange Rate Pass Through



Graph 5
Rolling Regression Estimates of the Wage Pass-Through



4. Some Policy Implications

The results in this paper show that the Mexican manufacturing industry is predominantly characterized by an imperfectly competitive structure. Also, it finds that the inflation dynamics of perfectly and imperfectly competitive industries have significant differences. For instance, the evidence we find shows that in the long run perfectly competitive manufactures prices are affected solely by exchange rate variations. This pattern is consistent with the law of one price. On the other hand, in imperfectly competitive manufactures wage variations also affect prices, which in principle is consistent with a cost push.

The cost-push view of the wage-price dynamics implies that monetary policy and the resulting inflation environment do not matter in determining the ability of firms to pass forward higher wage costs in the form of higher product prices. Higher wage growth should lead to higher future inflation irrespective of the monetary policy stance and the inflation history. Thus, this view requires in addition to the existence of a long term relationship between prices and wages, which is sustained for both the perfectly and the imperfectly price indexes in the cointegration tests we perform, that this long term relationship is in fact the long term price equation in which wages can be considered exogenous (Mehra, 2000). To verify this possibility we check the weak exogeneity properties of the variables included in the price relationship estimating a vector error correction model with the key analysis variables (see appendix). The estimations do not result supportive of the cost push view of inflation because the only weakly exogenous variable of the system is the price level.[13] Hence, this finding suggests that the central bank's policy does matter in determining the ability of firms to pass forward higher wage costs in the form of higher product prices.

An additional feature is that perfectly competitive manufactures have a lower degree of inflationary inertia than imperfectly competitive industries. This may imply different employment responses, with less employment adjustment where prices vary more. The classification of industries used to build the price indexes can be used to build output and employment indexes with the MIS data. This variables can be put together in vector autorregressions to obtain the impulse response functions of two sectors that differ on their degree of price stickiness to innovations in future research. On the other hand, this feature

[13] In fact, the perfectly competitive price index satisfies the weak exogeneity condition barely. But additional Granger causality tests do reject the hypothesis that this price index does not cause wages and do not reject the hypothesis that wages cause prices.

would also suggest that an inflationary bout could produce a significant relative price misalignment between the goods produced in perfectly and imperfectly competitive industries. Evidently, when inflation is trending downwards the effect would the opposite, producing a reallocation of resources within the manufacturing industry. All this aspects may be analyzed with a multi-sector theoretical model in the fashion of Ohanian, Stockman and Kilian (1995) or Bils and Klenow (2002).

Another interesting finding of this study is the high degree of coincidence among industries with high import penetration and industries with a Panzar-Rosse statistic value suggestive of perfect competition in the manufacturing sector. Evidently the power of import competition to discipline prices is well recognized among economists. But the present results, together with the fact that data requirements to calculate import penetration ratios are less than those to estimate indicators of an industry's structure or competition level, beg questioning whether the price formation processes described are solely explained by foreign competition.[14] To address this issue we calculated the price indexes for manufactures with an import penetration rate higher and lower than 30 percent of total sales and, within these two groups, the price indexes for manufactures with a Panzar-Rosse statistic equal or less than 1. Then we estimated the price equation for this six categories. This exercise shows that among manufactures with a high import penetration rate, the perfectly competitive ones again exhibit higher exchange rate coefficients and lower wage coefficients. This pattern is also observed among manufactures with a low import penetration rate. As a result, the wage pass-through was not significant for the price of manufactures with a high import penetration rate, regardless of the degree of competition suggested by the Panzar-Rosse statistic, and its significance in the price of manufactures with a low import penetration rate can be traced to those where the Panzar-Rosse statistic is compatible with imperfect competition (see appendix).

Therefore, these findings suggest an affirmative answer to the question regarding the role of trade liberalization in a successful disinflation story, when a country's domestic markets are characterized by imperfect competition (Rogoff, 2003). However, higher exchange rate pass-through and lower inertia of competitive manufactures inflation implies a higher

[14] In 1993 when Mexico signed the NAFTA and passed a constitutional amendment to forbid monopolistic practices, passed a competition law and created a federal trade commission to perform its mandate.

volatility than in imperfectly competitive . The deepening of the globalization process and its extension to the service sector makes foreseeable that industries will be subject to a higher degree of competition. An implication of this process may be that, ceateris paribus, CPI variations will depend even more on the evolution of the exchange rate. Also, this may imply that for a certain level, inflation will be more volatile and therefore more costly to keep within a target band during a short span of time. Also, higher industry competition may translate into lower inflationary inertia and consequently a diminished role for monetary policy stimulus over the coming years. All these aspects constitute an interesting research agenda.

Finally, the evidence suggests that inflation of perfectly competitive manufactures precedes that of imperfectly competitive manufactures. Hence, monitoring the evolution of the first price index might prove to be useful in order to identify future inflationary pressures in the economy.

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6. Appendix

Table A1
Industry Structure According to Panza-Rosse Classification and Share of Imports

Generic	*CPI Weight*	*Panzar - Rose*	*Imports > 30%*
Fresh meat	1.2037	PERF COMP	X
Sweaters for kids	0.0207	PERF COMP	X
Glass and refractory products	0.0861	PERF COMP	X
Eyeglasses	0.1888	PERF COMP	X
Pharmaceutical products	1.2040	PERF COMP	
Fresh fish and seafood	0.5611	PERF COMP	
Coffee	0.0329	PERF COMP	
Chocolate	0.0601	PERF COMP	
Tequila	0.2771	PERF COMP	
Rum	0.1224	PERF COMP	
Batteries	0.0259	PERF COMP	
Cars	3.3030	PERF COMP	
Books	1.0238	IMP COMP	X
Insecticide	0.0845	IMP COMP	X
Furniture, mainly of wood	0.8228	IMP COMP	X
Outerwear for men	0.7480	IMP COMP	X
Outerwear for women	0.3932	IMP COMP	X
Uniforms	0.2511	IMP COMP	X
Outerwear for kids	0.5085	IMP COMP	X
Socks	0.0635	IMP COMP	X
Wine	0.0975	IMP COMP	X
Films, plates and photography paper	0.0998	IMP COMP	X
Car lubricants	0.1434	IMP COMP	X
Tires	0.1322	IMP COMP	X
Electric appliances	0.5778	IMP COMP	X
Music players	0.3002	IMP COMP	X
Washing and drying machines	0.1410	IMP COMP	X
Watches, jewelry and imitation jewellery	0.0512	IMP COMP	X
Canned meat and sausages	0.9186	IMP COMP	
Milk	1.8649	IMP COMP	
Milk derivatives	0.9688	IMP COMP	
Condensed, evaporated and maternalized milk	0.0474	IMP COMP	
Canned fruits and vegetables	0.3767	IMP COMP	
Soups	0.0461	IMP COMP	
Canned fish and seafood	0.1744	IMP COMP	
Rice	0.1500	IMP COMP	
Wheat milling	0.0304	IMP COMP	
Corn flour	0.0362	IMP COMP	
Generic cookies	0.0837	IMP COMP	
Bakery	0.9841	IMP COMP	
Cooking oil	0.3210	IMP COMP	
Sugar	0.2073	IMP COMP	
Soluble coffee	0.1183	IMP COMP	

Powder gelatins	0.0311	IMP COMP
Snacks and other corn products	0.0967	IMP COMP
Other cooked food	0.5272	IMP COMP
Grape spirits	0.1009	IMP COMP
Other spirits	0.1375	IMP COMP
Beer	1.4633	IMP COMP
Cigarettes	0.6002	IMP COMP
Healing material	0.0234	IMP COMP
Sheets, bedspreads and table cloth	0.2861	IMP COMP
Handbags, suitcases and belts	0.0867	IMP COMP
Athletic footwear	0.4553	IMP COMP
Other house furnishing	0.0632	IMP COMP
Newspapers and magazines	0.3654	IMP COMP
Perfumes and lotions	0.4625	IMP COMP
Detergents	0.3885	IMP COMP
Deodorants	0.0875	IMP COMP
Household plastic articles	0.0420	IMP COMP
Toys	0.3656	IMP COMP
Electric light bulbs	0.0441	IMP COMP
Music disks and tapes	0.3537	IMP COMP
Stoves and ovens	0.0540	IMP COMP
Refrigerators and freezers	0.1423	IMP COMP
Heating devices and house wares	0.0206	IMP COMP
Bicycles	0.0229	IMP COMP
Dental equipment	0.2383	IMP COMP

Table A2
Cointegration Test: Price Index of Perfectly Competitive Manufactures, Wage and Real Exchange Rate

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.142166	46.17143	29.68	35.65
At most 1 *	0.053928	16.88259	15.41	20.04
At most 2 *	0.032416	6.294125	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 3 cointegrating equation(s) at the 5% level
Trace test indicates 1 cointegrating equation(s) at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.142166	29.28883	20.97	25.52
At most 1	0.053928	10.58847	14.07	18.63
At most 2 *	0.032416	6.294125	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LOG(INPCOMP13)	LOG(E*CPIEU)	LOG(W3)
-20.28224	17.62031	3.381288
-14.87362	10.45014	2.314473
2.932722	5.370933	-8.174258

Unrestricted Adjustment Coefficients (alpha):

D(LOG(INPCOMP13))	0.002507	0.001175	0.000166
D(LOG(E*CPIEU))	-0.0029	0.006129	-0.004917
D(LOG(W3))	-0.002318	0.002552	0.001501

1 Cointegrating Equation(s): Log likelihood 1544.599

Normalized cointegrating coefficients (std.err. in parentheses)

LOG(INPCOMP13)	LOG(E*CPIEU)	LOG(W3)
1	-0.868756	-0.166712
	-0.0808	-0.07771

Adjustment coefficients (std.err. in parentheses)

D(LOG(INPCOMP13))	-0.050845
	-0.01365
D(LOG(E*CPIEU))	0.058818
	-0.06577
D(LOG(W3))	0.047022
	-0.0254

2 Cointegrating Equation(s): Log likelihood 1549.893

Normalized cointegrating coefficients (std.err. in parentheses)

LOG(INPCOMP13)	LOG(E*CPIEU)	LOG(W3)
1	0	-0.108663
		-0.26757
0	1	0.066818
		-0.31666

Adjustment coefficients (std.err. in parentheses)

D(LOG(INPCOMP13))	-0.068316	0.056447
	-0.01675	-0.01364
D(LOG(E*CPIEU))	-0.032347	0.012954
	-0.08053	-0.06559
D(LOG(W3))	0.009067	-0.014183
	-0.03103	-0.02528

Sample(adjusted): 1986:02 2001:12
Included observations: 191 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: LOG(INPCOMP13) LOG(E*CPIEU) LOG(W3)
Exogenous series: FEB MAR ABR MAY JUN JUL AGO SEP OCT NOV DIC
Warning: Critical values assume no exogenous series
Lags interval (in first differences): 1 to 12

Table A3
Cointegration Test: Price Index of Imperfectly Competitive Manufactures, Wage and Real Exchange Rate

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.129332	42.2419	29.68	35.65
At most 1 *	0.049945	15.78953	15.41	20.04
At most 2 *	0.030943	6.003521	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 3 cointegrating equation(s) at the 5% level
Trace test indicates 1 cointegrating equation(s) at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.129332	26.45237	20.97	25.52
At most 1	0.049945	9.786009	14.07	18.63
At most 2 *	0.030943	6.003521	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LOG(INPOLIG13)	LOG(E*CPIEU)	LOG(W3)
-29.24659	20.69056	9.006888
18.48801	-7.533189	-9.059211
-5.192329	10.01129	-5.651408

Unrestricted Adjustment Coefficients (alpha):

D(LOG(INPOLIG13))	0.001621	-0.000361	0.000488
D(LOG(E*CPIEU))	-0.000933	-0.008524	-0.001358
D(LOG(W3))	-0.00138	-0.001331	0.0024

1 Cointegrating Equation(s): Log likelihood 1627.774

Normalized cointegrating coefficients (std.err. in parentheses)

LOG(INPOLIG13)	LOG(E*CPIEU)	LOG(W3)
1	-0.707452	-0.307964
	-0.06092	-0.05928

Adjustment coefficients (std.err. in parentheses)

D(LOG(INPOLIG13))	-0.047395
	-0.01299
D(LOG(E*CPIEU))	0.027285
	-0.09569
D(LOG(W3))	0.040364
	-0.03758

2 Cointegrating Equation(s): Log likelihood 1632.667

Normalized cointegrating coefficients (std.err. in parentheses)

LOG(INPOLIG13)	LOG(E*CPIEU)	LOG(W3)
1	0	-0.737264
		-0.09213
0	1	-0.606827
		-0.13598

Adjustment coefficients (std.err. in parentheses)

D(LOG(INPOLIG13))	-0.054075	0.036251
	-0.01533	-0.00975
D(LOG(E*CPIEU))	-0.130301	0.044908
	-0.11047	-0.0703
D(LOG(W3))	0.015761	-0.018531
	-0.0443	-0.02819

Sample(adjusted): 1986:02 2001:12
Included observations: 191 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: LOG(INPOLIG13) LOG(E*CPIEU) LOG(W3)
Exogenous series: FEB MAR ABR MAY JUN JUL AGO SEP OCT NOV DIC
Warning: Critical values assume no exogenous series
Lags interval (in first differences): 1 to 12

Table A4
Weak Exogeneity Test: Price Index of Perfectly Competitive Manufactures, Wage and Real Exchange Rate

Cointegrating Eq:	CointEq1		
LOG(INPCOMP13(-1))	1		
LOG(E(-1)*CPIEU(-1))	-0.868756		
	-0.0808		
	[-10.7519]		
LOG(W3(-1))	-0.166712		
	-0.07771		
	[-2.14528]		
C	2.660731		
Error Correction:	D(LOG(INPCOMP13))	D(LOG(E*CPIEU))	D(LOG(W3))
CointEq1	-0.050845	0.058818	0.047022
	-0.01365	-0.06577	-0.0254
	[-3.72376]	[0.89425]	[1.85120]
R-squared	0.917425	0.337236	0.827176
Adj. R-squared	0.889513	0.113204	0.768757
Sum sq. resids	0.012292	0.285225	0.042538
S.E. equation	0.009304	0.044818	0.017308
F-statistic	32.86786	1.505299	14.15928
Log likelihood	650.6609	350.3775	532.1031
Akaike AIC	-6.300114	-3.155785	-5.058672
Schwarz SC	-5.465761	-2.321432	-4.224319
Mean dependent	0.01965	0.018912	0.021242
S.D. dependent	0.027991	0.047592	0.035992
Determinant Residual Covariance		4.62E-11	
Log Likelihood		1544.599	
Log Likelihood (d.f. adjusted)		1459.667	
Akaike Information Criteria		-13.71379	
Schwarz Criteria		-11.15965	

Vector Error Correction Estimates
Sample(adjusted): 1986:02 2001:12
Included observations: 191 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Table A5
Weak Exogeneity Test: Price Index of Imperfectly Competitive Manufactures, Wage and Real Exchange Rate

Cointegrating Eq:	CointEq1		
LOG(INPOLIG13(-1))	1		
LOG(E(-1)*CPIEU(-1))	-0.707452		
	-0.06092		
	[-11.6119]		
LOG(W3(-1))	-0.307964		
	-0.05928		
	[-5.19506]		
C	2.222568		
Error Correction:	D(LOG(INPOLIG13))	D(LOG(E*CPIEU))	D(LOG(W3))
CointEq1	-0.047395	0.027285	0.040364
	-0.01299	-0.09569	-0.03758
	[-3.64960]	[0.28514]	[1.07396]
R-squared	0.955085	0.325345	0.818028
Adj. R-squared	0.939903	0.097293	0.756517
Sum sq. resids	0.005347	0.290342	0.044789
S.E. equation	0.006137	0.045218	0.01776
F-statistic	62.90754	1.426624	13.29879
Log likelihood	730.149	348.6792	527.1775
Akaike AIC	-7.13245	-3.138002	-5.007094
Schwarz SC	-6.298097	-2.303649	-4.172742
Mean dependent	0.020174	0.018912	0.021242
S.D. dependent	0.025032	0.047592	0.035992
Determinant Residual Covariance		1.93E-11	
Log Likelihood		1627.774	
Log Likelihood (d.f. adjusted)		1542.842	
Akaike Information Criteria		-14.58473	
Schwarz Criteria		-12.03059	

Vector Error Correction Estimates
Sample(adjusted): 1986:02 2001:12
Included observations: 191 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Table A6
Estimation Results of Price Error Correction Models of Manufactures with Import Penetration Rate above and below 30 Percent

Dependent Variable		c2	c3	c4	c5	c6	c7	Adj. R^2	F-stat.	Prob(F-stat)
PRICE INDEX OF MANUFACTURES WITH IMP. PEN >30%	Coeff.	0.00356	0.02365	-0.02983	0.77127	0.05345	0.03592	0.92708	168.5264	0
	Std. Error	0.00257	0.00666	0.00877	0.07244	0.01851	0.02024			
	t-Stat.	1.38722	3.55164	-3.40210	10.64752	2.88845	1.77434			
	Prob.	0.16690	0.00050	0.00080	0.00000	0.00430	0.07750			
PRICE INDEX OF MANUFACTURES WITH IMP. PEN >30% AND ψ^* =1	Coeff.	0.00615	0.03431	-0.04378	0.72725	0.03638	0.02745	0.92024	153.0212	0
	Std. Error	0.00304	0.00807	0.01088	0.08572	0.02124	0.02062			
	t-Stat.	2.02004	4.25486	-4.02503	8.48359	1.71310	1.33096			
	Prob.	0.04470	0.00000	0.00010	0.00000	0.08820	0.18470			
PRICE INDEX OF MANUFACTURES WITH IMP. PEN >30% AND ψ^* <1	Coeff.	0.00882	0.02416	-0.03421	0.76490	0.09218	0.02191	0.89887	118.1188	0
	Std. Error	0.00414	0.00659	0.00880	0.05564	0.03312	0.01288			
	t-Stat.	2.13197	3.66479	-3.88952	13.74777	2.78321	1.70102			
	Prob.	0.03420	0.00030	0.00010	0.00000	0.00590	0.09040			
PRICE INDEX OF MANUFACTURES WITH IMP. PEN <30%	Coeff.	0.01252	0.04375	-0.05878	0.66556	0.11335	0.02708	0.88499	102.3863	0
	Std. Error	0.00423	0.01050	0.01351	0.07849	0.03160	0.01548			
	t-Stat.	2.95958	4.16882	-4.35210	8.47978	3.58735	1.74968			
	Prob.	0.00340	0.00000	0.00000	0.00000	0.00040	0.08170			
PRICE INDEX OF MANUFACTURES WITH IMP. PEN <30% AND ψ^* =1	Coeff.	0.00964	0.02908	-0.04031	0.58733	0.08845	0.00682	0.78272	48.46494	0
	Std. Error	0.00655	0.00607	0.00879	0.09284	0.02937	0.01789			
	t-Stat.	1.47061	4.79289	-4.58858	6.32661	3.01178	0.38129			
	Prob.	0.14290	0.00000	0.00000	0.00000	0.00290	0.70340			
PRICE INDEX OF MANUFACTURES WITH IMP. PEN <30% AND ψ^* <1	Coeff.	0.01011	0.04860	-0.06218	0.60535	0.14006	0.03490	0.84177	71.09921	0
	Std. Error	0.00426	0.01241	0.01527	0.08437	0.03738	0.02077			
	t-Stat.	2.37306	3.91506	-4.07239	7.17473	3.74672	1.68072			
	Prob.	0.01860	0.00010	0.00010	0.00000	0.00020	0.09430			

Method: Least Squares
Sample(adjusted): 1985:02 2003:10
Included observations: 225 after adjusting endpoints
Newey-West HAC Standard Errors & Covariance (lag truncation=4)

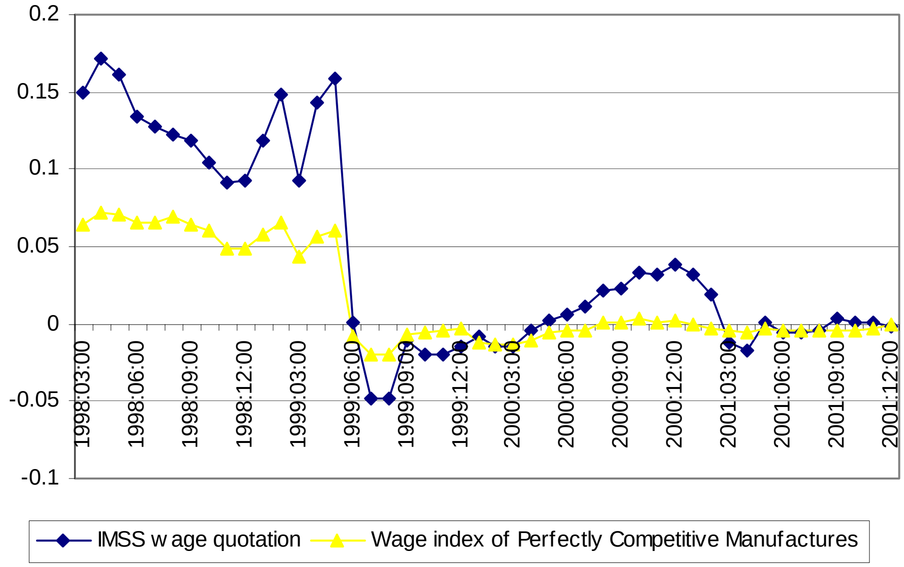
Table A7
Pass-Through Coefficients of Wage and Exchange Rate of Manufactures with Import Penetration Rate above and below 30 Percent

Dependent Variable	λw	λe
PRICE INDEX OF MANUFACTURES WITH IMP. PEN >30%	0.1195	0.7928
PRICE INDEX OF MANUFACTURES WITH IMP. PEN >30% AND ψ^* =1	0.1404	0.7838
PRICE INDEX OF MANUFACTURES WITH IMP. PEN >30% AND ψ^* <1	0.2577	0.7062
PRICE INDEX OF MANUFACTURES WITH IMP. PEN <30%	0.2129	0.7443
PRICE INDEX OF MANUFACTURES WITH IMP. PEN <30% AND ψ^* =1	0.2390	0.7214
PRICE INDEX OF MANUFACTURES WITH IMP. PEN <30% AND ψ^* <1	0.1626	0.7815

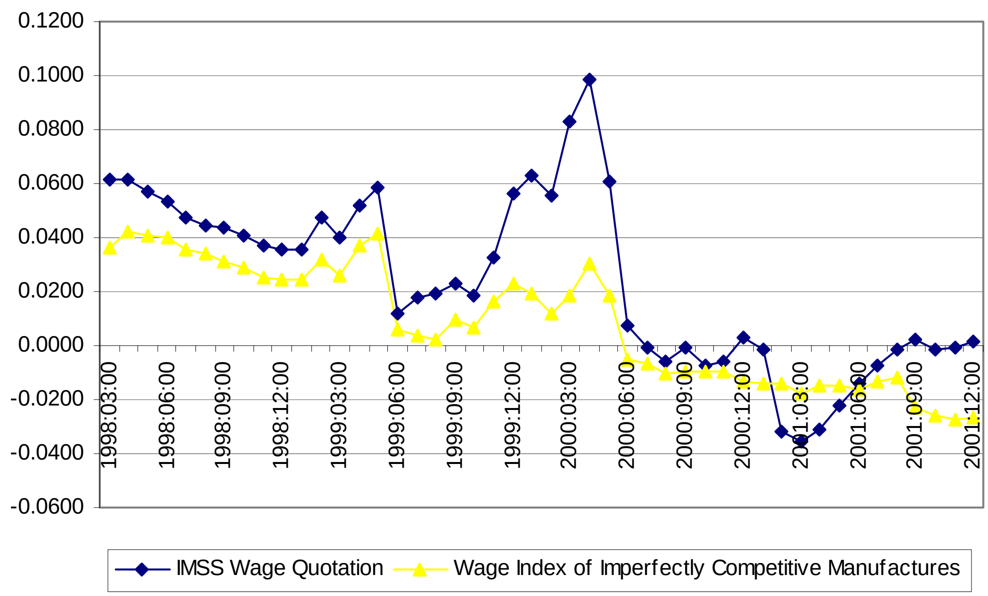
Wald Coefficient tests.
*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

Graph A1
Rolling Regression Estimates of the Labor Cost Coefficient Using Different Wage Measures

Perfectly Competitive Manufactures



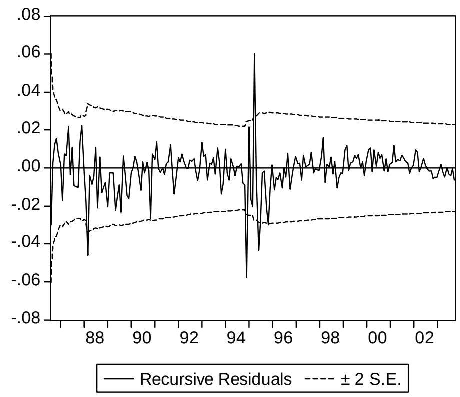
Imperfectly Competitive Manufactures



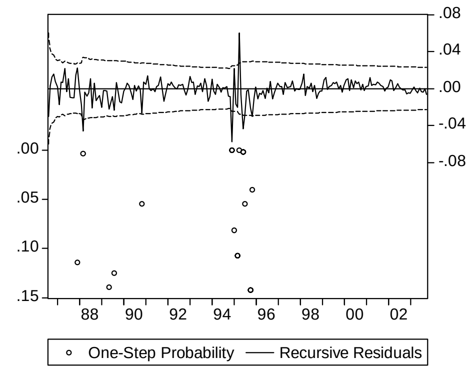
Graph A2

Stability Tests of the equation for the Price Index of Perfectly Competitive Manufactures

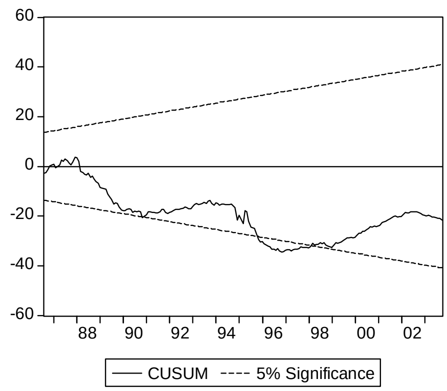
A.2.1 Recursive residuals



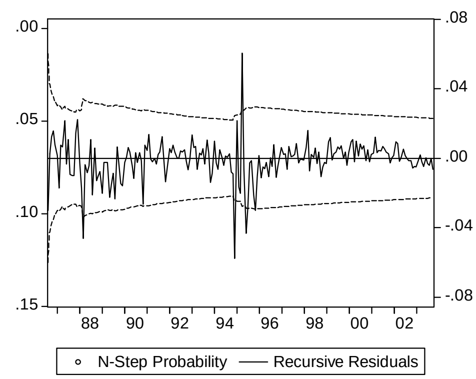
A.2.4 One Step Forecast Test



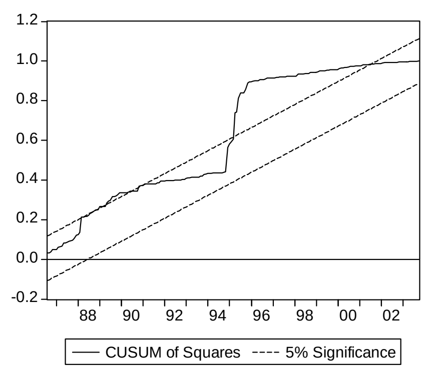
A.2.2 CUSUM test



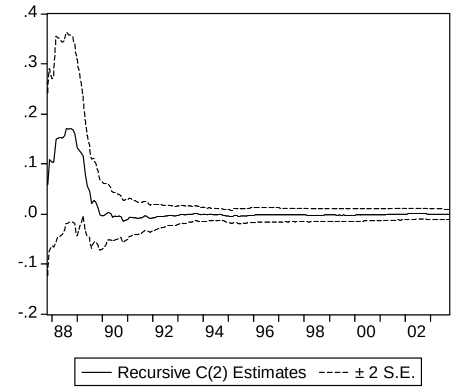
A.2.5 N-Step Forecast Test

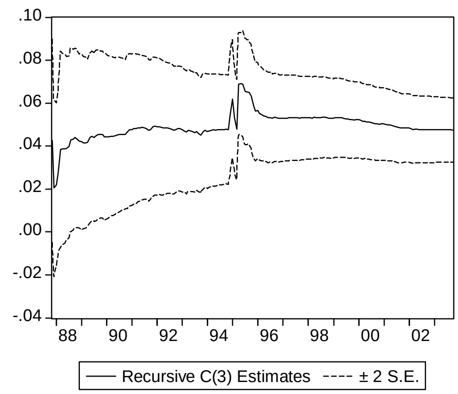


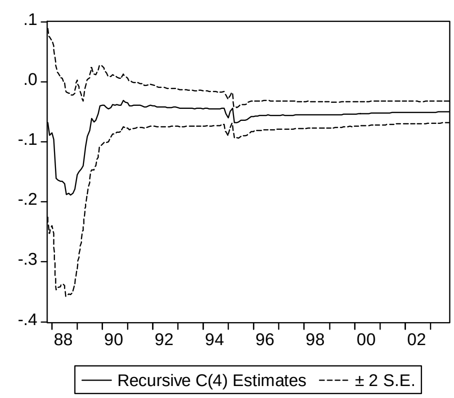
A.2.3 CUSUM of Squares test



A.2.6 Recursive estimates of the error correction term coefficients c_2, c_3 and c_4

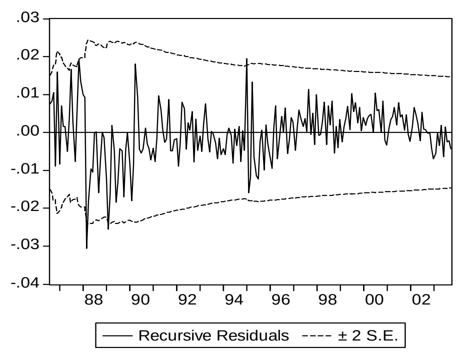




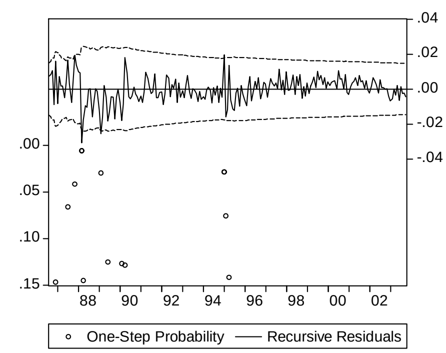


Graph A3
Stability Tests of the equation for the Price Index of Imperfectly Competitive Manufactures

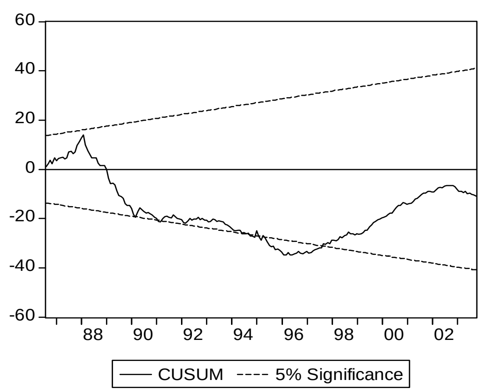
A.3.1 Recursive residuals



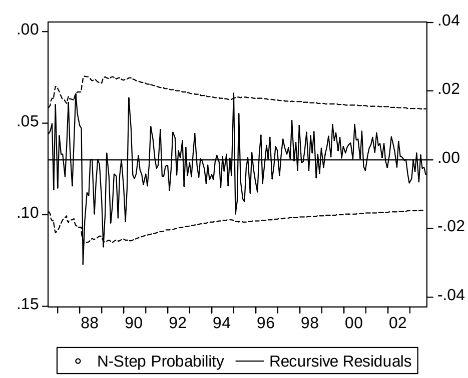
A.3.4 One Step Forecast Test



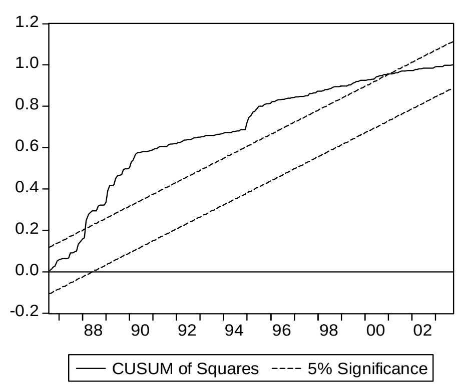
A.3.2 CUSUM Test



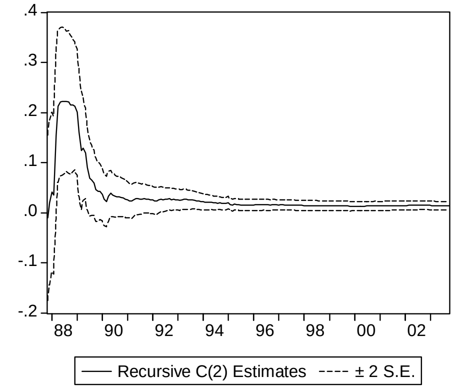
A.3.5 N-Step Forecast Test

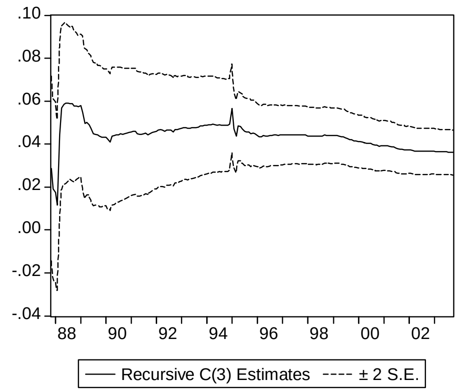


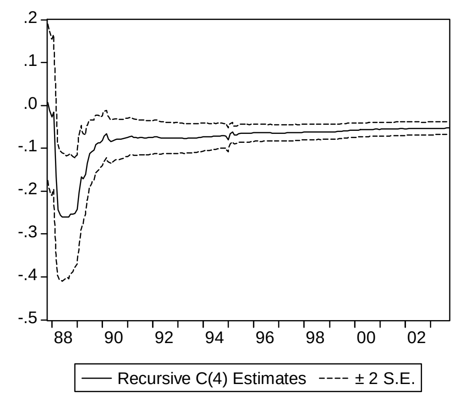
A.3.3 CUSUM of Squares Test



A.3.6 Recursive estimates of the error correction term coefficients c_2, c_3 and c_4







Graph A4
Rolling Regression Estimates of the Price Equation Error Correction Term's Coefficients

Dependent Variable: Price Index of Perfectly Competitive Manufactures	Dependent Variable: Price Index of Imperfectly Competitive Manufactures