New Directions in Price Test for Market Definition

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NEW DIRECTIONS IN PRICE TESTS FOR MARKET DEFINITION

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ABSTRACT
The appropriate definition of the relevant market is the main task in competition cases. But this definition, and its application, has proved difficult in abuse of dominance cases, mainly because of the cellophane fallacy. I offer new interpretations for the cointegration test and its vector error correction representation, in antitrust market definition. Then I apply them to define the beer market in Uruguay as an example.

JEL: C22, C32, L40, L66.

I. INTRODUCTION

Competition policy sets a framework to avoid actions from firms with market power which may reduce social welfare. As market power is difficult to measure directly, competition agencies rely on indirect evidence to evaluate the competition effect of mergers or other business practices by firms.[1] In brief this procedure starts by defining the relevant market where firms compete, taking into account barriers to entry, and finally measuring firms market shares. The result of this various measures (narrow markets, high barriers to entry, high market shares of the firms involved, high switching costs for consumers, atomistic competitors, and the like) should presume the existence of market power, or dismiss it.

The "Horizontal Merger Guidelines"[2] issued by the U.S. Department of Justice (DOJ) and the Federal Trade Commission (FTC) in 1982, and its revisions in 1984, 1992 and 1997, have set the standard to evaluate relevant antitrust markets in merger analysis. Although this framework is highly abstract to be applied literally, it also establishes a very detailed framework to delimit markets in antitrust analysis.

Nevertheless, in abuse of dominance or monopolization cases there is not a general rule for relevant market delineation. Abuse of dominance cases are different in nature from merger cases. In the latter the focus is made on the enhancement or creation of market power through mergers between firms. In abuse of dominance cases, the focus is on actions by firms designed to sustain existing market power, or to create it if firms do not already have it. In this setting, applying the "Merger" provisions is difficult because of the well known "cellophane fallacy".

Instead, some authors have proposed price tests to define antitrust markets. These tests are associated with the law of one price (LOP), and study the behaviour of different product prices in order to establish integration between markets. With a few exceptions these analysis have hardly been used in antitrust cases for either relevant product or geographical market definition, although it requires less information than structural analysis.

This paper proposes a new interpretation for cointegration tests in the relevant market definition. I contend that the long run relationship, if it exists, could be interpreted as a reaction function of a dynamic price game. Also, weak exogeneity of one product can signal the existence of a price leader in the market. As an example, I apply this new interpretations to the beer market in Uruguay. This sector is a suitable example as one firm has 96% of the market. As a result, some controversies exist on how to set its boundaries or if it is needed to expand it to neighbour's markets. My conclusion is that beer is a separate antitrust market, or if one is to accept a broader market definition, the beer producer is the price setter in this expanded market.

The paper is organized as follows. In the next section, traditional definitions of relevant markets are briefly reviewed. Next, I briefly describe price tests and offer new theoretical interpretations of the cointegration relationship for antitrust market definition. In section IV, price tests are applied to the Uruguayan beer sector. Section V shows the main conclusions.

II. TRADITIONAL DEFINITIONS OF RELEVANT MARKET

The methodology set out in the *Guidelines* is now standard for relevant market delineation in antitrust cases.[3] They define a market as the set of products in which a hypothetical monopolist could benefit imposing a non transitory

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Disclaimer: part of this work was done when the author was working for the antitrust agency in Uruguay conducting an investigation on the beer market.

1 *See* Massimo Motta, COMPETITION POLICY: THEORY AND PRACTICE (Cambridge University Press, 2004), at Chapter 3.

2 Hereinafter *Guidelines*.

3 *See* Jeffrey Church and Roger Ware, INDUSTRIAL ORGANIZATION: A STRATEGIC APPROACH (McGraw-Hill, 2000) at Chapter 19 Massimo Motta, COMPETITION POLICY: THEORY AND PRACTICE, *supra* note 1, at Chapter 3.

increase in price.[4] This idea, and further elaborations included in the *Guidelines* are the main reference for relevant market definition for various antitrust agencies.[5]

This analysis, however, could be misguided if used on monopolization or abuse of dominance cases, as shown in the *Du Pont* case, which give rise to the label "cellophane fallacy".[6] The case was dismissed because the Supreme Court agreed with the firm that the market was flexible packaging materials, instead of cellophane. The firm argued that there was high substitution between cellophane and other flexible packaging materials. But high substitution could be the result of firm already having market power: as its pricing policy approach that of a monopoly, substitution tend to become higher and substitute goods tend to show up as prices increases.

The cellophane fallacy gives a word of caution when the SSNIP test is applied in monopolization cases, as it should not be applied to the prevailing market price, as in merger cases, but to more competitive ones. This solution advances further problems such as how to establish which should be the "competitive" price, as it is not observed in the market.[7] As a result, the SSNIP test is not suitable for monopolization cases. This was established either by defenders or detractors of the *Guidelines*.[8]

Taking into account these limitations, some author's advice is to use price tests to establish if products or geographical areas belong to the same relevant market. Stigler and Sherwin in 1985 define a market as the area in which the price is determined, and two products should be in the same market if their prices tend to co-move.[9] This methodology has its roots in the LOP which establish that if two commodities belong to the same market arbitrage should equate their prices in the long run or. Nonetheless, Geroski and Griffith point that there is no obvious relationship between market limits obtained applying this definition and the one set in the Guidelines.[10]

III. PRICE TESTS

The literature points to four price tests, which can be divided into descriptive tests and analytical ones. Descriptive tests are correlation analysis, and unit root tests. Analytical test are those associated with vector error correction models (VECM): cointegration, weak exogeneity and Granger causality.[11]

A. Descriptive tests

The first test was proposed by Stigler and Sherwin who study the correlation between the logarithm of the price of goods candidates to be in the same geographic market and their first differences.[12] If correlation is not high enough, one could presume that goods should not belong to the same product market.

A second test was proposed by Forni who analyses the stationarity of the log of the price ratio of products candidates to belong to the same relevant market.[13] If two goods belong to the same market we would expect that their price ratio should be stationary. If not, prices are driven away from each other and there is no arbitrage mechanism that binds them. Forni uses a unit root test to delineate the geographic market for Italian milk at the producer level, and Boshoff does the same for South Africa.[14]

Hosken and Taylor make the point that the lack of relevant information in the unit root test as proposed by Forni could result in misguided results.[15] The authors advocate for collecting adequate institutional information, and use this test as a complement of qualitative information. This should always be the case in dealing with quantitative

4 *See* U.S. Department of Justice and Federal Trade Commission, *Horizontal Merger Guidelines* (1997), at 4. This test is also know as the SSNIP test.

5 For the UE see the "Commission Notice on the definition of the relevant market for the purposes of the Community competition law" available at http://ec.europa.eu/comm/competition/antitrust/relevma_en.html (accessed the 6 of September, 2008). For the UK, see Office of Fair Trading, Market Definition, available at http://www.oft.gov.uk/shared_oft/business_leaflets/ca98_guidelines/oft403.pdf (accessed the 22 of June 2008).

6 *U.S. v. E.I. du Pont de Nemours & Co.*, 351 U.S. 377 (1956). See Jeffrey Church and Roger Ware, Industrial Organization: A Strategic Approach, *supra* note 3, at 599 – 600, for a brief discussion.

7 Massimo Motta, Competition Policy: Theory and Practice, *supra* note 4, at 105.

8 See, as an example, Lawrence H. White, *Market Definition in Monopoly Cases: A Paradigm is Missing,* New York University, Leonard N. Stern School of Business, Department of Economics Working Paper (2005); Gregory J. Werden, *Market Delineation under the Merger Guidelines: Monopoly Cases and Alternative Approaches,* Review of Industrial Organization, 16(2), 211-18 (2000); Mario Forni, *Using Stationarity Tests in Antitrust Market Definition*, American Law and Economics Review, 6(2), 441-64 (2004); and Paul A. Geroski and Rachel Griffith, *Identifying anti-trust markets*, Institute for Fiscal Studies Working Papers W03/01(2003).

9 George J. Stigler and Robert A. Sherwin, *The Extent of the Market*, Journal of Law & Economics, 28(3), 555-85 (1985).

10 Paul A. Geroski and Rachel Griffith, *Identifying anti-trust markets, supra* note 7. Justice been said that the *Guidelines* were though to be applied in merger cases. See also Luke M. Froeb and Gregory J. Werden, *Correlation, Causality, and all that Jazz: The Inherent Shortcomings of Price Tests for Antitrust Market Delineation*, Review of Industrial Organization, 8(2), 329-53 (1993), the reply by Robert A. Sherwin, *Comments on Werden and Froeb - Correlation, Causality, and all that Jazz*, Review of Industrial Organization, 8(2), 355-58 (1993), and the discussion in Neils Haldrup, *Empirical Analysis of Price Data in the Delineation of the Relevant Geographical Market in Competition Analysis*, University of Aarhus, Economics Working Paper (2003), at 4 - 7.

11 A detailed exposition of each of these tests can be found in Neils Haldrup, *Empirical Analysis of Price Data in the Delineation of the Relevant Geographical Market in Competition Analysis*, *supra* note.

12 George J. Stigler and Robert A. Sherwin, *The Extent of the Market*, *supra* note 8.

13 Mario Forni, *Using Stationarity Tests in Antitrust Market Definition*, *supra* note 7. Technically, if this is the case, then both prices are cointegrated with cointegration vector being $[-1,1]$.

14 Mario Forni, *Using Stationarity Tests in Antitrust Market Definition*, *supra* note 7 and Willem Boshoff, *Stationarity tests in geographic market definition: an application to South African milk markets*, South African Journal of Economics, 71(1), 1-14 (2007).

15 Daniel Hosken and Christopher T. Taylor, Discussion of "Using Stationarity Tests in Antitrust Market Definition", American Law and Economics Review, 6(2), 465-75 (2004) and Mario Forni, *Using Stationarity Tests in Antitrust Market Definition*, *supra* note 7.

information.

B. Analytical tests

The main analytical test is cointegration between product prices. Two or more product prices are cointegrated if the series co-move, that is there exists a long run relationship between them that sets at least one common path for the series. This analysis has been widely used to study financial market integration, but also in the geographic market delimitation for fed cattle, and in antitrust analysis to delineate -product and- geographic market for salmon in a merger case.[16]

The key element is to determine the number of cointegration relationships -if any- that exist in the system, in order to establish if there is one or more common stochastic trends in the series. If there are q series, and r cointegration relationships, then there are q-r common stochastic trends that set in motion the whole price system. Haldrup points that in order to define one relevant market the key element is to establish that only one common stochastic trend exists; e.g. q-r=1.[17] But this is not the only interpretation: Alexander and Wyeth maintain that the main point is to find if there is at last one cointegration relationship between the price series to establish one market.[18] In the next section, I offer new directions for interpretation.

A related test is Granger causality, that explains the channels through which the price series interact dynamically. If lagged values of one price series do not add new information to a second price series, other than information included in lagged values of this second one, then we should not view both goods as substitutes. We should expect two goods to belong to the same market if there is bi-directional Granger causality between them.[19]

Slade studies a stringent requirement as is the exogeneity of price series, and applies it to define the relevant market in the petroleum sector in USA.[20] She proposes that two goods belong to the same market if exogeneity is rejected for both goods.

It should be noted that the use of price tests in antitrust analysis have been seriously attacked by Coe and Krause.[21] The authors design an experiment in order to test the empirical performance of all the tests defined above. Their results show that price tests fail to correctly discern antitrust markets, with the exception of the correlation test. Their experiment is constructed upon small samples -up to 260 observations-, and this critique is directed to the well known power problems of unit root and cointegration tests in small samples.[22]

Price tests have been rarely used in antitrust analysis, and they have not been reported by antitrust agencies. An exceptions is the analysis of Copenhagen Economics which analyse geographic relevant market at the UE level for Scottish and Norwegian salmon, beer, tobacco, electricity and facial tissue.[23] For the beer market, they test the existence of one single market in the United Kingdom, Sweden, Holland, Italy, France and Germany through price tests at both the producer and the consumer level. They do not find evidence that support the existence of one relevant geographic market at the consumer level either for all countries or for groups of countries.[24]

C. New theoretical interpretations

This section try to advance informally some new directions for interpreting price tests. Cointegration analysis was mainly done in macroeconomics and finance, and its link with industrial organization awaits further developments.

Competition in differentiated products industries have been simply formalized through Bertrand and Hotelling models.[25] This models find equilibrium relations between prices in differentiated industries, mainly through reaction functions of prices which could be written as $p_i = f(p_{-i}, \theta)$ where p_{-i} is a vector of all prices less p_i and θ is a vector of cost and demand parameters. If $\frac{\partial p_i}{\partial p_{-i}} > 0$ then products are said to be substitutes, otherwise they are complements.[26]

In empirical analysis if two products are I(1) and they are cointegrated then they share one long run relationship. In this case they can be represented by a VECM which shows short run adjustment to the long run

16 Ted C. Shroeder, *Fed Cattle Spatial Transactions Price Relationships*, Journal of Agricultural and Applied Economics, 29, 347-62 (1997) and UK Competition Commission, *Nutreco Holding NV and Hydro Seafood GSP Ltd: A report on the proposed merger* (2000). See also Niels Haldrup, Peter Møllgaard, and Claus Kastberg Nielsen, *Sequential Versus Simultaneous Market Delineation: the Relevant Antitrust Market for Salmon*, Journal of Competition Law and Economics, 4, 893 – 913 (2008).

17 Neils Haldrup, *Empirical Analysis of Price Data in the Delineation of the Relevant Geographical Market in Competition Analysis*, *supra* note 10.

18 Carol Alexander and John Wyeth, *Cointegration and Market Integration: An Application to the Indonesian Rice Market*, Journal of Development Studies, 30(2), 303-34 (1994).

19 See Phillip A. Cartwright, David R. Kamerschen and Mei-Ying Huang, *Price Correlation and Granger Causality Tests for Market Definition*, Review of Industrial Organization, 4(2), 79-98 (1989).

20 Margaret E. Slade, *Exogeneity Test of Market Boundaries Applied to Petroleum Products*, The Journal of Industrial Economics, XXXIV(3), 291-303 (1986).

21 Patrick J Coe and David Krause, *An Analysis of Price-based Test of Antitrust Market Delineation*, Journal of Competition Law and Economics, 4(4), 983-1007 (2008)

22 See Helmut Lütkepohl, New Introduction to Multiple Time Series Analysis, Springer (2005).

23 Copenhagen Economics, *The internal market and the relevant geographical market: The impact of the completion of the Single Market Programme on the definition of the relevant geographical market*, UE Commission, DG Enterprise, Enterprise Paper 15 (2003).

24 See *Copenhagen Economics, The internal market and the relevant geographical market: The impact of the completion of the Single Market Programme on the definition of the relevant geographical market,* supra note, at 58.

25 *See* Oz Shy, Industrial Organization: Theory and Applications, The MIT Press (1996), at 135.

26 *See* Nirvikar Singh and Xavier Vives, *Price and Quantity Competition in Differentiated Duopoly*, The RAND Journal of Economics, 15(4), 546-54 (1984).

relationship.[27] Suppose two goods with prices p_1 and p_2 are both I(1) and are cointegrated. Then the VECM representation is:

$$\begin{pmatrix} \Delta p_{1t} = p_{1t} - p_{1t-1} = m_1 + \alpha_{11}(p_{1t-1} + \beta_{21} p_{2t-1}) + \varepsilon_{1t} \\ \Delta p_{1t} = p_{2t} - p_{2t-1} = m_2 + \alpha_{21}(p_{1t-1} + \beta_{21} p_{2t-1}) + \varepsilon_{2t} \end{pmatrix}$$

where m_i is a constant, α_{ij} are the loading coefficients, $\beta' = (1, \beta_{21})$ is the cointegration vector, and ε_{it} is a stochastic error term. These equations show the equilibrium relationship between prices, and the short run adjustment process to arrive to that equilibrium.

In this setting, the cointegration vector in the VECM could be reinterpreted as a reaction function in prices, as the equilibrium relationship shows how prices react to each other in the defined market. Goods will be substitutes if $\beta_{21} < 0$ and complements otherwise.

The VECM shows also the dynamic of the adjustment process between prices. But reaction functions in traditional models of competition in differentiated goods markets show a long run relationship, and there is no short run maladjustment. That is, there are no lags in the reaction function. Some models explicitly show the dynamic of the short run analysis.[28]

But the VECM also conveys additional information besides the sign of the cointegration relation. The loading coefficients (α_{ij}) indicate the speed of the adjustment to the long run equilibrium. Suppose now that there are two endogenous variables and one of the loading coefficients is zero, then this variable, say 1, is weakly exogenous in statistical terms. Now the VECM can be rewritten as,

$$\begin{pmatrix} \Delta p_{1t} = p_{1t} - p_{1t-1} = m_1 + \varepsilon_{1t} \\ \Delta p_{1t} = p_{2t} - p_{2t-1} = m_2 + \alpha_{21}(p_{1t-1} + \beta_{21} p_{2t-1}) + \varepsilon_{2t} \end{pmatrix}$$

This means that although both variables are linked in the long run, variable 1 do not adjust to the long run equilibrium and as a result it drives the whole system. In this setting, variable 1 puts competitive pressures to variable 2, but not the opposite. Note that testing weakly exogeneity of one variable is a way to detect the existence of the cellophane fallacy. Let's show this through one simple example.

Suppose that a monopolist faces potential product competition from the next best alternative in the country. Suppose that competition is more intense in this second market. If products are substitutes enough, then we could find cointegration between markets, as goods should share a common long run trend. Suppose now that we find that the monopolist product is weakly exogenous in the system. This means that the competition between firms in those markets is asymmetric. If we are interested in determine the competitive pressures, then the competitive fringe does not set a competitive constrain on the monopolist's ability to set prices, and as a result the market is the product produced by the monopolist. But instead we could also establish that the competitive fringe and the monopoly constitute a single market, when analyzing competitive forces in the second market. As a result of weakly exogeneity, the whole system price is set in motion by the monopolist and the competitive fringe adapts. The monopolist acts as a price leader.

This example points to the fact that if two markets are integrated, then firms in this single market should compete on the same grounds. Price competition models of product differentiation show that competition in these markets should have at last two empirical results. First, all but one coefficients of the cointegration relationship should be negative, and second weakly exogenous variables are not present. The first one points to the reaction function in this models; if both products are substitutes then they have to have opposite sign. The second one establishes how competition takes place, and which firm, if any, acts as a price leader and sets the price system in motion.

These informal interpretations are designed to ground empirical analysis with theoretic background, and do not exhaust the richer settings that can be found in market analysis.

IV. AN APPLICATION TO THE URUGUAYAN BEER MARKET

This section applies price tests to the beer market in Uruguay, testing wine as a possible substitute, in order to establish the relevant product market for beer. This analysis is an extension of the one made in an antitrust case in the beer market.[29]

This sector is interesting because a major beer producer exists in Uruguay -FNC S.A. (FNC)- as a result of the 2003 international merger of firms that owned the three main local producers. FNC has 96% of local beer sales, and the remaining 4% represent imports and sales of other small local producers. The three main brands, Pilsen, Patricia and Norteña account for nearly 90% of beer consumption before the merger, and today just Pilsen and Patricia account for that number.

Beer consumption is highly seasonal, mainly in summer -December, January and February, in that order-, with a pronounced drop in winter. Beer sales have suffered a sharp drop in annual sales after the 2002's Uruguayan economic crisis, growing thereafter but without reaching its previous levels. In 2006 beer consumption per capita was 21.7 liters per year.

The wine market has different characteristics. It is highly atomized with 268 wine cellars in 2007 and local

27 *See* Helmut Lütkepohl, New Introduction to Multiple Time Series Analysis, *supra* note 22, section 6.3.

28 *See* Curtis Eberwein and Ted To, *Simple Dynamic Oligopoly*, mimeo (2004).

29 The author was working at the Uruguayan Antitrust Office at that time.

sales account for 97% of total sales.[30] Although wine consumption also dropped in 2002, it has rapidly stabilized in 85 million liters, which represents 25 liters per capita per year.[31] Uruguayan wine has two very marked quality markets: one high quality market, called VCP "Vino de calidad Preferente" Preferred Quality Wine, which is sold in bottle of less than a liter; and one of lower quality mainly sell in bulk for resale. The high quality wine accounts just for 5,6% of total consumption, and the lower quality wine for the rest, although in different presentations.[32]

Both sectors have very different structure, but nearly similar consumption. The main difference is the seasonal characteristic of beer consumption.

Price data was obtained from the web site of the "Instituto Nacional de Estadística" which contains an index of articles that conform the Consumer Index Price for the period March 1997 - May 2008.[33] The database consist of 135 observations. The products were Beer (Cerveza) and Wine (Vino). All series were log transformed, in order to eliminate scale effects associated with each one. Price information is at the consumer level and is an average of different prices set by retailers. From now on reference to the series of logs of price index of each product will be either as series, price series or products indifferently.

The span of time is rather long and characterized by high inflation in Uruguay, compared to international standards. This poses some problems to perform price tests, in the sense that spurious relationships could emerge due to inflation. In order to manage these issues, tests will be conducted first for CPI deflated variables, in order to correct for inflation inertia in the period and avoid spurious relationships.

4.1 Previous Work

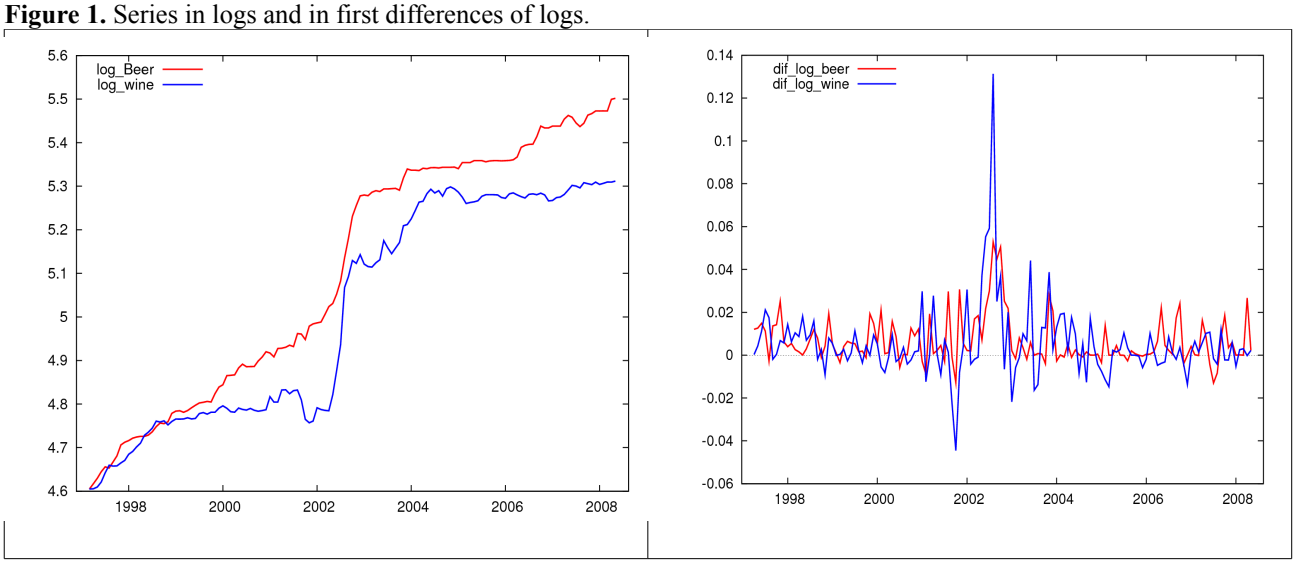
There is just one previous study of the beer sector in Uruguay.[34] They study the effects of a 2003 merger in the beer sector and its impact on price. They use price and quantity data to estimate the price elasticity of beer, and the cross price elasticity of wine and soft drinks, and finally the income elasticity. Their analysis span from January 1992 to June 2003. It is worth noting that the Uruguayan economy suffered a huge economic crisis in 2002 with a 10% drop in GDP, so it is difficult to disentangle the effects of the merger from the crisis in their analysis.

They estimate a VECM for beer quantity and price, using price of wine and soft drinks as substitutes for beer, and a wage index as a demand shifter. The estimated cointegration relationship between deflated variables, rejects wine as a substitute for beer. Nevertheless, FNC reveal information that shows that wine is cointegrated with beer but not with soft drinks. As this could be the result of the Cellophane Fallacy I used wine as a substitute of Beer in the analysis.

4.2 Unit root tests

The first step in the analysis of the relevant market is to check whether series have the same integration order. Figures 1 and 2 show the price series in levels and first differences, and deflated series in levels and first differences.

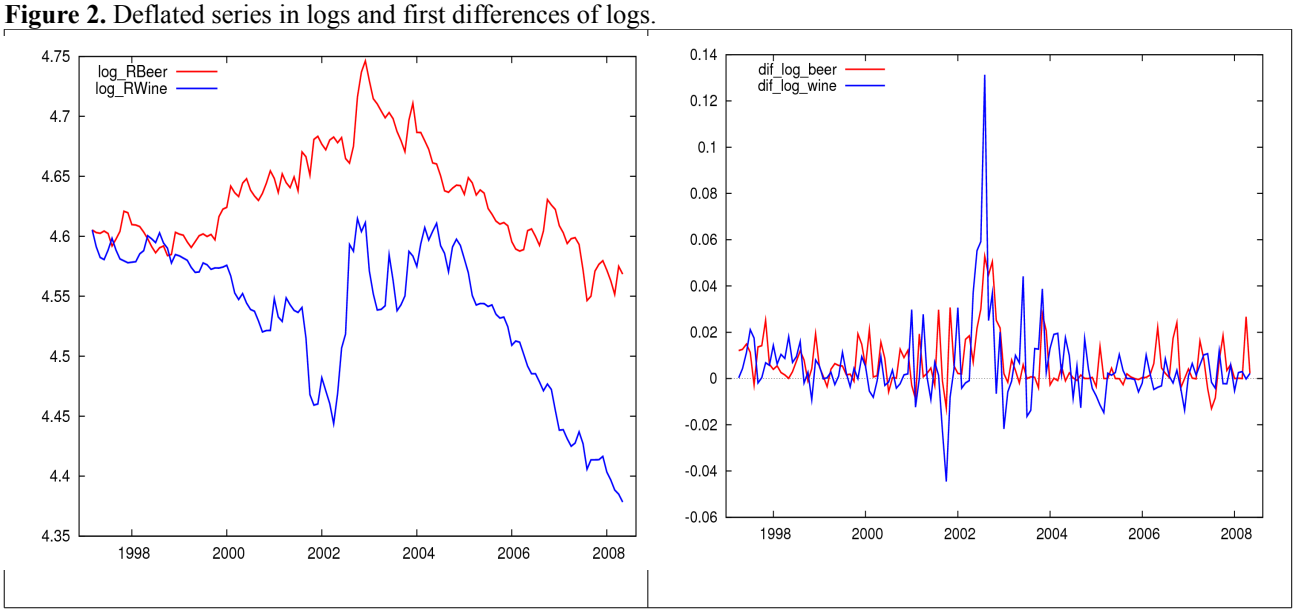
Figure 1. Series in logs and in first differences of logs.



Source: Author own calculations.

30 Source "Instituto Nacional de Vitivinicultura", www.inavi.com.uy
31 Source "Instituto Nacional de Vitivinicultura", www.inavi.com.uy
32 Data for 2006, but figures are rather stable.
33 Available at: http://www.ine.gub.uy/banco%20de%20datos/ipc/IPC%205%20gral%20rubagsubarfa%20M.xls, accessed on June 9th 2008.
34 *See* Natalia Melgar and Laura Rovegno, *La Defensa de la Competencia en Uruguay: un debate necesario.* Mimeo, Facultad de Ciencias Económicas y Administración (2004).

Figure 2. Deflated series in logs and first differences of logs.



Source: Author own calculations.

Visual inspection of the series in levels shows that wine and beer prices grow in the period, with a sharp impulse at the end of the year 2002. The wine deflated price shows a slow decrease until the end of the year 2002 -when it exhibits a jump- and then it continues decreasing. Beer price do not show a changing pattern until the end of 2002, when it slowly decreases.

Three unit root tests were run for each series: i- Augmented Dickey Fuller (ADF) test ; ii- Kwiatkowski Phillips Schmidt Shin (KPSS) test; iii- ADF with structural change test. Tests were chosen in order to limit problems in small samples, as in this case. In this regard, two different null hypothesis were chosen -stationarity, unit root- in order to limit bias.[35] ADF test with structural change was used in order to avoid non rejection of the null when there is no unit root but structural change in the series.[36] As previously shown, at the end of the year 2002 there was a sharp increase in all price indexes, as a result of a sharp depreciation of the *peso*, the Uruguayan currency. In the case of Wine the dummy variable takes a zero value up to August 2002 and one afterwards, and for Beer the zero value goes up to October 2002.

ADF tests were run in its three variants -no time trend zero mean, no time trend but nonzero mean, trend and nonzero mean-. If the null hypothesis was not rejected in none of the three test, then the unit root was not rejected. Akaike Information Criteria (AIC) was used to establish the optimal number of lags.

As the KPSS test is highly sensitive to lag inclusion 12 lags were chosen for all tests.[37] As the number of lags increases, the estimated parameter is lower and closer to the rejection area. If stationarity was rejected in the worst case scenario with a large number of lags, then it will also be rejected with a lower number of lags. In this case, the null hypothesis was rejected if rejected in any of KPSS tests -level stationary or trend stationary-.[38] Tests were run for series in levels and deflated by IPC, and results show that all of them are I(1), as shown in the following table.[39]

Table 1. Unit root tests for series in level.

	ADF	KPSS	ADF with structural change
Beer	non stationary*	non stationary**	non stationary*
Wine	non stationary*	non stationary*	non stationary*

Note: Critical values: *** 1%, ** 5%, * 10%.
Source: Author own calculations.

Table 2. Unit root tests for deflated series.

	ADF	KPSS	ADF with structural change
Beer	non stationary*	non stationary***	non stationary*
Wine	non stationary*	non stationary**	non stationary**

Note: Critical values: *** 1%, ** 5%, * 10%.

35 *See* Mario Forni, *Using Stationarity Tests in Antitrust Market Definition*, *supra* note 7.
36 *See* Walter Enders, Applied Econometric Time Series, 2nd Edition, Wiley (2004), at 200.
37 *See* Neils Haldrup, *Empirical Analysis of Price Data in the Delineation of the Relevant Geographical Market in Competition Analysis*, *supra* note 10.
38 All test are available upon request to the author.
39 As ADF and ADF with structural change are non rejection tests its significance is the inverse of the KPSS test; e.g. the worst scenario is when non rejection is at the 1% critical value.

Source: Author own calculations.

The results shows that all series are I(1). In the case of the series in levels, they show clearly that there is a stochastic trend in the series. The main point of this section is that all series are non-stationary. This means that traditional econometric analysis could lead to erroneous results because of the spurious regression problem pointed by Granger and Newbold.[40] This is the main explanation of why cointegration analysis is needed.[41]

4.3 Cointegration analysis

Results in previous sections show that inflation has played a mayor role in explaining actual correlation between price series. To check these results, cointegration analysis is performed in two different levels: first for the nominal series and then for the deflated ones. But cointegration analysis was also carried out because series are all non stationary.

For each series -nominal and deflated- the analysis was made in order to establish if there exists one common trend. Only the Johansen test with constant was used, as testing a trend implies that cointegration vectors have also a trend and this results in price differences growing without bounds, which in this setting does not make economic sense.[42] As with unit root tests, cointegration tests with and without structural change were run. All results show that residuals are not normal distributed, but Johansen cointegration test is robust to this result.[43] The next two tables shows the results.

Table 3. Cointegration Test: Beer and Wine Nominal Series.

No structural change			Structural change		
r0=	LR	pval	r0=	LR	pval
0	27.87	0.0029	0	37.48	0.0000
1	4.87	0.3085	1	8.04	0.2824
T =132, AIC endogenous lags = 3			T =132, AIC endogenous lags = 3		

Source: Author own calculations.

Table 4. Cointegration Test: Beer and Wine Deflated Series.

No structural change			Structural change		
r0=	LR	pval	r0=	LR	pval
0	6.59	0.9146	0	30.62	0.0017
1	0.46	0.9876	1	6.10	0.4910
T =130, AIC endogenous lags = 5			T =130, AIC endogenous lags = 5		

Source: Author own calculations.

The tests shows that one cointegration relationship exist for the series in levels. These results might be driven by inflation inertia, and the relationship could be spurious. To check these results the same analysis was carried out using deflated series in order to isolate the inflationary phenomena. Cointegration is found between Beer and Wine only if structural breaks are included in the cointegration test. This means that the cointegration relationship change in the period.

1. VECM and weak exogeneity

This section test the main theoretical propositions for Beer and Wine markets, analyzing VECM, and testing weak exogeneity. The analysis of the previous section shows that cointegration between both variables exists only if structural change is incorporated in the analysis. Then a VECM including one dummy variable in the analysis was estimated. This variable takes 0 value before August 2002, when wine price jump, and 1 after that. In this case, the cointegration relationship became significant with four lagged differences, restricting both the dummy variable and the constant to the cointegration vector. The two equations estimated in the VECM analysis are presented in the following chart, showing only the significant lags.

40 Clive W. J. Granger and Paul Newbold, *Spurious Regressions in Econometrics,* Journal of Econometrics, 2, 111-20 (1974).

41 *See* Robert F. Engle and Clive W. J. Granger, *Co-Integration and Error Correction: Representation, Estimation, and Testing,* Econometrica, 55(2), 251-76 (1987).

42 *See* Neils Haldrup, *Empirical Analysis of Price Data in the Delineation of the Relevant Geographical Market in Competition Analysis, supra* note 10, at 48.

43 See Jesus Gonzalo, *Five alternative methods of estimating long-run equilibrium relationships*, Journal of Econometrics, 60(1-2), 203-33 (1994).

Table 5. Cointegration Test: Beer and Wine Deflated Series.

Deflated Beer				Deflated Wine			
lag	Coef.	t-stat	pval	lag	Coef.	t-stat	pval
Beer (t-1)	-	-	-	Beer (t-1)	-0.279	-2.378	0.019
Beer (t-2)	-0.324	-3.350	0.001	Beer (t-2)	-0.211	-1.699	0.092
Beer (t-3)	-	-	-	Beer (t-3)	-0.263	-2.128	0.035
Beer (t-4)	-0.308	-3.162	0.002	Beer (t-4)	-0.324	-2.589	0.011
Wine (t-4)	0.194	2.839	0.005	Wine (t-4)	-	-	-
Load. Coef.	0.026	1.752	0.082	Load. Coef.	0.074	3.791	0.000
			Cointegration relationship				
Beer	1.000	0.000	0.000	Wine	-0.679	-2.346	0.019
T =130, AIC endogenous lags = 5							

Source: Author own calculations.

The dummy variable has a value of -0.1244 and the constant of -1.506 in the cointegration equation, and both are statistically significant (LR = 11.444, P-value = 0.003). The cointegration relationship shows that the estimated parameters have the right signs -positive for Beer, and negative for Wine-. The cointegration vector could be interpreted as a reaction function in prices, and the results show that products are substitutes. One caveat to this interpretation is that information is aggregated at the industry level, and theoretical reaction functions are at the firm level.

In the Wine equation, only Beer lags are significant -first, third and fourth- but none of the Wine lags are, and the short run adjustment parameter is also significant. In the Beer equation, the second and fourth lags of beer are significant and the fourth lag of Wine is, but interestingly the loading coefficient is nearly zero and hardly significant at the 90% level. As a result, a test over the loading coefficient in the Beer equation was run, and it could not be rejected that it is equal to zero.[44] This means that Beer is weakly exogenous in the VECM.

This result shows that the whole price system is set in motion by the Beer sector, as showed in section III.C. This means that the Beer market should be considered as a separate market, but should be included when analyzing the Wine market because prices are set in the long run taking into account Beer.

2. Caveats

It should be stressed that the normality assumption of the residuals is strongly rejected in both equations, but do not change the results from the cointegration test and analysis, as showed by Gonzalo (1994). Also, after a period of sharp depreciation of the peso, the residuals of the Wine equation display high volatility in the form of an ARCH process.[45] This result is interesting, because it shows that a more concentrated market display less volatility than a more competitive one.

5 CONCLUDING REMARKS

Technical difficulties exist for defining relevant antitrust markets in monopolization cases, using either structural analysis or price tests. In this setting, price tests might have a practical advantage for defining relevant antitrust markets in monopolization cases, as information requirements are lower than those for structural analysis.

I present two new interpretations for the VECM in price test analysis for the definition of antitrust markets. First, the cointegration relationship of product prices could be interpreted as a reaction function of a price game, in line with the conclusions of theoretical models, although they are inherently static. In this setting, it could be tested whether products are substitutes or complements. Second, weak exogeneity of one or more products could be tested in the estimated VECM. Firms which prices are weakly exogenous in the VECM are the price setters in the market. I apply this definitions to the beer market in Uruguay and found that wine and beer are substitute products and that beer is weakly exogenous in this extended market for the period.

44 LR = 2.499, pvalue = 0.11.

45 LM = 32.3912, pvalue = 0,0012, 12 lags used.