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Germán Coloma

Abstract

This paper presents alternative models of oligopoly behavior for the Argentine gasoline market and applies parametric estimations to analyze the effect that the Repsol-YPF merger had on that market. Using monthly data for the different provinces of Argentina during 1998-2000, we make an evaluation of that effect. After performing a series of nested and non-nested hypothesis tests, we conclude that we cannot reject the hypothesis that the market was a Cournot oligopoly before the merger, and after that it became one with a price leader (Repsol-YPF). This implies an efficiency loss estimated in more than $36 million per month.

JEL Classification Numbers: C33, L13, L71.

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The aim of this paper is to analyze the behavior of the Argentine gasoline market and to evaluate the competitive effects on that market of the merger between Repsol and YPF, which took place in August 1999. In doing so, we attempt to answer the following questions:

a) Did the merger have an impact on the prices and quantities traded in the market?

b) Which market structure explains the behavior of the industry better?

c) Did that structure change as a consequence of the merger?

d) Which are the welfare implications of that change?

In order to answer those questions, we use a data set that contains monthly gasoline price information by province for YPF during the period 1998-2000. We also use data on quantities, market shares, oil prices, population and GDP.

The paper is organized as follows. In the first section we provide a brief review of the literature about merger evaluation and we discuss the importance of the Repsol-YPF merger in the context of antitrust policy in Argentina. In the second we describe the basic characteristics of the Argentine gasoline market for the period under study, and the changes that took place as a consequence of the merger. In the third section we present the theoretical model used to answer our questions, and in the fourth we analyze the estimation results obtained. In the fifth section we derive some welfare implications, by calculating the changes suffered by the consumer, producer and government surpluses. Finally, the sixth section summarizes the main conclusions of the whole paper.

1. General overview

The literature about merger evaluation is diverse and has tried a variety of techniques to study the effects of mergers on market structure, price levels, profits and welfare. In his survey about mergers and acquisitions, Pautler (2001) distinguishes five basic approaches, which are stock market studies, large-scale econometric studies, clinical econometric case studies, structure-conduct-performance studies and experimental economics studies.

This study about the effects of the Repsol-YPF merger on the Argentine gasoline market is clearly a clinic econometric case study in Pautler's classification. Its importance can therefore be appraised by comparing it to some other studies that enter into the same category. One prominent example is Werden, Joskow and Johnson (1991), that measures the effects of two actual airline mergers on prices and service quality. The authors use a model that incorporates specific supply and demand variables, but their estimations are made using reduced-form equations. This allows them to get estimates of price and quality changes, but they are not able to translate those numbers into estimates of changes in consumer and producer surpluses.

Another important study in the same line is Baker and Bresnahan (1985), which is a study of the effects of a merger between two brewers that uses explicit demand and supply equations and is able to estimate both price and welfare changes that result from that merger. Its main drawback, however, is that it analyzes a fictitious merger, and it therefore uses only pre-merger data to make their estimations.

In a more recent example of a clinical merger study, Vita and Sacher (2001) applied a specific supply and demand framework to analyze the effect of an actual merger between two hospitals, using both pre-merger and post-merger data. Their approach uses a control group of hospitals that did not merge in order to contrast the results obtained for the hospitals that did merge, but once again the study only focuses on price changes and does not provide evidence on profit or welfare changes.

The three examples mentioned above evaluate mergers using a general market power approach, but they do not test alternative market behavior hypotheses before and after the merger. In general, the literature about oligopoly model testing has been developed to analyze market behavior in a context in which mergers may or may not happen[1], but it is not common to find examples that deal with cases in which there is a question about which market structure existed before and after the merger.

When mentioning the sectors that have been object of more intense merger study, Pautler (2001) refers to airlines, hospitals and banks, and does not mention the oil industry. This is because the studies that exist about mergers in the oil and fuel markets are generally oriented to issues related to finance and corporate governance (for example, Weston, Johnson and Siu, 1999) or focus on market concentration rather than explicit market behavior. An example of this last category is Hendricks and McAfee (2000), who study the merger between Exxon and Mobil in the context of different concentration measures that incorporate several horizontal and vertical dimensions that a merger may have.

Our study of the Repsol-YPF case, therefore, is novel in several respects. On one hand, it refers to a merger in a sector whose importance for the economy is very large, but has not been the object of intense scrutiny about the competitive and anticompetitive effects of mergers. On the other hand, it incorporates a well-established methodology developed to test market structure hypotheses in a context where it is likely that the merger has produced a change in that market structure. Finally, it is able to derive some welfare implications that had to do not only with price levels but also with profits and surpluses, estimating the efficiency changes that occurred in a market as a consequence of the merger.

It is worth noting that the acquisition of YPF by the Spanish firm Repsol is also important by itself. It is by far the largest merger in Argentine history, and it also ranks in

[1] The leading example of those studies is Bresnahan (1987), which contrasts several alternative hypotheses (basically price competition and collusion) to analyze the behavior of the American automobile industry in different years of the 1950's. In that study, the analyzed event was not a merger but a possible price war that ended a period of tacit cartel behavior.

the all-time top-ten list for both Latin American and Spanish mergers. Although the merger affected many markets, our focus will be exclusively put on the Argentine gasoline market, and on the horizontal effects that the merger had on that market. It can be argued that the main purpose of the merger was not horizontal but vertical, since the acquiring firm (Repsol) was stronger in refining and the acquired firm (YPF) was stronger in oil production and exploration. However, from a competitive point of view, the main concerns of the merger have been on the horizontal side, especially because YPF already had a very large market share in the Argentine gasoline market and Repsol already controlled a refining company (Eg3 SA) that was the fourth largest supplier in that market.

The Repsol-YPF merger also marked a turning point in the Argentine antitrust history. When the transaction was completed in August 1999, the existing competition law (Act No 22,262, from 1980) did not include a pre-merger notification procedure that allowed the Argentine antitrust agency to intervene before the merger had taken place. One month later the Argentine Congress passed a new competition act (Act No 25,156) that included such a procedure, and several congressmen even argued that the Repsol-YPF merger should be reviewed under the new act although it had occurred under the old antitrust regime. That opinion was finally disregarded, but nevertheless the merger involved a series of negotiations between Repsol and the Argentine government that ended in a commitment from the Spanish firm to sell its shares in Eg3 to another company that would be interested in entering the Argentine gasoline market. That commitment, however, was not fulfilled until December 2001, when Eg3 was finally bought by the Brazilian firm Petrobras.

2. Descriptive analysis

According to the statistics of the Argentine Department of Energy, total gasoline consumption in Argentina between 1998 and 2000 was equal to 15.51 million cubic meters. This was the result of processing an average of 2605 thousand cubic meters per month, and

implies an average of 11.9 liters per capita per month for the whole country. The average retail price of gasoline was equal to 40.35 cents per liter (without including taxes), and 94.84 cents per liter (if we include the 21% value added tax and a specific fuel tax that averages 46.02 cents per liter)[2]. Supply concentration in Argentina is relatively high for this market, as it is shown by the fact that the average Herfindahl-Hirschman Index (HHI) for 1998-2000 was 0.3428. This is strongly influenced by the fact that the largest supplier (YPF) had a market share whose average was equal to 47.75% (see table 1).

TABLE 1 – ARGENTINE GASOLINE MARKET – 1998/2000

Concept	Pre-merger	Post-merger	Average
Price without taxes ($/liter)	0.3621	0.4611	0.4035
Specific fuel tax ($/liter)	0.4608	0.4594	0.4602
Price with taxes ($/liter)	0.8989	1.0173	0.9484
Price oil WTI ($/liter)	0.0967	0.1813	0.1343
Consumption (liters/cap/month)	12.5407	11.0377	11.8652
Processed oil (Dam3/month)	2649.34	2549.34	2604.90
Concentration (HHI)	0.3119	0.3857	0.3428
YPF market share	0.4416	0.5275	0.4775

Source: Own calculations based on data from the Argentine Department of Energy.

The acquisition of the majority of YPF shares by Repsol in August 1999 had an important effect on some of the figures mentioned in the previous paragraph. As Repsol already controlled Eg3, which had an average market share of around 10%, the HHI concentration index jumped from 0.3119 (for the period January1998-August1999) to 0.3857 (for the period September1999-December2000). This was primarily a consequence of the fact that YPF alone had an average market share of 44.16% between January 1998 and August 1999, and Repsol-YPF as a whole (that is, YPF plus Eg3) had an average market share of 52.75% between September 1999 and December 2000.

[2] These numbers are the ones charged by YPF for the "ordinary premium gasoline" (between 92 and 97 octanes). They represent weighted averages for the whole country, and take into account the fact that there are provinces in which gasoline is exempted from specific fuel taxes. The reported Argentine cents are equivalent to US cents, since the Argentine peso had a fixed exchange rate of 1 with the US dollar during the whole period under analysis.

If we look at the average YPF price without taxes reported in table 1, this was equal to 36.21 cents/liter between January 1998 and August 1999, and it increased to 46.11 cents/liter for the period September1999-December2000. However, this increase is not necessarily a consequence of the Repsol-YPF merger. International oil prices also increased during the period (the WTI price averaged 9.67 cents/liter in January1998-August1999 and 18.13 cents/liter in September1999-December2000), and gasoline consumption was smaller (the average per capita consumption was 12.54 liters per month in January1998-August1999 and 11.04 liters per month in September1999-December2000).

The effects of the Repsol-YPF merger on the gasoline market concentration differed considerably in the different Argentine provinces. As Eg3 did not sell gasoline in every province, there are nine cases (Catamarca, Chaco, Corrientes, Jujuy, Mendoza, Misiones, Salta, Tierra del Fuego and Tucumán) in which concentration was virtually unaffected by the merger. Conversely, there are five provinces (Chubut, La Pampa, Neuquén, Río Negro and Santa Cruz) in which Eg3 was the second largest supplier and therefore the merger considerably pushed the concentration indices up. The other ten cases (Buenos Aires Province, Buenos Aires City, Córdoba, Entre Ríos, Formosa, La Rioja, San Juan, San Luis, Santa Fe and Santiago del Estero) lie between those extremes. This can be seen on table 2, which shows the pre-merger and post-merger HHI concentration indices for the 24 jurisdictions, and the corresponding YPF market shares.

To see if the Repsol-YPF merger really had an effect on gasoline prices, we made an initial set of two ordinary least square regressions for the data available. Both regressions used the YPF gasoline price as the dependent variable, and the independent variables were the 24 province dummies (the 23 Argentine provinces plus the city of Buenos Aires), 11 monthly dummies, 2 annual dummies, a merger dummy (0 for January1998-August1999, 1 for September1999-December2000), and the WTI oil price. The first regression included the HHI index as an additional variable, while the second used the YPF market share. The total number of observations was 864 (24 jurisdictions times 36 months) and the YPF gasoline prices were the retail “ordinary premium prices” (gasoline between 92 and 97

octanes) without taxes, that corresponded to the main urban area of each province. The HHI indices were calculated for each month for each province using quantity data provided by the Argentine Department of Energy, and the same data was used to calculate the YPF market shares. For the period January1998-August1999, YPF and Eg3 were considered as separate entities. For the period September1999-December2000, conversely, they were considered as a single entity in order to calculate the HHI indices and YPF market shares.

TABLE 2 – HHI CONCENTRATION INDICES AND YPF MARKET SHARES – 1998/2000

Jurisdiction	HHI		YPF Market Share	
	Pre-merger	Post-merger	Pre-merger	Post-merger
1. Santa Fe	0.2526	0.2644	0.3479	0.3688
2. Tucumán	0.2699	0.2819	0.3244	0.3123
3. City of Buenos Aires	0.2422	0.2934	0.3492	0.3933
4. Chaco	0.3368	0.3301	0.4521	0.4319
5. Córdoba	0.3043	0.3316	0.4721	0.5141
6. Province of Buenos Aires	0.2558	0.3366	0.3862	0.4973
7. Catamarca	0.3526	0.3538	0.5177	0.4979
8. Corrientes	0.3650	0.3581	0.4749	0.4713
9. Salta	0.4097	0.3819	0.5811	0.5419
10. Entre Ríos	0.3080	0.3905	0.4685	0.5597
11. Santiago del Estero	0.4957	0.4753	0.6717	0.6421
12. Misiones	0.4015	0.4818	0.5688	0.6602
13. Jujuy	0.5384	0.4922	0.7008	0.6521
14. La Rioja	0.4862	0.4968	0.6661	0.6670
15. Mendoza	0.5009	0.5081	0.6742	0.6833
16. Formosa	0.4757	0.5123	0.6397	0.6792
17. San Luis	0.2912	0.5172	0.4485	0.6672
18. Río Negro	0.4479	0.6241	0.6256	0.7781
19. La Pampa	0.3450	0.6834	0.4254	0.8178
20. Chubut	0.3993	0.6857	0.4544	0.8171
21. San Juan	0.5586	0.6886	0.7296	0.8209
22. Neuquén	0.5202	0.7300	0.6993	0.8472
23. Santa Cruz	0.5293	0.8270	0.6596	0.9070
24. Tierra del Fuego	0.9916	0.9874	0.9958	0.9936
Weighted Average	0.3119	0.3857	0.4416	0.5275

Source: Own calculations based on data from the Argentine Department of Energy.

The main results of the regressions performed appear on table 3. In it we see that in both cases the WTI oil price has a positive and significant effect on the gasoline price. The additional variables related to HHI, YPF market share and the Repsol-YPF merger are also

positive and significant in the two regressions. As the regressions are linear, the coefficients obtained have very direct interpretations. The estimated parameters for the WTI oil price, for example, imply that an increase in one cent per liter in the price of oil generates an average increase of around 0.43 cents per liter in the price of gasoline. Similarly, an increase of 0.01 in the HHI or in YPF's market share induces an average increase of 0.024 (in regression 1) or 0.022 (in regression 2) cents per liter of gasoline. Finally, the merger itself seems to account for an additional increase of 4.2 cents per liter.

TABLE 3 – PRICE REGRESSION RESULTS

Concept	Coefficient	Std error	P-value
Regression 1			
Constant Bs As City Jan 1998	0.318403	0.004239	0.0000
WTI Oil Price	0.426619	0.035199	0.0000
HHI Index	0.023773	0.007343	0.0013
Repsol-YPF Merger Dummy	0.042334	0.002597	0.0000
R-squared	0.973459		
Sum squared residuals	0.139899		
Regression 2			
Constant Bs As City Jan 1998	0.316262	0.004551	0.0000
WTI Oil Price	0.428463	0.035194	0.0000
YPF Market Share	0.022130	0.006916	0.0014
Repsol-YPF Merger Dummy	0.042486	0.002587	0.0000
R-squared	0.973451		
Sum squared residuals	0.139940		

As the merger implied an increase of the average HHI index from 0.3119 to 0.3857 and an increase of the average YPF market share from 0.4416 to 0.5275, the net estimated effect of the merger on the average gasoline price is 4.41 cents per liter (under regression 1) or 4.44 cents per liter (under regression 2). This implies that, absent the merger, average gasoline prices would have been around 10% lower (if we compute them without taxes) and around 5% lower (if we include the VAT and the specific fuel tax).

3. Theoretical model

In order to analyze the behavior of the Argentine gasoline market, we will develop four models of supply and demand and try to estimate their parameters. The models differ in the behavior that we assume for the supply, and correspond to four market structures: price taking, Cournot oligopoly, price leadership and collusion[3]. In all four cases, the demand has the same shape, given by the following price equation:

$$Pg + Tg = A_t + \beta_1 \cdot GDPpc + \beta_2 \cdot Dens + \beta_3 \cdot (Qg/Pop) \quad ;$$

where "Pg" is the gasoline price without taxes, "Tg" is the specific fuel tax (equal to 48.65 cents per liter in the city of Buenos Aires and 20 Argentine provinces, and equal to zero in Chubut, Santa Cruz and Tierra del Fuego), "GDPpc" is an estimation of the gross domestic product per capita (which varies by month and by province), "Dens" is the population density of each province, "Qg" is total gasoline consumption per province per month, and "Pop" is the population of each province. "A_t", "β_1", "β_2" and "β_3" are the parameters to be estimated, with "t" varying monthly and yearly. As we see, this function tries to capture the average demand of the Argentine person during 1998-2000, and it implicitly assumes that such a demand has the same shape in the whole country[4].

The other function that we need to estimate is the marginal cost of retail gasoline (MCg), for which we follow this specification:

$$MCg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil \quad ;$$

where "WTI" is the international crude oil price and "Oil" is the total quantity of oil processed in refining in Argentina during each month. "C_i", "γ_1" and "γ_2" are the parameters to be estimated, with "i" varying for each province. As we see, this function

[3] For a more complete explanation of the characteristics of these alternative models, see Coloma (1999).

[4] We tried additional specifications for the demand function (a logarithmic function instead of a linear one, a direct demand function instead of a price demand function) but we did not obtain improvements in the behavior of the regressions performed.

assumes that the basic determinants of the marginal cost of gasoline are the price of crude oil, the quantity of oil processed and a number of factors due to geographic location (summarized by a set of province dummies)[5].

According to the market structure that we assume, supply will behave differently. This difference in behavior has to do with the marginal revenue function that firms perceive (MRg)[6], which can be defined as follows:

$MRg = Pg$ (1: Price taking) ;

$MRg = Pg + \beta_3 \cdot HHI \cdot (Qg/Pop)$ (2: Cournot oligopoly) ;

$MRg = Pg + \beta_3 \cdot SYPF \cdot (Qg/Pop)$ (3: Price leadership) ;

$MRg = Pg + \beta_3 \cdot (Qg/Pop)$ (4: Collusion) ;

where "SYPF" is the market share of YPF (or Repsol-YPF, after the merger). Taking into account this, we can write a different supply price function for each market structure, by equating "MCg" with "MRg" and taking "Pg" as the dependent variable. This implies that:

$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil$ (1: Price taking) ;

$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot HHI \cdot (Qg/Pop)$ (2: Cournot oligopoly) ;

$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot SYPF \cdot (Qg/Pop)$ (3: Price leadership) ;

$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot (Qg/Pop)$ (4: Collusion) .

[5] We also tried to include other variables into the marginal cost function (e.g., gasoline consumption, interest rate, a merger dummy) but their estimated coefficients were never statistically significant.

[6] These alternative definitions of marginal revenue come from the first order conditions of different optimization and equilibrium problems. In a price-taking environment, firms maximize their own profit taking price as given. In a Cournot oligopoly, they maximize their own profit taking their competitors' quantities as given. In a perfectly collusive environment, the cartel of all firms maximize total joint profits. In a situation of price leadership, finally, the leading firm maximizes its own profit taking the reactions of the other firms as given. For this last case, we have assumed that the followers' supply is totally inelastic.

Although our model will be run using monthly data by province, the implicit idea behind it is that the relevant market that we are analyzing is national and not regional. Each province and each month is therefore treated as an observation of a market that is supposed to work under the same rules in the whole Argentine territory, and we will assume that the kind of competition that we observe is defined at a national level and not at a regional or local level. This is because we are interested in the behavior of the gasoline producers (which are firms that are partially integrated with their retailers and, in the majority of the cases, have national retail networks) and not in the behavior of the gasoline stations.

Another feature of the kind of analysis that we will perform is that we are considering gasoline as a homogeneous product rather than as a differentiated one. This is because we are interested in aggregate prices and quantities and not in the existence of local market power of each gasoline supplier on its own brand of gasoline. That is also why we will not test an explicit alternative model of Bertrand oligopoly. If marginal costs were constant, that model would be equivalent to the price-taking model. If, conversely, marginal costs were increasing, Bertrand oligopolies exhibit multiple equilibria, which imply a range of allocations around the price-taking equilibrium[7].

As we have found that, after the Repsol-YPF merger, there has been an increase in the gasoline price that cannot be fully explained by exogenous factors, we will try to explain it using endogenous factors, that is, market behavior. Given our four assumptions, there are at least eight different explanations for the increase. We will classify them using two-digit codes, which correspond to the market structure assumed before and after the merger:

12: Before the merger there was price taking; afterwards, there was Cournot oligopoly.

13: Before the merger there was price taking; afterwards, there was price leadership.

14: Before the merger there was price taking; afterwards, there was collusion.

22: Before and after the merger there was Cournot oligopoly.

23: Before the merger there was Cournot oligopoly; afterwards, there was price leadership.

[7] For a detailed explanation of this phenomenon, see Vives (1999), chapter 5.

24: Before the merger there was Cournot oligopoly; afterwards, there was collusion.

33: Before and after the merger there was price leadership.

34: Before the merger there was price leadership; afterwards, there was collusion.

Note that two explanations (22 and 33) assume that there has been no change of market structure after the merger, but merely the fact that in a more concentrated market the Cournot equilibrium and the behavior of a price leader would lead to higher prices. Conversely, the other six hypotheses imply a change in the structure of the market, that moves from a more competitive to a less competitive situation.

In order to estimate the supply price functions for these alternative hypotheses, we need to mix the original price functions and to use the Repsol-YPF merger dummy (Merge). This gives the following relationships:

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot Merge \cdot HHI \cdot (Qg/Pop) \quad (12)\ ;$$

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot Merge \cdot SYPF \cdot (Qg/Pop) \quad (13)\ ;$$

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot Merge \cdot (Qg/Pop) \quad (14)\ ;$$

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot HHI \cdot (Qg/Pop) \quad (22)\ ;$$

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot [(1-Merge) \cdot HHI + Merge \cdot SYPF] \cdot (Qg/Pop) \quad (23)\ ;$$

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot [(1-Merge) \cdot HHI + Merge] \cdot (Qg/Pop) \quad (24)\ ;$$

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot SYPF \cdot (Qg/Pop) \quad (33)\ ;$$

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot [(1-Merge) \cdot SYPF + Merge] \cdot (Qg/Pop) \quad (34)\ .$$

To perform an analysis about which model is better, we must contrast their relative explanatory power. Two approaches are possible to do this: a nested approach and a non-nested approach. To perform a nested approach it is necessary to run a general regression that includes all the models as particular cases. Then each case can be contrasted against the general model by testing the restrictions that it implies when we compare it to that model. In our context, we can write the general model in the following way:

$$Pg + Tg = A_t + \beta_1 \cdot GDPpc + \beta_2 \cdot Dens + \beta_3 \cdot (Qg/Pop) \quad ;$$

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \theta_1 \cdot \beta_3 \cdot (1\text{-}Merge) \cdot (Qg/Pop) - \theta_2 \cdot \beta_3 \cdot Merge \cdot (Qg/Pop) \quad ;$$

where "θ_1" and "θ_2" are market power coefficients for the pre-merger and the post-merger periods[8]. Theoretically, these coefficients should lie between 0 and 1. A coefficient of zero implies no market power at all, and can be identified with a situation of price taking. A coefficient of one implies maximum market power, and can be identified with a situation of perfect collusion. Under Cournot oligopoly the coefficients should equal the average HHI indices, while under price leadership they should be equal to the average market share of the leader.

The other way to contrast the different models is to treat them as non-nested hypotheses and to perform tests that compare each specific model against the others. The most direct of those tests is probably the J-test proposed by Davidson and MacKinnon (1981), which consists of running additional regressions that incorporate the results of one model as dependent variables of another model. In particular, the variation of this test that we will use implies running regressions of the following form:

$$Pg + Tg = A_t + \beta_1 \cdot GDPpc + \beta_2 \cdot Dens + \beta_3 \cdot (Qg/Pop) + \alpha \cdot [\overline{(Pg + Tg)}_1 - \overline{(Pg + Tg)}_0] \quad ;$$

$$Pg = C_i + \gamma_1 \cdot WTI + \gamma_2 \cdot Oil - \beta_3 \cdot X_0 + \alpha \cdot [\overline{Pg}_1 - \overline{Pg}_0] \quad ;$$

where "0" is the model that we want to test (null hypothesis) and "1" is the model that plays the role of alternative hypothesis. In this context, "$\overline{(Pg + Tg)}_0$" is the series of demand prices estimated by model 0, while "$\overline{(Pg + Tg)}_1$" is the series of demand prices estimated by model 1. Similarly, "$\overline{Pg}_0$" and "$\overline{Pg}_1$" are the series of supply prices estimated by those models, while "X_0" is the vector of variables that model 0 incorporates to the supply equation (which is different for each model).

[8] This idea of market power coefficients that vary in different periods first appeared in Porter (1983). For a general reference about it, see Bresnahan (1989).

Under this specification, what we test is the hypothesis that "$\alpha = 0$", that is, the idea that adding the values estimated by model 1 to the regression does not improve the explanatory power of model 0. In order to do this, we can look at the t-statistic of the estimated coefficient and its corresponding probability value. If this probability is high (e.g., more than 10%), then we cannot reject the hypothesis that "$\alpha = 0$" and therefore model 0 cannot be "beaten" by model 1. If it is low, then we can reject the hypothesis that "$\alpha = 0$" and therefore we can conclude that model 1 has enough explanatory power to improve the explanation given by model 0.

4. Estimation results

The first set of results that we will show consists of an estimation of the general model of demand and supply prices developed in the previous section, in order to perform a series of nested tests about the eight alternative hypotheses defined. To do this, we estimated a system of two equations using three-stage least squares. We therefore took into account the possible correlation between the equations and the fact that, in a model of demand and supply, prices and quantities are endogenous variables. To solve the endogeneity problem, we used the following exogenous variables as instruments: a constant, eleven monthly dummies, two annual dummies, twenty-three province dummies, WTI oil price, total population, population density and GDP per capita. The total number of observations is 864 (one per month per province) and the main results of the regressions are summarized on table 4.

As we see, the regressions are satisfactory in the sense that most of their variables are significant and have the expected signs. This is particularly true for the coefficient of consumption per capita in the demand price function (i.e., for the slope of the demand curve), which is negative and significantly different from zero. The coefficient for the GDP per capita is also significantly different from zero, and it is also negative (which would imply that gasoline is an "inferior good", at least in the short run). The coefficient for

population density, conversely, is positive (and it is also significant at any reasonable level).

TABLE 4 – GENERAL MODEL REGRESSION RESULTS

Concept	Coefficient	Std error	P-value
Demand price function			
Constant January 1998	1.057772	0.014283	0.0000
GDP per capita	-0.000011	0.000001	0.0000
Population density	0.000019	0.000001	0.0000
Consumption per capita	-0.012885	0.000609	0.0000
R-squared regression	0.695300		
Sum squared residuals	8.465576		
Supply price function			
Constant Buenos Aires City	0.297049	0.028905	0.0000
WTI oil price	0.827299	0.058075	0.0000
Oil quantity	-0.000046	0.000008	0.0000
Pre-merger market power (θ_1)	0.385933	0.065559	0.0000
Post-merger market power (θ_2)	0.585764	0.073929	0.0000
R-squared regression	0.933907		
Sum squared residuals	0.348380		
Total sum squared residuals	8.813956		

In the supply price function the situation is similar. The model captures a positive and significant effect of the WTI oil price on the gasoline price, while the coefficient for oil quantity is negative and significantly different from zero. This last phenomenon may be associated to the presence of scale economies in the observed production range. Finally, the estimated values for "θ_1" and "θ_2" (i.e, for the pre-merger and post-merger market power coefficients) are respectively equal to 0.385933 and 0.585764. They are also significantly different from zero, and significantly different between themselves[9].

To compare our eight specific models with this general model, we should test some implicit restrictions for the values of "θ_1" and "θ_2". In model 12, for example, "θ_1" is assumed to be equal to zero and "θ_2" is assumed to be equal to the average post-merger HHI, while in model 34 "θ_1" is assumed to be equal to the average YPF market share and "θ_2" is assumed to be equal to one. In order to test those restrictions we calculated a Wald

[9] The null hypothesis that "$\theta_1 = \theta_2$" generates a Wald coefficient of 32.89011, whose probability value is negligible.

coefficient for each model and associated it to a certain probability value. The results of those tests appear on table 5, which clearly shows that the only model that cannot be rejected at a reasonable probability level is model 23 (i.e., the one that assumes pre-merger Cournot competition and post-merger price leadership), for which that probability is 47.96%. On the other side, models 22 and 33 have relatively high Wald coefficients and very small probability values (0.07% and 0.34%), and all the other models have extremely high Wald coefficients (and their p-values are therefore negligible).

TABLE 5 – NESTED HYPOTHESIS TESTS

Null Hypothesis	θ_1	θ_2	Wald Coeff	P-value
Price taking-Cournot (12)	0.0000	0.3857	62.4768	0.0000
Price taking-Leadership (13)	0.0000	0.5275	121.9728	0.0000
Price taking-Collusion (14)	0.0000	1.0000	559.3168	0.0000
Cournot-Cournot (22)	0.3119	0.3857	14.4425	0.0007
Cournot-Leadership (23)	0.3119	0.5275	1.4698	0.4796
Cournot-Collusion (24)	0.3119	1.0000	197.3365	0.0000
Leadership-Leadership (33)	0.4416	0.5275	11.3567	0.0034
Leadership-Collusion (34)	0.4416	1.0000	106.8079	0.0000

As we also mentioned in section 3, an alternative approach to test which hypothesis is better consists of performing non-nested tests. In order to do this, we first have to regress each of our specific models, and generate the corresponding series of their estimated demand and supply prices. We did that using the same methodology employed for the general model regression (i.e., three-stage least squares), and the main results that we obtained are the ones that appear on table 6.

As we see, all the models have roughly the same R-squared coefficients for the demand price function, but models 12, 13 and 14 have considerably lower R-squared coefficients for the supply price function. Using the total sum of the squared residuals as an overall measure for the eight systems of equations, models 12, 13 and 14 exhibit the largest values (and therefore the poorest results) while the other five hypotheses have the smallest values (and are therefore better). This is strongly linked to the fact that the first three models are the ones with a worse fit in their supply price equations.

TABLE 6 – SPECIFIC MODELS REGRESSION RESULTS

Model	R-squared coefficients		Total sum squared residuals
	Demand	Supply	
Price taking-Cournot (12)	0,692462	0,708437	10,081250
Price taking-Leadership (13)	0,692951	0,662263	10,311064
Price taking-Collusion (14)	0,693314	0,611176	10,570246
Cournot-Cournot (22)	0,695556	0,880995	9,085720
Cournot-Leadership (23)	0,695596	0,857584	9,208119
Cournot-Collusion (24)	0,693544	0,838921	9,363424
Leadership-Leadership (33)	0,695610	0,871914	9,132113
Leadership-Collusion (34)	0,693608	0,858612	9,257841

To perform non-nested J-tests we need to re-regress each of our models including an additional coefficient (α), which corresponds to the series of demand and supply prices estimated by the other models. In our case, those tests are simply t-statistic tests about the significance of "α", when the original model is contrasted against each of the alternative hypotheses postulated. In table 7 we can see the main results of those tests, given by the t-statistics and p-values obtained when we contrasted models 22, 23, 24, 33 and 34 against each other[10].

TABLE 7 – NON-NESTED HYPOTHESIS TESTS

Model 0 / Model 1		22	23	24	33	34
Cournot-Cournot (22)	**t-stat**	---	1.444147	2.738174	-0.145148	2.462162
	p-value	---	0.0082	0.0062	0.8261	0.0139
Cournot-Leadership (23)	**t-stat**	-0.447848	---	1.107948	-0.631145	0.926093
	p-value	0.4164	---	0.2680	0.2306	0.3545
Cournot-Collusion (24)	**t-stat**	7.070034	6.863481	---	6.751249	2.551980
	p-value	0.0000	0.0000	---	0.0000	0.0108
Leadership-Leadership (33)	**t-stat**	1.144653	1.623861	2.690494	---	2.321978
	p-value	0.0839	0.0018	0.0072	---	0.0204
Leadership-Collusion (34)	**t-stat**	6.574113	6.445094	-0.956600	6.182691	---
	p-value	0.0000	0.0000	0.3389	0.0000	---

Once again, the tests show a clear preference for model 23 (i.e., the one that assumes that the market was as a Cournot oligopoly before the Repsol-YPF merger and

[10] We also performed non-nested tests that incorporated the other hypotheses, but their results do not alter the conclusions presented here.

after that it became a market with a price leader). This is the only model that, when playing the role of model 0, produces t-statistics that are low enough so that the hypothesis that "$\alpha = 0$" cannot be rejected in any case at any reasonable level of significance (its p-values are 0.4164 against model 22, 0.2680 against model 24, 0.2306 against model 33, and 0.3545 against model 34). Moreover, all the other models display relatively high t-statistics when they are contrasted against model 23, whose probability values for the hypothesis that "$\alpha = 0$" are less than 1% in all cases. This implies that model 23 is able to improve the explanations given by models 22, 24, 33 and 34, while the opposite is not true.

5. Welfare implications

The models presented in section 3 and the estimations performed in section 4 can be used to derive some welfare implications. They allow us to compare the post-merger market equilibrium with the equilibrium that could have taken place if the merger had not happened. Those equilibria generate different consumer and producer surpluses and different tax revenues, and we can therefore calculate the changes in efficiency and income distribution that occurred as a consequence of the merger.

In order to perform our exercise, we will use the general regression results that tell us that the marker power coefficient rose from a pre-merger level of 0.385933 to a post-merger level of 0.585764. The first figure that we have to calculate is the average post-merger marginal revenue. To do this, we used the data about gasoline prices and consumption for September1999-December2000 ($0.4611 per liter and 11.0377 liters per capita per month) and the estimated values for the parameters "β_3" (slope of the demand price function) and "θ_2" (post-merger marker power coefficient). We obtained that:

$$MRg_{post} = Pg_{post} + \beta_3 \cdot \theta_2 \cdot (Qg_{post}/Pop) = 0.4611 - 0.012885 \cdot 0{,}585764 \cdot 11.0377 = 0.3778 \quad .$$

As the implicit assumption in our models is that marginal revenue (MRg_{post}) is equated to marginal cost (MCg), the number calculated ($0.3778 per liter) can also be seen as an estimation of the average gasoline's marginal cost. Making use of that assumption, it

is possible to estimate which would have been the average consumption per capita if the Repsol-YPF merger had not happened. To do that we need to assume that in that case the market power coefficient would have remained equal to "θ_1" instead of "θ_2". This implies an estimated average consumption per capita (Qg*/Pop) equal to:

$$\frac{Qg^*}{Pop} = \frac{Pg_{post} - MCg - \beta_3 \cdot (Qg_{post} / Pop)}{-\beta_3 \cdot (1 + \theta_1)} =$$

$$= \frac{0.4611 - 0.3778 + 0.012885 \cdot 11.0377}{0.012885 \cdot (1 + 0.385933)} = 12.6287 \quad .$$

With this new quantity, together with the observed price and per capita consumption ("Pg_{post}" y "Qg_{post}/Pop") and the estimated slope of the demand price function, we can estimate which would have been the net gasoline price if the merger had not occurred (Pg*). This is equal to:

$$Pg^* = Pg_{post} + \beta_3 \cdot (Qg^* - Qg_{post})/Pop = 0.4611 - 0.012885 \cdot (12.6287 - 11.0377) = 0.4406 \quad .$$

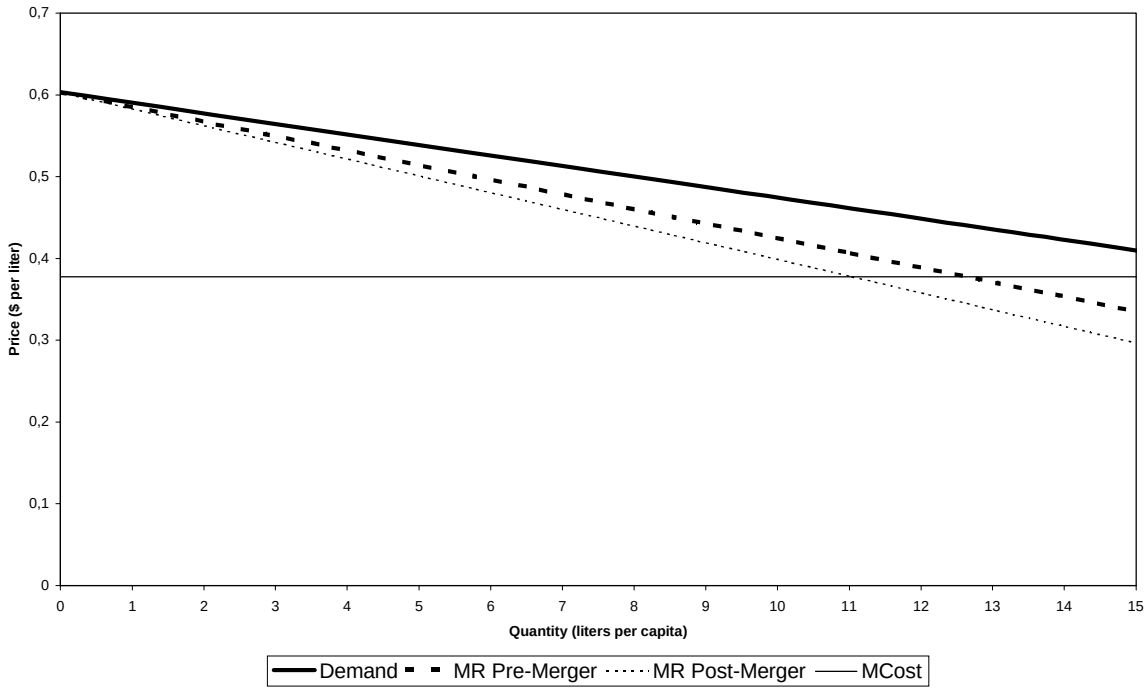
If we add the value added tax (21%) and the average specific fuel tax ($0.4594 per liter), this price becomes equal to $0.9925 per liter.

The calculations performed allow us to compare actual and theoretical prices and quantities. We can therefore conclude that, if the merger had not happened, gasoline consumption would have been 14.4% higher than the observed level for the period September1999-December2000. Average gasoline prices, conversely, would have been 4.4% lower (if we compute them without taxes) and 2.3% lower (if we include the VAT and the specific fuel tax)[11].

[11] Note that these estimations are different form the ones that appear at the end of section 1. This is because those numbers came from preliminary regressions that did not explicitly consider the effect of the different supply and demand forces, while our new estimates are the result of a market equilibrium model.

The numbers already shown are represented in figure 1, where we have depicted the average post-merger equilibrium for the Argentine gasoline market. The demand price function is graphed without taxes (Demand), and we see that the post-merger marginal revenue function (MR Post-Merger) is lower than the pre-merger one (MR Pre-Merger). This implies that the actual equilibrium (MR Post-Merger = MCost) determines a higher price and a smaller quantity than the theoretical equilibrium that would have taken place if the merger had not occurred (MR Pre-Merger = MCost).

1. Argentine Gasoline Market: Post-Merger Equilibrium



In order to calculate the welfare effects of the Repsol-YPF merger, we could use the information obtained to estimate the changes in the consumer and producer surpluses (ΔCS, ΔPS) and in the tax revenue collected by the government (ΔTax). Expressed in Argentine

pesos (equal to US dollars) per capita per month, those changes are the following:

$$\Delta CS = -(Pg_{post}-Pg^*)\cdot(1+VAT)\cdot Qg_{post} - (Pg_{post}-Pg^*)\cdot(1+VAT)\cdot(Qg^*-Qg_{post})/2 =$$

$$-(1.0173-0.9925)\cdot 11.0377 - (1.0173-0.9925)\cdot(12.6287-11.0377)/2 = -0.29346 \quad ;$$

$$\Delta PS = (Pg_{post}-Pg^*)\cdot Qg_{post} - (Pg^*-MCg)\cdot(Qg^*-Qg_{post})$$

$$= (0.4611-0.4406)\cdot 11.0377 - (0.4406-0.3778)\cdot(12.6287-11.0377) = 0.12636 \quad ;$$

$$\Delta Tax = VAT\cdot[(Pg_{post}-Pg^*)\cdot Qg^* - Pg^*\cdot(Qg^*-Qg_{post})] - Tg\cdot(Qg^*-Qg_{post}) =$$

$$0.21\cdot[(0.4611-0.4406)\cdot 11.0377 - 0.4406\cdot(12.6287-11.0377)]$$

$$-0.4594\cdot(12.6287-11.0377) = -0.83060 \quad ;$$

where "VAT" is the value added tax rate.

Adding up all these figures, we obtain a net efficiency loss of $0.9977 per capita per month, which becomes equal to a total of $36,640,632 per month when we multiply it by the average post-merger number of inhabitants of Argentina (which is approximately 36.7251 million people)[12]. This is the result of a decrease in consumer surplus of $10,777,348 and a decrease in tax collection of $30,530,868 per month, which are only partially compensated by an increase in producer surplus of $4,640,584 per month. Note that the economic agent that suffers the highest loss is in this case the government, since the reduction in consumption induced by the price increase has a large negative effect on tax collection.

6. Concluding remarks

The conclusions of this study can be expressed as answers to the four questions

[12] This estimation for the efficiency loss might be biased upwards. This is because it does not include the effect of a possible cost reduction originated in the merger, which cannot be wholly estimated with the data available. It nevertheless shows that the merger has had a negative "external welfare effect", in the sense that the aggregate surplus of the economic agents that did not merge has decreased. For a theoretical explanation of this concept, see Farrell and Shapiro (1990).

asked in the introduction. From our descriptive analysis we can conclude that the Repsol-YPF merger had an impact on the prices and quantities traded in the Argentine gasoline market, probably related to the exercise of market power. This conclusion is reinforced by the results of the regressions performed in section 4, where we found that the estimated post-merger market power coefficient was significantly higher than the pre-merger one.

When trying to answer which market structure explains the behavior of the industry better, we can conclude that it is probable that before the Repsol-YPF merger the market behaved like a Cournot oligopoly. This conclusion is similar to the ones obtained by Serebrisky (2000) and by Perussia (2000) when studying the Argentine gasoline market in the last years of the decade of 1990.

We also have to answer affirmatively to the question about the possibility of a structural change as a consequence of the merger. In the two hypothesis testing approaches that we used (nested and non-nested), we have found that the model that explains the data better is the one that assumes that the pre-merger Cournot oligopoly changed into a post-merger situation of Repsol-YPF price leadership.

The welfare implication of this change is an increase in the producer surplus ($4.6 million per month), which is considerably smaller than the decreases experienced by the consumer surplus ($10.8 million per month) and the government surplus ($30.5 million per month). Therefore, we can conclude that there was an efficiency loss, estimated in more than $36 million per month.

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