Pricing Strategies in the Brazilian Brewing Industry

Danilo R. D. Aguiar, Malú N. P. S. Cerqueira and Adelson M. Figueiredo[1]

Contributed Paper prepared for presentation at the 91st Annual Conference of the Agricultural Economics Society, Royal Dublin Society in Dublin, Ireland

24 - 26 April 2016

Abstract

The Brazilian brewing industry went through a sharp process of market concentration in 2000, when the two largest breweries, Brahma (producer of Skol and Brahma brands), and Antarctica (producer of Antarctica brand) merged and started controlling 70% of Brazil's market. This process raises concerns on the exploitation of market power in the beer sector. Therefore, this article aims to analyse the pricing strategies used by Brazilian breweries by means of cointegration analysis. We use price series of the main brands of beer, collected in bars and in supermarkets of São Paulo city. We verify that the two main brands of Ambev (Skol and Brahma) tend to be more exogenous, while Antarctica acts and reacts more directly to Nova Schin. The latter, on the other hand, seems to change its pricing strategies based on what happens to Ambev's brands. Moreover, there are evidences that Brahma and Antarctica changed their pricing patterns after Ambev creation raising barriers to competitors.

Key-words: *Market power, pricing strategies, beer industry, Brazil.*

JEL code: *L1.*

---

[1] Danilo R. D. Aguiar is a professor, Malú N. P. S. Cerqueira is a former Master's student and Adelson M. Figueiredo is an associate professor in the Department of Economics, School of Management and Technology, Federal University of São Carlos, Sorocaba, Brazil. E-mail: danilo@ufscar.br for correspondence. The authors thank to Coordination for Improvement of Graduates of Brazilian Ministry of Education (Capes/MEC) for financial support.

1. Introduction

The beer industry is a very important component of Brazilian economy, as the country is the world's third largest producer, behind China and the United States, selling more than 14 billion litres yearly (CervBrasil, 2014). In terms of market structure, the beer industry, which has traditionally been an oligopoly, has become even more concentrated after 2000, when the two largest breweries, Brahma, the leader with a market share of 49% held conjointly by its two main brands (Skol and Brahma), and Antarctica, the next largest with a market share of 20% held by its namesake brand, merged creating Ambev. In 2004, another merger affected the beer sector when Ambev and Belgium Interbrew merged to found AB InBev (Rosa et al., 2006). Since then, Ambev (the company's name in Brazil) has held near 70% of market share, while the remaining is filled by three other breweries: Kirin (whose main brand is Nova Schin), Petrópolis and Heineken (Moreira et al., 2014).

Such impressive increase in market concentration has raised concerns on the exploitation of market power, though the studies conducted up to now have drawn conflicting conclusions. While some (Viegas, 2006; Gregorine, 2006) argue that efficiency gains provided by the merger offset consumer losses, others (Prezotto and Lavall, 2011; Moreira et al., 2014) say that consumers have mostly been harmed and that Ambev would be using Antarctica as a fighter brand[2] to prevent competitors from growing (Salgado et al., 2008). These dissonant conclusions indicate that more research is needed to identify and analyse the strategies adopted by brew companies in Brazil.

Unfortunately, lack of proper data precludes the estimation of New Empirical Industrial Organization structural models (Bresnahan, 1989) to measure the degree of market power in the Brazilian beer industry. An interesting alternative, when only price data are available, is to analyse oligopolistic strategies by means of cointegration analyses, using the reduced form vector error correction (VEC) model to identify price responses of competitors in terms of direction, magnitude, and speed (Vickner and Davies, 2000; Vickner and Davies, 2002). Accordingly, the objective of this article is to analyse empirically the pricing strategies adopted by Brazilian breweries through cointegration analysis. More specifically, we aim to: (a) identify the existence of a dominant brand; (b) verify if there is a long-run price relationship between brands; (c) measure the impact of the dominant brand's price on other brands' prices; and (d) determine if the pricing strategies involving Brahma and Antarctica brands changed after the merger. We also test two hypotheses: first, Brahma brand's price

[2] To learn more about this concept, see Ritson (2009).

changes before other brands' prices; and second, Brahma and Antarctica brands started to cooperate with each other after the merger.

2. Conditions for market power exploitation

The concerns on market power exploitation in Brazil have both theoretical and practical reasons. The relationship between market structure and market power has long been the central issue in industrial economics, as since Mason's (1939) seminal paper, the idea that market structure (characterised by market concentration, product differentiation and barriers to entry) determines the conduct of the firms, which affects industry performance, has prevailed among the followers of the structure-conduct-performance paradigm (Martin, 1993). Though a unidirectional causality from structure to conduct and from the latter to performance is highly questionable, it is clear that some strategic conducts aiming to garner or hold market share are only possible in concentrated oligopolies with highly differentiated products. That is exactly what we find in the Brazilian beer industry, where around 95% of the domestic market is held by only four firms (Moreira et al., 2014), while the leader holds near 70%, as we have already mentioned. The three main brands (Skol, Brahma and Antarctica), all produced by Ambev, have demand price-elasticities significantly lower than the elasticities of the other brands (Salgado et al., 2008), indicating product differentiation of Ambev's brands. Moreover, according to Moreira et al. (2014), most of the strategies adopted in the Brazilian beer industry are aimed to raise barriers to entry, such as spending too much on advertisement, what forces competitors to do the same and incur sunk costs (Martin,1993), and controlling distribution channels by means of contracts.

3. Database

We use monthly price series collected by the Economic Research Foundation (FIPE)[3] for the main brands of beer sold in the city of São Paulo, the most populous city in the country, located in Brazil's leading state in both production and consumption of beer. There are two different sets of prices, one for **bars** (the main selling point with about 50% of market share) and another for **supermarkets**. For bars, the brands are Brahma, Antarctica and Nova Schin (formerly produced by Schincariol company and now belonging to Kirin), the unit is "Real" (Brazilian currency) per bottle of 600 ml and the time range is from November 2003 to June

---

[3] The Economic Research Foundation (FIPE) is an organization linked to the University of São Paulo (USP), for which the authors are thankful for data provision.

2014. For supermarkets, the brands are Skol, Brahma, Antarctica and Nova Schin, the unit is "Real" per can of 355 ml and the range is from December 2003 to June 2014. To compare price strategies before and after the merger we analyse prices of two brands, Brahma and Antarctica, sold in bars from January 1994 to June 2014. All prices are deflated by FIPE's consumer price index and then transformed into natural logarithms, so the parameters of the cointegration vectors can be interpreted as elasticities.

4. Econometric procedures

Following Vickner and Davies (2002), we start applying unit root tests to the natural logarithm of each price series aiming to identify if they are integrated of first order [I(1)]. The I(1) series are then analysed using Johansen's full information maximum likelihood cointegration tests (Johansen, 1988) to determine which of them are cointegrated. Finally, VEC models are estimated for each of the market segments (bars and supermarkets) and the cointegration vectors, the speed of adjustment, and the impulse-response functions are used to identify price relations among different brands of beer. All the econometric procedures were conducted by means of Eviews 6.0 and Jmulti 4.23.

Starting from stationarity verification, we apply three tests (KPSS, Ng-Peron and HEGY) in addition to the traditional Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979; Dickey and Fuller, 1981) used by Vickner and Davies (2002). Differently from the ADF, the KPSS test (Kwiatkowski et al., 1992) aims to identify unit roots in series described by moving average parameters (Bueno, 2012). The Ng-Perron test, proposed by Ng and Perron (2001) as an improvement over the Phillips-Perron test (Phillips and Peron, 1988), is assigned to test for unit roots when the root of the moving average process is very high. Finally, as the demand of beer is supposed to be seasonal (Prezotto and Laval, 2011), we check for seasonal unit roots through HEGY test, proposed initially by Hylleberg et al. (1990) and later adapted for monthly data by Beaulieu and Miron (1993).

In order to define the lag-length of the VEC models we use three criteria: BIC (Bayesian Information Criterion), AIC (Akaike Information Criterion), and HQ (Hannan-Quinn). Then, we select the lag-length indicated by the majority of the criteria. If each criterion indicates a different lag-length, we decide based on the lag-length indicated by the BIC, since it is considered superior (Lütkepohl and Krätzig, 2004). To conduct such tests, we first estimate three different specifications of VAR models (all in level and with seasonal dummies): with intercept only, with trend and intercept, and without both. Following Vickner and Davies (2002), the variables are ordered in such a way that the brand with the largest market share is the most exogenous. Based on AMBEV (2013), the sequence in terms of market share is: Skol (32,7%), Brahma (19,3%), Antarctica (15,7%) and Nova Schin (9,6%).

The price series integrated of first order, I(1), are then tested using Johansen's cointegration test to verify if some of them share a long-run trend, in other words, if they are cointegrated. Johansen's statistics allows testing cointegration by means of two tests: trace test and maximum eigenvalue. We use only the trace test because it is considered the most powerful (Bueno, 2012).

The next step is to estimate VEC models for the cointegrated series. A VEC model is a VAR model (proposed by Sims, 1980) in first difference form (since the variables are integrated of first order), including cointegration. In the VEC with *n* endogenous variables, each of them is represented as a function of its own lagged values, the lagged values of the other *n-1* cointegrated variables, and n-1 cointegrating equations, as we specify in section 5. VEC models can also include seasonal dummies, intercept and trend. In addition, the effects can be analysed through the impulse-response function, which shows the effects of shocks of one standard-deviation in one variable on each of the other variables. The impulse-response function represents short-run effects and they are estimated using Cholesky decomposition.

After estimating the VEC models, econometric tests are employed to ascertain some of the functions' properties, such as stability and absence of both autocorrelation and heteroscedasticity. To analyse stability, we verify if the characteristic roots of the VEC model lie outside the unit circle. Moreover, as the models cannot contain autocorrelation in order to assure parameters efficiency, we use the LM test for multivariable models to identify the presence of error autocorrelation. Finally, to check for the presence of heteroscedasticity, we use the ARCH LM test[4]. As the pattern of endogeneity/exogeneity among brands is an important tool to analyse firms conduct (Margarido and Bueno, 2008), we analyse this issue by means of the significance of matrix α's parameters in the VEC model.

5. Results

5.1. Analysis of Beer Prices in Bars

Figure 1 shows that the prices of the three beer brands analysed at the bar segment, which are Brahma, Antarctica and Nova Schin (the first two produced by Ambev and the latter currently produced by Kirin), behave very similarly, suggesting that they are probably

---

[4] For details on these tests, see Lütkepohl and Krätzig (2004) or Bueno (2012).

cointegrated. However, it is also possible to identify that in the middle of 2009, Nova Schin's price falls heavy, originating a gap between this price and other brands' prices, which persists since then.

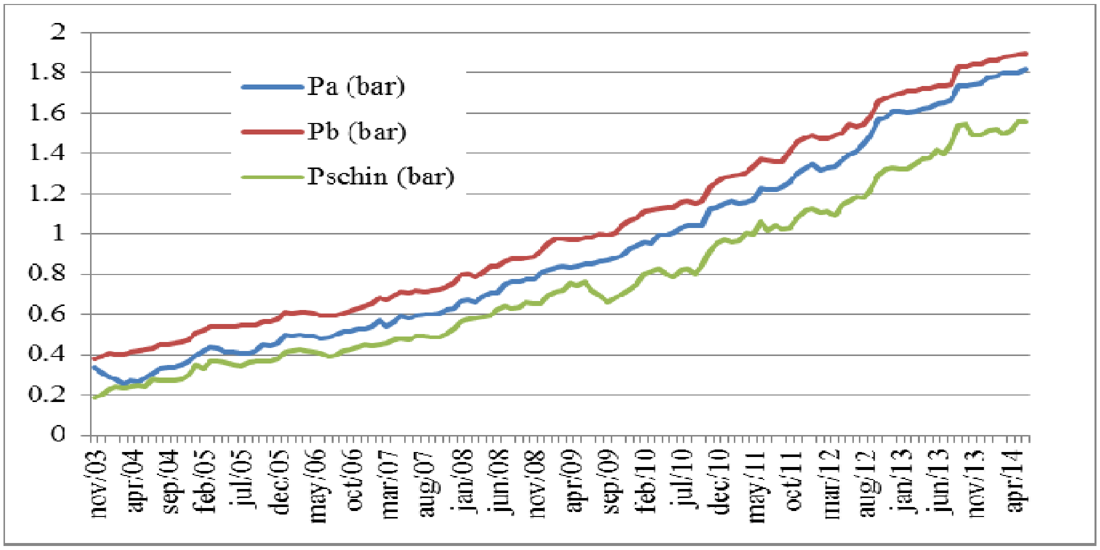

Figure 1: Natural logarithms of the deflated monthly prices of bottles of beer brands sold in bars of São Paulo, where Pb, Pa and Pschin are, respectively, the prices of Brahma, Antarctica and Nova Schin, from November 2003 to June 2014.
Source: original prices from FIPE.

The unit root tests indicated the presence of seasonal unit roots for Brahma's as well as for Nova Schin's price, so the equations of both brands were modelled including seasonal dummies. In addition, all unit root tests indicated that the series are non-stationary in level, becoming stationary after first-differencing, what means that all price series are I(1). Proceeding with the analysis, we verified that the lag-length for the three series should be "two", according to AIC, or "one", according to the remaining criteria. Following our method, one-lag was chosen.

Johansen's cointegration test was then applied using zero, one and two lags, and in all circumstances there were indication of at least one cointegration vector. The best VEC model, selected using the results of the tests of unit roots, lag-length and cointegration, contains one lag and one cointegration vector, being represented as:

$$d(Pb^b) = \gamma_{11}d(Pb_{t-1}^b) + \gamma_{12}d(Pa_{t-1}^b) + \gamma_{13}d(PSchin_{t-1}^b) + \sum_{i=1}^{11}(s_{i1}d(Pb^b)) + \delta_{11} + \alpha_{11}(\varepsilon_{1t-1}) + (\in_{1t})$$

$$d(Pa^b) = \gamma_{21}d(Pb_{t-1}^b) + \gamma_{22}d(Pa_{t-1}^b) + \gamma_{23}d(PSchin_{t-1}^b) + \sum_{i=1}^{11}(s_{i2}d(Pa^b)) + \delta_{12} + \alpha_{12}(\varepsilon_{1t-1}) + (\in_{2t})$$

$$d(PSchin^b) = \gamma_{31}d(Pb_{t-1}^b) + \gamma_{32}d(Pa_{t-1}^b) + \gamma_{33}d(PSchin_{t-1}^b) + \sum_{i=1}^{11}(s_{i3}d(PSchin^b)) + \delta_{13} + \alpha_{13}(\varepsilon_{1t-1}) + (\in_{3t})$$

$$\varepsilon_{1t-1} = Pb_{t-1}^b - \beta_{11}Pa_{t-1}^b - \beta_{12}PSchin_{t-1}^b \qquad (1)$$

where "P*b*", *"Pa"* and *"PSchin*" are the natural logarithms of the prices of Brahma, Antarctica and Nova Schin, respectively; the superscript "b" refers to bars; d*(Pi)* is price differences for brand i; ε_{1t-1} is the cointegration vector, which represents the residues of one month lags of long-run equilibria; and $s, \gamma, \delta, \alpha, \beta$ are the model's unknown parameters.

Chart 1 brings the parameter estimates. As the VEC model is estimated following the order Brahma→Antarctica→Nova Schin, the parameter β_{11}, which is significant at the level of 1% indicates that a hypothetical increase of 1% in Brahma's price would cause an increase of 1.89% in Antarctica's price. The fact that both prices move in the same direction is consistent with cooperation, though it is not clear the reason why Antarctica's price varies more than proportionally. In addition, the speed of adjustment is 0.08, significant at the 5% level, indicating that about 12 months are required for Antarctica's price to return to the long-run equilibrium after a shock. Regarding the estimate of β_{12}, however, it is negative (-1.08) and significant at the 1% level, indicating that an increase of 1% in Brahma's price would cause a decrease of 1.08% in Nova Schin's price. Apparently, Nova Schin's manufacturer and distributors take advantage of Brahma's price rises to reduce Nova Schin's price and, consequently, garner market share. The speed of adjustment coefficient of Nova Schin's price is 0.20, significant at the 1% level, what means that five months would be required for Nova Schin's price to restore the equilibrium after a shock in Brahma's price. Concerning the own-brand lagged prices parameters, none is significant. Nevertheless, are significant the effects of Nova Schin's lagged price on the prices of both other brands, as well as the effects of Brahma's and Antarctica's lagged prices in the equation of Nova Schin's price. Finally, the seasonal parameters are mostly not significant, likewise the long-run adjustment parameter (α_{11}), suggesting that Brahma's price has weak exogeneity.

With respect to stability, since the model has one characteristic root outside the unit circle, it can be considered stable. In addition, the LM and the ARCH-LM tests reject both autocorrelation and heteroscedasticity.

Chart 1
Parameter estimates for the VEC model including natural logarithm of prices of Brahma, Antarctica and Nova Schin collected in bars

Variables	ε_{1t-1}		
Pb^b_{t-1}	1		
Pa^b_{t-1}	-1.898***		
	(-10.21)		
$PSchin^b_{t-1}$	1.084***		
	(4.95)		
	Dependent Variables		
Variables	$d(Pb^b)$	$d(Pa^b)$	$d(PSchin^b)$
ε_{1t-1}	-0.029	0.085**	-0.201***
	(-0.63)	(-1.69)	(-3.14)
Price differences of lagged variables			
$d(Pb^b_{t-1})$	-0.086	0.035	-0.53***
	(-0.587)	(-0.222)	-2.623
$d(Pa^b_{t-1})$	0.023	-0.042	-0.323**
	(0.183)	(-0.306)	(-1.862)
$d(PSchin^b_{t-1})$	0.140**	0.123*	0.052
	(1.79)	-1.438	(0.475)
Deterministic variables of the model			
δ_{1i}	0.015***	0.001	0.034***
	(2.478)	(0.111)	(3.991)
s_{i1}	0.005	0	0.005
	(0.681)	(-0.052)	(0.497)
s_{i2}	-0.01*	-0.013**	-0.012
	(-1.51)	(-1.816)	(-1.286)
s_{i3}	-0.013**	-0.02***	-0.005
	(-1.968)	(-2.743)	(-0.492)
s_{i4}	-0.006	-0.008	0.003
	(-0.906)	(-1.087)	(0.28)
s_{i5}	-0.007	-0.013**	-0.001
	(-0.972)	(-1.675)	(-0.054)
s_{i6}	-0.008	-0.008	0.001
	(-1.123)	(-1.072)	(0.119)
s_{i7}	-0.011*	-0.008	-0.006
	(-1.593)	(-1.059)	(-0.619)
s_{i8}	-0.01*	-0.006	-0.003
	(-1.425)	(-0.762)	(-0.303)
s_{i9}	-0.004	0.001	-0.002
	(-0.51)	(0.172)	(-0.232)
s_{i10}	0.003	0	0.001
	(0.402)	(-0.015)	(0.142)
s_{i11}	0.003	0.002	-0.003
	(0.51)	(0.289)	(-0.316)

Note: ε_{1t-1} represents perturbations in the cointegration equation between one-month lagged prices of Brahma, Nova Schin and Antarctica.
S_{i1} to S_{i11} are seasonal dummies.
Estimated values of "t" statistics are in parentheses.
***1% significance level; ** 5% significance level; *10% significance level.

The impulse-response functions respect to Brahma's price are not significant for both Antarctica and Nova Schin, since their confidence intervals include zero. The same occurs for the impact of Antarctica's price on Brahma's price, what was already expected since the latter has weak exogeneity. The effect of Antarctica's price on Nova Schin's price is the only significant, as well as positive, showing that after a shock of one standard-deviation on Antarctica's price it takes seven months for the Nova Schin's price to restore equilibrium (Figure 2). This result suggests that the price of a minor brand (Nova Schin) does not affect the prices of Ambev's brands, and also that Nova Schin's price responds to changes in Antarctica's price.

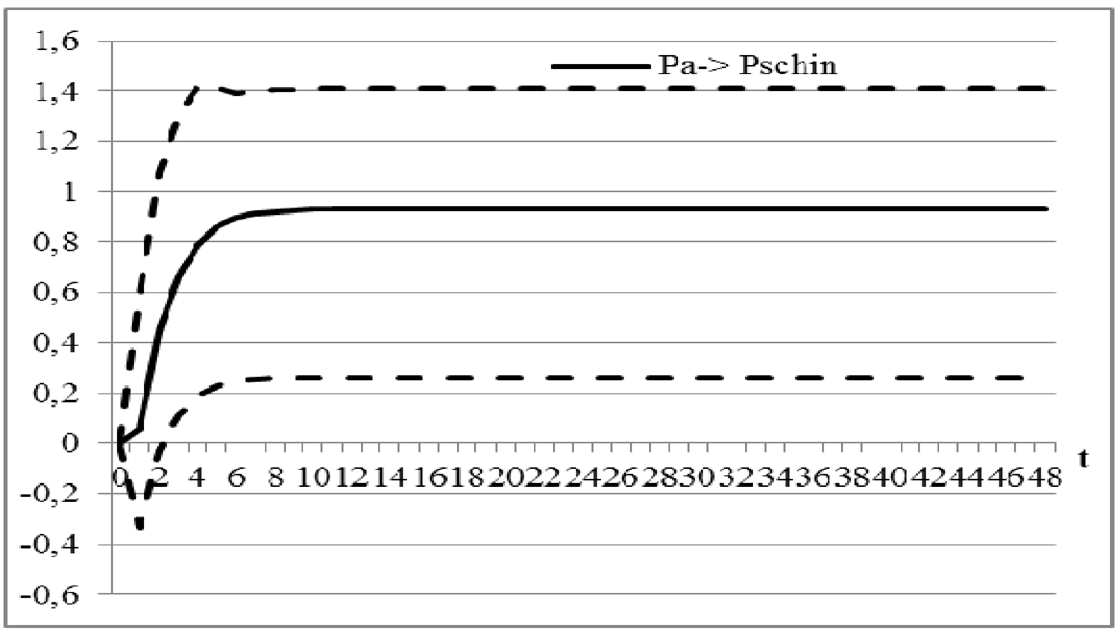

Figure 2: Vector error correction impulse response function of Nova Schin's price to a shock in Antarctica's price in bars.

Note: - - - Confidence interval (95%)

5.2. Analysis of Beer Prices in Supermarkets

At supermarket level, we analyse the prices of four brands (Brahma, Skol, Antarctica and Nova Schin, the first three belonging to Ambev), which show very similar and upwards trends, not being apparently stationary (Figure 3).

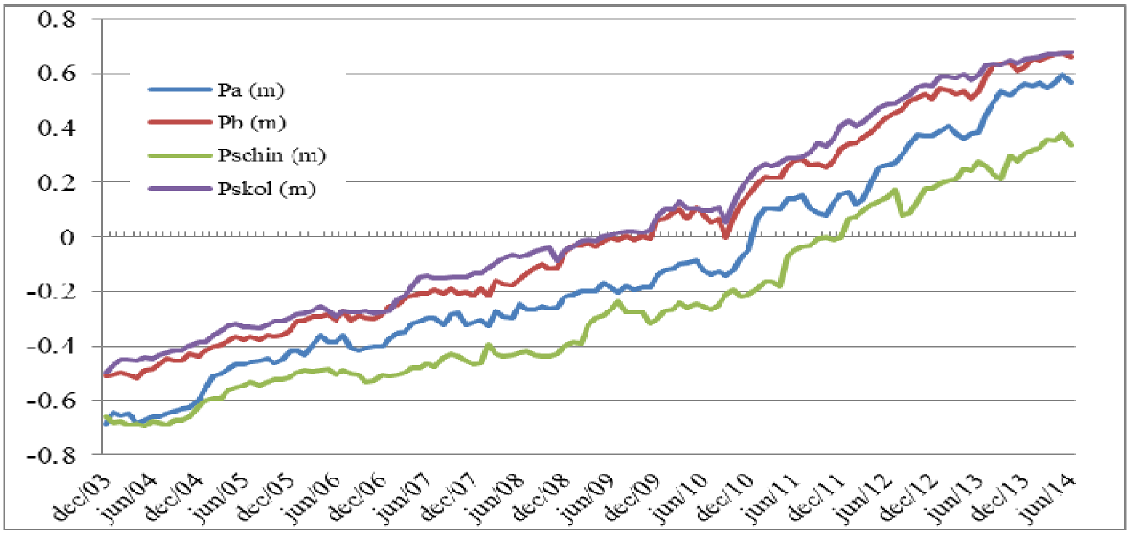

Figure 3: Natural logarithms of the deflated monthly prices of cans of beer brands sold in supermarkets of São Paulo, where Pb, Pa, Pskol and Pschin are, respectively, the prices of Brahma, Antarctica, Skol and Nova Schin, from December 2003 to June 2014.
Source: original prices from FIPE.

Proceeding with the econometric analysis, the HEGY test rejects seasonal, but not unseasonal, unit roots. The other three tests – ADF, KPSS and Ng-Peron – confirm that the series are I(1). Moreover, all lag-length criteria indicated one lag for all brands.

Applying Johansen's cointegration test, we verified that for two of the test options, with constant and with constant and trend in the vector, the results indicate at least one cointegration vector, implying long-run equilibrium among the brands sold in supermarkets.

The next step is the estimation of the VEC model. As the VEC models without endogenous lags presented autocorrelation, heteroscedasticity, and instability, we tested other models with additional lags. The model which best fitted was a VEC with one endogenous lag, three cointegration vectors, an intercept in the model and a trend in the vector, as follows:

$$d(PSkol^m) = \gamma_{11} d(PSkol^m_{t-1}) + \gamma_{12} d(Pb^m_{t-1}) + \gamma_{13} d(Pa^m_{t-1}) + \gamma_{14} d(PSchin^m_{t-1}) + \sum_{i=1}^{11} (s_{i1} d(PSkol^m)) + \delta_{11} + \alpha_{11}(\varepsilon_{1t-1}) + \alpha_{12}(\varepsilon_{2t-1}) + \alpha_{13}(\varepsilon_{3t-1}) + (\epsilon_{1t})$$

$$d(Pb^m) = \gamma_{21} d(PSkol_{t-1}^m) + \gamma_{22} d(Pb_{t-1}^m) + \gamma_{23} d(Pa_{t-1}^m) + \gamma_{24} d(PSchin_{t-1}^m) + \sum_{i=1}^{11} (s_{i2} d(Pb^m)) + \delta_{12} + \alpha_{21}(\varepsilon_{1t-1}) + \alpha_{22}(\varepsilon_{2t-1}) + \alpha_{23}(\varepsilon_{3t-1}) + (\in_{2t})$$

$$d(Pa^m) = \gamma_{31} d(PSkol_{t-1}^m) + \gamma_{32} d(Pb_{t-1}^m) + \gamma_{33} d(Pa_{t-1}^m) + \gamma_{34} d(PSchin_{t-1}^m) + \sum_{i=1}^{11} (s_{i3} d(Pa^m)) + \delta_{13} + \alpha_{31}(\varepsilon_{1t-1}) + \alpha_{32}(\varepsilon_{2t-1}) + \alpha_{33}(\varepsilon_{3t-1}) + (\in_{3t})$$

$$d(PSchin^m) = \gamma_{41} d(PSkol_{t-1}^m) + \gamma_{42} d(Pb_{t-1}^m) + \gamma_{43} d(Pa_{t-1}^m) + \gamma_{44} d(PSchin_{t-1}^m) + \sum_{i=1}^{11} (s_{i4} d(PSchin^m)) + \delta_{14} + \alpha_{41}(\varepsilon_{1t-1}) + \alpha_{42}(\varepsilon_{2t-1}) + \alpha_{43}(\varepsilon_{3t-1}) + (\in_{4t})$$

$$\varepsilon_{1t-1} = PSkol_{t-1}^m - \pi_{11}.t - \beta_{11} PSchin_{t-1}^m$$

$$\varepsilon_{2t-1} = Pb_{t-1}^m - \pi_{12}.t - \beta_{12} PSchin_{t-1}^m$$

$$\varepsilon_{3t-1} = Pa_{t-1}^m - \pi_{13}.t - \beta_{13} PSchin_{t-1}^m \qquad (2)$$

where “PSkol”, “P*b”, “Pa”* and *“PSchin*” are natural logarithms of the prices of Skol, Brahma, Antarctica and Nova Schin, respectively; the superscript “m” refers to prices collected in supermarkets; d*(Pi)* are price differences for brand i; ε_{1t-1} is the cointegration vector, which represents the residues of one month lags of long-run equilibria; and s, δ, α, β and π are the model’s unknown parameters.

All parameters of β were significant at the 1% level and positive, as expected, what means that all brands follow the leader’s price (Chart 2). A hypothetical increase of 1% in the prices of either Skol, or Brahma, or Antarctica would increase Nova Schin’s price by 0.72%, 0.69% and 0.86%, respectively. These estimates imply that Nova Schin’s price follows (but does not vary as much as) the prices of Ambev’s brands.

With respect to exogeneity, both the estimates of α_{11} and α_{12}, referring to the time taken for Skol’s price to restore the equilibrium after a shock in Brahma’s and Antarctica’s prices, are not statistically significant, while α_{13} is significant only at the 10% level. Brahma’s price is affected by both Skol’s and Antarctica’s prices, but not by Nova Skins’s price. Antarctica, on the other hand, is affected only by Nova Schin’s price, what gives support to the hypothesis that Antarctica is not in the same market segment as Skol and Brahma and that it is used to fight Nova Schin (Salgado et al., 2008).

Chart 2

Parameter estimates for the VEC model with prices of Skol, Brahma, Antarctica and Nova Schin collected in supermarkets

Variables	ε_{1t-1}	ε_{2t-1}	ε_{3t-1}	
$PSkol_{t-1}^{m}$	1	0	0	
Pb_{t-1}^{m}	0	1	0	
Pa_{t-1}^{m}	0	0	1	
$PSchin_{t-1}^{m}$	-0.725***	-0.698***	-0.861***	
	(-8.92)	(-10.2)	(-5.86)	
π_{1i}	-0.003***	-0.004***	-0.003**	
	(-4.99)	(-6.67)	(-2.08)	
	Dependent Variables			
Variables	$d(PSkol^{m})$	$d(Pb^{m})$	$d(Pa^{m})$	$d(PSchin^{m})$
ε_{1t-1}	-0.029	0.162**	0.098	0.179**
	(-0.45)	(2.156)	(1.061)	(2.066)
ε_{2t-1}	-0.072	-0.275***	-0.014	0.113
	(-0.91)	(-2.89)	(-0.12)	(1.034)
ε_{3t-1}	-0.061*	-0.049	-0.175***	0.015
	(-1.57)	(-1.07)	(-3.08)	(0.288)
Price differences of lagged variable				
$d(PSkol_{t-1}^{m})$	-0.05	-0.105	0.008	-0.1
	(-0.42)	(-0.73)	(0.043)	(-0.61)
$d(Pb_{t-1}^{m})$	0.07	-0.142	0.074	-0.13
	(0.689)	(-1.15)	(0.49)	(-0.91)
$d(Pa_{t-1}^{m})$	0.112*	0.221***	0.1	0.019
	(1.569)	(2.582)	(0.945)	(0.194)
$d(PSchin_{t-1}^{m})$	-0.151***	-0.106*	-0.039	-0.046
	(-2.41)	(-1.41)	(-0.42)	(-0.52)
Deterministic variables of the model				
δ_{1i}	0.002	-0.011**	-0.007	0.014**
	(0.349)	(-1.88)	(-0.92)	(2.096)
s_{i1}	-0.001	-0.021***	-0.021**	-0.006
	(-0.21)	(-2.61)	(-2.04)	(-0.61)
s_{i2}	-0.004	-0.014**	-0.014*	-0.011
	(-0.53)	(-1.75)	(-1.34)	(-1.14)
s_{i3}	-0.005	-0.028***	-0.016*	-0.012
	(-0.71)	(-3.39)	(-1.58)	(-1.27)
s_{i4}	-0.006	-0.016**	-0.006	-0.006
	(-0.94)	(-1.94)	(-0.62)	(-0.66)
s_{i5}	-0.018***	-0.025***	-0.025***	-0.011
	(-2.57)	(-3.07)	(-2.44)	(-1.18)
s_{i6}	-0.006	-0.016**	-0.017*	-0.011
	(-0.81)	(-1.81)	(-1.57)	(-1.12)
s_{i7}	-0.01*	-0.023***	-0.024**	-0.032***
	(-1.39)	(-2.72)	(-2.32)	(-3.31)
s_{i8}	-0.014**	-0.028***	-0.016*	-0.015*
	(-1.95)	(-3.14)	(-1.46)	(-1.42)
s_{i9}	-0.003	-0.025***	-0.019**	-0.008
	(-0.49)	(-2.91)	(-1.80)	(-0.85)
s_{i10}	-0.009*	-0.021***	-0.015*	-0.022**
	(-1.34)	(-2.49)	(-1.44)	(-2.32)
s_{i11}	0.005	-0.011	-0.003	-0.006
	(0.723)	(-1.23)	(-0.23)	(-0.56)

Note: ε_{1t-1} represents perturbations in the cointegration equation between one-month lagged prices of Skol and Nova Schin; ε_{2t-1} represents perturbations in the cointegration equation between one-month lagged prices of Brahma and Nova Schin; ε_{3t-1} represents perturbations in the cointegration equation between one-month lagged prices of Antarctica and Nova Schin; S_{i1} to S_{i11} are seasonal dummies. Estimated values of "t" statistics are in parentheses.
***1% significance level; ** 5% significance level; *10% significance level.

After estimating the empirical model, several tests were performed to verify how good the estimation was. It was verified that the model is stable (it had only one unit root, while the remaining characteristic roots were larger than one) and the LM and the ARCH LM tests rejected both autocorrelation and heteroscedasticity.

The analysis of the input-response functions shows that none of the variables cause short-run disequilibrium on the others, as the functions were not significant (reason why we do not portray them). This fact suggests that the beer firms tend to base their pricing decisions on the long-run.

5.3. Price behaviour of Brahma and Antarctica before and after Ambev creation

Considering that we need long price series, covering similar periods before and after Ambev creation, this part of the analysis is restricted to the prices of two brands, Brahma and Antarctica, collected in bars. As Figure 4 shows, until the beginning of 2003 the prices of both brands were very close to each other. Afterwards, a gap was open between Brahma's and Antarctica's prices, which still persists. A remarkable fact occurred in 2003, which is likely to be related to this new pricing pattern of Ambev's brands, is the Nova Schin's launching with massive advertisement expenses. Clearly, after the entrance of the new competitor, Ambev adopted different pricing strategies for Brahma and Antarctica.

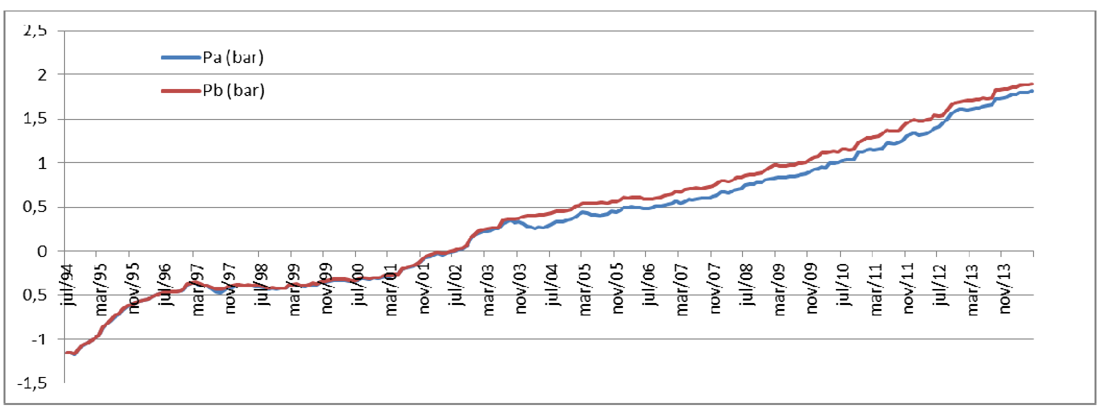

Figure 4: Natural logarithms of the deflated monthly prices of bottles of Brahma (Pb) and Antarctica (Pa), from July of 1994 to June of 2014, sold in bars.

Source: original prices from FIPE.

Considering the pattern showed in Figure 5, we sought a cointegration model including only the prices of Brahma and Antarctica, and split the analysis into two periods: **t1**, from July 1994 to October 2003; and **t2**, from November 2003 to June 2014.

As **t2** is the same period studied in the previous analysis, when we had found a seasonal unit root for Brahma's price, we conducted unit root tests only for **t1**, for which none seasonal unit root was identified by means of HEGY test. The other three tests – ADF, KPSS and NG Peron – gave conflicting results, as two of them – ADF and NG Peron – indicated that the series are I (1) while the KPSS test pointed to stationarity. Given this conflict, we based our decision on the correlograms, what allowed us to define the series as I(1).

Proceeding with the analysis, we considered Antarctica exogenous in **t1**, when this brand held larger market share than Brahma, while for **t2** Brahma was considered exogenous because its market-share surpassed Antarctica's. The majority of the information criteria indicated three lags for a VAR and, consequently, two legs for a VEC, in **t1**. For **t2**, all criteria indicated one lag.

The cointegration analysis identified, for both periods, at least one cointegration vector, which was significant at the 1% level. Then, VEC models including Brahma and Antarctica for both periods were estimated.

For period **t1**, the best fitted model is a VEC with one lagged endogenous variable and one cointegration vector, being the constant the only deterministic variable. It is represented in expression 3 and the estimated parameters are in chart 3.

$$d(Pa^{t1}) = \gamma_{11} d(Pa_{t-1}^{t1}) + \gamma_{12} d(Pb_{t-1}^{t1}) + \alpha_{11}(\varepsilon_{1t-1}) + (\in_{1t})$$

$$d(Pb^{t1}) = \gamma_{21} d(Pa_{t-1}^{t1}) + \gamma_{22} d(Pb_{t-1}^{t1}) + \alpha_{21}(\varepsilon_{1t-1}) + (\in_{1t})$$

$$\varepsilon_{1t-1} = Pa_{t-1}^{t1} - \pi_1 - \beta_{11} Pb_{t-1}^{t1} \quad (3)$$

The cointegration vector shows a positive relationship between Brahma's and Antarctica's prices, as the estimated value of β_{11} indicates that a hypothetical increase of 1% in Antarctica's price would cause an increase of 0.98% in Brahma's price, what means that both prices were changing at the same rate. After a shock, Antarctica's price would take 2.5 months (as the estimated coefficient is 0.41 and significant) to restore to equilibrium. Despite α_{12} being non-significant, the fact that α_{11} is significant at the 10% level allows us to deduce that Brahma's price is caused by Antarctica's price.

Chart 3

Parameters of the VEC model estimated for the prices of Brahma and Antarctica brands of beer between July 1994 and October 2003

Variables	ε_{1t-1}	
Pa_{t-1}^{t1}	1	
Pb_{t-1}^{t1}	-0.982***	
	(279.9)	
π_{11}	0.015***	
	(8.20)	
	Dependent Variables	
Variables	$d(Pa^{t1})$	$d(Pb^{t1})$
ε_{1t-1}	-0.418*	0.091
	(-1.334)	(0.281)
Price differences of lagged variable		
$d(Pa_{t-1}^{t1})$	0.684***	0.820***
	(2.155)	(2.5)
$d(Pb_{t-1}^{t1})$	-0.016	-0.153
	(-0.05)	(-0.477)

Note: ε_{1t-1} represents perturbations in the cointegration equation between one-month lagged prices of Brahma.
Estimated values of "t" statistics are in parentheses.
***1% significance level; ** 5% significance level; *10% significance level.

For period **t2**, the best model was a VEC without endogenous lag and with a cointegration vector with intercept. Its representation is in expression 4 and the estimated values are in Chart 4.

$$d(Pb^{t2}) = \sum_{i=1}^{11}(s_{i1}d(Pb^{t2})) + \Phi_{11}td(Pb^{t2}) + \alpha_{11}(\varepsilon_{1t-1}) + (\epsilon_{1t})$$

$$d(Pa^{t2}) = \sum_{i=1}^{11}(s_{i1}d(Pa^{t2})) + \Phi_{21}td(Pa^{t2}) + \alpha_{21}(\varepsilon_{1t-1}) + (\epsilon_{1t})$$

$$\varepsilon_{1t-1} = Pb_{t-1}^{t2} - \pi_{11} - \beta_{11}Pa_{t-1}^{t2} \qquad (4)$$

Chart 4

Parameters of the VEC model estimated for the prices of Brahma and Antarctica brands of beer, November 2003 to June 2014

Variables	ε_{1t-1}	
Pb^{t2}_{t-1}	1	
Pa^{t2}_{t-1}	-0.895***	
	(-22.58)	
π_{11}	-0.146***	
	(-18.62)	
	Dependent Variables	
Variables	$d(Pb^{t2})$	$d(Pa^{t})$
ε_{1t-1}	-0.104*	0.164**
	(-1.321)	(-1.91)
ϕ_{1i}	0***	0
	(3.113)	(-0.107)
s_{i1}	0.006	0.003
	(0.846)	(0.409)
s_{i2}	-0.009*	-0.009*
	(-1.296)	(-1.307)
s_{i3}	-0.013**	-0.018***
	(-2.024)	(-2.478)
s_{i4}	-0.006	-0.005
	(-0.915)	(-0.635)
s_{i5}	-0.006	-0.009
	(-0.966)	(-1.248)
s_{i6}	-0.008	-0.005
	(-1.226)	(-0.688)
s_{i7}	-0.011*	-0.004
	(-1.537)	(-0.55)
s_{i8}	-0.01*	-0.003
	(-1.585)	(-0.459)
s_{i9}	0	0.004
	(-0.613)	(0.567)
s_{i10}	0.002	0.002
	(0.294)	(0.283)
s_{i11}	0.003	0.005
	(0.488)	(0.673)

Note: ε_{1t-1} represents perturbations in the cointegration equation between one-month lagged prices of Brahma and Antarctica.
S_{i1} to S_{i11} are seasonal dummies.
Estimated values of "t" statistics are in parentheses.
***1% significance level; ** 5% significance level; *10% significance level.

Considering **t2**, a hypothetical increase of 1% in Brahma's price would produce an increase of 0.89% in Antarctica's price. As this estimate is slightly smaller than the response found in **t1**, this can be an indication that despite being able to raise Antarctica's price as much as Brahma's price, Ambev does not do so in the same rate, perhaps aiming to raise barriers to competitors. The adjustment coefficients were 0.1 for Brahma's and 0.16 for Antarctica's price, significant at the 10% and at the 5% levels, respectively, rejecting the hypothesis that one of the prices could have weak exogeneity.

Seasonal unit roots were included in the model because the HEGY test for Brahma's price indicated so. As the characteristic roots lie of the unit circle, the VEC models are stable as well as uncorrelated.

A noticeable fact is that heteroscedasticity was not possible to be removed from the model estimated for the first period, what might be an indication of higher price volatility of both Brahma's and Antarctica's prices when the brands were still competing to each other. Therefore, despite the estimation showing that both prices used to change by the same amount, such changes were not necessarily synchronised.

6. Conclusion

This research brings some indications of the exploitation of market power in the Brazilian beer industry after a merger between the two top breweries. First, it is noticeable that the prices of all brands, and especially the prices of Ambev's brands, have been increasing through time. Thought this evidence is not very strong because the prices might be increasing owing to input price rises or even due to increases in retailers' mark-ups, other evidences are provided by the econometric analysis.

The results suggest that Ambev has strategically combined its three brands. While the two main brands (Brahma and Skol) tend to follow an independent pricing pattern, behaving almost exogenously, Antarctica has been more connected to the main competitor, Nova Schin. The latter, however, has been pricing according to what happens with Ambev's brands.

The new pricing pattern adopted by Ambev is also evident in the relationship between its brands Brahma and Antarctica. Before Nova Schin's launching (2003), the prices of both brands used to be very volatile, despite being very close to one another. Afterwards, a gap opened between the prices of those two brands and they stopped moving at the same rate. Such behaviour is consistent with the usage of Antarctica as a fighter brand to raise barriers to low-price competitors.

To finish, it is important to acknowledge that a strong limitation of this research is related to our database, which refers to retail prices and not manufacturer prices. Pricing at the two retail segments studied here is quite distinct, as most consumers go to bars specifically to drink beer and to consume a narrow choice of products, while in supermarkets beer is only a little part of a wide array of products and is sometimes used to attract consumers to the store. Moreover, breweries have more power to negotiate with bars than with supermarkets. In spite of such limitations, the results found for both retail segments are very similar and in agreement with our hypotheses.

References

AMBEV. *Relatório Anual e de Sustentabilidade 2013*. Companhia de Bebidas das Américas (2013). Available at: http://ri.ambev.com.br/conteudo_pt.asp?idioma=0&tipo=43232&conta=28# (last accessed 30 March 2014).

Beaulieu, J. J. and Miron, J. A. 'Seasonal Unit Roots in Aggregate US Data', *Journal of Econometrics*, Vol. 55 (1993) pp. 305-328.

Bresnahan, T. 'Empirical Studies of Industries with Market Power', in: R. Schmalensee and R. Willig (eds.), *Handbook of Industrial Organization* (Amsterdam: North-Holland, 1989, pp. 215-242).

Bueno, R. L. S. *Econometria de Séries Temporais*, 2nd ed., São Paulo: Editora Cengage Learning, (2012).

CERVBRASIL. *Anuário 2014*, Associação Brasileira da Indústria da Cerveja (2014). Available at: http://cervbrasil.org.br/arquivos/anuariofinal2014.pdf (last accessed 25 March 2014).

Dickey, D. A. and Fuller, W. A. 'Distribution of the Estimators for Autoregressive Time Series With a Unit Root', *Journal of the American Statistical Association*, Vol. 74, (1979) pp. 427-431.

Dickey, D. A. and Fuller, W. A. 'Likelihood Ratio Statistics for Autoregressive Time Series With a Unit Root', *Econometrica*, Vol. 49, (1981) pp. 1057-1072.

Gregorini, G. S. *Estratégias Competitivas no Mercado de Bebidas: Estudo de Caso na Companhia de Bebidas das Américas – Ambev*, Undergraduate Monograph, Florianópolis, Universidade Federal de Santa Catarina (2006), pp. 69.

Hylleberg, S., Engle, R. F., Granger, C. W. J. and YOO, B. S. 'Seasonal Integration and Cointegration', *Journal of Econometrics*, Vol. 44, (1990) pp. 215-238.

Johansen, S. 'Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models', *Econometrica*, Vol. 59, (1988) pp.1551-1580.

Kwiatkowski, D., Phillips, P., Schmidt, P. and Shin, Y. 'Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root: How Sure Are We that Economic Time Series Have a Unit Root?', *Journal of Econometrics*, Vol. 54, (1992) pp. 159-178.

Lütkepohl, H. and Krätzig, M. *Applied time series econometrics*, New York: Cambridge University Press, (2004).

Margarido, M. A. and Bueno, C. R. F. 'Análise do Poder de Compra no Mercado de Arroz em São Paulo', *Revista de Economia e Administração*, Vol. 7, (2008) pp. 69-92.

Martin, S. *Industrial Economics*, 2nd ed. (New York: Macmillan, 1993).

Mason, E. S. 'Price and Production Policies of Large-scale Enterprise', *American Economic Review*, Vol. 29, (1939) pp. 61-74.

Moreira, É. T. 'Análise da Competitividade do Segmento de Cerveja do Brasil, 1997-2012', *Informações Econômicas*, Vol. 44, (2014) pp. 51-62.

Ng, S. and Perron, P. 'Lag Length Selection and the Construction of Unit Root Tests With Good Size and Power', *Econometrica*, Vol. 61, (2001) pp.1519-1554.

Phillips, P. C. B. and Perron, P. 'Testing for a Unit Root in Rime Series Regression', *Biometrika*, Vol. 75, (1988), pp. 335–346.

Prezotto, K. and Lavall, V. L. 'Ambev – Análise da Fusão e os Efeitos Sobre o Mercado', Paper presented at the 5th Encontro de Economia Catarinense, (2011), Florianópolis, SC, Brazil. Available at: http://www.apec.unesc.net/V_EEC/sessoes_tematicas/Economia%20industrial,%20ci%C3%AAncia,%20tecnologia%20e%20inova%C3%A7%C3%A3o/AMBEV%20%20AN%c3%81LISE%20DA%20FUS%c3%83O%20E%20OS%20EFEITOS%20SOBRE%20O%20MERCADO.pdf (last accessed 10 December 2016).

Ritson, M. 'Should You Launch a Fighter Brand?', *Harvard Business Review*, Vol. 87, (2009) pp. 86-94. Available at: https://hbr.org/2009/10/should-you-launch-a-fighter-brand (last accessed 18 September 2016).

http://ri.ambev.com.br/conteudo_pt.asp?idioma=0&tipo=43232&conta=28#

Rosa, S. E. S., Cosenza, J. P. and Leão, L. T. S. 'Panorama do Setor de Bebidas no Brasil', *BNDES Setorial*, n. 23, (2006) pp. 101-150. Available at: http://www.bndes.gov.br/SiteBNDES/export/sites/default/bndes_pt/Galerias/Arquivos/conhecimento/bnset/set2304.pdf (last accessed 10 March 2014)

Salgado, L. H., Oliveira, A. V. M. and Ferreira, N. S. 'Investigação de Práticas Predatórias em Mercados de Cerveja no Brasil: Uma Abordagem Antitruste', In: C. Mattos (Ed.), *A*

Revolução do Antitruste no Brasil: A Teoria Econômica Aplicada a Casos Concretos (São Paulo: Singular, 2008, Vol. 2, pp. 471-498).

Sims, C. A. 'Macroeconomics and Reality', *Econometrica*, Vol. 48, (1980) pp. 1-40. Available at: http://www.ekonometria.wne.uw.edu.pl/uploads/Main/macroeconomics_and_reality.pdf (last accessed 12 September 2014).

Vickner, S. S. and Davies, S. P. 'Estimating Strategic Price Response in Differentiated Oligopoly: The Case of a Domestic Canned Fruit Industry', *Agribusiness*, Vol. 16, (2000) pp. 125-140.

Vickner, S. S. and Davies, S. P. 'Estimating Strategic Price Response Using Cointegration Analysis: The Case of the Domestic Black and Herbal Tea Industries', *Agribusiness*, Vol. 18, (2002) pp. 131-144.

Viegas, C. A. S. Fusões e Aquisições na Indústria Brasileira de Alimentos e Bebidas: Efeito Poder de Mercado e Efeito Eficiência, Documento de Trabalho 38, SEAE/MF, 2006. Available at: http://www.seae.fazenda.gov.br/central-de-documentos/documentos-de-trabalho/documentos-de-trabalho-2006/DT_38.pdf (last accessed 17 November 2014).