THE JOURNAL OF INDUSTRIAL ECONOMICS 0022-1821
Volume LVII December 2009 No. 4

CUT-THROAT FRINGE COMPETITION IN AN EMERGING COUNTRY MARKET: TAX EVASION OR THE ABSENCE OF MARKET POWER?*

ALBERTO SALVO†

Brazil's established soft-drink firms recently lost ground to multiple low-price entrants, with small-scale operations and minimal advertising. While incumbents attributed such undercutting to entrants' lower costs from non-compliance with the law, 'generics' counterargued that incumbents' high prices stemmed from unilateral market power rather than cost heterogeneity. By estimating a structural model, I can single-handedly explain established brands' high prices through low equilibrium price elasticities of demand. Tax evasion in the fringe, while plausible, appears to be offset by higher procurement costs or less efficient scale. More generally, a competitive informal sector can alleviate the allocative distortions in certain concentrated industries.

'In Bolivia, one of the most heavily regulated economies in the world, an estimated 82% of business activity takes place in the informal sector. There, workers enjoy no social benefits and cannot use pension plans and school funds for their children. Businesses do not pay taxes, reducing the resources for the delivery of basic infrastructure. There is no quality control for products. And entrepreneurs, fearful of inspectors and the police, keep operations below efficient production size.' World Bank [2004]: *Doing Business: Understanding Regulation* (p. xv).

'It is cut-price, regional companies . . . that are prising sales away from the leading brands in one of the world's largest soft drinks markets. Coca-Cola blamed difficulties in developing countries such as Brazil

*This paper won a Young Economists' Essay Award from the European Association for Research in Industrial Economics (EARIE) in 2007. It circulated previously under the title 'Testing for Heterogeneous Business Practices across Firms in Developing Countries.' I am greatly indebted to Ricardo Fort at the Coca-Cola Company for facilitating access to Nielsen's market data and McCann Erickson's advertising data. I also thank Isadora Nardy, Claudia Pessoa and Daniela Pisetta at the Coca-Cola Co. and, in particular, Bruno Gouvea at Nielsen. I am grateful to Alaor Dall'Antonia, Jr. and Maria Cristina Costa at the National Institute of Meteorology (INMET) for access to climatic data. I further thank Allan Collard-Wexler, Peter Davis, Tom Hubbard, Cristian Huse, Mike Mazzeo, Margaret Slade, Joel Slemrod, Scott Stern, John Sutton and Catherine Thomas, as well as the Editor and a referee, for comments. Financial support from CAPES and from the LSE, and the provision of research facilities by STICERD, are gratefully acknowledged. The usual disclaimer applies.

†Author's affiliation: Northwestern University, Kellogg School of Management, Strategy Department, 2001 Sheridan Road, Evanston, Illinois, U.S.A. 60208.
e-mail: a-salvo@kellogg.northwestern.edu

when it shocked Wall Street in December by announcing a rare drop in quarterly sales.' *Financial Times* [June 1999]: 'Brazil's regional drinks makers slake thirst for value: The tax regime and growing demand have penalized leading brands.'

I. INTRODUCTION

THERE IS A VIEW AMONG MARKETING PRACTITIONERS that large established consumer goods firms have been somewhat slow to respond to the rapid growth of the lower middle class that is observed in developing countries (Boston Consulting Group [2002]). One observes examples, particularly in low-technology sectors such as grocery products, where established firms–multinational corporations and large traditional domestic firms alike–have seen their market share erode in the face of competition from cut-price entrants. In contrast to the established firms' branded products, or 'A' brands, 'low-end' entrants typically offer low-price, low-quality, largely unadvertised products, or 'B' brands, to price-sensitive low-income consumers, often distributing their products within limited geographic areas, such as a few counties of a state or province.

Several factors have been suggested to explain the rise in the competitive fringe. These include the established firms' traditional focus on higher-income consumers, the inability to price discriminate according to income, and shifts in production and distribution technologies reducing barriers to entry. Some relate the growth of the fringe to the rise of retailers' 'private labels'–a phenomenon the CEO at Procter & Gamble calls 'commodity hell' (*Economist* [2006a])–as retailers provide additional outlets to generics makers. A more contentious factor that has been proposed centers on the heterogeneous business practices that established firms and low-price entrants adhere to in emerging markets. The argument goes that while established firms are more visible to regulators, taxmen, consumers and activists, and thus in equilibrium pay their taxes and comply with labor and environmental laws, this does not apply to the small-scale operations of individual fringe producers–see the opening World Bank quote. Naturally, scarce monitoring and enforcement resources are deployed where the tax revenue base is concentrated, and multinational corporations such as Coca-Cola and Nestlé will want to protect their corporate image. Such an asymmetry, goes the claim, confers a competitive advantage, in developing countries, on the small fringe operators at the expense of the large law-abiding established firms[1].

A case in point of the tension created by this dichotomous market structure is provided by the Brazilian carbonated soft drink industry–see the FT quote. The industry, the world's third largest by volume, is dominated by

[1] The informal economy in developing countries is substantial. Schneider [2002] estimates its average size at 41% of official GDP (compared to a still high 18% for OECD countries).

Coca-Cola, with a 50–60% volume share (and an even higher value share). Over the 1990's, Coca-Cola, along with two traditional domestic firms that later merged into Ambev (and ran the local Pepsi franchise), saw their established (and heavily advertised) soft drink businesses come under attack from low-price entrants. The aggregate volume share of (ultimately) hundreds of local B brand producers grew from less than 10% in 1990 to 32% by 2000. The entry and growth of B brands was acute between 1996 and 1999, following an economic stabilization plan in mid 1994 where very high and chronic inflation was successfully brought down to single-digit levels. Price stability boosted the purchasing power of low-income households, as it represented a reduction in the 'inflation tax' borne disproportionately by the poor, who did not have access to price-indexed savings accounts. In the period 1994 to 1997, soft drink consumption almost doubled from 6 to 11 billion liters.

The fringe's growth was not free of controversy. The established soft drink makers complained that their low-price counterparts were engaging in 'unfair competition,' claiming that B brands could afford to undercut their A brands–by as much as 45% (even after Coca-Cola abruptly lowered its prices by a hefty 25% in 1999)–thanks to lower marginal costs enjoyed by not complying with the law. The Brazilian Association of Soft Drink Makers (ABIR), seen to represent the established industry, lobbied the government for measures to curb the growth of the fringe, such as legally requiring that bottlers across the country install complex flowmeter systems along their filling lines that record output onto a central register, hence enabling the inspection of tax and other liabilities by the authorities[2]. B brand makers retorted that Coca-Cola and Ambev's higher prices owed to market power and that these firms were seeking to protect their highly profitable businesses at the expense of consumer gains from lower prices.

This paper sets out to evaluate the relative merit of these two allegations in explaining the price differential. Relative to B brands, how much of the A brands' price premium owes to a higher cost on the supply side vis-à-vis a less price sensitive consumer on the demand side? For reasons alluded to above, one might not doubt the theoretical validity of either argument. Akin to the Bolivian case, economic activity in Brazil is heavily regulated and taxed. Soft drinks are no exception. As ABIR points out, the tax intake along the soft drink supply chain totals 40% of the end retail price. As for (unilateral) market power, the Coca-Cola brand has, after all, been systematically ranked as the world's most valuable (e.g. Interbrand/*BusinessWeek* 2007 ranking). But while the productive inefficiency side of the argument–the inefficient scale of operations in the fringe and its (alleged) tax

[2] The measure was enacted in 2002 (IRS NI 265) but is still under implementation. Such a complex (and allegedly tamper-proof) enforcement system, as ABIR admits, is the first of its kind in the world.

non-compliance–has been highlighted in business and policy circles[3], less appears to have been said about the allocative efficiency aspect–that B brands sell at low prices also because they are fiercely competitive. No matter how substantiated, the B-brand-as-villain view is not shared by Brazil's new middle class.

The empirical strategy is straightforward. Drawing on original panel data, I estimate a demand system for Brazilian soft drinks. I follow Hausman, Leonard and Zona [1994] and estimate a two-stage budgeting system *à la* Gorman [1995]. Conditional on a representative consumer's soft drink expenditure (relative to the outside good) in the first stage, the allocation among the alternative soft drink brands in the second stage is specified as an AIDS demand function (Deaton and Muellbauer [1980]). I adopt this flexible continuous-choice approach since the richness of the data (including my confidence in the identification strategy, as I comprehensively discuss) allows me to estimate the patterns of substitution *directly*, rather than having to project brands on a reduced space of product characteristics[4]. Further, because of the reduced number of differentiated brands, I avoid making arbitrary assumptions regarding the consumer's sequence of choices.

I find limited equilibrium support for the cost hypothesis, but strong support for the demand side (i.e., market power) hypothesis–that consumers have different preferences over established A brands in counterpoint to B brands. The price of A brands (Coke, say) is considerably higher than that of B brands in large part because demand for A brands in equilibrium is not very elastic: the own price elasticity of demand for Coke, for example, is estimated at a low 2. I combine the estimated matrix of own and cross price elasticities with standard pricing assumptions for the established firms (such as multiproduct Bertrand in the period after Coca-Cola's price cut) to back out marginal costs and price-cost margins[5]. The marginal cost I estimate for

[3] Two (further) quotes sum the view. ABIR representative Araújo [2008] states 'Any price below (Reais) R$ 1.10 for a 2-liter PET bottle is strongly indicative of tax evasion. Soft drink consumption is popular and highly sensitive to price. The difference between prices set by ethical companies and prices set by unethical ones tends to be marked.' McKinsey consultant Lewis [2004] argues: 'When taxes are included, it costs more productive companies as much to do business as it costs less productive, informal ones, which don't pay taxes. Modern, productive enterprises can't easily take market share from their unproductive counterparts, and the economy's natural evolution is stymied.' (p.6)

[4] In related (and unfinished) work, I am modeling the changes in household demographics, thus estimating a random-coefficients discrete choice model. The aim is to study the dynamics of pricing and consumer welfare. Was Coca-Cola's abrupt (rather than gradual) 25% price reduction in July 1999 an optimal response to the growing mass of low-income consumers relative to a stable mass of high-income consumers, or did it characterize a belated shift in company strategy, as suggested by the change in its Brazilian management team around that time, following the period of sharp growth in B brands?

[5] While I estimate the substitutability across individual A brands and the *aggregate* demand for B brands, I cannot do so at the *individual* B brand level, due to data aggregation. But I can rely on the institutional setting to assert that behavior at the individual B brand level is sufficiently competitive.

A brands is *not* significantly greater than that for B brands. If B brand makers are assumed to be price takers (motivated through perfect substitutability among brands in the fringe), the market power of the A brands single-handedly explains the approximate 80% price premium–i.e., $1/(1-45\%)$–they command over the B brands. One might find this assumption of competitive (price-taking) conduct on the part of B brand makers to be too strong, preferring to model them as single-product Bertrand firms selling near rather than perfect substitutes. Even then, however, I find that at most a 5–10% overall (marginal) cost advantage over the A brands is consistent with the data.

In the absence of detailed cost data, I cannot tell whether cost advantages arising from evading taxes, subjecting workers to 'sweatshop' labor conditions, not complying with environmental regulation, or using lower quality materials, are being offset by cost disadvantages from less efficient scale or (conceivably) higher costs of procurement (sugar, plastic). But what the exercise emphasizes is that the 'cut-throat' prices of low-end entrants can be explained by the fundamentally asymmetric nature of consumer demand alone, a hypothesis that appears to have been overlooked.

Though estimating welfare is beyond this paper's scope, the analysis highlights a more general tradeoff between allocative and productive efficiency, resulting in a tension between two types of players. On the one hand–allocative efficiency–generics are priced lower and, through competition, may also exert downward pricing pressure on established brands. It may be that in some industries, at least temporarily, a burgeoning low-income consumer's reduced willingness to pay for quality or advertising is tilting the balance back in favor of the competitive fringe, a 'reversal' of the escalation mechanism identified by Sutton [1991]. On the other hand–productive inefficiency–social costs may arise from small-scale manufacturing and less than full conformity with the law (including intellectual property[6]; see Schneider and Enste [2000]). This welfare tradeoff can help explain situations in which the authorities turn a blind eye on asymmetric business practices in the informal sector relative to the formal one. While acknowledging the productive implications, my paper seeks to emphasize the allocative side of the welfare equation.

The dichotomous tension present in the Brazilian soft drink case is reminiscent of two other literatures. A first literature examines competition between heavily advertised national brands and low-price private labels that, while not enjoying the same pricing power and scale economies, may benefit from mitigating the double marginalization problem (Mills [1995]; see also Hoch and Banerji [1993]). A second literature addresses competition between

[6] For example, Chaudhuri, Goldberg and Jia [2006] study low-end entry in Indian pharmaceuticals in the context of global patent infringement, where (global) patented branded drugs compete with (local) copycat low-price generics and the local authorities seem to look the other way.

heavily advertised brands and generic entrants in the U.S. pharmaceutical market, where substantial price differentials may persist well into the off-patent period (e.g., Hurwitz and Caves [1988], Scott Morton [2000]).

The paper is organized as follows. Section II reviews the industry and the data. Section III estimates demand. Section IV backs out implied marginal cost that is consistent with demand and plausible pricing assumptions. Section V concludes.

II. INDUSTRY AND DATA

Soft drink consumption in Brazil trails only the United States and Mexico, amounting to 14 billion liters in 2002. That year, Coca-Cola Co. commanded a nationwide share of 59% by value and 50% by volume. Its flagship brand, (regular) Coca-Cola (Coke hereafter), alone accounted for a 39% value share, with the balance accruing to a handful of other brands, such as Fanta (8%), Diet Coke (5%), Sprite (2%) and a local brand Guaraná Kuat (3%), based on the Amazon berry guaraná. (See Table I.) As in other countries, Coca-Cola Co. tightly controls a franchising system by which each franchisee produces, bottles and distributes its brands within an exclusive territory. Through these regional distributors, Coca-Cola Co. appears to strike a balance between exploiting their local knowledge of downstream operations–particularly important in light of Brazil's vast regional differences–and centralizing control upstream[7].

Operating a somewhat similar distribution system, the second largest firm, Ambev (American Beverages), was formed through the merger of Antarctica and Brahma in March, 2000.[8] Ambev's share in 2002 amounted to 23% by value and 18% by volume, its best-selling Guaraná Antarctica brand attaining a 13% value share. The Pepsi brand, which Ambev has been selling under contract for PepsiCo, had a low 5% value share. Like Coca-Cola Co., Ambev heavily advertises its brands (*Gazeta Mercantil* [1998]).

Contrasting with Coca-Cola Co. and Ambev's 'A' brands, low-end brands are referred to somewhat depreciatively as 'B' due to their perception of inferior quality, lack of advertising and substantially lower prices. While differentiation among A brands tends to be horizontal, there is vertical differentiation between A brands and B brands[9]. Retail outlets typically

[7] Regional income disparities are exploited in identifying demand. Vertical relations are further discussed in the Appendix.

[8] Beyond soft drinks, Antarctica and Brahma were the country's two leading brewers, with a joint 70% share of the beer market. Subsequently, in 2004, Ambev merged with Belgium-based Interbrew.

[9] Consumer studies report that, in a same shopping trip, a lower-income household may well buy both B brands and A brands, respectively for regular consumption (weekends, say) and special occasions (extended family gatherings).

TABLE I
SHARES IN THE BRAZILIAN SOFT DRINK INDUSTRY, 2002 AGAINST 1997

	2002 shares by		1st half 1997 shares by	
	Value	Volume	Value	Volume
Coke	39%	32%	42%	38%
Fanta	8%	7%	8%	7%
Diet Coke	5%	4%	2%	2%
Guaraná Kuat*	3%	3%	2%	3%
Sprite	2%	2%	3%	2%
Other Coca-Cola Co.	2%	2%	1%	1%
Total Coca-Cola Co.	**59%**	**50%**	**58%**	**53%**
Guaraná Antarctica	13%	10%	11%	9%
Pepsi	5%	4%	6%	6%
Other Ambev	5%	3%	12%	12%
Total Ambev	**23%**	**18%**	**30%**	**27%**
Total A Brands	**82%**	**67%**	**88%**	**80%**
Total B Brands	**18%**	**33%**	**12%**	**20%**
Grand Total	**100%**	**100%**	**100%**	**100%**

*In early markets of the sample, Coca-Cola Co.'s guaraná drink was marketed under the brand name Guaraná Taí.

carry two to three B brands, at similar prices, which consumers perceive as close substitutes for one another. This limited differentiation is consistent with the fact that B brand makers are essentially single-product, rather than multiple brand, firms. The small-scale operation of the typical B brand bottler covers a limited area, in some instances as little as a dozen or two municipalities[10]. Despite being individually small, the aggregate nationwide share across all B brands grew from a value share of 11% in 1996 to 18% in 2002, or in volume terms from a share of 18% to 33% (see Figure 1). This corresponds to a large 4.7% volume share gain per year in the three years between 1996 and 1999. B brands have grown even more markedly if only family-size packaging is considered, as I explain below. Though estimates vary, the number of fringe producers is said to have risen from around 100 to 500 in a decade.

What might lie behind the entry and growth of these popular brands? Two exogenous shocks to the industry took place in the early 1990's (see Salvo [2006] for greater details). The taming of chronically high inflation in 1994, from double-digit monthly levels to single-digit annual levels, sharply raised the real income of a large mass of unbanked

[10] Brazil's population amounts to 175 million (in mid 2002), distributed across 27 states, or around 5,600 municipalities. On average, each state comprises 210 municipalities, each with a population of 31,000.

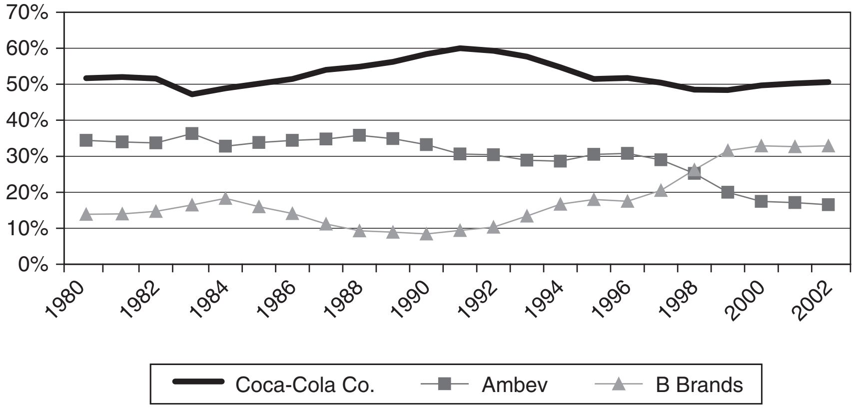

Figure 1
Historic Evolution of Volume Shares in the Brazilian Carbonated Soft Drink Industry, by Firm (Type).

low-income consumers without resource to monetary protection. Given their high propensity to consume, this boosted demand across a broad spectrum of goods, such as food, durables and housing. In particular, soft drink consumption grew by a staggering 22% per year between 1994 and 1997, with growth slowing to + 8% per year in the period 1997 to 2002. It is noteworthy that several other grocery categories that experienced similar consumption growth also experienced expansion of the competitive fringe (Exame [2002]). A second shock relates to a shift in packaging and distribution away from returnable and refillable glass bottles toward one-way (non-returnable) plastic bottles, reducing barriers to entry. Introduced in the early 1990's, PET technology rapidly substituted for glass. Glass had required that a bottler maintain a high fixed cost, and thus large scale, bottle refill operation. The family-size returnable 1-liter glass bottle, the industry standard for decades, soon gave way to the low-cost 2-liter PET bottle. Consistent with this argument, most B brand bottlers offer their soda in this large container only, with a minority catering also to individual consumption by adding small glass bottles or aluminium cans to their offerings. In 2002, for example, the 2-liter PET bottle accounted for 84% of aggregate volume consumption of B brands, to be compared with 70% of total volume consumption in the soft drink category. Offering the family-size bottle only limits the incursion of B brands into distribution channels where individual consumption takes place, such as bars and restaurants.

The Brazilian economy is highly regulated. It is notorious for the complexity of its many tax codes, and the rigidity of its labor laws. Environmental restrictions on industry, such as waste water disposal, are becoming more stringent. In the soft drink industry, taxes incurred along the formal vertical chain amount to 40% of the end consumer price, and are largely collected by the bottler. (As the recent flowmeter regulation suggests, authorities naturally favor inspecting the activities of hundreds of manufacturers over that of several hundred thousand retail establishments.) Taxes are incurred on sales, purchases, payroll (e.g., social security), income, etc. McKinsey [2004] lists several illicit practices that firms may follow to reduce cost, such as underinvoicing on sales or purchases and not registering workers. For perspective, registering a worker more than doubles his cost. I model the cost of complying with the law (tax, labor, environmental, etc.) as a component of marginal cost.

II(i). *Data*

I draw on a proprietary Nielsen panel dataset. Nielsen samples retail outlets located in the coastline states and in some neighboring states, dividing this area into seven 'regional markets;' the sparsely-populated jungle states are not audited. In each region, data are aggregated across outlets into three types of distribution channel: (i) supermarkets with checkouts ('self-service' outlets), (ii) over-the-counter stores ('traditional' outlets), and (iii) bars and restaurants ('bars'). Data are collected at the brand and flavor level, and are further broken out for two packaging sizes: (i) the standard family-size 2-liter PET bottle ('family size'), and (ii) single consumption sizes such as the standard 300-milliliter glass bottle and 350-ml aluminium can ('single size'). Data are available between December, 1996, and March, 2003, (at bimonthly frequency until January, 2000, with Nielsen increasing the frequency of its audits to monthly thereafter), totaling 57 time periods (or 'time markets'). Variables include average prices, quantities sold and weighted distribution. The latter is defined as the proportion of sampled outlets that stock the brand, weighted by the outlets' sales in the category. To provide an example, one observation in the dataset consists of the average price, quantity sold and weighted distribution for the family-size bottle of the Fanta brand, orange flavor, sold through self-service outlets in region 6 (the three southernmost states of Brazil) in July, 2000. I subsequently exploit this rich panel structure–variation over time and across regions and across outlet types–to estimate a baseline demand specification and test for robustness.

The cross-sectional variation in market size–in liters and in local currency, Reais (R$)–among other variables, aggregated across the two packaging types, is summarized in Table II, for 2002. Prices are in constant March, 2003, R$, adjusted for inflation (which was low by 1995) using the 'CPI-br' published by the Fundação Getúlio Vargas. The fringe of B brands is largest (a 24% value share) in the northeastern states (region 1), the region where per capita disposable income is lowest. Due to their typical family-size

TABLE II
QUANTITIES, SALES, PRICES AND VALUE SHARES BY NIELSEN REGIONAL MARKET AND OUTLET TYPE IN 2002 (BOTH PACKAGING TYPES INCLUDED)

					Average value shares			Disposable income**	
Regional market	Outlet type	Quantity (million liters)	Sales* (R$ mi)	Avg price* (R$/liter)	Coke Co.	Ambev	B Brands	Total $	Per capita $
1 Northeast	All	1,461	1,948	1.33	51%	25%	24%	78.7	1,944
	Self-Service	565	569	1.01	53%	21%	26%		
	Traditional	498	587	1.18	45%	20%	35%		
	Bar	398	792	1.99	54%	32%	14%		
2 ES, MG, RJ Interior	All	1,587	1,951	1.23	59%	19%	21%	108.1	3,990
	Self-Service	772	686	0.89	58%	17%	25%		
	Traditional	437	505	1.16	58%	14%	28%		
	Bar	378	760	2.01	61%	25%	14%		
3 RJ Metro	All	845	1,185	1.40	65%	21%	14%	56.5	5,945
	Self-Service	390	374	0.96	61%	21%	17%		
	Traditional	229	309	1.35	64%	16%	20%		
	Bar	227	501	2.21	67%	25%	8%		
4 SP Metro	All	1,292	2,034	1.57	62%	28%	10%	87.4	5,790
	Self-Service	646	627	0.97	60%	26%	14%		
	Traditional	277	431	1.56	64%	23%	13%		
	Bar	369	976	2.64	62%	32%	6%		
5 SP Interior	All	1,965	2,381	1.21	59%	21%	20%	133.6	5,790
	Self-Service	1,179	1,090	0.92	58%	20%	22%		
	Traditional	403	502	1.25	59%	17%	24%		
	Bar	383	790	2.06	61%	25%	14%		
6 South	All	1,799	2,217	1.23	59%	23%	18%	120.5	4,643
	Self-Service	1,022	901	0.88	58%	21%	21%		
	Traditional	393	451	1.15	56%	18%	26%		
	Bar	384	866	2.25	62%	27%	11%		
7 DF, GO, MS	All	732	941	1.29	57%	22%	20%	41.7	4,329
	Self-Service	391	391	1.00	53%	22%	25%		
	Traditional	176	219	1.24	60%	17%	24%		
	Bar	165	332	2.02	61%	27%	12%		
All	All	9,681	12,657	1.31	59%	23%	18%	626.5	4,154
	Self-Service	4,963	4,638	0.93	58%	21%	22%		
	Traditional	2,412	3,002	1.24	57%	18%	25%		
	Bar	2,305	5,017	2.18	61%	28%	11%		

*In constant March, 2003, R$.
**In rescaled monetary units. Source: IBGE.

packaging, the penetration of B brands is indeed far higher in self-service and traditional outlets (respective value shares of 22% and 25%) relative to bars (an 11% value share).

Figure 2 depicts the evolution of volume and value shares, as well as revenues, by firm (or firm type) across all regional markets and all outlet types considering only family-size bottles. At this aggregate level, the speed with which B brands gained share in the first half of the sample's time period, especially at the expense of Ambev–in particular, its lesser 'Other Ambev' brands, recalling Table I–is striking. In the second half, from mid 1999, shares stabilized. In using the full sample to estimate the patterns of price substitution, I will add brand and region specific

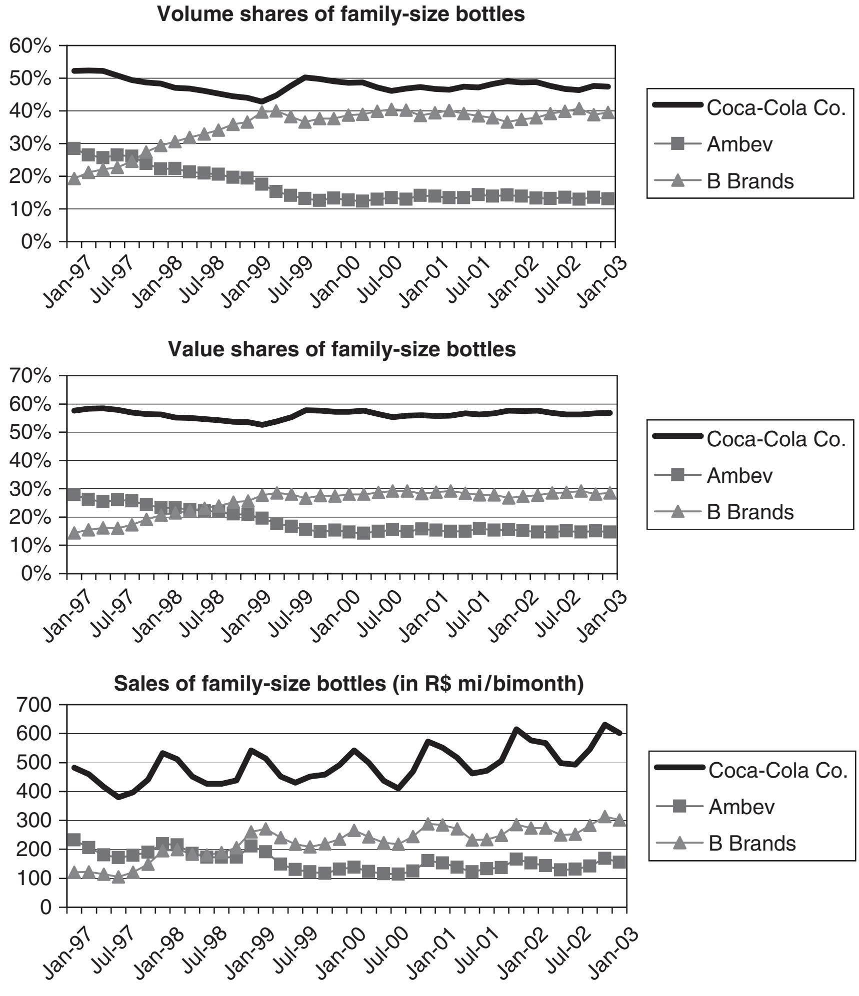

Figure 2
Bimonthly volume shares, value shares and sales of family-size bottles across all regions and all outlet types in the sample, by firm (type). On the horizontal axis, 'Jan' denotes the (summer) Dec-Jan bimonth and 'Jul' denotes the (winter) Jun-Jul bimonth. Shares (sales) for Ambev prior to the March, 2000, merger are the sum of the shares (sales) for the constituent firms. Sales are in constant March, 2003, Reais (R$) per bimonth.

drifts to control for any change in preferences and demographics over time. Re-estimating using data only from the second half of the time period, during which aggregate shares were stable, will provide a valuable robustness test that the full sample is yielding consistent price elasticities.

Why may aggregate shares have stabilized in mid 1999? Recall that the income shock on poor households occurred in 1994/1995. Soft drink consumption boomed up to 1997, with growth slowing to $+8\%$ p.a. thereafter[11]. Fringe capacity may have become very tight around 1996, inviting considerable entry (again, accurate fringe numbers are hard to come by). If so, one should expect to see B brand prices fall starting in late 1996, when the data sample begins. Figure 3 portrays the by-region evolution of prices and value shares for the aggregation of B brands, in the top panel, and the main A brand, Coke, in the bottom panel (and only for family-size bottles sold through self-service outlets, to reduce noise). The fact that B brand prices declined over 1997/1998 from around R$ 0.90 to R$ 0.55 per liter (and Coke prices were relatively flat) is consistent with the hypothesis that fringe capacity was fast-expanding. Competition among 'generic' brands was becoming fierce. Notice that the fringe has grown faster in the poorer northeast, albeit starting from a lower base. (This again guides the inclusion of brand-and-region specific drifts.) The weighted distribution variable (not reported in the figure) tells a story that is consistent with tight fringe capacity early on. In 1997, B brands were stocked by 86.5% of self-service outlets, averaged across region-time markets that year, i.e., B brands were out of stock in 13.5% of outlets at that point. By 1999, the proportion of self-service outlets that had B brands in stock had risen to 97.5% (for perspective, the weighted distribution for the Coke brand is a persistent 99.5% throughout the sample).

As for Coke, in July 1999 Coca-Cola Co. significantly and abruptly lowered the price of the family-size bottle only, from around R$ 1.30 to R$ 1.00 per liter (also cutting prices on its other brands). I do not know whether the growth of the fringe took Coca-Cola Co. by surprise only in 1998/1999 (as was the case for Wall Street–recall the FT quote). But Figure 3 indicates that the firm was able to stem (and even reverse) the decline in Coke's share in most market areas, paying heavily in terms of lower unit revenue. (Ambev also lowered its prices around this time, but the reduction was more gradual[12].) I return to this event when discussing demand identification, where I argue that the magnitude and abruptness of the price drop strongly suggests that it was supply-motivated at that discrete point in time (and thus not correlated with the demand unobservable, i.e., there is nothing that suggests that the demand residual changed discretely in July, 1999).

[11] In the bottom panel of Figure 2, notice the steady but slower growth in soft drink expenditure from 1997. Notice also the seasonal nature of demand, with the high season being centered around the summer month of January, in counterpoint to the winter month of July.

[12] In an online appendix, available on the *Journal*'s editorial website, I reproduce the information depicted in Figure 3 (value shares and prices for B brands and for Coke) for Fanta (Coca-Cola Co.'s number two brand) and for Ambev's two main brands (Guaraná Antarctica and Pepsi).

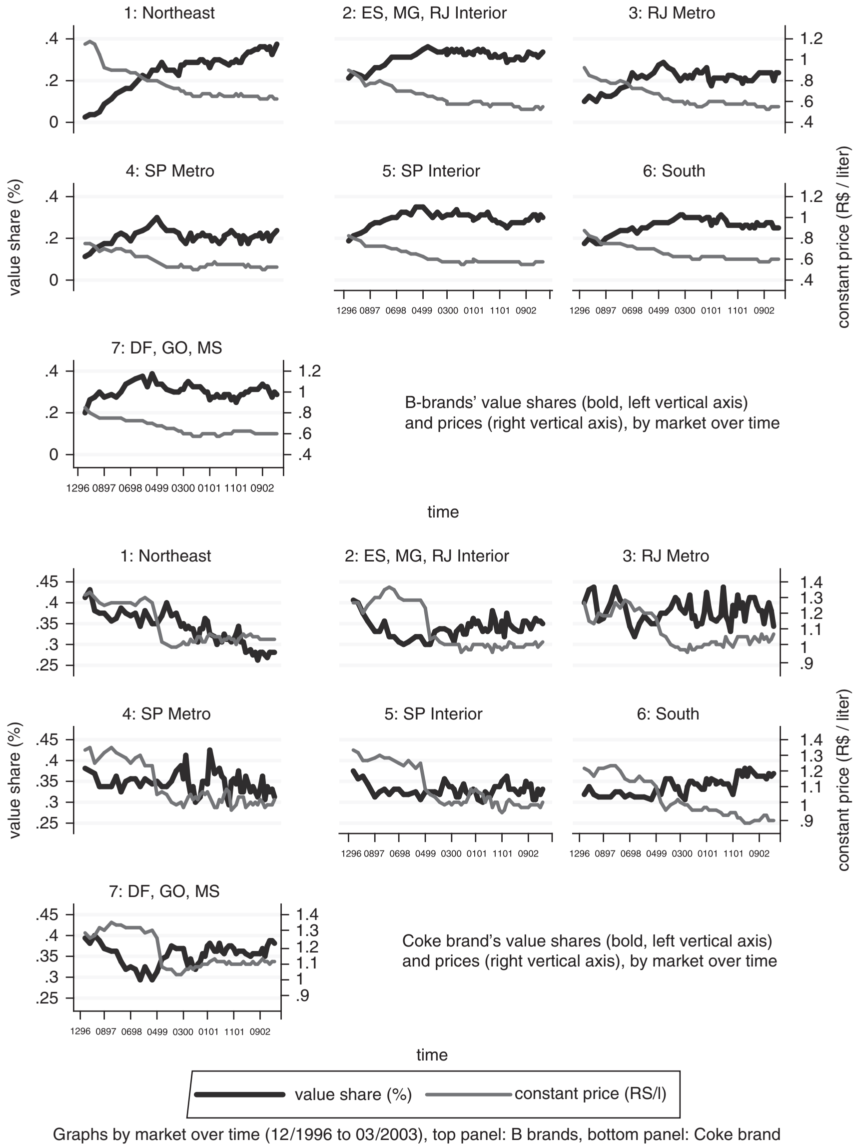

Figure 3
Value shares (bold, left vertical axis) and prices (right vertical axis, in constant March, 2003 R$ per liter) for B brands (top panel) and for Coke (bottom panel), by Nielsen regional market (each subpanel). Family-size bottles sold through self-service outlets.

Media advertising by brand for ten main cities, in monthly gross rating points (GRP's), was obtained from McCann Erickson (through Coca-Cola Co.). GRP's are a standard measure of advertising intensity in the industry, the product of 'reach' and 'frequency.' Climatic data in each state capital (monthly averages for temperature in degrees Celsius, the amount of sunlight in hours per day, and the amount of rain in millimeters per day) are available from the National Institute of Meteorology (INMET). Total disposable income for each state is available from the Brazilian Institute for Geography and Statistics (IBGE). As for one class of demand-side instruments (discussed below), prices of refined sugar (wholesale), diesel oil, and (high-voltage) electricity were obtained from the Institute for Applied Economic Research (IPEA), the National Agency for Oil (ANP), and the National Agency for Electrical Energy (ANEEL). Manufacturing-sector wages were obtained from the Confederation of National Industry (CNI).

A final comment that will guide specification is in order. While Nielsen 'swears by the quality' of its aggregate B brand data (i.e., composite measures across all individual B brands collected at the store), data on individual B brands are very noisy. Nielsen justifies this by asserting that its main customers, the established firms, were mostly tracking B brands as a group, rather than particular B brands, consistent with the view that shoppers treat B brands as being symmetrically differentiated, if at all. For this reason, the fringe will enter the demand specification as a group (and I argue that one can plausibly work around this data limitation in deriving the paper's results). Another reason for not specifying individual B brands is geographic. The area Nielsen audits covers 4500 municipalities, translating into $4500/7 \simeq 640$ municipalities per average Nielsen region. As mentioned, the typical B brand operation covers only a small fraction of this. Thus, Nielsen's data on individual B brands are not very informative about the choices consumers make *among* the different B brands at the point of sale[13].

III. DEMAND

I specify a two-stage budgeting system since the number of brands is conveniently small (Gorman [1995]; Blackorby, Primont and Russell [1978]; Hausman, Leonard and Zona [1994]). The richness of the data allows me to adopt this direct and flexible approach, rather than working with computationally more demanding discrete-choice models *à la* Berry, Levinsohn and Pakes [1995] or Hendel [1999]. As Nevo [2000] argues, 'the main motivation for the use of discrete choice models (is) to reduce (the) dimensionality problem' (p.537). The sensible demand estimates I obtain indicate that the choice is appropriate for my purpose.

[13] Ideally, the econometrician would use store-level data to estimate this choice among B brands, thus controlling for the limited geographic coverage of each individual B brand.

III(i). *Baseline Specification*

The AIDS demand function at the bottom stage, conditional on soft drink expenditure from the top stage, is:

$$(1)\qquad s_{int} = \alpha_{1in} + \alpha_{2in} T_t + \beta_i \log(\frac{Y_{nt}}{P_{nt}}) + \sum_j \gamma_{ij} \log p_{jnt} + \theta_{in} Z_{int} + \varepsilon_{int}$$

$$\text{for } i = 1, \ldots, I;\ n = 1, \ldots, N;\ t = 1, \ldots, T$$

where $s_{int} := \frac{p_{int} q_{int}}{Y_{nt}}$ is brand i's value share in region n at time t, p_{int} is the price per liter of brand i in region n at time t, q_{int} is the quantity sold in liters (per month) of brand i in region n at time t, and $Y_{nt} := \sum_i p_{int} q_{int}$ is total expenditure on soft drinks in region n at time t. P_{nt} is an overall soft-drink price index across brands in region n at time t, such as Stone's [1954] price index, given by $\log P_{nt} := \sum_i s_{int} \log p_{int}$. [14] The econometric error is denoted by ε_{int}. The remaining terms capture time-varying changes in preferences and demographics: (i) a brand-and-region specific fixed effect (through α_{1in}); (ii) a brand-and-region specific time trend (through an element of $\alpha_{2in} T_t$); (iii) brand-specific bi-monthly seasonal effects (through $\alpha_{2i} T_t$, an element of $\alpha_{2in} T_t$); (iv) brand-and-region specific effects of climatic conditions in region n at time t (through $\theta_{in} Z_{nt}$, elements of $\theta_{in} Z_{int}$); (v) a region-specific effect of brand-level advertising intensity (GRP's) (through $\theta_{in} Z_{int}$); and (vi) the weighted distribution of brand i in region n at time t (through $\theta_i Z_{int}$, an element of $\theta_{in} Z_{int}$). Covariate (vi) controls for the lower distribution of B brands in some early markets, due to tight capacity. Recall the fringe's 87% distribution in 1997 relative to 98% by 1999 (or relative to 100% for Coke throughout). Yet estimates are robust to dropping (vi) from the specification, or using it as an alternative instrument (as I explain below).

The top stage captures overall demand for soft drinks, specified log-linearly as:

$$(2)\qquad \log Q_{nt} = \alpha_{1n} + \alpha_{2n} T_t + \beta \log X_{nt} + \gamma \log P_{nt} + \theta_n Z_{nt} + \varepsilon_{nt}$$

where $Q_{nt} := Y_{nt}/P_{nt}$ is overall soft drink consumption[15] in region n at time t, X_{nt} is disposable income in region n at time t, and price index P_{nt} is defined as before. ε_{nt} denotes the econometric error. The remaining terms similarly capture time-varying differences in preferences and demographics, through region-specific fixed effects, region-specific drifts, bi-monthly seasonal effects, region-specific climatic effects, and region-specific advertising intensity (sum of GRP's across brands).

[14] A discussion is provided in the online appendix.
[15] Alternatively, one can define $Q_{nt} := \sum_i q_{int}$. See the online appendix.

Sample Characteristics

In terms of data aggregation, $N = 7$ and $T = 57$ such that there are $NT = 399$ region-time markets. As explained, the baseline specification considers soft drinks sold in the predominant family-size bottle through self-service outlets. In particular, recall the limited penetration of B brands in bars. The self-service channel is also more than twice the size of the next largest channel, traditional outlets. A vast 80–90% of soft drink volume sold by self-service outlets is in the form of the family-size bottle[16]. To strike a balance between dimensionality and capturing competition at the point of sale, I aggregate flavors (and brands) into 9 'brands,' $I = 9$: Coke, Diet Coke, Fanta, Kuat, Other Coca-Cola Co., Guaraná Antarctica, Pepsi, Other Ambev, and B brands. Recall that the aggregation of B brands is imposed by the data. But this is reasonable for my purpose. Plausibly, the generic brands compete essentially on price. Further, because of separate ownership, B brands enter the pricing equations of A brands only through the own-price elasticities of A brands (as I later show). The Appendix performs several robustness tests around these modeling choices, including the baseline exclusion restrictions I detail next.

Identification Strategy

In the special situation where a large component of the brand-specific price variation is due to an exogenous promotional calendar–by which manufacturers and retailers agree to mark prices up and down before unobserved demand shocks are realized–prices can be treated as predetermined and OLS will generate consistent estimates. However, to the extent that firms set prices after observing demand shocks that the econometrician does not observe (and is unable fully to control for with the inclusion of fixed effects, climatic data or advertising), prices in (1) and (2) will be endogenous and OLS will be inconsistent.

One must then deal with the situation in which firms reoptimize prices in response to non-trivial residual demand shocks. My (baseline) identification strategy hinges jointly on three sources of variation. (In the Appendix, I test for robustness using alternative, or reduced, sets of instruments to these three sources.) First, I exploit Coca-Cola Co.'s decision to abruptly lower the price of the family-size version of its brands across all regions by an average 25% in July 1999. Whether this large and sudden price cut was consistent with optimizing behavior, or was the result of a belated shift in strategy as suggested by the firm's replacing its country manager around that time, it is natural to attribute the price change as being motivated on the

[16] Among alternative specifications, I allow *direct* (i.e., within the bottom stage) substitution across family-size and single-size containers, or use sales through traditional outlets as demand instruments, or use only later markets (when shares were relatively stable). See the Appendix.

supply side[17]. The identifying assumption is that whatever prompted the firm to cut prices is econometrically exogenous to residual demand shocks once the underlying trend growth of the fringe and/or the lower middle class has been controlled for through brand-and-region specific drifts. The fact that only family-size bottles–i.e., the entry point–had their prices reduced, and not single-size cans or bottles, further supports the notion that Coca-Cola Co. was responding to the gradual growth of the fringe, and not to some large sudden demand shock. To be clear, the argument is that no unobserved demand shock occurred at that exact point in time which would have prompted an immediate response from the firm (and, econometrically, the discrete change in price would then be correlated with the discrete shift in the demand unobservable, invalidating the instrument). I create a dummy variable which takes on the value 1 for all time periods after July, 1999, and interact it with region fixed effects, thus allowing the effects of this shift in supply to vary by regional market. (Doing so also conveniently provides $N = 7$ exclusion restrictions.) This follows the classic strategy of identifying demand through movements in supply. A marketing literature traditionally estimates demand in a similar manner, observing how consumers respond to certain movements in prices–e.g., a promotional calendar, or in-store experiments–which the researcher argues are exogenous to unobserved demand shocks. Here, the institutional context in which the large and abrupt price reduction is embedded provides strong economic evidence in favor of its exogeneity.

A second source of identification borrows from Hausman, Leonard and Zona [1994]. They use prices in other regions to instrument for prices in a given region, i.e., p_{imt} may serve as an instrument for p_{int}, $n \neq m$ (and, in the top-level equation, P_{mt} may instrument for P_{nt}). The identifying assumption is that p_{imt} is correlated with p_{int}–through a common cost structure for a same brand sold in different regions, or through common shifts in the way firms strategically interact[18]–while not being correlated with ε_{int}. The maintained hypothesis is that the unobserved demand shock is largely region specific relative to the magnitude of common supply shocks, once brand-and-region fixed effects and time trends (among the other controls) have been added. Despite their widespread use in the recent IO literature on differentiated-product demand estimation, if only due to the typical absence of alternatives, this class of instruments has faced criticism[19]. In the U.S. cereal industry, for example, where brands are marketed nationally, Bresnahan [1997a, 1997b] worries about unobserved demand shocks that

[17] In other words, faced with a growing mass of low-income consumers, was such an action (*ex post*) rational, or had the firm been too slow to react as a result of mistaken priors?

[18] For example, Coca-Cola Co.'s decision to cut prices across all regions in July, 1999.

[19] See, for example, Hausman [1997a, 1997b] and Bresnahan [1997a, 1997b] for a heated exchange over the use of such instruments in estimating demand for nationally branded products.

might stem from national advertising or promotional campaigns. In the present setting, however, several features of the data or of the institutions support my adoption of this class of instruments. First, I observe a measure of advertising intensity. Second, despite the established firms being major national advertisers, there is considerable variation in the way their brands are distributed and promoted within each region of Brazil. As mentioned in Section II (and elaborated in the Appendix), the established firms employ regional distributors with a view to exploiting their on-the-ground knowledge of local demand differences. For example, in coordination with upstream firm Coca-Cola Co., regional franchisees tailor promotional strategies downstream to better meet region-specific demand opportunities[20]. Relatedly, while nationwide macroeconomic shocks are no doubt important, exogenous demand variation across Brazil's vast regions, with their huge social and economic differences, should not be understated. To provide a sense of perspective, region 1 (Brazil's northeast) alone covers a land area *4.5 times* the size of Germany. Recall the wide regional variation in per capita income reported in Table II. *The Economist* [2006b], illustrating the importance of region-specific demand shocks, writes 'Cash transfers have animated the economy of the poor north-east, where retail and wholesale trade jumped 15.6% in the year to July. In the southern state of Rio Grande do Sul, the economy shrank 5% last year because of drought, which hurt farming, and the strong real, which damaged industries such as shoe- and furniture-making. The economy of Rio de Janeiro, the second-largest city, has not grown since 1975.' Unsurprisingly, the penetration of national retailers is still limited relative to the country Bresnahan [1997a, 1997b] was considering.

A complementary reason calling for the use of this second class of Hausman instruments relates back to Coca-Cola Co.'s decision to cut prices on its brands in July, 1999. The firm's price reduction was synchronized across regional markets and its effects were brand-specific. Instrumenting for the price of a given brand in a given region with the price of the same brand in another region should capture, in a complementary way to the first class of instruments (the set of time and region-varying dummies), what was effectively a large brand-specific supply shock.

Cost shifters provide a third complementary class of instruments. Given their lack of brand-specific variation, these traditional instruments are particularly relevant in light of the brand-aggregated top-level equation. I use (brand-common and region-common) factor prices such as refined sugar and (brand-common and region-specific) factor prices such as

[20] Soft drink firms in the U.S. may also differ from the typical large manufacturer of nationally-branded food products that Bresnahan had in mind. Muris, Scheffman and Spiller [1992] document the 'importance of promotion via local and regional television, radio, and newspapers' (p.99) and how 'promotional pricing has become a major competitive tactic at the bottling (i.e., franchisee) level' (p.88; parentheses added).

manufacturing-sector wages and energy (electricity for manufacturing and retailing, and diesel oil for road transportation). The identifying assumption is that these supply-shifters are uncorrelated with unobserved demand shocks.

Cross-Equation Restrictions and Estimation

The demand system is comprised by one bottom-level equation (1) for each brand and one top-level equation (2), i.e., $I+1$ equations. In the interest of efficiency, I simultaneously estimate the system using three-stage least squares (3SLS). As a further robustness test, I check that 3SLS is not improving efficiency at the expense of consistency, by comparing the 3SLS estimates to estimates obtained from (equation-by-equation) 2SLS.

Cross-equation restrictions can be applied to further improve efficiency. Homogeneity (of degree zero with respect to prices and income) implies that $\sum_j \gamma_{ij} = 0$. The symmetry property restricts $\gamma_{ij} = \gamma_{ji}$. To check whether efficiency is being improved at the expense of consistency, likelihood ratio tests can be conducted[21].

Estimates of the unconditional own and cross price elasticities can be calculated by combining the estimates from the two levels[22]. Standard errors can be obtained by the delta method.

III(ii). *Results*

Table III presents estimated price elasticities of demand for three selected brands–the two leading A brands and the aggregation of B brands. The demand system is estimated under both OLS/SURE (column I, with no cross-equation restrictions imposed; column III where homogeneity and symmetry are imposed) and 3SLS (columns II and IV respectively). Elasticities under 3SLS tend to be higher (in absolute value) than under OLS (though this difference is not statistically significant). Own-price elasticities for Coke are in the -1.9 to -2.7 range (-2.1 under 'restricted 3SLS' in column IV) and between -2.1 and -2.5 for Guaraná Antarctica (-2.5 under restricted 3SLS). These elasticities fall at the low end of the range of estimates typically obtained in studies of demand for differentiated products, including (U.S.) soft drinks, as I outline in the Appendix.

[21] See the online appendix for a discussion. An additional 'adding-up' restriction is $\sum_i \beta_i = 0$. Notice also that the regressors in the I bottom-level equations are not identical thanks to Z_{int}. Were the regressors identical, one bottom-level equation would have to be dropped from the simultaneous estimation due to perfect multicollinearity, and separately estimated by 2SLS. (To see this, consider the symmetry restriction $\gamma_{ij} = \gamma_{ji}$ and note that $\sum_i s_{int} = 1$.) An alternative to dropping an equation from the simultaneous estimation is to drop one of the $(I^2 - I)/2$ symmetry conditions.

[22] The online appendix derives the exact expression. I report elasticities calculated at the mean value of covariates across the full sample.

TABLE III
ESTIMATED PRICE ELASTICITIES OF DEMAND FOR SELECTED BRANDS: COKE BRAND, GUARANÁ ANTARCTICA BRAND AND THE AGGREGATION OF B BRANDS

	(I) OLS Unrestricted	(II) 3SLS Unrestricted	(III) OLS Restricted	(IV) 3SLS Restricted
$\eta_{\text{Coke,Coke}}$	− 2.229 (0.199)	− 2.700 (0.295)	− 1.929 (0.114)	− 2.071 (0.149)
$\eta_{\text{Coke,Diet Coke}}$	0.659 (0.162)	0.983 (0.225)	0.266 (0.043)	0.361 (0.072)
$\eta_{\text{Coke,Fanta}}$	0.106 (0.080)	0.200 (0.103)	0.116 (0.047)	0.098 (0.056)
$\eta_{\text{Coke,Tai/Kuat}}$	0.129 (0.059)	0.038 (0.073)	0.132 (0.038)	0.138 (0.044)
$\eta_{\text{Coke,Other Coke}}$	0.283 (0.058)	0.284 (0.076)	0.169 (0.028)	0.208 (0.036)
$\eta_{\text{Coke,Guar Antar}}$	0.158 (0.099)	0.133 (0.130)	0.154 (0.049)	0.124 (0.059)
$\eta_{\text{Coke,Pepsi}}$	0.221 (0.092)	0.413 (0.122)	0.283 (0.064)	0.299 (0.081)
$\eta_{\text{Coke,Other Ambev}}$	0.122 (0.074)	0.243 (0.099)	0.285 (0.066)	0.349 (0.089)
$\eta_{\text{Coke,B brands}}$	0.116 (0.118)	− 0.036 (0.152)	0.085 (0.106)	− 0.029 (0.137)
$\eta_{\text{Guar Antar,Coke}}$	0.430 (0.314)	1.077 (0.484)	0.220 (0.160)	0.316 (0.201)
$\eta_{\text{Guar Antar,Diet Coke}}$	− 0.180 (0.274)	− 0.833 (0.407)	0.035 (0.074)	− 0.037 (0.109)
$\eta_{\text{Guar Antar,Fanta}}$	0.467 (0.122)	0.426 (0.159)	0.514 (0.086)	0.465 (0.105)
$\eta_{\text{Guar Antar,Tai/Kuat}}$	0.039 (0.091)	0.064 (0.114)	− 0.032 (0.073)	− 0.001 (0.087)
$\eta_{\text{Guar Antar,Other Coke}}$	0.299 (0.088)	0.380 (0.117)	0.207 (0.062)	0.237 (0.078)
$\eta_{\text{Guar Antar,Guar Antar}}$	− 2.118 (0.154)	− 2.541 (0.200)	− 2.171 (0.131)	− 2.509 (0.166)
$\eta_{\text{Guar Antar,Pepsi}}$	0.571 (0.138)	0.802 (0.183)	0.297 (0.111)	0.299 (0.139)
$\eta_{\text{Guar Antar,Other Ambev}}$	0.633 (0.111)	0.932 (0.146)	0.484 (0.099)	0.663 (0.132)
$\eta_{\text{Guar Antar,B brands}}$	0.053 (0.151)	− 0.169 (0.185)	0.086 (0.145)	0.092 (0.176)
$\eta_{\text{B brands,Coke}}$	0.703 (0.292)	1.036 (0.424)	0.570 (0.091)	0.611 (0.095)
$\eta_{\text{B brands,Diet Coke}}$	− 0.566 (0.246)	− 1.014 (0.340)	− 0.113 (0.027)	− 0.165 (0.034)
$\eta_{\text{B brands,Fanta}}$	0.421 (0.115)	0.514 (0.148)	0.160 (0.046)	0.174 (0.048)
$\eta_{\text{B brands,Tai/Kuat}}$	0.033 (0.083)	0.078 (0.102)	0.139 (0.039)	0.128 (0.040)
$\eta_{\text{B brands,Other Coke}}$	− 0.169 (0.085)	− 0.154 (0.110)	0.059 (0.028)	0.087 (0.031)
$\eta_{\text{B brands,Guar Antar}}$	0.351 (0.145)	0.365 (0.189)	0.245 (0.049)	0.242 (0.050)
$\eta_{\text{B brands,Pepsi}}$	− 0.277 (0.131)	− 0.290 (0.173)	0.228 (0.069)	0.215 (0.088)
$\eta_{\text{B brands,Other Ambev}}$	1.007 (0.102)	1.194 (0.137)	0.791 (0.075)	0.818 (0.109)
$\eta_{\text{B brands,B brands}}$	− 2.570 (0.144)	− 2.905 (0.176)	− 2.614 (0.125)	− 2.837 (0.157)

Notes: Family-size bottles sold through self-service outlets. Standard errors in parentheses. Under 3SLS, instruments for prices are region-specific effects of Coca-Cola Co.'s July, 1999, price reduction, prices in other regions, and factor prices. Restrictions are homogeneity and symmetry.

The estimated own elasticity for the aggregation of B brands is also low, lying in the − 2.6 to − 2.9 range (− 2.8 under restricted 3SLS). This may appear odd at first glance, since at the point of sale, consumers can typically choose among two to three rival B brands, which they view as being close substitutes for one another. But this low elasticity relates to demand for generic brands as a group: while 2.8% of overall demand for B brands would switch away to the A brands or to the outside good were the price of *all* B brands raised by 1%, the drop in demand faced by any specific B brand would surely be much higher should only its price rise relative to the price of other generics. That is, each individual B brand's own elasticity should be much higher given the limited differentiation between B brands.

Most cross-price elasticities are positive, over half of which are significant at the 1% level, many falling in the 0.1 to 0.5 range. For example, under restricted 3SLS, the elasticities of Coke demand with respect to the prices of Diet Coke (cross elasticity 0.36), Kuat (0.14), other Coca-Cola Co. brands

(0.21), Pepsi (0.30) and other Ambev brands (0.35) are all positive and significant at the 1% level. The elasticities of Coke demand with respect to the prices of Guaraná Antarctica (0.12) and Fanta (0.10) are positive and significant at the 5% and 10% levels respectively. The elasticity of Coke demand with respect to the price of B brands (– 0.03) is negative but insignificant. These estimates suggest that Coke and Diet Coke are close substitutes, while Coke and B brands are not. By these estimates, Coke is a closer substitute for rival A brands than it is for B brands, i.e., this accords with the intuition that B brands are located at a distance from A brands in (vertical) product space. Still, a 1% increase in the price of Coke (which leads 2.1% of Coke demand to switch away to other brands or the outside good) raises aggregate demand for B brands by 0.6% (significant at the 1% level), indicating that on raising prices, Coke does lose some consumers to the fringe. The elasticity of Coke demand with respect to the price of Pepsi, at 0.30, may seem low, since the two brands are in the 'cola' segment, but one must adjust this value for Coke's much larger share relative to Pepsi (and thus every percentage gain in the demand for Coke represents a much larger consumption loss for Pepsi).

As expected, estimated standard errors for the elasticities are substantially lower under the restricted systems (either 3SLS or OLS) relative to the unrestricted ones, though in most cases estimated elasticities do not statistically differ when restrictions are imposed. Restrictions thus appear to be buying efficiency, but not at the expense of consistency. The unrestricted estimates also seem inferior: for example, the elasticity of Coke demand with respect to the price of Diet Coke, at 1.0, is odd[23].

Table IV reports the entire matrix of elasticities estimated under restricted 3SLS[24]. Further interesting substitution patterns are obtained. The high elasticity of Diet Coke demand with respect to Coke's price, at 3.0 (to be interpreted in light of Coke's much higher relative share), again suggests that consumers view the two brands as close substitutes. In contrast, when the price of Coke is raised by 1%, the demand for Fanta increases by only 0.16% (again, this is low considering the much larger demand for Coke relative to Fanta). Similarly, the elasticity of Guaraná Antarctica demand with respect to Coke's price is a low 0.32. At current prices, Coke's consumers appear to view neither

[23] To see this, one must again consider this value in light of Coke's much larger share relative to Diet Coke. Other unrestricted cross elasticities of demand with respect to the price of Diet Coke are odd: Guaraná Antarctica's – 0.8 and B brands' – 1.0. One possibility is that the restrictions reduce distortions arising from the high collinearity in the prices of Coke and Diet Coke: the correlation between the two sets of prices is high at 0.98 (to be contrasted with 0.91 between the prices of Coke and Fanta). But as Table IV shows, some odd elasticities remain even after restrictions are imposed, such as $\eta_{DietCoke,BBrands} = -1.4$. One robustness test, presented in the Appendix, attempts to control for this multicollinearity by subsuming Diet Coke into the Coke brand.

[24] See the online appendix for the entire matrix of elasticities estimated under restricted OLS.

TABLE IV
MATRIX OF ELASTICITIES ESTIMATED UNDER RESTRICTED 3SLS

	With respect to the price of								
	Coke	Diet Coke	Fanta	Tai/Kuat	Other Coke	Guar Antar	Pepsi	Other Ambev	B brands
Electricity of the demand for									
Coke	– 2.071	0.361	0.098	0.138	0.208	0.124	0.299	0.349	– 0.029
	(0.149)	(0.072)	(0.056)	(0.044)	(0.036)	(0.059)	(0.081)	(0.089)	(0.137)
Diet	2.963	– 2.913	– 0.383	0.126	0.322	0.005	0.132	0.535	– 1.357
Coke	(0.556)	(0.463)	(0.163)	(0.133)	(0.136)	(0.224)	(0.223)	(0.178)	(0.220)
Fanta	0.156	– 0.292	– 2.058	– 0.323	0.036	0.538	0.988	0.627	– 0.098
	(0.211)	(0.098)	(0.136)	(0.088)	(0.078)	(0.123)	(0.138)	(0.126)	(0.191)
Tai/	1.229	0.128	– 0.363	– 2.556	0.278	0.106	0.087	0.101	0.386
Kuat	(0.253)	(0.121)	(0.131)	(0.155)	(0.093)	(0.153)	(0.181)	(0.163)	(0.232)
Other	1.624	0.324	0.074	0.284	– 3.669	0.535	0.122	0.378	– 0.103
Coke	(0.283)	(0.161)	(0.156)	(0.123)	(0.154)	(0.182)	(0.204)	(0.160)	(0.225)
Guar	0.316	– 0.037	0.465	– 0.001	0.237	– 2.509	0.299	0.663	0.092
Antar	(0.201)	(0.109)	(0.105)	(0.087)	(0.078)	(0.166)	(0.139)	(0.132)	(0.176)
Pepsi	0.462	– 0.095	1.075	– 0.159	– 0.039	0.162	– 1.411	0.478	– 0.547
	(0.344)	(0.174)	(0.173)	(0.156)	(0.133)	(0.208)	(0.334)	(0.198)	(0.297)
Other	0.098	0.169	0.514	– 0.278	0.066	0.668	0.392	– 3.568	2.190
Ambev	(0.349)	(0.154)	(0.174)	(0.154)	(0.121)	(0.219)	(0.239)	(0.273)	(0.344)
B brands	0.611	– 0.165	0.174	0.128	0.087	0.242	0.215	0.818	– 2.837
	(0.095)	(0.034)	(0.048)	(0.040)	(0.031)	(0.050)	(0.088)	(0.109)	(0.157)

Notes: Family-size bottles sold through self-service outlets. Standard errors in parentheses.

Fanta nor Guaraná Antarctica as a good alternative to Coke. Further, the (statistically and economically) high cross elasticities between Other Ambev and B brands is consistent with the earlier observation that the growth of the fringe occurred primarily at the expense of Ambev's lesser brands.

The point estimate for Pepsi's own-price elasticity, at – 1.4, seems too low, yet a large estimated standard error of 0.33 (relative to standard errors for most other A brands' own elasticities of about 0.15) suggests a wide confidence interval. Indeed, estimates for Pepsi's own elasticity under several alternative specifications described in the Appendix fall in the – 2.2 to – 2.5 range (with similar precision).

The robustness tests of the Appendix largely confirm the substitution patterns obtained from the baseline specification. In particular, the low own-price elasticities of the A brands are robust to the choice of instruments, aggregation and controls.

IV. SOLVING THE STRUCTURAL MODEL

Following much of the structural literature on differentiated products[25], I make plausible assumptions on the pricing behavior of firms, analyzing the

[25] Examples include Hausman, Leonard and Zona [1994], Berry, Levinsohn and Pakes [1995], Goldberg [1995], Verboven [1996] and Nevo [2001]. Suslow [1986] assumes competition in the fringe.

implications for marginal cost. I begin by assuming that (in post price cut markets[26]) A-brand owners are multiproduct Bertrand oligopolists facing a competitive fringe of B brands. I derive marginal costs that are consistent with this behavioral specification and the demand elasticities. I then modify the behavioral assumption for each type of firm in a direction that is conservative for my present purpose, i.e., increasing any backed-out cost advantage enjoyed by B brands over A brands. I assume that the established firms price *à la* single-product Bertrand, by which each A brand is priced without internalizing the externality on its owner's substitute brands. This is equivalent to demerging each established firm into independent single-brand units. At current prices, this lowers unilateral markups and *raises* estimated marginal costs. For the generics, I replace the price-taking assumption by assuming that they, too, behave strategically *à la* single-product Bertrand. This is equivalent to raising markups from zero, which *lowers* implied marginal costs at observed prices. But since data aggregation did not allow me to estimate the own-price elasticity for the small individual B brand that, under this modified assumption, would constrain its pricing, I assume a plausible lower bound.

IV (i). *Dominant Multiproduct Bertrand Oligopoly facing a Competitive Fringe*

Label the aggregation of B brands by $i = I$. The $i = 1, \ldots, I-1$ A brands are owned by $F \leq I-1$ multiproduct firms. Denoting the set of brands it owns as $O_f \subseteq \{1, \ldots, I-1\}$, firm f sets prices such that

$$D_i(p) + \sum_{j \in O_f} (p_j - c_j) \frac{\partial D_j(p)}{\partial p_i} = 0, \text{ where } i \in O_f, \text{ for } i = 1, \ldots, I-1$$

where $D_i(p)$ and c_i are respectively the demand for and the (flat) marginal cost of brand i. (To simplify notation, region-time market subscripts nt are omitted, e.g., given changes in brand ownership over the sample period, one should write O_{ft}.) This multiproduct Bertrand FOC may be rewritten as

$$s_i(p) + \sum_{j \in O_f} s_j(p) \frac{p_j - c_j}{p_j} \eta_{ji}(p) = 0$$

Stacking up the $I-1$ FOC's one can write

$$(3) \qquad s(p) + \left(\Theta^B . \times \eta(p)'\right)(s(p) . \times L(p; c)) = 0$$

where $L(p;c)$ is an $(I-1) \times 1$ vector of Lerner indices with elements $\frac{p_i - c_i}{p_i}$, '.' denotes an element-by-element operation, $\eta(p)$ is an $(I-1)$-order square matrix of price elasticities of demand with elements η_{ij}, and Θ^B is an $(I-1)$-

[26] To emphasize, understanding the 1999 price reduction is the subject of ongoing research.

order square ownership matrix with (time-varying) elements

$$\Theta_{ij}^{B} = \begin{cases} 1 & \text{if } \exists f | \{i,j\} \subseteq O_f \\ 0 & \text{otherwise} \end{cases}$$

System (3) can be rearranged to

$$(4) \qquad L(p;c) = -\left(\left(\Theta^{B}.\times\eta(p)'\right)^{-1} s(p)\right)./s(p)$$

From the estimated elasticities $\hat{\eta}_{ij,nt}$ and observed ownership $\Theta^{B}_{ij,t}$ and value shares s_{int}, one backs out Lerner indices L_{int} from which marginal cost estimates c_{int} are obtained[27]. Different pricing assumptions can be modeled by modifying the ownership matrix Θ^{B}; for example, adopting an $(I-1)$-order diagonal matrix would correspond to single-product Bertrand.

As for the competitive fringe of B brands, marginal cost is immediately backed out from the price-taking assumption $p = c$ (and the implicit assumption that a B brand operation faces upward sloping marginal cost, which is reasonable in view of its limited capacity). One can alternatively motivate this pricing specification by considering the close substitution across B brands and the fact that consumers typically find two to three rival B brands on the shelf, approximating homogeneous Bertrand. For the more conservative pricing assumption where each generic brand, typically owned by a firm with no other brand, behaves *à la* (single-product) Bertrand, (4) can similarly be used, in which case the Lerner index collapses to the reciprocal of the individual B brand's own elasticity.

IV(ii). *Results*

Table V reports the different brands' predicted markups and marginal costs, in the later period of the sample, conditional on the baseline demand estimates of Section III and the different pricing assumptions. Markups and marginal costs can be solved out for every market *nt*, but mean values across only post July, 1999, markets–i.e., time periods after Coca-Cola Co.'s price cut–are shown. Standard errors are obtained through bootstrapping, where every bootstrap sample is drawn from the original $NT = 399$ markets of the full sample (since demand is estimated off the entire sample).

[27] I specify marginal cost as being flat in quantity (in the relevant range). Alternatively, I could allow for richer cost specifications (e.g., quadratic or translog cost functions, or more generally the generalized McFadden [1978] cost function; see Diewert and Wales [1987] and Kumbhakar [1994]) or more sophisticated (and possibly dynamic) models of behavior. I would then estimate each alternative parametric model of supply and statistically select (using, say, Vuong's [1989] non-nested LR test) among the alternative models. Given the resulting large demand on the data, I would have to adopt a considerably more parsimonious demand specification. See Gasmi, Laffont and Vuong [1990] for a discussion, and Gasmi, Laffont and Vuong [1992] for an application–to soft drinks, where demand is linear.

TABLE V
INFERRED MARGINAL COST UNDER ALTERNATIVE BEHAVIORAL ASSUMPTIONS

	p	(p – c)/p	c
A brands			
Behavioral assumption: Multi-product Bertrand			
Coke	1.02	86% (14%)	0.15 (0.14)
Fanta	0.86	50% (19%)	0.44 (0.16)
Guaraná Antarctica	0.93	48% (9%)	0.48 (0.08)
Pepsi	0.88	92% (51%)	0.07 (0.44)
Behavioral assumption: Multi-product Bertrand with Other Coca-Cola & Other Ambev not internalized			
Coke	1.02	65% (8%)	0.35 (0.08)
Fanta	0.86	55% (12%)	0.38 (0.10)
Guaraná Antarctica	0.93	41% (9%)	0.54 (0.08)
Pepsi	0.88	80% (102%)	0.18 (0.89)
Behavioral assumption: Single-product Bertrand			
Coke	1.02	48% (4%)	0.53 (0.05)
Fanta	0.86	50% (3%)	0.43 (0.03)
Guaraná Antarctica	0.93	38% (4%)	0.57 (0.03)
Pepsi	0.88	64% (31%)	0.31 (0.27)
B brands			
Behavioral assumption: Price-taking			
B brands	0.58	0%	0.58
Behavioral assumption: Single-product Bertrand, own-price elasticities of 6 (symmetric and limited differentiation)			
B brands	0.58	17%	0.48

Notes: Family-size bottles sold through self-service outlets. Supply-side estimates correspond to the baseline demand specification (including restricted 3SLS). Prices and estimated marginal cost in constant March, 2003, R$ per liter. Prices, estimated Lerner index and estimated marginal cost are mean values across all regions and over time periods after July, 1999. Standard errors in parentheses, estimated through bootstrapping, with 200 replications, where every bootstrap sample is drawn, with replacement, from the $7 \times 57 = 399$ region-time markets of the full sample.

Under the multiproduct Bertrand hypothesis, the marginal cost backed out for a family bottle of Coke is a very low 0.15 R$/l, corresponding to an equilibrium price-cost markup of 86%. Marginal costs for the other main A brands are at most 0.48 (Guaraná Antarctica). These point estimates lie *below* a marginal cost of 0.58 (equal to price) implied by the hypothesis of perfect competition in the fringe.

Marginal costs for Coke (0.15) and Pepsi (0.07) appear too low (and are not significantly different from zero), and their estimated markups appear too high. Also, it is not clear why Coke's cost would be one-third of Fanta's (0.44). I consider different possibilities that could explain this result. The first is that the low estimates of the own-price elasticities are biased downward due to attenuation bias. In view of the earlier discussion of demand identification, I judge this possibility to be remote.

Another possibility is that established firms do not price *à la* multiproduct Bertrand. It is conceivable that (on raising prices) firms are not fully accounting for the (positive) effect of within-firm switching by consumers (which can be quite high, e.g., $\eta_{DietCoke,Coke} = 3.0$ and $\eta_{GuarAntar,OtherAmbev} = 0.66$ in

Table IV). I conservatively relax the multiproduct Bertrand assumption in two ways. If each established firm sets prices taking into account only the externalities across its two main brands (Coca-Cola Co.'s Coke and Fanta, and Ambev's Guaraná Antarctica and Pepsi), but not across other smaller brands (i.e., 'other Coke' and 'other Ambev' brands are priced independently), the A brands' inferred marginal costs mostly increase. Coke's marginal cost increases to 0.35, corresponding to a 65% markup. The second way in which I relax multiproduct Bertrand is by going all the way and assuming that each A brand is priced independently, i.e., that established firms behave *à la* single-product Bertrand. Predicted marginal costs for the A brands are now higher, in the 0.31–0.57 range, with markups falling between 38% and 64%. If one ignores Pepsi, whose estimates are considerably less accurate (as was the case for demand), marginal costs are in the 0.43–0.57 range, and markups lie between 38% and 50%.[28] Alongside the 0.58 marginal cost for the competitive fringe, this suggests that the (post July 1999) average 0.44 R$/l (or 43%) price discount for B brands (relative to Coke's price of 1.02) need not be due to cost heterogeneity. Rather, the market power of the A brands can singlehandedly explain the price premium they command over the B brands.

In this vein, one can conjecture whether the (maintained) model of pricing behavior–static multiproduct Bertrand–is appropriately specified. It is possible that the established firms are pricing lower than they would were there no tomorrow, in an attempt to stave off, or slow down, low-end entry. This possibility would explain why the established firms, facing such low (short-run) demand elasticities, do not raise prices and move up their demand curves to a point where demand is more elastic[29]: they may believe that this would only invite further entry in the fringe. By this limit-price hypothesis, static marginal revenue under multiproduct Bertrand falls short of, rather than being equal to, marginal cost. Such a possibility is consistent with the view that Coca-Cola Co. would have cut prices on its family-size bottles in July, 1999, to stem the

[28] As a point of comparison, with the usual caveats, Ambev's 2003 financial statements report a 'gross margin' (i.e., 'net sales' minus 'cost of goods sold,' which includes plant depreciation but not distribution expenses) for its Brazilian soft drink operations of 35%. Similar accounting data for Coca-Cola Co. are not available. However, industry insiders state that the firm's vertical operations are more profitable than Ambev's. I also note from Coca-Cola Co.'s 2003 Form 10-K that 'operating income' (i.e., margin *after* deducting advertising and distribution expenses) amounted to 48% of net sales in Latin America, compared to 19% in North America (while the firm sells mainly soft drinks–the 'trademark Coca-Cola' representing 56% of its worldwide sales–I caution that these proportionate accounting margins are not comparable to those of typical branded food firms, given much outsourcing downstream).

[29] Unless, of course, the high markups predicted by the multiproduct Bertrand hypothesis are accurate, in which case the established firms do not raise prices since every marginal consumer that would then switch to other firms' brands (or to the outside good) is very lucrative.

staggering growth of the fringe. Understanding the dynamics of pricing in the wake of a rising middle class and ensuing low-end entry is left for future research[30].

Finally, to test the sensitivity of the estimated cost difference with respect to the fringe's pricing assumption, I allow B brands some limited degree of symmetric differentiation, and thus some power over price. (One can motivate this through a symmetric demand system, say the logit or the CES.) In view of (i) the magnitude of elasticities typically estimated in the literature for branded, advertised goods (see the Appendix), (ii) that B brands (generics) are perceived to be close substitutes, and (iii) that consumers can typically choose among several B brands, one can plausibly conjecture a safe lower bound to the own-price elasticity of the individual fringe brand. Applying an elasticity of 6 to the single-product Bertrand pricing equation, this translates into a markup of 17%, or a marginal cost of (no less than) 0.48. This is still only 0.05 to 0.09 lower than the most conservative (i.e., higher) predicted marginal cost for the A brands (Coke's 0.53 and Guaraná Antarctica's 0.57 under single-product Bertrand).

V. CONCLUSION

This paper considers the contentious claim that low prices of small generic brands in a developing country's highly regulated soft drink market are explained by cost advantages, stemming from illicit practices, relative to high-price established brands. It estimates a standard structural model to disentangle cost asymmetry from demand asymmetry that enables the exercise of market power, letting the data inform on the plausibility of each hypothesis. While I cannot reject the hypothesis of cost symmetry between generics and established brands, I find that the large price premium enjoyed by the established brands can be explained by the low price sensitivity of their marginal consumer in equilibrium, relative to the competitive fringe of generics. To the extent that fringe brands evade taxes and do not comply with labor and environmental regulation, this cost advantage is offset by less efficient scale or higher procurement costs.

While the dataset I use is unique in several respects, it also has limitations pertaining to the individual fringe producer. First, since I do not observe firm-specific cost data, particularly at the scale of operation of a fringe firm, I cannot measure productivity and thus decompose cost. One can, however, use the notion of equilibrium–given the

[30] I briefly entertain the possibility that prior to 1999, the established firms–perhaps due to some form of bounded rationality, only belatedly realizing changes to the consumer landscape–had modeled B brands as competing in a different market (the outside good). I re-estimate demand using pre July, 1999, data only and dropping B brands from the dataset. Estimated own-price elasticities (not reported) remain low.

regulator's difficulty in inspecting small operations–to conjecture sensibly that allegations of (at least some) informality among fringe brands are well-founded. Second, I am unable to estimate the demand curve for any specific fringe brand, and I therefore draw on the institutional context instead. But while one might worry about whether my assumption of competitive fringe pricing is excessive, the estimated market power (price-cost margin) of the established brands does not depend–because of the separation of ownership–on the pricing assumption for the fringe. The general point, which the particular setting highlights, remains: that a competitive fringe, whether unproductive or informal, can bring about lower prices and lead to allocative gains in certain oligopolistic industries. Perversely, turning a blind eye on a highly competitive informal sector–that lies outside the regulator's radar screen–may effectively act as a discriminatory subsidy that alleviates the welfare loss of pricing power. In evaluating regulatory policy (e.g., tax on small businesses[31]), particularly toward fast-growing, developing country markets where a fringe is expanding, one may want to balance this potential gain against social costs. Ask the new lower middle class in highly-regulated Brazil.

APPENDIX

FURTHER INSTITUTIONAL BACKGROUND AND ROBUSTNESS TESTS

Distribution

In 2002, Coca-Cola Co.'s distribution system was comprised of 17 franchisees, down from around 25 five years earlier (Robarts [2002]). Coca-Cola Co. is a minority investor in several franchisees, and in a few cases owns the majority of shares. Though disputes periodically break out between the upstream firm and its distributors, industry sources argue that the former remains much in command of market positioning, while allowing the latter sufficient autonomy to tailor distribution and promotional efforts to meet local demand variation. This is to be expected considering that, after all, Coca-Cola Co. owns 'the world's most valuable brand' ($67.3 bi in 2007, according to Interbrand/*BusinessWeek*) and Brazil–the world's third largest soft drink market–is a country of continental dimensions that exhibits stark socio-economic regional differences.

Despite the large extent of outsourcing, Coca-Cola Co. appears to effectively control prices set by franchisees to retailers. In addition to the ownership stake it takes in many

[31] The idea that preferential treatment (explicit or implicit) of relatively small firms within an industry might be part of optimal tax (and regulatory) policy has been considered recently by Dharmapala, Slemrod and Wilson [2007]. While the mechanism by which tax exemption (or non-compliance) at the lower end of the firm size distribution induces entry and lowers prices is present in the background, the authors focus on the fixed administrative costs incurred in taxing firms. Returning to the pharmaceuticals analogy, one can view the Waxman-Hatch ('Drug Price Competition') Act of 1984, that reduced the burden of redundant testing for generic entrants to gain government approval, as one instance of 'preferential' treatment to alleviate the distortion from monopoly power (Hurwitz and Caves [1988]).

franchisees, Coca-Cola Co. relies on several instruments to 'cure' vertical externalities, such as charging for the concentrate and syrup from which its soft drinks are made, paying for distribution and promotion and sharing the heavy brand advertising costs with franchisees, thus employing a combination of marginal and fixed fees (e.g., the firm may charge franchisees for syrup based on sales objectives, regardless of whether these are met). Another potential vertical distortion arises from double marginalization between retailer and manufacturer. Though this is a standard concern in empirical studies where retail data are used to make inference about producer supply, in the present case I believe any such distortion is limited given that retail margins on soft drinks are typically low (indeed marketing practitioners often cite these products as 'loss leaders').

As a point of comparison, Muris, Scheffman and Spiller [1992] describe how Coca-Cola Co.'s U.S. distribution system has evolved since the late 1970's, including consolidation among franchisees and forward integration by Coca-Cola Co. They argue that such restructuring has stemmed from increased scale economies and the upstream firm's need to secure control of the vertical chain in response to changes in technology and the competitive environment.

Alternative Demand Instruments

The baseline demand specification of Section III uses prices in other geographic markets (regions) as one source of identification. I explore the robustness of this specification by experimenting with two alternative sets of instruments. A first alternative is potentially available by virtue of the channel-specific nature of soft drink distribution and consumption, and the richness of the panel dataset. Denote prices (of family-size bottles) observed in traditional outlets by p^{TRAD} (alternatively, one may use prices in the bars channel, p^{BAR}) and recall that endogenous self-service prices in the baseline specification are denoted by p. Should one use p_{int}^{TRAD} as an instrument for p_{int}, the identifying assumption is that p_{int}^{TRAD} is correlated with p_{int} while not being correlated with ε_{int}. The maintained hypothesis is that the unobserved demand shock is largely channel specific relative to the magnitude of common supply shocks in explaining price variation. To the extent that promotional expenditure or other demand shocks, in the presence of controls such as advertising and climate, are uncorrelated across distribution channels (the more modern self-service supermarkets and hypermarkets in urban centers, vis-à-vis the traditional over-the-counter outlets in urban peripheries and rural areas), the identifying assumption is plausible. Say, for example, that income shocks affecting (or promotional campaigns targeted at) lower-income households who shop in traditional outlets in rural areas are (largely) orthogonal to income shocks (or promotion) affecting better-off urban households who shop in self-service outlets. Or say that income effects on soft drink consumption inside the home (i.e., sales through self-service and traditional outlets) differ from income effects on soft drink consumption outside the home, on social occasions (i.e., sales in bars). Using prices in other channels ('distribution markets') as instruments is similar in spirit, though not in terms of economic rationale, to using prices in other geographic markets[32].

[32] See Ellison *et al.* [1997] for an application of such a class of instruments to the demand for pharmaceuticals sold through different channels, namely drugstores and hospitals.

The second alternative set of instruments hinges on the growing capacity of the fringe. Recall that (brand-and-region specific) weighted distribution is included in the baseline specification on the basis that fringe capacity may have been very tight in the first half of the sample period, with capacity constraints (and prices) in the fringe easing by the second half thanks to entry and heightened competition. In the spirit of Berry, Levinsohn and Pakes [1995] and Bresnahan, Stern and Trajtenberg [1997], these supply-side changes in brand-level distribution over time (and across regions) are correlated with prices, yet are exogenous (in an econometric sense) to the unobserved short-term demand shocks. In view of this, I use the region-specific distribution for B brands as alternative instruments, excluding the corresponding covariates from the demand equations.

Some Other Demand Studies

The A brands' low own-price elasticities estimated in Section III fall at the low end of the range of estimates obtained in other demand studies of the soft drink industry, as well as of other differentiated product markets. Gasmi, Laffont and Vuong [1992] similarly estimate a low own-price elasticity of 1.7, but this corresponds to the aggregate firm's (Coca-Cola Co.) elasticity in the 'cola market,' obtained through a parsimonious linear demand specification in a duopolistic game against PepsiCo. Dhar *et al*. [2005] estimate a somewhat aggregated four-brand system–though they adopt a more flexible continuous-choice AIDS specification (similar to the one I use)–to obtain brand-level estimates in the 3–4 range. Dubé [2005] uses more disaggregated data (at the UPC level observed from individual household purchases) to estimate a multiple discreteness model (Hendel [1999]), also finding higher (UPC-level) own-price elasticities in the 3–4 range. Employing similar brand-and-market-level panels to the Nielsen data I use, and a similar continuous-choice demand specification, Hausman and Leonard [1997] point out that the own-price elasticities they have found for differentiated product brands typically lie between 2 and 5 (e.g., 2–3 for breakfast cereal in Hausman [1997a], 2–4 for paper tissue in Hausman and Leonard [2002], and above 4 for beer in Hausman, Leonard and Zona [1994]). Adopting the discrete-choice approach of Berry, Levinsohn and Pakes [1995], but a similar identification strategy to that of Hausman [1997a], Nevo [2001] finds similarly low estimates (2–3) for the own-price elasticities of cereal brands.

Robustness of the Demand Estimates

I briefly describe some of the alternative specifications that I have estimated, in an attempt to ascertain whether my choice of instruments, aggregation or controls may be biasing the results (downward). As Table VI conveys, the low own-price elasticities are robust. These robustness tests confirm the sensible substitution patterns obtained from the baseline specification of Section III.

- Robustness test 1A: Instruments: Prices in other regions. I keep the first and third class of instruments of the baseline specification (respectively, region-specific effects of Coca-Cola Co.'s July, 1999, price reduction, and factor prices), replacing the second class of instruments (prices in other regions, *à la* Hausman, Leonard and

TABLE VI
ROBUSTNESS TESTS: OWN-PRICE ELASTICITIES ESTIMATED UNDER DIFFERENT SPECIFICATIONS

Specification:		Baseline	Robust-ness 1A	Robust-ness 1B	Robust-ness 2A	Robust-ness 2B	Robust-ness 3	Robust-ness 4
Number of brands, I		9	9	9	9	9	6	11
Coke	Family	– 2.071	– 1.986	– 2.009	– 1.888	– 2.344	– 1.454*	– 1.752*
		(0.149)	(0.182)	(0.189)	(0.260)	(0.339)	(0.129)	(0.156)
Diet Coke	Family	– 2.913	– 3.740	– 3.939	– 1.748	– 2.022		
		(0.463)	(0.468)	(0.539)	(0.544)	(0.781)		
Fanta	Family	– 2.058	– 1.974	– 1.875	– 3.092	– 2.717	– 1.845	– 2.287
		(0.136)	(0.144)	(0.154)	(0.250)	(0.286)	(0.153)	(0.161)
Kuat	Family	– 2.556	– 2.514	– 2.619	– 2.170	– 2.795		
		(0.155)	(0.175)	(0.197)	(0.211)	(0.297)		
Other Coke	Family	– 3.669	– 3.649	– 3.435	– 3.725	– 4.260	– 2.434**	– 2.682**
		(0.154)	(0.167)	(0.191)	(0.195)	(0.303)	(0.179)	(0.174)
Guar Antar	Family	– 2.509	– 2.566	– 2.570	– 2.756	– 1.853	– 2.477	– 2.481
		(0.166)	(0.180)	(0.209)	(0.209)	(0.283)	(0.177)	(0.177)
Pepsi	Family	– 1.411	– 1.148	– 0.446	– 2.467	– 2.547		– 2.243
		(0.334)	(0.371)	(0.423)	(0.299)	(0.343)		(0.324)
Other Ambev	Family	– 3.568	– 3.309	– 2.342	– 3.855	– 4.806	– 2.022 ±	– 2.982
		(0.273)	(0.293)	(0.411)	(0.244)	(0.375)	(0.273)	(0.260)
B Brands	Family	– 2.837	– 2.858	– 2.188	– 1.624	– 1.260	– 3.309	– 3.166
		(0.157)	(0.196)	(0.412)	(0.263)	(0.315)	(0.171)	(0.181)
Coke	Single							– 1.346*
								(0.141)
Fanta	Single							– 1.592
								(0.179)
Guar Antar	Single							– 1.370
								(0.064)
Pepsi	Single							– 2.272
								(0.320)

Notes: Restricted 3SLS. Sales through self-service outlets. Standard errors in parentheses. (Also see the online appendix.)
*Includes Diet Coke.
**Includes Kuat.
± Includes Pepsi.

Zona [1994]) by prices in other channels. Estimated elasticities are mostly similar, including the finding of low own-price elasticities (see Table VI).

- Robustness test 1B: Instruments: Prices in other regions. Again, I keep the first and third class of instruments (respectively, the July, 1999, price reduction and factor prices), but now replace the second class of instruments (prices in other regions) by the region-specific distribution of B brands (now excluded from the bottom-level equation (1) for B brands). Similar (low) own-price elasticities obtain (except for Pepsi's elasticity, which drops by two-thirds and now has a point estimate of less than one).
- Robustness test 2A: Instruments: The July, 1999, price reduction. I keep the second and third class of instruments of the baseline specification (respectively, prices in other regions and factor prices) but, rather than using Coca-Cola Co.'s price reduction in July, 1999, to instrument for prices as per the first class of instruments, I control for the price reduction directly in the demand equations. Specifically, in each of the bottom-level brand equations (1) and the top-level equation (2), I now allow the region-specific fixed effects to jump, and the region-specific time trends to

change, upon Coca-Cola Co.'s price reduction in July, 1999. Clearly, including these intercept-and-drift-change covariates improves the goodness of fit of the system of equations by soaking up variation in the left-hand-side variables following July, 1999. By doing this, I am in some sense making the remaining instruments 'work harder' at identifying demand, though the supply shift is still operating to some extent (above and beyond the specific functional form taken on by the included controls) through the change in prices in other regions (the second class of instruments). While the estimated price elasticities change somewhat (in particular, the demand for Pepsi is now more elastic), low own-price elasticities are a robust result.

- Robustness test 2B: Instruments: The July, 1999, price reduction. An alternative to worrying about the exclusion versus inclusion of variables to account for Coca-Cola Co.'s price reduction is to drop all observations prior to the price reduction. I allow the July, 1999, price reduction to take effect over the course of the third quarter of 1999. Thus I drop all markets up to and including September, 1999. An added benefit of this specification is that it relies on data only from the later part of the sample, where the established firms managed to stem the (net) entry of B brands and aggregate shares stabilized (recall Figures 2 and 3). Identification operates through the second and third classes of instruments (respectively, prices in other regions and factor prices). Again, the estimated elasticities change somewhat (to be expected considering one important element of identification–the July, 1999, price reduction–is now absent), but the earlier result of low own-price elasticities remains. As in robustness test 2A, the point estimate for Pepsi's own-price elasticity is higher compared to the baseline estimate.
- Robustness test 3: Brand aggregation. In an attempt to deal with potential multicollinearity in the prices of some brands (e.g., Coke and Diet Coke–see footnote 23), I aggregate brands further. One such specification entails $I = 6$ (Coke + Diet Coke, Fanta, Kuat + Other Coca-Cola Co., Guaraná Antarctica, Pepsi + Other Ambev, and B brands). Low own-price elasticities persist. In fact, the point estimates for the aggregated brands (Coke + Diet Coke, Kuat + Other Coca-Cola Co., Pepsi + Other Ambev) are significantly lower relative to the baseline specification, in line with what one would expect from the positive cross-price elasticities of that less aggregated specification (recall Table IV).
- Robustness test 4: Substitution across package sizes. While family-size 2-liter PET bottles account for the lion's share of soft drinks sold through self-service outlets (on average as high as 80% of the volume sold of Coke, and 90% in the case of Fanta), the baseline specification, which employs data on family-size sales only, may not be appropriately capturing some substitution at the point of sale across different consumption sizes, such as between family-size bottles and single-size (350-ml) aluminium cans or (300-ml) bottles (in the baseline specification, any such substitution toward single-size containers would hopefully be captured by the outside good). To possibly better control for such potential substitutability, I augment the family-size data with single-size data for some brands, such as the specification with $I = 11$: Coke(+ Diet Coke) 'family,' Coke(+ Diet Coke) 'single,' Fanta 'family,' Fanta 'single,' Other Coke 'family,' Guaraná Antarctica 'family,' Guaraná Antarctica 'single,' Pepsi 'family,' Pepsi 'single,' Other Ambev 'family' and B brands 'family'. The augmented matrix of estimated

elasticities (under restricted 3SLS) is reported in the online appendix. Importantly, own-price elasticities remain low (and Pepsi family's own-price elasticity is now similar to that of Fanta and Guaraná Antarctica, in the -2.2 to -2.5 range). Further substitution patterns are noteworthy. Cross-price elasticities between family and single sizes are significantly positive in most, but not all, cases (e.g., $\eta_{CokeSingle,CokeFamily} = 0.57$).[33] Moreover, own-price elasticities for single sizes are significantly lower than for family sizes in three of the four cases (Coke, Fanta and Guaraná Antarctica). This would predict higher equilibrium markups for the single size relative to the family size (these are not reported). On validating this finding in an interview with a Coca-Cola Co. executive, the executive assured me that the industry enjoyed 'much higher' markups on single size containers as compared to family-size bottles.

REFERENCES

Araújo, E., 2008, 'Choosing a Product: An Act of Responsibility,' *Interview at the Brazilian Association of Soft Drink Makers*, *accessed at http://www.abir.org.br/article.php3?id_article=403*, on 27 January, 2008. (in Portuguese).

Berry, S.; Levinsohn, J. and Pakes, A., 1995, 'Automobile Prices in Market Equilibrium,' *Econometrica*, 63, pp. 841–890.

Blackorby, C.; Primont, D. and Russell, R. R., 1978, *Duality, Separability, and Functional Structure: Theory and Economic Applications* (North-Holland, New York, New York, USA).

Boston Consulting Group, 2002, *Under-Explored Markets: Discovering the 'C' Class* (Boston Consulting Group, São Paulo, Brazil).

Bresnahan, T. F., 1997a, 'Valuation of New Goods under Perfect and Imperfect Competition: A Comment,' in Bresnahan, T. F. and Gordon, R. (eds.), *The Economics of New Goods, Studies in Income and Wealth*, Vol. 58 (National Bureau of Economic Research, Chicago, Illinois, U.S.A.).

Bresnahan, T. F., 1997b, *The Apple Cinnamon Cheerios War: Valuing New Goods, Identifying Market Power, and Economic Measurement* (Stanford University, mimeo).

Bresnahan, T. F.; Stern, S. and Trajtenberg, M., 1997, 'Market Segmentation and the Sources of Rents from Innovation: Personal Computers in the Late 1980's,' *RAND Journal of Economics*, 28, pp. S17–S44.

Chaudhuri, S.; Goldberg, P. K. and Jia, P., 2006, 'Estimating the Effects of Global Patent Protection in Pharmaceuticals: A Case Study of Quinolones in India,' *American Economic Review*, 96, pp. 1477–1514.

Deaton, A. and Muellbauer, J., 1980, 'An Almost Ideal Demand System,' *American Economic Review*, 70, pp. 312–326.

Dhar, T.; Chavas, J.-P.; Cotterill, R. W. and Gould, B. W., 2005, 'An Econometric Analysis of Brand-Level Strategic Pricing between Coca-Cola Company and PepsiCo,' *Journal of Economics & Management Strategy*, 14, pp. 905–931.

Dharmapala, D.; Slemrod, J. and Wilson, J. D., 2007, *Optimal Tax Remittance with Firm-Level Administrative Costs* (University of Connecticut, University of Michigan and Michigan State University, mimeo).

[33] Dubé [2005] finds that the potential substitutability, which this robustness test directly controls for, is limited: in response to price changes, 'consumers tend to substitute primarily between products of the same size' (p.897), rather than stay with a brand and substitute across sizes.

Diewert, W. E. and Wales, T. J., 1987, 'Flexible Functional Forms and Global Curvature Conditions,' *Econometrica*, 55, pp. 43–68.

Dubé, J.-P., 2005, 'Product Differentiation and Mergers in the Carbonated Soft Drink Industry,' *Journal of Economics & Management Strategy*, 14, pp. 879–904.

Economist, 2006a, 'A Post-Modern Proctoid: A. G. Lafley has made P&G Great Again, but Commodity Hell is Never Far from his Mind,' edition of 15 April, 2006.

Economist, 2006b, 'Special Report on Brazil,' edition of 30 September, 2006.

Ellison, S. F.; Cockburn, I.; Griliches, Z. and Hausman, J., 1997, 'Characteristics of Demand for Pharmaceutical Products: An Examination of Four Cephalosporins,' *RAND Journal of Economics*, 28, pp. 426–446.

Exame, 2002 'Why Leading Brands are Losing Market Share to Cheap and Popular Products,' edition of 1 September, 2002 (in Portuguese).

Financial Times, 1999, 'Brazil's Regional Drinks Makers Slake Thirst for Value: The Tax Regime and Growing Demand have Penalised Leading Brands,' edition of 16 June, 1999.

Gazeta Mercantil, 1998, 'The Soft Drink and Water Industries,' *Análise Setorial* (Gazeta Mercantil, São Paulo, Brazil) in Portuguese.

Gasmi, F.; Laffont, J. J. and Vuong, Q. H., 1990, 'A Structural Approach to Empirical Analysis of Collusive Behavior,' *European Economic Review*, 34, pp. 513–523.

Gasmi, F.; Laffont, J. J. and Vuong, Q. H., 1992, 'Econometric Analysis of Collusive Behavior in a Soft-Drink Market,' *Journal of Economics and Management Strategy*, 1, pp. 277–311.

Goldberg, P. K., 1995, 'Product Differentiation and Oligopoly in International Markets: The Case of the U.S. Automobile Industry,' *Econometrica*, 63, pp. 891–951.

Gorman, W. M., 1995, in Blackorby, C. and Shorrocks, A. F. (eds.), *Separability and Aggregation: Collected Works of W. M. Gorman* (Clarendon Press, Oxford and New York).

Hausman, J. A.; Leonard, G. K. and Zona, J. D., 1994, 'Competitive Analysis with Differentiated Products,' *Annales D'Economie et de Statistique*, 34, pp. 159–180.

Hausman, J. A., 1997a, 'Valuation of New Goods under Perfect and Imperfect Competition,' in Bresnahan, T. F. and Gordon, R. (eds.), *The Economics of New Goods, Studies in Income and Wealth*, Vol. 58 (National Bureau of Economic Research, Chicago, Illinois, U.S.A.).

Hausman, J. A., 1997b, 'Reply to Prof. Bresnahan,' MIT, Cambridge, Massachusetts, Mimeo.

Hausman, J. A. and Leonard, G. K., 1997, 'Economic Analysis of Differentiated Product Mergers using Real World Data,' *George Mason Law Review*, 5, pp. 321–344.

Hausman, J. A. and Leonard, G. K., 2002, 'The Competitive Effects of a New Product Introduction: A Case Study,' *Journal of Industrial Economics*, 50, pp. 235–261.

Hendel, I., 1999, 'Estimating Multiple-Discrete Choice Models: An Application to Computerization Returns,' *Review of Economic Studies*, 66, pp. 423–446.

Hoch, S. J. and Banerji, S., 1993, 'When Do Private Labels Succeed?,' *MIT Sloan Management Review*, 34, pp. 57–67.

Hurwitz, M. A. and Caves, R. E., 1988, 'Persuasion or Information? Promotion and the Shares of Brand Name and Generic Pharmaceuticals,' *Journal of Law and Economics*, 31, pp. 299–320.

Kumbhakar, S. C., 1994, 'A Multiproduct Symmetric Generalized McFadden Cost Function,' *Journal of Productivity Analysis*, 5, pp. 349–357.

Lewis, W. W., 2004, 'The Power of Productivity,' *McKinsey Quarterly*, 2/04, pp. 101–111.

McKinsey, 2004, *Eliminating the Barriers to Economic Growth and the Formal Economy in Brazil* (McKinsey, São Paulo, Brazil).

McFadden, D. L., 1978, 'Cost, Revenue, and Profit Functions,' in McFadden, D. L. and Fuss, M. (eds.), *Production Economics* (North-Holland, Amsterdam, The Netherlands).

Mills, D. E., 1995, 'Why Retailers Sell Private Labels,' *Journal of Economics & Management Strategy*, 4, pp. 509–528.

Muris, T. J.; Scheffman, D. T. and Spiller, P. T., 1992, 'Strategy and Transaction Costs: The Organization of Distribution in the Carbonated Soft Drink Industry,' *Journal of Economics and Management Strategy*, 1, 84–128.

Nevo, A., 2000, 'A Practitioner's Guide to Estimation of Random Coefficients Logit Models of Demand,' *Journal of Economics & Management Strategy*, 9, pp. 513–548.

Nevo, A., 2001, 'Measuring Market Power in the Ready-To-Eat Cereal Industry,' *Econometrica*, 69, pp. 307–342.

Robarts, A., 2002, *Taste Trends in Mexico and Brazil: Changing Competitive Landscapes* (Santander Central Hispano Latin American Equity Research, New York, U.S.A.).

Salvo, A., 2006, 'Testing for Heterogeneous Business Practices across Firms in Developing Countries: The Case of the Brazilian Soft Drink Industry', *CSIO Working Paper 80*.

Schneider, F., 2002, 'Size and Measurement of the Informal Economy in 110 Countries around the World', *World Bank working paper*.

Schneider, F. and Enste, D., 2000, 'Informal Economies: Size, Causes, and Consequences,' *Journal of Economic Literature*, 38, pp. 77–114.

Scott Morton, F. M., 2000, 'Barriers to Entry, Brand Advertising and Generic Entry in the U.S. Pharmaceutical Industry,' *International Journal of Industrial Organization*, 18, pp. 1085–1104.

Stone, J., 1954, 'Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand,' *Economic Journal*, 64, pp. 511–527.

Suslow, V., 1986, 'Estimating Monopoly Behaviour with Competitive Recycling: An Application to Alcoa,' *RAND Journal of Economics*, 17, pp. 389–403.

Sutton, J., 1991, *Sunk Costs and Market Structure: Price Competition, Advertising and the Evolution of Concentration* (MIT, Cambridge, Massachusetts, U.S.A.).

Verboven, F., 1996, 'International Price Discrimination in the European Car Market,' *RAND Journal of Economics*, 27, pp. 240–268.

Vuong, Q. H., 1989, 'Likelihood Ratio Tests for Model Selection and Non-Nested Hypothesis,' *Econometrica*, 57, pp. 307–333.

World Bank, 2004, *Doing Business: Understanding Regulation* (World Bank, Washington, D.C., U.S.A.).