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Abstract

In this paper we empirically analyse two counterfactual situations facing an anti-trust authority following the merger of two of the largest international cigarette companies. First we estimate a nested logit model of demand for cigarettes. The implied elasticity of demand for smoking and implied marginal costs are both broadly consistent with the limited independent estimates available. We then use the model to simulate the proposed merger and the partial divestiture that was accepted by the Australian anti-trust authority. A comparison of the relative price changes predicted by the divestiture simulation with the actual post-divestiture price changes shows the model successfully anticipated the behaviour of the divested brands. This suggests structural econometric analysis using a nested logit may be usefully utilised by anti-trust authorities to assess the welfare implications of proposed mergers and partial divestitures.

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1 Introduction

In 1999 a merger took place internationally between two of the largest cigarette companies in the world, British American Tobacco and Rothmans International. Anti-trust authorities around the world responded to this merger, within a few months, by imposing various partial divestiture regimes on the local subsidiaries. In doing so, each anti-trust authority would have considered various counterfactuals including permitting the merger and various divestiture agreements. This brings to the fore two issues for consideration. First, whether the decisions of the anti-trust authorities were welfare improving and second, whether simple structural econometric models could have been effectively utilised in analysing the different counterfactuals.

Since the 1990s, highly sophisticated random coefficient logit models suitable for analysing mergers between oligopolists producing differentiated products have been developed (Ackerberg et al, 2007). However, the technical and computational demands of these models have limited their use even in academic circles. Anti-trust authorities are unlikely to have the time or expertise to estimate and simulate these models for a quick, robust merger analysis. The nested logit model, a special case of the random coeffficients models, has the advantages of being relatively simple and quick to estimate. However, the price of simplicity is that the functional form restricts the nature of the relationship between brands that can be estimated. Whether the simpler nested logit model yields useful results for anti-trust authorities can only be determined by validation against actual events — a practice that is becoming of increasing interest.[1]

In this paper we estimate a nested logit model of the Australian cigarette market using a new database compiled from documents made public as a result of extensive litigation against the U.S. cigarette industry. We then analyse two counterfactual scenarios associated with 1999 merger that would have been considered by the the local anti-trust authority, the Australian Competition and Consumer Commission (ACCC). Specifically we simulate both the merger, which would have reduced the number of large cigarette firms operating in Australia from three to two, and the partial divestiture accepted by the ACCC and their consequent impacts on consumer welfare. We also perform a validation exercise, comparing the pattern of relative price movements predicted by

[1]Peters (2006) compares results for actual mergers in the U.S. airline industry, and Keane (2010) argues more generally for validation of the results of structural models.

the model with those that actually happened following the divestiture.

While the model successfully predicts the pattern of price movements for the entrant receiving the divested brands, results for the merged firm and the other incumbent are not as conclusive. The results are significant for two reasons. First, it provides quantitative evidence on the potential consequences of mergers and forced partial divestitures. There have been no studies estimating market power at the brand level for the cigarette industry, relatively few empirical studies of mergers between differentiated product oligopolists and very little work on divestitures in general (Jayaratne and Shapiro, 2000; Tenn and Yun, forthcoming). Second, it provides an example of how a relatively simple econometric technique can be used to provide information for anti-trust authorities who have little time to empirically assess competition issues around specific mergers.

The paper is structured as follows: the next section details the background of the cigarette industry and describes the merger. Section three reviews the nested logit model we use for estimation. Section four describes the data used in estimation and section five discusses results and interpretation. Section six presents the results of our simulations and the validation exercise and section seven summarises our conclusions.

2 The Australian cigarette industry

During our observation period, 1974 to 1992, Rothmans Holdings Ltd, WD & HO Wills Holdings Ltd (owned by British American Tobacco) and Philip Morris (Australia) Ltd, each supplied, on average, about a third of the Australian cigarette market. Like many industrialised economies, the market for cigarettes in Australia has been steadily declining since the 1970's. In 1974 about 36% of Australian adults smoked and by 1992 this percentage declined to about 25% (Hill and White, 1995). While the discovery of the negative health effects of smoking was a fundamental cause of the decline, it has been estimated that demographic and income changes, government policies on taxation and regulation of advertising and consumption also contributed to the continuing decline in demand in Australia.[2] In this section we focus on the developments in the cigarette industry

[2]See Bardsley and Olekans (1999). For a detailed account of the evolution of the Australian cigarette market up to the early 1980s see Walker (1984) and for developments in the U.S. see Brandt (2007).

Table 1: Excise and state tax rates

Year	Excise	NSW	VIC	QLD
1975	9.92	0	2.5	0
1980	9.92	10	12	0
1984	8.63	15	25	0
1990	8.27	35	35	30
1995	11.90	100	75	100

Excise is dollars per kilogram.
(deflated by CPI (1970 base))
Rates (%) for three largest states.

from the start of our sample period up to the merger.

2.1 Government intervention in the cigarette market

The government intervened in four ways to discourage cigarette smoking. First, taxes were increased enormously to discourage smoking. The Federal government already had an excise on tobacco in the early 1970s, which was based on the weight of the tobacco. But from 1975, state governments introduced ad valorem taxes on cigarettes, the rates of which increased from about 10% in 1980 to almost 100% across all states by 1995 (Table 1). Second, the government regulated advertising, including general marketing practices. Direct advertising on television and radio was phased out by 1976. Further regulation ultimately prohibited advertising in print media, broadcast media, billboards, cinema, sporting events and sponsorships, or any other outdoor signs. This was complemented by campaigns against smoking by government and non-governmental organizations. Third, from the mid-1980s to the mid-1990s, smoking in workplaces and public places was increasingly restricted (Winstanley et al, 1995)

Fourth, the cigarette industry was specifically monitored by a series of prices surveillance agencies between 1973 and 1996. Between 1973 and 1982, prices of large firms in certain industries, like the cigarette industry, were monitored by the Prices Justification Tribunal (PJT). PJT annual reports show that between 1973 and 1974, firms were required to notify the PJT of proposed price increases. While the PJT had no powers to control prices, they could respond with highly publicised recommendations. In one instance WD & HO Wills sought an increase of 1.9% but the PJT recommended that the firm not increase prices.[3] Nieuwenhuysen and Norman (1976) note that after 1975, the PJT became less activist, and over time it became more like a pure monitoring body until its abolition in 1981. In 1984, price monitoring was re-established through the Prices Surveillance Authority (PSA).[4] After a review of cigarette company prices in 1985, the PSA sought an average reduction of 0.5 per cent in prices to occur by the following year (PSA, 1985). Ironically, the PSA's demand was at odds with the government's efforts to deter cigarette consumption through tax increases. Price monitoring only ceased in 1996, following evidence cited by the ACCC of increasing competitive behaviour in the cigarette industry (ACCC, 1996).[5]

2.2 Cigarette industry responses to tax increases

The cigarette companies responded to the increases in tobacco and cigarette taxation by moving toward the 'value' or 'discount' segment of the market. The typical number of cigarettes per packet in many of the leading brands increased from 20 to 25 and then, in some brands, up to as high as 50. The larger packs featured lower per-stick prices. The lower per-stick prices proved to appeal to the lower socio-economic classes which were still a sizeable proportion of smoker demographics (Hill and White, 1995). Winstanley et al (1995) also argued that this was also a tactic to entice new smokers who may have been worried about the long term expenses of a cigarette habit. Profit margins were to some extent preserved because the large pack cigarettes had lower marginal costs. Winstanley et al (1995) report that discount brands were around ten per cent lighter per stick than other brands and this meant lower input costs and lower federal excise per stick. In addition, lower per-stick prices meant lower state government taxes. Winstanley et al (1995) calculated that tax was approximately 20% lower on the discount brands than other brands.

The discount segment was created in the mid-1970s by, initially, extending already successful brands from packs of 20s to 25s. At the time it was considered a less risky marketing strategy than

[3]This occurred on 29 August 1974 (Prices Justification Tribunal, 1974-1975).

[4]The PSA's activities were subsumed in 1995 by the Trade Practices Commission and then, in 1996, the ACCC.

[5]There have been no empirical analyses of the effect of the PJT and the PSA on market power by firms so their effect on behaviour has not been established. These institutions do not affect our estimation since our demand model does not require any assumption about the nature of competition. Furthermore, the cigarette industry was no longer monitored by the PSA when the merger took place. But, the PSA was monitoring in the period when we estimate marginal costs, which does require an assumption about competition, and hence our estimates during this period are subject to this caveat.

Table 2: Market shares of largest brands in 1992

Mainstream			Discount		
Brand	Company	Share	Brand	Company	Share
Winfield	Rothmans	15.8	Longbeach	Philip Morris	15.2
Benson & Hedges	Wills	8.5	Peter Jackson	Philip Morris	13.6
Dunhill	Rothmans	3.4	Horizon*	Wills	11.2
Alpine	Philip Morris	3.3	Holiday	Rothmans	7.1
			Stradbroke	Wills	5.3
			Escort*	Wills	2.7

* Divested to Imperial Tobacco Australia in 1999.
Source: Philip Morris (1993).

undertaking costly launches of new brands — particularly with greater restrictions on advertising. This proved to be successful and larger packs of 30s, 40s and 50s were introduced. The larger packs were increasingly associated with new brands or relaunched older smaller brands. The market share of the 20s segment fell from 47% in 1980 to 4% in 1991, and the 25s segment rose from 51% in 1980 to 64% in 1983 (Beriot, 1993). By 1992, 30s, 35s, 40s and 50s made up 16%, 11%, 14% and 17% of sales respectively (Beriot, 1993). The market shares of the largest brands in the mainstream and discount segments in 1992 are summarised in Table 2.

2.3 The 1999 merger and divestiture

In January 1999, British-American Tobacco PLC, Rembrant Group Limited, Compagnie Financiere Richemont AG and Rothmans International BV agreed to merge. In both Canada and New Zealand the anti-trust authorities required divestitures of brands.[6] The Australian subsidiaries, WD & HO Wills Holdings Ltd and Rothmans Holdings Limited, also proposed to merge to form British American Tobacco Australasia, Limited (BATA). A merger application was submitted to the ACCC to obtain clearance for the proposed merger between the parties.

For the ACCC, the central test in determining whether a merger is approved is determining whether the acquisition will 'substantially lessen competition' under s 50 of the *Trade Practices Act*

[6] Competition Bureau Canada, 13 May 1999, *Consent Order Sought from Competition Tribunal in Tobacco Case*. Available from http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/00730.html [accessed on 5 July 2009]. New Zealand Commerce Commission, 5 February 2003, *Media Release*. Available from http://www.comcom.govt.nz/business-competition-media-releases/detail/2003/commissionagreesout [accessed on 29 October 2010].

1974 (Cth). The ACCC initially rejected the application, in March 1999, citing that the merged company would have a market share of 62% and 'would control nearly all of the major Australian cigarette brands' (ACCC, March 1999).[7]

In May 1999, it was proposed to the ACCC that a set of brands would be divested from BATA to Imperial Tobacco Group PLC, another large international cigarette company that had not been selling cigarettes in Australia. The divestiture proposal was accepted by the ACCC in June 1999 and clearance granted for the merger (ACCC, June 1999). Imperial Tobacco Group's Australian subsidiary was Imperial Tobacco Australia Ltd (ITA) which began trading on 3 September 1999 (ITA, 1999). At premerger shares, it was stated that BATA would have 44% and ITA 17% of the market. ITA's brands, as noted in Table 2, included one large discount brand, Horizon as well as four other much smaller mainstream and discount brands.

3 The model

Anti-trust authorities have relied on a range of traditional empirical techniques, using data on prices or market shares, in the hope of determining the anti-competitive effects of a merger.[8] However, these techniques do not directly address the central concern of competition authorities in a merger assessment, namely, the effects on consumer surplus. The effects on consumer surplus can be assessed through merger simulations of oligopoly models.[9] The parameters of these models are usually supplied by estimating differentiated products models of demand. The most flexible and sophisticated of these demand models is the random coefficients logit model.[10] The application of these models has, however, been limited by the considerable econometric skills required for implementing them. Indeed, the computational aspects of implementing these models are still

[7]The approach of the ACCC reflects the qualitative nature of assessment used, following the ACCC's *Merger Guidelines 1999*. Empirical tools for assessment are not as widely used in Australian competition law as they are in the United States or Europe, there being a 'perceived reluctance' by many parties there to utilise empirical analysis techniques (King, 2005).

[8]These include, but are not limited to price/concentration analysis, elasticity analysis, critical loss analysis, switching analysis and price correlation analysis: Introduction to Quantitative Techniques in Competition Analysis [online], Lexecon. Available from http://www.crai.com/ecp/publications/2003/index.htm [accessed on 30 December 2009].

[9]See Budzinski and Ruhmer (2009) for a recent survey.

[10]As specified in Berry, Levinsohn and Pakes (BLP) (1995) and applied in Nevo (2000) to a hypothetical merger.

being debated.[11] Furthermore, the use of simulated data can reduce the robustness and exact replicability of the results — a feature desired by competition authorities investigating contentious issues (King, 2005). Finally, collecting the data, programming, estimation and simulation can take months and months of full-time work — which renders their use difficult when, as illustrated in the case above, decisions must be made quickly.

Hence, we will focus on the nested logit model, which is a restricted version of the full random coefficients logit model. The demand equation can be estimated quickly using a linear instrumental variables regression in a standard econometrics package. There are dozens of published studies of static differentiated products models, with many of these studies utilising various forms of nested logits.[12]

3.1 Nested logit

The nested logit model is a discrete choice model in which consumers choose their most preferred brand out of a set of brands or not to consume at all. Even though smokers consume multiple cigarettes, choices of cigarette brands are discrete in the sense, as argued by McFadden, that even when the consumer can afford more than one option people typically use only one brand at a time (Anderson et al, 1992;3). Furthermore, experience estimating random coefficients models with actual data (Nevo, 2000) and nested logit models with simulated data (Huang et al, 2008) suggest that satisfactory results can be obtained analysing products with discrete brand choices.[13] A potential complication is that the addictive nature of cigarettes makes the decision to smoke a dynamic problem. This is probably more important for smoking, in general, than for smoking particular brands, and specification and estimation of dynamic models is even more computationally involved.[14]

In the nested logit brands are are grouped into G + 1 mutually exclusive sets, $g = 0, 1, ...G$, and the products in group g are denoted as φ_g. The variable common to all products in group

[11] See Knittel and Metaxoglu (2008) and Dube, Fox and Su (2008).

[12] Recent examples include Chiou (2008), Einav (2007) and Richards (2007).

[13] Hendel (1999) requires individual data as well as aggregate data to estimate a model of both brand choice and quantity choice.

[14] See Aguirregabiria and Nevo (2010) for a recent survey.

g is denoted as ζ_{ig}, and this has a distribution function that depends on σ, where $0 \leq \sigma \leq 1$. For brand j denote x_j as the set of observed product characteristics, ξ_j as an unobserved product characteristic and p_j as the price. In addition, for consumer i denote ε_{ij} as the individual product specific error term that is identically and independently distributed type I extreme value. The utility of consumer i for product j can be writtten as,

$$u_{ij} = \delta_j + \zeta_{ig} + (1 - \sigma)\,\varepsilon_{ij} \tag{1}$$

where the mean utility, $\delta_j = x_j\beta - \alpha p_j + \xi_j$. Cardell (1997) shows that if ε is a type I extreme value, then this implies the error term, $\zeta_{ig} + (1 - \sigma)\,\varepsilon_{ij}$, is also a type I extreme value. The parameter σ is referred to as the nesting coefficient. As σ approaches one, the within group correlation of utility approaches one and the alternatives within the nest are closer and closer substitutes. Conversely, as σ approaches zero, the within group correlation approaches zero and consumers' tastes for products within a nest are increasingly independent.

Cardell's result ultimately enables the derivation of a closed form equation for the market share of brand j as derived in Berry (1994). The demand equation relating observed market shares, s_j, to market shares predicted by the model, χ_j, is given by,

$$s_j = \chi_j(\delta(x, p, \xi); \theta)$$

Defining $D_g = \sum_{j\epsilon\varphi_g} e^{\frac{\delta_j}{(1-\sigma)}}$, it can be shown that the market share for product j of entire market is:

$$\chi_j\,(\delta; \sigma) = \frac{e^{\frac{\delta_j}{(1-\sigma)}}}{D_g^{\sigma} \sum_g D_g^{(1-\sigma)}} \tag{2}$$

With the outside good as only member of group zero, with market share s_0, and normalising the mean utility of outside good such that $\delta_0 = 0$, an equation suitable for estimation using a linear instrumental variable regression can be derived as:

$$\ln s_j - \ln s_0 = x_j\beta - \alpha p_j + \xi_j + \sigma \ln s_{j/g} \tag{3}$$

where ξ_j is the error term. Instrumental variables are required as both p_j and $s_{j/g}$ are endogenous.

The relative simplicity of the nested logit does come at a cost in that it allows correlation patterns to depend only on predetermined groupings of products rather than explicitly on their characteristics (Berry, 1994). Furthermore, as is well known, the functional form allows only limited patterns of substitutability across products, as captured by the formulas for the own and cross-price elasticities:

$$\varepsilon_{jj} = \alpha_j p_j \left[s_j - \frac{1}{(1-\sigma)} + \frac{\sigma}{(1-\sigma)} s_{j/g} \right] \tag{4}$$

$$\varepsilon_{jk} = \begin{cases} \alpha_k p_k \left[s_k + \frac{\sigma}{(1-\sigma)} s_{k/g} \right] & \text{if } k \neq j \text{ and } k \in g \\ \alpha_k p_k s_k & \text{if } k \neq j \text{ and } k \notin g \end{cases} \tag{5}$$

The formula for the cross-price elasticities plausibly requires greater substitutability with products within the same nest than in a different nest, increasing with σ. However, we also see that the cross price elasticities do not allow for any differences across brands. For example, all brands within each group have an identical cross-price elasticity to the k^{th} brand (though it differs if it is included or not included in the same group).

3.2 Supply and equilibrium

In this subsection we present the assumptions required for performing the merger simulations. First, for the five firms that operate in the Australian market between 1974 and 2000, denote $\mathcal{F}_f$ as the set of the $j = 1, \ldots, J$ brands owned by the f^{th} firm where $f = 1, \ldots, 5$. The profit of the f^{th} firm is:

$$\Pi_f = \sum_{j \in \mathcal{F}_f} (p_j - mc_j) M s_j(p) - C_f \tag{6}$$

where mc_j is the marginal cost of product j, C_f is the fixed cost of production, and M is the size of the market. The equilibrium concept assumed for the oligopoly game is Bertrand-Nash in prices. Denote Ω_{jf}^{pre} as follows:

$$\Omega_{jr}^{pre} = \begin{cases} -\frac{\partial s_j(p)}{\partial p_r}, & \text{if} \exists f : \{r, j\} \subset \mathcal{F}_f; \\ 0, & \text{otherwise.} \end{cases} \tag{7}$$

Note the elements of this matrix depends on the assignment of brands to firms. We can then write the first order conditions, in vector notation, to be satisfied in equilibrium as:

$$s(p) - \Omega^{pre}(p)(p - mc) = 0 \tag{8}$$

This can be rearranged to solve for mc:

$$mc = p - \Omega^{pre}(p)^{-1} s(p) \tag{9}$$

With estimates of the parameters and the data we can obtain estimates of marginal cost. Denote Ω^{post} as the post-merger equivalent of Equation 7. We can solve for the post-merger price as the solution to:

$$p* = \hat{mc} + \Omega^{post}(p*)^{-1} s(p*) \tag{10}$$

Once we have $p*$ and $s(p*)$ we can estimate profits and consumer surplus. The per-consumer consumer surplus is:

$$CS = \frac{1}{\alpha} ln \left(\sum_g D_g^{1-\sigma} \right) \tag{11}$$

4 Data

In this section we discuss the nature and sources of the data we use to estimate the nested logit model. We also present and discuss some summary statistics from the data and raise some identification issues. Finally, we describe the variables we will use in estimation, and outline our estimation strategy. The first set of data needed is the variables suggested by the model: prices and market shares. The second set of data needed is a set of instruments for price and the within

Table 3: Selected summary of descriptive statistics

Variable	Mean	Standard deviation	Minimum	Maximum
Price	0.019	0.003	0.012	0.026
Number of Mainstream Brands	50.14	5.00	42	58
Number of Discount Brands	13.82	3.99	10	21
Brands s_j	0.011	0.013	0.0002	0.068
Outside alternative s_0	0.766	0.015	0.746	0.796

Note: The dataset has 294 observations

group market share, $s_{j/g}$. Summary statistics for all dependant and explanatory variables are reported in Table 3.

4.1 Market shares and prices by brand

Market share data for the largest cigarette brands is collected from the Tobacco Industry Document Database.[15] The database, which includes documents used during the trials as well as data from other sources, was established in 1998 as part of the 'Master Settlement Agreement' reached between between several U.S. state governments and U.S. tobacco companies regarding litigation over the recovery of Medicaid costs associated with smoking related illnesses from the U.S. tobacco industry. We use four reports compiled by Philip Morris and RJ Reynolds providing market shares for the largest brands in Australia (which varies across the reports) by year, as well as total cigarettes sold, for 1974 to 1984 and 1987 to 1992. Thirty-three different brands, listed in Appendix C, are observed for varying periods in our dataset and make up between 80% to 90% of cigarette sales. The Tobacco Industry Document Database also includes marketing reports for Australia which we draw on to interpret our results.

Prices were collected from the lists of tax inclusive recommended retail and wholesale prices for cigarettes per pack by brand in the June editions of the trade journal, Australian Retail Tobacconist, and adjusted for inflation using the CPI.[16] Each cigarette brand features a variety of packaging alternatives and sizes. To make these comparable, we calculate the price per cigarette stick and then average the per stick prices across the different alternatives to obtain a price for each brand.

[15] Appendix A lists full references for internal industry documents used in collection of market share data.

[16] The May edition was used for 1975 and July edition used for 1987 when the June edition was unavailable.

Because our price and tax data is at the state level but our market share data is at the national level we need to aggregate the state data up to national data. Average price (tax) per cigarette by state is weighted by state populations and aggregated to a national level. Weighting by population is reasonable given that smoking prevalence rates across states are not significantly different from each other.

4.2 Market share of the outside alternative

Because we observe the total factory made cigarettes sold we define the outside alternative as not smoking factory made cigarettes. Market size is estimated on the basis of the number of smoking opportunities per year. We make the assumption of 25 cigarettes per day per person.[17] Hence the total market in a year is calculated as 25 multiplied by the number of days in the year multiplied by the population. For example, assume there are 100 people of which 30 smoke 20 cigarettes a day, and one particular brand has 10% market share. Then the market share of the outside alternative is 76% and the market share of the brand is 2.4%. By using not smoking as the outside good, our results will also be of interest to those interested in the public policy issues around cigarette use and enables comparison with estimates using aggregate data.

Note though that other tobacco related products are included in our outside goods — smokeless tobacco, cigars, pipes, roll-your-own cigarettes and illegal cigarettes (chop-chop). In Australia, most of these have very small market shares and any likely impact would be more on the demand for cigarettes in general rather than the demand for specific brands of cigarettes.[18] Furthermore, these products tend to be excluded from other studies of the demand for cigarettes so our results remain comparable.

[17] We used 25 days as we estimated the average daily number of cigarettes per smoker over the sample period ranged from 16.3 to 19.5. We estimated the number of smokers using the predicted values from a regression of the number of smokers in eight years as surveyed between 1974 and 1995, on a constant and time trend. Coefficients were statistically significant and yielded an R-squared value of 0.92. The survey results are available from the Australian Bureau of Statistics.

[18] As described in Winstanley et al (1995), smokeless tobacco products never had a sizeable market in Australia and were progressively banned by the states and federally from the mid-1980s. Survey evidence in Hill and White (1995) is that less than 2% of people smoke cigars or pipes and less than 8% of people smoke roll-your-own cigarettes. The best estimate of illegal tobacco, PriceWaterhouseCoopers (2005) is that 1 in every 17 cigarettes smoked in Australia is chop-chop though the same report emphasises it is probably more of a substitute for roll-your own cigarettes than factory made cigarettes.

One implication of defining non-smoking as the outside good is that brands with very small market shares are not, as in other studies, included in the outside good. In our study they are also not explicitly analysed as we observe prices but not brand market shares. We can still identify all parameters of the model except for those on the dummy variables associated with the missing brands. With their extremely small market shares, these brands are likely to be unavailable from many retail outlets from which cigarettes are purchased and it is unlikely that these brands affect the decisions made regarding pricing the larger brands. This segment of the market, which presumably caters to consumers with strong preferences for particular brands, may be better thought as monopolistically competitive. Hence not having estimates of their brand-specific constants is unlikely to cause problems for our simulations or validation exercise.

4.3 Nests

An important part of the nested logit model is to classify brands into categories or groups. Brands in each group share characteristics common only to that group. In this case brands were classified by the availability of discount packs. Discount packs are classified as packs containing thirty or more cigarettes, and have been purposely marketed at the price/value segment (Hirji, 1984). These discount brands are characterised by prices which increase less than proportionately with quantity. Internal documents and government reports were used to support brand classification. While the cigarette companies identified three major segments, 'Prestige,' 'Mainstream,' and 'Discount', all brands we observe are included in the 'Mainstream' and 'Discount' nests. The prestige brands were sold in very small numbers and hence are not recorded among the major brands when calculating market shares. Appendix C also classifies each brand we observe into their nest.

4.4 Other explanatory variables

We follow Nevo (2001) and include brand dummy variables, obviating the need for data on brand characteristics, which in many cases is not available. Cigarettes as a product is very mature and simple. There have been no major brand-specific changes in cigarettes as a product over our time period and no major product relaunches. Furthermore, over most of our period advertising has been restricted which also limits the opportunities for manufacturers to suggest differentiation between brands. Finally, brand fixed effects will control for, to a certain extent, correlation in demand for particular brands over time.

We also follow Ackerberg and Rysman (2005) and include the number of mainstream and discount brands as explanatory variables. Ackerberg and Rysman (2005) demonstrate an implication of assuming logit ε_{ij} is that each product is equally distinctive (though the value is random) in terms of its unobserved characteristics. In other words, the entry of a new brand cannot crowd out the demand for another product because of similar unobserved characteristics. This is unrealistic, and while the nesting in our model helps to address this issue, it only works to the extent that the relevant product characteristics are observed. This problem seems highly relevant for cigarettes given the rapid expansion of discount brands and the large number of mainstream brands. Ackerberg and Rysman (2005) argue that this problem can lead to biased estimates of parameters, overpredict welfare gains from the introduction of new products, and affect price elasticities in terms of both magnitudes and statistical significance. But they show the problem can be dealt with by adding a function of the number of products in the nest into the demand equation. We would expect to see a negative sign on the parameter which implies that there is congestion in the product space.

4.5 Instruments

Once brand dummy variables are included in the regression, the error term is the unobserved deviation from the overall mean valuation of the brand. Since firms observe and account for this deviation, it will be correlated with prices and therefore least squares estimates will be inconsistent. While Berry (1994) suggests using combinations of observed characteristics of the products as instruments we cannot use this strategy to construct instruments as we have no variation in each brand's observed characteristics over time.

However, we have a set of instruments which are undoubtedly exogenous and important: state and federal taxes. These can be used as instrumental variables because they are correlated with the endogenous explanatory variables, price and within-group market share, but uncorrelated with the error term and mean utility. Unlike product characteristics, these are not choice variables of the firm, and so are unlikely to be correlated with demand shocks. Table 1 summarises the changes in taxes over time.

The changes in taxes are substantial and evidence from PSA (1994) demonstrates that they are important components of the price of a cigarette. Specifically, in 1993, for a 30-cigarette pack in the state of New South Wales (NSW) 23.1% of the price goes to the manufacturer, 16.5% goes to the retailer, 35.8% covers state tax and 24.6% covers federal excise. Hence, about a third of the price of a pack of cigarettes reflects taxes that were not in existence (for NSW) at the start of our sample period. Furthermore there has also been substantial movements in excise rates which makes up a further quarter of the price of a cigarette pack.

The main drawback of using tax rates as an instrument is that they are not brand specific. But because the state taxes are ad valorem, changes in the tax rates will have different effects on different brands of cigarettes. We extract once lagged prices for all brands and multiply them by the change in the tax rates. For new brands we choose the lagged value of a similar brand — ideally by the same firm. We use changes in tax rates to reduce the endogenous component that would occur if we used lagged taxes paid. Lagged taxes are substantially correlated with lagged prices and would be an inappropriate instrument because it is likely that unobserved determinants of brand market shares are correlated over time. Interacting the lagged price with the tax change reduces this correlation.

An important advantage of using taxes as an instrument is that the effect on prices from taxes, that are unlikely to be repealed, will be similar to that of a merger, in that such effects are permanent (as opposed to using exogenous temporary variation such as weather driven tobacco shortages). Because both changes are likely to be permanent, consumers are likely to respond in similar ways.

5 Results

In this section we present the estimates of the nested logit demand model. In addition, we determine that our simple model is robust to allowing coefficients to change over time and across

Table 4: Results from nested logit model

Variable	Coefficient
Price	-32.55** (17.03)
$\ln s_{j/g}$ (σ)	0.78*** (0.009)
Number of Mainstream Brands	-0.007 (0.009)
Number of Discount Brands	-0.014 (0.016)
Anderson Underidentification Test	Reject***
Sargan Overidentification Test	Fail to Reject
Cragg-Donald Weak Identification Test	Fail to Reject
Observations	294
Significance: 1%***, 5%**, 10%*	

nests. We then discuss the estimates of the own price elasticities, the cross price elasticities and the elasticity of substitution to non-smoking. We then use our model to simulate the markups on each brand, and predict the marginal costs. These are compared with estimates published by the PSA.

5.1 Demand estimates

Table 4 presents the estimates of the nested logit model using IV regression. The coefficient on price indicates there is a negative relationship between price and mean utility. This is plausible given that one would expect an increase in price to correspond with a decrease in utility and is consistent with the long held perception that cigarettes are normal goods.

In respect of σ, estimates between 0 and 1 are consistent with the requirements of the nested logit. Somewhat unexpectedly, the insignificant coefficients on the number of mainstream and discount brands suggests that product crowding is not an issue for the cigarette market. We perform three tests for the overall performance of the IV regression. Sargan's Overidentification test indicates that the instruments are uncorrelated with the error terms and therefore there is no systematic failure due to endogeneity or functional form. For structural models, this is a strong result. We are also able to reject underidentification.[19]

[19] While the Stock-Yogo version of the Cragg-Donald test indicates that the instruments are weak, given the positive results of the Anderson and Sargan tests, with the recent concerns about the power of the Stock-Yogo test (Poskitt and Skeel, 2009), and the compelling exogeneity of tax increases, we are confident in our results.

Table 5: Results across periods

Period	1974-1984	1987-1992
Price	-18.34 (13.14)	-49.67 (41.91)
$\ln s_{j/g}$ (σ)	0.63*** (0.14)	0.50*** (0.10)
Number of Mainstream Brands	-0.011** (0.006)	0.0046 (0.015)
Number of Discount Brands	-0.013 (0.047)	-0.046* (0.033)
Anderson Underidentification Test	Reject***	Reject***
Sargan Overidentification Test	Fail to Reject	Reject***
Cragg-Donald Weak Identification Test	Fail to Reject	Fail to Reject
Observations	179	115
Significance: 1%***, 5%**, 10%*		

As previously noted, the period of the dataset is marked by a number of regulatory changes and incremental increases in taxes. Due to these changes, the pool of consumers change as older consumers die, younger consumers take up smoking, and a non-random set of consumers quit smoking. Consumers who smoked during the 1970s may remember the successful advertising campaigns on television, whereas those who took up smoking in the late 1980s will have observed advertising only via sports sponsorships and ads in print. All of these changes may cause the parameters of the model to change over time

Therefore we split the dataset into subsets to reflect the increase in advertising restrictions and taxation towards the end of the first subset, and to account for the lack of market share data for the period 1985 to 1986. Our results are presented in table 5. We note that the equations for 1987-1992 fail Sargan's overidentification test. As this period features the most substantial increases in taxes, this is probably more likely due to a functional form issue than a failure of exogeneity.

There are two notable changes in the coefficients. First, the increase in α suggests a general increase in the sensitivity of all consumers in the later period to price. This is also noted in a report by Philip Morris (Philip Morris USA, 1990). This may be a result of the increased restrictions on the means by which firms can differentiate their products and the impact of health warnings on consumer preferences, forcing firms to compete on price. Second, the lower estimate of σ in the later period indicates that the degree of substitutability within nests fell. One possible explanation

Table 6: Mainstream and discount nesting coefficients

Variables	Coefficients
Price	-37.73** (19.97)
$\ln s_{j/g_{mainstream}}$ (σ)	0.93*** (0.37)
$\ln s_{j/g_{discount}}$ (σ)	0.72*** (0.20)
Significance: 1%***, 5%**, 10%*	

is that those smokers that did not give up smoking were those that tended to be most loyal to smoking particular brands. It may also be a consequence of the greater restrictions in advertising in the later period, which worked to limit tobacco companies' influence in consumer choice and to reinforce brand loyalty to those brands that are already established.

In respect of the coefficients on the number of brands of each group, the negative sign is consistent with there being congestion. In each case the effect is larger for the discount brands than for the mainstream brands. This is consistent with the discount brands being less distinctive from one another compared with the mainstream brands, which were mainly launched before advertising was restricted. This corresponds with the increase in the 'crowding out' effect resulting from the increase in discount brands in the second period. For the mainstream brands, the effects are stronger in the first period than the second period, which again corresponds with the decrease in the number of mainstream brands in the second period.

Finally, we note that the specification in the model may be too restrictive in that it requires the same value for the nesting coefficient, σ, for both mainstream and discount brands. As one group of brands was largely introduced with extensive advertising and the latter without, it is plausible that the degree of differentiation may be greater in the earlier group. Hence we re-estimate the model allowing for separate nesting coefficients for each group and report the findings at Table 6. The estimated nesting coefficient is greater for the mainstream brand than the discount brands and a hypothesis test fails to reject that the two coefficients are identical. These equations also fail to reject the null hypothesis of underidentification.

Compared with the first set of results, the specifications reported in tables five and six either have more substantial econometric problems or fail to capture the expected heterogeneity across time or over groups. Hence all remaining analysis will be done using the model reported in table

Table 7: Sample of selected own price elasticities

Brand	Average	Maximum	Minimum
All	-2.89	-3.77	-1.99
Mainstream	-3.34	-3.77	-2.29
Discount	-2.63	-3.12	-1.99

four.

5.2 Own price elasticities

Table 7 summarises the estimates of the own-price elasticities by group and by market definition. All are calculated as for 1992, the last year in our sample. Unsurprisingly, all elasticities are negative. On average, the demand for mainstream cigarettes is more (own-price) elastic than the demand for discount cigarettes.

This appears to go against common intuition. Mainstream brands are potentially more differentiated in that firms have had greater opportunity through advertising to differentiate their products. Therefore the theory is that greater differentiation should translate into greater degrees of market power. Our results also appear to go against results found in other studies, such as Tauras, Peck and Chaloupka (2006) who found that market shares for discount and deep discount cigarettes are three or more times as responsive to own price changes than the mainstream market shares.

We suggest that these striking results reflect that the mainstream brands are priced such that firms are operating on sections of the demand curve in which market power has already been extracted. In other words, the price of the mainstream cigarette has increased to the point where it has attracted more and more substitutes and appears more elastic. Following from this theory, we would therefore expect to see greater cross price elasticities between mainstream cigarette brands than cross price elasticities between discount cigarette brands, and greater elasticities of substitution between mainstream and non-smoking (the outside good) than the elasticities of substitution between discount and non-smoking. Our results for cross price elasticities and elasticities of substitution confirm this and are presented in the following sections.

The hypothesis that products can appear elastic was the reasoning which gave rise to the

‘Cellophane fallacy’ in which Mueller and Stocking (1955) pointed out the error of concluding that a monopolist was unable to exercise market power by raising price above the current price instead of it having already exercised market power by raising price significantly above the competitive price. Tobacco marketing documents suggest that mainstream brands were priced in this way because they were the flagship brands of the particular company and were used to attract new consumers. For example, Wills’ marketing strategy for Benson & Hedges was to increase the appeal of the brand to 25-35 year old ‘YAUS’ (young adult urban smokers) (WD & HO Wills (Australia) Limited, 1992). Flagship brands such as Winfield, Benson & Hedges and Marlboro may attract new smokers who believe they will not be addicted to cigarettes. These consumers are known as ‘chippers’ and are defined as smokers who consume less than five cigarettes a day (Shiffman, 1989). Hence, image and taste, rather than price is a determining factor in initial cigarette choice. These consumers may have relatively elastic demands because if the price of a particular brand of mainstream cigarettes becomes too high, they will opt not to smoke or smoke an alternative mainstream brand. Upon addiction, price plays an increasingly important factor in cigarette choice and addicted consumers begin consuming discount brands. This approach was taken by Wills, who in an internal company document acknowledged that the over 40 age group were “more price conscious than the under 40’s, with the under 30’s franchise being key target market prospects for high priced image brands” (WD & HO Wills (Australia) Limited, undated). Thus, the relative inelasticity of discount brands may be reflective of higher degrees of addictiveness.

5.3 Cross-price elasticities

A selected sample of cross price elasticities are presented in Table 8. Signs on the cross price elasticities are positive, indicating that the brands are substitutes. While the results generated appear small, this is a common feature of estimated differentiated products models.

As foreshadowed in section 5.2, the cross price elasticities are greater for mainstream brands compared with the cross price elasticities generated for discount brands. We hypothesise that the relative cross price inelasticity between the discount brands is reflective of the cycle of consumption

Table 8: Cross price elasticities

Brand Combination	Average	Maximum	Minimum
Discount wrt Mainstream	0.0069	0.024	0.0006
Mainstream wrt Discount	0.0053	0.019	0.0003
Within Mainstream	0.31	1.09	0.03
Within Discount	0.16	0.57	0.008

where consumers who initially smoke the mainstream brands turn to cheaper alternatives as they become more price sensitive. Their level of addiction may be the factor influencing brand loyalty. This is confirmed by the results generated for cross price elasticities between the groups. On average, consumers who switch from mainstream to discount cigarettes have a higher cross price elasticity than those consumers who would switch from discount to mainstream cigarettes. This indicates that consumers are less likely to switch from discount cigarettes to mainstream cigarettes, as consumers who are addicted and are price sensitive would be less inclined to purchase the more expensive brands.

5.4 Elasticity of substitution to the outside good

The elasticities of substitution to the outside good are reported in Table 9. This statistic is of greater interest than usual because of the public policy interest in whether individuals continue or stop smoking.

As foreshadowed in section 5.2, the results show that the cross price elasticity between mainstream cigarettes and not smoking is higher than the cross price elasticity between discount cigarettes and not smoking. This is because consumers who begin with mainstream cigarettes are more responsive to price changes in mainstream cigarettes, and would therefore be more likely to quit smoking than those consumers who smoke discount cigarettes. The results are consistent with our hypthesis above. The greater degree of addictiveness a consumer exhibits, the less likely they will be to 'consume' the outside good (ie not smoking).

These estimates are much smaller than the own-price elasticities of demand for cigarettes estimated using aggregate data. For example, Scollo et al (2003) cite research that states a typical estimate for Australia is -0.4. The low estimates in table 9 are because these estimates are for an

Table 9: Elasticity of substitution to the outside good

Brand	Average	Minimum	Maximum
All	0.0059	0.0003	0.0241
Mainstream	0.0069	0.0006	0.0241
Value	0.0053	0.0003	0.0194

increase in the price of a single brand rather than a general increase in the price analysed with aggregate data. Hence, many smokers would likely opt for another brand of cigarettes than to make the harder decision to quit. To obtain an estimate comparable to those using aggregate data we apply uniform proportional increases to the marginal cost of each brand (which we estimate as described in the next sub-section) and solve for the Bertrand-Nash equilibrium set of prices. Marginal costs are increased until the average equilibrium price of a cigarette increases by 1%. This requires increasing brand marginal costs by 2.1%. We found that the market share of smoking had fallen by 0.58%. It is not surprising that our estimate of the own-price elasticity is a bit greater than the typical result as the prices of cigarettes had increased substantially, due to tax increases, by the end of our sample period.

5.5 Marginal costs and markups

In order to simulate mergers and divestitures, estimates for marginal cost need to be obtained. As described in section 3.3., we assume a Bertrand-Nash equilibrium and solve for the marginal costs consistent with the observed prices, market shares and model parameters. The estimates of the marginal costs are summarised by group in the first three columns of Table 10. These estimates are then compared to estimates of marginal cost from external reports reported in the last three columns of the table. We discuss how our estimates from external reports are obtained in Appendix B but, in general, we combined some brand specific tax information from the Australian Retail Tobacconist, and brand specific wholesale prices broken down into variable costs and margins using an estimate of a typical decomposition in PSA (1994).

In respect of the estimates of marginal cost from the model, mainstream cigarettes are reported to have higher marginal costs per stick than those of discount cigarettes. There are two reasons which may explain the higher estimated marginal cost of mainstream cigarettes. First, excise on

Table 10: Marginal costs

Brand	Estimates from model			Estimates from external reports		
	Average	Maximum	Minimum	Average	Maximum	Minimum
All	0.012	0.018	0.007	0.015	0.018	0.011
Mainstream	0.015	0.018	0.011	0.017	0.018	0.016
Value	0.009	0.013	0.007	0.013	0.015	0.011

mainstream cigarettes tend to be greater by comparison to discount cigarettes. As explained in section 2.2 mainstream brands have higher marginal costs due to containing more tobacco and incurring greater taxes. Second, state taxes are calculated on the vale of cigarettes in dollar terms. Since mainstream brands are typically more expensive, calculated state taxes are therefore larger.

Comparing the estimates from our model with the estimates compiled from external reports, our results are broadly consistent. However, the marginal cost estimates generated from the nested logit model tend to be systematically lower than those of external reports.

Using the marginal costs implied by the nested logit model, markups were calculated with the results reported in Table 11. Across the two groups, the markups are on average higher on the discount cigarettes than the mainstream cigarettes. This largely follows from the lower elasticity of demand for discount cigarettes. While the prices on discount cigarettes are lower than on mainstream, their costs are likely to be lower due to lower retail taxes and lower federal excise. We note that in PSA (1994) and in some internal reports from tobacco companies, discount cigarettes are suggested to have, on average, lower margins than mainstream cigarettes. There are two reasons why our results may still be consistent with these reports. First, the markups reported in our study are based on marginal production and taxation costs and do not include amounts spent on price specialing. Price specialing is essentially a subsidy, involving the manufacturers paying retailers an amount for each packet sold, on condition that the retailer resells at a lower retail price (PSA, 1994). The levels of discounting have been reported to be greater for larger pack sizes than smaller pack sizes (Scollo et al, 2000). Internal industry documents reveal that Philip Morris was prepared to launch aggressive promotions of cheap brands "even at a considerable cost to margins" (British American Tobacco Co., 1999), an example of which was the offer of free movie tickets with

Table 11: Mark-ups

Brand	Average	Maximum	Minimum
All	46%	62%	30%
Mainstream	39%	52%	30%
Value	50%	62%	40%

purchases of Peter Jackson cigarette cartons (Philip Morris, 1990). Second, it is not clear what costs are included when markups are calculated in these reports. For example, when calculating the wholesale margin in PSA(1994) indirect costs are included, which would be excluded in our estimates.

Next we compare our estimated markups with estimates of typical markups provided in PSA(1994). They suggest the typical retail margin on a packet of 30's in NSW is approximately 16.5%. While the wholesale margin is not stated, Figure 7.1 of the PSA report implies a margin of around 5% of the wholesale price though indirect costs, such as marketing and administration, are included in costs. When we exclude these costs the wholesale margin is closer to 32%. As the wholesale price makes up 47.7% of the final price of a packet of 30's in NSW, the combined (manufacturer and retailer) margin is 32%. However, comparing the PSA's estimates to our results suggests that the model is over-estimating the markup. This is likely because the market was in fact more competitive than that implied by the Bertrand-Nash assumption used to generate the marginal costs. This may have been because Bertrand-Nash in differentiated products is not appropriate for the cigarette industry at this period, or that the PSA was encouraging greater competition.

6 Merger and divestiture

In this section we apply our model to simulate the effects on prices and average consumer surplus from the merger that was prevented in 1999 and from the partial divestiture approved by the ACCC. As a base case for both simulations, we use the set of brands and estimated marginal costs from 1992, the last year in the estimation sample. The seven year gap is unlikely to be problematic as between 1992 and 1999 there are no major changes to the market structure — only one small brand exits and one new brand is introduced. After discussing the results of our simulations, in section 6.4, we perform a validation exercise, comparing the simulated price changes from the partial divestiture with the actual changes. Validating a partial divestiture is particularly challenging because all prices are determined simultaneously. Hence a set of substantial shocks to a large enough set of brands could potentially render all predictions wrong as other brands that were not directly affected by the shocks, react to the prices of the shocked brands. Furthermore, as described in section 6.3, this is complicated by a substantial increase in the tax on cigarettes which happened almost simultaneously with the merger. Hence, in the validation, we focus on the relative changes in the prices of the different brands rather than the absolute changes.

6.1 Simulation of the merger

Table 12 reports predicted price changes for discount and mainstream cigarette groups following the merger. Our simulations predict that following the merger, the per stick prices of all brands owned by BATA rise. The largest percentage increases would have occurred among mainstream brands. Table 2 indicates that the merger would have brought together three of the four largest mainstream brands. The relatively greater increase in the prices of former Wills brands (32.1% compared with 17.4% for Rothmans and 3.4% for Philip Morris) is consistent with this as competition would have ceased from two large competitors, whereas for the former Rothman's mainstream brands only one major competitor would have been removed. The smaller proportional increases in the discount market (9.3% for Wills, 16.8% for Rothmans and 4.1% for Philip Morris) is due to the combination of Philip Morris having the two largest brands and Wills have three out of the next four largest brands. The former Rothman's discount brands increase their prices due to no longer competing with the larger Wills brands. The general increase in the price of discount brand cigarettes would have been due in part to the very large increases in mainstream cigarette prices. Philip Morris raises its prices as well but to a much smaller degree — particularly in the mainstream market where it has only one of the larger brands. Using equation 11 we can calculate that these price changes reduced consumer surplus by approximately 7%. These results show the increase in market power following the merger would have created considerable deadweight losses and is the first ground upon which the ACCC's actions in opposing the merger can be justified. However, these results

Table 12: Predicted changes following merger

Company brands	Discount	Mainstream
BATA (merged entity)	13.5%	24.8%
Former Wills brands	9.3%	32.1%
Former Rothmans brands	16.8%	17.4%
Philip Morris	4.1%	3.4%

do not necessarily imply that the divestiture increased welfare, an analysis which we now turn to.

6.2 Simulation of the divestiture

We first analyse the predicted changes from the divestiture and our results are summarised in Table 13. Our simulation predicts that the divestiture results in prices of discount cigarettes sold by BATA increasing approximately 1.8% whereas those sold by ITA fall by 2%. ITA gains the third largest discount brand from Wills as well as another one of Wills' larger brands, Stradbroke. Hence, those Will's brands retained by BATA face a relatively tougher environment and cut their prices by 3%. The position for the former Rothman's brands held by BATA and ITA has improved in that it no longer competes with one of the larger brands so the prices on former Rothman's brands rises by between 3 and 4 per cent. The price cuts for the former Wills discount brands held by ITA can be rationalised because these brands now compete with Stradbroke. In general, the average price changes are not enormous, nearly all falling in between ±4%.

By comparison, there are still substantial price increases of, on average, 18%, predicted for the mainstream brands held by BATA after the divestiture as, implied by Table 2, three of the four largest mainstream brands no longer compete with each other. Consistent with this intuition is that the largest price cuts of 19% are on the Rothmans brands divested to ITA. They now have to compete with the large mainstream brands retained by BATA. In another simulation not reported here, we included Benson & Hedges, the largest mainstream brand of Wills, in the partial divestiture and found found much smaller increases in the prices of mainstream brands. The variation in price responses is much greater ranging from -19% to +25%.

The effect on consumer welfare, calculated using equation 11, compared with pre-merger was

Table 13: Predicted and actual price changes following divestiture

Company	Predicted price changes		Actual price changes	
	Discount	Mainstream	Discount	Mainstream
BATA (merged entity)	+1.8%	+17.8%	26.3%	14.1%
Wills brands owned by BATA	-3.0%	+24.5%	26.2%	12.7%
Rothmans brands owned by BATA	4.1%	+11.1%	26.3%	15.4%
ITA	-2.0%	-12.6%	26.3%	15.7%
Wills brands owned by ITA	-4.5%	-6.3%	25.1%	+19.8%
Rothmans brands owned by ITA	3.2%	-18.9%	28.8%	+11.7%
Philip Morris	-0.04%	1.8%	20.3%	15.3%

to reduce average consumer welfare by about 2%. In comparison to the 7% reduction in consumer welfare in the case of the merger, this provides the second ground upon which the ACCC's actions were justified in requiring a divestment of brands. However, it also provides grounds for the ACCC perhaps having sought for a large mainstream brand to be divested from Wills or Rothmans to ITA in order to better promote competition in the mainstream market.

6.3 Validation of the divestiture predictions

To evaluate the model's predictions about the outcomes of the divestiture we collected data on prices from the Australian Retail Tobacconist for June 1998, before the merger, and June 2000, after the divestiture had been completed, and adjusted the data for inflation. However, we cannot do a simple comparison of the predicted with the actual changes because of the complicating factors outlined in section 6.3.1.

6.3.1 Tax changes during the validation period

By 1997, all state retail tax rates had become 100%. However, in 1997, the High Court ruled these taxes unconstitutional. By the end of 1997 these taxes were replaced with an equivalent ad-valorem surcharge on the federal excise that was then returned to the states. Then, in November 1999, the excise was replaced with a per-stick tax of \$0.18872 (Costello, 2000). The reason for this change was because it was recognised that a weight charge encouraged manufacturers to make larger numbers of lighter sticks. The government's initial proposal stated that including the 10% GST the price of premium cigarettes should only rise by 6.5% but that the price increase on discount cigarettes would be much greater (Costello, 1998). At the time the changes were made though there was no official statement on what the expected price effects on cigarettes would be. BATA stated in its GST compliance statement that prices had risen by 10% to 30% depending on pack size following the change in excise (BATA, 2000). Finally, from 1 July 2000, the 10% GST was introduced replacing a set of wholesale taxes. While in theory the change in the legal incidence may have been less than 10% due to eliminating wholesale taxes, the GST compliance statements of BATA and ITA stated that these credits were very small (BATA, 2000; ITA, no date).[20]

An additional complication is that due to public concern that firms would take advantage of the tax changes to exert market power, the ACCC was required to extensively monitor all companies pricing during this period (ACCC, July 1999). As part of this process, some of the largest companies across the economy, including BATA and ITA, were invited to make public statements about how they planned to comply with the GST, which we have already cited.

These changes have three implications for our validation exercise. First, the change to a per-stick excise is likely to have substantially increased the price of discount cigarettes relative to mainstream cigarettes. The price on mainstream cigarettes may have also increased in response to the excise as well — either because of a higher tax or in response to higher prices on discount cigarettes. Second, the introduction of the GST would have further increased the price of all cigarettes. These changes mean we will only be able to focus on the predicted relative price changes within discount and value cigarette brands rather than the absolute changes and changes across the two groups. Third, if the merger created incentives to raise prices, firms (primarily BATA) may have been reluctant to do so under this scrutiny. This would be of less concern for firms that prefered to cut prices (primarily ITA) in response to the merger though. Hence, it is possible that we may see more evidence of price cuts than price increases following the merger during this period.

6.3.2 Comparison with actual price movements

The third and fourth columns of Table 13 contain the average actual price changes. The average increase of the sets of discount brands are nearly all closely concentrated around 26% and the

[20] See Scollo et al (2004) for more details about this period.

average price increases for the mainstream brands are around 15% but more widely dispersed. The higher average price increases for the discount brands compared with the mainstream brands is consistent with the changes to the excise having greater effect on discount brands but the differing variability is consistent with the predictions of the simulations.

With respect to the mainstream brands, the simulation predicted that the BATA brands would have had the largest increases for the three companies, which did not occur. However, the relative price changes of the brands taken by ITA are consistent with the simulation. The simulation predicted that there would be much greater price cuts for the former Rothmans brands, as they now competed with the successful mainstream Rothmans brands and it was the Rothmans brands taken by ITA that experienced the lowest increase in response to the excise (11.% compared with 19.8%). The simulation also correctly predicted that Philip Morris would not substantially change its prices in response to the merger.

With respect to the discount brands, BATA increases on average the prices of all of its brands by around 26%. There is more variability in the price changes for the brands taken by ITA and this is consistent with the predictions of the simulations, which suggested that the former Wills brands would have their prices cut relative to the former Rothmans brands. Strikingly, Philip Morris's discount brands rise by 6 percentage points less than the average increase for the other two companies brands — but this substantial relative price cut was not predicted by the model.

Overall, despite the tax changes and increased ACCC scrutiny, the nested logit model has been able to successfully predict the direction of the average relative price movements for the brands held by ITA — where ACCC scrutiny was less likely to be a problem — and, to a much lesser extent, Philip Morris. In general, BATA did not appear to take advantage of the reduced competition in mainstream cigarettes to increase the prices of its leading brands but ITA adjusted its relative prices in a way consistent with the predictions of the nested logit for the partial divestiture. While the partial success in predicting the outcome of the divestiture may reflect the effect of increased monitoring and tax changes, it must be qualified by the caveat that the restrictiveness of the nested logit in handling substitution patterns may have some impact on these results.

7 Conclusion

The research question this paper seeks to address is whether simple structural econometric models can inform counterfactual scenario analysis by anti-trust authorities faced with an anti-competitive merger. We estimated a simple nested logit model of demand for cigarettes using a new dataset constructed from industry documents and various external sources. The nested logit produced coefficient values and demand elasticities that resemble those found in the extensive literature on cigarette demand. We were then able to simulate two counterfactual scenarios — a merger between two of the three largest cigarette companies in Australia, Wills and Rothman, and a merger involving a partial divestiture to an entrant, ITA.

The results of our merger simulation suggested that, on competition policy grounds, the ACCC was correct to oppose the merger as it would have led to substantial price increases and substantially lower consumer welfare. The results of our partial divestiture simulation suggest that the partial divestiture would have substantially reduced the negative effects of the merger in the discount cigarette market but still enabled an increase in market power in the mainstream cigarettes market. Overall the loss in consumer welfare was less than a third of that if the merger had been permitted to go ahead. We suggest that greater welfare improvements might have been obtained if the ACCC were able to assess various brand mix ownership arrangements. While validating our results from the simulation of the partial divestiture were complicated by substantial tax changes occurring at the time and the increased ACCC scrutiny of pricing by large companies, we found that our model successfully predicted the relative price changes by the entrant receiving the divested brands.

Importantly, the significance of these results is that it is worthwhile further investigating the performance of nested logit in other industries unencumbered by the intense regulation of the cigarette market, in that it can provide quick results and a general indication of welfare effects for anti-trust authorities who wish to supplement their qualitative analysis with a more rigorous quantitative assessment.

A Sources for market share data

Market share data was obtained from the following internal documents which are downloadable from http://old.tobacco.health.usyd.edu.au/site/gateway/docs/advsearch.htm:

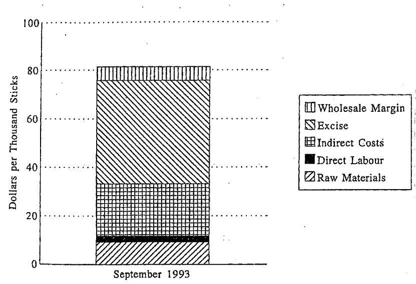
- RJ Reynolds Tobacco International. 1979. *Australia 1980 Business Plan*. Bates no. 505525644/505525648. [accessed on 13 November 2010].
- Philip Morris International. 1983. *Philip Morris International Fact Book*. Bates no. 2500085185/2500085236. [accessed on 13 November 2010].
- Philip Morris International. March 1985. *Philip Morris International Fact Book* Bates no. 2026306424/2026306514.[accessed on 13 November 2010].
- Philip Morris International. April 1993. *1993 world cigarette fact book: Philip Morris International Fact Book* Bates no. 2500058766/2500059015. [accessed on 13 November 2010].

B Breakdown of wholesale price

Marginal cost from external reports had to be estimated from the wholesale price charged by each firm as reported in the Australian Tobacco Retailer. We calculate the marginal cost of a cigarette sold to the consumer as the sum of three components. The first component is the state retail taxes, which we observe. The other two components are the federal excise tax and the manufacturer's direct costs of production. We do not observe the latter components but in Figure 7.1 of the PSA (1994), included below, a diagram shows the average percentage of raw materials, direct labour, indirect costs, excise and margin of a wholesale price. Excise is reported on average to be 53% of the wholesale price. Direct labour and raw materials account for approximately 15% of the wholesale price. We apply these percentages to all wholesale prices to estimate the excise and direct costs for all cigarettes.

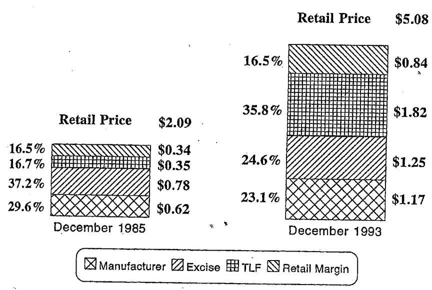
There are likely to be systematic differences between these estimates and the estimates from the model for two reasons. First, if different firms have different costs, there will be systematic differences across firms in that, for example, the costs for a low cost suggested by the model will be smaller than the average estimates. Secondly, the model may imply lower costs for all firms than the average cost if the market is more competitive than the Bertrand-Nash equilibrium.

Figure 7.1: Breakdown of the weighted average wholesale list price: September 1993



Source: Company Notifications.

Figure 7.2: Price breakdown for typical pack of 30's in NSW, 1985 and 1993



Source: Company price lists and PSA data.

Source: PSA (1994)

C Classification of brands into nests

Mainstream:

- Philip Morris: Alpine, Du Maurier, Marlboro, Park Drive, Viscount.
- Wills: Albany, Ardath, Benson & Hedges, Claridge, Craven A, John Player*, Kent, Kool.

- Rothmans: Dunhill, Peter Stuyvesant*, Rothmans, Winfield.
- RJ Reynolds: Camel (from 1992 on, distributed by Rothmans).

Discount:

- Philip Morris: Black & White, Fortune, Longbeach, Peter Jackson, Superlights.
- Commodore, Escort*, Horizon*, Stradbroke, Wills.
- Rothmans: Brandon*, Cambridge, Holiday, Ransom, Special Mild.

*Brands divested to Imperial Tobacco Australia.

References

Ackerberg, Daniel, C. Lanier Benkard, Steven Berry and Ariel Pakes. 2007. "Econometric Tools for Analyzing Market Outcomes." In *Handbook of Econometrics*, vol. 6 part 1., 4171-4276, edited by James J. Heckman and Edward E. Leamer. Amsterdam: North-Holland.

Ackerberg, Daniel A. and Marc Rysman. 2005. "Unobserved Product Differentiation in Discrete-Choice Models: Estimating Price Elasticities and Welfare Effects." *RAND Journal of Economics*, 36(4), 771-788.

Aguirregabiria, Victor and Aviv Nevo. 2010. "Recent Developments in Empirical Dynamic Models of Demand and Competition in Oligopoly Markets." Unpublished manuscript. July.

Anderson, Simon P., Andre De Palma and Jacques-François Thisse. 1992. *Discrete Choice Theory of Product Differentiation*. Cambridge MA: MIT Press.

Australian Competition and Consumer Commission. 19 September 1996. "Prices surveillance reform welcomed." http://www.accc.gov.au/content/index.phtml/itemId/86817/fromItemId/378002 [accessed on 13 November 2010].

Australian Competition and Consumer Commission. 31 March 1999. "ACCC opposes cigarettes merger." http://www.accc.gov.au/content/index.phtml/itemId/322870/fromItemId/378008 [accessed on 29 October 2010].

Australian Competition and Consumer Commission. 3 June 1999. "ACCC accepts cigarettes divestiture." http://www.accc.gov.au/content/index.phtml/itemId/322820/fromItemId/378008 [accessed on 29 October 2010].

Australian Competition and Consumer Commission. 14 July 1999. "ACCC launches comprehensive GST surveillance." http://www.accc.gov.au/content/index.phtml/itemId/322961/fromItemId/378008 [accessed on 6 November 2010]

Bardsley, Peter and Nilss Olekalns. 1999. "Cigarette and Tobacco Consumption: Have Anti-Smoking Policies Made a Difference?" *Economic Record*, 75(230), 225-240.

Beriot, M. C. 1993. *Tobacco prices, taxes and consumption in Australia.* Carlton South: Victorian Smoking and Health Program.

Berry, Steven T. 1994."Estimating Discrete-Choice Models of Product Differentiation." *Rand Journal of Economics*, 25(2), 242-262.

Berry, Steven T., James Levinsohn and Ariel Pakes. 1995. "Automobile Prices in Market Equilibrium." *Econometrica*, 63(4), 841-890.

Brandt, Allan M. 2007. *The cigarette century: the rise, fall and deadly persistence of the product that defined America*. New York NY: Basic Books.

British American Tobacco Co. 20 October 1999. *Overview of Philip Morris' Marketing Strategy.* Bates no. 500098281. http://old.tobacco.health.usyd.edu.au/site/gateway/docs/advsearch.htm [accessed on 25 March 2010].

British American Tobacco Australia. 2000. "The new tax system public compliance commitment." http://www.accc.gov.au/content/index.phtml/itemId/6043 [accessed on November 6, 2010].

Budzinski, Oliver and Isabel Ruhmer. 2010. "Merger Simulation in Competition Policy: A Survey." *Journal of Competition Law and Economics*, 6(2), 277-319.

Cardell, Scott N. 1997. "Variance Components Structures for the Extreme-Value and Logistic Distributions with Application to Models of Heterogeneity." *Econometric Theory*, 13(2), 185-213.

Chiou, Lesley. 2008. "The timing of movie releases: Evidence from the home video industry." *International Journal of Industrial Organization*, 26(5), 1059-1073.

Costello, Peter. 1998. "Tax reform, not a new tax, a new tax system." AGPS, November, 1998.

Costello, Peter. 2000. "Excise Tariff Amendment Bill (No. 1), Explanatory Memorandum." http: www.comlaw.gov.au[accessed November 6, 2010].

Dubé, Jean-Pierre, Jeremy Fox and Che-Lin Su. 2009. "Improving the Numerical Performance of BLP Static and Dynamic Discrete Choice Random Coefficients Demand Estimation." Working Paper No. 14991. National Bureau of Economic Research, Cambridge, Mass.

Einav, Liran. 2007. "Seasonality in the U.S. motion picture industry." *RAND Journal of Economics*, 38(1), 127-145.

Hendel, Igal. 1999. "Estimating Multiple Discrete Choice Models: An Application to Computerization Returns." *Review of Economic Studies*, 66(2), 423-446.

Hill, David J. and Victoria M. White. 1995. "Australian Adult Smoking Prevalence in 1992." *Australian Journal of Public Health*, 19(3), 305-308.

Hirji, T. 12 May 1984. *Value-for-Money Marketing Brand Development Course, Egham, Surrey, 29th April-12th May 1984 [includes WD & HO Wills (Australia) Limited presentation]* Bates no. 102245184/102245197. http://old.tobacco.health.usyd.edu.au/site/gateway/docs/advsearch.htm [accessed on 2 May 2007].

Huang, Dongling, Christian Rojas and Frank Bass. 2008. "What happens when demand is estimated with a misspecified model?" *Journal of Industrial Economics*, 56(4), 809-839.

Imperial Tobacco Australia. no date. "Public Compliance Commitment." http://www.accc.gov.au/content/index.phtml/itemId/6043 [accessed on 6 November 2010].

Imperial Tobacco Group. 1999. "Australian acquisition." http://imperial-tobacco.com [accessed on 12 December 2009].

Jayaratne, Jith and Carl Shapiro. 2000. "Simulating Partial Asset Divestitures to 'Fix' Mergers." *International Journal of the Economics of Business*, 7(2), 179-200.

Keane, Michael P. 2010. "Structural vs. atheoretic approaches to econometrics." *Journal of Econometrics*, 156(1), 3-20.

King, Stephen. 2005. "The use of empirical methods in merger investigations." http://www.accc.gov.au/content/index.phtml/itemId/693299/year/2005 [accessed December 29, 2009].

Knittel, Christopher R. and Konstantinos Metaxoglou. 2008. "Estimation of Random Coefficient Demand Models: Challenges, Difficulties and Warnings." Working Paper No. 14080. National Bureau of Economic Research, Cambridge, Mass.

Mueller, Willard F. and George W. Stocking. 1955. " The Cellophane Case and the New Competition." *American Economic Review*, 45(1), 29-63.

Nevo, Aviv. 2000. "Mergers with Differentiated Products: the Case of the Ready-to-Eat Cereal Industry." *RAND Journal of Economics*, 31(3), 395-421.

Nevo, Aviv. 2001. "Measuring Market Power in the Ready-to-Eat Cereal Industry." *Econometrica*, 69(2), 307-342.

Nieuwenhuysen, John P. and Neville R. Norman. 1976. *Australian competition and prices policy: trade practices, tariffs, and prices justification*. London: Croom Helm.

Peters, Craig. 2006. "Evaluating the Performance of Merger Simulation: Evidence from the U.S. Airline Industry." *Journal of Law and Economics*, 49(2), 627-649.

Philip Morris. October 3 1990. *1991 original budget: Marketing Presentation October 3, 1990*. Bates No. 2504107139A/2504107171. http://old.tobacco.health.usyd.edu.au/site/gateway/docs/advsearch.htm [accessed on 25 March 2010].

Philip Morris USA. March 1990. *Value segment synopsis: the Australian market*. Bates No. 2048568608/2048568613. http://old.tobacco.health.usyd.edu.au/site/gateway/docs/advsearch.htm [accessed on 25 September 2007].

Poskitt, D. S. and C. L. Skeels. 2009. "Assessing the magnitude of the concentration parameter in a simultaneous equations model." *Econometrics Journal* 12, 26-44.

Prices Justification Tribunal. 1974-1975. *Annual Report*. Canberra: Prices Justification Tribunal.

Prices Surveillance Authority. 26 November 1985. *Inquiry in Relation to the Supply of Cigarettes*, matter number PI/85/2. Canberra: Prices Surveillance Authority.

Prices Surveillance Authority. 5 September 1994. *Inquiry into the Cigarettes Declaration*. Matter No: PI/94/1, Report No. 52. Canberra: Prices Surveillance Authority.

PriceWaterhouseCoopers. 2005. "Research Report on the Illegal Tobacco Market." PriceWaterhouseCoopers.

Richards, Timothy R. 2007. "A Nested Logit Model of Strategic Promotion." *Quantitative Marketing and Economics*, 5(1), 63-91.

Scollo, Michelle, Tim Owen and Jason Boulter. 2000. "Price discounting of cigarettes during the National Tobacco Campaign." 155-200 in *Australia's National Tobacco Campaign. Evaluation Report Volume Two*. Canberra: Commonwealth Department of Health and Aged Care.

Scollo, M., S. Younie, J. Wakefield, J. Freeman and F. Iscasiano. 2003. Impact of tobacco tax reforms on tobacco prices and tobacco use in Australia. *Tobacco Control*, 12(Suppl II):ii59-ii66.

Scollo, Michelle, Ron Borland and World Health Organization. 2004. *Taxation reform as a component of tobacco control policy in Australia*. UC San Francisco: Center for Tobacco Control Research and Education. http://www.escholarship.org/uc/item/95t699r7.

Shiffman, Saul. 1989. "Tobaco "chippers" individual differences in tobacco dependence." *Psychopharmacology*, 97(4), 539-547.

Tauras, John A., Richard M. Peck and Frank J. Chaloupka. 2006. "The Role of Retail Prices and Promotions in Determining Cigarette Brand Market Shares." *Review of Industrial Organization*, 28(3), 253-284.

Tenn, Steven and John M. Yun. Forthcoming. "The Success of Divestitures in Merger Enforcement: Evidence from the J&J - Pfizer Transaction." *International Journal of Industrial Organization.*

Walker, Robin. 1984. *Under fire: A History of Tobacco Smoking in Australia.* Victoria: Melbourne University Press.

WD & HO Wills (Australia) Limited, undated, *Value for money marketing in Australia.* Bates no. 621707306/621707370. http://old.tobacco.health.usyd.edu.au/site/gateway/docs/advsearch.htm [accessed on 25 March 2010].

WD & HO Wills (Australia) Limited. 1992. *Wills Australia: Marketing Strategic Plan Synopsis 1993-1997.* Bates no. 500245407/500245418. http://old.tobacco.health.usyd.edu.au/site/gateway/docs/advsearch.htm [accessed on 25 March 2010].

Winstanley, Margaret, Stephen Woodward and Noni Walker. 1995. *Tobacco in Australia: Facts and Issues 1995.* Victoria: Victorian Smoking and Health Program. Second Edition.