The impact of plain packaging of cigarettes in Australia: a simulation exercise

A report for Philip Morris International

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1. Introduction and summary

I have been asked by Philip Morris International (PMI) to analyse the expected impact of plain packaging on tobacco consumption and prices in Australia.[2]

Plain packaging would remove an important method by which cigarette suppliers can distinguish their brands. Given current restrictions on advertising, packaging is perhaps the most important, if not the only, method of branding still available. Plain packaging will therefore significantly reduce, if not eliminate, the role of brands.

Economic theory shows that suppliers with brands that consumers value highly are able to charge higher prices than firms with weaker brands. I therefore expect that plain packaging, by reducing the role of brands, will force suppliers who currently possess valuable brands to reduce prices, resulting in increased cigarette consumption.

In addition, I expect that plain packaging will make market entry by new suppliers of low price non-branded products easier. This effect will lead to further price reductions and increases in consumption.

These predictions of economic theory are supported by the results of a simulation exercise I have used to predict the impact on prices and consumption of removing branding. I find that plain packaging is expected to reduce prices and increase

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[2] Plain packaging implies the removal of all trademarks, texts and logos, together with all colours and other attractive decorative or design features. Only some information and graphics, such as brand names, product names, etc. can appear on packs in a prescribed size, font, colour and location. It may be the case that packs are required to be made from a material in a standardized, dull colour and shape (inside and outside the pack). The permitted shapes and formats of packs are also prescribed.

consumption. I find that plain packaging is expected to reduce prices by between 4.8% and 19.2% and increase consumption by between 2.6% and 16.6%.

In this report I first describe the relevant economic theory, provide evidence on the importance of branding in the cigarette market and explain the effects of plain packaging predicted by economic theory (section 2). I then provide the results of a simulation exercise (section 3).

2. Lessons from economic theory

Introduction

Economists distinguish between two types of goods: homogeneous products, where the product of one supplier is, in the eyes of a consumer, identical to those of any other supplier; and differentiated products where consumers do not view the products of different suppliers to be identical.

Economic theory shows that when products are homogeneous the main way for producers to compete is on price, and all products will tend to sell for the same price. However, when products are differentiated price competition is reduced and prices will vary. In particular, suppliers of products that consumers value highly will be able to charge higher prices.

Cigarettes are a branded good, which means that in economic terms, they are a differentiated product: in the eyes of a consumer different brands of cigarettes are not identical to each other. Consequently, suppliers of brands which are valued more highly by consumers are able to charge a price premium.

Plain packaging will remove the most important, if not the only, method by which manufacturers can distinguish their brands from other brands. This will have several effects. The most obvious effect is that it will reduce product differentiation within the cigarette market, thereby increasing price competition and leading to a reduction in prices. In addition, it will make market entry of non-branded products easier, which will increase competition and further reduce prices. It will make it more attractive, easier, and cheaper to produce counterfeit cigarettes which sell at lower prices than legitimate products; it will make it more attractive for consumers to purchase branded cigarettes abroad which have paid no duties in Australia; and it will make it more attractive to import contraband cigarettes which also sell at lower prices. All these effects will lead to lower prices and will result in increased cigarette sales.

Below I describe the relevant economic theory, demonstrate that branding is important for cigarettes and discuss the expected impact of plain packaging on prices and consumption. Plain packaging will lead to competition focused solely on price, lower prices and, therefore, increased consumption. I identify a direct effect on prices and indirect effects due to easier market entry of non-branded products and increased illicit trade in cigarettes.

Economic theories of product differentiation

Economic theory shows that when the products of all suppliers are identical, no company can raise its price above its competitors' prices without losing its entire market share.[3] However, when products are differentiated and consumers have different preferences for different products, companies can increase prices without losing their entire customer base.

These are the key conclusions of the most widely cited economic models of product differentiation. These are the "Hotelling" model[4] and one of its extensions, the "Circle" model.[5] These models use geographic location as a proxy for differences in product characteristics. But their findings can be applied more generally to products which are differentiated in any other way.

These models show that firms differentiate their products in order to emphasize product attributes that permit firms to charge higher prices. If products are differentiated, a consumer is less likely to switch to a different product following a price increase – because consumers are less likely to view different products as interchangeable. Price reductions are therefore less likely to be profitable, because a price reduction is less likely to lead to a significant increase in sales at the expense of rival products. So product differentiation reduces the incentives for firms to compete on price and makes it easier for firms to increase prices without losing sales to rivals.

Manufacturers of premium cigarettes differentiate their products from their competitors' products so that they can charge a price premium. Branding is one way to do so. Branding creates a degree of brand loyalty which makes it less likely that consumers will be willing to switch to rival products, allowing suppliers to charge higher prices.

In summary, branding, which is a form of product differentiation, allows manufacturers to charge higher prices than they would if all products were viewed by consumers as identical.

Importance of branding in cigarette markets

Cigarette manufacturers can differentiate their products from competitors' products through their physical characteristics, their branding and/or their price. The main physical differences in cigarettes sold in Australia are length, pack size, packaging quality, tobacco quality, tar yield and menthol flavour.[6] Consumers select products according to their preferred mix of characteristics (including price). Appendix 1 provides data which shows Australian consumer preferences. It shows that in Australia, consumers have quite strong revealed preferences for Virginia tobacco, box packages, packs of more than 20, and king size cigarettes.

[3] This is true as long as firms do not face capacity constraints, as shown by the "Bertrand" model of oligopolistic competition. However, even if they face capacity constraints firms will still all charge the same price for an identical product, as shown by the "Cournot" model. The Cournot competition may be thought of as a two-stage game in which firms first choose capacities (more generally, scale variables) and then compete through prices. See Jean Tirole, *The Theory of Industrial Organisation*, MIT Press, 1988, Chapter 5

[4] Hotelling, H "Stability in Competition" *Economic Journal* 39:41-57 (1929)

[5] Salop, S.C. "Monopolistic Competition with Outside Goods" *Bell Journal of Economics* 10:141-156 (1979)

[6] The type of tobacco and package type are also physical characteristics of cigarettes; in Australia almost all cigarettes are Virginia tobacco blends sold in hinge lid packets.

Given that there are very few observable characteristics of cigarettes and, as shown above, given that in Australia consumers show a strong preference for a particular combination of them, branding is perhaps the only way in which cigarette suppliers can differentiate their products. It is the main method of product differentiation in this industry. Plain packaging will remove this key aspect of product differentiation. As I explain below this will have the direct effect of reducing prices and increasing consumption. It will also increase competition from new entrants of non-branded products, counterfeit products and contraband products, all of which will further reduce prices and increase consumption.

Direct impact on price

As discussed above, economic theory predicts that product differentiation will allow manufacturers to charge a price premium. Branding is an important element of product differentiation for cigarettes, so removing it will reduce manufactures' ability to charge this price premium.

In the absence of product differentiation, consumers are more willing to switch between products. This would lead to competition focused on price and lower prices.

There are different ways in which the impact on price might arise. There could be a decrease in prices of the premium brands. I would expect to see this if – on the removal of branding – all consumers switched to the cheapest brand. The (previously) premium brands would need to drop prices to maintain sales volume.

I note that there is an economic theory of price signalling, which indicates that some consumers will prefer to pay higher prices for either the perception of quality or for status.[7] This theory explains why – in certain circumstances – customers prefer higher priced products all else equal. If the theory applied to cigarette markets, it could be argued that manufacturers could *increase* the price differential to signal quality in the absence of branding. However, I believe this is unlikely to occur under plain packaging. The reason is because price signalling usually comes hand in hand with branding. The higher price paid by consumers needs to be conspicuous to have value (i.e. it needs to be clear to others that the consumer has paid a lot for the product). Plain packaging will remove this ability to engage in conspicuous consumption.

Impact on volumes

Changes to the prices of cigarettes will have an impact on cigarette consumption. In general, it would be expected that a fall in the price of any product would lead to increased sales and consumption. Past econometric studies on cigarette demand have confirmed that, despite the addictive nature of tobacco products, cigarettes follow this same pattern of price responsiveness. Ross and Chaloupka examine the literature on this topic and conclude that:

[7] This theory was first introduced by Veblen, T. B. "The Theory of the Leisure Class. An Economic Study of Institutions". (1899)

> *"The single most consistent conclusion from the economic literature on the demand for cigarettes is that consumers react to price changes according to general economic principles – an increase in price leads to a decrease in consumption."* [8] [9]

Another examination of the existing literature on the response of cigarette demand to changes in prices is presented in a report by the US Department of Health and Human Services. The report notes:

> *"Even with the differences in data, theoretical modelling, and estimation techniques, one general conclusion can be drawn from these aggregate studies – increase in cigarette prices will reduce cigarette consumption."*[10]

Impact on entry and exit

It is well established in economic theory that, everything else being equal, competition is more effective in markets where it is easier for new firms to enter the market. This is because, if prices rise above competitive levels, new firms will be attracted by this profit opportunity and will enter the market. They will be able to price below existing firms in order to capture market share and still earn a profit. The process of new entry will therefore lead to prices being competed downwards, towards the competitive level.[11]

In contrast, if there are barriers that make new entry costly or difficult, it may be possible for the incumbent firms to maintain prices above the competitive level. If the expected costs and risks incurred on entering the market do not outweigh the expected profit opportunity, firms will not enter and incumbent firms may be able to maintain prices above competitive levels.[12]

For example, Carlton and Perloff in their text book on Industrial Organisation note that:

> *"in a market that is protected from entry, price remains above marginal cost because no firm can enter the market and drive down price . . . Thus, restrictions on entry are the reason that many markets are not perfectly competitive, so that prices are above marginal cost."* [13]

Carlton and Perloff add that if:

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[8] Ross, H. and F. J. Chaloupka. 2001. "The Effect of Cigarette Prices on Youth Smoking." Tobacco Control. Reports on Industry Activity from Outside UCSF, Paper YO4, University of California.
[9] Consumers also react to a decrease in price: a fall in price would lead to an increase in consumption.
[10] US Department of Health and Human Services. 1994. "Preventing Tobacco Use Among Young People: A Report of the Surgeon General," p.10
[11] See e.g. Carlton, Dennis W. and Jeffrey M. Perloff. 2005. *Modern Industrial Organization.* Boston: Pearson Addison Wesley, p. 76; Tirole, Jean. 2003. *The Theory of Industrial Organisation*. Cambridge: MIT Press, p. 278; or Pindyck, Robert S. and Daniel L. Rubinfeld. 2001. *Microeconomics*. Prentice Hall International, p. 273.
[12] See e.g. Motta, Massimo. 2004. *Competition policy: Theory and Practice*. New York: Cambridge University Press, pp. 74-75; or Carlton, Dennis W. and Jeffrey M. Perloff. 2005. *Modern Industrial Organization.* Boston: Pearson Addison Wesley, pp. 76-78.
[13] Carlton, Dennis W. and Jeffrey M. Perloff. 2005. *Modern Industrial Organization.* Boston: Pearson Addison Wesley, p. 76.

> *"large sunk costs are associated with entry and if entry is unsuccessful, the entrant's losses are large" and "in such a setting, threats of strategic behaviour (for example vigorous price cutting) may prevent new entry".*[14]

In summary, the level of competition in a market, and consequently price levels, will depend on the existence and impact of any barriers to new entry. These entry barriers can take many forms, but one potential barrier is the strength of existing brands.[15] As Carlton and Perloff note,

> *"consumer goodwill toward established brand names may make it more difficult for a new brand to enter".*[16]

In a market where incumbent firms have strong brands it will be difficult for new entrants to attract customers away from the incumbent firms. Even if the entrant offers a lower price, customers who place a high value on incumbents' brands will not switch unless the price differential is greater than the value they place on the brand. Consequently, new entrants will have to either (a) price very low in order to overcome the impact of branding or (b) invest in creating their own brand. In either case, entry will be less profitable than in a market where branding is less important.

While the existence of strong brands does not make entry impossible, it makes entry more difficult than would be the case if branding was weaker. Since plain packaging will significantly reduce the importance of branding, it will reduce, if not eliminate, these entry deterrents. Of course, under plain packaging, *branded* cigarettes cannot be supplied in the market and, therefore, entrants would only supply *non-branded* cigarettes.[17] The result will be further downward pressure on prices, in addition to the direct effect on prices described above. This price reduction will cause a further increase in consumption.

Impact on illicit trade

Illicit trade includes both contraband and counterfeit cigarettes. *Contraband* cigarettes are cigarettes that have been imported from countries where tax rates are lower and/or cigarettes imported without having paid taxes in any other country which can be resold (illegally) at a lower price than products on which domestic sales taxes are levied. *Counterfeit* cigarettes are cigarettes that have not been produced by the relevant manufacturer but are sold using its packaging design and are "passed-off" as the genuine product.

Plain packaging will affect the supply of both contraband and counterfeit cigarettes:

- It will make contraband cigarettes relatively more attractive to consumers, since contraband cigarettes will be branded but domestic supplies will not. Branded contraband cigarettes will provide more value to consumers than non-branded domestic supplies. This will increase demand for contraband cigarettes.[18]

[14] Ibid, p. 80.
[15] Ibid, p. 80.
[16] Ibid, p. 80.
[17] Note that plain packaging will eliminate those entry deterrents of non-branded products but it will deter the entry of branded products not yet established in Australia.
[18] I note that there are other implications, for example the distribution of contraband cigarettes might be more easily detected.

- It will make counterfeit cigarettes easier to produce. I would expect the cost of counterfeiting to fall as less sophisticated techniques will be required to replicate the precise design of a cigarette packet. The reduction in cost would be expected to lead to an increase in supply.

Since illicit supplies are sold at lower prices than legitimate supplies, average prices will decrease as supplies increase. Plain packaging will also make it more attractive for consumers to legally purchase branded cigarettes abroad, so called cross-border sales. The impact of plain packaging on cross-border sales, and in turn on overall price and consumption levels in a market are the same as described here for illicit trade.

An increase in illicit trade is also likely to reduce the price of legally traded cigarettes. If demand for contraband cigarettes increases – and supply of both contraband and counterfeit cigarettes increases – then there will be some switching away from legally traded cigarettes to illicit supplies. I would expect this to reduce the price of legally traded cigarettes; prices are likely to fall in response to the reduction in demand. Branded contraband and counterfeit could also be sold at premium, which would also force legal unbranded product prices downwards in order to compete.

This indirect effect on price has been observed in pharmaceutical markets, where (legal) parallel imports have had an effect on the price of patented drugs. In its investigation of AstraZeneca, the European Commission found that "*cheaper parallel imports combined with market forces also exert further downward pressure on the prices of original medicines, especially in high price countries.*"[19]

In summary, the impact on illicit trade will cause (a) an increase in consumption of (lower-priced) illicit products and (b) a reduction in the prices of legitimate products. This further reduction in prices of legitimate products will cause a further increase in consumption.

Conclusion

Economic theory shows that branding increases product differentiation and allows branded suppliers to charge higher prices by targeting specific customers that value their brand. Plain packaging will weaken existing brands, thereby reducing product differentiation. Economic theory predicts that this will increase competition on other fronts, most notably, price, causing prices to fall. This reduction in price will lead to increased consumption.

In addition, plain packaging will make entry of non-branded products easier and increase illicit trade and legal cross-border trade in cigarettes. These effects will cause a further reduction in prices and increase in consumption.

In the following section I provide evidence of these predicted effects using a simulation model to predict the expected impact on prices and consumption.

[19] EC Case COMP/A.37.507/F3 AstraZeneca (2005), ¶142

3. Results of simulation exercise

Introduction

In order to test the predictions of economic theory described in section 2 above I have modelled the impact of removing the effect of branding on prices and consumption. To do this I have created a simulation model which allows me to analyse the impact of a reduction in product differentiation, in other words a removal of distinctions between different brands.

I have analysed the impact of plain packaging under a range of different assumptions, which I explain below. I find that plain packaging is expected to reduce prices and increase consumption. Depending on the assumptions used, I find that plain packaging would reduce average prices by between 4.8% and 19.2%, and that this reduction in prices would lead to an increase in sales of between 2.6% and 16.6%.

In this section I describe the simulation model, the data and the assumptions I have used.[20] I then set out the results of my analysis.

The simulation model

The technique I have used involves constructing a simulation model. This technique is commonly used, for example, to assess the impact of a company merger on prices and output.[21] The technique involves using certain data and assumptions to create a model that predicts prices and output. The model contains two elements: a demand side which simulates how consumers behave and a supply side which simulates how firms behave.

This model is "calibrated" so that it accurately predicts current levels of prices and output. Once the model has been calibrated it can be used to predict the impact when certain assumptions or variables are changed.

My calibrated model takes into account the differences between different types of cigarette brands. Brands are placed in different categories depending on their prices. In particular, brands are classified in three price categories: premium, medium and low. My calibrated model also takes into account the differences between brands in the same category.

I simulate the impact of plain packaging on cigarette prices and sales in two *simultaneous* steps. First, I remove the differentiation by category. This reduces the differentiation between brands in that all premium category brands, for example, are no longer identified as high quality brands. Similarly, all brands in the low segment are no longer identified as the most economical ones. Second, I simulate the effect of decreasing the differentiation between brands within the same price category, i.e. plain packaging also increases the degree of substitution between brands within the same price category.

Assumptions

My calibrated model incorporates three key assumptions:

[20] Further detail on methodology can be found in the appendices.
[21] See, for example, Verboven, F. and Ivaldi, M,, "Quantifying the effects from horizontal mergers in European competition policy", *International Journal of Industrial Organization* 23: 669-691 (2005).

- consumers perceive differences between brands that belong to different categories;
- each firm sets the prices of its brands to maximize profits, taking into account the expected non-collusive responses of its competitors; and
- plain packaging facilitates entry of non-branded products in the market.

First, as explained above, my model reflects the fact that different brands can be placed into different categories. In order to reflect these differences between groups of brands the demand side of my model uses a particular type of demand model called a "nested-logit" model.[22] This model places each product into a particular "nest". Each nest corresponds to one of the brand categories identified above: premium brands, medium brands, or low brands. It therefore reflects the current situation where there is significant product differentiation between cigarette brands. Appendix 2 provides additional details of the nested logit model I have used.

A nested logit model requires certain assumptions regarding the consumers' reaction to a change in price, measured by the own-price elasticity, and the degree of substitution between different products measured by the cross-price elasticity of demand.[23] As explained below, my model uses estimates of these parameters that are consistent with reasonable levels of marginal costs.

The second key assumption concerns the supply side of my model. My model uses a standard economic model of competition between firms in "oligopolistic" markets, that is, markets where there are a small number of suppliers. In this model, known as the Bertrand model, each firm sets the prices of its brands to maximize profits, taking into account the expected non-collusive responses of its competitors.[24] An equilibrium results when no firm can increase its profit by changing its prices. This model is widely used by economists to study competition in oligopolistic markets. Appendix 3 provides additional details of the supply side model I have used.

Third, I have assumed that plain packaging facilitates entry of non-branded products in the market place. In particular, I present below results assuming entry in the super-low segment.

Data

My simulations use three sets of data:

- market data on prices and sales volumes;

[22] There are several alternative demand models that can be used in a simulation model. The nested logit model I use in my simulation has been widely used in the literature. See, for example, Foncel J. and Ivaldi M., "Operating system prices in the home PC market", *Journal of industrial economics* 53: 265-297, (2005); Verboven, F. and Ivaldi, M, "Quantifying the effects from horizontal mergers in European competition policy", *International Journal of Industrial Organization* 23: 669-691 (2005); Verboven, F, "International price discrimination in the European car market", *RAND Journal of Economics* 27: 240-268 (1996); Werden, G.J. and Froeb, L.M., "The effects of mergers in differentiated products industries: logit demand and merger policy", *The Journal of Law, Economics, & Organization* 10: 407-426 (1994).

[23] The own-price elasticity of demand measures how demand of an individual firm varies as its own price increases. The cross-price elasticity measures how demand for a product varies as the price of a competing product increases. Technically speaking, the model requires assumptions regarding the parameters α and σ. See Appendix 2.

[24] The Bertrand model is a standard economic model widely used in the literature. See, for example, Foncel J. and Ivaldi M., "Operating system prices in the home PC market", *Journal of Industrial Economics* 53: 265-297, (2005).

- data on costs; and
- data on the market elasticity of demand for cigarettes.

Market data

I have used data on tobacco sales and prices for 17 separate brands sold in Australia for the year 2008. These brands account for more than 99% of total sales in Australia. The data was provided by PMI and the source is PricewaterhouseCoopers (PWC). Appendix 4 includes further information on this data.

Data on costs

I have used data on costs for PMI brands. In particular, the weighted average marginal cost for PMI brands represents, on average, 20% of the weighted average price.[25] These costs include trade margin, variable costs, distribution costs and shipping costs. As explained below, the demand model used in the simulation is consistent with the actual level of marginal costs. The data was provided by PMI.

Market elasticity of demand for cigarettes

Elasticity of demand measures the impact on sales of a change in price. For a given change in price, the elasticity is calculated as the percentage change in sales volume divided by the percentage change in price.[26] An elasticity of demand with an absolute value greater than one implies that the percentage change in sales volume will be higher than the percentage change in price – in other words a price change has a relatively larger impact on sales. An elasticity of demand with an absolute value less than one implies that the percentage change in sales volume will be lower than the percentage change in price – in other words a price change has a relatively smaller impact on sales.

I have reviewed a number of previous studies that estimate the market elasticity of demand for cigarettes. The results of these studies suggest that the elasticity lies in the range between -0.5 and -1.0.[27] I have therefore considered two cases: an elasticity of -0.5 and an elasticity of -1.0. An aggregate price elasticity of -0.5 implies that if prices of all products increase by 1%, the volume of sales will decrease by 0.5%. An aggregate demand elasticity of -1.0 implies that if prices of all products increase by 1%, the volume of sales will decrease by 1%.

Results

Using the data and the assumptions described above my analysis involved three steps:

[25] Note that, approximately, the Federal Excise Duty accounts for 53.4% of the retail price of cigarettes and the Goods and Services Tax (GST) accounts for a further 9.1%. See, for example, Scollo, MM and Winstanley, MH [editors], *Tobacco in Australia: Facts and Issues*. Third Edition, Melbourne: Cancer Council Victoria, 2008, Chapter 13.2, available from http://www.tobaccoinaustralia.org.au.

[26] An elasticity of demand can be calculated for an individual firm (in other words the impact on that firm's sales if only that firm increases price) or for the whole market (the impact on all sales of the product if all suppliers increase prices. The relevant elasticity for this discussion is the market elasticity.

[27] See for instance Cogan, F. J and Viscusi, W. K. *Principles for cigarette taxation*. Paper prepared for the Conference on Excise Taxation, sponsored by the National Treasury of South Africa, June 11-13, 2003.

a. First, I calibrated the model so that it simulates actual price levels, sales and marginal costs in 2008. To do this I adjusted the own-price elasticities and the cross-price elasticities, which are used as inputs in the model. This is a standard technique to calibrate simulation models. In particular, I adjusted the own and cross-price elasticities such that (i) calibrated marginal costs were positive for all brands, (ii) the weighted average calibrated marginal cost was approximately equal to 20% of the weighted average price (which, according to the data I have, it is the average level of marginal costs in 2008) and (iii) it simulates actual price levels and sales in 2008. Sixteen different demand models were consistent with these assumptions.[28] [29] As shown below I simulated the effect of plain packaging for each of these demand models.

b. Second, I simulated the impact of plain packaging. As explained in Section 2, the introduction of plain packaging implies that the differentiation that exists across brands will be substantially reduced. I have therefore simulated the impact of plain packaging in two *simultaneous* steps. First, I have simulated the effect of removing the distinctions between low, medium and premium brands. To do this I have adjusted the model so that after the introduction of plain packaging, the degree of substitution between brands in the same category is the same as the degree of substitution between brands in different categories, i.e. consumer preferences for one type of brand over another disappears.[30] Second, I simulated the effect of decreasing the differentiation between brands within the same price category, i.e. plain packaging also increases the degree of substitution between brands within the same price category.[31] In summary, I assume that plain packaging (i) removes the distinction between low, medium and premium brands and (ii) increases the degree of substitution between brands within the same price category. I have been conservative in my modelling as I have not removed all distinctions between different cigarette brands. If I was to assume that plain packaging would eliminate all product differentiation (i.e. products were homogeneous), the results would be even stronger.

   I then calculate the new prices and volume of sales that maximize profits for the existing manufacturers using the adjusted costs.

c. Third, I also considered that plain packaging could facilitate the entry of new competitors in the market. I have considered the entry of competitors supplying cheaper (non-branded) products than those in the low segment (that is, products in a super-low segment). Since there are no super-low products in this market, I assume the entry of competitors supplying products identical to those currently offered in the low segment but with *lower marginal costs*. I have considered three cases: (i) the marginal costs of super-low products supplied by the entrants are 25% lower than the marginal costs of existing low brands, (ii) the marginal costs of super-low products supplied by the entrants are 50% lower than the marginal costs of existing

[28] The sixteen selected demand models have a weighted average calibrated marginal cost between 18% and 21% of the weighted average price.
[29] Each demand model is defined by a particular combination of the parameters α and σ (see Appendix 2). 441 different combinations of α and σ were tested for the model calibration. In particular, in my simulation, α ranges between 2 and 50 and σ ranges between 0.1 and 0.9 (by definition σ ranges between 0 and 1).
[30] Technically speaking, this is equivalent to combining all products within the same nest.
[31] Technically speaking, this is equivalent to increasing the parameter of the demand function that measures the correlation of the consumers' utility across brands belonging to the same price category (i.e. the parameter σ). See Appendix 2.

low brands, and (iii) the marginal costs of super-low products supplied by the entrants are 75% lower than the marginal costs of existing low brands. In these three alternative scenarios I assume that each entrant only supplies one super-low product.

To summarize, I estimate prices and volumes under plain packaging assuming that (i) the degree of substitution between brands in the same category is the same as the degree of substitution between brands in different categories, (ii) the degree of substitution between brands within the same price category increases, and (iii) new competitors enter the market place. The results of my analysis can be summarised as follows.

Calibrated marginal costs and calibrated price elasticities

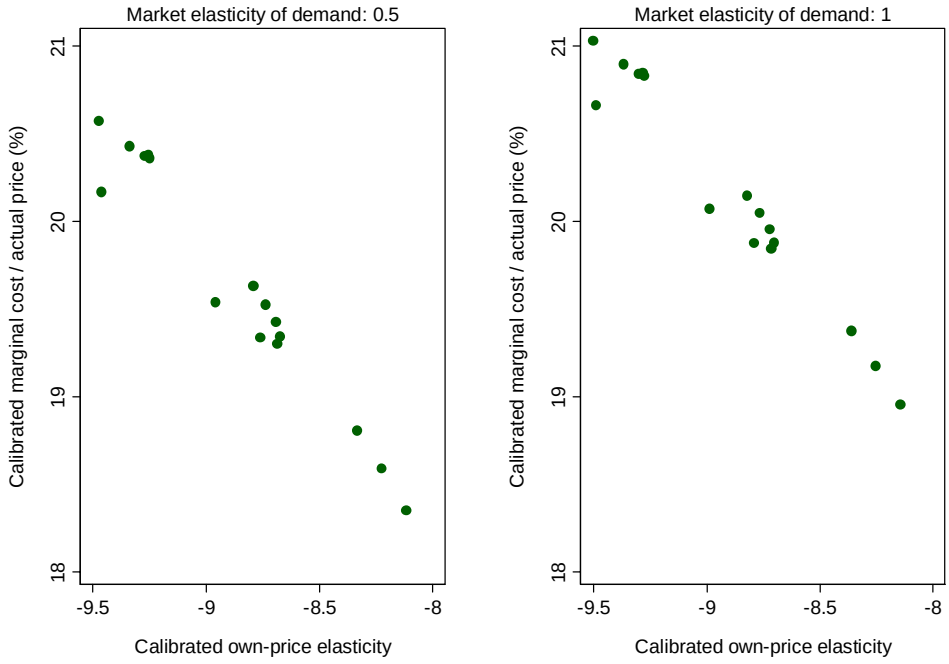
As explained above, I calibrated the model so that (i) it simulates actual price levels and sales in 2008, (ii) calibrated marginal costs are positive for all brands, and (iii) the weighted average calibrated marginal cost is approximately equal to estimates of the actual level of marginal costs. Sixteen different demand models are consistent with those three assumptions. I have used each of these demand models to simulate the effect of plain packaging.[32]

Figure 1 shows, for each of the sixteen demand models and for each market elasticity of demand (-0.5 and -1), on the y-axis the weighted average calibrated marginal cost as a proportion of the weighted average price and on the x-axis the average calibrated own-price elasticity. The weighted average calibrated marginal cost ranges between 18% and 21% of the weighted average price for all demand models. Therefore, the selected demand models used in my simulation are consistent with the actual level of marginal costs for PMI brands (20% of the weighted average price). The average calibrated own-price elasticity ranges between -8.1 and -9.5.[33]

[32] Each demand model is characterized by a different combination of α and σ. α measures consumers' price sensitivity and σ measures the correlation of consumers' preferences across products belonging to the same nest (see Appendix 2).

[33] The own-price elasticity at the brand level is usually much larger than the market elasticity of demand. For example, the own-price elasticity at the product level in the car industry varies between 5 and 15 (see Verboven, F, "International price discrimination in the European car market", *RAND Journal of Economics* 27: 240-268 (1996), and references therein). In the PC market, the own-price elasticities range between 47 and 65 (see Foncel J. and Ivaldi M., "Operating system prices in the home PC market", *Journal of Industrial Economics* 53: 265-297, (2005)). When products are homogeneous the own-price elasticity at the product level tends to infinite.

Figure 1 Calibrated marginal costs and calibrated own-price elasticity



Source: Author's calculations based on PMI and PWC data

Impact of plain packaging

Table 1 and Table 2 below show the estimated impact of plain packaging on prices and market size respectively for four different plain packaging scenarios. Each scenario depicts a combination of market elasticity of demand (-0.5 and -1) and an increase of the cross-price elasticity between brands within the same price category (average increase and large increase of the within nest substitutability).[34] As explained above, in the four scenarios I also removed the distinction between low, medium and premium brands.

Plain packaging would lead to increased price competition, lower prices and higher cigarette consumption. I have used sixteen different demand models to simulate the effect of plain packaging. In particular, Table 1 shows the mean, minimum and maximum change in price as a result of introducing plain packaging. Table 2 shows the mean, minimum and maximum change in sales volume as a result of introducing plain packaging.

[34] Technically speaking, the cross-price elasticity between brands in the same category increases when the parameter σ increases. As σ increases products within same group are perceived as closer substitutes. I assume two alternative increases of the parameter σ: first I assume that σ reaches the average between the current σ and 0.9 ("average increase"); and, second I assume that σ reaches 0.9 ("large increase"). Note that 0.9 is still smaller than 1, the maximum value σ could take (see Appendix 1).

Table 1 Estimated impact on prices of plain packaging

Market elasticity of demand	Increase of within nest substitutability	Change in weighted average prices		
		Mean	Minimum	Maximum
- 0.5	Average	-7.0%	-7.8%	-5.1%
	Large	-13.4%	-15.3%	-8.4%
-1	Average	-6.6%	-7.3%	-4.8%
	Large	-12.9%	-14.8%	-8.0%

Source: Author's calculations based on PWC data

Table 2 Estimated impact on volume of sales of plain packaging

Market elasticity of demand	Increase of within nest substitutability	Quantity change		
		Mean	Minimum	Maximum
- 0.5	Average	3.0%	2.6%	3.2%
	Large	4.8%	4.2%	5.5%
-1	Average	5.8%	5.2%	6.4%
	Large	9.9%	8.6%	11.1%

Source: Author's calculations based on PWC data

The simulation results indicate that plain packaging would result in a price decrease between 4.8% and 15.3% depending on (i) the decrease in the differentiation between brands within the same price category and (ii) the market elasticity. The subsequent increase in consumption would be (i) between 2.6% and 5.5% if the market elasticity is equal to -0.5 and (ii) between 5.2% and 11.1% if the market elasticity is equal to -1. As expected, the larger the decrease in the differentiation between brands within the same price category or the larger the market elasticity of demand (in absolute value), the larger the price decrease and the larger the increase in consumption.

Impact of plain packaging and entry of new competitors in the super-low segment

Table 3 and Table 4 below show the estimated impact of plain packaging on prices and market size respectively if it leads to the entry of competitors in the super-low segment. We report results for each of the three scenarios considered with respect to the entry in the super-low segment: (i) the marginal costs of super-low brands supplied by the entrants are 25% lower than the marginal costs of existing low brands, (ii) the marginal costs of super-low brands supplied by the entrants are 50% lower than the marginal costs of existing low brands, and (iii) the marginal costs of super-low brands supplied by the entrants are 75% lower than the marginal costs of existing low brands. (The results for each product category are shown in Appendix 5.) In summary, the entry of new competitors in the super-low segment means that prices fall further than in the results presented above, and consequently there is a greater increase in sales.

Table 3 Estimated impact on prices of plain packaging and entry

Market elasticity of demand	Increase of within nest substitutability	Entry	Marginal costs differences between low and super-low brands	Change in weighted average prices		
				Mean	Minimum	Maximum
- 0.5	Average	No entry	-	-7.0%	-7.8%	-5.1%
		SUPER-LOW brands	-25%	-9.6%	-10.4%	-7.9%
			-50%	-10.8%	-11.5%	-9.3%
			-75%	-12.0%	-12.6%	-10.6%
	Large	No entry	-	-13.4%	-15.3%	-8.4%
		SUPER-LOW brands	-25%	-15.2%	-16.9%	-10.8%
			-50%	-16.5%	-18.2%	-12.2%
			-75%	-17.5%	-19.2%	-13.5%
- 1	Average	No entry	-	-6.6%	-7.3%	-4.8%
		SUPER-LOW brands	-25%	-9.2%	-9.9%	-7.5%
			-50%	-10.4%	-11.0%	-8.9%
			-75%	-11.6%	-12.1%	-10.2%
	Large	No entry	-	-12.9%	-14.8%	-8.0%
		SUPER-LOW brands	-25%	-14.7%	-16.5%	-10.4%
			-50%	-15.9%	-17.5%	-11.8%
			-75%	-16.8%	-18.3%	-13.1%

Source: Author's calculations based on PWC data

Table 4 Estimated impact on volume of sales of plain packaging and entry

Market elasticity of demand	Increase of within nest substitutability	Entry	Marginal costs differences between low and super-low brands	Quantity change		
				Mean	Minimum	Maximum
- 0.5	Average	No entry	-	3.0%	2.6%	3.2%
		SUPER-LOW brands	-25%	3.9%	3.4%	4.4%
			-50%	4.4%	3.8%	5.1%
			-75%	4.9%	4.1%	5.9%
	Large	No entry	-	4.8%	4.2%	5.5%
		SUPER-LOW brands	-25%	5.3%	4.5%	6.1%
			-50%	5.8%	4.7%	6.9%
			-75%	6.3%	4.9%	7.8%
- 1	Average	No entry	-	5.8%	5.2%	6.4%
		SUPER-LOW brands	-25%	7.8%	6.9%	8.7%
			-50%	9.0%	7.7%	10.4%
			-75%	10.3%	8.6%	12.4%
	Large	No entry	-	9.9%	8.6%	11.1%
		SUPER-LOW brands	-25%	11.0%	9.3%	12.6%
			-50%	12.2%	10.2%	14.4%
			-75%	13.6%	10.9%	16.6%

Source: Author's calculations based on PWC data

If new competitors enter in the super-low segment, prices are reduced by between 7.5% and 19.2% depending on (i) the decrease in the differentiation between brands within the same price category, (ii) the market elasticity, and (iii) the difference in marginal costs between the low and the super-low brands. The expected increase in consumption would be between 3.4% and 16.6%.

Conclusion: overall impact

In summary, I find that, depending on various assumptions as described above, plain packaging is expected to reduce prices by between 4.8% and 19.2% and increase consumption by between 2.6% and 16.6%. These estimates take account of the direct impact of plain packaging and the effect of new entry.

However, these estimates may underestimate the actual impact of plain packaging because:

- I do not take into account the potential impact of plain packaging on illicit trade;
- I do not remove all distinctions between different cigarette brands; if I was to assume that plain packaging would eliminate all product differentiation (i.e. products were homogeneous), the impact would be even stronger;
- I do not consider that plain packaging could also facilitate the entry of new competitors in the low segment.

Appendix 1: Smoker preferences

This Appendix summarises data on cigarette volumes segmented by different product characteristics. The overall indications of aggregate Australian consumer preferences are shown in Table 5 below.

Table 5: Australian smoker preferences

Product characteristic	Sales by characteristic
Blend	92% of sales are of Virginia tobacco cigarettes.
Package type	95% of sales are (hinge lid) box packages.
Package size	87% of sales are of more than 20 items per pack (25, 30 and 40).
Length	99% of sales are king size cigarettes.

Source: PWC data (2008)

Appendix 2: Demand side of the simulation model[35]

The utility to consumer i from purchasing product j is given by:

$$u_{ij} = \delta_j + \zeta_{iG_j} + (1-\sigma)\varepsilon_{ij} \quad [1]$$

The first term, δ_j, is the mean valuation for product j, common to all consumers. It depends on the price of product j, p_j, a vector of observed characteristics of product j, x_j, and an error term reflecting unobserved characteristics:

$$\delta_j = x_j\beta - \alpha p_j + \zeta_j \quad [2]$$

The second and the third term in [1] , ζ_{iG_j} and ε_{ij}, are random variables reflecting individual *i's* deviation from the mean valuation. The term ζ_{iG_j} is consumer i's utility, common to all products belonging to group G_j, whereas the term ε_{ij} is consumer i's utility, specific to product j. The parameter σ lies between 0 and 1 and measures the correlation of the consumers' utility across products belonging to the same group. If $\sigma = 1$, there is a perfect correlation of preferences for products within the same group; so these products are perceived as perfect substitutes. As σ decreases, the correlation of preferences for products within same group decreases. If $\sigma = 0$ there is no correlation of preferences: consumers are equally likely to switch to products in a different group as to products in the same group in response to a price increase. In this case, we have the standard logit model in which products compete symmetrically.

Normalizing the mean utility level for the outside good to 0, i.e., δ_0 =0, the probability sj that a potential consumer chooses product j is given by:

$$s_j = \frac{e^{\frac{\delta_j}{1-\sigma}}}{D_{G_j}} \frac{(D_{G_j})^{(1-\sigma)}}{(1+\sum_{\forall G_j}(D_{G_j})^{(1-\sigma)})} \quad [3]$$

where $D_{G_j} = \sum_{k \in G_j} e^{\frac{\delta_k}{1-\sigma}}$ and G_j denotes the group of products that belong to the same nest than product *j*.

Applying logarithms and rearranging [3], we get the estimated equation:

$$\ln s_j - \ln s_0 = x_j\beta - \alpha p_j + \sigma \ln s_{jG_j} + \zeta_j \quad [4]$$

The estimation of this equation yields estimates of β, σ and α.

Using the demand expression described above we can derive the own and cross price elasticities:

[35] For a detailed description see, for example, Appendix A and B in Foncel J. and Ivaldi M., "Operating system prices in the home PC market", *Journal of Industrial Economics* 53: 265-297, (2005)

Own-price elasticity: $$\varepsilon_{jj} = -\frac{\partial q_j}{\partial p_j}\frac{p_j}{q_j} = \alpha p_j\left[\frac{1}{1-\sigma} - \frac{\sigma}{1-\sigma}\frac{q_j}{Q_{G_j}} - \frac{q_j}{N}\right], \quad [5]$$

Intra-nest cross-price elasticity: $$\varepsilon_{\substack{jk \\ k\in G_j \\ k\neq j}} = \frac{\partial q_j}{\partial p_k}\frac{p_k}{q_j} = \alpha p_k\left[\frac{\sigma}{1-\sigma}\frac{q_k}{Q_{G_k}} + \frac{q_k}{N}\right], \quad [6]$$

Inter-nest cross-price elasticity: $$\varepsilon_{\substack{jk' \\ k'\notin G_j}} = \frac{\partial q_j}{\partial p_{k'}}\frac{p_{k'}}{q_j} = \alpha p_{k'}\frac{q_{k'}}{N}, \quad [7]$$

where q_j is the quantity sold of brand j, p_j if the price of brand j, Q_{Gj} are the total sales of nest G_j to which the brand j belongs, and N is the total market size, including the outside good.

Appendix 3: Supply side of the simulation model[36]

The profit-maximizing firm f solves, for each product j, the following first-order condition:

$$q_j + \frac{\partial q_j}{\partial p_j}(p_j - c_j) + \sum_{\substack{k \in G_j \\ k \neq j \\ k \in S_f}} \frac{\partial q_k}{\partial p_j}(p_k - c_k) + \sum_{\substack{k' \notin G_j \\ k' \in S_f}} \frac{\partial q_{k'}}{\partial p_j}(p_{k'} - c_{k'}) = 0 \qquad [8]$$

where S_f is the set of products shipped by firm f and G_j denotes the group of products that belong to the same nest than product j. Note that a multiproduct firms taken into account all its products in the profit maximization decision.

Using the demand elasticity expressions [5], [6] and [7] and rearranging, the previous equation can be restated as:

$$(p_j - c_j) = \frac{1}{\alpha}\left[\frac{1}{1-\sigma} - r_{G_j} Q_{G_j}^f - r_0 \Lambda_j \sum_{\substack{k' \notin G_j \\ k' \in S_f}} \frac{q_{k'}}{\Lambda_{k'}}\right]^{-1} \qquad [9]$$

where $r_{G_j} = \left[\frac{\sigma}{1-\sigma}\frac{1}{Q_{G_j}} + \frac{1}{N}\right]$, $r_0 = \left[\frac{1}{N}\right]$, $\Lambda_j = (r_0 - r_{G_j})Q_{G_j}^f + \frac{1}{1-\sigma}$, and

$\Lambda_{k'} = (r_0 - r_{G_{k'}})Q_{G_{k'}}^f + \frac{1}{1-\sigma}$.

[36] For a detailed description see, for example, Appendix C in Foncel J. and Ivaldi M., "Operating system prices in the home PC market", *Journal of Industrial Economics* 53: 265-297, (2005)

Appendix 4: Description of the data used

Table 6 below includes some descriptive statistics on the number of brands by price-class and the distribution of weighted average price per stick within each price-class.

Table 6 Descriptive statistics of the weighted average monthly price per stick (AUD)

Price class	Number of brands	Average price per stick	Standard deviation of price per stick	Minimum of price per stick	Maximum of price per stick
LOW	8	0.4123	0.0133	0.3987	0.4342
MEDIUM	4	0.4585	0.0165	0.4417	0.4731
PREMIUM	5	0.4929	0.0077	0.4846	0.5024
Total	17	0.4469	0.0379	0.3987	0.5024

Source: Author's calculations based on PWC data

Prices described in the table have been calculated using the average monthly price per stick weighted by the volume of sales of each brand in 2008.

Table 7 below shows, by brand in 2008, the annual volume of sales, the weighted average price, the Good and Services Tax (GST), and the excise tax.

Table 7 Description of the information used for the simulation model

Price class	Owner	Brand	Actual quantity (total, 2008) (million sticks)	Actual price (weighted average) (AUD/stick)	GST	Excise tax (weighted average)
LOW	BAT	HOLIDAY	1208.92	0.4048	0.0909	0.2500
LOW	BAT	STRADBROKE	239.55	0.3995	0.0909	0.2501
LOW	BAT	PALL MALL	475.65	0.4208	0.0909	0.2505
LOW	ITA	HORIZON	2259.28	0.4144	0.0909	0.2501
LOW	ITA	SUPERKINGS	210.4	0.4342	0.0909	0.2502
LOW	ITA	BRANDON	396.17	0.3987	0.0909	0.2502
LOW	PMI	CHOICE	555.33	0.4012	0.0909	0.2508
LOW	PMI	LONGBEACH	3677.74	0.4251	0.0909	0.2502
MEDIUM	BAT	WINFIELD	5331.3	0.4723	0.0909	0.2501
MEDIUM	ITA	ESCORT	356.51	0.447	0.0909	0.2502
MEDIUM	PMI	ALPINE	503.68	0.4731	0.0909	0.2503
MEDIUM	PMI	PETER JACKSON	3233.89	0.4417	0.0909	0.2502
PREMIUM	BAT	DUNHILL	1006.04	0.4939	0.0909	0.2501
PREMIUM	BAT	BENSON & HEDGES	1856.91	0.4846	0.0909	0.2501
PREMIUM	BAT	KENT	34.73	0.4979	0.0909	0.2502
PREMIUM	ITA	PETER STUYVESANT	531.51	0.5024	0.0909	0.2503
PREMIUM	PMI	MARLBORO	505.76	0.4855	0.0909	0.2503

Source: Author's calculations based on PWC data

Appendix 5: Results of the simulation by price class

Table 8.Estimated impact on prices by price class; market elasticity = -0.5

Increase of within nest substitutability	Entry	Marginal costs differences between low and super-low brands	Price class	Change in weighted average prices		
				Mean	Min	Max
Average	No entry	-	LOW	-6.8%	-7.7%	-4.2%
Average	No entry	-	MEDIUM	-6.9%	-7.8%	-4.8%
Average	No entry	-	PREMIUM	-7.4%	-8.3%	-6.8%
Average	SUPER LOW	-25%	LOW	-8.2%	-9.3%	-5.7%
Average	SUPER LOW	-25%	MEDIUM	-8.7%	-9.7%	-6.4%
Average	SUPER LOW	-25%	PREMIUM	-8.9%	-9.6%	-8.1%
Average	SUPER LOW	-25%	SUPER LOW	-13.8%	-14.6%	-11.9%
Average	SUPER LOW	-50%	LOW	-8.7%	-9.7%	-6.1%
Average	SUPER LOW	-50%	MEDIUM	-9.3%	-10.1%	-7.2%
Average	SUPER LOW	-50%	PREMIUM	-9.6%	-10.3%	-8.7%
Average	SUPER LOW	-50%	SUPER LOW	-17.8%	-18.3%	-16.3%
Average	SUPER LOW	-75%	LOW	-9.1%	-10.1%	-6.5%
Average	SUPER LOW	-75%	MEDIUM	-9.9%	-10.7%	-7.9%
Average	SUPER LOW	-75%	PREMIUM	-10.2%	-11.4%	-9.0%
Average	SUPER LOW	-75%	SUPER LOW	-21.8%	-22.1%	-20.7%
Large	No entry	-	LOW	-13.5%	-15.9%	-7.6%
Large	No entry	-	MEDIUM	-13.4%	-15.3%	-8.1%
Large	No entry	-	PREMIUM	-13.3%	-14.8%	-10.6%
Large	SUPER LOW	-25%	LOW	-14.2%	-16.9%	-8.7%
Large	SUPER LOW	-25%	MEDIUM	-14.6%	-16.5%	-9.6%
Large	SUPER LOW	-25%	PREMIUM	-14.3%	-15.7%	-11.9%
Large	SUPER LOW	-25%	SUPER LOW	-18.3%	-19.9%	-14.4%
Large	SUPER LOW	-50%	LOW	-14.5%	-16.7%	-9.2%
Large	SUPER LOW	-50%	MEDIUM	-15.5%	-17.6%	-10.3%
Large	SUPER LOW	-50%	PREMIUM	-15.1%	-16.4%	-13.0%
Large	SUPER LOW	-50%	SUPER LOW	-22.2%	-23.5%	-18.9%
Large	SUPER LOW	-75%	LOW	-14.8%	-17.8%	-9.6%
Large	SUPER LOW	-75%	MEDIUM	-15.8%	-18.5%	-10.9%
Large	SUPER LOW	-75%	PREMIUM	-15.6%	-16.9%	-14.0%
Large	SUPER LOW	-75%	SUPER LOW	-26.3%	-27.5%	-23.2%

Source: Author's calculations based on PwC data

Table 9.Estimated impact on prices by price class; market elasticity = -1

Increase of within nest substitutability	Entry	Marginal costs differences between low and super-low brands	Price class	Change in weighted average prices		
				Mean	Min	Max
Average	No entry	-	LOW	-6.5%	-7.3%	-4.0%
Average	No entry	-	MEDIUM	-6.5%	-7.3%	-4.3%
Average	No entry	-	PREMIUM	-7.0%	-7.9%	-6.2%
Average	SUPER LOW	-25%	LOW	-7.9%	-8.8%	-5.4%
Average	SUPER LOW	-25%	MEDIUM	-8.2%	-8.9%	-5.9%
Average	SUPER LOW	-25%	PREMIUM	-8.5%	-9.3%	-7.6%
Average	SUPER LOW	-25%	SUPER LOW	-13.5%	-14.2%	-11.6%
Average	SUPER LOW	-50%	LOW	-8.3%	-9.2%	-5.8%
Average	SUPER LOW	-50%	MEDIUM	-8.8%	-9.5%	-6.7%
Average	SUPER LOW	-50%	PREMIUM	-9.2%	-10.2%	-8.2%
Average	SUPER LOW	-50%	SUPER LOW	-17.6%	-18.0%	-16.1%
Average	SUPER LOW	-75%	LOW	-8.7%	-9.7%	-6.3%
Average	SUPER LOW	-75%	MEDIUM	-9.4%	-10.1%	-7.3%
Average	SUPER LOW	-75%	PREMIUM	-9.7%	-10.8%	-8.8%
Average	SUPER LOW	-75%	SUPER LOW	-21.7%	-22.0%	-20.6%
Large	No entry	-	LOW	-13.0%	-15.4%	-7.4%
Large	No entry	-	MEDIUM	-12.8%	-14.7%	-7.6%
Large	No entry	-	PREMIUM	-12.8%	-14.1%	-10.3%
Large	SUPER LOW	-25%	LOW	-13.7%	-15.9%	-8.4%
Large	SUPER LOW	-25%	MEDIUM	-14.0%	-16.1%	-9.0%
Large	SUPER LOW	-25%	PREMIUM	-13.9%	-15.2%	-11.6%
Large	SUPER LOW	-25%	SUPER LOW	-18.1%	-19.6%	-14.2%
Large	SUPER LOW	-50%	LOW	-13.9%	-16.0%	-8.9%
Large	SUPER LOW	-50%	MEDIUM	-14.6%	-16.8%	-9.8%
Large	SUPER LOW	-50%	PREMIUM	-14.6%	-15.7%	-12.5%
Large	SUPER LOW	-50%	SUPER LOW	-22.3%	-23.6%	-18.6%
Large	SUPER LOW	-75%	LOW	-14.1%	-16.0%	-9.3%
Large	SUPER LOW	-75%	MEDIUM	-14.6%	-16.5%	-10.3%
Large	SUPER LOW	-75%	PREMIUM	-14.9%	-16.2%	-13.5%
Large	SUPER LOW	-75%	SUPER LOW	-26.6%	-27.8%	-23.1%

Source: Author's calculations based on PwC data

Table 10. Estimated impact on volume sales by price class; market elasticity = -0.5

Increase of within nest substitutability	Entry	Marginal costs differences between low and super-low brands	Price class	Quantity change		
				Mean	Min	Max
Average	No entry	-	LOW	-8.5%	-17.9%	1.3%
Average	No entry	-	MEDIUM	4.1%	-5.3%	10.7%
Average	No entry	-	PREMIUM	26.4%	7.8%	69.8%
Average	SUPER LOW	-25%	LOW	-28.8%	-33.3%	-23.1%
Average	SUPER LOW	-25%	MEDIUM	-10.2%	-20.9%	-2.0%
Average	SUPER LOW	-25%	PREMIUM	4.1%	-13.6%	52.6%
Average	SUPER LOW	-25%	SUPER LOW	65.8%	49.9%	83.2%
Average	SUPER LOW	-50%	LOW	-42.8%	-48.1%	-36.6%
Average	SUPER LOW	-50%	MEDIUM	-25.4%	-32.5%	-19.0%
Average	SUPER LOW	-50%	PREMIUM	-10.7%	-29.9%	28.8%
Average	SUPER LOW	-50%	SUPER LOW	126.9%	105.4%	150.2%
Average	SUPER LOW	-75%	LOW	-57.5%	-64.3%	-50.1%
Average	SUPER LOW	-75%	MEDIUM	-41.8%	-52.6%	-33.6%
Average	SUPER LOW	-75%	PREMIUM	-27.6%	-46.1%	11.2%
Average	SUPER LOW	-75%	SUPER LOW	193.2%	169.0%	228.4%
Large	No entry	-	LOW	-27.2%	-45.6%	4.4%
Large	No entry	-	MEDIUM	3.8%	-12.7%	11.4%
Large	No entry	-	PREMIUM	80.7%	19.6%	135.7%
Large	SUPER LOW	-25%	LOW	-55.3%	-80.5%	-21.3%
Large	SUPER LOW	-25%	MEDIUM	-13.6%	-40.6%	0.5%
Large	SUPER LOW	-25%	PREMIUM	30.0%	-18.7%	94.2%
Large	SUPER LOW	-25%	SUPER LOW	83.9%	51.9%	191.3%
Large	SUPER LOW	-50%	LOW	-83.7%	-97.3%	-42.6%
Large	SUPER LOW	-50%	MEDIUM	-38.6%	-75.0%	-5.8%
Large	SUPER LOW	-50%	PREMIUM	-17.8%	-73.7%	56.6%
Large	SUPER LOW	-50%	SUPER LOW	208.5%	97.4%	345.6%
Large	SUPER LOW	-75%	LOW	-90.0%	-99.8%	-40.2%
Large	SUPER LOW	-75%	MEDIUM	-68.8%	-99.2%	-4.0%
Large	SUPER LOW	-75%	PREMIUM	-60.8%	-98.5%	21.1%
Large	SUPER LOW	-75%	SUPER LOW	318.0%	107.6%	421.3%

Source: Author's calculations based on PwC data

Table 11. Estimated impact on volume sales by price class; market elasticity = -1

Increase of within nest substitutability	Entry	Marginal costs differences between low and super-low brands	Price class	Quantity change		
				Mean	Min	Max
Average	No entry	-	LOW	-5.2%	-13.5%	0.6%
Average	No entry	-	MEDIUM	7.1%	-9.9%	11.8%
Average	No entry	-	PREMIUM	28.0%	9.3%	85.7%
Average	SUPER LOW	-25%	LOW	-25.6%	-30.0%	-20.5%
Average	SUPER LOW	-25%	MEDIUM	-8.4%	-21.6%	1.7%
Average	SUPER LOW	-25%	PREMIUM	6.6%	-16.1%	63.0%
Average	SUPER LOW	-25%	SUPER LOW	76.2%	60.0%	88.0%
Average	SUPER LOW	-50%	LOW	-40.9%	-46.6%	-34.8%
Average	SUPER LOW	-50%	MEDIUM	-25.9%	-31.1%	-16.6%
Average	SUPER LOW	-50%	PREMIUM	-8.6%	-30.6%	38.0%
Average	SUPER LOW	-50%	SUPER LOW	147.1%	124.4%	166.5%
Average	SUPER LOW	-75%	LOW	-56.4%	-63.6%	-48.0%
Average	SUPER LOW	-75%	MEDIUM	-42.7%	-49.9%	-34.9%
Average	SUPER LOW	-75%	PREMIUM	-28.3%	-46.6%	16.8%
Average	SUPER LOW	-75%	SUPER LOW	221.1%	197.3%	248.2%
Large	No entry	-	LOW	-26.3%	-39.0%	-4.5%
Large	No entry	-	MEDIUM	8.5%	-9.2%	17.2%
Large	No entry	-	PREMIUM	96.1%	46.6%	132.6%
Large	SUPER LOW	-25%	LOW	-70.0%	-82.2%	-43.8%
Large	SUPER LOW	-25%	MEDIUM	-21.0%	-42.4%	5.4%
Large	SUPER LOW	-25%	PREMIUM	45.6%	-16.4%	118.8%
Large	SUPER LOW	-25%	SUPER LOW	128.7%	69.8%	188.5%
Large	SUPER LOW	-50%	LOW	-91.2%	-99.0%	-61.6%
Large	SUPER LOW	-50%	MEDIUM	-67.5%	-97.4%	-18.3%
Large	SUPER LOW	-50%	PREMIUM	-36.9%	-95.2%	73.3%
Large	SUPER LOW	-50%	SUPER LOW	325.0%	164.9%	436.0%
Large	SUPER LOW	-75%	LOW	-97.2%	-100.0%	-77.8%
Large	SUPER LOW	-75%	MEDIUM	-94.0%	-99.9%	-66.2%
Large	SUPER LOW	-75%	PREMIUM	-77.1%	-99.9%	23.9%
Large	SUPER LOW	-75%	SUPER LOW	428.2%	274.2%	457.9%

Source: Author's calculations based on PwC data