Economic Analysis of a Plain Packs Requirement in the UK

A Report from Europe Economics

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29 June 2012

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1 INTRODUCTION AND CONTEXT

Europe Economics

1.1 My full name is Dr Andrew Lilico and I am a Principal and Chairman at Europe Economics[1], a private sector consultancy, based in London, which specialises in the application of economics and econometrics to problems arising predominantly in the fields of public policy, regulation and competition. Europe Economics' clients include government departments, regulators and competition authorities, companies large and small, professional and trade associations, charities, law firms and public affairs firms. My expert credentials, qualifications and list of publications which I have authored are set out in his curriculum vitae which appears in the appendix to this report. In particular, I am expert in microeconomic analysis and regulatory impact assessment. I am the author and project director of this report. However, in preparing this report, I have drawn upon support from the resources of Europe Economics.

1.2 On 16 April 2012, the Department of Health in the UK published its "Consultation on standardised packaging of tobacco products (hereafter "the Consultation"). In this context, Europe Economics is providing to JT International ("JTI") and Gallaher Limited (both members of the Japan Tobacco Group) expert economic advice on the economic issues raised by aspects of the Consultation. This report sets out the analysis and conclusions of Europe Economics in relation to this.

1.3 This report reproduces and expands the relevant analysis of our report dated 2 September 2008 entitled "Economic Analysis of a display ban and/or plain packs requirement in the UK" (hereafter "the 2008 Report"), which we prepared in relation to the Department of Health's "Consultation on the future of tobacco control", dated 31 May 2008 (hereafter "the FTC Document").

The Options Assessed in this Report

1.4 The Consultation seeks views on a policy initiative that would require packaging of tobacco products to be standardised. The analysis in this report addresses that requirement, which we (for reasons explained below) will typically refer to as the "plain packs requirement".

1.5 The plain packs requirement set out at paragraph 4.6 of the Consultation proposes that:

- *All internal and external packaging be in a prescribed colour/s;*
- *All text on the pack, including brand names, to be in a standard colour and typeface;*

[1] "Europe Economics" is the trading name of European Economic Research Limited, often hereinafter "we".

- *No branding, advertising or promotion be permitted on the outside or inside of packs or attached to the package, or on individual tobacco products themselves. For this purpose, 'branding' includes logos, colours or other features associated with a tobacco brand;*

- *Any foils within a pack to be of a standard format and colour with no text permitted;*

- *Packs to be of a standard shape and opening, and possibly manufactured with particular materials.*

1.6 Amongst our contentions in this report is that a requirement of this sort is not in fact a plain *packaging* requirement, for a cigarette pack should be understood as both having a continuing independent function in itself and as delivering an integral and inseparable part of what is typically purchased by cigarette consumers.

Summary of the Report's Findings

1) Cigarette packs are a product in themselves, not the mere packaging of a product.

2) Branding changes the nature of products.

3) A branded product communicates its nature to its actual and potential consumers.[2]

4) It is not required that most consumers switch for switching between products to be important to market functioning and to act to the benefit of consumers in general. In many markets competition is dependent upon switching by consumers at the margin.

5) Innovation is an important source of enhanced consumer welfare.[3] Regulations that undermine innovation can be even more destructive of consumer welfare than regulations that undermine competition. A plain packs requirement would totally eliminate pack innovations. Furthermore, there are many potential innovations in tobacco products that would be rendered all-but infeasible by a plain packs requirement. As well as impeding new innovation (a process that research across many sectors has found can be even more damaging to consumers than damaging competition) this would raise barriers to entry for new brands.

6) Because of the key roles of branding to informed consumer choice and the discovery of new products, a plain packs requirement should be expected to have very significant negative competition effects. In particular:

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[2] By "actual and potential consumers" here we mean to include both those that have previously purchased the particular product and those that have not previously purchased this particular product. We make no comment here, and have not considered, the population from which, in practice, potential consumers of any specific product are drawn. Hereafter we shall use the term "potential consumers" of a product unqualified, but always reflecting the amplification in this footnote.

[3] See paragraphs 4.3ff for the definition of the economic term "consumer welfare".

a. reducing the ability of consumers to engage in informed switching;

b. which leads to a risk of vesting the market power of a small number of established brands; and

c. the reduced capacity for new products to enter the market challenging existing products, other than at the lowest quality/price level.

7) Particularly if a plain packs requirement led to an increase in counterfeiting and/or contraband, there could be negative impacts on UK tobacco industry employment and upon the UK tax take from tobacco.

8) We have modelled the competition effects formally in a simulation model deploying standard economic theories and mathematical modelling techniques applied to vertical product differentiation, signalling and adverse selection. Our simulation model, based on UK data for roll-your own ("RYO") and ready-made-cigarette ("RMC") products, has been calibrated so as to reflect well the recent UK tobacco market and produces results that are qualitatively robust to multiple cross-checks. The effects of plain packaging can be modelled as a reduction in brand characteristic awareness for consumers (i.e. how accurately consumers are aware of the characteristics of products).

9) In such a simulation model for the UK, the pattern is that as brand characteristic awareness degrades, competition initially becomes fixated on one or two brands for most price segments (damaging within-price-segment competition) and eventually there is large-scale downtrading into lower-quality products.

10) For modest degrees of brand degradation the model suggests that average prices for tobacco products as a whole fall. The prices for RMC products as a whole fall (as RMC products tend to include higher quality brands that would be driven from the market) whilst those for RYO products are broadly stable. For modest degrees of brand degradation, effects on prices of individual brands vary — prices for some products rise (as market power increases) whilst those of others decrease (as consumer uncertainty reduces the willingness to pay for quality).

11) The net effect of the changes in market structure discussed above is an increase in market concentration (even for modest degrees of brand characteristic awareness degradation), as measured by the HHI. This increase in concentration is associated with an increase in above-marginal-cost profits for a few players (whilst simultaneously reducing profits for other firms) – strongly suggesting a material increase in market power. At the same time many players and products are driven out of the market altogether.

12) The increases in concentration are of a scale that would normally be considered of interest and concern to policymakers, as measured on their own standard criteria. . Indeed, a key reason competition impacts are assessed in regulatory analysis is to avoid introducing regulations that so vest market power and damage competition.

Structure of this Report

- Section 2 draws out some important distinctions between packaging and dispensing, and considers how branding changes the nature of products.
- Section 3 goes into more detail on the economic role of branding imagery and switching.
- Section 4 considers the role of brands in innovation and the welfare losses that would be associated with the undermining of this role.
- Section 5 considers the economic theory on the role of brands in market competition and predicts qualitatively the effects of a plain packs requirement.
- Section 6 draws upon the analysis of previous sections to develop a simulation model of the effects of plain packaging.
- Section 7 provides the results of the simulation model of the effects of plain packaging.

1.7 The Report has three appendices: 1 (more detail on the key features of the simulation model), 2 (a technical appendix regarding the simulation model) and 3 (Dr Lilico's curriculum vitae).

2 PACKAGING, FUNCTIONAL PACKS AND BRANDS

2.1 In this section we shall propose that:

(a) a cigarette pack should be understood as both having a continuing independent function in itself and as delivering an integral and inseparable part of what is typically purchased by cigarette consumers;

(b) branding changes the nature of a product.

Cigarette Packets and Packaging

2.2 Many products come in packaging. For example, a computer may come in a cardboard box, with bubble wrap and polystyrene foam. This packaging is discarded in order that the product can be used. In terms of the use of the product we have little interest in whether the cardboard box was brown or white. Other products come in packaging that is stored when the product is not in use — think, for example, of a box for a chess set. In that case we have more interest in the nature of the packaging, but it is still "packaging" in the sense that its only function is storage.

2.3 In contrast, other products come in dispensing cases. Think, for example, of a box of artificial sweeteners, where one presses a button on the top in order to dispense just one or two drops of sweetener. For such products, the packet or case is not a mere storage device in which the product is kept when in the store or perhaps at home. Rather, it serves independent functional purposes — carriage and dispensing — at which it might be better or worse. The packet is not mere packaging in which the good is sold. It is itself a good.

2.4 In the case of cigarettes this can be appreciated further when one remembers older practices for carrying and dispensing cigarettes. Think of the silver cigarette case, for example. Cigarette cases at one time had their own separate market. More recently, cigarette manufacturers produced their own, sturdy, often colourful cases with interesting artwork. In addition to different aesthetic features, there are a variety of different functional natures of a packet, reflecting differing consumer needs and tastes. Some ways in which packets have met differing consumer needs and tastes are:

(a) The most common cigarette pack in the UK is hard cardboard in a rectangular prism packet with a flip-top lid and the cigarettes fitting inside in two or three layers.

(b) Another packet type has the cigarettes arranged in one layer.

(c) In another packet type there is no flip top, but the packet is opened by sliding out a drawer.

(d) Many cigars are dispensed in metal tins, rather than cardboard packets.

(e) In many countries cigarettes are sold in softer packets more suited to someone carrying cigarettes in a trouser pocket.

(f) Some packets that may be used in darker conditions (e.g. at certain kinds of party) are fluorescent.

2.5 Thus, when a consumer purchases a packet of cigarettes, there is a bundle of two goods being bought.

2.6 That the role of the packet is not mere packaging can be seen even further by reflecting upon what *is* packaging of packet-cigarettes bundles. For example, cigarette packets generally come wrapped in plastic; similarly, a purchase of a multi-pack carton may involve paper or cardboard wrapping.

How a Branded Product is Different from an Unbranded Product

2.7 Brands differ from one another, and branding alters the economic nature of a product. This can be seen most clearly if we explore the distinction between branded and unbranded products.

2.8 Brands serve many economic functions. Setting aside for now how the branding is acquired or expressed, two physically identical goods, one with a brand and one without, are not the same product. Having a brand changes the economic nature of a product in a fundamental way.

2.9 We shall explore in later sections the significance of the functions of brands to competition and innovation in tobacco markets. For now, however, we shall explain below why the effects of branding are sufficiently significant to mean that branded product is not the same product as an unbranded product. Indeed, in other contexts a sufficiently powerful brand can be enough that the branded product is regarded for competition purposes as its own market.

2.10 Suppose that you purchased an unbranded set of batteries. Now compare that with batteries purchased from a well known and recognised battery brand, such as Duracell, for example. Typically the presence of the brand would provide you with reassurance that the batteries would actually power your electronic device, that the device would not be corrupted in any way by these batteries, and that the device would be powered for a reasonable amount of time. This in turn means, for example, that if you are a music lover who likes to pass train journeys by listening to your pocket mp3 player and you purchase the branded batteries prior to a train journey; then you can have confidence that your preferred means of passing the train journey will be possible. Even if, as it turned out, the unbranded batteries were physically precisely the same as the branded batteries, made using the same materials and by the same production processes, it would still not have been the same thing that you bought.

2.11 Again, suppose, for example, that you were considering replacing an old Goodyear tyre on your car with an unbranded tyre. Now contrast that with a new Goodyear tyre. Even if, as it turned out, the tyres were physically precisely the same, made using the same materials in precisely the same way, it would clearly not be the case that the unbranded and the Goodyear tyres are the same product. With the branded (i.e. Goodyear) product you would probably, for example, be more certain that the tyre would actually have been made from appropriate rubber, instead of merely looking like a rubber tyre or being made from some inferior rubber that would wear down very quickly and need to be replaced.

You would also be more confident that your tyre would have tread that meets the standard required for your car to be legal to drive — that it met the statutory requirements for legal tyres.

2.12 Without, in this section, going into the economic detail of *how* a brand delivers these functions, it is clear that a brand *does* do this. A product without a brand is not the same as a product with a brand.

2.13 A plain packs requirement, in combination with existing advertising and point of sale display bans in the UK, would strip away everything other than the name of the brand. As described above at paragraph 1.5, there would remain the name, of course, but without any means to express a brand the nature of the product purchased would have been changed profoundly — in a sense, it would have become a different product. In the short term, people might perhaps remember the previous pack design, and the name might evoke memories of this branding (though the scale even of this would be uncertain, and one plausible result, as discussed further in later sections, would be to entrench the position of products that already have a large market share or high brand awareness, and undermine new innovations, creating dominance and related competition issues), but eventually instead of branded cigarette packs, as we now understand them, all that would be on sale would be, as it were, pieces of tobacco wrapped in paper with a filter in a cardboard container.

Conclusion

2.14 A plain packs requirement would be the banning of a set of products. The products banned would be many functionally useful varieties of cigarette packet and the branded bundle that consists of such packets and the cigarettes they contain.

3 BRANDING IMAGERY AND BRAND SWITCHING

3.1 In this section we consider further the role that branding imagery plays. Our key contention will be that branding imagery (*cf* the plain packs idea) plays a key role in enabling a consumer to make informed purchasing decisions.

3.2 In our 2008 Report, we also examined the role of branding visibility at point-of-sale. Since that report, we note that a display ban in the UK is currently partially in force, and will enter into force for large retailers in April 2015.

The Role of Brand Imagery

3.3 Branding is crucial to the ability of a product to communicate with a consumer. Most consumer products can come in a number of slightly different forms, and consumers differ in their preferences between these. Branding imagery is a key device by which the product communicates its nature to consumers, allowing them to discover that the product matches their (self-known) niche tastes. For example, the Smirnoff range includes plain vodka, vodka with citrus flavour, with raspberry flavour, and orange flavour, amongst others. As can be seen in Figure 3.1 colour and images are central to the efficient communication of these different product niches. Even if we could not read, did not have our reading glasses, were looking at a distance, were in a hurry and did not have time to read, we would know all-but-immediately which vodka was going to be plain and which have a flavour (from the twist-bottle), and which of the flavoured would be citrus flavoured, which raspberry flavoured, and which orange flavoured, just from the bottle shape, colour and imagery.

Figure 3.1: Four varieties of Smirnoff

3.4 As well as branding allowing products to communicate to consumers that their characteristics match preferences of which consumers are aware, branding is also important to consumers *discovering* their own preferences between products.[4] This reflects the Hayekian concept that a market is a preference discovery mechanism. Without branding, consumers would probably become more bound by what they had tried in the past, and more random if they trialled new products at all — with the trying out of new products often leading to disappointment, thereby reducing the tendency for consumers to try out new products at all.

3.5 Imagine if all Smirnoff products had to come in identical packaging. People would sometimes end up buying products they didn't want, by mistake, and new types of Smirnoff vodka would be less likely to be sampled. If Smirnoff products could not be compared via their packaging, consumers would often be unsure what they wanted.

3.6 Thus, brands allow products to communicate their nature to consumers, assist consumers in discovering their own preferences between products, and facilitate consumer trialling.

Switching

3.7 Given the roles of brands — for example, the importance of repeat purchasing and brand loyalty — it is entirely unsurprising that most consumers do not switch regularly. But in all

[4] Note that this includes both discovering preferences between brands and discovering preferences between branded and unbranded product. For example, it may be only when I see a cup of branded Costa coffee that I realise how much more I am prepared to pay for it than for an unbranded coffee in the shop next door.

markets (including FMCG markets), competition is determined at the margin, typically with only a minority of consumers switching.

3.8 A further thing to emphasize is that all consumers benefit as a result of switching by only a minority.[5] Consider the following narrative example. There was a town in which there was just one established shop in which to buy milk. The milk cost £1 per pint, it was only possible to buy it in pint cartons, and sometimes it went off very quickly after people took it home. People often complained, but the owners of the shop never did anything about it — after all, where else were their customers going to buy their milk?

3.9 One day a new shop opened, offering cartons of milk at the same price but of more reliable quality. Some people that used to buy from the old shop started switching to buying their milk at this new venue. Clearly these people were made better off by the extra available choice — they got better quality milk for the same price as before.

3.10 That evening the owners of the original shop reflected upon their day's takings. They were upset to lose the revenue from their former customers, and were concerned about losing more custom. So when the shop opened the next day they cut their prices a little, so that they were lower than at the other shop. Furthermore, they started being more careful about how their milk was stored, so that it didn't go off. Over time, they also started thinking about ways they might attract back customers of the other shop — they thought they might offer milk in different sized cartons, perhaps some in two-pint cartons, and some in six-pint cartons.

3.11 So after a while, even those that stayed with the established shop were better off — their prices were lower; the quality was higher; and over time there were new innovations.

3.12 This is how competition works. The availability of alternative choices creates competitive pressure on providers to reduce their prices and increase their quality, *even for those customers that do not switch*. Over the longer term it also stimulates innovation, so that those that do not switch will benefit from new product options from the same supplier.

3.13 Thus, it is not required, for switching to be important to market functioning, that most consumers switch regularly. We shall consider competition in more detail in Section 4. But before then we shall turn to the roles of branding in enabling, facilitating and expressing innovation.

[5] We acknowledge here that the example to illustrate this point would need to be more complicated in a setting involving perfect segmentation, but set that complexity aside for now.

4 BRANDS AND INNOVATION EFFECTS

4.1 Economists have long recognised the importance of innovation, as well as the importance of competitive markets, in securing maximum welfare gains to consumers and producers. In this section we consider the welfare losses that might be associated with the process of innovation being undermined in the UK tobacco market. Because brands are key to the process of innovation, as explained below, the plain packs measures considered by the Department of Health, by materially damaging or even effectively eliminating brands, threaten to undermine the process of innovation.

What is meant by innovation

4.2 Economists understand innovation to mean the search for, and the discovery, development, improvement, adoption, and commercialisation of new processes, new products, and new organisational structures and procedures. This can take the form of process innovations, which is to say cost-reducing or quality-enhancing technologies, or product innovations, which are technologies for producing new products.[6]

Innovation and welfare

4.3 Social welfare as defined by economists is usually calculated by summing "consumer surplus" and "producer surplus", and indeed this concept is applied to the tobacco market by the Department of Health in, for example, the Consultation. Each consumer's "surplus" is defined as the difference between what she would have been willing to pay for a product and what she actually did pay — also sometimes called the consumer's "gains from trade". Consumer "welfare" is then typically conceived of as the sum across consumers of their individual surpluses. Producer surplus typically refers to the aggregate profits firms make in a specific market. Economic theory demonstrates that the more competitive and contestable[7] markets are, the more effective they are at securing welfare gains.

4.4 Furthermore, economists are not only concerned with ensuring that markets are as competitive as possible. It is recognised that innovation can also, and independently of competition, secure welfare gains for producers and consumers. Even markets that are not particularly competitive in their structure, taking a monopolistic or oligopolistic form, for example, can generate welfare increases through innovation. A well-known example of this is in information technology. This includes both innovations by players with market power (e.g. Microsoft) and market dynamics that replace one dominating player with another through technological change (e.g. if "android" operating system mobile devices were to replace iPhones and iPads).

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6 See, for example, Oz Shy, *Industrial Organization, Theory and Applications*, (1995), pp. 221/222

7 A "contestable" market is one in which, even if there is only one firm, the threat of a new firm entering the market is sufficient to keep the market operating at the competitive equil brium. Such markets are of particular interest in an innovation context, as sometimes the threat of a new innovation is sufficient to make a market in there is only one current player contestable.

4.5 It is recognised that regulation that undermines innovation can be even more destructive of consumer welfare than regulation that damages competition.

The Role of Brands in Innovation

4.6 Brands, especially when protected by intellectual property rights, increase firms' incentives to innovate. Moreover, the presence of brand loyalty generally allows firms (e.g. FMCG manufacturers) to achieve more rapid market penetration for new products. The overall effect of brands is to stimulate a virtuous innovation cycle.

4.7 This cycle operates in terms of product innovation, as opposed to process innovation (which has its own independent significance but will not be considered here), and can be seen in developments in the UK tobacco market over time (see Section 4 of our 2008 Report).

Predicted Impacts of a Plain Packs Requirement upon Innovation

4.8 In the Impact Assessment accompanying the Consultation, the Department of Health claims that "On the issue of innovation, the Europe Economics (2008) report merely states that, aside from the restrictions imposed by a standardised packaging regulation, "*it is impossible to quantitatively assess the impact of the plain packs measure upon innovation*"."[8] This is a misleading representation of our position. In our 2008 Report we stated: "*a plain packs requirement would make pack innovation impossible*"[9] and "[a] *plain packs requirement would, in addition, be expected to have a much more clearly marked effect than a display ban in reducing innovation in tobacco products. Whilst a display ban would make it difficult for new products to communicate their nature to consumers, a plain packs requirement (in combination with established restrictions on advertising) would make this all-but impossible.*"

4.9 As we have seen, pack innovation represents an active class of innovation in this industry. There are many potential innovations in tobacco products that would be rendered all-but infeasible by a plain packs requirement. We consider this clear. Furthermore, we consider this material in importance. Regulatory restrictions that damage innovation are typically regarded, across many sectors, as creating considerable welfare losses even in cases where they result in lower prices.[10]

4.10 The quote used in the Impact Assessment was not to be interpreted as indicating that little could be said about effects upon innovation. Rather, the context of that quote was a section entitled "*Empirical Evidence on Innovation from other Tobacco Markets*" which

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[8] Standardised packaging for tobacco products — IA No: 3080, paragraph 71, available at http://consultations.dh.gov.uk/tobacco/standardised-packaging-of-tobacco-products

[9] Europe Economics, 2008, paragraph 4.26

[10] For example, see the work of Hausman, JA, who has researched this topic in depth in the telecommunications sector — e.g. http://www.brookings.edu/~/media/projects/bpea/1997%20micro/1997_bpeamicro_hausman.pdf

considered whether data from other jurisdictions could be used as a basis for quantifying impacts on innovation. Since no other jurisdiction had implemented a plain packs requirement, at the time of our 2008 Report, there was no data from other jurisdictions to use to address this question and thus it was indeed "*impossible to quantitatively assess the impact of the plain packs measure upon innovation*" using such data. Australia has adopted a plain packs requirement but it is effective only from 1 December 2012 — thus it remains the case that there is no data available from other jurisdictions on which to base a quantitative assessment of how plain packs requirements have impaired innovation.

4.11 That does not mean it is impossible to conduct qualitative analysis of the sort above. Neither does it mean that quantitative analysis of other sorts (e.g. simulation modelling) could not be conducted. However, such a model would be necessarily a quantitative prediction rather than a quantitative assessment of past events.

5 COMPETITION EFFECTS OF BRANDS

5.1 This section sets out some of the economic theory of the role of brands in the process of market competition, and draws on that theory plus the material of previous sections here to produce predicted competition impacts, from a theoretical perspective, of a plain packs requirement. In Section 6 and Section 7 we vivify the analysis below using a simulation model.

5.2 Hobbling competition reduces consumer welfare, as generally understood by economists in terms of "consumer surplus".[11] This should be of concern to policymakers with an interest in competition issues.

5.3 A plain packs requirement, in combination with existing advertising bans in the UK, would effectively destroy branding.

5.4 In our 2008 Report we also explored the competition impacts of a display ban. We explore below how competition would be affected even in the presence of a display ban (noting that the display ban in the UK is currently partially in force).

Functions of Brands in the Competition between Existing Products

5.5 In this section we consider various functions of brands most relevant to competition between existing products that are additional to the preference discovery, switching and innovation functions already covered in previous sections.

Brands facilitate product variety

5.6 The vodka example above[12] is an illustration of brands facilitating greater variety and, therefore, choice. The more choice that consumers have the more likely they are to be able to find a match for their particular tastes, and the more precisely they are able to understand what their own tastes are. Also having increased choice acts as a vehicle towards increased consumer power in the market, driving efficiency and other improvements.

Brands allow the Market to address various potential market function problems

5.7 Brands are a device by which the Market solves certain problems that might otherwise lead to market imperfections. For example, the well-established economic situation called “asymmetric information” arises principally because firms are often better informed than consumers about certain detailed characteristics of products that consumers find difficult to observe directly. If I buy a second-hand car, for example, I will know less than the seller about how likely the car is to break down. Again, in the case of the battery example

[11] See paragraph 4.3.
[12] See paragraphs 3.3ff.

discussed above, the person selling the battery knows much better than the purchaser how long it is likely to last.

5.8 We have already discussed (pp 3.3ff) how brands allow products to communicate better their characteristics to consumers. This addresses the problem above directly, by reducing the asymmetry. But of course not all information asymmetry can be eliminated in this way. So the Market addresses these problems in two other key connected ways:

(a) by allowing individual consumers to enhance their understanding of products through repeated purchasing;

(b) by allowing even those that have not tried a particular product themselves to find out — e.g. by word of mouth — about its characteristics from other consumers.

5.9 Brands are central to each of these. If products are simply commoditised (i.e. perceived by consumers as identical, in the way of commodities such as wheat or copper), then each individual firm has limited incentives to achieve high quality (say — if that is the dimension of information asymmetry) because by doing so that will not make consumers more likely to buy that firm's products again any more than those of other firms. And similarly if no-one can identify a product with a good or bad wider reputation beyond its current consumers.

5.10 Brands allow reputation to be built up and stored through repeated purchase of a specific product. The experience of repeated purchase allows consumers:

- to better learn their preference and increase their product awareness; and
- to be more credible and effective in communicating their purchasing experiences to other consumers — allowing consumers as a group to learn more fully about products and their suppliers than would typically be possible for any one consumer.

Brands facilitate market entry

5.11 Brands decrease barriers to entry to markets in which the signalling of characteristics is important because products are diverse and consumer information incomplete, by constituting a channel through which products can signal their nature to consumers. In the absence of branding new potential products would be deprived of the possibility of making their nature visible to consumers, which, ultimately, would impair the ability of firms to enter new markets — their only realistic mechanism for doing this would be via the purchase of existing brands.

5.12 In markets where there are quality differences, where brands (or similar repeated-use mechanisms) cannot be deployed to establish a reputation for high quality, there is a risk

of most higher-quality products being driven out — this is the so-called "adverse selection" or "lemons" problem.[13] In such a case the only successful form of new entry that could occur would be at the lowest quality level.

5.13 A market without brands, operating at a common minimum-quality level is sometimes described as "commoditised".

Brand identification markets

5.14 Brands allow the existence of brand identification markets — i.e. markets for products such as Rolex or Police, in which the brand itself is a key part of what is being purchased and in which the manufacturers of those goods employ techniques to control their image — for example, by paying for celebrity endorsements (e.g. David Beckham endorsing Police sunglasses). These markets, like markets for luxury goods, are characterized by the fact that consumers value manufactured goods not only for their tangible features but also for how they allow identification with the brand.[14]

Competition Effects of a Plain Packs Requirement in the Context of a Display Ban

5.15 In our 2008 Report we argued that the ability for consumers to observe brands displayed at the point of sale was important to the ability of consumers to switch and that display bans would damage such brand awareness, whilst plain packs would have much more extensive effects.

5.16 Since our 2008 Report, the UK has introduced a display ban, which is currently partially in force. The question thus arises of what additional effects there should be expected to be of a plain packs requirement when display bans are already in place.

5.17 In particular, the display ban adopted in the UK damages, though does not entirely eliminate, the ability of consumers to make choices informed by branding characteristics at the point of sale (it is not eliminated because, as the legislation was ultimately adopted, consumers are still able to observe branding on packs, on specific request to the retailer, before agreeing to purchase). A plain packs requirement leaves only the residual memory of past branding characteristics and any information implied in the product name.

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[13] See Akerlof, George A. (1970) "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism", *Quarterly Journal of Economics*, 84 (3), pp488-500

[14] We emphasize that the feature of brands raised in this paragraph is distinct from that in 5.8 and 5.10. Of course, celebrities might be amongst the consumers of a product that discuss its features with others, but the key to a brand identification market is that manufacturers control celebrity endorsements and advertising to achieve specific image objectives. Thus, for example, many people know certain of the schools to which certain politicians sent their children, and that may tell us something about those establishments, but the schools were not paying for the politician's endorsement, and so this belongs to consumer communication, not brand identification. Similarly, doubtless some celebrities are known to be smokers of certain brands, but since tobacco manufacturers have no direct control over which celebrities like which brand, this again belongs to consumer communication.

5.18 With a display ban, but without plain packs, consumers are still able to observe the branding characteristics when other smokers consume their products — e.g. when another smoker takes out a pack of cigarettes (as set out in paragraphs 5.8 and 5.10).

5.19 Thus although a display ban should be expected to damage brand awareness and undermine switching, it should be expected to do so materially less than a plain packs requirement — as spelt out in our 2008 Report.

Predicted Impacts

Market functioning effects

5.20 Our discussion thus far has been at the level of general theory. Based upon the discussion above concerning the economic functions of brands, we would expect the competition impacts of a plain packs requirement to be:

- Reduced competition; and
- Increased concentration.

5.21 In addition, there would be loss of consumer welfare through less accurate preference matching (consumer mistakes) and less switching (less attempt to match niche preferences to niche products).

5.22 The negative consumer impacts would be very difficult to observe, by their nature, but the impacts on firms should be more straightforward — analysis of degrees of competition is common and widespread and subject to standard techniques.

5.23 The competition impacts would differ between firms depending upon the extent to which they have already established their market position and depending upon the nature of their business model. Firms for which their business model depends upon the use of diversity so as to appeal to niche tastes and firms that are currently seeking to enhance their market position by winning market share from the leading firms stand to suffer more than a firm relying on one dominant brand — indeed, the latter may gain (in these terms) because it will still take benefit from being known as the market leader and will be subject to less competitive pressure from other firms.

5.24 In our 2008 Report we argued that although, in principle, plain packs could lead to the crystallisation of market shares, where by “crystallisation” we mean that the competitive process would be so completely undermined that market shares would become (more-or-less) completely fixed, such crystallisation would be unlikely. A scenario we regarded as somewhat more probable was that the market would move materially towards this state, to a “crystallisation for practical purposes”. Such crystallisation would leave consumers largely captive to specific products, increasing market power and reducing the scope for new entry and/or innovation, as discussed above.

5.25 To summarize the position here:

(a) The 2008 Report suggested that the most extreme market evolution scenario it is reasonable to posit would be a crystallisation for practical purposes, not occurring in the short term but occurring in the medium term. In practice this would mean that market concentration stabilised in a very narrow band and the market lost almost all its dynamism — so, concentration would vary little through time — with perhaps a long-term downward trend in concentration as the vested position of well-established brands very gradually faded away. Although, as we shall see in a later section, we now consider this even less likely than we did in our 2008 Report, it continues to be the case that we cannot altogether rule this out.

(b) Perhaps, in the very long term or in the case of other mechanisms by which brands would become very highly degraded, something like "commoditisation" would occur whereby all cigarettes within particular groupings came eventually to be regarded as perfect substitutes. Our view remains, as in our 2008 Report, that theory suggests that for a plain packs requirement although such a scenario should be considered unlikely it should not altogether be ruled out.

(c) The scenario we consider "more plausible", as we did in our 2008 Report, is that a plain packs requirement might lead to the dynamics of competition being very noticeably impaired (as opposed to largely eliminated), with materially greater market power of well-established brands and loss of competitive position for firms that depend upon innovation or brand proliferation (addressing many niches). In Section 6 we provide a simulation model producing the competition effects of this "more plausible" scenario from the theory of the role of branding set out in Sections 3 and 4.

(d) We continue to emphasize, as in 2008, that, overall, our view remains that the negative competition effects of a plain packs requirement would be noticeable and material, but the lost innovation associated with a plain packs requirement (probably the total loss of most innovation in the sector) in combination with greater consumer confusion (and hence reduced consumer surplus from trade) would be even greater.

(e) In this case, as we argued in 2008, a plain packaging requirement would produce materially greater negative impacts than a display ban alone. Perhaps some innovation would still occur, but probably not enough to provide a material contestability threat[15] to established brands.

Effects on counterfeiting and contraband

5.26 It is natural to suppose that a plain packs measure would lead to increased incidence of counterfeit cigarettes, because it would become much less expensive to duplicate cigarette packs. In addition, there might be a niche market for product that had the

[15] A "contestability threat" is simply the threat present in a contestable market. See footnote 7.

outward appearance of a legitimate branded product[16], and in the absence of genuine branded product for comparison, it might be difficult for consumers to distinguish counterfeits from genuine versions of the branded product.

5.27 Contraband might also increase with a plain packs requirement, with illegal imports from jurisdictions that did not have plain packs. This might be more attractive than today, because such imports could be sold at a premium price because of their branding and logos.

5.28 If counterfeiting and contraband were indeed to increase, that would reduce the UK government's tax take.

Price effects

5.29 Very probably, at least following an initial period in which there would presumably be transition costs associated with the move to a plain packs manufacturing regime, costs for cigarette manufacturers would ultimately tend to fall, as they would no longer be spending the same money on pack branding.

5.30 Whether there would therefore be falls in the cost of a pack compared with a situation without a plain packs requirement would depend on the interplay between reduced competitive pressure (tending to raise prices) and increased focus on pricing (tending to reduce prices) and, ultimately, reduced manufacturing costs (again tending to reduce prices). In the UK RMC context in which it appears that there are price differentials of as much as £1.50 for premium products over value product, a natural scenario might be:

(a) Rapid falls in the prices of premium product after a plain packs requirement is introduced (as costs fell and consumer willingness to pay fell, notwithstanding the ongoing presence of the brand name[17]);

(b) Price stabilisation later, as ongoing competitive pressures are reduced.

In Section 7, for moderate levels of brand degradation (10-25 per cent), we shall see a model that produces such a scenario.

5.31 Overall, the theory set out above suggests that average prices would probably be lower in the short- to medium-term (as the effects of the loss of premium product differentials were lost), but perhaps higher prices over the long term (as market power and loss of innovation effects began to predominate). If counterfeit and contraband were to increase from what are already high levels (recent estimates suggest that illicit product makes up

[16] This could be the appearance of either a branded product that would be legitimate if sold somewhere abroad, or the appearance of the pre-plain-packs requirement branded product sold in the UK.

[17] See paragraph 2.7ff.

approximately 10 per cent of the UK market for RMC, and 46 per cent of the UK market for RYO[18]) that might well limit the scope for tax rises to offset these price falls.

[18] See page 26, Measuring Tax Gaps (September 21, 2011), HMRC, http://www.hmrc.gov.uk/stats/mtg-2011.pdf

6 A FORMAL SIMULATION MODEL OF THE MARKET IMPACTS OF A PLAIN PACKS REQUIREMENT: MODEL SETUP

6.1 In earlier sections we have rehearsed the arguments we offered in 2008 in response to the FTC document. In this section we shall present a formal model of the UK market, drawing upon the theory set out in earlier sections, illustrating how, if our arguments are correct, matters might potentially play out in the UK market if a plain packs requirement were introduced.

6.2 We have argued that branding should be understood as a mechanism by which products communicate their nature to consumers, facilitating consumer search and switching processes and thereby (in a market in which products differ in their underlying nature — e.g. by tasting different) facilitating competition between differentiated products.

6.3 We have argued that, given this role of branding in the tobacco market, we would expect a plain packs requirement to very significantly affect competition. We have suggested a number of dimensions to this, but of particular interest are the points:

(a) that we would expect a general reduction in quality (a "trading down", as higher-quality products ceased being able, through branding, to communicate their higher quality to consumers and hence were unable to compete with cheaper alternatives) — perhaps even leading to commoditization at the lower end of the market under extreme circumstances and in the very long run; and

(b) within some market segments particular well-established brands might, under moderate degrees of brand degradation, increase their market power because they faced less competitive pressure from less well-established alternatives.

6.4 In the case of a formal model, if the model involves brand awareness being degraded following the introduction of a plain packs requirement, we might expect that at moderate degrees of such brand degradation there would be:

(a) a reduction in the number of brands in the market in certain market segments, probably higher-quality segments (such as the premium and sub-premium categories), with perhaps a focus on just one or two brands in some segments. This would probably be associated with an increase in industry concentration (or other such measures of market power) within higher market segments.

(b) lower-quality products gaining market share at the expense of higher-quality products.

6.5 At more extreme levels of brand degradation we might expect to see products in segments other than value-for-money being largely or even altogether eliminated.

Nature of the Model

6.6 The model we report in this section has been specially developed for this report. However, although bespoke, we emphasize that

(a) the model uses a standard theory of brands as set out in previous sections — namely that brands serve to signal features of underlying products, such as quality or taste;

(b) deploys a standard mathematical characterisation of signalling, that would be widely recognised in the academic approach to such modelling;

(c) uses the model to produce results using detailed data on the UK tobacco market.

Signalling models

6.7 Signalling models are, in economics, a class of model in which

(a) there is some relevant information that is not known with certainty by all market participants;

(b) something either happens or is present, as part of the market process, that allows market participants to learn something of that unknown information;

(c) what happens or is present does not necessarily allow market participants to learn the unknown information perfectly (though that may be possible in principle), but might instead provide just a "signal" about it.[19]

6.8 In our signalling model, products (in this case roll-your-own (RYO) and ready-made cigarettes (RMC)) communicate their characteristics to consumers via their packaging. In economic theory, there are two key forms of such characteristics.

(a) Economists use the term "horizontal differentiation" to refer to the possibility that in considering two products, A and B, some consumers will prefer A to B and others B to A. When horizontally differentiated, it is not that one product is better than the other; rather, they are simply different.

(b) By contrast, when products are "vertically differentiated" some products are regarded by all consumers as better than others — e.g. perhaps all consumers prefer B to A.

6.9 In developing the model reported in this section, we analysed both horizontally and vertically differentiated models of the UK tobacco sector. We found that vertically differentiated models worked (where we shall unpack what it means for a model to "work" in more detail below) whilst horizontally differentiated models did not work.[20] This is fairly unsurprising given that there is a vertical quality scale in widespread consensus use in the

[19] In the majority of (though not all) signalling models, the signal is chosen — indeed how the signal is chosen is often the central question of the model. We shall explain in more detail later, but note now, that in our model signals are not a strategic choice.

[20] See paragraphs 6.63ff.

tobacco market — some products are regarded as "premium", others "sub-premium", others "mid-range" and others as "value-for-money".[21]

6.10 Thus, in our model what branding does is to inform the consumer about the quality of the product — how good it is, relative to other products, on a quality scale on which all consumers would agree. In the mathematical versions of our models below, we refer to quality as "q".

6.11 We assume that branding can only ever imperfectly communicate quality. In other words, branding signals are always imperfect. In the absence of branding (e.g. with plain packs), consumer awareness of the quality of products would be less. Consumers might be more likely to believe, for example, that a high-quality product is of low quality and vice versa.

6.12 In the mathematical versions of our models below, we refer to consumer awareness of brands as "sigma". Our representative consumer regards the product as having an expected quality which is, formally speaking, a weighted combination of its actual quality (with weight sigma) and the average quality of all products of the same type (RYO, RMC) (with weight 1 – sigma).

6.13 Thus, in what follows, we use the following terminology:

(a) We use the terms "consumer awareness of brands" or "brand characteristic awareness" (often hereafter just "brand awareness" for short, but always understood as meaning awareness of characteristics[22]) to refer to the awareness consumers have of the actual quality of products.[23]

(b) We use the term "brand power" to refer to the ability of brands to make consumers aware of their quality. Thus, "brand awareness" and "brand power are two sides (from the one side that of the consumer, and from the other side that of the brand) of the same coin.

(c) We use the term "sigma" to refer to the mathematical expression in our model of that one coin, i.e. to the variable by which we model brand awareness and brand power.

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[21] We note that we offer no comment or analysis here on whether the UK tobacco market is better regarded as one market overall, one market per quality segment, one market for each of RYO and RMC or any other relevant market analysis for competition purposes.

[22] We have, as a cross-check, produced versions of our model in which brand awareness was measured simply by consumer awareness of the existence of brands, rather than the accuracy of awareness of their characteristics. Such a model produces results very similar to those we report below.

[23] It also might have been possible to produce a model in which, if their regular product were not available, consumers asked for a product the name of which they knew. I consider such consumer behaviour plausible, and likely to produce much the same results seen here.

How the model works

6.14 Our model uses a standard way to express, in mathematical terms, the standard theory of branding set out in earlier sections, and the model is populated with actual UK tobacco market data. Below we shall explain the model in more detail. But it is useful to form an initial high-level intuition.

6.15 Imagine the products lined up, left to right, with the lowest quality product on the left and the highest quality on the right. And imagine that, as far as consumers are concerned, the quality of each product is uncertain but that consumers know what the average quality is in the marketplace. Uncertainty about a product's quality tends to drag its perceived quality towards the average, and away from its actual quality. So, for example, a value for money product with a low sigma (low brand awareness) might appear to consumers to be fairly similar to a mid-range product.

6.16 If a plain packs requirement resulted in brand awareness falling, that would mean consumers regarding all products as more like the average product. But that would mean consumers would be unwilling to pay as much of a price premium for a higher quality product — to them it would appear to be simply an expensive average product. So one effect, as brands degraded, would be that demand for (and thus market shares of) premium and sub-premium products as a whole would fall, with lower-quality products gaining market share at their expense.

6.17 But there is another effect at work. If brand degradation is not too high and if brand awareness is rather higher for some higher-quality products than for others, then market shares for higher-quality products will not fall all away at the same rate. Indeed, some higher-quality products could even gain market share, as consumers became so uncertain about the characteristics of their rival products that they disappeared from the market, leaving the few surviving higher-quality brands with a stronger market position, increased market share and increased pricing power. It could thus happen that even if the total market share of, say, all premium products collectively fell, the market share and market power of some specific well-known premium brands could rise.

6.18 In our results below, we shall see the kinds of patterns sketched out above, but with more products, more complexity, and derived from actual UK tobacco market data.

Purpose

6.19 The model set out below is devised to vivify and explore the qualitative analysis set out in Section 5. The context of this report is certain policy proposals regarding the introduction of a plain packs requirement set out in the Consultation. The model is designed to address this policy question, reflecting the analysis of Section 5.

6.20 Models could be devised for other purposes. For example, a model might be devised to explore, for academic purposes, the implications of a particular radical new economic theory in this sector, to demonstrate how such a theory could be used. With such a purpose in mind, it could be of limited interest whether the economic theory in question

actually constituted the best theory of the functioning of the tobacco sector — it is the theory that is of interest, not the sector.

6.21 Another purpose might be commercial. A tobacco manufacturer might be interested in a model of how market shares and profits would evolve in a sector so as to guide its business decision-making. In such a setting there would be considerable interest in issues such as which specific brands might flourish or disappear.

6.22 The purpose of the model is of particular relevance when considering the conclusions that should be drawn from it. It is designed to address policy questions, and thus the questions it addresses concern issues such as what happens to competition, to market structures, to average prices and other matters of standard concern to regulators and competition authorities. It is not well-suited to address questions about what happens to specific brands, in particular because it does not take into account the possibility of multi-brand firms pursuing multi-brand pricing strategies nor of firms with "deep pockets" keeping products going at a loss until their rivals depart the market leaving the opportunity to gain profits from the market power of being one of the few surviving brands.

Competition Between RYO and RMC Products

6.23 In our model, RMC products compete with each other in terms of price given expected quality, and RYO products likewise compete with one another. But what about competition between RYO and RMC products?

6.24 We have considered two forms of such competition. In one form — reported in an Appendix — RYO products are assumed to be regarded by consumers as of lower quality than RMC products (reflected in their lower prices). Thus, if one imagined all the RMC and RYO products lined up, with the lowest quality products on the left and the highest-quality products on the right, then all the RYO products would appear in an unbroken line with one another at the left, then all the RMC products would continue the line to the right. We refer to this as the "linear" model.

6.25 In this main report we adopt a different approach. We assume that, from the consumer point of view, buying an RYO product entails bearing an additional cost of consumption — the "cost of rolling" the RYO product to produce a cigarette. The cost of rolling can be interpreted as including a cost of the time taken to do the rolling, with the consequence that consumers with higher budgets (which we assume arise from higher incomes) have a higher cost of rolling. We refer to this as the "composite" or "benchmark model".

6.26 Each of the approaches — the linear approach or the approach including a cost of rolling — has its own advantages. The linear model has the academic advantage of simplicity, reducing the challenge of introducing a cost of rolling. The model with a cost of rolling, however, reflects consumer survey data that suggests material direct switching between

RMC and RYO products (not just between the lowest price RMC and the highest price RYO, as might be an intuitive interpretation of the linear model).[24] The composite model therefore allows for better intuitive engagement and sense-checking by those with knowledge of and familiarity with the tobacco sector. The ability for better intuitive engagement materially reduces the risk that the model produces spurious results, with the consequence that, despite the robustness challenges created by the cost of rolling, we use this as our preferred model. In the Appendix we explore the results of making the "linear" assumption. We shall see that they are extremely similar to the results of the composite benchmark model, as reported in Section 7.

6.27 We estimate product quality from consumer survey data and from the amounts consumers are prepared to pay for products (the price). So in the Composite Model, a consequence of assuming that consumers pay a cost of rolling for RYO products is that RYO products are modelled as being of higher quality than they are in the "linear" model (since consumers are assumed prepared to pay more for them).

6.28 By introducing a cost of rolling, if we return to the thought experiment of lining our products up, lowest quality to the left and highest quality to the right, RYO products are now interleaved with RMC products. We shall explain below how this interleaving is done.

A Slightly More Technical Statement of the Theoretical Framework

Simulation modelling

6.29 The results we report in this section are derived from a simulation model. A "simulation" is an analytical technique, based on converting a theory into numbers. The theory underpinning the model is built into its mathematical structure. Thus a simulation can be characterised as describing how the world works, on the basis of a pre-determined model. This distinguishes a simulation from, for example, certain forms of econometric model which aim to *discover* how the world works. A simulation vivifies a model, demonstrating how it might work out in practice, and demonstrating that the model can be applied formally to the situation in question.

6.30 The simulation exercise consists of three main steps:

(a) A theoretical framework of how branding works in the tobacco market.

(b) Calibration to populate the theoretical framework with data.

(c) Interpretation of the introduction of plain packs in terms of the underlying model in order to produce simulations.

[24] Although such direct switching can be conceptualised within the linear model it is less intuitive how such switching occurs. The RYO-to-RMC switching data was prepared by TNS for JTI. Further technical discussion can be found in Appendix 2.

6.31 We discuss below the three conceptual steps of a simulation exercises in very general terms. Later we shall consider the key components of each step in more detail (e.g. by explaining the data used for the calibration).

Theoretical framework

6.32 The theoretical framework we have adopted is one which allows us to establish a mathematical relationship between the following variables:

(a) The marginal cost of producing each brand ("Costs").

(b) The underlying quality of each brand ("Qualities").

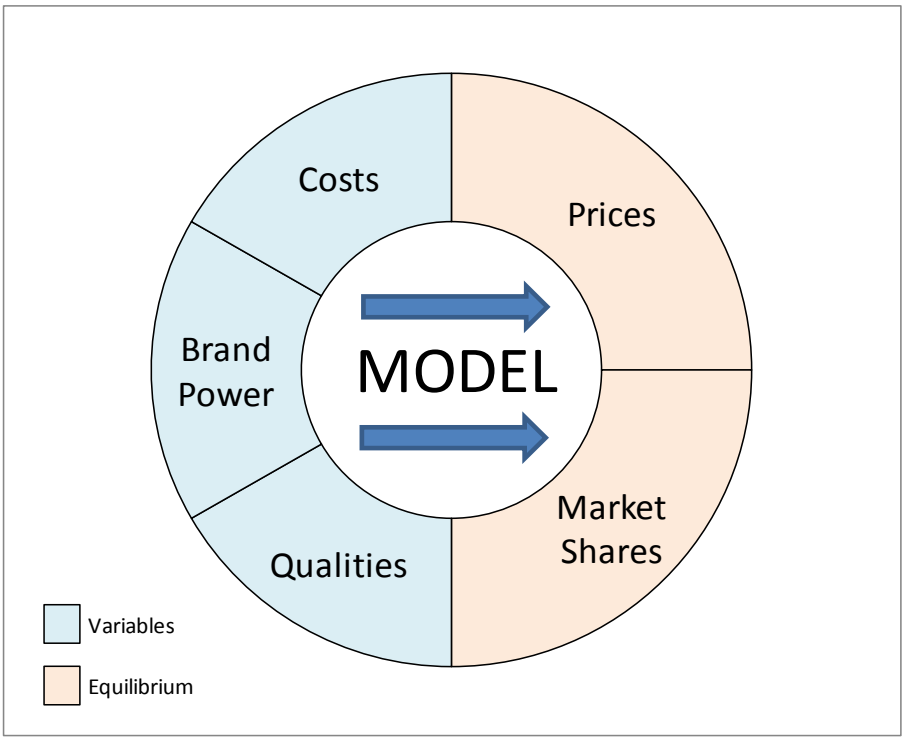
(c) The "power" of each brand, i.e. the brand's ability to communicate the underlying quality of the product ("Brand Power").

(d) The price of each brand ("Prices").

(e) The market share of each brand ("Market Shares").

6.33 More precisely, the theoretical framework determines which prices and market shares (i.e. the market equilibrium) arise for different values of marginal costs, qualities and brand power (i.e. the variables). It is therefore useful to think of the causal direction of the theoretical model as proceeding from the variables to the equilibrium (see figure below).

Figure 6.1: Theoretical Model



Calibration

6.34 A calibration makes use of the same mathematical structure of the theoretical model but reverses the direction of Figure 6.1, inferring underlying variables from an initial market equilibrium. In other words, any calibration proceeds from

(a) what data are available;

(b) what data are most reliable

to determine which parameters of the model are inputs and which are to be deduced from the calibration.

6.35 More specifically, since for the UK tobacco market we have available

(a) good data on market shares and prices;

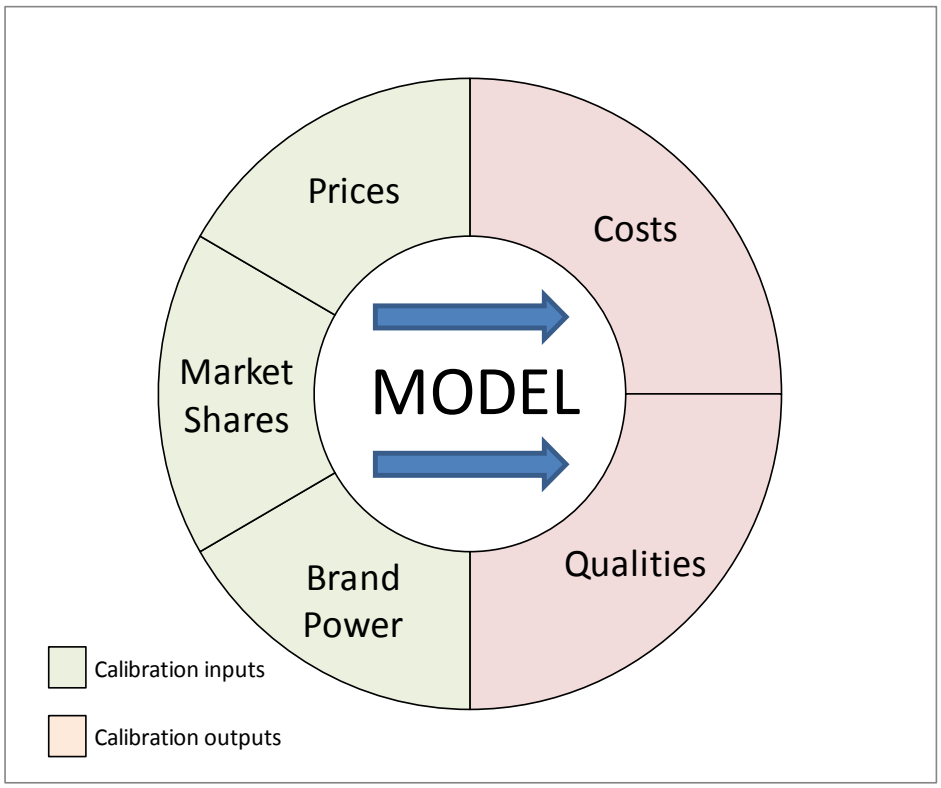
(b) no data on costs; and

(c) our data on brand power is more robust than our data on qualities

the question we ask in this case when calibrating the model is as follows: *Given we observe prices, market shares and brand power values (the calibration inputs), what*

should the costs and qualities (the calibration outputs) be in order for the model to produce exactly the same prices and market shares we observe (see figure below)?

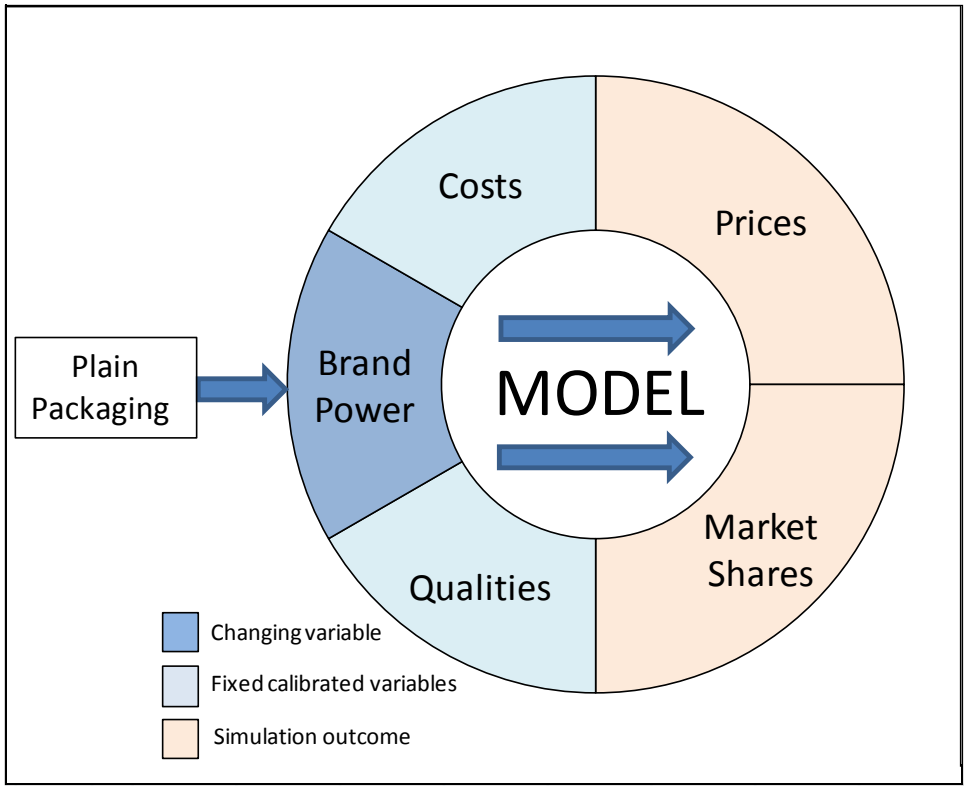
Figure 6.2: Calibration



Interpretation of a plain packs requirement in terms of the model

6.36 In terms of the model, the introduction of plain packs is assumed to decrease brand power. Therefore, the impact of the introduction of plain packs can be simulated by looking at the impact that a decrease in brand power has on the equilibrium outcomes of the model (see figure below).

Figure 6.3: Simulation



The tobacco market

6.37 Our model analyses the tobacco market at the level of brands, i.e. predictions are possible with regards to specific tobacco brands, as opposed to being possible only for broader product categories (e.g. RYO versus RMC, premium products versus value for money products, etc.). In the model, RMC brands and RYO brands are considered simultaneously, i.e. we do not have two separate models, one for RMC brands and one for RYO.

6.38 We do not allow for any new brand entry into the market. However, our models assumes that, in addition to the known brands, there also exist "commodity" products (products of the minimum quality found in the market and that consumers would recognise as being low-quality). In the initial market equilibrium, commodity products are assumed to have negligible market share but the model permits them to expand their market shares if there were a plain packs requirement.

Quality

6.39 We assume that products differ in one vertically differentiated characteristic: "quality".[25] Quality should be interpreted here broadly: it could refer to the quality of the tobacco used, the strictness of quality control standards implemented during the manufacturing process, the quality of the filter tips (for RMC products), or any other feature resulting in consumers preferring one brand over others.

Brand awareness

6.40 In our model the key role of branding is that of communicating product features (in this context "quality") to consumers.

6.41 Consumers have a higher degree of certainty about the quality of certain branded products (i.e. those of which brand awareness is relatively high) and a lower degree of certainty about the quality of other branded products (i.e. those of which brand awareness is relatively low). We refer to an adjusted form of the actual quality, where the adjustment is for the awareness of quality, as "perceived quality". For a brand that had perfect brand awareness, actual and perceived qualities would coincide (the brand communicates the product quality perfectly). However, for all our actual products brand power is less than total (brand awareness is less than perfect) and so actual and perceived qualities differ.

6.42 We note that by our definition, the brand power of a product is not simply a matter of that product's own communication about its nature with consumers. It also depends upon how accurately other products communicate their characteristics. For example, if a low quality product communicates its quality poorly, that reduces the brand power of a higher quality product (since consumers are less able to distinguish that higher quality product from the lower quality one than they would be if the lower quality product had higher brand power).

Consumers

6.43 Consumers are rational and when making purchasing decisions care only about perceived quality (*ceteris paribus*, they prefer products of higher perceived quality) and price (*ceteris paribus*, they prefer cheaper products). We also assume that some consumers are willing to pay higher prices in order to buy more products perceived to be of quality, whilst other will prefer cheaper options perceived to be of lower quality. This could be interpreted in terms of differing budget constraints or in terms of differing sensitivity to quality. We shall usually adopt the differing budget constraints interpretation.

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[25] See paragraph 6.8(b) for the definition of vertically differentiated.

Firms

6.44 We assume that every branded product competes independently as if it were its own firm, and it does so by setting prices so as to maximise profits from sale of the brand. Once a product is unprofitable at any price generating positive market share, it exits the market altogether. After exit, a product cannot re-enter.

6.45 The exact price a brand will set will depend upon its marginal cost of production (a higher cost is generally associated with a higher price) and upon the brand's quality, to the extent that this can be communicated to consumers through branding (e.g. a brand can charge a higher price insofar as it is able to communicate to consumers that it is of higher quality). Different prices and different perceived qualities will result in different market shares.

6.46 Note the following restrictions implied by our assumptions:

(a) Since every branded product competes independently as if it were its own firm, and it does so by setting prices so as to maximise profits from sale of the brand, multi-brand strategies are excluded.

(b) Since once a product is unprofitable at any price generating positive market share, it exits the market altogether, there is no possibility of selling a product at a loss to await the exit of rivals, hoping to exploit longer-term market power once rivals have exited so as to make up temporary losses.

(c) Firms cannot change costs, qualities, or brand power or produce new products to enter the market. They can only change prices for their existing product.

Interpretation of a plain packs requirement in terms of the model

6.47 We have explained above that a plain packs requirement would reduce awareness, amongst consumers, of the characteristics of products. In terms of our model, that means the awareness of quality, the sigma, is reduced.

6.48 When sigma is lower, technically speaking that has the consequence that consumers expect the quality of the product to be closer to that of the average product than is truly the case. The degree of such a reduction in consumer awareness, associated with a plain packs requirement, is not something that the model itself predicts. Instead, we must introduce an assumed reduction in brand awareness as an input into the model. We do not have data that allow us to estimate the degree of such reduction. We therefore consider a range of scenarios for the reduction in consumer awareness.

6.49 In Section 5, we described two key potential kinds of scenarios for the impact of a plain packs requirement:

(a) For an extreme reduction in brand awareness, perhaps achieved only over the long term, the market would become commoditised — competition would be vigorous but

occur only on price for the lowest quality products, all higher-quality products having been driven out of the market; and prices would be lower.[26]

(b) For some moderate degree of reduction in brand awareness, by contrast competition would be damaged some well-known higher-quality brands would survive but with increased market power, and thus the overall impact on prices would be ambiguous (some prices would be lower; others higher).

6.50 The scenarios for the degree of brand awareness degradation we explore aim to identify levels of brand degradation delivering these two broad classes of effect.

6.51 Other technical assumptions concerning the interpretation of plain packs in terms of the model are worth noticing:

(a) *A plain packs requirement induces a uniform market-wide proportionate reduction in branding quality signals*[27] — This means there is no change in the relative ranking of brand signals — if one product's true quality was better known by consumers than another product's true quality before plain packs were introduced, its true quality remains better known by consumers after plain packs are introduced.

(b) *Products have fixed qualities and costs of production, and once plain packs are introduced, firms cannot spend money to adjust their brand awareness further* — Firms cannot adjust the quality of products (e.g. by changing the manufacturing process). In particular, they do not adjust costs or quality at all in response to the introduction of plain packs. Furthermore, once a plain packs requirement is in place, firms cannot adjust their brand awareness — awareness simply degrades proportionately in line with that of other products.

Summary

6.52 The key assumptions behind the theoretical model are thus as follows:

(a) Products differ in their intrinsic quality levels. Given full information, all consumers would rank product quality in the same way.

(b) The ability of consumers to distinguish products according to quality depends on the power of specific brands: the higher (lower) the power of a brand the higher the degree of certainty (uncertainty) consumers have about the quality of that brand.

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[26] See paragraph 5.25(b).

[27] e.g. if two products have sigmas of 0.7 and 0.5 in the status quo, then a 10 per cent degradation in brand power leaves them with sigmas of 0.63 and 0.45.

(c) When making purchasing decisions consumers trade off higher prices for higher perceived qualities but they do so to different degrees — i.e. some consumers are more prepared than others to pay extra for higher perceived quality.

(d) Brands compete with each other by setting prices to maximise profits. The resulting prices will lead to a market equilibrium which is ultimately represented by a set of market shares and prices.

(e) A plain packs requirement introduces a proportionate reduction in brand power.

Dataset, Estimation of the "Cost of Rolling", and Calibration Outputs

6.53 Calibration of our model involves using real-world UK data for market shares, prices, and brand power (the *calibration inputs*) in order to produce estimates for the quality and marginal costs of each brand (the *calibration outputs*). We provide below: a description of the data sources used, the estimates for the cost of rolling used in the Composite Model, and of the calibration outputs. Further technical details on the calibration approach can be found in the Technical Appendix.

Data Sources

6.54 The model has been calibrated using actual market data for a number of RMC and RYO brands. To make the analysis tractable, we have restricted it to the seventeen RMC brands with largest market shares (collectively constituting 95 per cent of RMC sales in the UK) and the seven RYO products with largest market share (constituting 97 per cent of RYO sales).

6.55 For each brand we used the following data as inputs:

- *Market shares* — These have been normalised to account for the fact the 24 brands considered do not represent 100 per cent of the UK market. In other words, the "raw" market shares are scaled up, within the model. Market shares data are obtained from Nielsen Market Track and are the market shares as of 2010, being the data available to us at the time of preparing the simulation model.

- *Price (20-sticks-equivalent)* — For prices we use Nielsen Market Track data on prices as of 2010. The price used is that of a 20 sticks-equivalent-price for each type (i.e. according to size) of cigarette and RYO pack sold in the UK. Since the average price per stick differs according to the size of the pack, the 20 stick equivalent price of each brand has been calculated as a weighted average according to the market shares of different pack sizes within a given brand.

- *Brand Power* — There is no direct measure of brand power in the same way as there are direct measures of prices and market shares. However, for a number of brands (12 RMC brands and 7 RYO brands) JTI Tracker provides consumer survey data on brand attributes as reported from smokers (defined as those aged 18-44 who smoke 6 or more RMC per day, and those aged 18+ who smoke more than one RYO stick

per day). This dataset has been used to infer brand power values (we refer to the Technical Appendix for details on how this has been done). In our model brand power is measured as an index that can take any value between 0 and 1, where 0 represents a complete lack of brand power, while 1 represents the highest possible brand power value.

6.56 A table with a list constructed from the brands in our datasets and the corresponding prices, market shares, and brand power values is provided below (brands are ranked according to their actual prices, and RYO products are shaded in grey).

Table 6.1: Tobacco Brands' Market Shares and Prices, 2010

Type of product	Price segment	Brand Code	Market share	Price (£)	Brand Power
RYO	Value	a	1.11%	1.74	0.33
RYO	Mid Price	b	0.95%	1.83	0.94
RYO	Mid Price	c	2.58%	1.85	0.75
RYO	Mid Price	d	6.95%	1.86	0.74
RYO	Mid Price	e	2.30%	1.93	0.77
RYO	Premium	f	0.91%	2.03	0.57
RYO	Premium	g	8.42%	2.04	0.94
RMC	Value	H	1.98%	4.70	0.93
RMC	Value	I	3.65%	4.73	0.80
RMC	Value	J	3.70%	4.76	0.76
RMC	Value	K	7.45%	4.77	0.74
RMC	Mid Price	L	2.94%	5.08	0.75
RMC	Mid Price	M	10.68%	5.35	0.62
RMC	Mid Price	N	10.92%	5.36	0.82
RMC	Sub Premium	O	1.12%	5.56	0.92
RMC	Sub Premium	P	0.95%	5.74	0.92
RMC	Sub Premium	Q	11.41%	5.77	0.95
RMC	Sub Premium	R	2.68%	5.81	0.76
RMC	Premium	S	2.51%	6.04	0.86
RMC	Premium	T	1.90%	6.27	0.86
RMC	Premium	U	3.70%	6.30	0.96
RMC	Premium	V	3.82%	6.30	0.85
RMC	Premium	W	2.07%	6.31	0.86
RMC	Premium	X	5.30%	6.36	0.72

Source: AC Nielsen Market Track data and EE calculations.

6.57 As noted above (see paragraph 6.19ff) the model is designed to assess policy questions, not business decisions. It abstracts from certain possibilities, such as the use of multi-brand strategies or the use of "deep pockets" to keep selling products for a period even after they became unprofitable, with the consequence that the results of the model cannot

be interpreted as predictions about individual brands. Hence, in Table 6.1 and hereafter we refer to products only by their brand codes, so as to emphasise that the results of the model should not be regarded as robust in respect of specific brands. However, it should be understood clearly that products "a" to "X" have prices, market shares, types and quality segment attributions derived from the actual price and market share data of products in the UK market (as explained further in Appendix 1) — they are not simply invented for the purposes of creating a model. RYO brands appear with lower case letters, and RMC brands in upper case.

The "Cost of Rolling"

6.58 Our preferred strategy for modelling simultaneously RMC and RYO is the Composite Model. As noted earlier, this approach requires an estimation of the "cost of rolling". The most natural approach to estimating the cost of rolling (i.e. the monetised value of the disutility arising, for example, from the time and effort spent on rolling tobacco) is to consider the price differential between RMC and RYO products. The following table allows comparing prices (average prices, minimum prices and maximum prices) between RYO and RMC products across all segments.

Table 6.2 Weighted Average price, Minimum Price, and Maximum Prices by Segment

	RYO			RMC		
	Weighted average	**Maximum**	**Minimum**	**Weighted average**	**Maximum**	**Minimum**
Value	1.74	1.74	1.74	4.75	4.77	4.70
Mid-Price	1.87	1.93	1.83	5.32	5.36	5.08
Sub-Premium	-	-	-	5.76	5.81	5.56
Premium	2.04	2.04	2.03	6.28	6.36	6.04

Source: AC Nielsen Market Track data and EE calculations

6.59 The first aspect worth noticing from Table 6.2 is that (irrespective of which price measure is used) the price differential between RMC and RYO increases with the price segment. This would suggest that the opportunity cost of rolling is higher for premium segment RYO consumers than, say, for value segment RYO consumers.

6.60 The exact approach we have used for estimating the cost of rolling consists in subtracting the (weighted) average price of each RYO segment from the price of the cheapest RMC brand in the corresponding segment. This led to the following "cost of rolling" estimates for 20-stick equivalents:

- £2.95 for the RYO value segment.
- £3.21 for the RYO mid-price segment.
- £4.00 for the RYO premium segment.

6.61 The adjusted price of RYO products obtained by adding the above "costs of rolling" to the actual prices generates a quality ranking for tobacco products which has a number of

features that, from a modelling perspective, reinforce the view that the model reflects the economic characteristics of the tobacco market well (see the Table below). In particular:

(a) The quality segment ranking is fully preserved (i.e. the cheapest premium product is more expensive than the most expensive sub-premium product; the cheapest sub-premium product is more expensive than the most expensive mid-price product, and so on). This implies that premium RYO products are close substitutes of premium RMC products, and so on for other quality segments, a feature which is in line with TNS RMC-to-RYO brand-switching data.

(b) Within each quality segment RYO products tend to sit at the bottom, which reflects the intuitive observation that RYO products tend to be perceived as the cheaper options among products that fall within the same price segment.

Table 6.3: Ranking of Tobacco Brands according to the Composite Model

Type of product	Price segment	Brand Code	Adjusted Price* (£)
RYO	Value	a	4.69
RMC	Value	H	4.70
RMC	Value	I	4.73
RMC	Value	J	4.76
RMC	Value	K	4.77
RYO	Mid Price	b	5.04
RYO	Mid Price	c	5.06
RYO	Mid Price	d	5.08
RMC	Mid Price	L	5.08
RYO	Mid Price	e	5.14
RMC	Mid Price	M	5.35
RMC	Mid Price	N	5.36
RMC	Sub Premium	O	5.56
RMC	Sub Premium	P	5.74
RMC	Sub Premium	Q	5.77
RMC	Sub Premium	R	5.81
RYO	Premium	f	6.03
RMC	Premium	S	6.04
RYO	Premium	g	6.04
RMC	Premium	T	6.27
RMC	Premium	U	6.30
RMC	Premium	V	6.30
RMC	Premium	W	6.31
RMC	Premium	X	6.36

** Prices for RYO products have been adjusted to reflect the "cost of rolling". The "adjusted price" for RMC products is the same as the actual price.*

Calibration Outputs

6.62 The outputs of the calibration exercises are reported below.

Table 6.4: Calibration Output

			Calibration inputs			*Calibration outputs*	
Type	**Price segment**	**Brand Code**	**Market share**	**Adjusted Price***	**Brand Power**	**Quality**	**Costs**
	Commodity**		0.00%	3.880	1.00	16.87	3.880
RYO	Value	a	1.11%	4.686	0.33	16.87	4.685
RMC	Value	H	1.98%	4.696	0.93	20.30	4.695
RMC	Value	I	3.65%	4.731	0.80	20.17	4.729
RMC	Value	J	3.70%	4.755	0.76	20.17	4.754
RMC	Value	K	7.45%	4.771	0.74	20.20	4.768
RYO	Mid Price	b	0.95%	5.043	0.94	21.39	5.043
RYO	Mid Price	c	2.58%	5.063	0.75	21.28	5.062
RYO	Mid Price	d	6.95%	5.077	0.74	21.32	5.077
RMC	Mid Price	L	2.94%	5.084	0.75	21.34	5.084
RYO	Mid Price	e	2.30%	5.144	0.77	21.53	5.142
RMC	Mid Price	M	10.68%	5.345	0.62	22.06	5.343
RMC	Mid Price	N	10.92%	5.361	0.86	22.10	5.359
RMC	Sub Premium	O	1.12%	5.557	0.92	22.43	5.556
RMC	Sub Premium	P	0.95%	5.739	0.92	22.73	5.739
RMC	Sub Premium	Q	11.41%	5.770	0.95	22.75	5.768
RMC	Sub Premium	R	2.68%	5.814	0.76	23.00	5.813
RYO	Premium	f	0.91%	6.029	0.57	23.77	6.029
RMC	Premium	S	2.51%	6.041	0.86	23.23	6.041
RYO	Premium	g	8.42%	6.042	0.94	23.13	6.042
RMC	Premium	T	1.90%	6.274	0.86	23.54	6.274
RMC	Premium	U	3.70%	6.304	0.96	23.42	6.304
RMC	Premium	V	3.82%	6.304	0.85	23.59	6.304
RMC	Premium	W	2.07%	6.312	0.86	23.59	6.312
RMC	Premium	X	5.30%	6.356	0.72	23.95	6.354

** Prices for RYO products are adjusted to reflect the "cost of rolling"*

*** The nature of the commodity product is explained at paragraph 6.38. The quality is by definition that of the lowest quality product (here Gold Leaf). Brand power (sigma) is by definition 1. The implied initial price arises directly by calculation from the quality and brand power.*

Points of interest from the calibration output

6.63 A simulation is, of necessity, a model — thus it abstracts from certain features of the world so as to concentrate attention on the features of interest. One consequence of this is that one would never expect any simulation model to perfectly capture all features of the world. A simulation model is, instead, regarded as having been calibrated successfully if, with relative little forcing, by changing parameters within a plausible zone of discretion, the model makes economic sense. In our context, making economic sense implies the following features:

(a) calibrated costs being above zero;

(b) calibrated costs being below prices, or not so far above them as its being implausible that a product is being sold at such a loss temporarily; and

(c) calibrated qualities being fairly similar, in ranking, to the ranking of prices.

6.64 A simulation model might be acceptable that did not have all of these features — one might have to "make do" with the best that was available. On the other hand, even if it did have all these features, it could, in other areas, have implications that made the model less plausible.

6.65 We shall highlight a number of features of our calibration outputs. We shall see that, without our needing to introduce significant ad hoc assumptions to achieve this (as even reputable simulation models sometimes need to do), our model makes excellent economic sense. It also has other features that are economically intuitive and appealing. We believe that the most natural interpretation of this is that the theoretical model we propose works well for the UK tobacco market.

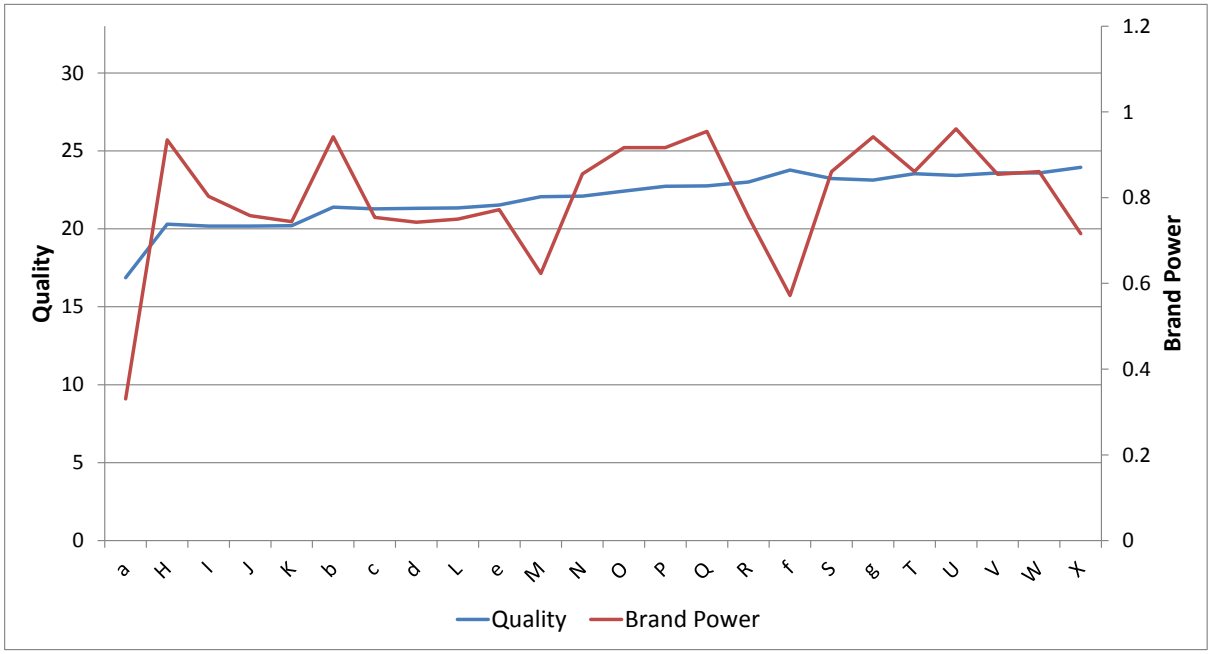
6.66 We first note that the calibration exercise is successful in uniformly producing calibrated costs in the region of, but below, prices and qualities that rise relatively smoothly and sensibly with prices. A calibration exercise would not have to be as successful as this in order to be considered a sound basis for a simulation. There is no necessity that a model should be able to be calibrated in this way.[28]

6.67 The calibration produces costs, as a calibration output, that are close to prices. That means that the calibration implies that the market is highly competitive initially.

6.68 The figure below reports the calibrated quality values and brand power values for each brand. We observe that brands of higher quality tend to have higher brand power values. This is an appealing property because in our theoretical framework high quality products are those that benefit the most from strong brand power. Consequently one would expect efforts to build a brand to be greatest in respect of higher quality products.

[28] Calibration exercises can fail in a number of ways. In the current context, for example, they might produce negative costs or costs ten times prices, or qualities might be inverted (the cheapest products might, in the calibrated model, have the highest qualities), or a number of other such nonsensical outputs. As an example of a calibration exercise failing, we attempted to calibrate an analogous model with "horizontal" differentiation — i.e. brands are simply different from one another and to the taste of some consumers but not others, rather than some being universally regarded by consumers as better or worse. That model could not be calibrated — it did not produce sensible cost and quality output.

Figure 6.4: Brand Power and Calibrated Qualities

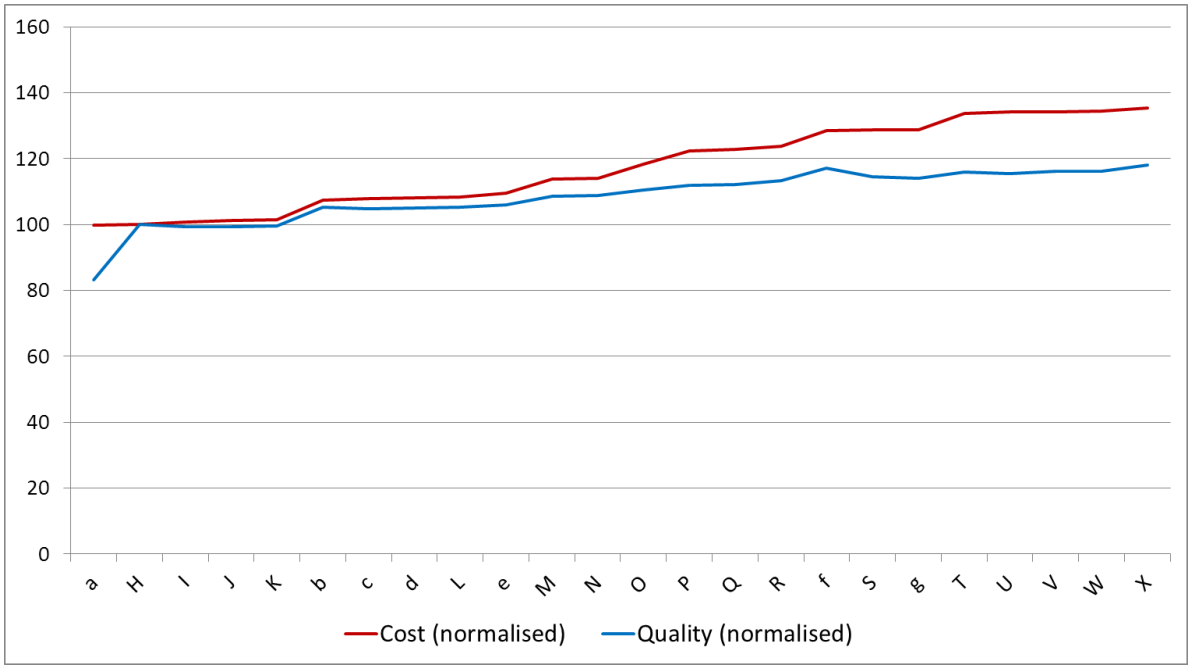


Note: In the axes, RYO brand codes are reported in lower case, while RMC brand codes are reported in capital.

6.69 The figure below illustrates how both calibrated marginal costs and qualities increase in line with price segments, but (with the exception of brand "a") costs do so at a higher rate than qualities, as can be seen in the figure below. Therefore the calibration outputs are consistent with the idea that an increase in quality leads to a more than proportional increase in marginal cost. Two other ways to express this are to say that there are decreasing marginal quality returns to cost, or that there is an increasing marginal cost of quality.

6.70 Decreasing marginal quality returns to cost are an attractive feature, because they reflect the standard economic feature of "diminishing marginal returns" in cost functions — in other words, typically one would expect it to become harder and harder to generate incremental improvements in quality. If that were not so, one might expect most products to be of the highest quality.

Figure 6.5: Calibrated Qualities and Calibrated Marginal Costs



Note: Both calibrated costs and qualities are expressed in this figure relative to a value of 100 for "H". The quality for "a" is anomalously low, as can be seen in Table 6.4. The remarks in paragraph 6.69 should be interpreted as applying to the relationship between cost and quality for products other than "a".

6.71 We regard this as a remarkably successful and intuitively attractive calibration. We would have considered the model usable and informative even had the calibration been markedly less successful than it is.

7 SIMULATION MODEL: MAIN RESULTS

Interpretation of the Simulation Results

7.1 We do not have data that allow us to estimate how much brand awareness would be affected by a plain packs requirement. We deal with this by considering a range of reductions in brand awareness. We present here results for five scenarios, covering a range from moderate (but material) impacts on competition through to the elimination of all higher-quality brands.

7.2 So, simulation results have been reported below for different scenarios:

(a) 10 per cent (limited) brand degradation level.

(b) 25 per cent (moderate) brand degradation level.

(c) 50 per cent (significant) brand degradation level.

(d) 75 per cent (extreme) brand degradation level.

(e) 100 per cent (complete) brand degradation level.

7.3 It should be emphasised that the specific numbers here — 10 per cent, 25 per cent, etc. — are of relatively little significance and should not be over-interpreted. We have chosen scenarios that produce market structures of particular interest — namely those reflecting what we claim in 5.25(b) and 5.25(c) are the most plausible results: commoditisation for some extreme level of brand degradation, perhaps achieved only over the very long-term; for more moderate levels of brand degradation, damage to competition, increased market power for a small number of well-established brands, and some products rising in price whilst others fall.

7.4 The degrees of brand degradation required to generate such effects are sensitive to the precise technical assumptions made in the model and should not be considered robust.[29] The qualitative features of those scenarios — market structure changes, what happens to average prices, changes in excess profits, etc. — are much more robust. The model does not make any attempt to quantify the precise degree of brand degradation required to produce these scenarios. Indeed, given that sigma is a variable that is not directly observed, but instead reflects unobserved internal features of consumers (how they perceive the qualities of products relative to their actual qualities), even the interpretation of the meaning of percentage degrees of sigma degradation is not entirely straightforward. The focus of the reader should be on the qualitative features of the various scenarios and their policy implications, not on the quantitative degrees of brand

[29] For example, we have considered models in which the qualitative features of the 10 per cent scenario here are generated by 1 per cent brand degradation, rather than 10 per cent.

degradation that constitute those scenarios. **Our judgement, as set out in Section** 5**, is that one should expect enough brand degradation, from a plain packs requirement, to produce scenarios of these sorts.** It is much less clear, in a quantitative sense, precisely how much brand degradation that is.

7.5 We have selected two kinds of scenarios: one in which competition is damaged but nonetheless some brands survive successfully signalling that they are not of the lowest quality (in our 10-50 per cent brand degradation scenarios); and one in which all or virtually all product sold is at the very low end of the quality spectrum and competition is strong (the transition to this occurring in our 75-100 per cent brand degradation scenarios).

7.6 For each of the scenarios above we shall explore:

(a) Impacts on brand survival and market shares;

(b) Impacts on prices; and

(c) Impacts on competition (evidenced by impacts on concentration and on profits above marginal costs).

Analysis for moderate to significant brand degradation levels (10%-50%) — Scenarios of the type set out in paragraph 5.25(c)

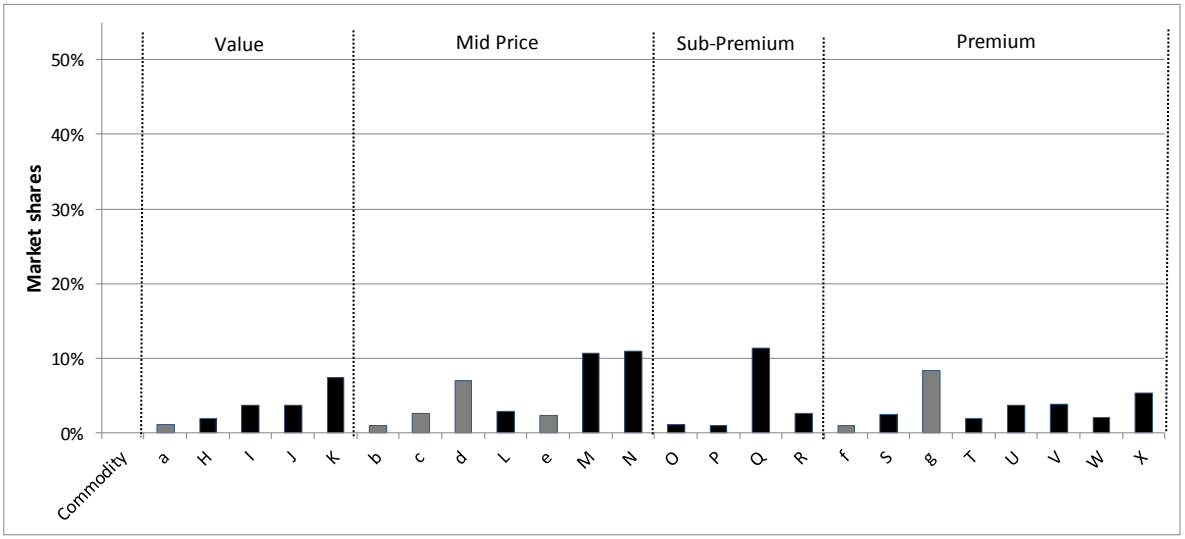
Impact on brand survival and market shares

7.7 The following graphs provide 2010 market shares (the status quo, "SQ") as well as changes in market share resulting from a gradual increase in brand degradation (10 per cent, 25 per cent, and 50 per cent).

7.8 We begin in Figure 7.1 with consideration of the status quo — that is to say, the market shares and prices that prevail in the UK tobacco market, for the 24 products (17 RMC, 7 RYO, and nugatory potential "commodity" rivals) in our dataset, as at 2010, normalised so that the total market shares in our dataset sum to 100 per cent.[30] (Note that in each of the charts that follows, RYO products are marked in a lighter shade than RMC products — so, for example in the SQ graph they are gray.)

[30] Again, we note that our 17 RMC products constituted 95 per cent of 2010 RMC sales and our 7 RYO products constituted 97 per cent of RYO sales. Thus the normalisation involves scaling up actual market shares only very slightly.

Figure 7.1: Status Quo scenario

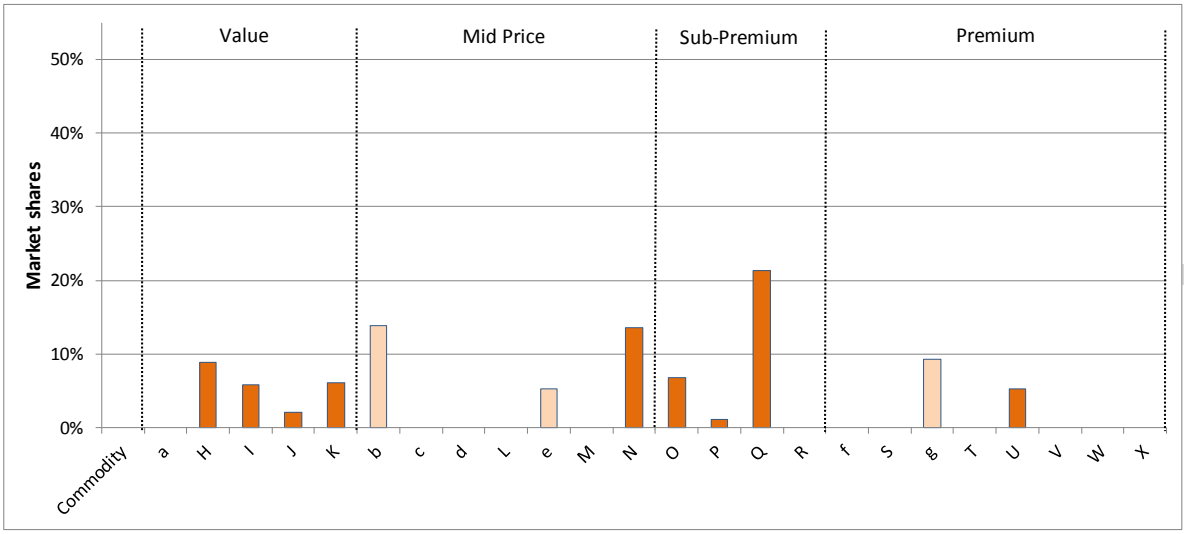


7.9 We see that the best-selling RMC brands, at 2010, were "Q", "N" and "M" (in the sub-premium and mid-range segments). Brands "g", "d" and "c" (in the premium and mid-range segments) had the largest shares amongst RYO brands.

7.10 We see that there is a spread of products across quality segments — 5 value-for-money products, 7 mid-range, 4 sub-premium, and 8 premium — and that the highest market shares are held by products in the middle of the quality range (the mid-range and sub-premium segments). Only one segment (sub-premium) has a sole product with more than half the market share held within that segment.

7.11 Next we consider how our model predicts the market would look, in equilibrium, if brand power were 10 per cent less (e.g. as a consequence of a plain packs requirement).

Figure 7.2: 10% brand degradation scenario

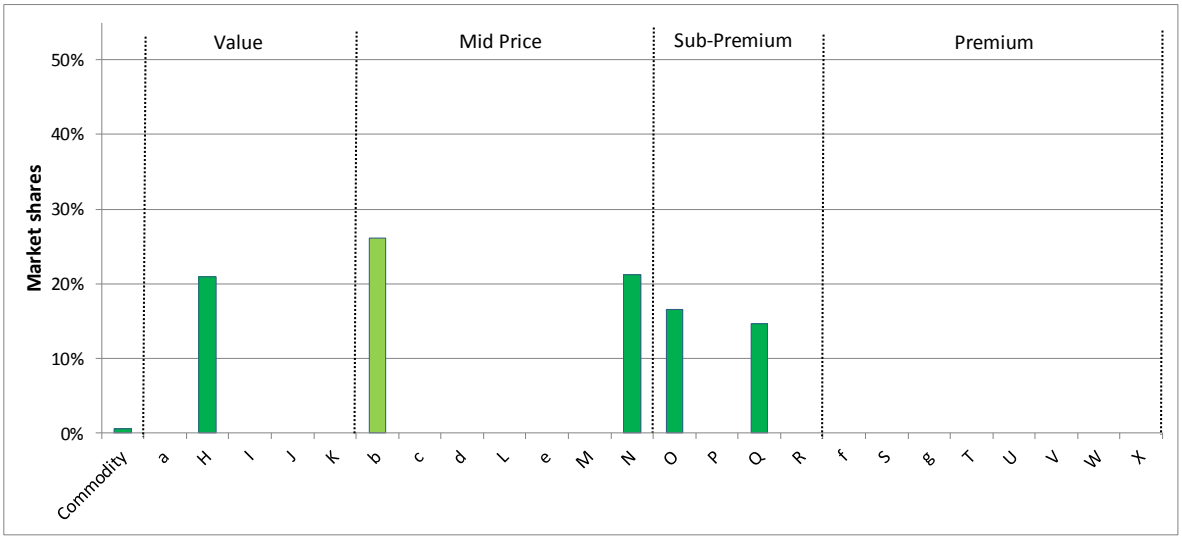


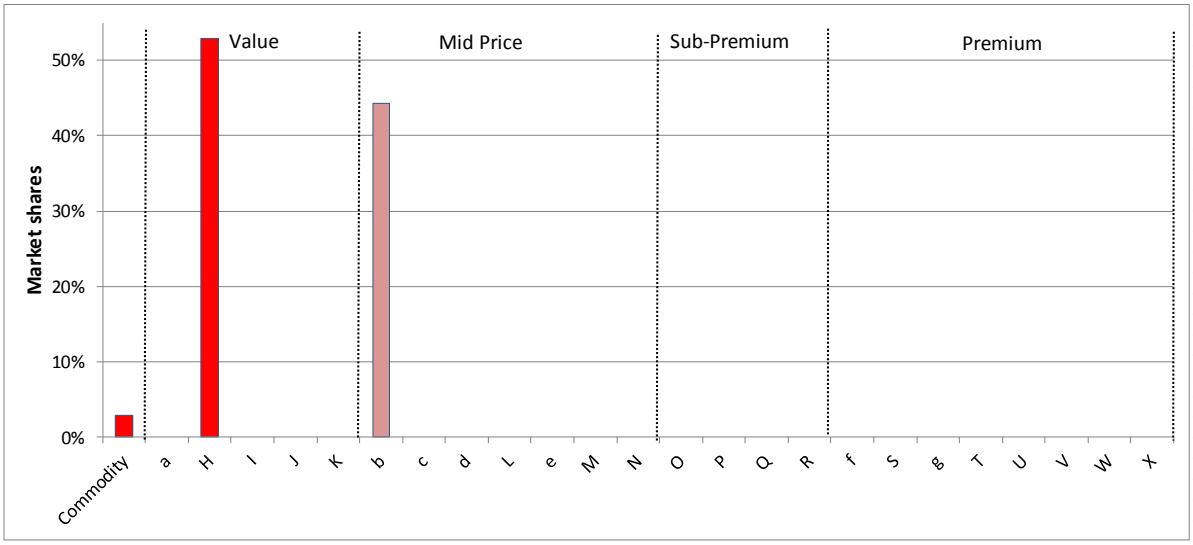
7.12 At the 10 per cent brand degradation level we note the pattern of focus upon a small number of brands per segment (per category) other than in the value-range. In particular, in the premium segment only one RMC brand ("U") and one RYO brand ("g") survive, and in the mid-price segment only one RMC brand ("N") survives. Even in some segments where more than one brand survives, competition is materially reduced. In the mid-price segments only two RYO brands ("b" and "e") survive. This pattern of fixation on few brands in many price segments is in line with what we expected from our discussion in the Section 5.

7.13 The other feature we can observe is a general drift downwards in quality. The most visible form this takes at 10 per cent brand degradation, relative to the status quo, is a reduction in market share for the Premium segment and an increase for the value for money segment.

7.14 These general patterns — increased market share for a few brands within segments, and a general drift downwards in average quality — are extended as we consider higher levels of brand degradation, 25 and 50 per cent.

Figure 7.3: 25% and 50% brand degradation scenarios



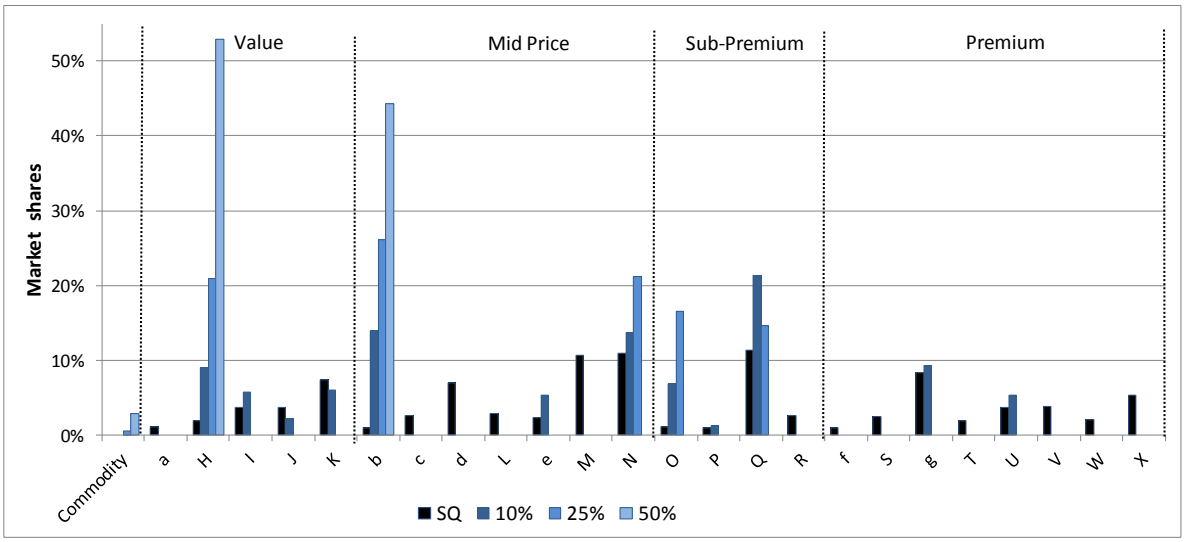


7.15 By 25 per cent per cent brand power degradation, the premium segment has been eliminated entirely, and only two or fewer brands remain in each lower quality segment.

7.16 By 50 per cent per cent brand degradation the sub-premium segment has also disappeared completely, and only one brand in each category ("H" in the RMC, and "b" in the RYO) survive.

7.17 By placing all these diagrams together, we can see how different degrees of brand degradation are associated with gains in market shares for particular brands (especially "H" and "b", but also (at lesser levels of degradation) "N", "O" and "Q".

Figure 7.4 Summary of market shares in Status Quo and with 10%-50% brand degradation scenarios



7.18 The following key conclusions of our model are robust and reproduced in all our cross-checks (of which we report a few in an Appendix below):

(a) For some low degree of brand degradation (in this case, 10 per cent), even if there continues to be non-trivial sales of products in all market segments (value for money, mid-range, sub-premium, premium), market shares in particular segments become focused on a small number of products.

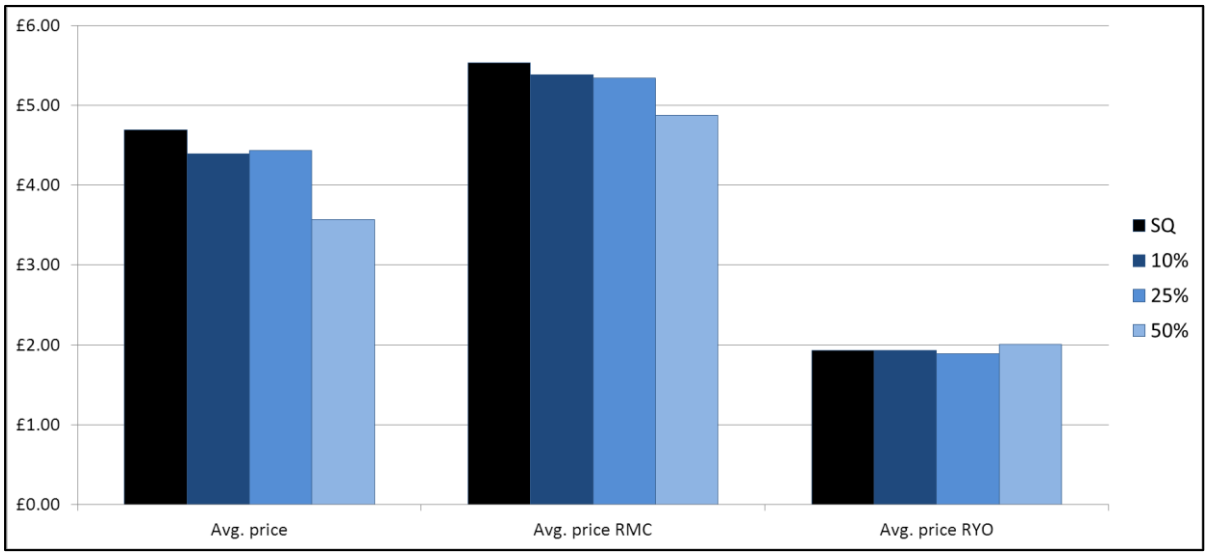
(b) lower-quality products gain market share at the expense of higher-quality products.

7.19 This is precisely in line with our discussion in 6.4.

7.20 We emphasise once again that the message to be drawn from this model is not that this or that specific brand will flourish. Neither is the correct message that if brand degradation is precisely this or that percentage then the market structure will be thus or so. Different specific brands gain or lose in different variants of our model, and the degrees of brand degradation required to produce results of the form reported here are sensitive to the assumptions of the model.

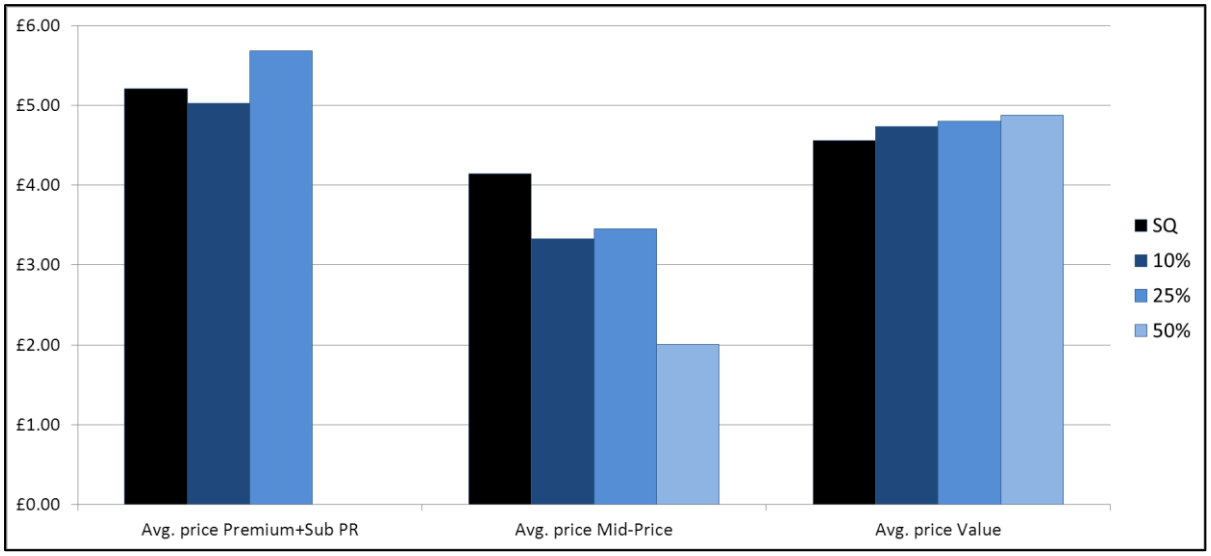
Impact on prices

Figure 7.5: Average prices by segment and brand power degradation (overall averages)



7.21 In the simulation, the average price of tobacco products as a whole falls from the SQ. The average prices for RMC fall for all degrees of brand degradation, whilst average prices for RYO are fairly stable (dropping only a little down to 25 per cent but at 50 per cent being higher than under the status quo). The RMC fall is significantly driven by the reduction in average quality for RMC products sold (many of the higher quality brands are eliminated). We see that at up to 50 per cent degradation, the average price paid for RYO rises.

Figure 7.6: Average prices by segment and brand power degradation (segment averages)



7.22 Similarly, prices for the average value product rises up to 50 per cent degradation. In each case these reflect the gains those lower-priced products that survive make as they are able to increase prices and market shares as brand power diminishes.

7.23 We can also see that for a number of segments and for RMC products as a whole, after an initial drop between the status quo and the 10 per cent degradation level, prices stabilise or even rise between 10 and 25 per cent degradation. This is very much in line with the discussion of Section 5 paragraph 5.30.

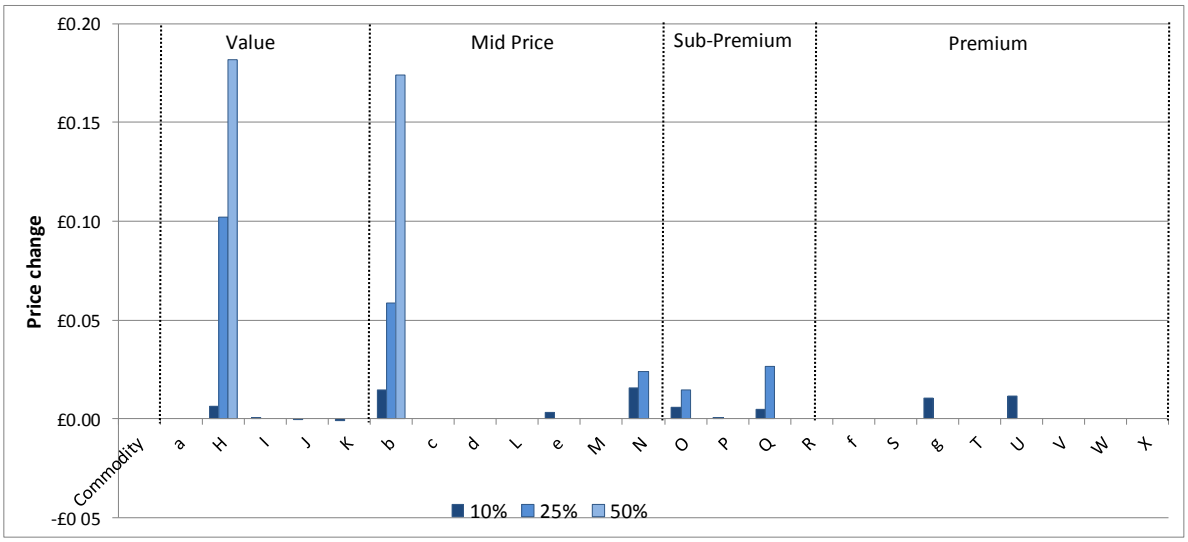
7.24 By 50 per cent degradation, on the other hand, market shares for RYO have risen sufficiently high that they drag down overall average prices for tobacco products quite materially.

7.25 Turning to price impacts by brand, the two most salient features of the diagram below are: first, that only a small minority of individual products fall in price (e.g. “K”); and secondly the marked increase in prices for the two brands that gain the most market share up to the 50 per cent degradation scenario, namely “H” and “b”. This reflects the fact that in the model, as well as gaining market share, these products gain pricing power. Similarly, but to a lesser extent, other brands that had the highest gains in market share, up to the level of degradation at which they survive, also were able to raise their prices — e.g. “Q”, “g” and “U”.

7.26 The fact that average prices of RMC fall even though the prices of almost all individual RMC products are either stable or rising, reinforces the point made above that the fall in the average overall price of tobacco and of RMC is driven by a change in the market structure (i.e. that lower-price-point products command an increased market share).

7.27 We note that the model presented here does not include the impacts of illicit trade. These could potentially have a material impact, especially on price changes.

Figure 7.7: Summary of price changes (absolute) with 10%-50% brand degradation



Impact on concentration

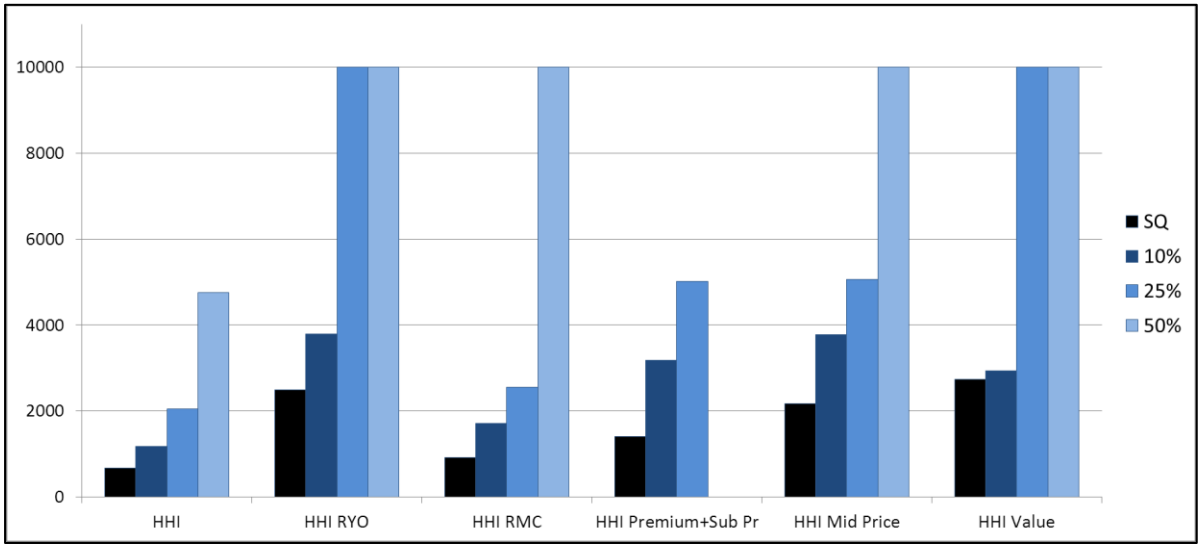
7.28 A standard economic approach to quantifying the degree of competition in a market is to calculate the Herfindahl-Hirschman index (HHI) value for that market. The HHI is calculated by squaring the market share of each firm competing in the market and summing the resulting numbers. The HHI takes into account the relative size and distribution of the firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. The HHI increases both as the number of firms in the market decreases and as the disparity in size between those firms increases. Formally, if there are N firms operating in a market, HHI is defined as:

$$HHI = 10{,}000\sum_{i=1}^{N} s_i$$, where s_i denotes the market share of firm i

7.29 We note that in our model, each brand is produced by its own firm. Thus there is no distinction between brand concentration and manufacturer concentration. It should, however, be noted that the HHI figures presented in what follows are brand HHI.

7.30 In our model, as can be seen in the figure below we observe a rise in the HHI of brands as competition declines, and this process occurs materially in every market segment and each category.

Figure 7.8: HHI by segment and 10%-50% brand power degradation



7.31 In Europe, markets are typically regarded as of low concentration (and thus likely to be competitive) if the HHI is below 1,000. Between 1,000 and 1,800 markets are often regarded as of moderate concentration, though European Commission merger guidelines use a range of 1,000-2,000 as their intermediate level.[31] With an HHI above this, markets are regarded as highly concentrated.

7.32 Similarly, in their 2010 Merger Guidelines[32], the US Department of Justice and Federal Trade Commission classify markets into three types:

(a) "Unconcentrated Markets: HHI below 1500

(b) Moderately Concentrated Markets: HHI between 1500 and 2500

(c) Highly Concentrated Markets: HHI above 2500"

7.33 In the SQ, the tobacco market as a whole, having an HHI below 1,000, would by these criteria be "unconcentrated" but would become "highly concentrated", on European definitions, by 25 per cent degradation, or on US definitions, by 50 per cent degradation. More narrowly defined markets would become highly concentrated at lower levels of brand degradation.

7.34 Both EU and US agencies also provide guidance as the changes in concentration that they regard as giving rise to concern:

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31 See http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2004:031:0005:0018:EN:PDF, paragraph 20.

32 Section 5.3 http://www.justice.gov/atr/public/guidelines/hmg-2010.html#5c

(a) For the European Commission: Where the post-merger HHI would be between 1,000 and 2,000, a change in HHI of less than 250 would not be of concern. Again, where the post-merger HHI would be above 2,000 a change in HHI of less than 150 would not be of concern.[33]

(b) For the US: "*Highly Concentrated Markets*: Mergers resulting in highly concentrated markets that involve an increase in the HHI of between 100 points and 200 points potentially raise significant competitive concerns and often warrant scrutiny. Mergers resulting in highly concentrated markets that involve an increase in the HHI of more than 200 points will be presumed to be likely to enhance market power. The presumption may be rebutted by persuasive evidence showing that the merger is unlikely to enhance market power."

7.35 Thus, any transaction increasing HHI by more than 200 would be regarded by US authorities as creating serious competition concerns worthy of scrutiny and "presumed to be likely to enhance market power", whilst in Europe a transaction of more than 250 basis points would not meet the HHI criterion for being unlikely to be of concern.

7.36 In our simulation, HHI for the tobacco market as a whole increases by

(a) 510 Points for 10 per cent degradation

(b) 1380 Points for 25 per cent degradation

(c) 4090 Points for 50 per cent degradation.

7.37 Concentration increases would be far in excess of these levels for more narrowly-defined markets.

7.38 So, even the lowest level scenarios for brand degradation here produce increases in concentration that, in almost any other context, would be regarded as significant by competition authorities or regulatory policy-makers.

Impact on profits above marginal costs

7.39 A rise in market concentration is an indicator of a reduction in competition. But not all rises in concentration imply increased market power. A rise in concentration combined with a rise in profits above marginal costs is a strong indicator of increased market power / reduced competition. Note that in a competitive market firms make what is known as "normal profits". The profits we focus upon here are those in excess of normal profits.

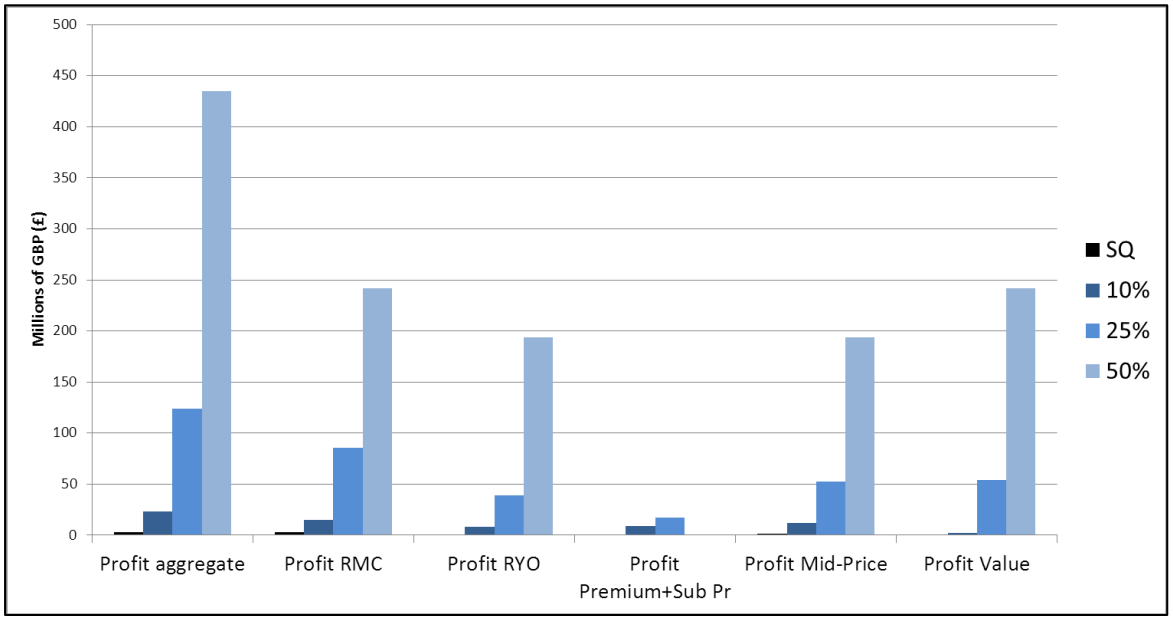
7.40 In our model, as noted at paragraph 6.34ff, the calibration generates a set of marginal costs as a calibration output (we did not have access to data on the costs of individual

[33] The European Commission expresses its approach to HHI in terms of sufficiently small changes in concentration being unlikely to give rise to concern, rather than as sufficiently large changes being likely to give rise to concern. See http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2004:031:0005:0018:EN:PDF, paragraph 20.

firms or brands). The simulation generates a set of quantities and prices. We define "profits in excess of marginal costs" as the difference between prices and marginal costs times quantities (always understanding that marginal costs are an output of the model, not an input to it).

7.41 In the light of the market structure and prices impacts described above, the increased concentration is associated with a material rise in profits above marginal costs, as illustrated in the figure below.

Figure 7.9: Profits above marginal costs by segment and brand power degradation (10%-50%)



7.42 It is important to emphasise that this is not a prediction that the tobacco sector would make increased total profits. For example, if normal profits in the premium sector are higher than in the value sector (reflecting the not-unnatural notion that risks and required entrepreneurial skill are greater in the case of higher-quality products), if the premium segment loses market share then aggregate normal profits for the industry would fall. Thus in respect of total profits we might have two partially-offsetting factors: a rise in profits above marginal costs but a fall in normal profits.

7.43 Thus, our result here reinforces the concentration (HHI) result, suggesting that increased concentration is indeed associated with increased market power. It should not, however, be interpreted as a prediction about aggregate profits for (for example) financial analysis purposes.

Analysis for very high brand degradation levels (75%-100%) — Scenarios of the type set out in paragraph 5.25(b)

Impact on brand survival and market shares

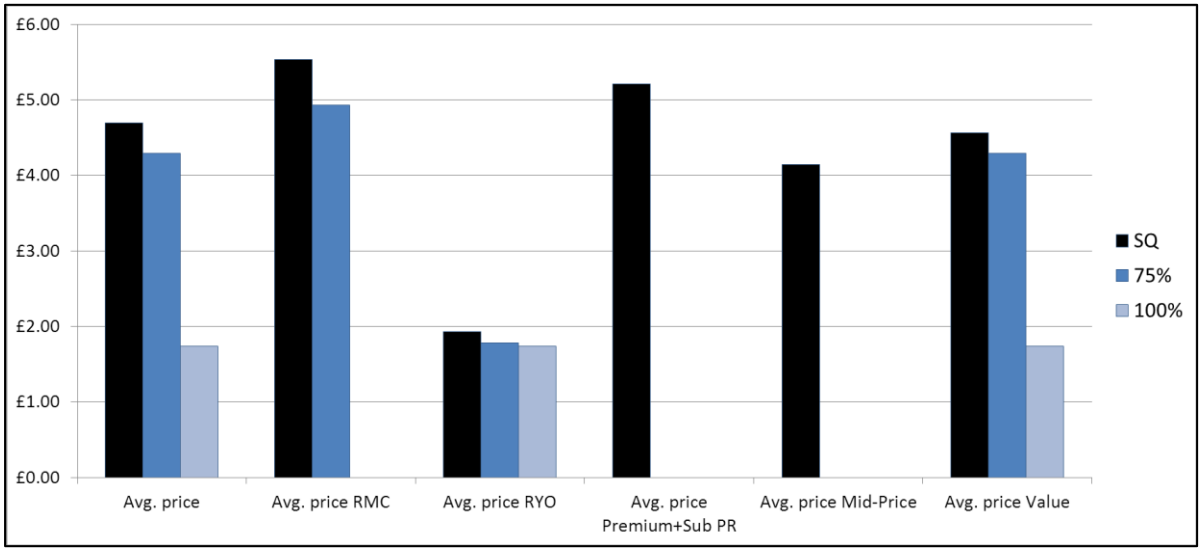
7.44 At very high levels of brand degradation (75 per cent plus), the only surviving brands are the lowest quality — the lowest-quality RMC ("H"), the lowest-quality RYO ("a") and purely commoditised new entrants (referred to as "Commodity") — see the figure below. At 100 per cent degradation, only the commodity and brand "a" survive ("a" survives because, by construction, its quality and costs are identical to that of the commodity).

Figure 7.10: Market shares with 75% and 100% brand degradation

Impact on prices

7.45 Average prices fall, as one would expect, at very high levels of brand degradation. At such high levels the undermining of brands overwhelms the forces that vested market power, and so raised some prices, at lower levels of degradation.

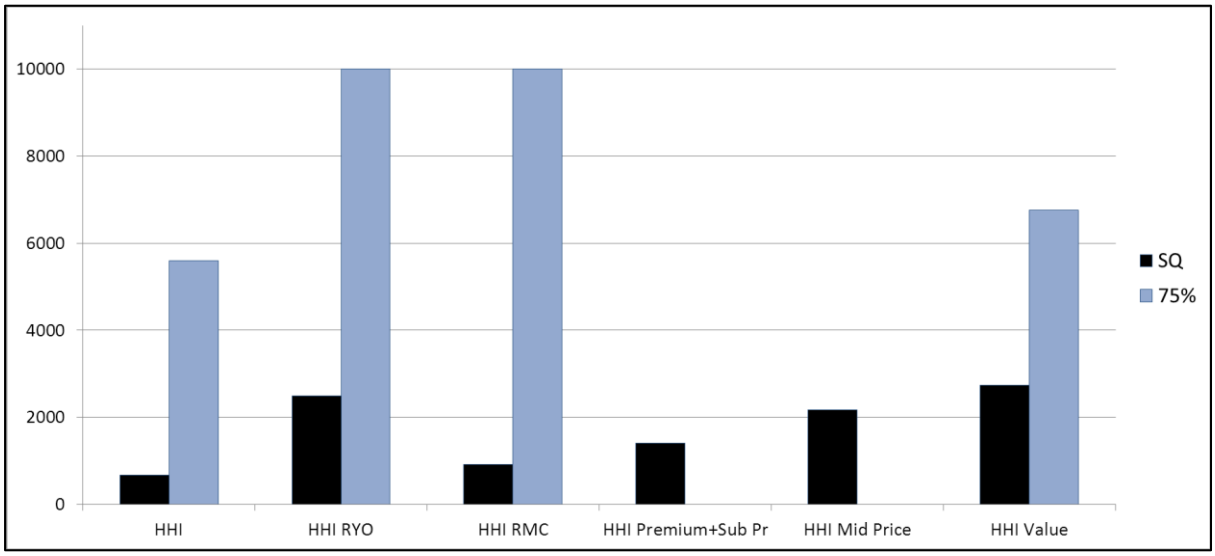
Figure 7.11: Average prices by segment and brand power degradation



Impact on concentration

7.46 For 75 per cent brand degradation, since brands "H" and "a" predominate, concentration is quite high. We do not report the 100 per cent case in the figure below as, in respect of HHI, this extreme case is not meaningfully represented directly in our models.

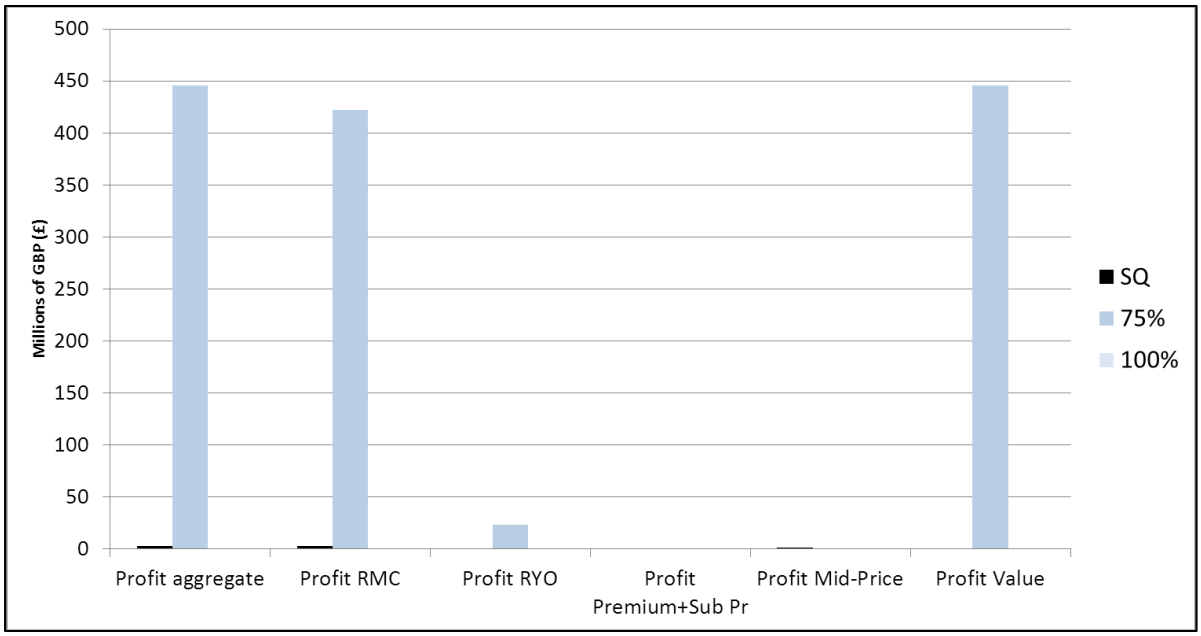
Figure 7.12: HHI by segment and 75% brand power degradation



Impact on profits above marginal costs

7.47 In the figure below we see that profits above marginal costs are still substantial at 75 per cent brand degradation, but are eliminated once the Commodity dominates at 100 per cent brand degradation.

Figure 7.13: Profits above marginal costs by segment and brand power degradation (75%-100%)



Robustness Checks

7.48 We have reproduced the key qualitative features of the results above in a wide range of models. In particular, we have found that the following key results are highly robust in models of this broad class — i.e. models in which branding serves the role of providing signals about the quality of tobacco products:

(a) With vertical quality differentiation — i.e. consumers agree which products are better and which are worse, rather than simply having tastes that differ (some preferring this product, others that one) — we can successfully calibrate models of the UK tobacco market.

(b) There exist scenarios in which limited brand degradation produces a focus upon specific brands within a number of quality segments — e.g. one premium brand, one mid-range brand. This process increases market power for certain products.

(c) There exist scenarios in which, with higher levels of brand degradation, there is an increase in the market shares of lower-quality and cheaper products at the expense of higher-quality products.

7.49 In Appendix 2 we set out three important cross-check models:

(a) A "linear" model (see paragraph 6.24) in which RYO products are of universally lower quality than RMC products. That is to say, there is no "cost of rolling" adjustment to the prices to consumers of RYO products.

(b) Two models in which, as in our main model, RYO products are introduced with a cost of rolling but the degree of potential variability in consumption is (i) higher; and (ii) lower than in our main model.

We show in Appendix 2 that the qualitative results obtained are very similar to those we have presented above for our main model. A particularly striking example of the similarity between the baseline case presented here and that in our cross-checks is provided by comparing the following two figures (for definitions and derivations of these figures, see the Appendix).

Figure 7.14: Market shares in the Benchmark Composite Model (θ_0= 0.23)

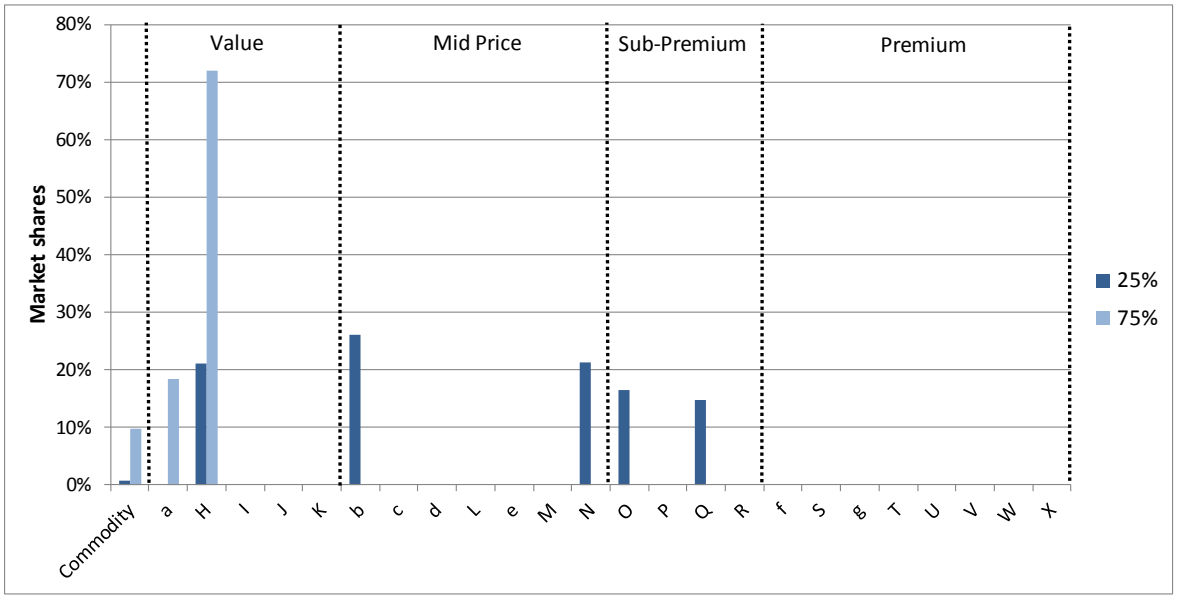
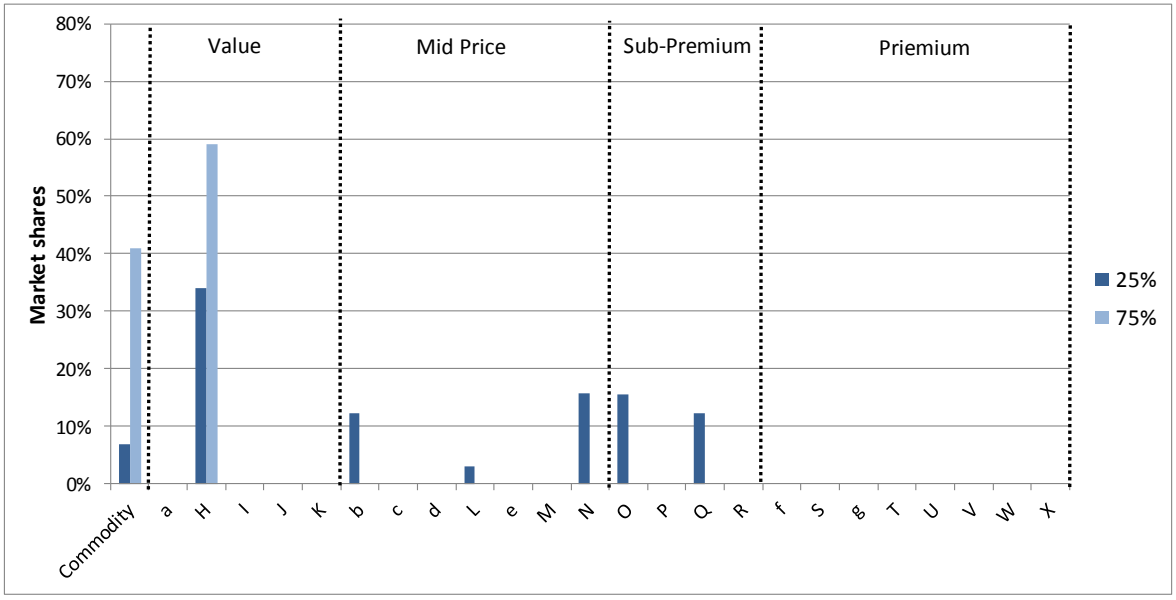


Figure 7.15: Market Shares in the "Linear model" (θ_0 = 0.23)



7.50 We can see clearly that the structure of the market and even approximate market shares in our benchmark and cross-check models are (quite remarkably) almost identical, even though the structural assumptions underpinning the linear model are significantly different. This strongly suggests that the qualitative results of the model are driven overwhelmingly by our characterisation of the role of branding, rather than by any accidental detail of the specific numbers for the UK market as at 2010 or our treatment of issues such as the cost of rolling.

Key Conclusions

7.51 The simulation model produced here reflects the theory of branding set out in earlier sections. As with any simulation model, we do not claim that such a simulation proves our theory to be correct — it reflects the theory; it does not produce it. But by producing a model, we gain insights into how straightforwardly applicable our theory is to the real world, we test the robustness and relevance of our conclusions (for it could be that there are offsetting causal mechanisms that only become apparent when a formal model is created, or that effects that are possible in theory are negligible in practice), and we refine our understanding. Mathematics thus produces new insights and intuitions, adding to pure qualitative theory.

7.52 We group our conclusions about this simulation model under three headings:

(a) *Does the model work?* There are two aspects to this:

⇒ Can our account of the role of branding accurately characterise the current UK tobacco market, before a plain packs requirement is introduced?

⇒ Can our account of the impact of plain packs be reflected in a model that initially so characterises the UK market?

(b) *Which of the theoretical results are reinforced by the process of producing a mathematical model?*

(c) *Which of our results are refined and what else new do we learn?*

Does the model work?

7.53 A model in which products are vertically differentiated — in which consumers broadly agree that some products are better than, rather than simply different from, others — works very well to characterise the UK market, whilst a model in which products simply differ, without universally being regarded as better or worse, does not. More specifically, the theory set out in earlier sections can be modelled in a very standard economic theory setting deploying normal mathematical modelling techniques involving vertically differentiated products and a signalling model.

7.54 Such a model allows us to produce scenarios, for plausible levels of brand degradation, in which the effects our theory predicts would indeed arise.

Which of the theoretical results are reinforced by the process of producing a mathematical model?

7.55 We use a natural interpretation of branding, set out above, in our model — namely that branding assists consumers in identifying the characteristics of products. Given this interpretation of branding, it follows naturally that a plain packs requirement would undermine the ability of consumers to identify the characteristics of products. Our model produces the result we argued for in Section 5 above and in the 2008 Report, namely that there is not simply uniform commoditisation and vigorous price competition unless levels of brand degradation are very high. Instead, for modest degrees of brand degradation, market competition is damaged, with fixation on a few brands in many price segments and the market power of some surviving products strengthened. There is also a general drift downwards in quality.

7.56 As regards prices, the 2008 Report suggested that impacts were ambiguous. Production costs might fall somewhat, whilst reduced competitive pressures might imply price rises for particular market segments, but the willingness of consumers to pay premium prices for premium product on average should be expected to fall.[34]

7.57 In our simulation model, prices in some market segments rise, driven by reduced consumer willingness to pay for premium product and a consequent change in the mix of

[34] Because our model abstracts from the possibility of premium products either reducing their production costs or selling, for a period, unprofitably, some of the dynamics of possible pricing behaviour discussed in 2008 are not investigated here.

products sold. The overall average price of tobacco products falls from the SQ, driven overwhelmingly by a reduction in the quality of products sold, not by any increase in competition. The prices for RMC products as a whole fall (as RMC products tend to include higher quality brands that would be driven from the market) whilst those for RYO products are broadly stable. For modest degrees of brand degradation effects on prices of individual brands vary— prices for some products rise (as market power increases) whilst those of others decrease (as consumer uncertainty reduces the willingness to pay for quality).

7.58 The net effect of the change in market structure discussed above results in an increase in market concentration (even for modest degrees of brand degradation), as measured by the HHI. This increase in concentration is associated with an increase in above-marginal-cost profits for a few players (whilst simultaneously reducing profits for other firms) — strongly suggesting a material increase in market power. At the same time, many players and products are driven out altogether.

7.59 The increases in concentration are of a scale that would normally be considered of interest and concern to policymakers, as measured on their own standard criteria. Indeed, a key reason competition impacts are assessed in regulatory analysis is to avoid introducing regulations that so vest market power and damage competition.

Which of our results are refined and what else new do we learn?

7.60 First, the analysis in Sections 2 and 5 would have been compatible with a tobacco market that was either vertically or horizontally differentiated or both. The fact that our model can be calibrated for a purely vertically differentiated model and cannot be calibrated for a horizontally differentiated model suggests that the market may be more naturally regarded as vertically differentiated and less strongly horizontally differentiated than was obvious to us before producing the simulation.

7.61 At the time of our 2008 Report we expressed scepticism about the likelihood of crystallisation. The process of producing a simulation model has made it even clearer to me than was the case in 2008 that our account of branding is in tension with the possibility of crystallisation, and that for crystallisation to occur there would need to be significant additional economic mechanisms at work, beyond those we have described in our theory of how brands work in the tobacco market.

8 APPENDIX 1: MORE DETAIL ON KEY FEATURES OF THE SIMULATION MODEL

8.1 We shall now explain the key features of the model in more detail.

The model is agnostic concerning whether consumption changes arise from the same number of consumers consuming more or less, or from the number of consumers changing

8.2 Consumption is variable in our models. The degree of variability of consumption is set, in our main model, according to the variability in consumption of UK smokers over the period 1991-2010. More specifically, in our main model we assume that potential consumption is up to one standard deviation (of 1991-2010 consumption) above actual consumption.[35]

8.3 However, the "consumption" variable in this model could be equally interpreted in terms of all consumption being by one smoker, there being a fixed set of smokers who each vary the amount they consume (e.g. smoke more or fewer cigarettes per day) or there being a set of potential smokers each of which might or might not smoke one cigarette, depending on prices and qualities, or any weighted combination of the above.

8.4 For ease of explanation, in what follows we shall often describe the functioning of the model as if there were a set of potential consumers, each of whom consumes precisely one cigarette. Obviously, this should not be taken literally or regarded as an assumption or conclusion of the model, but merely as a stylised explanatory device.

Products have underlying differences in quality

8.5 In our model we assume that products could differ in one vertically differentiated characteristic: "quality". Quality should be interpreted here broadly: it could refer to the quality of the tobacco used, the strictness of quality control standards implemented during the manufacturing process, the quality of the filter tips (for RMC products), or any other feature resulting in consumers preferring one brand over others.

8.6 In economic theory it is normal to distinguish between so-called "horizontal" and "vertical" quality differences. When there are horizontal quality differences, some products are simply different from others, but not universally either better or worse from the point of view of consumers (e.g. some consumers will prefer American blend tobacco products; other consumers will prefer Virginia style tobacco products[36]). When there are vertical quality differences, some products are simply better than others, and all consumers prefer them. See below.

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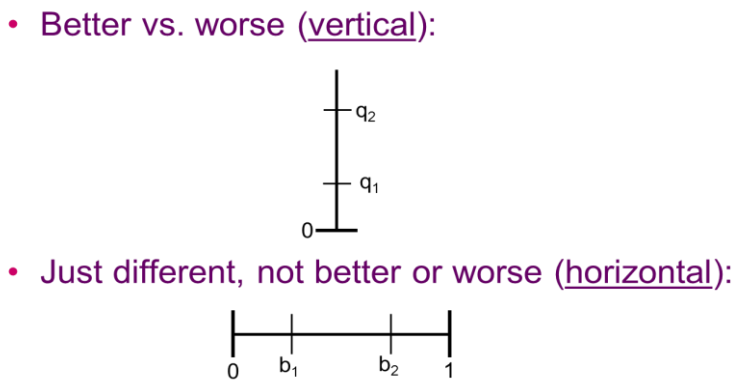
[35] See paragraph 9.10ff for more details on this point.

[36] We understand that the vast majority of products sold in the UK are Virginia blend).

8.7 Figure 8.1. below.

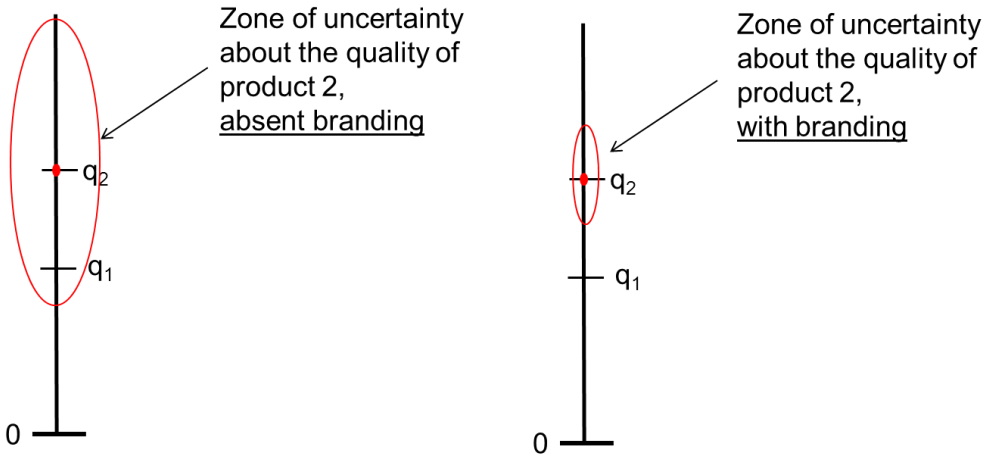
Figure 8.1: Difference in Nature



Branding allows products to communicate their quality

8.8 Consider Figure 8.2. In the left-hand panel there is considerable uncertainty regarding the quality of product 2. Consumers are, for example, uncertain as to whether it is of higher or lower quality than product 1. Branding reduces the uncertainty about the product's quality. But it does so imperfectly — in the right-hand panel there is still residual uncertainty about the product's quality, even with branding.

Figure 8.2: Role of Branding (stylised)



Treatment of RYO and RMC

8.9 We assume that the main distinction between RYO and RMC lies in the opportunity cost associated with rolling tobacco. In other words, we assume that the lower price at which RYO products are sold (compared to RMC) does not reflect the idea that RYO products are of lower quality than RMC. Instead, we assume that consumers purchasing a RYO

product will bear a total cost which is equal to the retail price of the RYO product plus the cost of rolling. Consequently, we adjust the prices of RYO product to account for this extra cost of rolling. We provide more details on how the cost of rolling was estimated further below.

8.10 As a cross-check we have also estimated an alternative version of the model (which we refer to as the "Linear model") where we abstract from the cost of rolling and where RYO brands are introduced linearly below the set of RMC in quality. Consequently, the nearest neighbours of the cheapest RMC are the second-cheapest RMC and the most expensive RYO product.

8.11 We assume that the model is segmented between RYO and RMC in the following sense: when comparing any two products, consumers know whether they are RYO or RMC. If the market in question is subject to a display ban, this assumption might be slightly less trivial than it might at first appear.

8.12 Furthermore, in equilibrium, what consumers expect to be the average quality of a pack of RMC is equal to the actual average quality of a pack of RMC and what consumers expect to be the average quality of a pack of RYO is equal to the actual average quality of a pack of RYO. This also constitutes a form of segmentation relative to, for example, the assumption that in equilibrium it was merely required that what consumers expected to be the average quality of all tobacco products (RMC and RYO combined) was equal to the actual average quality of all tobacco products.

Consumers are interested only in the expected value of consumption

8.13 This is a technical assumption about consumer utility functions, which are assumed to be linear in consumption. It implies, for example, that they are indifferent between obtaining their expected quality of product at a particular price with certainty and having a 50 per cent chance of the product's being twenty per cent better or twenty per cent worse than their central expectation.

The market consists of 17 RMC products and 7 RYO products plus a hypothetical commodity product

8.14 To make the analysis tractable, we have restricted it to the seventeen RMC brands with largest market shares (collectively constituting 95 per cent of RMC sales in the UK) and the seven RYO products with largest market share (constituting 97 per cent of RYO sales). In additional we assume the presence of a latent commodity product (i.e. an unbranded tobacco product). The purpose of this commodity is that of imposing a competitive constraint on branded products. More specifically, the commodity is modelled in to have zero market share in the status quo (because it cannot sell profitably at current market prices) but it may start selling profitably (e.g. because competitive pressure from branded products decreases) in the simulated scenarios.

8.15 The table below reports the 17 RMC and 7 RYO products used, their prices and their normalised market shares as of 2010. In our model these are referred to by brand code,

as reported here, since the model does not purport to make predictions about individual brands (for the reasons explained above). RYO products are referred to with lower case letters and RMC with upper case.

Table 8.1: Tobacco Brands' Market Shares and Prices, 2010

Type of product	Price segment	Brand Name	Brand Code	Market share	Price (£)
RYO	Value	GOLD LEAF	a	1.11%	1.74
RYO	Mid Price	GOLDEN VIRGINIA YELLOW	b	0.95%	1.83
RYO	Mid Price	CUTTERS CHOICE	c	2.58%	1.85
RYO	Mid Price	AMBER LEAF	d	6.95%	1.86
RYO	Mid Price	DRUM	e	2.30%	1.93
RYO	Premium	OLD HOLBORN	f	0.91%	2.03
RYO	Premium	GOLDEN VIRGINIA GREEN	g	8.42%	2.04
RMC	Value	PALL MALL	H	1.98%	4.70
RMC	Value	WINDSOR BLUE	I	3.65%	4.73
RMC	Value	JPS SILVER	J	3.70%	4.76
RMC	Value	STERLING	K	7.45%	4.77
RMC	Mid Price	ROTHMANS ROYALS	L	2.94%	5.08
RMC	Mid Price	RICHMOND	M	10.68%	5.35
RMC	Mid Price	MAYFAIR	N	10.92%	5.36
RMC	Sub Premium	SOVEREIGN	O	1.12%	5.56
RMC	Sub Premium	BERKELEY	P	0.95%	5.74
RMC	Sub Premium	LAMBERT & BUTLER	Q	11.41%	5.77
RMC	Sub Premium	B&H SILVER	R	2.68%	5.81
RMC	Premium	SUPERKINGS	S	2.51%	6.04
RMC	Premium	EMBASSY	T	1.90%	6.27
RMC	Premium	SILK CUT	U	3.70%	6.30
RMC	Premium	B&H GOLD	V	3.82%	6.30
RMC	Premium	REGAL	W	2.07%	6.31
RMC	Premium	MARLBORO	X	5.30%	6.36

Source: AC Nielsen Market Track data and EE calculations.

Every product competes independently, as if it were its own firm

8.16 Thus, for example, we do not model strategic decisions that might be made by a firm that owned two major brands — e.g. to exit the market with one brand to protect the position of the other.

All products exist in one geographic market

8.17 Some products may be sold more in some regions of the country — e.g. we are aware that Marlboro is sold more in London and the South East than in the North of England. One could investigate whether such patterns reflected the existence of geographically focused markets. Our model assumes just one geographic market for the UK.

Products set prices to maximise profits each period

8.18 In principle, one could imagine strategic behaviour by firms, such as being willing to price products at a loss for a period in order to stay in the market anticipating other products exiting at a later stage. Our model assumes no such behaviour occurs. Firms simply set prices to maximise profits each period and make no sales rather than accepting losses.

At market prices that prevail before a plain packs requirement is introduced, products of a higher price have a higher perceived quality

8.19 In our model consumers are prepared to pay more for products precisely because they believe quality is higher.

Products compete with all other products, but do so most vigorously with products closest to them in price

8.20 "Consumers" (or, more strictly, consumption) can, in principle, substitute directly from, say, value RMC products into premium RMC products. However, consumers vary in their willingness to pay — we can interpret this in terms of each consumer having a different budget constraint (e.g. a different income level). The presence of differing budget constraints determines a continuum of "positions" of consumers. This means that between any two products with positive market shares at a given set of prices there will be one indifferent "consumer" (unit of consumption). Such a consumer finds it most straightforward to substitute between products closest to it. Consequently, products compete most vigorously with those closest to them.

The introduction of a plain packs requirement leads to a reduction in consumer awareness of the quality of products

8.21 As a result of plain packs perceived quality comes to place a higher weight upon products being the average quality of all tobacco products and a lower weight upon the actual underlying quality of products.

8.22 We note that the degree of reduction in consumer awareness associated with a plain packs requirement is exogenous to the model, rather than being a result of it, and we do not have data that allow us to estimate the degree of such reduction. We therefore consider a range of scenarios for the reduction in consumer awareness.

A plain packs requirement induces a uniform market-wide proportionate reduction in branding quality signals

8.23 This means there is no change in the relative ranking of brand signals — if one product's true quality was better known by consumers than another product's true quality before plain packs were introduced, its true quality remains better known by consumers after plain packs are introduced.

Products have fixed qualities and costs of production, and once plain packs are introduced, firms cannot spend money to adjust their brand awareness further

8.24 Firms cannot adjust the quality of products (e.g. by changing the manufacturing process). In particular, they do not adjust costs or quality at all in response to the introduction of plain packs.

8.25 Furthermore, once a plain packs requirement is in place, firms cannot adjust their brand awareness — it simply degrades proportionately in line with that of other products.

9 APPENDIX 2: TECHNICAL APPENDIX

9.1 This appendix is organised in five sub-sections:

(a) Mathematical structure of the theoretical framework.

(b) Imputation of brand power values (sigmas) from brand attributes' data

(c) Calibration.

(d) Simulation.

(e) Robustness analysis.

Mathematical Structure of the Theoretical Framework

9.2 The theoretical framework on which the simulation exercise is based is that of a spatial model of vertical differentiation, developed to take into account for the role branding plays within the model.

9.3 We present the key components of the theoretical model below.

The Tobacco Market

9.4 There tobacco market is composed of n brands, n_{RMC} cigarette brands, and n_{RYO} roll-your-own (RYO) brands. The total number of tobacco brands is therefore $n = n_{RMC} + n_{RYO}$. Each tobacco brand i is characterised by:

- A brand-specific constant marginal cost of production, denoted by mc_i
- A brand-specific quality, denoted by q_i
- A brand-specific price, denoted by p_i

The role of branding

9.5 The key role branding plays in our setting is that of communicating product features (in our context called "quality") to consumers. Each branded product is characterised by a specific brand "power", denoted by $\sigma_i \in 0,1$, and which is defined as the probability with which the product is capable to perfectly signal its underlying quality to consumers.

9.6 More specifically, a consumer faced with a tobacco brand i will infer that the quality of the product is q_i with probability σ_i, and $E\ q$ with probability $1 - \sigma_i$, where $E\ q$ is the (weighted) average quality across all tobacco products.

9.7 Given the information setting described above, consumers have an expectation about the quality of each brand (i.e. the perceived quality), which is:

- $E\ q_i\ = \sigma_i q_i + (1-\sigma_i)E(q)$

9.8 Since all brands (both RYO and RMC) can be ranked in terms of their expected qualities, we assume that the label of each brand, i.e. $i = 1, \dots, n$, indicates the brand's position within the expected quality rank.

The latent commodity

9.9 We also assume that there exists a latent commodity product which we label $i = 0$. We assume that the commodity has the quality of the lowest brand, i.e. $q_0 = q_1$, and that consumers observe the commodity's quality with certainty, i.e. $\sigma_0 = 1$.

The demand-side

9.10 Potential consumption is uniformly distributed on a unit segment, and each atom of consumption is defined by its location on the segment, denoted by $\theta \in 0,1$. As noted above, the model could be equally interpreted in terms of all consumption being by one smoker, there being a fixed set of smokers who each vary the amount they consume (e.g. smoke more or fewer cigarettes per day) or there being a set of potential smokers each of which might or might not smoke one cigarette, depending on prices and qualities, or any weighted combination of the above. For ease of explanation, in what follows we shall often describe the functioning of the model as if there were a set of potential consumers, each of whom consumes precisely one stick.

9.11 The utility "consumer" θ receives from the consumption of brand i is:

- $u_i\ \theta\ = v + \theta\ \sigma_i q_i + (1-\sigma_i)E(q)\ - p_i$

9.12 The first term in the utility function above, v, represents the utility consumers receive from smoking, irrespectively of the tobacco product (RYO or RMC), and of the specific brand smoked. The second term, in contrast, represents the utility component which depends on the specific brand smoked and indicates that brands of higher expected quality lead to higher utility levels.

9.13 The second component indicates the that consumers are equally sensitive to price, but they differ in their sensitivity to quality (i.e. consumers with higher θ extract more utility from a given quality level than consumers with lower θ).

9.14 We observe that although v can in the above setup take a range of values, the model can be solved with $v = 0$, and it is this version of the model that we use.

9.15 Given this setup, it is straightforward to see that then the consumer who is indifferent between brand i and brand $i+1$ (indicated by $\theta_{i,i+1}$) is characterised by the following equation:

- $\theta_{i,i+1} = \frac{p_{i+1} - p_i}{E\ q_{i+1}\ - E\ q_i}$

9.16 Whilst we assume that potential consumption is uniformly distributed on the unit segment, we assume that only consumption located between $\theta_0, 1$ actually occurs, and that consumption located between $[0, \theta_0)$, though being potentially available, does not occur at current market conditions. Therefore, the location of "consumer" θ_0 (i.e. that atom of consumption that is indifferent between not occurring and smoking the product with the lowest expected quality, i.e., at current market condition, brand $i = 1$) is characterised by the equation:

- $\theta_0 = \frac{p_1}{E\ q_1}$

9.17 Therefore the share of potential consumption which does not occur at current market prices is θ_0, whilst current consumption (expressed as a share of total potential consumption is equal to $1 - \theta_0$.

The supply-side

9.18 We assume that each product operates as an independent firm which seeks to maximise its profit. The profit of brand i is given by:

- $\pi_i = \ p_i - c_i \ \ \theta_{i,i+1} - \theta_0$ if $i = 1$
- $\pi_i = \ p_i - c_i \ \ \theta_{i,i+1} - \theta_{i-1,i}$ if $1 < i < n$
- $\pi_i = \ p_i - c_i \ \ 1 - \theta_{i-1,i}$ if $i = n$

Market Equilibrium

9.19 The market equilibrium is the solution of the following system of equations:

$$\begin{aligned} \frac{\partial \pi_1}{\partial p_1} &= 0 \\ &\vdots \\ \frac{\partial \pi_i}{\partial p_i} &= 0 \\ &\vdots \\ \frac{\partial \pi_n}{\partial p_n} &= 0 \end{aligned}$$

9.20 This yields to the following system of first-order-conditions (FOCs):

$$p_1\ p_2\ = \frac{1}{2}c_1 + \frac{1}{2}\ \frac{E\ q_1}{E\ q_2}\ p_2$$

$$\vdots$$

$$p_i\ p_{i-1}, p_{i+1}\ = \frac{1}{2}c_i + \frac{1}{2}\ \frac{E\ q_{i+1}\ - E\ q_i}{E\ q_{i+1}\ - E\ q_{i-1}}\ p_{i-1} + \frac{1}{2}\ \frac{E\ q_i\ - E\ q_{i-1}}{E\ q_{i+1}\ - E\ q_{i-1}}\ p_{i+1}$$

$$\vdots$$

$$p_n\ p_{n-1}\ = \frac{1}{2}c_n + \frac{1}{2}\ E\ q_n\ - E\ q_{n-1}\ + \frac{1}{2}p_{n-1}$$

Imputation of Brand Power Values from Brand Attributes' Data

9.21 Data on brand attributes are reported as the percentage of smokers who associated each brand with a series of attributes such as whether the brand is perceived as being: a leader, international, dynamic, prestigious, of high quality, providing value for money, etc. We have run a simple regression analysis which aims at explaining differences in actual prices from the mean price in terms of the underlying reported attributes.[37] The estimated model has a very high R-squared (more than 95 per cent), a result which we interpret as indicating that, on average, self-reported attributes are good predictors of the underlying prices, and therefore qualities, of brands.[38,39]

9.22 We have then used the residuals of the regression as a relative measure of how accurately consumers can predict the underlying quality of a brand. A low residual — in absolute value — implies that consumers are relatively aware of the underlying quality of the product (or alternatively, that the brand is able to communicate effectively the underlying quality to consumers). A high residual, in contrast, indicates that consumers have a poor perception of the underlying quality of the product (or, alternatively, that the brand is less capable to communicate product features to consumers).

9.23 The last step consists in normalising the residuals of each brand in order to translate them into estimates for sigmas. We have done so by calculating sigmas as follows:

- $\sigma_i = 1 - (\varepsilon_i / E)$

where ε_i indicates the brand's residual obtained from the brand attribute regression, and *E* is the average difference (in absolute value) between price and mean price across all brands. Notice that *E* is nothing other than the mean of the residuals obtained from a trivial regression in which prices are explained only by a constant and, therefore, it can be interpreted as the typical residual which would occur in a counterfactual scenario in which brand attributes — and thus brands — cannot be used to infer product features.

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[37] For RYO brands, differences in prices were calculated relative to the mean price of RYO products only and, similarly, differences in prices for RMC brands calculated relative to the mean price of RMC products.

[38] We should stress that the coefficients of the regressions are often not statistically significant. This is not surprising given that small sample size (i.e. 19 brands). However, the purpose of the regression in this context is not that of providing robust empirical evidence, but simply that of measuring correlations between attr butes and prices.

[39] Note that here we use brand prices as proxies for brand qualities.

9.24 To summarise, the formula above implies that:

- if the value of ε_i is close to zero (which, as we said earlier, indicates that brand *i* has a high power of communication) the resulting sigma value would be close to one;
- if the value of ε_i is close to *E* (i.e. the typical residual we would observe in a counterfactual scenario where brand attributes cannot be used to infer a product's characteristics) the resulting sigma value would be close to zero.

9.25 The table below reports the sigma estimates. For some of the brands included in our analysis brand attributes data was not available.[40] For such brands sigmas were calculated as the weighted average of sigmas across brands (for which brand attributes data is available) belonging to the same price category.

[40] Brand attributes are not available for: Rothmans Royals, Sovereign, Berkeley, Superkings, Embassy, and Regal. Also, attributes are available for the Golden Virginia band family but not separately for Golden Virginia Green and Golden Virginia Green Yellow. Therefore the same sigma value has been assigned to both brand varieties.

Table 9.1: Brand Power (sigmas)

Type of product	Price segment	Brand	Sigma
RYO	Value	a	0.33
RMC	Value	H	0.93
RMC	Value	I	0.80
RMC	Value	J	0.76
RMC	Value	K	0.74
RYO	Mid Price	b	0.94
RYO	Mid Price	c	0.75
RYO	Mid Price	d	0.74
RMC	Mid Price	L	0.75
RYO	Mid Price	e	0.77
RMC	Mid Price	M	0.62
RMC	Mid Price	N	0.86
RMC	Sub Premium	O	0.92
RMC	Sub Premium	P	0.92
RMC	Sub Premium	Q	0.95
RMC	Sub Premium	R	0.76
RYO	Premium	f	0.57
RMC	Premium	S	0.86
RYO	Premium	g	0.94
RMC	Premium	T	0.86
RMC	Premium	U	0.96
RMC	Premium	V	0.85
RMC	Premium	W	0.86
RMC	Premium	X	0.72
Average sigma (RYO)			**0.83**
Average sigma (RMC)			**0.72**
Average sigma (Premium and sub-premium)			**0.85**
Average sigma (Mid Price)			**0.78**
Average sigma (Value)			**0.71**

9.26 We notice that, on average, sigmas tend to be higher for RMC compared to RYO, and that they tend to increase with the price segment.

Calibration Approach

9.27 The calibration was conducted in two separate steps:

- First, we have set an initial value for θ_0, i.e. the share of potential consumption which does not occur at current market prices — there is no definite measure or definition of

potential additional consumption (i.e. units of consumption that do not occur at current market prices but which may occur in the simulated scenarios) in the UK tobacco market. In order to set a value for potential additional consumption, we have drawn upon data from HMRC.[41] More specifically, we have calculated the standard deviation of annual (millions of) sticks cleared over the period 1991-2010 (calendar years), and noticed that this represents approximately 30 per cent of the average number of sticks cleared over the same period. We interpret this as a measure of potential consumption in excess to average and require that the share of potential additional consumption over the total (additional plus current) potential consumption is also 30 per cent. This leads to a value for θ_0 of approximately 0.23, since 0.23 / (1 – 0.23) = 0.3. Since we acknowledge that there is a degree of uncertainty over the exact value of θ_0, our robustness analysis runs simulations also for value of θ_0 equal to 0.1 and 0.3.

- Second, we have used market shares and prices (adjusted for RYO products to reflect the "cost of rolling") in order to obtain the perceived qualities (i.e. the values $E\ q_i$) and the marginal costs for each brand.

- Third, we have used the sigma values of each brand and the fact that the perceived qualities are expressed as $E\ q_i = \sigma_i q_i + (1-\sigma_i)E(q)$ in order to calculate the actual (as opposed to perceived) quality of each brand, i.e. q_i.

9.28 By following the calibration strategy described above the values for the calibration could be perfectly identified (i.e. the underlying system of equations is not under-identified).

Simulation

9.29 Simulation results are obtained in two steps:

(a) The first is a *short run* analysis where changes in market shares and prices result only from the supply side, e.g. firms (brands) update their pricing behaviours in light of a changes in sigmas, but consumers hold the same expectation with regard to average quality (i.e. $E(q)$) they have in the status quo. In economic terms this short-run outcome is considered to be *non-rational in expectations*.

(b) The second is a *long run* analysis where consumers, in light of the observed changes in brand market shares, update gradually their beliefs on average quality. In turn this leads to further reactions (i.e. further changes in prices and market shares) on the supply side, and this process continues up to the point in which consumers' expectations about the average quality of products are consistent with the actual average quality of products available in the market. In economic terms, this long-run outcome is considered to be one of *rational expectations*. During the adjustment to

[41] See: https://www.uktradeinfo.com/Statistics/Statistical%20Factsheets/TobaccoFactsheet2011.xls

the long-run, any iteration in which a product makes negative profits results in that product being dropped in later iterations.

9.30 The results we report are for the long-run equilibrium.

Robustness Analysis

9.31 We have simulated the three variations of the model in order to test the robustness of our central results; these are:

(a) A model where the share of potential additional consumptions is assumed to be 0.1, i.e. a model with θ_0 = 0.1.

(b) A model where the share of potential additional consumptions is assumed to be 0.3, i.e. a model with θ_0 = 0.3.

(c) A model (which we refer to as the "Linear model") where we abstract from the cost of rolling and where RYO brands are introduced linearly below the set of RMC in quality (θ_0 is assumed to take the benchmark value of 0.23).

9.32 The mathematical assumptions of the "Linear Model" are partially different from those of our benchmark model. More specifically, a consumer faced with a cigarette brand i will infer that the quality of the product is q_i with probability σ_i, and $E\ q_{RMC}$ with probability $1-\sigma_i$, where $E\ q_{RMC}$ is the (weighted) average quality across all cigarette brands. Similarly, a consumer faced with a RYO brand i will infer that the quality of the product is q_i with probability σ_i, and $E\ q_{RYO}$ with probability $1-\sigma_i$, where $E\ q_{RYO}$ is the (weighted) average quality across all RYO brands.

9.33 Given the information setting described above, consumers have an expectation about the quality of each brand, which is:

- $E\ q_i = \sigma_i q_i + (1-\sigma_i)E(q_{RMC})$, if i is a RMC brand
- $E\ q_i = \sigma_i q_i + (1-\sigma_i)E(q_{RYO})$, if i is a RYO brand

9.34 In the "linear" model the commodity sits at the bottom of the RYO segment and therefore is assumed to be a RYO product.

9.35 For each of the three alternative models described above, simulations have been run for moderate levels (25 per cent) and extreme levels (75 per cent) of brand degradation. We report below market shares at 25 per cent and 75 per cent brand degradation levels for the benchmark model and for the three alternatives models.

Figure 9.1: Market shares in the Benchmark Composite Model (θ_0= 0.23)

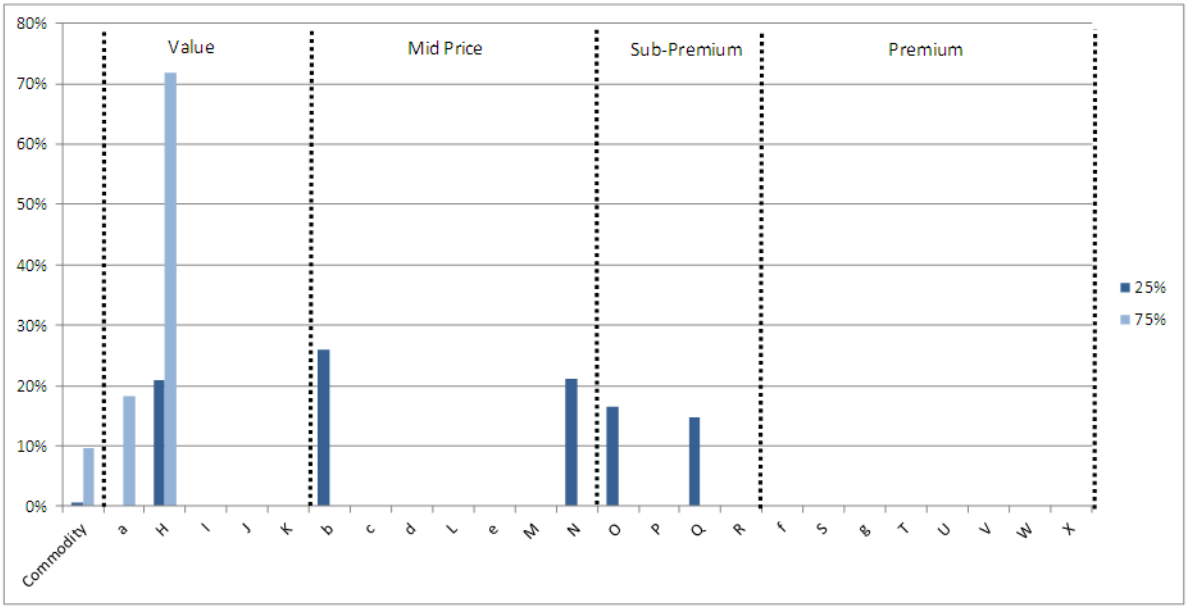


Figure 9.2: Market Shares in the "Linear model" (θ_0 = 0.23)

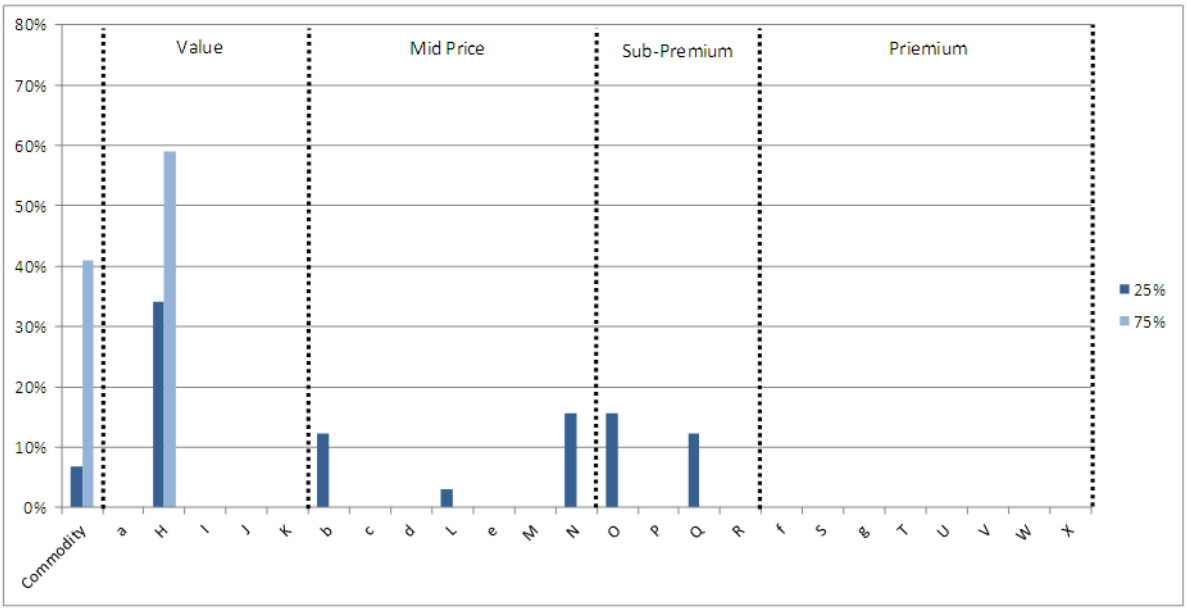


Figure 9.3: Market shares in the Composite Model with θ_0= 0.3

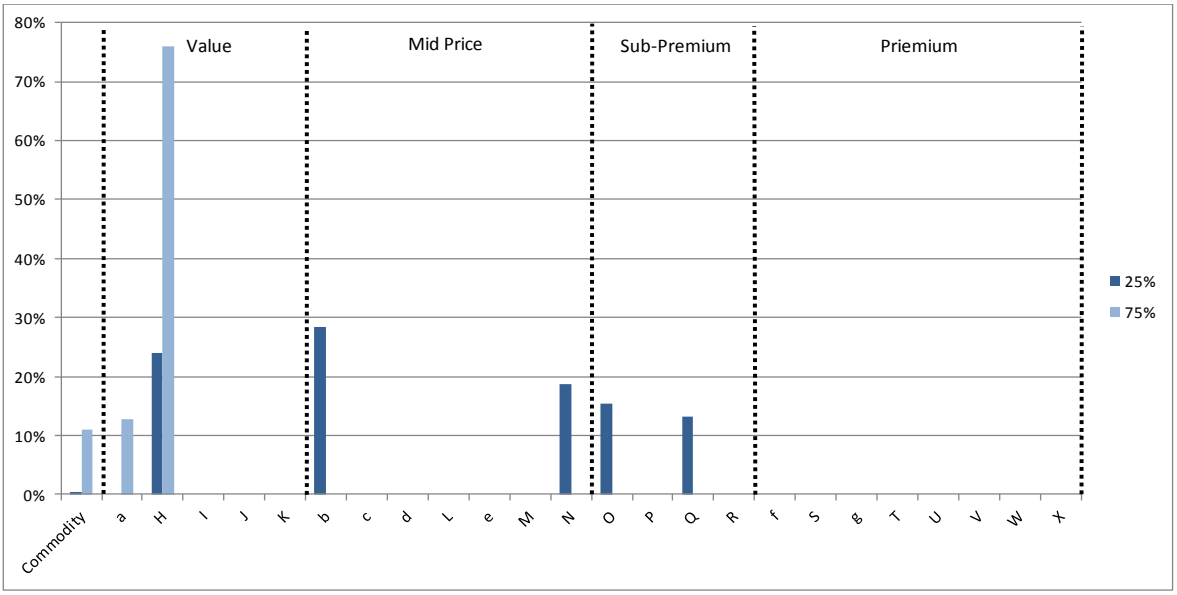
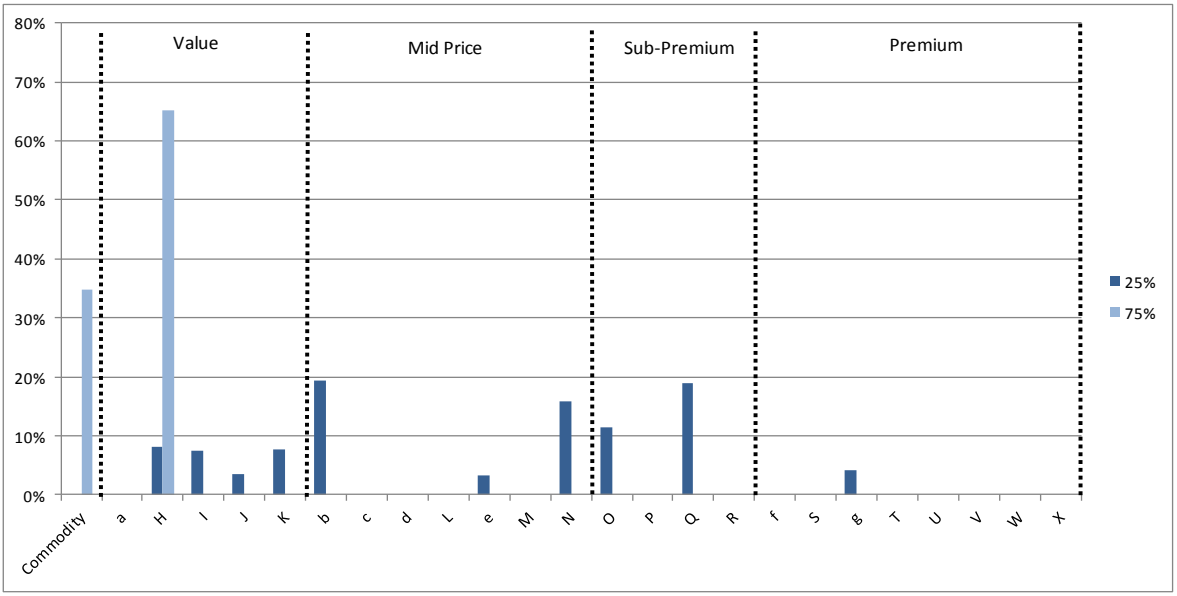


Figure 9.4: Market shares in the Composite Model with θ_0= 0.1



9.36 We note the following:

(a) The results of the linear model (with θ_0= 0.23) are remarkably similar to those of the benchmark model. In fact the results are virtually identical at 25 per cent brand degradation level, and they differ only in the number of surviving brand (two in the benchmark model and one in the linear model) at the 75 per cent degradation level.

(b) The results of the composite model with θ_0= 0.3 are virtually identical to those of the benchmark model with θ_0= 0.23. At both 25 and 75 per cent brand degradation level,

the set of surviving brands in the two models is identical, and the relative market shares are also remarkably similar.

(c) The results of the composite model with θ_0= 0.1 are qualitatively identical to those of the benchmark model. The main differences between the two models are the following. First, a larger number of value brands survive at the 25 per cent brand degradation level in the cross-check (θ_0= 0.1) model compared to the benchmark model. Second, at the 75 per cent brand degradation level only one brand survives in the cross-check model compared to two brands surviving in the benchmark model. However, besides these differences, the two models display similar patterns, i.e. down-trading, and fixation on a small number of brands in each price segment.

10 APPENDIX 3: CURRICULUM VITAE OF DR ANDREW LILICO

QUALIFICATIONS

St. John's College, Oxford
BA (Hons) Politics, Philosophy and Economics (1989-92)

University College, London
MSc. Economics (1997-8)

University College, London
PhD. Economics (1998-02)

CAREER DETAILS

Sep 02 -	**EUROPE ECONOMICS, London** *Director (Chairman) and Principal*
1999 - Sep 02	**UCL, London** *Visiting Lecturer and Teaching Assistant in Economics*
1999-2003	**Welwyn Hatfield District Council** *Shadow Finance Spokesman (2001/2), Shadow Spokesman for Economic Development (2000/1)*
1994-99	**PlasPET Group, Florida, USA** *Business Consultant (free-lance)*
1998	**The Adam Smith Institute (International Division)** *Economic Consultant (free-lance)*
1997	**Institute of Directors** *International and Public Sector Economist*
1992-94	**Institute for Fiscal Studies, London** *Economist*
1988-89	**ICI Runcorn Heath Site** *Mathematical Research Scientist*

SELECTED PROFESSIONAL EXPERIENCE

IMPACT ASSESSMENT

European Parliament
Two impact assessments on the Alternative Investment Fund Managers Directive (September 2009 to November 2009)
Critiquing the European Commission's Impact Assessment concerning the AIFM Directive and producing our own alternative ex ante IA.

European Parliament
Critique of EC IA on CRD (November to December 2008)
This project critiqued the European Commission's impact assessment on the revision to the Capital Requirements Directive in respect of cross-border supervision and crisis management.

European Parliament DG Internal Policies
Briefing on the economic impact of the proposed defence procurement directive (2008)
Project Director on a study of the economic impact of the proposed directive 2007/0280 (COD) on competition, the coordination of procedures for the award of certain public work contracts, public supply contracts and public service contracts in the fields of defence and security.

European Commission DG Internal Market
Cost of complying with EC Financial Services Action Plan (December 2007 to October 2008)
Director of project assessing and quantifying the cost of complying with the EU's financial services action plan.

European Parliament
Impact of EC Financial Services Action Plan and Financial Services White Paper (December 2005 to February 2007)
Project director for large-scale project for DG Internal Policies assessing and quantifying the impact of the EU's financial services framework on all EU Member States, both individually and collectively.

FSA
Cost and Benefits of the FSA Training & Competence Exams Requirement (September 2006 to February 2007)
Project director for project assessing and quantifying the costs and benefits associated with a particular FSA regulation.

FSA

Benefits of the Markets in Financial Instruments Directive (September 2005 to April 2006)

Project leader for project assessing and quantifying the benefits associated with a major EC directive.

European Commission

Impact of transport policies on growth and productivity in the EU (December 2005 to September 2006)

Project leader for project, conducted for DG TREN, developing a new economic growth model and conducting an econometric study.

FSA

The Costs of Compliance (April to June 2003)

Played a leading role in a major study to assess the size and drivers of incremental cost of compliance with FSA regulation since 1998.

FSA

The Costs and Benefits of FSA Authorisation of General Insurance and Mortgage Intermediation (November 2002 to January 2003)

Part of a team assessing the costs and the costs and benefits of authorisation proposals for the FSA regulation of mortgages and general insurance.

HEALTH

European Commission DG Enterprise
Impact assessments concerning safety issues relating to parallel trade in medical devices (four projects) (2007-8)
Project Director for two major impact assessments conducted on behalf of DG Enterprise assisting with analysis of scope for and details of a potential Directive.

European Commission DG Enterprise
Impact assessments concerning safety issues relating to parallel trade in counterfeit medicines (two projects) (2007-8)
Senior Advisor for two major impact assessments conducted on behalf of DG Enterprise assisting with analysis of scope for and details of a potential Directive.

European Commission DG Enterprise
Assessment of medicines patient information regulations (2008)
Senior advisor on team advising DGENT on the functioning of rules restricting the provision of information direct to patients regarding medicines and potential reform thereof.

Wyeth Portugal
Reimbursement status of Enbrel in Portugal (December 2005 to September 2006)
Advocacy project considering the case for a change in the reimbursement status of a drug.

INFARMED
Redesign of Portuguese Pharmaceuticals Regulation (July 2004 to April 2005)
Redesigning the Portuguese co-participation and pricing systems for the government pharmaceuticals regulator.

Ranbaxy
Assistance with legal defence in alleged cartel: Cillins case (May 2004 to April 2005)
Assisting the defence in critiquing the alleged damages in a court case alleging that generics pharmaceuticals companies colluded in the late 1990s, with regards to the prices of a set long-established generic medicines.

Ranbaxy
Assistance with legal defence in alleged cartel: Ranitidine case (August 2004 to April 2005)
Assisting the defence in critiquing the alleged damages in a court case alleging that generics pharmaceuticals companies colluded in the late 1990s with regards to the production and pricing of a newly off-patent medicine.

MSD / LASM
Article 82 (June 2004)
Competition economics analysis of impact of European Treaty article pertaining to abuse of a dominant position with reference to parallel trade.

Pfizer
Analysis of alternative pharmacist reimbursement schemes (January 2004)
Analysis of alternative pharmacist reimbursement schemes.

Merck Sharp & Dohme
NHS Reforms (August 2003)
Analysis of UK NHS reforms for an industry seminar.

Staff Working Paper
Risk-sharing pricing models in the distribution of pharmaceuticals (February 2003)
Technical paper analysing conditions under which payment-by-results contracts for pharmaceuticals could be advantageous.

EFPIA
Parallel trade with Accession States (November 2002)
Analysis of the proper application of Article 81 to parallel trade in pharmaceuticals with Eastern Europe after New Member States join EU.

ECONOMIC REGULATION AND COST OF CAPITAL

BAA, UK
Cost of Capital of Heathrow Airport (March 2011 — ongoing)
Provision advice to BAA on the cost of capital of Heathrow Airport in the context of the Q6 Price Control.

BSkyB, UK
Advice relating to Ofcom consultation on various BT charge controls (January 2011 — on-going)
Advice based on cost of capital methodology to influence Ofcom's decisions with regard to price control reviews.

Ofgem, UK
Weighted Average Cost of Capital (October 2010 — January 2011)
Role: Project leader. Study: The analysis consisted first in estimating equity betas for individual companies, and for the entire sector. The latter estimation was based on an approach which consists in defining the sector's return as a weighted average of the companies' returns, where each company's weight is proportional to the company's market capitalisation. It also involved the development of a methodology for disaggregating the industry beta into separate betas for each company's regulated business division based on accounting data.

CER
The Cost of Capital for electricity transmission and distribution companies (September 2009 to July 2010)
Current analysis of the cost of capital, on behalf of the Irish regulator CER, over the 2011 to 2015 period.

Air New Zealand
The Cost of Capital for the New Zealand Airports (July 2010)
Critiquing the Commerce Commission's assessment.

CAA
The Cost of Capital for NATS (August 2009 to May 2010)
Director of project assessing the cost of capital for the regulated entity managing air traffic control.

Ofwat
The Cost of Capital for the Water Industry (July 2008 to May 2010)
Director of project assessing the cost of capital for the regulator.

Ofcom
Applicability of Real Options in Regulation of third generation mobile phone termination charges (August 2006)

CAA
The Cost of Capital for BAA (February 2006 to April 2008)
Core advisor on project assessing the cost of capital for the regulated entity managing the main London airports.

FICORA
Cost of Capital for Digita
Advisor on project, conducted for the Finnish Communications Regulatory Authority, assessing the cost of capital for the company responsible for Finnish digital television broadcasting and transmission networks.

Ofcom
Cost of Capital, Real Options (May to September 2005)
During a full-time secondment at Ofcom, participating in a major policy statement by Ofcom on its approach to regulatory cost of capital, including being the main author of the section on the application of real options theory in regulation; assessing BT's permitted group beta; assessing the case for granting different costs of capital on different parts of BT's business.

BEHAVIOURAL ECONOMICS AND CONSUMER DETRIMENT

Peer-reviewed publication CESifo Economic Studies (2010) 56 (2): 141-164
Smoking Today and Stopping Tomorrow: a Limited Foresight Perspective
This article considers an intertemporal decision problem in which the agent has limited foresight. It offers an interpretation of why people may smoke when they are young—as a result of having a short horizon of foresight — and refrain from smoking when they get older — as a result of having better foresight. (JEL codes: D03, D83, D91, I10)

Financial Services Authority
Firm-level predictors of consumer loss through poor financial advice (2007)
Project Director of a statistical and theoretical analysis to determine the drivers of consumer loss of Personal Investment Firms in the UK market.

European Commission, DG SANCO
Defining and measuring consumer detriment (2006)
Team member in a large-scale nine-month project for the European Commission on defining and measuring consumer detriment. The project comprised five elements:

- A multidisciplinary review of the literature, covering the fields of economics, behavioural economics, psychology, and marketing;
- Definition of the concept of consumer detriment, and analysis of what might cause it;
- Development of a methodology for estimating consumer detriment;
- Development of market monitoring indicators;
- Pilot testing of the proposed methodology.

Doctoral thesis
Limited foresight (2004)
Mathematical modelling of why agents might have limited foresight, how to determine a solution (equilibrium) concept, and the implications of limited foresight for monetary policy-making.

Staff Working Papers
Regulating markets with short-sighted decision-makers? (March 2004)
Technical paper setting out a formal economic framework within which to consider how markets are affected by shortsightedness, and how to regulate them.

Why might people take on "too much" debt? (July 2004)
Technical paper considering under what conditions people might take on more debt than, in retrospect, they would consider ideal.

When might people pay too much for their housing? (February 2003)
Technical paper considering under what conditions people might pay more for their housing than, in retrospect, they would consider ideal.

SOME PUBLICATIONS

Six issues in pharmaceuticals — Economic Affairs, September 2006
Transforming the information environment in pharmaceuticals — Scrip Magazine, March 2004
The measure of inflation — Economic Affairs, March 2004
Calculated risk? — Parliamentary Monitor, November 2003
Virtuous price discrimination, pharmaceuticals, and parallel trade — Competition Law Insight, May 2003

Could deflation be ideal? — Economic Affairs, March 2003
Risk-sharing pricing models in the distribution of pharmaceuticals — Europe Economics Staff Working Paper, February 2003
When might people pay too much for their housing? — Europe Economics Staff Working Paper, February 2003
The role and regulation of short selling — Europe Economics Staff Working Paper, October 2002
The Liquidity Trap and Price-Level Targeting — Economic Affairs, June 2002
Ireland, The ECB, and the Maastricht Treaty — European Journal, March 2001
US Economic Success - Is it merely a Statistical Mirage? — Capital Economics/Deloitte & Touche Economic Review, Dec. 2000
A price-stabilising fuel duty — eBow Brief, October 2000
Price-Level Targeting — Economic Affairs, June 2000
Rover, The Euro, and What If…? — European Journal, April 2000
When is it good to join a Customs Union? — European Journal, Midsummer 1999
Is Cyclical Convergence a Good Thing? — European Journal, May/June 1999
Can "Tax Competition" be harmful? — European Journal, Summer 1998
The End of the CAP? — European Journal, February 1998
Is money spent on students wasted? — The Independent, December 4 1997
Does the UK need more graduates? — IoD Economic Comment, September 1997
The Single Market - What more can be achieved? — IoD Economic Comment, August 1997
The BBC Budget Guide 1993 — IFS, February 1993
The IFS/Goldman Sachs Green Budget 1993 (part-author) — IFS, January 1993
Analysis of the 1993 Budget for the Daily Telegraph