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Tobacco packaging regulation
An international assessment of the intended and unintended impacts

Contents

1. Executive summary

Context

With the aim of reducing tobacco consumption, an increasing number of governments and regulators are considering, or have recently considered, the further development of pack space appropriation (PSA) regulation and the potential introduction of plain packaging (PP) regulation:

There is a trend towards larger, graphic health warnings and the potential introduction of plain packaging.

- In recent years there has been a trend in PSA regulation towards larger and more graphic health warnings with the aim of discouraging uptake (particularly amongst young people) and encouraging quitting through increasing awareness of the adverse health effects of smoking.

Packaging regulation is primarily focused on reducing smoking initiation, consumption and quitting relapse.

- PP regulation has not yet been introduced but is currently under discussion in a number of jurisdictions, including Australia and the UK. These jurisdictions have suggested that PP, through making tobacco products less attractive to young people, will reduce the prevalence of daily smoking through reducing initiation, consumption and quitting relapse. Previously, both Australia and the UK, along with Canada, New Zealand and Lithuania, have considered, but decided not to proceed with PP.

Recognising the importance of such developments to governments, consumers and the industry, British American Tobacco (BAT) asked Deloitte to develop an objective, international report, based on available data, research and commentary, on the potential impacts (intended and unintended) of PSA and PP regulation on a specified set of impact areas.

This report provides a detailed examination of the relationship between packaging regulation and trends in consumption, supported by a comprehensive review of research and commentary available on the subject.

The history of PSA regulation internationally now makes it possible to test quantitatively its effectiveness in reducing consumption. To do this, this report uses econometric analysis based on the most detailed and disaggregated information available to researchers across a substantial number of markets in which PSA regulation has been introduced. This analysis is also supported by a review of the substantial literature in this area.

No such quantitative analysis is possible in relation to PP regulation as it is yet to be implemented. We have therefore reviewed the available research and commentary and distilled informed opinion in order to provide a platform for informed debate, discussion and constructive engagement with relevant stakeholders.

Our analysis did not identify any direct impact of PSA regulation on consumption

We undertook a panel study of 27 countries over 14 years (1996 – 2009), supported by an event study for Australia, allowing for one of the most comprehensive investigations to date of this issue.

Our econometric modelling is centred on developing an understanding of the impact of PSA regulation on licit consumption. We constructed a panel of data from 27 countries over a period of 14 years (1996 – 2009), allowing for, as far as we are aware, the most comprehensive investigation to date of this issue. Our modelling approach is based on extending the work of a series of academic studies focused primarily on advertising and smoking bans within the OECD from 1970 to 1995. The aim is to determine the relative importance of different variables in explaining observed patterns in licit consumption (which have experienced a gradual decline over the last 15 years in parallel with the introduction and extension of a range of regulatory interventions designed to reduce tobacco consumption) and whether these variables have a statistically significant relationship to consumption.

The results of our econometric modelling consistently demonstrate that PSA regulation, including increasing the size of government health warnings and the presence of graphic images, has not had a statistically significant direct impact upon licit tobacco consumption.

Our modelling has passed all applicable statistical tests for robustness.

Further information on the modelling is provided in the main report, where we demonstrate that these results:

• Pass all applicable tests for statistical robustness.

• Are consistent with the findings of existing academic literature in relation to other explanatory factors, absent PSA regulation. For example, cigarette price elasticity is well within the range provided by other studies of elasticity in this area.

Our analysis concludes that there is no statistically significant direct relationship between PSA regulation, including increasing the size of government health warnings, and licit tobacco consumption.

The results from the cross-country panel study are confirmed by an event study conducted for the Australian market. This analysis uses statistical techniques to test the hypothesis that structural changes or breaks in licit cigarette consumption have occurred as a result of two changes in PSA regulation introduced in 1995 and 2006. No such correlation was found to exist.

Consistent with other research in this area, our analysis also identifies a significant relationship between increases in price and reductions in licit consumption. Whilst it is not the purpose of this report to comment in depth on this area, it should be noted that some studies find that increases in price can result in consumers switching from licit to illicit tobacco products. As such, while our findings show that (tax driven) price rises do reduce licit volumes, it may not necessarily follow that this is the most effective way of controlling total tobacco consumption.

Given the findings our research raises regarding the impact of PSA regulation, we suggest that governments consider the extent to which PP will deliver policy objectives in advance of any implementation.

Although focused on PSA regulation, these results also provide some commentary on the possible impact of PP regulation. Given the findings regarding the impact of PSA regulation, we suggest that governments consider the extent to which PP has the potential to deliver policy objectives in advance of any implementation. Recommended areas of further research are discussed in the main report.

Plain packaging also presents a number of potential unintended consequences

We also assessed the potential impact of packaging regulation on price/competition, illicit consumption, government and retailers.

In addition to looking at consumption, we also considered, through an extensive review of available research and commentary, the potential impact of packaging regulation on:

• Price and competition.

• Consumption of illicit tobacco products.

• Cost to government.

• Cost to retailers.

The majority of available literature was qualitative in nature and focused on PP. Limited robust and independent research exists.

As the vast majority of research and commentary we identified was focused on PP (as opposed to PSA) we have primarily, though not exclusively, focused on synthesising the debate in this area. That being said, whilst there was extensive commentary on the potential unintended impacts of PP, there was only a limited robust and independent research in this area.

Our findings are summarised below and discussed in more depth in the main report.

Price and competition

PP is expected to result in lower prices in some or all segments of the market in the short to medium term, in the absence of tax increases, and reduced consumer choice

To date, there have been two main research studies that have looked at the potential impact of PP regulation on the competitive dynamics of tobacco markets.

Whilst these studies draw differing conclusions around competitive dynamics, there is consensus that PP will reduce product differentiation and lower prices in some or all segments of the market in the short to medium term in the absence of further tax increases.

PP may also, by creating barriers to innovation, lead to an overall reduction of the breadth of products in the market.

Consumption of illicit tobacco products

A range of commentators, including the Australian government, recognise that PP could lead to an increase in illicit trade.

The illicit market is sizeable in many countries, including Australia (c. 16%), Canada (c. 27%) and the UK (c. 13%), and an area of increasing concern for governments and the tobacco industry.

The potential impact of PP on the illicit market has been highlighted by a number of commentators as an area of concern, including the Australian government who recognised that PP, if it made counterfeiting easier and enforcement less effective, could lead to an increase in illicit trade. Concerns centre on:

• Whether PP will increase the supply of and demand for illicit tobacco through, for example, making contraband more attractive or, by removing branding, making it harder for consumers to justify the premium paid for licit tobacco products.

• The scale of illicit trade in certain countries and links to organised crime.

Given the concern around this area, from both tobacco companies and governments, we recommend further research into the potential impact of PP on illicit trade to establish an evidence base to inform the debate going forward. Recommended areas of further research are discussed in the main report.

Cost to government

Failure to successfully defend claims that PP infringes international trademarks, IP and trade agreements could result in significant legal and compensation costs for governments.

Commentators from a range of sources have suggested that PP may infringe international trademark rights, intellectual property laws and trade agreements, potentially resulting in legal and compensation costs for government.

Industry commentators and governments also recognise the potential negative impact of packaging regulation on tax revenues, citing changes in licit and illicit consumption as potential causes.

Whilst governments are likely to incur costs due to packaging regulations, uncertainty regarding the outcome of legal challenges, compensation and consumer reactions makes it difficult to quantify the overall scale of the potential impact.

Cost to retailers

Deloitte research in Australia raises concerns regarding the potential cost burden of plain packaging on small to medium sized retailers.

Deloitte recently carried out a study to estimate the likely cost to retailers of PP in Australia, based on business-reported data. Areas where potential direct cost impacts were identified included inventory management, transaction efficiency and product selection errors. Indirect impacts included increased security costs, potential for channel shift to larger retailers disadvantaging smaller independent stores (especially if packaging regulation is combined with retail display bans), and potential loss of revenues to illicit trade.

Consistent with good regulatory practice, in advance of deciding to implement new forms of packaging regulation, we suggest that governments conduct more robust research into these impact areas

The output of our econometric modelling, coupled with the assessment of available research and commentary, raise a number of important findings for regulators seeking to introduce new forms of packaging regulation.

In advance of deciding to implement new forms of packaging regulation, we suggest that governments conduct more robust research into these impact areas.

The complete removal of all forms of branding and advertising has the potential to fundamentally change the dynamics of the market in ways that are not yet fully understood. These issues go beyond the pure commercial interests of the companies involved, into areas ranging from consumer choice to illicit trade. In the absence of evidence that PSA regulation has been effective in driving actual (as opposed to self reported) reductions in consumption, we believe that it is important that governments consider the extent to which PP will deliver policy objectives in advance of any implementation. Clear, focused and independent research is needed to:

• Establish with greater certainty the impact of any such regulation on consumption.

• Understand the scale and direction of potential unintended consequences on a number of areas including price/competition, illicit trade, cost to government and cost to retailers.

In line with regulatory best practice we would see this research forming part of the normal impact assessment process in advance of any decision to legislate or implement further regulation in this area.

2. Preface

With the aim of reducing tobacco consumption, an increasing number of governments and regulators are considering, or have recently considered, the further development of pack space appropriation (PSA) regulation and the potential introduction of plain packaging (PP) regulation. Recognising the importance of such developments to governments, consumers and the industry, British American Tobacco (BAT) asked Deloitte to develop an objective, international report on the potential impacts (intended and unintended) of PSA and PP regulation on a specified set of impact areas.

2.1. Purpose of the report

The contents of this report have been prepared by Deloitte and represent an objective, international assessment of the potential impact of PSA and PP regulation on a specified set of impact areas, based on econometric analysis and a broad review of publicly available information and research on the topic. The purpose of this report is to provide a platform for informed debate, discussion and constructive engagement with relevant stakeholders.

2.2 Scope of work

This report focuses on the potential impact of two forms of regulation, Pack Space Appropriation (PSA) and Plain Packaging (PP).[1]

Definition of PSA – Health warning messages imposed by governments on cigarrette packs. Charecterised by warning format (e.g. text versus graphic), warning size (% coverage) and position (e.g. front/back/side).[2]

Definition of PP – A cigarette pack of a standardised base colour devoid of all promotional elements (e.g. brand imagery, trademarks and logos), where the brand name is printed using an agreed typeface, colour and font size, and where country specific legislation for displaying contents, tax-paid stamps, security markings, toxic constituents and health warnings is met.[3]

The following impact areas are covered within this report:

Impact area	Regulations covered[4]
Consumption of licit tobacco products	PP & PSA
Price and competition	PP
Consumption of illicit tobacco products	PP
Cost to government	PP & PSA
Cost to retailers	PP

This report is international in perspective and draws upon information and data from a broad range of geographies, including Australia, New Zealand, Canada, US, UK, France and the EU. Conclusions are also 'international' in perspective and not intended to be specific to an individual country.

1 Whilst, at points in the report we will refer to other forms of regulation (e.g. retail display bans), these other forms of regulation are not the subject of the report nor are they covered in any significant detail
2 Design elements such as location, rotation, colour and message content have not been covered in detail
3 This definition is consistent with that used by regulators such as the UK Government and the European Commission
4 The extent to which we have been able to cover the impact of PP and PSA regulation on the above impact areas is dependent on the availability of secondary research relating to that impact area. For some impact areas there is little if any research and commentary regarding PSA regulation. In these instances we have limited our commentary to PP

2.3 Methodology

2.3.1 Literature review

We have drawn upon a broad base of publicly available information, covering a range of viewpoints, including but not limited to academic studies and literature reviews, industry reports, regulatory proposals by governments and stakeholder responses, relevant news articles and industry data.[5]

Whilst we have sought to undertake an extensive review of available information we recognise that, given the global nature of the report and the timeframes available, it will not have been possible to identify 100% of the information available globally on the subject. In addition, whilst we have reviewed in detail all information drawn together as part of this work, we have not sought to comment on every piece of information reviewed, instead focusing on information that in our opinion is key to presenting an objective review of the topic in hand.

2.3.2 Econometric modelling

We have also applied econometric modelling techniques in order to understand the independent historical impact of packaging regulations on the consumption of licit tobacco products. The modelling has been undertaken using two different but complementary approaches which consider potential consumption effects of more recent package regulation, in particular with reference to the introduction of new graphical based health warnings, given that plain packaging is yet to be introduced in any country. The two approaches are:

• Cross-country panel analysis – This approach uses data from 27 countries, over a period of 14 years, to investigate the historic impact of PSA regulation on licit consumption.[6]

• Event study – This approach provides a statistical examination of historic licit consumption data in a single market, in this case Australia, to understand whether there are changes in consumption following the introduction of package based regulation.

Our methodology has been able to extend and improve upon previous empirical studies by:

• Complementing publicly available information with data provided by BAT as well as up-to-date industry data on volumes and prices. This data has allowed us to extend the analysis over a broader set of countries, not considered in previous studies. Furthermore, it has enabled us to assess the impact of PSA regulation based on actual empirical outcomes, as opposed to evidence reliant on consumers' perceptions and 'self reporting'.

• Considering the impact of package regulation based on measuring the percentage of package space appropriated by text or graphic health warnings. We are not aware of other econometric studies that have explicitly used this measure of package regulation.

Although these empirical techniques have some clear advantages, identified above, it is important to recognise that these techniques are unlikely to fully capture any potential impacts on longer-term market dynamics through, for example, changes in the broader social context.

Each approach is further described below, with a more comprehensive explanation provided in Appendix B.

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5 The information drawn upon for this report is clearly referenced in the appropriate sections. When drawing upon third party information, Deloitte has neither sought to corroborate this information nor provide anything more than a high level review of its reasonableness
6 Consumption in the modelling is analysed on a per capita basis

Cross-country panel analysis

A number of published academic studies have sought to use cross-country econometric analysis to evaluate the impact of tobacco control regulations on consumption.[7] These studies use data on consumption across a panel of countries across time and look to fit a model describing this consumption based on variables such as income and price. Further variables are then included in these models, describing the scale and evolution of different tobacco control regulations. The impact of regulations is evaluated by assessing whether a statistically significant direct relationship exists between those variables representing the level of regulation and the level of consumption.

These previous studies have focussed primarily on advertising and smoking bans within the OECD countries from 1970 to 1995. The analysis undertaken in this report seeks to draw on this existing literature, while extending it. For example, our panel study includes variables to control for price, income, socioeconomic factors and the size of the illicit market (see also Table 2 below). By holding these factors equal the analysis is able to identify the relationship between licit consumption and package based regulation. The approach taken enables the modelling to add insight compared to previous studies in a number of ways:

• Countries included – This investigation has been able to consider a broader set of countries to account for greater market variation, including advanced and developing economies. This enhances both the robustness as well as the comprehensiveness of our findings. Country data was checked for robustness.

Figure 1. Countries included in the cross-country panel analysis

Advanced economies		Emerging and developing economies	
Australia	Japan	Argentina	Nigeria
Belgium	South Korea	Brazil	Pakistan
Canada	Netherlands	Chile	Poland
France	New Zealand	Colombia	Romania
Germany	Spain	Egypt	South Africa
Greece	Switzerland	Malaysia	Turkey
Italy	United Kingdom	Mexico	

Source: Deloitte

• Time period – This investigation has had available a more up-to-date data set covering the period 1996 to 2009. Using more recent data means the results should have more applicability to current markets.

• Package regulation – This investigation was able to consider the impact of the overall space on cigarette packs covered by either a text or a graphic health warning, in a particular country at a particular point in time. This compares to previous studies which have been limited to investigating package regulation through a binary variable indicating whether such regulation is in effect.

• Econometric techniques – This investigation has been able to apply more modern panel techniques than previous studies, which allow for consumption today to be related to previous consumption.[8] Theoretical models of cigarette consumption, suggest such relationships are important in estimating consumer demand effects (Becker, Grossman, & Murphy, 1994).

Consumption data across the panel of countries has been collected from BAT and Oxford Economics. In the absence of direct data available, our research estimated the consumption level in each country on the basis of duty-paid shipment volumes.[9] The price of a cigarettes pack in each market has also been provided in local currency units by BAT and Oxford Economics. These prices have been converted to US$ based on purchasing power parity (PPP) exchange rates.[10]

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7 In particular this literature includes papers by Nelson (2003), Saffer & Chaloupka, (2000) and Padilla, (2009). We note that Saffer and Chaloupka (2000) was criticised in an expert witness report by Heckman (2002) for not including an appropriate country-specific time trend in their analysis, and for making a number of errors in their treatment of the data
8 Techniques include the Arellano-Bond procedure (Arellano & Bond, 1991)
9 Annual volumes are converted to per capita consumption by dividing the volumes by the population of each country
10 PPP is the number of national currency units per U.S. dollar required for a given basket of goods

A summary of the data and sources used for each variable considered by the model is presented in Figure 2.

Figure 2. Data for cross-country panel analysis

Category	Variable
Consumption and pricing	Duty-paid shipment volumes of cigarettes Price per pack
Income and employment	GDP per capita, PPP Employment to population ratio
Socioeconomic – health related	Immunization, DPT and measles[11] Life expectancy at birth Total expenditure on health, % of GDP[12]
Socioeconomic – general	Civil liberties score Political rights score
Illicit market controls	Corruption Perceptions Index score Imports of goods and services

Data on tobacco regulation has been drawn from the tobacco market data supplied by BAT. Where more detailed information was required, particularly in relation to the percentage of pack coverage of health warnings, specific country legislation was drawn-upon. Additional public information was used and assumptions made, as described in Appendix B.

A summary of the findings from the cross-country panel analysis are presented in the section 4.1.1.

Event study

Event studies are an econometric tool that can be used to determine whether structural changes or "breaks" in a market have occurred as a result of regulatory intervention, in this case packaging regulation in the cigarette market. These approaches have been used in a number of reports including LECG (2010) and Europe Economics (2010). Whilst event studies are useful in understanding the impact of regulation on consumption trends in single countries, in this case Australia, they are specific to that market. As such, in this report we have used an event study in order to test/validate our findings from the broader cross-country panel study.

To understand how event study analysis is undertaken, consider the hypothetical consumption series in Figure 3. In this series there is a clear break in the time trend element of the series, as illustrated by the differences in the fitted trend lines Trend A and Trend B. A simple test of the effectiveness of packaging policies would be to determine whether this structural break coincides with package regulation coming into place.

Figure 3. Hypothetical time-series
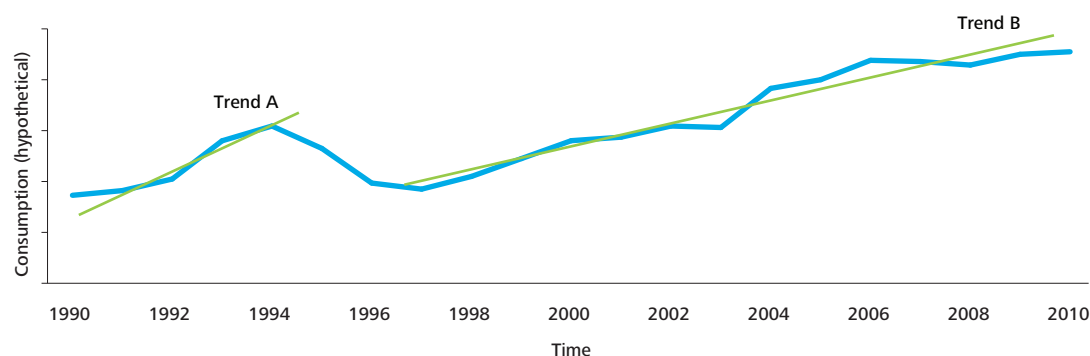
Source: Deloitte, the blue line indicates the hypothetical time series of consumption, the green lines fitted trends before and after a structural break point

11 Average immunization rates of DPT and measles were used in the panel. These socioeconomic variables were considered as additional controls for development and education
12 Only available for OECD countries

The hypothetical example above has very obvious breaks in the series. Often, however, visual inspection of a data series is not able to accurately reveal the time or form of the breakpoints. In such circumstances time-series econometric techniques are the preferred tool to conduct an event study, as they allow for a systematic search of consumption for structural breaks without specifying the breakpoint. This allows concerns around data mining the location of breaks to be addressed. These techniques have been used across a wide variety of applications and industries.[13] A full description of the methodology used can be found in Appendix B.

In order to undertake the event study analysis, licit consumption data has been collected for Australia, where two relevant changes to PSA have occurred recently, these changes are described further in section 4.1.1. Consumption data has been drawn from internal BAT data on the volumes of products shipped to markets.[14]

The main findings from the event study are presented along with those from the panel analysis in the section 4.1.1.

13 See for example Perron (2005) for a survey of theoretical and empirical application. The key techniques deployed in this report were developed by Andrews-Zivot (Zivot & Andrews, 1992) and Bai-Perron (Bai & Perron, 1998)
14 Given this data is not the volume actually consumed, our analysis has focussed on using quarterly, as opposed to monthly, observations. Using this frequency of data has the advantage of smoothing any monthly observations where cigarette supply and demand may be out of balance

3. Trends and drivers of regulation

Since the 1960s the advertising, sale and consumption of tobacco products has undergone significant regulatory reform. A variety of different regulations, from government health warnings through to retail display bans, have been introduced across countries. In general, new regulation has tended to emanate from more developed economies, spreading across geographies and becoming stricter in its application.

Tobacco products have a long history of government taxation and minimum age limits. However in the 1960s, following several reports by public health authorities regarding the health risks of smoking,[15] this was extended to include wide scale regulatory reform. Government health warnings were introduced, followed by advertising restrictions and the enforced disclosure of ingredients. The 1990s saw the extension of advertising bans and the restriction of public smoking across a range of locations. During the last decade, the general trend of regulatory tightening has continued, with the introduction of larger, graphic health warnings and an increased focus on new forms of regulation such as retail display bans and plain packaging.

To illustrate this, in Figure 4 we have set out for a representative basket of 33 developed and emerging countries,[16] the development and spread of regulation over the past 13 years.

Figure 4. Number of countries within basket where regulation is in place (1997 – 2009)

	1997	2001	2005	2009
Minimum legal age greater than 17 years old	9	15	18	24
Number of media channels where advertising ban imposed[17]				
None	7	6	6	4
1 to 3	16	11	6	3
4 to 5	10	16	21	26
Number of public places where smoking ban imposed[18]				
None	2	2	1	1
1 to 3	31	30	27	22
4 to 5	0	1	3	5
6 to 7	0	0	2	5
Government health warnings				
None	1	0	0	0
Mandatory graphic health warnings	0	1	2	11
Mandatory text health warnings	31	30	30	21
Voluntary health warnings	1	2	1	1
Retail display bans	0	0	1	2
Plain packaging	0	0	0	0

Source: BAT data

As we can see from the Figure 4, tobacco regulation has become more widespread and stringent over time:

• The **minimum legal age** for purchasing tobacco products has increased.

• The number of media channels with **tobacco advertising bans** has increased.

• **Public smoking bans** have been gradually introduced and extended across countries.

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15 For example: Royal College of Physicians (1962); US Surgeon General (1964)
16 Basket of 33 countries covers: Africa (South Africa, Egypt); Asia (Bangladesh, China, India, Indonesia, Japan, Malaysia, Pakistan, South Korea, Vietnam); Australasia (Australia, New Zealand); Europe (Belgium, France, Germany, Greece, Ireland, Italy, Netherlands, Poland, Romania, Spain, Switzerland, Turkey, UK); North America (USA, Canada, Mexico); South America (Argentina, Brazil, Chile, Columbia)
17 Out of 5 main media channels: cinema, outdoor, press, radio and television
18 Out of 7 public places: domestic airlines, international airlines, buses, restaurants/cafes/hotels, cinemas/theatres, private sector workplaces and public sector workplaces

- The number of countries that have introduced **graphic health warnings** has increased, particularly between 2005 and 2009.

- **Retail display bans**, present in Iceland for 10 years, have been recently introduced in Canada (2002-2009)[19], Ireland (2010) and Norway and Australia (2010).

- **Plain packaging**, though yet to be introduced, is under discussion in a number of countries.

3.1 PSA regulation

In recent years there has been a developing trend towards the implementation of larger and more graphic health warnings. The main purpose put forward by governments for new forms of PSA regulation is the reduction of consumption (i.e. discouraging uptake and encouraging quitting) through raised awareness of the health risks of smoking:

- The Australian Government Department of Health and Ageing states that "graphic images, in combination with the health warnings and explanatory messages, are intended to increase consumer knowledge of health effects relating to smoking, to encourage cessation and to discourage uptake or relapse."[20]

- The UK Government puts forward that the goal of graphic health warnings is to reduce the appeal of tobacco to young people and raise the awareness of the risks of smoking.[21]

- In a document detailing possible revisions to the European tobacco products directive,[22] the European Commission declared that graphic warnings if properly sized and well placed, are "an efficient measure to inform the public about the dangers of smoking, and they are particularly effective among vulnerable groups. The bigger the size of the picture warning, the more effective it is [in informing about the dangers of smoking]."

Of the representative basket of 33 developed and emerging countries set out in the previous section, 11 had by 2009 introduced mandatory graphic health warnings. Percentage coverage of front and back ranged from 60% (Australia and New Zealand) to 48% (UK and Romania).

In addition, a number of other countries are currently considering or have recently amended PSA regulation:

- PSA proposals involving introduction and increases to GHWs are currently being discussed in a wide range of countries including Canada, Costa Rica, Ecuador, Guatemala, Peru, Paraguay, Trinidad & Tobago, Mongolia, Nepal, Philippines, Togo and Russia.[23]

- As of May 2011 Spain will require graphic health warnings on 43% of the front and 53% of the back of cigarette packs, making it the 7th country in the EU to put such measures into law.[24]

- The European Commission is considering mandatory graphic health warnings as part of an update to the 2001 Tobacco Products Directive.[25]

- Finally, in 2010 Uruguay introduced two forms of regulation: one introducing 80% graphic health warnings to the front and back of packs; the second banning brands from offering more than one variant.[26] Philip Morris is pursuing a claim before the International Centre for Settlement of Investment Disputes alleging that Uruguay is violating its trade agreement with Switzerland by requiring that anti smoking warnings cover 80% of cigarette packs.[27]

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19 First display ban was introduced in Sask in 2002. Last ban was implemented in 2010
20 Australian Department of Health and Ageing (2010)
21 UK Government (2010a), p.10
22 DG Sanco (2010), p.6
23 BAT Data (2010)
24 Spanish Government (2010)
25 DG Sanco (2010), p.5
26 The New York Times (2010)
27 Bloomberg (2010)

3.2 PP regulation

No country has, to date, implemented PP regulation. Proposals are currently being discussed in jurisdictions including the EU, Australia and the UK. In recent years, Australia, UK, Canada, New Zealand and Lithuania have considered, but not proceeded with PP.

Common goals put forward for the introduction of PP regulation include reducing smoking initiation consumption and quitting relapse and enhancing the 'effectiveness' of package warnings:

• The 2009 Australian Plain Packaging Bill's objectives are to "reduce initiation of tobacco use, tobacco consumption and quitting relapse; enhance the effectiveness of package warnings; and remove the package's ability to mislead and deceive consumers."[28]

• In November 2010 the UK Government stated that they will "look at whether the plain packaging of tobacco products could be an effective way to reduce the number of young people smoking and to help those who are trying to quit smoking."[29]

On 30 March 2010, the Lithuanian parliament rejected a plain packaging proposal, considering it to be contrary to fundamental principles embodied in the Lithuanian Constitution. Specifically, plain packaging was considered to contradict the constitutional principles of free enterprise, competition and consumers' rights and violate obligations deriving from international treaties.[30]

28 Australian Parliament Bill (2009), p.6
29 UK Government (2010b), point 3.25
30 International Law Office (2010)

4. Research findings

In the following pages we have set out a high level summary of the findings of the literature review by individual impact area, along with the results of the econometric analysis of the impact of packaging regulation on tobacco consumption. The detailed analysis that supports these findings is set out in Appendix A for the literature review and Appendix B for the econometric modelling.

4.1 Consumption of licit tobacco products

4.1.1 Potential impact of PSA regulation

To date there have been a sizeable number of studies that have used survey methods to evaluate the role of health warnings in raising awareness of the specific health risks of smoking and changing smokers' attitudes towards tobacco use. However, only a small number of studies have focused on the ability of health warnings to achieve stated policy objectives through causing an actual (as opposed to self reported) reduction in tobacco consumption.

To explore the relationship between PSA regulation and consumption further, we have undertaken econometric analysis using two complementary approaches; cross country panel analysis and an event study for Australia. The main finding of both these pieces of research is that, PSA regulation (including increasing the size of health warnings) does not appear to have had a direct impact on consumption.

Findings from the literature review

As outlined in section 3.1 the broad intention of governments and regulators, in introducing and extending PSA regulation, is to discourage uptake and encourage quitting (thereby impacting consumption), through improving consumer knowledge regarding the health risks of smoking.

Such proposals build on a long history of PSA regulation which has over a number of years, alongside other media and education based initiatives, raised public awareness regarding the health risks of smoking (in particular links to lung cancer and heart disease) in both developed and developing countries.

To date there have been a sizeable number of studies that have used survey methods, including focus groups, interviews and web based surveys, to evaluate the role that health warnings (text and graphic) play in raising awareness of the specific health risks of smoking and changing smokers attitudes towards tobacco use (e.g. increasing motivation to quit smoking).

A 2009 literature review by Sambrook Research International,[31] prepared for the European Commission, Directorate General for Health and Consumers, identified c.42 studies across a range of geographies that evidenced the role that tobacco health warnings play in "educating consumers" (17 studies), as a "critical element of health risk campaigns" (11 studies), in "increasing motivation to quit/undermining brand values" (17 studies), and in "targeting specific consumer groups to enhance effectiveness" (8 studies), and in "other factors" (12 studies). Whilst many studies looked at effectiveness "most [studies] were unclear about what is meant by 'effective', and definitions were not given in reports."

Two of the larger and more extensive studies were undertaken by European commission[32] and the NGO funded International Tobacco Control (ITC) project,[33] which surveyed c. 26,500 and 15,000 people across 28 and 4 countries respectively:

• The European Commission survey found that "three out of 10 EU citizens think that health warnings on tobacco packs are effective in informing them about the negative health effects of tobacco" and that "55% of EU citizens believe that adding a colour picture to a text-only health warning strengthens the effectiveness of the text-only warning."[34]

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31 Sambrook (2009); p.12. Some studies cover multiple headings
32 Flash Eurobarometer (2008); A 2008 telephone survey of more than 26,500 randomly selected citizens aged 15 years and over in the 27 EU Member States and in Norway
33 Hammond et al (2007). The International Tobacco Control (ITC) project annually surveyed 14,975 adult smokers across four cohorts (Canada, the United States, UK and Australia) over five years (2002 to 2006)
34 Flash Eurobarometer (2008)

- In studying data from the ITC project, Hammond et al. (2006) put forward that "warnings that are graphic, larger, and more comprehensive in content are more effective in communicating the health risks of smoking"[35] and may be more likely to have a lasting impact on consumers than less prominent, text only warnings.[36] However, research into the relationship between warning type and intentions to quit were less conclusive. In 2009, Borland et al.[37] found that whilst thinking about the health risks of smoking (cognitive response) and forgoing cigarettes were consistent predictors of people making quitting attempts, reading and noticing health warnings (a key reason put forward by governments for increasing the size and visibility of health warnings) and avoidance of warnings were not. Importantly none of the four measures outlined above was demonstrated to have a "consistent effect on quit success".

The main challenge associated with interpreting the findings from these and other studies relates to the self reported nature of the survey information used. As put forward by Sambrook Research "it cannot be automatically assumed that the intention to quit and self reported behaviour correspond to actual behaviour."[38] There are also limitations regarding the accuracy of self reported outcomes. As such it is not possible to conclude from these studies what the impact of PSA regulation has been on actual (as opposed to self reported) tobacco consumption,[39] a key policy objective of governments.

It is also important to recognise that survey methods including sample size, selection criteria, and demographic focus, vary greatly. This needs to be taken into account when interpreting findings from studies, as does the extent to which studies have been able to control for other tobacco control measures and general social trends, which may also have had an effect on intentions to quit, smoke less or avoid smoking.

In contrast, literature looking at the direct impact of PSA regulation on consumption was relatively limited and typically focused on self-reported quit attempts, which are prone to the limitations outlined above.[40] The most direct evidence identified by our literature review into the impact of PSA regulation on actual tobacco consumption comes from Gospodinov and Irvine (2004). This study used a micro economic approach to analyse whether the introduction of Canadian pictorial warnings in 2000/2001 had resulted in a significant impact on smokers. The study drew upon micro data from two waves of Health Canada's Canadian tobacco use monitoring surveys (July 2000 and June 2001). The conclusions of the study were that "warnings have not had a discernible impact on smoking prevalence" and that whilst "the evidence of their impact on quantity smoked is positive [i.e. caused a reduction], [it is] only at a relatively low level of confidence".[41]

Recognising the limited amount of existing literature on the impact of PSA regulation on actual (as opposed to self reported) tobacco consumption, in this report we have used econometric analysis to provide a more up to date and detailed examination of this issue using the most detailed and disaggregated information available to researchers across a substantial number of markets in which PSA regulation has been introduced. The findings of this research are set out in the following section.

Findings from the econometric modelling

As described in section 2.2.3, the impact of PSA regulations on licit consumption has been assessed using a broad panel analysis covering 27 countries and an event study concerned with regulatory changes in Australia. In both cases we have sought to establish whether changes to PSA regulation are related to changes to licit consumption.

The findings of this work are summarised below, with a more comprehensive and technical review, provided in Appendix B, including a statement on the limitations of the methodology used. This work focuses on the relationship between PSA regulation and aggregate licit consumption levels. Data was not available to allow a segmentation of these results by different demographic groups, or to evaluate the overall effect of consumption taking account of illicit volumes.

35 Hammond et. al (2006), p.19
36 International Tobacco Control (2009), p.6
37 Borland et al. (2009b); p.4
38 Sambrook Research (2009), p.13
39 A recent literature review commissioned by the European Commission stated there was no reliable estimates available from any country on how many smokers have changed their behaviour because of health warning labels (Sambrook In Research, 2009)
40 For example Hammond et al. (2004)
41 Gospodinov and Irvine (2004), Abstract

Cross-country panel analysis

Key finding
- Our analysis did not find a statistically significant direct relationship between health warning size (text and graphic) and licit consumption.

The cross-country panel analysis uses variation in consumption across countries to determine the relative importance of different variables in explaining observed patterns in licit consumption, and whether these variables have a statistically significant relationship to consumption.

The purpose of testing for statistical significance is that it provides a systematic method in which to understand whether there is a relationship between variables in a model. A wide range of models were tested, (see Appendix B for more details of these and their results). Based upon an analysis of these, the work converged upon three different model specifications. The three models considered enjoy a common structure but differ in the variables they use to control for variations in consumption.

- Model 1 – includes variables to control for socioeconomic factors such as life expectancy and the employment rate.[42] These variables are included in addition to cigarette pricing, income and the package regulation variables.

- Model 2 – acts as a refinement to Model 1 whereby factors that are established to be statistically insignificant from Model 1 are excluded from the analysis, although we continue to consider the PSA regulation variables as they are the key factor of interest to this investigation.

- Model 3 – includes the PSA regulation variables lagged by one period. This means the model tries to describe consumption in a given year, based on the regulation which was in place in the previous year. This allows for the possibility that package regulation may have a more gradual or delayed impact on consumption. The accepted level of statistical significance across the academic literature is a 5% significance level, but we also report our results at the more stringent 1% level.

Figure 5 sets out the results of the modelling work, showing the relationship, or sensitivity, of consumption to each variable. These are expressed in terms of elasticities, which measures the percentage change in consumption estimated for a 1% change in the variable under consideration.[43] For example, if the model estimates a price elasticity of -0.25, this indicates that a 1% change in price is on average related to a -0.25% reduction in consumption.

The figure below also identifies which of the elasticities were found to be statistically significant from zero, as highlighted by the asterisks. The accepted level of statistical significance across the academic literature is a 5% significance level, but we also report our results at the more stringent 1% level.

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42 Inclusion of these variables is consistent to the existing literature; Saffer & Chaloupka, (2000) in Table 4 include the unemployment rate, whilst Nelson (2003) in Table 5 includes variables to control for healthcare
43 Note that technically the regulatory variables do not measure the elasticity as they are not specified in logarithms in the model. As such they measure the exponential growth or decay of consumption per capita in relation to health warnings

Figure 5. Panel data estimation of elasticities

| Variable	Model 1	Model 2	Model 3
Previous years cigarette consumption per capita	0.55***	0.56***	0.48***
Cigarette prices	-0.25***	-0.25***	-0.27***
GDP per capita	0.31***	0.29***	0.27***
Employment rate	-0.16	–	–
Life expectancy	-0.21	–	–
Text warning pack coverage	-0.13	-0.14	–
Graphic warning pack coverage	-0.14	-0.15	–
Previous years text warning pack coverage	–	–	-0.08
Previous years graphic warning coverage	–	–	-0.09
Test of model significance			
Wald chi-squared statistic	380	364	343
Prob > chi-squared statistic	0.00	0.00	0.00

Source: Deloitte analysis. *** indicates statistical significance at the 1% level, ** at the 5% level and * at the 10% level based on a standard t-test. The test of the models significance overall is based on a chi-squared statistic.

Across the three models estimated, a number of variables were found to be consistently related to consumption at a statistically significant level. Specifically, prices are negatively related to consumption, whilst previous year consumption levels and GDP are positively related to consumption in a given year. These results are stable across each of the three models, which provide increased confidence in their reliability.

Based on the results from Model 1, the socio-economic variables, life expectancy and the employment rate, were not found to have a statistically significant relationship with consumption and hence were dropped from Model 2.

Our analysis did find a statistically significant direct relationship between increased price and reduced licit consumption. The negative relationship between licit consumption and prices is illustrated in the scatter diagram of cigarette consumption provided in Figure 6; where countries with lower prices observe higher consumption, and countries with higher prices observe lower consumption. The model estimated that the price elasticity is around – 0.25%; which is similar to other studies investigating the price elasticity of licit cigarette consumption to be in the range of -0.1 to -0.5.[43] Interestingly, the results indicate that the relationship between licit consumption and price is lower in developing countries.

Figure 6. Scatter diagram of consumption (million of sticks) on price (USD PPP) in advanced countries across years 1996 to 2009
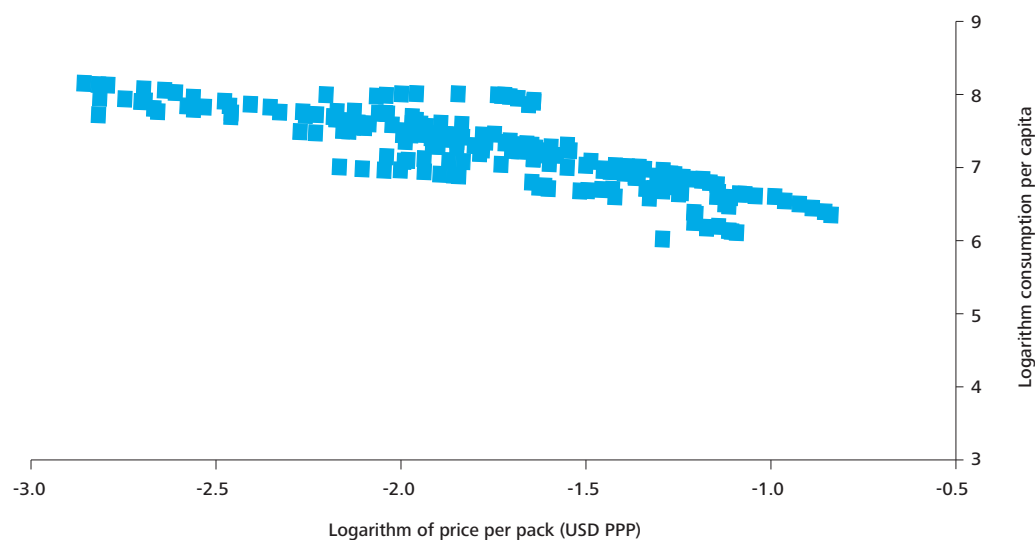
Source: Deloitte analysis

43 For example: Powell, Tauras, & Ross (2005) find -0.50%; Gruber, Senb, & Stabilec (2003) find –0.45% to –0.47%; Harris & Chan (1999) find -0.20% for ages 24-26

The finding that consumption increases by around 0.3%, for every 1% increase in GDP (where both are defined on a per capita basis) is also consistent to other panel studies finding a positive relationship between income and cigarette consumption.[45] This finding may suggest that the richer is the country, the more legal cigarettes are consumed.

In order to consider the relationship between package regulation and consumption, we considered the variables 'Text warning pack coverage' and 'Graphic warning pack coverage'. The results in this area across the three models are reported in Table 6 and did not find any statistically significant direct relationship between the percentage of pack coverage of health warnings and consumption, whether the warnings are either text or graphic. This test suggests that across the countries and the time period considered, consumption is not related to the presence of graphic images or the size of warnings displayed on cigarette packages.

This finding is consistent with the event study analysis and also has some precedent in the literature. Nelson (2003), for example, included a variable in his model which indicated where strong health warnings were present. This study also found this variable not to be statistically significant from zero, suggesting strong health warnings do not influence consumption. A further study by Gospodinov (2004), using micro level data, found warnings implemented in Canada in January 2001 had "not had a discernible impact on smoking prevalence" and that whilst "the evidence of their impact on quantity smoked is positive, [it is] only at a relatively low level of confidence".[46]

This finding is, however, at odds with much of the 'self report' evidence described in the previous section on the literature review (see also section 1.4.3 in Appendix A). This may indicate that the self reported evidence is not translating into actual behaviour.

Robustness checks and sensitivities

A series of procedures were conducted to test the robustness of the conclusions from the cross country panel analysis. Firstly a check was undertaken to determine the accuracy of the model estimations for previous levels of consumption. This test is undertaken informally in Figure 7, where total consumption estimated using Model 2 is compared to actual consumption.

Figure 7. Model predictive power within sample (billions of sticks)
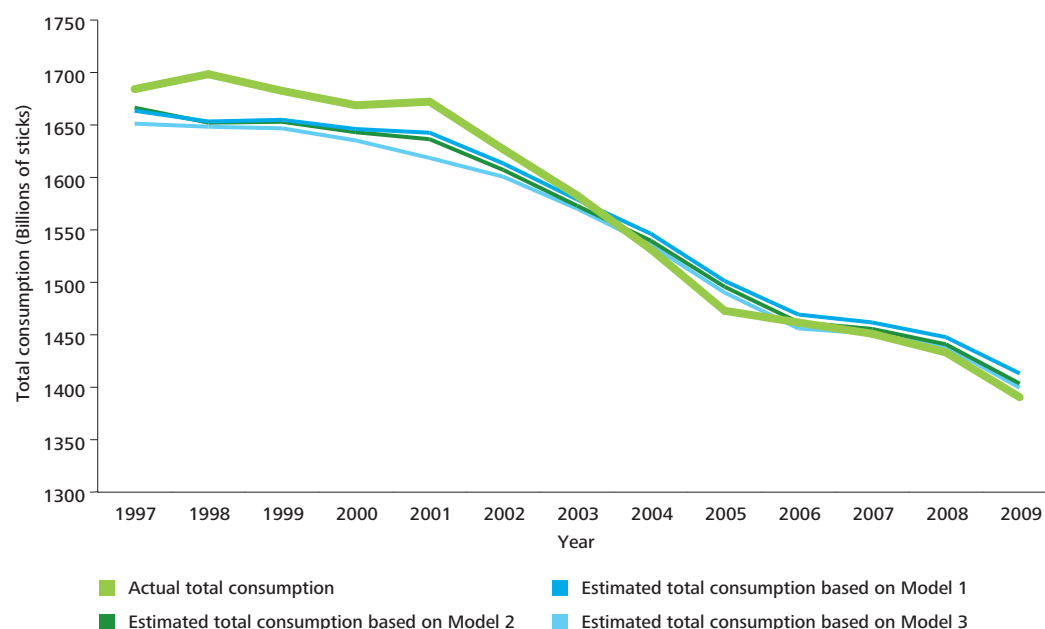
Source: Deloitte analysis

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45 For example, see Saffer & Chaloupka (2000), Becker, Grossman, & Murphy (1994), Nelson (2003), Laugesen & Meads (1991) and Baltagi & Levin (1986)
46 Gospodinov and Irvine (2004), Abstract

Based on this analysis, the difference between actual consumption and the estimated level, in any year, is not more than ±3%. More formal tests of the fit of the model were also undertaken as described in Appendix B. These tests also suggest the model is able to describe consumption behaviour effectively:

- Estimation of models in such a way that policy variable are allowed to have a non-linear relationships to consumption. In this sensitivity the panel models are re-estimated, allowing for the variable describing the percentage of package covered by health warnings to have a non-linear relationship to consumption. This allows for the possibility that increasing levels of PSA may have an increasing or decreasing relationship to consumption. The non-linear package regulation variables, however, continue to be statistically insignificant in the re-estimated models.

- Estimation of the policy variable based on potential step change impact. In this sensitivity the original variable describing the percentage of package coverage by graphic or text warning in the original model is replaced with a binary variable identifying if a text or graphic health warning is in place. This sensitivity investigates whether the results above, are sensitive to the estimates made of the percentage of the pack covered by graphic and text warnings. This binary variable was found to be statistically insignificant for text and graphic health warnings, across most estimates.

- Including additional socioeconomic variables within the investigation. In this sensitivity further variables are included to describe socioeconomic conditions across the panel of countries. Variables considered included the percentage of the population immunised for diphtheria, tetanus, polio and measles as a proxy for development and health status. These variables were found not to be statistically significant, suggesting the GDP variable is able to describe most of the variation in consumption from socioeconomic factors.[47]

- Controlling for the illicit market in the modelling. Previous panel studies have attempted to control for the illicit cigarette market by including variables describing the openness of the economy, such as the ratio of exports and imports.[48] However, this variable, and other potential proxies such as indices of corruption, was found to be statistically insignificant.

- Including a time trend in the modelling. A time trend was included in the model to potentially account for average movements in consumption over time and across the countries in the panel. The time trend was found to be statistically insignificant.[49]

Note on impact of price mechanisms on consumption

The correlation between the consumption of tobacco products and price – highlighted by our econometric modelling in line with several previous studies – might lead to the conclusion that price increases would constitute an effective mechanism for reducing overall tobacco consumption. However, it should be noted that our research focuses only upon licit consumption and there are a number of studies that have found a link between rising tobacco prices and consumption of illicit tobacco:

- A 2004 study by the UK HM Revenues & Customs found that the demand elasticity to changes in the duty paid price was negative for duty paid tobacco products and positive for smuggled products.[50]

- A similar academic study in Canada, noted that in 1990 there was a fall in the elasticity of total tobacco consumption (including licit and illicit), in correspondence with a rise in the illicit market. According to the study, this may suggest that 'consumer' purchases of legal cigarettes became more sensitive to price changes when a close substitute – otherwise-identical smuggled products – became readily available".[51] This is because consumers could avoid paying higher legal prices by entering the contraband market. The study concluded that "in considering the use of tax changes as an instrument of health policy", it should be recognised that "smuggling from other jurisdictions has the potential to negate tax changes to a large extent".[52]

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47 Due to data limitations, immunization rates and life expectancy were used as proxies of health and development status
48 See for example Taylor, Chaloupka, Guindon, & Corbett (2000) and Nelson (2003)
49 This is indicative that the major variation in consumption per capita can be explained by prices, GDP per capita and other control variables. In addition, the panel of countries have varied trends, with some registering an increase in consumption over time
50 HM Customs & Excise (2004), p.20
51 Galbraith and Kaiserman (1997), p.298
52 Galbraith and Kaiserman (1997), p.300

• A further and more recent study from the HM Revenue & Customs claimed that the growth of the UK illicit smuggled and counterfeit market during the 1990s was linked to the increase in the UK to overseas price gap (following the introduction of the tobacco duty escalator in 1993) as well as to the opening of national borders within the EU.[53]

Event study

> **Key finding**
>
> • The analysis indicates that consumption in Australia is on a long-run downward trend that does not appear to have been altered by changes to PSA regulation.
>
> – None of the four potential break points identified in the trend are statistically significant.[54]
>
> – No statistically significant changes in licit consumption levels were found.

The results from the cross-country panel study were confirmed by an Australian event study that looked into whether structural changes or breaks in cigarette consumption have occurred as a result of two changes in PSA regulation introduced in 1995 and 2006:

1. Quarter 1 1995 – text warnings package coverage increased from covering 15% of the front of the pack, to 25% and 33% of the front and rear of the pack respectively; and

2. Quarter 1 2006 – graphic health warnings introduced covering 30% and 90% of the front and rear of the pack respectively.[55]

A graph showing the logarithm of cigarette volumes in Australia over time is provided in Figure 8, with the changes in package regulation noted. [56, 57]

Figure 8. Australia volumes over time (quarterly)
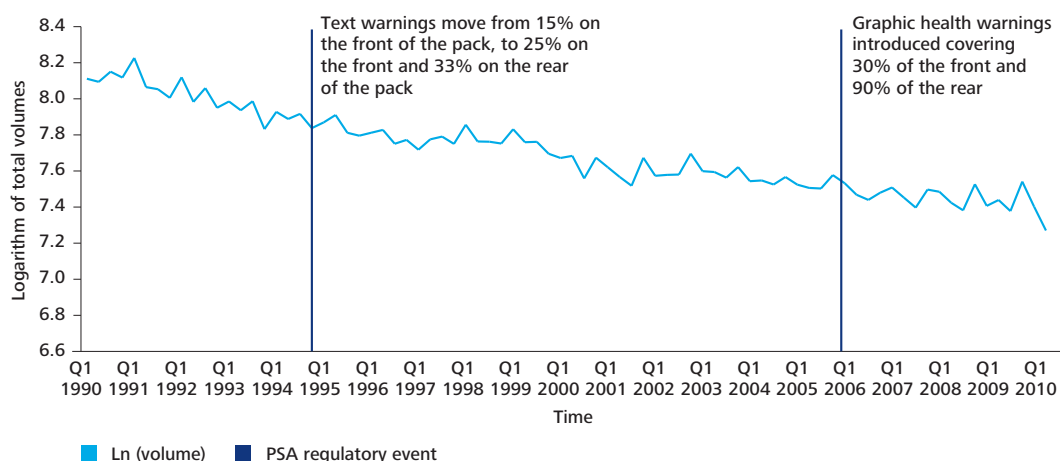
Source: Deloitte analysis, BAT data

53 HM Revenues & Customs (2010), p.16
54 Two of these break points occurred before the changes in PSA regulation
55 Inclusive of text warning coverage
56 The logarithm is taken, as the econometric modelling considered is based on considering non-linear relationships. Using a logarithm can also reduce some of the random variation inherent in the shipping data
57 Shipping volumes, relate to the cigarette inventory in Australia. At any particular point in time this inventory may differ from the actual quantity of cigarettes smoked. In the longer term, however, this inventory should match total consumption

A visual inspection of the data indicates a downward trend in consumption. There are fluctuations in the data, a typical feature of shipping data, as well as a degree of seasonal variation.

While there were two significant changes to PSA regulation in the period, there does not appear to be any visible evidence that these have significantly affected the existing consumption patterns. However, in order to test formally for potential breaks in the series, a statistical analysis was conducted to identify whether there are breaks in either consumption levels or the underlying downward trend in consumption. This analysis formally tested whether:

• The data series exhibits a break in the downward trend, showing an impact of the PSA regulations on the
  longer-term trend in consumption.

• The data series exhibits a break in the consumption level at specific points in time, showing a short-run impact of PSA regulations.

Whilst this approach identified four potential break points in the trend, none of these were found to be statistically significant and, in any case, two of these occurred before the changes in PSA regulation (see Figure 9). This suggests that, during the timeframe of our analysis, changes in the PSA regulations do not appear to have significantly affected observed consumption patterns.

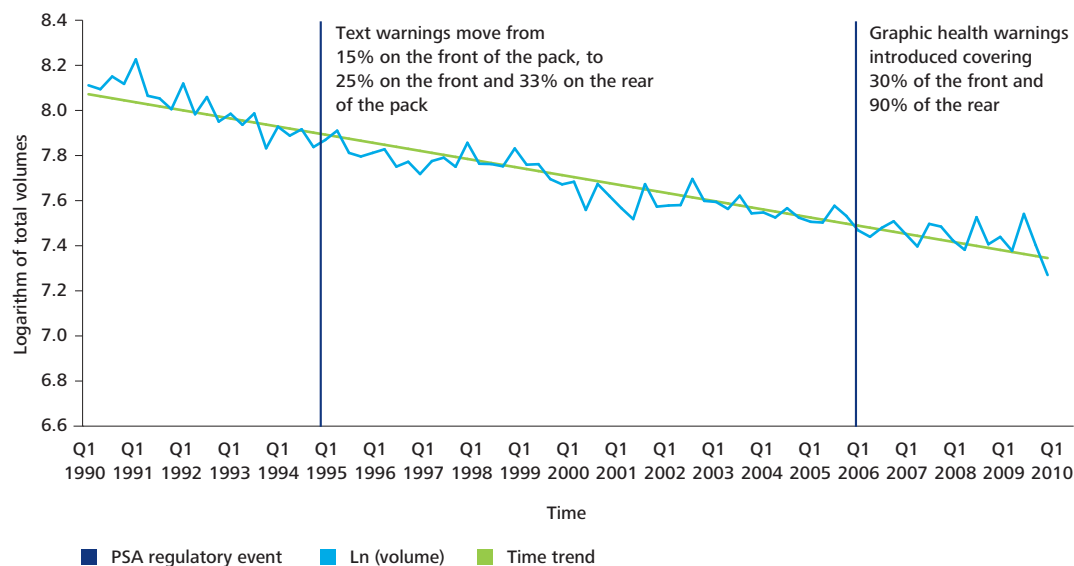**Figure 9. Suggested trend breaks in Australia**
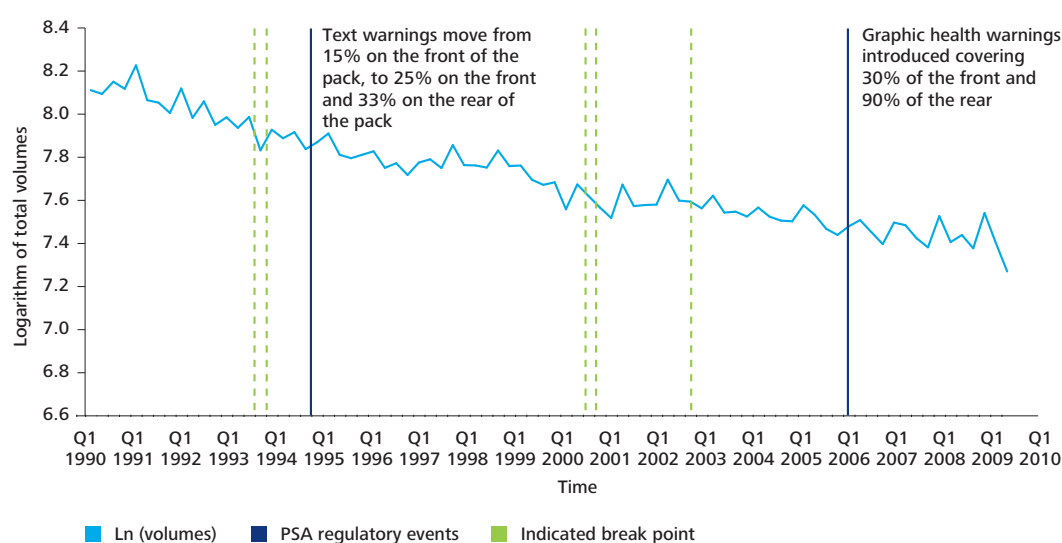
Source: Deloitte analysis, BAT data

Next a potential break in the mean of volumes was tested in order to establish whether there have been changes in the consumption level. As with the analysis of trend, this approach did not find any statistically significant break in the series.

In summary the analysis indicates that consumption in Australia is on a long-run downward trend that does not appear to have been altered by changes to PSA regulation (summarised in Figure 10). A variety of types of breakpoint were tested, including the possibility of multiple breaks, and none were found. This is evidence to suggest that the incidence of changes PSA regulation have not had a significant impact on consumption patterns.

Figure 10. Trend in Australia cigarette volumes

Text warnings move from
15% on the front of the pack, to
25% on the front and 33% on the rear
of the pack

Graphic health warnings
introduced covering
30% of the front and
90% of the rear

■ PSA regulatory event   ■ Ln (volume)   ■ Time trend

Source: Deloitte analysis, BAT data

Conclusions from the econometric modelling

Taking these two studies in conjunction, our analysis concludes that there is no statistically significant direct relationship between PSA (including the size and format of health warnings tested) and tobacco consumption.

4.1.2 Potential impact of PP regulation

Whilst a number of studies assess the impact of PP on pack attractiveness and health warning prominence, methodological limitations coupled with an absence of research into the likely impact of plain packaging on consumption make it difficult to predict whether or not PP will be effective in reducing consumption. Given the findings our research raises regarding the impact of PSA regulation, we suggest that governments consider the extent to which PP has the potential to deliver policy objectives in advance of any implementation.

The volume of literature on the impact of PP regulation on consumption is somewhat less than for PSA.[58] Existing studies have predominately focused on North America and Australasia, with lighter coverage in selected European countries.

Since PP regulation is yet to be implemented in any country, studies to date have not been able to measure the observed impact of PP regulation on smoking prevalence and incidence. Instead studies have used questionnaires, interviews, focus groups, visual recall and recognition experiments and stated preference methodologies[59] predominantly to assess and draw conclusions around the potential impact of PP regulation on pack attractiveness and the prominence of health warnings (See Appendix A, section 1.2 for a review of studies).

• Pack attractiveness – Recent studies by Wakefield, Germain and Durkin, from the Centre for Behavioural Research in Cancer (Australia), concluded that packs displayed with progressively fewer branding design elements were perceived as less appealing[60] and smokers of plain packs were rated as significantly less trendy/stylish, sociable/outgoing and mature.[61]

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58 Based on our review, a total of 26 research-based studies were referred to in the key documents published by and for the European Commission, UK, Australia and Canada as part of their consultation process for the introduction of the proposed regulations
59 Stated preference methodologies are a particular class of survey techniques specifically developed for eliciting consumer preferences. They include contingent valuation methods, conjoint analysis and choice modelling
60 Germain et al. (2009)
61 Wakefield et al. (2008)

• Prominence of health warnings – In this area conclusions were more mixed. Goldberg et al. (1999) and (1995) tested the recall rates of three types of warning on plain and regular packs. In 1999 they found that two of the three warnings were recalled better on plain packaging,[62] whilst in 1995 they found that generic packaging increased the recall rate of only one of three health warnings assessed.[63]

However, limitations associated with the body of studies on PP mean that it is very difficult to draw a link between the findings of these studies and what the likely impact of PP will be on smoking initiation and consumption. We have outlined our view of the main limitations below:

• **Self reported behaviour** – As with the majority of PSA literature, PP studies rely on survey based, self reported data to assess the potential impact of PP on smoking. One cannot automatically assume that self reported intentions will translate to actual behaviour, particularly when regulation is yet to be introduced. There are also limitations on the accuracy of self reported outcomes.

• **Uncertain link between PP and smoking knowledge, attitudes and behaviour** – Whilst many studies have sought to draw a link between plain packaging and the attractiveness/appeal of packs, few if any studies examined the relationship between packaging awareness/appreciation and smoking attitudes and behaviour.[64,65] According to Moodie et al. this would help understand to what extent the pack is a determinant of smoking.[66]

• **Methodological limitations** – Survey methods (e.g. sample size, selection criteria, and demographic focus) varied greatly. As such a number of studies were prone to methodological limitations which limit the ability to rely heavily on the findings. For example, survey methods used for recent studies by Wakefield, Germain and Durkin, outlined above, may have introduced social biases[67] and sample selection biases[68] into the results.

Whilst we recognise it is not possible to historically assess the impact of PP on consumption, as it has not been implemented, the findings of our PSA focused modelling do provide some commentary to the possible impact of PP regulation. Given the findings our research raises regarding the impact of PSA regulation, we suggest that governments undertake further research in advance of any implementation in order to consider the extent to which PP has the potential to deliver policy objectives.[69]

Elements that we would recommend that governments consider relate to the extent to which branding on packages acts to:

• Stimulate consumers to begin smoking cigarettes.

• Create a barrier to them quitting.

Specifically it is important to measure the role of branding in achieving the above, in circumstances that realistically simulate the environment in which PP will operate. A common criticism of recent studies is that they ask consumers to compare between branded and plain packs, an option that will not be legally available to them in a PP environment. Instead, further research should seek to understand the impact of PP in an environment where, aside from some illicit products, no alternative branded options exist. It is also important to recognise in such analysis the role that other factors play in smoking initiation. For example, as set out by Heckman et al. (2008) "The available evidence in the developing literature on adolescent risky behaviour, including smoking, supports a multi-causal model for youth smoking, as many factors have been empirically linked to youth smoking in this literature.

62 Goldberg et al. (1999)
63 Goldberg et al. (1995)
64 Moodie et al. (2009), p.19-20
65 LECG (2010a), p.12
66 Moodie et al. (2009), p.19
67 Germain et al. (2009)
68 Wakefield et al. (2008)
69 This is consistent with the view of the UK Department of Health who in 2010 declared that "the evidence base regarding plain packaging needs to be carefully examined. Therefore, the Government will encourage research to further our understanding of the links between packaging and consumption, especially by young people"

These factors include price, parental influences, risk preferences, peer influences, and access."[70] In addition, to provide a comprehensive insight into the impact of government health policy on consumption outcomes it is likely that this research would need to be broken down by different demographic groups and provide some insight into the efficacy of packaging regulation against other potential interventions.

4.2 Price and competition[71]

PP is expected to result in lower prices in some or all segments of the market in the short to medium term (in the absence of tax increases) and reduced consumer choice.

There are two main studies within existing literature, commissioned by Philip Morris and JTI, which use a mixture of economic argument and analysis to comment in detail on the potential impact of PP regulation on price and competition.[72, 73]

According to the LECG study, plain packaging will have a significant impact on market dynamics. In particular:

• Product differentiation within the market will reduce, as suppliers find it harder to differentiate their products in an environment where all products look the same

• In the absence of product differentiation, consumers will be more willing to switch between products, leading to price competition and consequently lower prices, However, according to the Department of Health a price reduction could be avoided by changes in product taxes.[74]

• Market entry of non branded products will be easier in an environment where incumbents no longer have strong brands. This in turn will lead to increased competition and a further downward pressure on prices, again before any potential effect of changes in product taxes.

A study by Europe Economics took a different view, contending that plain packaging is likely, at least initially, to reduce competition as smaller brands struggle to be recognised in an undifferentiated market. The study suggests that:

• There will likely be significant damage to tobacco brands with niche and growing brands being hardest hit.

• Well-established brands will have greater market power while manufacturers that depend upon innovation or brand proliferation will lose competitive position, at least in the short/medium term.

• Consistent with the view expressed in the LECG study, prices are expected to fall for premium based brands in the short to medium term, again before any potential effect of changes in product taxes.

• In the medium to long term the study suggested that stable market concentration and loss of market dynamism would be potentially followed by increased commoditisation with the possibility of increased prices as market power and loss of innovation effects began to dominate.

The main difference between these studies is that whilst LECG conclude that plain packaging will lead to price competition and as a result lower prices across the market, Europe Economics take the view that the impact across brands will vary with major brands retaining pricing power in the longer term at the expense of new entrants and premium, niche brands. Whilst, in the absence of hard evidence, it is difficult to be certain of how price and competition dynamics will play out, the economic theory put forward would suggest that a reduction in prices is a possible outcome in the short to medium term, albeit that governments may seek to counter this through increased product taxes.

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70 Heckman et al. (2008)
71 Our research uncovered little, if any, literature on the impact of PSA regulation on price/competition. Consequently our review
   of existing literature focused on plain packaging
72 LECG Consulting (2010b)
73 Europe Economics (2008)
74 See UK Department of Health (2008a). However it has been argued that tax increases may not effectively "counter" price
   competition as whether and how individual manufacturers pass on a tax increase is subject to speculation (see Philip Morris 2008)

In addition, several commentators, both supportive[75] and unsupportive[76] of PP measures, have claimed that plain packaging may reduce the incentive to launch new products and to innovate, thereby reducing the consumer choice within the market.

For further detail on price and competition refer to Appendix A, section 2.

4.3 Consumption of illicit tobacco products[77]

A range of commentators, including the Australian Government, recognise that PP could lead to an increase in illicit trade. We recommend further research to better understand this important area.

A recent study published by the International Union against Tuberculosis and Lung Disease estimated that 11.6% of the global cigarette market was illicit, resulting in losses to government revenues of US$40.5 billion globally.[78] While estimates in this area are inherently difficult, this points to a problem that is significant in scale in many geographies.

Moreover, a number of market commentators, including government bodies responsible for dealing with organised crime, have also recognised the presence of potential links between illicit tobacco and wider organised crime.[79] In its 2009 annual report on European organised crime, the European Police Office made a link between the sale of counterfeit commodities and other criminal activities, such as drug trafficking, illegal migration, stolen vehicle trafficking and terrorism.[80]

While there is little hard data on the subject, several commentators have argued that plain packaging may have unintended impacts on the drivers of illicit tobacco, notably:

• Price and price differential – As we have set out in section 4.1.1, there is a body of evidence that finds that increases in price levels can result in consumers switching towards illicit tobacco products.[81] Based on this, one might conclude that if PP leads to a short to medium term fall in licit prices then this might lead consumers switching back to licit cigarettes. However this would only be the case if consumers, having moved to a cheaper illicit product, were willing to switch back and governments, noticing a reduction in cigarette prices, did not seek to offset this through commensurate tax increases. In the latter instance, should PP result in consumers valuing the product less (due to loss of brand value), yet still be required to pay the same price (due to tax increases to offset licit price reductions), there may be a risk that consumers shift to illicit, as the marginal value of licit versus illicit cigarettes reduces and they find it harder to justify the premium paid for licit tobacco.

• Attractiveness – A number of commentators have argued that PP would increase demand for contraband 'branded' cigarettes, due to the perception that they are more attractive than licit plain packaging.[82]

• Ease of manufacture and ease of purchase – Commentators have argued that PP would make counterfeiting easier and more difficult to detect, leading to increased supply and more widespread distribution of illicit tobacco.[83]

The potential impact of PP on illicit trade was recently recognised by the Australian Government, though they believed that it could be mitigated through appropriate design arrangements.[84]

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75 Cunningham and Kyle (1995), p.84
76 E.g. Imperial Tobacco Australia (2010), p.31
77 Our research uncovered limited literature on the impact of PSA regulation on illicit consumption. Consequently our review of existing literature focused on plain packaging
78 Joossens et al. (2009), p.1
79 ANAO (2006), p.15; Criminal Intelligence Service Canada (2010), p.25; Shelley and Melzer (2008), p.2; UK Department of Health (2008a), p.21; US Government Accountability Office (2003), p.2; Shelley and Melzer (2008), p.2
80 European Police Office (2009), p.23
81 Galbraith and Kaiserman (1997), p.298-300; HM Revenues & Customs (2010), p16; HM Customs & Excise (2004), p.20
82 Philip Morris (2008), p.35; International Chamber of Commerce and Business Action to Stop Counterfeiting and Piracy (2010)
83 Amcor (2010), p.2; Anti-Counterfeiting Group (ACG) and the British Brands Group (2008), point 15; British American Tobacco (2008 & 2010), p.6; Economie Suisse (2009), p.2; Imperial Tobacco Australia (2010), p.2 & 30; International Chamber of Commerce and Business Action to Stop Counterfeiting and Piracy (2010); LECG (2010b); Philip Morris (2008 & 2009), p.34-35; Richard Janeczko and Rod Spencer (2010)
84 Australian Government Department of Health and Ageing (2010); Obtained through a Freedom of Information request

The Australian Government noted that, if "plain packaging made counterfeiting of tobacco easier and enforcement less effective" then "manufacturers, importers, distributors and retailers of tobacco products could lose business to the illicit trade," "government revenues could be put at risk," "smokers' health could potentially be put at greater risk." For further detail on the commentary above refer to Appendix A, section 3.

Given the potential concern around this area, from both tobacco companies and regulators, we would recommend further research into the impact of PP and other factors on illicit trade to establish an evidence base to inform the debate going forward. This is particularly important as growth in the illicit market could increase accessibility of tobacco products to youth smokers.

We recommend the following focused research, using survey, behavioural or experimental data (or a combination thereof) to provide evidence on the impact of PP on:

• Consumer preference for illicit versus licit tobacco (including counterfeit, contraband and unbranded).

• Consumer price sensitivity to licit versus illicit brands.

• Ability of consumers to distinguish between licit and illicit brands.

• Variation of the above effects across different market segments.

4.4 Cost to government[85]

Failure to successfully defend claims that PP infringes international trademarks, IP and trade agreements could result in significant legal and compensation costs for governments.

As we are not legal experts we are not able to comment on the validity of such considerations. However, several tobacco companies, trade organisations and legal providers have argued that plain packaging would infringe international agreements including the WTO's agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS), the Paris Convention, the General Agreement on Tariffs (GATT) and the Trade Agreement on Technical Barriers to Trade (TBT), resulting in potential legal and compensation costs for government.[86] IP Australia, the Australian Government organisation responsible for administering Australia's intellectual property rights system, in a note to the Australian Parliamentary Secretary, recently stated that "trade mark owners are given a broad exclusive right to use their mark in relation to the class of goods and/or services against which the market is registered. IP Australia considers that plain packaging of tobacco products if implemented would impinged on this right".[87] However, these arguments have been contested by other government departments, NGOs and academics.[88]

Several tobacco manufacturers have also stated that, even if governments can demonstrate that plain packaging and stringent PSA regulations are legal, they would seek compensation for what they see as the expropriation of their property rights.[89]

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85 Our research uncovered limited literature on the impact of PSA regulation on government. Consequently our review of existing literature focused on plain packaging
86 Philip Morris (2008 & 2009b); British American Tobacco (2008 & 2010); Imperial Tobacco Australia (2010); Economie Suisse (2009); US Chamber of Commerce (2010); International Trademark Association (2009); Institute of Public Affairs (2010); LALIVE (2009); The Law Society of New South Wales (2008); The Washington Legal Foundation (2009); Fratini Vergano (2010)
87 IP Australia (2010) – Document obtained by BAT through the Freedom of Information Act
88 Freeman et al. (2007); Cunningham and Kyle (1995); Physicians for a Smoke-free Canada (2008); Australian Department of Parliamentary Services (2010); Royal College of Australian Physicians (2009)
89 See for example Imperial Tobacco Australia (2010), p.1; Australian Department of Parliamentary Services (2010), p.78

The tobacco industry and governments recognised the potential negative impact of packaging regulation on tax revenues and employment, citing changes in licit and illicit consumption as potential causes.[90] The Anti-Counterfeiting Group and the British Brands Group have also argued that plain packaging will increase illicit trade enforcement costs, based on the assumption that plain packaging will make it easier to manufacture and more difficult to detect counterfeit packs.[91] For further detail on the commentary above refer to Appendix A, section 4.

Whilst governments are likely to incur costs due to packaging regulations, uncertainty regarding the outcome of legal challenges and compensation makes it difficult to quantify the scale of impact. However, if legal claims are successful, given the profile of many of the brands involved, we would envisage significant legal and compensation costs.

We recommend that governments consider the efficacy of such claims in advance of proceeding with regulatory proposals.

4.5 Cost to retailers[92]

Deloitte research in Australia raises concerns regarding the potential cost burden of plain packaging on small to medium sized retailers.

The potential cost impact of PP is an area of real concern for small to medium sized retailers. Whilst, in advance of implementation, it is difficult to confirm for certain what these costs will be, a recent Deloitte Australia study has sought to shed light on this, drawing upon retailer-reported views and data in order to estimate the expected direct and indirect costs of plain packaging for small to medium sized Australian retailers.[93] Total estimated direct costs amounted to AU$4,500 – 34,000 per store per annum, depending on the type of retailer, and included costs associated with increased time taken to receive and manage stock (as a result of more uniform homogenous packaging), increased transaction times and product selection errors.

Though not quantified in the report, indirect costs included loss of revenue and channel shift to other retailers based on the view that customers, frustrated by a less efficient service, would switch to larger stores (e.g. supermarkets) and/or illicit trade, leading to reduced sales of both tobacco and other products that customers pick up whilst purchasing cigarettes. In addition, retailers expressed concern that plain packaging may lead to channel shift to larger retailers, such as supermarkets and lead to increased theft caused by the increased time taken to retrieve cigarettes (particularly if staff have to turn their back to the customer).

Whilst the potential impact on retailers has been recognised by a number of other commentators in submissions to PP proposals, commentators such as the UK Department of Health[94, 95] have argued that use of, for example branded bulk containers, and alphabetical ordering could help to offset impacts on stock management and transaction times. For further detail on the commentary above refer to Appendix A, section 5.

90 UK Department of Health (2007a), p.12; British American Tobacco (2008b); Tobacco Station Group (2010), p.1-2
91 Anti-Counterfeiting Group (ACG) and the British Brands Group (2008), point 17
92 Our research uncovered limited literature on the impact of PSA regulation on retailers. Consequently our review of existing literature focused on plain packaging
93 Deloitte (2010)
94 Department of Health (2008), p.42
95 Cunningham and Kyle (1995), p.84

Appendix A – Detailed literature review

1. Consumption of licit tobacco products

A primary goal of regulators who have introduced, or are considering introducing, PSA and PP regulation is to reduce overall consumption of tobacco products, both today and in the future, through reduced initiation, consumption and quitting relapse.[96, 97]

In this section we set out at a high level the findings (and, where appropriate, limitations) of the literature we have reviewed on the potential impact of PSA and PP regulation on licit tobacco consumption (cigarettes in particular).
A review of literature covering the impact of regulation on consumption of illicit tobacco products is covered in section 3 of this Appendix.

1.1 Shape and findings of existing PSA literature

To date there have been a sizeable number of studies that have used survey methods to evaluate the role of health warnings in raising awareness of the specific health risks of smoking and changing smokers' attitudes towards tobacco use. However, only a small number of studies have focused on the ability of health warnings to achieve stated policy objectives through causing an actual (as opposed to self reported) reduction in tobacco consumption.

The body of PSA literature has grown significantly over the past ten years, in line with the increasing establishment across countries of health warnings on tobacco products. The overwhelming majority of studies have used qualitative[98] and some quantitative[99] survey methods, including focus groups, interviews and web based surveys, to evaluate the role that health warnings (text and graphic) play in raising awareness of the specific health risks of smoking and changing smoker's attitudes towards tobacco use. In addition a small number of studies have sought to evaluate the impact of PSA regulation on actual tobacco consumption (e.g. Gospodinov and Irvine, 2004):

Questions	Awareness	Ability of health warnings to raise awareness of the health risks of smoking
	Attitudes	Ability of health warnings to change smokers' attitudes towards smoking (e.g. increasing motivations to quit smoking, encouraging attempts to quit)
	Behaviour	Ability of health warnings to drive measurable reductions in tobacco consumption

A 2009 literature review by Sambrook Research International,[100] prepared for the European Commission, Directorate General for Health and Consumers, identified c.42 studies across a range of geographies that evidenced the role that tobacco health warnings play in "educating consumers" (17 studies), as a "critical element of health risk campaigns" (11 studies), in "increasing motivation to quit/undermining brand values" (17 studies), in "targeting specific consumer groups to enhance effectiveness (8 studies), and in "other factors" (12 studies). Whilst many studies looked effectiveness, "most (studies) were unclear about what is meant by 'effective', and definitions were not given in reports."

The main challenge associated with interpreting the findings from these studies relates to the self reported nature of the survey information used. As put forward by Sambrook Research "it cannot be automatically assumed that the intention to quit and self reported behaviour correspond to actual behaviour."[101] There are also limitations regarding the accuracy of self reported outcomes.

96, Australian Parliament Bill (2009), p.6; Australian Department of Health and Ageing (2010); UK Department of Health(2010b),
97 point 3.25; UK Government (2010a), p.10
98 Qualitative methods – Focused on testing consumer beliefs, attitudes and behaviours through, for example, focus group discussions and face-to-face interviews
99 Quantitative methods – Telephone or web based surveys, within one country or across a panel of countries. The most comprehensive studies have a cohort survey design, in which individuals are measured on the same key outcome variables over time, with the goal of examining the impact of changes in regulation longitudinally over time (e.g. International Tobacco Control project)
100 Sambrook (2009); p.12. Some studies cover multiple headings
101 Sambrook Research (2009), p.13

As such it is not possible to conclude from these studies what the impact of PSA regulation has been on actual (as opposed to self reported) tobacco consumption,[102] a key policy objective of governments.

It is also important to recognise that, of the studies outlined above, survey methods including sample size, selection criteria, and demographic focus, vary greatly. This needs to be taken into account when interpreting the findings from these studies, as does the extent to which studies have been able to control for other tobacco control measures and general social trends, which may also have had an effect on self reported intentions to quit, smoke less or avoid smoking.

Ability of health warnings to raise awareness of the health risks of smoking

To date the most extensive research (in terms of demographic/country coverage and analytical techniques) into the impact of PSA regulation on smoking awareness and attitudes is the International Tobacco Control Policy Evaluation Project, an international initiative funded by a number of government agencies, and third sector organisations.[103] The International Tobacco Control (ITC) project annually surveyed four cohorts of adult smokers (c. 15,000 people) in Canada, the United States, UK and Australia over five years (2002 to 2006), covering a range of education, income and ethnicity groups, in order to examine variations in smokers' knowledge about tobacco risks and the impact of package warnings.

In 2006, drawing upon data from the survey, Hammond et al.[104] found that a consistently high proportion of people believed that smoking caused lung cancer (94-95% across all four countries) whilst a slightly lower proportion believed that smoking caused heart disease (86-91% depending on the country). Links between smoking, lung cancer and heart disease have been established for decades and as such these findings are consistent with the long running communication of these risks through various media channels. Indeed, according to Antoñanzas et al. (2000), there is evidence that Spanish and American consumers overestimate these risks (e.g. risk of contracting lung cancer).[106] However, according to Hammond et al. recognition of other smoking related health risks, notably stroke, lung cancer among non-smokers and impotence was less widespread and varied across countries, with Canadian smokers endorsing a greater number of diseases than smokers from the other three countries. Drawing upon this, and the finding that knowledge of specific health risks of smoking was positively associated with noticing of health warnings, Hammond et al. concluded that "Canadian pictorial warning labels were more effective in informing smokers compared to smaller less comprehensive text warnings in Australia, the United Kingdom and the United States."

The European Commission survey,[106] of c. 26,500 people across 28 countries also found that "55% of EU citizens believe that adding a colour picture to a text-only health warning strengthens the effectiveness of the text-only warning [in informing them about the health risks of smoking]."[107] However, this was from a relatively low base where only "three out of 10 EU citizens [thought] that health warnings on tobacco packs [were] effective in informing them about the negative health effects of tobacco."

The salience (i.e. noticing and reading) effect of larger, pictorial warnings was also assessed by Hammond et al. in 2007[108] and Borland et al. in 2009.[109] Using updated ITC survey data, Hammond et al. found that following the introduction of larger text based warnings in the UK in 2003, there was a significant increase (44% to 80%) in respondents who noticed the warnings 'often' or 'very often'. A similar increase was found for reading warnings. The same was true following the introduction of new graphic warnings in Australia from March 2006.

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102 A recent literature review commissioned by the European Commission stated there was no reliable estimates available from any country on how many smokers have changed their behaviour because of health warning labels (Sambrook In Research, 2009)

103 In particular: Government agencies are the National Cancer Institute of the United States, the Canadian Institutes of Health Research, and the National Health and Medical Research Council of Australia; Agencies subsidised by national governments are: Roswell Park Transdisciplinary Tobacco Use Research Center, and the Canadian Tobacco Control Research Initiative; Third sector organisations are Robert Wood Johnson Foundation, and Cancer Research UK

104 Hammond et al. (2006)

105 Antoñanzas et al. (2000)

106 Flash Eurobarometer (2008); A 2008 telephone survey of more than 26,500 randomly selected citizens aged 15 years and over in the 27 EU Member States and in Norway

107 Flash Eurobarometer (2008)

108 Hammond et al. (2007)

109 Borland et al. (2009a)

However, whilst there is evidence to indicate that increasing the size and graphic content of health warnings makes them more noticeable, we were unable to identify further updates to Hammond et al.'s 2006 ITC study, demonstrating that knowledge of more specific health risks of smoking increased as a result of new warning introductions in the UK (2002) and Australia (2006).

Ability of health warnings to change smokers' attitudes towards smoking

Hammond et al. in their study on the role of warning labels in informing smokers about the health risks of smoking[110] found that "planning to quit smoking was positively associated with health knowledge. The odds of planning to quit were greater among smokers who endorsed each of the five diseases, and increased in a linear fashion with the total number of health effects reported." However, in this study no measurement was made of the extent to which plans to quit were implemented or successful.

Hammond et al. (2007) and Borland et al. (2009a) also found that following the introduction of new warning labels in the UK and Australia there was an increase in the percentage of respondents who reported that "warnings had led them to think about quitting in the past month" (UK) and "stopped them from having a cigarette in the past 6 months" (UK and Australia).

However, from this and similar research, it is less clear what the relative impact is of various aspects of new health warnings on reported attitudes to smoking. Whilst Hammond and Borland suggested that larger, graphic health warnings have larger 'impact' than smaller text based warnings, the nature of the studies undertaken (comparing health warnings across countries that varied considerably) meant that they were unable to isolate the impact of individual features (size, use of pictures, messaging etc.) and as such were only able to suggest conclusions in this area.

In 2009, Borland et al. sought to extend this work, through examining the impact of health warnings on quitting activity. Using ITS data, Borland et al. sought to assess whether or not warning salience (noticing and reading), cognitive responses (thoughts of harm and of quitting), forgoing of cigarettes and avoidance of warnings were predictors of quit attempts. Borland et al. found that whilst thinking about the health risks of smoking (cognitive response) and forgoing cigarettes were consistent predictors of making quit attempts, reading and noticing warnings (salience) or avoidance of warnings were not.[111] In addition, none of the four measures outlined above was demonstrated to have a "consistent effect on quit success".

Ability of health warnings to drive measurable reductions in tobacco consumption

The literature in relation to the direct effect of PSA regulation on consumption is relatively limited and typically focuses on self-reported quit attempts, which are prone to the limitations outlined above.[112,113] The most direct evidence identified by our literature review into the impact of PSA regulation on actual tobacco consumption comes from Gospodinov and Irvine (2004). This study drew upon micro data from two waves of Health Canada's Canadian tobacco use monitoring surveys (July 2000 and June 2001), to analyse whether the introduction of Canadian pictorial warnings in 2000/2001 had resulted in a significant impact on smokers. The conclusions of the study were that:

• "Warnings have not had a discernible impact on smoking prevalence"

• Whilst "the evidence of their impact on quantity smoked is positive [i.e. caused a reduction], [it is] only at a relatively low level of confidence".[114]

These conclusions are supported by our econometric modelling set out in section 4.1 and Appendix B of this report.

110 Hammond et al. (2006)
111 Borland et al. (2009b); p.4
112 For example Hammond et al. (2004)
113 Sambrook (2009) stated that "there are no reliable estimates available from any country on how many smokers have changed their behaviour because of tobacco health warning labels"
114 Gospodinov and Irvine (2004), Abstract

1.2 Shape and findings of existing PP literature

Whilst a number of studies assess the impact of PP on pack attractiveness and health warning prominence, methodological limitations coupled with a lack of research into the likely impact of plain packaging on smoking initiation and consumption make it difficult to predict whether or not PP will be effective in reducing consumption.

The body of literature looking at the area of plain packaging and consumption is somewhat smaller than for PSA. Our review identified a total of 26 published PP studies presenting research-based findings that have been used by regulators to support regulatory proposals.[115, 116]

These studies were developed during two broad time periods, with almost a decade elapsing between the first and second wave:[117]

- **Wave 1 – pre 2000;** 10 studies (Canada 8, Australasia 2); Triggered by initial plans to introduce PP in Canada and New Zealand; Focus on youth responses to PP.

- **Wave 2 – post 2000;** 16 studies (incl. US 2, UK 2, France 5); Triggered by ongoing government interest in PP; Broadened focus on adult regular smokers.

Given that PP is yet to be implemented, studies have not been able to measure the observed impact of PP regulation on consumption.[118] Instead they have used direct question surveys,[119] focus groups,[120] visual recall and recognition experiments[121] and stated preference methodologies[122] to assess the potential impact of PP regulation on, to a large part, pack attractiveness and recall of health warnings. Consequently the ability of these studies to predict the effectiveness of plain packaging, in terms of driving actual reductions in consumption, has been questioned by a number of commentators, as have limitations around the data analysis and data collection methods used.[123]

Questions	Pack attractiveness	Ability of PP to reduce the attractiveness of tobacco packaging
	Recall of health warnings	Ability of PP to increase the prominence of health warnings
	Impact on smoking behaviour	Ability of PP to change smoking behaviour

A few of these studies also examined the relative impact of different plain packaging features through, for example, assessing the relative attractiveness of different colours[124, 125] and the effect of including or excluding brand names.[126] Despite some recent attempts, studies looking to distinguish between the role of health warnings and the role of packaging, in the overall impact of plain packaging, have been limited.[127]

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115 To do this we looked at research referenced in public documents issued by international and national regulators, as well as in reviews prepared by external research organisations on their behalf. In particular, we focused on regulators that either had considered or are considering introducing, i.e. the European Commission (RAND, 2010), Canada (Canadian Government, 1994; Goldberg et al., 1995), Australia (Tobacco Working Group, 2008; Australian Government Preventative Health Taskforce, 2009) and the UK (Department of Health, 2007 and 2008a; Moodie et al., 2009)

116 Studies using underlying data from the same research were counted as one study (e.g. Goldberg, 1995; Goldberg, 1999; Rootman et al., 1995; Northrup and Pollard,1995)

117 Moodie et al. (2009), p.3; The 16 post-2000 studies were mainly carried out in the past 3 years

118 European Network for Smoking Prevention (2009), p.2

119 Administered through questionnaires and interviews with the purpose of collecting opinions or factual information. Individual direct questioning was the most commonly used survey technique

120 Gathered detailed information on a particular topic from group discussions

121 Exposed individuals to different pictures or objects and analysed their associations, recall or recognition capability

122 A particular class of survey specifically developed for eliciting consumer preferences. Include contingent valuation methods, conjoint analysis and choice modelling

123 LECG (2010a), p.5; Imperial Tobacco (2008), p.109

124 Gallopel-Morvan (2008). This study was carried out for the French National Cancer Institute

125 Comité National Contre le Tabagisme (2007)

126 Wakefield et al. (2008); Germain et al. (2009); GHK (2010)

127 Moodie et al. (2009), p.20

As we highlight above the body of literature on PP is subject to a number of limitations. Whilst many limitations are specific to individual studies (which we highlight below in our review of studies), there are a number of common themes:

Limitations of existing PP literature

Self reported behaviour – As with the majority of PSA literature, PP studies rely on survey based self reported data to assess the potential impact of PP on smoking. One cannot automatically assume that self reported intentions will translate to actual behaviour, particularly when regulation is yet to be introduced. There are also limitations on the accuracy of self reported outcomes.

Uncertain link between PP and smoking knowledge, attitudes and behaviour – Whilst many studies sought to draw a link between plain packaging and the attractiveness/appeal of packs, few if any studies examined the relationship between packaging awareness/appreciation and smoking knowledge, attitudes and behaviour.[128, 129] According to Moodie et al. this would help understand to what extent the pack is a determinant of smoking.[130]

Methodological limitations – Survey methods (e.g. sample size, selection criteria, and demographic focus) vary greatly. As such, a number of studies are prone to methodological limitations (e.g. sample selection biases) which may limit one's ability to rely heavily on the findings. In addition, whilst many studies acknowledge that the decision to smoke amongst young people is often driven by multiple factors (e.g. access, peer influence, and price) few consider the potential impact of such factors. As a recent LECG review of these studies highlighted,[130] omission of such variables, if positively related to perceptions of brand image and smoking intentions, could bias the estimated effect of brand image on decisions to smoke. Finally, not all studies apply measures of statistical validity to their results.

In the paragraphs below we have set out the findings of a selected number of these studies along with a high level review of associated limitations that the reader should be aware of when interpreting the findings. To do this we have reviewed regulatory proposals and supporting documents put forward in Australia, the UK, the EU and, in the mid 1990s, Canada and focused our commentary on studies referenced in more than one proposal. This allows us to focus on studies that have been more instrumental in informing the decision-making process in these geographies. Where appropriate we have also referred to the findings of recent reports reviewing these studies, for example Moodie et al. (2009) and LECG (2010a).

Reducing the attractiveness of tobacco packaging

Studies broadly concluded that plain packs were considered less desirable than branded packs[132] and that smokers of plain packs were also considered less "cool" and "trendy".[133] However, as outlined earlier, the extent to which one can conclude that this will lead to a behavioural change in consumers is uncertain. Details of specific studies reviewed are outlined below.

Study and findings	**Comments**
In 2009, Germain et al. conducted a web based study of 1087 adolescents exposing them to randomly selected cigarette packs (covering various types of plain packaging and health warnings across 3 brands). The authors concluded that packs displayed with progressively fewer brand elements were perceived as less appealing, rated the attributes of a typical smoker less positively and had more negative expectations of cigarette taste.	Whilst the study demonstrated that plain packaging is less attractive than colourful branded packaging the study does not seek to establish a clear link between pack (and smoker) perception and impact on cigarette consumption and initiation. In addition methodological limitations around, for example, the selection of respondents (self selected by parents with surveys conducted in the home) may have introduced some degree of 'social bias' to the results.

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128 Moodie et al. (2009), p.19-20
129 LECG (2010a), p.12
130 Moodie et al. (2009), p.19
131 LECG (2010a), p.12
132 Centre for Health Promotion (1993)
133 Wakefield et al. (2008), p.420

Study and findings	Comments
In 2008, Wakefield et al conducted an Australian study using a national web-based survey[134] to ask 813 adult smokers (aged 18-39) to rate cigarette packs with different types of packaging and brands.[135] The authors found that cigarette packages displaying progressively fewer branding design elements were perceived increasingly less favourably and that smokers of plain packaging cigarettes were rated as less 'trendy'. However the study seemed to be inconclusive in showing any significant impact on consumption behaviour, given that the percentage reduction in respondents that might try or smoke cigarettes when original packs are replaced by plain packs was only marginal (59% to 52%-56%).	This study was referenced in the majority of the literature reviews considered[135] and has the merit of comparing for the first time plain packs with and without standardised brand names.[137] However, the sample was not representative of the population and there were limitations associated with using a web-based survey, where respondents cannot touch the pack, a view shared by the authors.
In 2007, six focus groups were conducted in three French cities by Gallopel-Morvan.[138] A total of 50 people aged from 15 to 46 years (balanced between smokers/non-smokers, and women/men) were asked to comment on different pack options, including three plain packs: a grey, white and brown one. The study found that grey significantly reduced the attractiveness of the pack, while reactions toward the white pack were mixed, and reactions toward the brown one mostly positive (it was suggested that brown reminded participants of the colour of tobacco).	This was one of the first plain packaging studies conducted in continental Europe and one of few that aimed to examine the relative impact of different plain packaging features, such as colours.[139] Findings were based on a small number of focus group discussions and were therefore difficult to generalise. However, the study showed the need to gather further evidence on the impact of plain packaging, to avoid the risk of implementing polices that have effects opposed to the objectives of the regulation.
The 2008 studies conducted by the Comité National Contre le Tabagisme[140] in France have been mentioned in the literature review prepared from the UK Department of Health[141] and in Sambrook research (2009).[142] Like the study mentioned above, this was one of the few piece of research conducted in continental Europe. The research found that the normal branded pack was perceived by adult smokers and non smokers as more attractive than the two plain packs. The plain packs were also viewed as better in terms of highlighting the health pictorial warnings.	The limited sample size (10 male and 10 female) did not allow the extrapolation of results.
In 1995, Rootman et al. conducted more than 50 focus groups with teenagers from Ontario and Chicago to investigate the impact of plain packaging.[143] Both qualitative and quantitative components of the study found that plain packaging: a) Reduces the positive imagery associated with smoking particular brands; b) Makes the packages look more serious; and c) increases the attention to health warnings. With reference to smoking behaviour, the majority of the respondents said that plain packaging would make no difference in the amount of young smokers who would smoke (71%) or the proportion of young non-smokers would start smoking. However, the conclusions of the authors were that plain packaging holds little appeal to youth.	The findings of the research in terms of reduced positive imagery were confirmed by the fact that very few students chose to take home plain packages compared to the branded ones. However, the potential impact in terms of smoking behaviour was not evidenced, despite the author concluding that the percentage of respondents who thought that young smokers would smoke less with plain packaging reinforced results from previous similar research.[144] In addition, the study suffered from limitations regarding data collection, with potential social bias introduced through the direct question approach and the structure of the group interviews. The study was also undertaken under a different regulatory regime to that in place today.

134 Based on conjoint analysis technique
135 Wakefield et al. (2008), p.416-421
136 Referenced in Moodie et al. (2009); Sambrook Research (2009); RAND (2010); Tobacco Working Group (2008)
137 Moodie et al. (2009), p.21
138 Gallopel-Morvan (2008)
139 Moodie et al. (2009), p.17
140 Comité National Contre le Tabagisme (2008)
141 Moodie et al. (2009), p.15
142 Sambrook Research (2009), p.148
143 Rootman et al. (1995)
144 Rootman et al. (1995), p.10. The authors refer to the results presented by Goldberg et al. (1995)

Study and findings	Comments
In 1993 The Centre for Health Promotion[145] used surveys and 20 focus group discussions with 129 teenagers across Ontario to examine the relationship between images of packaging and youth smoking. Branded packs were considered more desirable than plain packs and associated with more positive images. Also about a half of non-smokers and a third of smokers surveyed, particularly younger and newer smokers, thought plain packs would decrease youth smoking. The authors concluded that plain packaging makes the product less attractive and that packaging has a greater influence on youths contemplating smoking than on regular smokers.	This was one of the first qualitative research studies conducted on plain packaging in Canada, and has been referenced in numerous literature reviews.[146, 147] However, as the author recognised, the study suffered from a small sample size (129 teenagers), particularly in the non-smokers group (32 teenagers).[148] Furthermore there was a risk that the purpose of the study could have been easily guessed by participants, leading to biased results. The study was also undertaken under a different regulatory regime to that in place today.

Other commentators have sought to assess the relationship between package design (including the use of colours and images) and perceptions around the health risks of smoking.

Study and findings	Comments
In 2009, Hammond and Parkinson[149] conducted a shopping mall intercept study with 312 adult smokers and 291 non smokers in Ontario Canada where participants viewed pairs of cigarette packages that differed along a single attribute and completed ratings of perceived taste, tar delivery and health risk. Hammond and Parkinson found that "respondents rated packages with lighter colours and a picture of a filter as significantly more likely to taste smooth, deliver less tar and lower risk [than 'regular' and 'full flavour' brands]".	The authors recognised that, as participants were not recruited using random sampling, findings were not necessarily representative of the Canadian population and some degree of bias is likely. In addition, despite the presence of a 'no difference' option, asking participants to choose between two packages may have resulted in higher levels of endorsement than for some other methods.
In 2009, a similar study was undertaken by Hammond et al.[150] where 515 adult smokers and 806 youths (aged 11-17) participated in an online survey and were asked to compare pairs of cigarette packs on five measures: taste, tar delivery, health risk, attractiveness and either ease of quitting (adults) or brand they would choose (youths). Hammond et al. found that adult smokers were significantly more likely to perceive packs "hypothesised to be a 'light/low tar' brand prior to the study" as delivering less tar, having a smoother taste, a lower health risk, being easier to quit and being more attractive than regular or full flavour brands. A similar pattern was found amongst youth smokers.	The authors recognised that, because participants were not selected randomly it is difficult to generalise findings to the UK population and youth responses may have been subject to parental influence. In addition, despite the presence of a 'no difference' option, asking participants to choose between two packages may have resulted in higher levels of endorsement than for some other methods.

Increasing the prominence of health warnings

Another argument for plain packaging is that it increases the salience of health warnings (through making them more prominent and explicit and through freeing up space and removing competing brand messages).[151]

145 Centre for Health Promotion (1993)
146 UK Department of Health (2008a), p.40; Moodie et al. (2009), p.9; Canadian Standing Committee on Health (1994), p.7
147 Moodie et al. (2009), p.9
148 Centre for Health Promotion (1993), p.8
149 Hammond and Parkinson (2009)
150 Hammond et al. (2009)
151 Moodie et al. (2009), p.5 & 7; Freeman et al. (2007), p.17; Hammond and Parkinson (2009), p.351

Study and findings	Comments
In 2008, the Environics Research Group was commissioned by Health Canada to carry out a study on the impact of increasingly larger pictorial health warnings and plain packaging.[152] 2000 respondents (half adults and half youths) were recruited by telephone from a database of research volunteers. Each respondent was interviewed and exposed to mock-up branded and plain packs with increasingly large pictorial health warnings. Controlling for the size of the health warning message, the majority of respondents thought that plain packs were more effective than branded packs in informing them about the health effect of tobacco and encouraging reduced tobacco use.	The recruiting technique for respondents may have significantly decreased the quality of the sample, which was defined by Moodie et al. (2009) as non representative.[153]
Study and findings Goldberg et al. (1999) and (1995) tested the recall rates of three types of warning on plain and regular packs. Findings were mixed. In 1999 they found that two of the three warnings were recalled better on plain packaging, whilst in 1995 they found that generic packaging increased the recall rate of only one of three health warnings assessed.	**Comments** Whilst the studies sought to establish a link between PP and health warning recall, it did not take this further to look at the link between health warning recall and smoking initiation and consumption. In addition, these studies were undertaken under a different regulatory regime to that in place today.
Study and findings In 1992, the New Zealand Department of Health funded a Beede and Lawson study to assess perceptions of health warnings on familiar New Zealand and unfamiliar US branded packs and plain packs.[154] Eighty focus group discussions were conducted involving a total of 568 teenagers after which participants were asked to recall the brand name and health warnings previously seen. Healthwarning recall rates were greater for plain packs compared to branded packs only for the US packs (with a small text-only warning), while no difference was noted in the recall rates of the larger warnings presented on the New Zealand packs.	**Comments** Whilst the authors concluded that health warning impact was greater on plain packs than branded packs, critics[155] have argued that the data could be interpreted in a different way, suggesting: a) a neutral effect of plain packaging on recall rates for packs with larger warnings; b) no effect on the recollection of the brand name. In addition, the study did not seek to establish a causal link between health warning recall and smoking initiation and consumption. The study was also undertaken under a different regulatory regime to that in place today.

Impacting smoking behaviour

In the studies reviewed, assessment of the impact on smoking behaviour was normally conducted alongside qualitative assessments of the attractiveness of plain packaging. As such analysis was subject to many of the limitations outlined earlier on in this section in that it was based on self reported as opposed to observed behaviour.

In terms of impact on smoking behaviour the studies reviewed mostly presented mixed evidence, in particular with reference to youth:

- Research by Rootman et al. (1995)[156] showed that the vast majority of teenagers believe that plain packaging would make no difference on youth decisions to start smoking or quit.

- Goldberg et al. (1995)[157] found that the effects of plain packaging will be more marginal than large (e.g. only about 30-40% believed that plain packaging would make a difference; and the difference they believed it would make was small in magnitude).

- In 2008, Wakefield et al.[158] was inconclusive in showing any sizeable impact on smoking behaviour, given that the difference in the percentage of respondents who declared they might try or smoke cigarettes in original packs compared to plain packs was only marginal (59% as compared to 52%-56%).

- Finally, the UK Department of Health stated that "children may be encouraged to take up smoking if plain packaging were introduced, as it could be seen as rebellious", although "the Department was not aware of any research evidence supporting this concern".[159]

152 Environics Research Group (2008a); Environics Research Group (2008b)
153 Moodie et al. (2009), p.14
154 Beede and Lawson (1992)
155 LECG (2010a), p.79
156 Rootman et al. (1995)
157 Goldberg et al. (1995)
158 Wakefield et al. (2008)
159 UK Department of Health (2008a), p.41

2. Price and competition

There have been two economic studies and a report commissioned by the European Commission that have looked at the potential impact of PP regulation on the competitive dynamics of tobacco markets. There is consensus between these studies that plain packaging will reduce product differentiation and negatively impact prices in some or all segments of the market in the short to medium term. The tobacco industry and other trade organisations have also maintained that plain packaging would likely lead to an overall reduction of the breadth of products in the market.

2.1 Shape of existing literature

Price and competition is an impact area that has received a moderate amount of coverage within existing literature. Price and competition includes the potential impact of PP on:

• The level of competitive intensity within the market and the basis upon which companies will compete (e.g. price based competition versus differentiation based competition).

• The ease with which new suppliers will be able to enter the market and the impact this will have over time on the breadth of products in the market and consumer choice.

• The expected impact of competitive dynamics on cigarette prices.

The two main studies within existing literature that comment on price and competition are:

• The impact of plain packaging of cigarettes in Australia: a simulation exercise; Jorge Padilla, LECG; 2010 – commissioned by Philip Morris.

• Economic analysis of a display ban and/or plain packs requirement in the UK; Europe Economics; 2008 – commissioned by Japan Tobacco Group.

Both of these studies used a mixture of economic argument and original analysis:

• The LECG report draws upon lessons from economic theory in order to set out a point of view regarding the potential impact of PP regulation on competition, cigarette prices and consumption (licit and illicit) within Australia. It then seeks to 'test the predictions of economic theory' set out in the report through the development of a simulation model that uses a nested logit analysis to predict what the potential impact of PP regulation might be on cigarette prices and consumption.

• The Europe Economics report is a broader assessment of the economic issues raised by the Future of Tobacco Control document, published by the UK Department of Health in 2008. It uses qualitative economic analysis, supported by empirical analysis of tobacco related data drawn from the UK, Canada, Thailand and Iceland in order to draw conclusions around the potential impact of PP and retail display ban regulation on, amongst other things, brand and innovation, competition and smoking prevalence.

In addition, several commentators, including tobacco manufacturers[160] and associations such as the Anti-Counterfeiting and British Brand Groups[161] and Economie Suisse[162] have made qualitative comments regarding the potential impact of PP on consumer switching and the range of products available in the market.

160 See for instance Imperial Tobacco Australia (2010)
161 Anti-Counterfeiting Group (ACG) and the British Brands Group (2008)
162 Economie Suisse (2009)

2.2 Findings from the literature

As outlined above the LECG study[163] used economic theory and a discrete simulation exercise in order to draw conclusions regarding the potential impact of PP regulation on price and consumption in Australia.

> **The main conclusions of the report were that:**
> Given the current restrictions on advertising, the introduction of plain packaging will have several market effects:
>
> - Product differentiation within the market will reduce, as suppliers find it harder to differentiate their products from each other.
>
> - In the absence of product differentiation, consumers will be more willing to switch, leading to price competition and lower prices.[164]
>
> - Market entry of non branded products will become easier, also increasing competition.
>
> - Illicit trade in cigarettes will increase due to:
>
>   – 'Branded' contraband cigarettes being perceived as relatively more attractive to consumers
>   – Simpler plain packets resulting in counterfeit cigarettes being easier and cheaper to produce – in turn leading to an increase in supply.
>
> - This in turn will lead to increased consumption due to reduced prices of licit cigarettes plus growth in illicit consumption.

In addition to providing a qualitative assessment of the likely impact of plain packaging, LECG ran a simulation exercise focused on modelling the effect of branding on prices and consumption. The simulation model, built upon the assumption that under PP consumers will switch products more, estimated that, for Australia:

• Plain packaging would reduce average prices by between 4.8% and 19.2%.

• This reduction in prices would lead to an increase in sales of between 2.6% and 16.6%.

However, as plain packaging is yet to be introduced, it is not possible to verify these predictions through empirical evidence.

This view was supported by the RAND report, commissioned by the European Commission Health and Consumer Directorate-General,[165] RAND agreed that plain packaging (and further labelling measures) could potentially lead to commoditisation and reduced pricing. Citing a 2008 Morgan Stanley[166] report they put forward that "two interrelated effects could be expected: a loss of brand value and commoditisation."

The UK Department of Health[167] also recognised that 'plain packaging may force tobacco companies to compete on price alone, resulting in cigarettes becoming cheaper.' However, they proposed that any decrease in price following the introduction of plain packaging could be offset by commensurate increases in tax. In response to this Philip Morris stated that manufacturers seeking to grow market share (particularly in a PP environment where "pricing will be essentially the only means of competition") may choose not to pass on tax increases to customers, citing that in the UK market recent tax increases of 42 pence per pack only translated to price increases of 23 pence per pack for 'cheap brands'.[168]

Like the LECG study, the Europe Economics study[169] drew upon economic theory to seek to understand the competition impacts of plain packaging and retail display bans. They also compared these findings with quantitative evidence from tobacco markets where display restrictions have been implemented.

163 LECG (2010b), p.1-7
164 The author recognises that there are different ways in which the impact on price might arise. One scenario put forward is that the removal of branding causes consumers of premium brands to switch to cheaper brands
165 RAND (2010), p.152
166 Morgan Stanley Research Europe (2008)
167 UK Department of Health (2008a), p.41
168 Philip Morris (2008), p.33-34
169 Europe Economics (2008), p.24-29

The Europe Economics study then sought to test the validity of these predictions through comparison with empirical results drawn from display bans already introduced in countries such as Thailand, Canada and Iceland.

Evidence from the Iceland and Thailand display bans suggested that negative competition effects occur almost immediately and are more marked than expected. One suggestion was that, in combination with other advertising restrictions, display bans have led to consumers effectively losing all practical ability to compare brands, leading to a significant stabilisation in market shares at the pre-ban level, with market dynamics largely disappearing. Europe Economics emphasised that they would expect PP to have even more negative competition and innovation impacts than display bans.

Furthermore, according to Europe Economics, a PP regime would reduce a company's ability and incentive to innovate their packs and products. This is because plain packaging would:

• Hamper pack innovation, by mandating design as well as shape.

• Limit incentives to achieve high quality, as this may not be enough to differentiate the product and influence consumer preferences.[172] This view is supported by Economie Suisse, a Swiss business federation, which stated that plain packaging will "reduce manufacturer's incentives to invest in quality and new products and lead to a price-based competition."[173]

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170 The LECG and Europe economics reports differ in their assessment of this point. Whilst the LECG proposed that brands creates barriers to entry, meaning that to win share from incumbents new entrants need to either invest in a differentiated brand position or compete on price (and margin), Europe Economics proposed that brands decrease barriers to entry by creating a channel by which products can signal their nature to existing consumers

171 Europe Economics (2008) suggested that firms relying on one dominant brand may gain in these terms because it will continue to benefit from being known as the market leader whilst being subject to less competitive pressure from other firms

172 Europe Economics (2008), p.25

173 Economie Suisse (2009), p.1

On this subject, Imperial Tobacco argued that under plain packaging there would be "little incentive for retailers to stock new brands and it will be very difficult for a new competitor to enter the market with any chance of real success, or for an existing competitor to launch a new brand. Consequently, consumers will have reduced choice."[174] Similarly, in their joint submission to the UK consultation on plain packaging, the British Brands Group and Anti-Counterfeiting Group maintained that under plain packaging it will be more difficult to launch new products and product variants as investment would be difficult to recoup.[175]

The two main studies on price and competition present differing views regarding how plain packaging will impact competition. However, the potential impact could be significant. Whilst we cannot be certain how competition dynamics will play out, the economic theory put forward would suggest that price reductions in the short to medium term are a possible outcome (absent of compensatory tax increases). We would recommend further research into this area, in order to better understand any unintended consequences in terms of price and competition and the knock on impact that this may have on licit and illicit consumption.

174 Imperial Tobacco Australia (2010), p.31
175 Anti-Counterfeiting Group (ACG) and the British Brands Group (2008), point 13

3. Consumption of illicit tobacco products

The illicit market is sizeable in many countries. The impact of PP on the illicit market has been also highlighted by a number of commentators, including the Australian government, as an area of potential concern. Several commentators have argued that PP will increase the supply of and demand for illicit tobacco (including contraband), whilst others have highlighted the scale of illicit trade in certain countries and cited links to organised crime. However, because of the nature of illicit trade, it is difficult to obtain hard data regarding the potential impacts of PP and PSA on the illicit market. Given the potential concern around this area, from both tobacco companies and regulators, we would recommend further research into the impact of PP and other factors on illicit trade to establish an evidence base to inform the debate going forward.

3.1 Estimates around the size of the illicit market

The illicit tobacco market represents an important issue for governments and the tobacco industry. Illicit tobacco undermines public health initiatives to curb tobacco consumption, harms the interests of legitimate businesses throughout the supply chain and leads to lost tax revenue for governments.[176, 177]

The illicit market can be broken down into three areas: [178]

Counterfeit tobacco	Contraband tobacco	Unbranded tobacco
• Identical copy of branded products, bearing the trademark without authorisation. • Manufactured and sold illegally, usually at a lower price compared to licit tobacco. • May pose additional health risks to consumers as production facilities are unregulated and do not adhere to the industry production standards.	• Genuine branded products imported from one excise regime (e.g. other countries or duty free) without payment of the applicable taxes or in breach of import/export laws. • Illegal importing of products from a low-tax to a high-tax country, to take advantage of the price differential. Also known as illegal cross-border trade.	• Tobacco products with little or no brand equity that are locally produced and consumed • Not usually illicit at the point of manufacture, but only when they are smuggled and evade tax

The very nature of the illicit tobacco market means that accurately estimating its size can be difficult.[179] That being said, a number of reports from governments, NGOs and tobacco companies have sought to do this, as outlined below.

A recent study published by the International Union against Tuberculosis and Lung Disease estimated that 11.6% of the global cigarette market was illicit, resulting in lost government revenues of US$40.5 billion globally.[180] An earlier KPMG study, commissioned by the European Commission, estimated that, in 2004, illicit tobacco represented approximately 8-9% of the European market,[181] or c.€10 billion in lost tax revenues.[182]

According to Joossens et al. (2009), whilst the size of the illicit market varies across geographies, it tends to be higher in low income countries (around 17% on average) than in high income countries (around 10%).[183] That being said, there is information to suggest that certain high income countries present a higher incidence of illicit tobacco.

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176 European Commission (2010)
177 According to the UK Department of Health, tobacco smuggling also exacerbates health inequalities and may be discouraging younger smokers from quitting – The Department referred in particular to evidence presented in May 2008 by the health charity ASH, revealing that "one smoker in twenty in professional groups admits to buying smuggled tobacco, but among poorer smokers the figure rises to one in five" and that "there is also a strong association with age, with one in three of the youngest smokers in the sample (16–24 year olds) reporting buying cigarettes from illicit sources" UK Department of Health (2008a, p.22)
178 See also PwC (2010), p.8
179 Measures of the size of the illicit tobacco trade and of its components (e.g. contraband, counterfeit) are at best estimates, given the scarce availability of reliable data on illegal activities
180 Joossens et al. (2009), p.1
181 KPMG (2005), p.8. The figure is referred to the EU-25 tobacco market
182 European Commission (2010)
183 Joossens et al. (2009), p.1

In particular:

- **Canada:** According to a recent estimate 27% of total cigarettes sales were illicit in 2007.[184] It was suggested by the Gazette of Montreal that this could cost the Canadian government approximately $1.6bn in lost taxes.[185]

- **Australia:** A recent report by Deloitte estimated that the Australian illicit tobacco market accounted for 15.9% of cigarette sales, equivalent to an annual revenue loss of $1.1 billion AUS in 2010.[186]

- **UK:** According to UK Customs in 2006-07 the market share of illicit products was 13% for cigarettes and 56% for hand-rolling tobacco. In 2006, HMRC put the Government's losses from the illicit tobacco trade at £2.9 billion a year.[187]

In addition, there is some evidence of a shift from contraband to counterfeit products in certain countries, due to manufacturers strengthening control over distribution and retail supply chains making less genuine product available for smuggling. A recent study from the UK Treasury Department indicated that, of all cigarettes seized by UK Customs & Excise, counterfeit cigarettes had risen from 15% in 2001/02 to 48% in 2005/06.[188] A similar shift occurred in the United States where, by 2003, seizures of counterfeit products exceeded those of genuine cigarettes.[189]

Likewise, there is little information available regarding the prevalence of illicit tobacco within younger smoking segments, an important consideration given that a number of regulators have cited reducing the uptake of smoking by younger people as a key reason for introducing plain packaging. However, a recent study by Callaghan et al[190], published in the British Medical Journal, found that "cheap, illicit cigarettes made on native reserves in the USA and Canada constituted a significant proportion (c. 43%) of all cigarettes smoked amongst Ontario high school daily smokers." Whilst, one cannot conclude that this is representative of youth smoking in other parts of the world, the authors do raise an important point in that "this situation may undermine key tobacco control policies... designed to reduce youth smoking."

3.2 Shape of existing literature

Literature on the impact of packaging regulation on illicit trade was predominantly subjective:

- We identified very little literature on PSA regulation and illicit trade.

- Literature of PP regulation and illicit trade was predominantly opinion based from sources including government bodies, NGOs and the tobacco industry.

- The majority of literature recognised that plain packaging could potentially increase illicit trade.

184 Physicians for a Smoke-Free Canada (2008), p.8
185 Marsden (2009)
186 Deloitte (2011), p.5
187 Quoted in British American Tobacco (2008), p.20
188 HM Revenue & Customs (2006), p.12
189 OECD (2008), p.388
190 Callaghan et al. (2010), p.1

This literature is broadly focused on the following drivers of illicit trade:

Drivers of illicit tobacco	Price and price differential	The price of licit tobacco and the price differential between licit and illicit tobacco[191]
	Attractiveness	Changes in the relative attractiveness of various forms of illicit tobacco vis-a-vis licit tobacco
	Availability and ease of purchase	Stimulation of illicit consumption through freely available and easily acquirable illicit products
	Ease of manufacture	Impact of PP on the ease with which illicit tobacco products can be manufactured
	Close resemblance to original	The extent to which PP makes it harder to distinguish between licit and counterfeit illicit tobacco

3.3 Findings from the literature

The potential impact of PP on illicit trade was recently recognised by the Australian Government who noted that:

• Manufacturers, importers, distributors and retailers of tobacco products could lose business to the illicit trade if plain packaging made counterfeiting easier.

• The efforts of the Australian Taxation Office and the Australian Customs and Border Protection Service to collect tobacco excise and customs duty could be affected by the design of plain packaging.

• Government revenues could be put at risk if the design of plain packaging made counterfeiting of tobacco products easier and enforcement efforts less effective.

• Smokers' health could potentially be put at greater risk if they consume counterfeit products.[192]

While there is little hard data on the subject, several commentators have argued that plain packaging may have unintended impacts on the drivers of illicit tobacco, notably:

Price and price differential

As discussed in the previous section, a number of reports, commissioned by both the industry and government bodies, put forward that plain packaging may lead, at least in the short to medium term, to a reduction in the price of licit tobacco products, as a consequence of greater price-based competition.[193] As we have set out in section 4.1.1 of the report, there is a body of evidence that finds that increases in price levels can result in consumers switching towards illicit tobacco products. Based on this, one might conclude that if PP leads to a short to medium term fall in licit prices then this might lead to consumers switching back to licit cigarettes. However, this would only be the case if consumers, having moved to a cheaper illicit product, were willing to switch back and governments, noticing a reduction in cigarette prices, did not seek to offset this through commensurate tax increases. In the latter instance, should PP result in consumers valuing the product less (due to loss of brand value), yet still be required to pay the same price (due to tax increases to offset licit price reductions), there may be a risk that consumers shift to illicit, as they find it harder to justify the premium paid for licit tobacco products.

191 PwC (2010), p. 22. More than half of the surveyed users identified price as the main reason they purchased contraband cigarettes. This was followed by 28% who were unaware they had purchased contraband cigarettes at the time (34% for counterfeit cigarettes). In addition, 8% purchased the contraband cigarettes as they were available or offered to them (10% for counterfeit cigarettes)
192 Australian Government Department of Health and Ageing (2010); Obtained through a Freedom of Information request
193 LECG Consulting (2010b); Europe Economics (2008)

Industry players, including BAT,[194] further commented that a plain packaging environment, with lower perceived value attached to individual brands, may encourage consumers to switch to cheaper products and/or untaxed illegal products, increasing the market share of illicit tobacco.

In the documents reviewed there was little commentary on the potential impact of plain packaging on the price differential between licit and illicit tobacco products. LECG put forward plain packaging may reduce counterfeiting costs and consequently increase the supply of illicit tobacco which could then in turn, through increased switching to illicit, lead to demand and price pressure on licit tobacco. However, they did not comment on what such a scenario would mean for the ongoing price differentials between licit and illicit tobacco.[195]

Given the extent and nature of the existing literature, it was very difficult to conclude as to whether plain packaging will lead to an increase or decrease in the price differential between licit and illicit tobacco. To a great extent this depends on the market dynamics within a given country, as well as potential government reactions to any price declines on licit tobacco through, for example increasing tax levels. Given that price and price differential are put forward as strong drivers of illicit tobacco, we would recommend that any further research into the potential impact of plain packaging on the illicit market looks carefully at this.

Attractiveness

A number of commentators have put forward that the introduction of plain packaging may generate demand for illicit 'branded' packs (particularly contraband), due to them being perceived as more attractive than licit plain packaging. Philip Morris and the International Chamber of Commerce argue that the introduction of plain packaging may drive consumption of illicit 'branded' tobacco through increasing its attractiveness vis-a-vis licit plain packaged tobacco.[196] This view was broadly supported by the arguments presented in the LECG [197] and Europe Economics [198] papers discussed in the previous section. They argued that this would occur for two main reasons:

• Contraband cigarettes may become more attractive in an environment where licit packs are plain.[199]

• Counterfeit branding may convey the impression of higher quality relative to unbranded plain packaged products.[200]

It has been noted that, for the same reasons, plain packaging may also increase the attractiveness of legitimate duty free purchases, leading to a loss of excise duty and VAT.[201]

Availability and ease of purchase

Several commentators have argued that, should detection of counterfeit plain packaged cigarettes become more difficult, then distribution of illicit tobacco may also become more widespread giving consumers greater access to the illicit tobacco.[202]

The tobacco industry put forward that plain packaging may boost the distribution of products through unregulated, untaxed criminal networks which may be more able to access underage smokers – the segment of population that regulators hope to protect most through PP regulation.[203]

194 British American Tobacco (2010), p.6
195 LECG (2010b)
196 Philip Morris (2008), p. 35; International Chamber of Commerce and Business Action to Stop Counterfeiting and Piracy (2010)
197 LECG (2010b), p.2 & 6
198 Europe Economics (2008), p.28
199 LECG (2010b), p. 2 & 6; Europe Economics (2008), p.28
200 Philip Morris (2008), p.35
201 LECG (2010b), p.2
202 See for instance International Chamber of Commerce and Business Action to Stop Counterfeiting and Piracy (2010); Imperial Tobacco Australia (2010), p.2 & 30
203 British American Tobacco (2010), p. 6; Imperial Tobacco Australia (2010), p.30

Ease of manufacture

Organisations, including Philip Morris,[204] BAT,[205] and the Anti-Counterfeiting Group and the British Brands Group[206] have expressed concerns that plain packaging may encourage the supply of illicit tobacco products. According to Amcor, a manufacturer of paper packaging, the introduction of plain packaging would make it significantly easier for counterfeiters to reproduce less complex and less sophisticated packaging.[207] Furthermore, according to the Anti-Counterfeiting Group and the British Brand Group, the ability to replicate multiple brands, all looking essentially the same, would further optimise the production process.[208]

These opinions are supported by recent comments by certain Australian customs and tax officials[209] who stated that plain packaging will "make the counterfeit product more difficult to detect due to the amorphous packaging requirements. It may lead to increased sales of illicit tobacco through recognised tobacco retailers. This is expected to lead to an increase in the illicit market as a percentage of the total market".

Close resemblance of counterfeit to original

Several tobacco companies and external trade organisations[210] have put forward arguments that, as plain tobacco products become more difficult to differentiate from one another, illicit cigarettes may become more difficult to detect. Notably:

• It might be more difficult for consumers to distinguish between counterfeit and genuine plain packs.[211]

• It might also be more difficult, in the case of, for example, 'branded' duty free imports, to detect counterfeits from genuine versions of the product as people would be less aware of the 'branded' packet characteristics.[212]

Other commentators suggested that plain packaging could act to help consumers identify illicit products. According to authors from the Canadian Cancer Society,[213] plain packaging could help reduce cigarette smuggling because "any package not appearing in the standardised format would be instantly recognisable as illicit", with contraband products being more easily identifiable for both law enforcement authorities and consumers. According to the Australian National Preventative Health Taskforce mandatory forms of tax markings would make cigarette packages difficult to counterfeit, reducing the potential for illicit trade.[214]

However, these points need to be considered alongside statements by government institutions that seem to recognise that in a plain packaging environment it would be easier (without additional countermeasures) for counterfeiters to produce packs that closely resemble the original.[215]

204 Philip Morris (2008), p.34-35
205 British American Tobacco (2010), p.6
206 Anti-Counterfeiting Group (ACG) and the British Brands Group (2008), point 15
207 Amcor (2010), p.2
208 Anti-Counterfeiting Group (ACG) and the British Brands Group (2008), point 15
209 Richard Janeczko and Rod Spencer (2010)
210 Philip Morris International (2009a), p.34; Anti-Counterfeiting Group (ACG) and the British Brands Group (2008), point 15; British American Tobacco (2008); British American Tobacco (2010), p.6; Economie Suisse (2009), p.2
211 Economie Suisse (2009), p.2
212 Europe Economics (2008), p. 28; International Chamber of Commerce and Business Action to Stop Counterfeiting and Piracy (2010); Philip Morris International (2009b), p.26
213 Cunningham and Kyle (1995), p.84
214 Australian Department of Parliamentary Services (2010), p.79
215 Australian Government Department of Health and Ageing (2010); Obtained through a Freedom of Information request

3.4 Links between illicit tobacco trade and other criminal activities

A number of market commentators, including government bodies responsible for dealing with organised crime, recognised the presence of potential links between illicit tobacco and wider organised crime. In its 2009 annual report on European organised crime, the European Police Office made a link between the sale of counterfeit commodities and other criminal activities, such as drug trafficking, illegal migration, stolen vehicle trafficking and terrorism.[216] In particular, links have been identified between criminal networks and the illicit trade of tobacco products, due to its high margin of profitability.[217]

For instance, the Australian National Audit Office observed that tobacco smugglers were often actively involved in other forms of criminality such as drugs, money laundering, identity fraud and car rebirthing.[218] The Canadian Criminal Intelligence Service reported that criminals smuggle Canadian produced marihuana into the US in exchange for cocaine, firearms, and contraband tobacco.[219] Studies highlight that for decades the illicit tobacco trade has served to fund organised crime.[220]

In its consultation document on plain packaging, the UK Department of Health stated that "illicit tobacco is linked to organised crime and smuggling of other illicit goods such as drugs, alcohol and weapons. Some of the organised criminal gangs responsible for drug smuggling into the UK are also engaged in the illicit trade in tobacco products".[221]

In their 2008 paper Shelley and Melzer put forward that, as well as having links to organised crime, illicit tobacco also has links to terrorist organisations. The US Government Accountability Office ranked cigarette smuggling among the top fundraising activities used by terrorists, along with illicit drug, weapon, and diamond trade.[222] As an example, the US government and law enforcement agencies have documented the manufacturing of counterfeit cigarettes by terrorist organisations in the tri-border region of South America.[223] Similarly, a number of well known terrorist groups have been linked to illicit tobacco.[224]

216 European Police Office (2009), p.23
217 For example, the PwC (2010) report on the illicit tobacco trade refers to estimates of profit margins from the sales of illicit tobacco in the United States equal to seven times the value of the illegal goods (p.12)
218 ANAO (2006), p.15
219 Criminal Intelligence Service Canada (2010), p.25
220 Shelley and Melzer (2008), p.2
221 UK Department of Health (2008a), p.21
222 US Government Accountability Office (2003), p.2
223 Shelley and Melzer (2008), p.2
224 Shelley and Melzer (2008), p.10
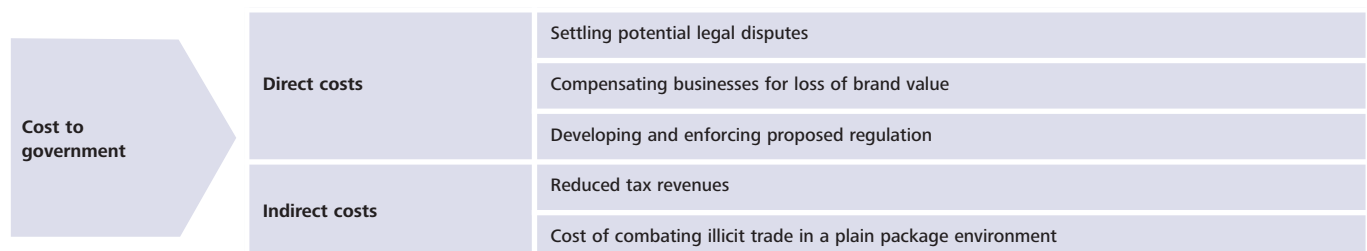
4. Cost to government

Commentators from a range of sources claim that PP will infringe international trademark rights, intellectual property laws and trade agreements, resulting in potential legal and compensation costs for governments. Tobacco commentators and governments also recognise a potential negative impact of packaging regulation on tax revenues and employment, citing changes in licit and illicit consumption as potential causes. Whilst governments are likely to incur costs due to packaging regulations, uncertainty regarding the outcome of legal challenges and compensation makes it difficult to quantify the scale of impact.

4.1 Shape of existing literature

Regulators across multiple jurisdictions emphasise the importance of understanding the potential costs of proposed regulation to the government and to taxpayers. For example, the European Commission, in its recent guidelines for impact assessments, recommends that policy initiatives are assessed with reference to "budgetary consequences for public authorities at different levels of government (national, regional, local), both immediately and in the long run".[225]

Existing literature is predominantly made up of qualitative comments put forward by stakeholders, mostly, but not exclusively, in the context of submissions to government consultations. Whilst governments have recognised the potential cost implications of introducing such regulation they have also highlighted a number of factors that, in their opinion, would mitigate such risks. Such qualitative comments are predominantly set out in submission documents that form the basis of consultation processes within individual jurisdictions, rather than as part of a specific and structured impact assessment.[226, 227]

We have structured our review of the literature around the following cost elements:

Cost to government	Direct costs	Settling potential legal disputes
		Compensating businesses for loss of brand value
		Developing and enforcing proposed regulation
	Indirect costs	Reduced tax revenues
		Cost of combating illicit trade in a plain package environment

4.2 Findings from the literature

Settling potential legal disputes

As we are not legal experts we are not able to comment on the validity of such considerations. However, a number of stakeholders, including tobacco manufacturers,[228] business associations,[229] think tanks,[230] and legal providers/associations[231] have raised concerns regarding the potential impact of PP regulation, and particularly stringent PSA measures, on international legal obligations. The primary objection is that mandatory plain packaging would prevent trademark owners from using their trademarks and therefore expropriate the value of their brands, with potential consequences in terms of breaching national and international intellectual property law as well as international trade agreements.

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225 European Commission (2009), p.32-33
226 UK Department of Health (2008a)
227 Australian Senate Community Affairs References Committee (1995)
228 In particular see the tobacco industry' responses to public consultations on plain packaging in Australia and UK: Philip Morris (2008), p.35-37 and Philip Morris International (2009b), p.2-3; British American Tobacco (2008); British American Tobacco (2010), p. 5&15; Imperial Tobacco Australia (2010), p.11
229 Economie Suisse (2009), p.1-2; US Chamber of Commerce (2010); International Trademark Association (2009)
230 Such as the Institute of Public Affairs (2010)
231 LALIVE (2009), p. 7&11-13; The Law Society of New South Wales (2008), p.1-2; The Washington Legal Foundation (2009), p.1-2; Fratini Vergano (2010)

In particular commentators refer to potential infringement of the intellectual property law set out in the World Trade Organisation's Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS) and the Paris Convention for the Protection of Industrial Property of the World Intellectual Property Organization (WIPO), as well as of the General Agreement on Tariffs (GATT) and the Trade Agreement on Technical Barriers to Trade (TBT).

This view is shared by IP Australia – the Australian Government organisation responsible for administering Australia's intellectual property rights system – which in a note to the Australian Parliamentary Secretary, recently stated that "trade mark owners are given a broad exclusive right to use their mark in relation to the class of goods and/or services against which the market is registered. IP Australia considers that plain packaging of tobacco products if implemented would impinged on this right".[232]

Several industry representatives[233] and law firms have also claimed that that the introduction of plain packaging could expose governments to legal claims. In a recent briefing to the new government, the Australian Department of Parliamentary Services stated that "the tobacco industry is strongly opposed to the proposal, with a number of companies having indicated that they are prepared to fight it on legal grounds."[234] According to LALIVE (2009), "WTO Member States seeking to impose the plain packaging requirement on tobacco products are likely to face international legal proceedings" as "such measures would amount to abuse of Member States' regulatory authority under the [TRIPS] agreement".

Alemanno and Bonadio[235] also put forward that WTO Member States could find it difficult to implement PP as measures "pursuant to Article 8(1) [TRIPs] should prove inter alia that [the measure] is (i) necessary for the promotion of the public interest" and "(ii) consistent with the TRIPs Agreement." For point (i) Alemanno and Bonadio state that "because of the uncertainty surrounding its inherent ability and effectiveness to reduce the incidence of smoking, it might be difficult for states seeking to adopt generic packaging to prove the existence of a causal relationship between such a measure and the protection of public health." In addition, "there might indeed be other means of attaining the same public health objective that would be more effective and less restrictive of IPRs." Regarding point (ii) Alemanno and Bonadio recognise that "it is not an easy matter to meet the second condition of Article 8(1)" and as such "finding generic packaging is contrary to TRIPs cannot be ruled out."

Finally, the US chamber of commerce, put forward that PP proposals are not supportive of the spirit of the multilateral anti-counterfeiting trade agreement, negotiated by approximately thirty governments and with a view to establishing international standards on intellectual property rights enforcement.[236]

Counter arguments

A number of counter arguments have been put forth by academics[237] and an anti-smoking association,[238] maintaining that the relevant international laws and treaties provide enough flexibility to introduce appropriately drafted plain packaging.

Freeman et al, in an academic paper funded by the National Health and Medical Research in Australia, also expressed the view that costs to government may be less significant than anticipated by industry, in particular with reference to potential legal costs.[239]

232 IP Australia (2010) – Document obtained by BAT through the Freedom of Information Act
233 See for example Imperial Tobacco Australia (2010), p.1
234 Australian Department of Parliamentary Services (2010), p.78
235 Alemanno and Bonadio (2010)
236 US Chamber of Commerce (2010)
237 See Freeman et al. (2007), p.14-16; Cunningham and Kyle (1995), p.84-85
238 Physicians for a Smoke-free Canada (2008)
239 Freeman et al. (2007)

Compensating businesses for loss of brand value

In a recent briefing to the new government, the Australian Department of Parliamentary Services stated that the "tobacco industry is likely to first fight the [plain packaging] proposal on the grounds that it violates the right of property ownership. Should it fail in this approach, it is likely to demand significant compensation for what it sees as the deprivation of its property rights".[240] Similarly the UK Department of Health reported that "several manufacturers have said they would seek compensation for loss of intellectual property if the [plain packaging] measures were implemented".[241] This view is consistent with statements made by Philip Morris regarding UK and Australian regulatory proposals, notably:

- In Australia, Philip Morris maintained that "mandating plain packaging is extreme and disproportionate, unsupported by the evidence, and would constitute an expropriation [of trademarks] for which compensation is due".[242] According to Philip Morris plain packaging would be equal to a compulsory acquisition of property, "since it would prevent trademark owners and their licensees from using and exercising control over their property rights".[243]

- Philip Morris have also made an argument for compensation in cases where PSA regulations "dedicate the entire package" to health warnings, as this would make trademarks hardly recognisable and jeopardize the validity of corresponding rights.[244] Philip Morris make specific references to countries proposing warnings covering more than 50% of the package, and going up to 90% of the front and 100% of the back of the pack (like Australia or Uruguay).

- In 1995, following the rejection of PP by the Australian federal government, a spokeswoman for the then Minister for Health, Dr Lawrence, said "Unfortunately, [PP] is just not feasible. We would have to buy the tobacco companies' trademarks, and that would cost us hundreds of millions of dollars."[245]

No estimate has been made, to our knowledge, of what could be deemed to be a fair compensation to the trademark owners. However, the industry believes that compensation should be proportionate to the value of the expropriated brand. In the case of leading brands, this could be sizeable. For example, Interbrand (2010)[246] recently ranked Marlboro as 17th most valuable brand in the world, with a total brand value of US$19 billion.

Counter arguments

Commentators questioning the legal grounds of potential compensation claims maintain that PP and PSA regulations are not in violation of intellectual property laws and international trade agreements:

- The Australian Department of Parliamentary Services argued that, given that the government would not stand to gain any benefit from the acquisition, the proposal would not amount to an acquisition of property as specified at section 51(xxxi) of the Constitution.[247]

- It has also been recently noted that "no tobacco company has succeeded in being compensated for any loss of trade, predicted by the industry".[248] In particular, "governments have appropriated large surface areas of tobacco packs for health warnings without legal impediment or need to compensate tobacco companies".[249]

240 Australian Department of Parliamentary Services (2010), p.79
241 UK Department of Health (2008b) – Consultation on the future of tobacco control: Consultation report
242 Philip Morris (2009a), p.22
243 Philip Morris (2009a), p.27. According to Philip Morris, this would constitutes a Federal "acquisition" for purposes of section 51(xxxi) of the Australian Constitution, which also provides that the Federal Government should provide just terms for any acquisition of property (including every species of valuable rights and interest)
244 Philip Morris (2009a), p.22; Philip Morris International (2009b), p.2
245 Sydney morning herald (1995)
246 Interbrand (2010)
247 Australian Department of Parliamentary Services (2010), p.79
248 Royal College of Australian Physicians (2009), p.3
249 Freeman et al. (2007), p.5

Developing and enforcing proposed regulation

There was only limited commentary within the literature reviewed regarding potential costs of developing and enforcing proposed regulation:

- In proposing the introduction of mandatory picture/text warnings, the UK Department of Health stated that there would be no extra enforcement costs, as enforcement arrangements already in place would not change (i.e. Trading Standards Officers would continue to enforce health warnings).[250] Based on the summary or responses prepared by the UK Department of Health, this view was broadly supported by respondents in their submission to the consultation on tobacco pictorial warnings.[251]

- No comments were identified on potential development and enforcement costs associated with PP regulations.

Reduced tax revenues

In the literature reviewed, there was limited commentary regarding the potential impact of PP and PSA regulations on government tax revenues from tobacco products.

- According to UK Department of Health (2007), introducing graphic health warnings on all tobacco products would drive a decrease in smoking prevalence of 0.5%. This would lead to a proportional decrease in profit in the tobacco industry of to £37.8 million per year, and an annual reduction in tobacco excise of around £52.5 million from reduced UK tobacco sales. [252]

- Industry commentators, such as British American Tobacco and the Tobacco Station Group, conversely put forward that reductions in tax revenues would follow from a shift of consumption from licit to illicit products as a consequence of the introduction of plain packaging.[253, 254]

Finally, in addition to a reduction of tax duty collected, a potential decrease in tobacco sales may have a knock-on effect on the amount of corporate taxes that governments may be able to raise, although this will in part depend on the companies' tax structures.

Cost of combating illicit trade in a plain package environment

As set out in section 3 of this Appendix, it is the opinion of the tobacco industry and a number of other commentators, that counterfeit plain tobacco packs would be easier to manufacture and more difficult to detect. As a consequence, according to the Anti-Counterfeiting Group and the British Brands Group, plain packaging "is likely to increase rather than decrease burdens on already overstretched enforcement organisations" (such as Trading Standards Officers, Customs and Police), working to enforce intellectual property protections in the face of escalating counterfeiting and piracy.[255]

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250 Department of Health (2007a), p.12
251 UK Department of Health (2007b), p.11. UK Department of Health; Consultation on the Introduction of Picture Warnings on
    Tobacco Packs – Report on Consultation; 2007b
250 UK Department of Health (2007a), p. 12; There is current debate around whether this decrease in smoking prevalence has
    come to pass (For example, as discussed by PHRC (2010))
253 British American Tobacco (2008b)
254 Tobacco Station Group (2010), p.1-2
255 Anti-Counterfeiting Group (ACG) and the British Brands Group (2008), point 17

5. Cost to retailers

Deloitte recently carried out a study to estimate the likely cost to retailers of PP, based on business-reported data. Areas where potential direct cost impacts were identified included inventory management, transaction efficiency and product selection errors. Indirect impacts included increased security costs, potential for channel shift to larger retailers disadvantaging smaller independent stores (especially if packaging regulation is combined with retail display bans), and potential loss of revenues to the illicit trade.

5.1 Shape of existing literature

Regulators across a number of jurisdictions have emphasised the importance of understanding the implications of regulation on individual companies. For example, the European Commission, in its recent guidelines for impact assessments, recommends that policy initiatives are assessed with reference to their economic impacts on corporate and small and medium enterprises across the industry supply chain, including impacts on operating costs and administrative burdens.[256]

Literature on cost to retailers originates primarily from specific studies and public consultations, for example:

• Quantitative cost estimates – Deloitte recently conducted research for the Alliance of Australian Retailers,[257] on the potential operational impacts of plain packaging based on quantitative estimates provided by retailers.[258]

• Qualitative comments – mostly put forward by retailers in consultation submissions, qualitative comments cover concerns around the impact of PP on direct operational costs and indirect economic consequences.

In this section we will review the literature relating to the costs that retailers may incur following the potential introduction of PP regulation.

The key costs areas covered in our review are summarised below:

Cost to retailers	Direct costs	Indirect costs
	• Stock management costs • Transaction costs • Product selection errors	• Loss of revenue • Channel shift to other retailers • Security costs

5.2 Findings from the literature

Deloitte was recently engaged by the Alliance of Australian Retailers to identify the likely costs and operational impacts for retailers from the introduction of plain packaging.[259] Based on consultations with retail operators – including service stations, convenience stores, tobacconists and newsagents – we identified a number of potential impacts of plain packaging on retailers – direct and indirect.[260]

Figure 11 summarises the main quantitative results of the research, with reference to total direct costs only.

256 European Commission (2009), p.32-33
257 The Alliance of Australian Retailers brings together the Service Station Association, the Australian Newsagents' Federation and the National Independent Retailers Association. The Alliance is supported by British American Tobacco Australia Limited, Philip Morris Limited and Imperial Tobacco Australia Limited
258 Deloitte (2010)
259 Deloitte (2010)
260 Deloitte's methodology aimed to assess the additional economic costs resulting from compliance with new regulation, in particular, estimating additional business activities (primarily measured in time). (See Deloitte, 2010, p.4)

Figure 11. Estimated annual total direct costs of the introduction of plain packaging of cigarettes on Australian retailers, per store[260]

Operator	Estimated number of daily transactions	Indicative annual additional time (hours)	Indicative extra annual costs
Service station/Convenience store	200 – 400	455 – 1,692	AU$9,000 – 34,000
Tobacconist	100 – 200	323 – 1,218	AU$6,500 – 24,000
Newsagent	50 – 200	216 – 834	AU$4,500 – 17,000

In the following paragraphs, we set out the main findings from this research, along with relevant remarks from other commentators identified through our literature review. As the majority of the literature was focused on PP (versus PSA) our analysis has focused on this area.

Stock management costs

According to the Australian retailer survey by Deloitte, plain packaging, by removing key distinguishing features from packs, may lead to retailers needing to spend more time managing stock.[262] The report estimated that the increase in daily time taken for stock management would be of the order of 10-45 minutes, resulting in an annual cost increase of AU$1,200 – 5,500 per retailer,[263] as a consequence of increased time in:

• Receiving and unloading stock, due to more complex checking-off procedures.

• Restocking of product by staff, as they will have to read and check each individual package more carefully.

• Completing the regular tobacco stock takes, due to increased time needed to manually count the number of items for each product on the shop front and in the store room.

The UK Department of Health recognises in its consultation document that "if plain packaging was to be introduced, it could be more difficult for retailers to conduct inventory checks". However, the Department also notes that "provision could be made for bulk containers of tobacco products to carry the names of products in larger typeface, so long as they were not exhibited within the retail environment."[264] Similarly, authors from the Canadian Cancer Society had previously noted that "under plain packaging legislation, crates and boxes containing tobacco products for distribution by wholesalers, and not seen by consumers, could still carry trademarks and brand colours. Boxes stored in a retailer's backroom could also feature brand colours and trademarks".[265]

Transaction costs

Our research in Australia highlighted that, according to retailers, plain packaging may increase the time to complete a transaction by 15-45 seconds per customer, resulting in AU$3,000 – 27,000 of additional annual costs per individual retailer.[266] This would be the consequence of potential increases in the time taken for customers to locate the product and for sales assistants to search for stock.

A similar concern was expressed by retailers in the UK. In particular, "the AITS survey of specialist tobacconists said that it would make their work impossible, and vending machine operators also pointed out that it would make products identification very difficult for staff and customers".[267]

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261 Deloitte (2010), p.5
262 Deloitte (2010), p.10
263 This estimate is based on the assumptions that wage is of AU$20 average per hour and that stores are open seven days a
    week. See Deloitte (2010), p.11
264 UK Department of Health (2008a), p.42
265 Cunningham and Kyle (1995), p.84
266 The range reflects the different size and categories of retailers. In particular the indicative annual cost is of:
    a) AU$3,000 – 10,500 for newsagents; b) AU$5,000 – 18,000 for tobacconists; c) AU$7,500 – 27,000 for service station and
    convenience stores. These estimates are based on the assumptions that wage is of AU$20 average per hour and that stores
    are open seven days a week. See Deloitte (2010), p.13
267 UK Department of Health (2008b)

A different opinion has expressed by the UK Department of Health, who stated that alternative solutions could be found to minimise the impact on point of sale customer, for example "brands could be stacked in alphabetical order to facilitate quick identification."[268] This view has also been expressed by the Canadian Cancer Society.[269]

Product selection errors

According to Deloitte (2010), "visual cues such as colouring and branding attempt to ensure that retailers can clearly identify the requested tobacco product. In the absence of such cues, as would be the case under plain packaging, retailers expected that there would be a greater instance of product selection errors".[270] The estimated additional annual economic costs are of AU$180 – 1,400 per individual retailer.[271] This estimate refers to two possible costs scenarios:

- The consumer recognises the mistake before opening the package and exchanges the product – in this case the retailer will face costs associated with increased transaction time from having to complete a second transaction.

- The consumer leaves the store, opens the package (diminishing re-sale value), recognises the mistake and later exchanges the product – This has the potential to lead to both increased transaction times and higher levels of stock shrinkage (as once the product is unsealed it no longer holds any re-sale value).

Further comments were provided in the Service Station Association who, in response to the Australian inquiry on plain packaging, stated that "without that unique packaging, console operators would only have stereotype words to help them locate the product of choice, which will take considerably longer and lead to a high error rate".[272]

As seen in the previous paragraph, commentators have proposed a way to facilitate a quick identification of packs at point of sale by stacking brands in alphabetical order.[273] This may not only reduce the transaction costs, but also mitigate the risk of selection errors.[274]

Loss of revenue

There are a number of routes through which retailers have expressed concern regarding the potential impact of plain packaging on retailer revenues:

- The Australian Newsagents' Federation Limited expressed concern that potential losses in tobacco sales due to, for example, customer delays may also result in lost non-tobacco sales associated with each lost customer.[275]

- The UK Department of Health – based on the assumption that pictorial warnings may succeed in reducing tobacco consumption – stated in its consultation document that "fewer tobacco sales would also have a knock-on effect on retail". As a consequence, "there may be scope, as the levels of smokers decreases over time, for looking at wider simplification measures for the retail industry.[276]

268 UK Department of Health (2008b)
269 UK Department of Health (2008a), p.42
270 Cunningham and Kyle (1995), p.84
271 Deloitte (2010), p.13
272 The range reflects the different size and categories of retailers. In particular the indicative annual cost is of: a) AU$180 – 640 for tobacconists; b) AU$200 – 710 for newsagents; c) AU$400 – 1,400 for service station and convenience stores. Deloitte research found that according to retailers "currently, errors in tobacco product selection rarely occur"; however under plain packaging, "the selection errors would increase by approximately 5% to the reduced number of distinguishing features on the packaging". See Deloitte (2010), p.14
273 Service Station Association (2010), p.2
274 Department of Health (2008a), p.42; Cunningham and Kyle (1995), p.84
275 See Department of Health (2008a), p.42; Cunningham and Kyle (1995), p.84
276 Australian Newsagents' Federation Limited (2010), p.2

Our research on Australian retailers found a widespread belief that "the removal of branding makes it easier for genuine stock to be reproduced".[276] This may impose additional impacts to their business, notably[278] a greater risk that stock will include counterfeit product and increased competition from the illicit tobacco market.

Channel shift to other retailers

Australian retailers expressed concern that the introduction of plain packaging may lead to channel shift to other retailers, such as supermarkets, for a number of reasons:[279]

• Customers may respond to greater uncertainty and lack of visibility in terms of available tobacco products by choosing to visit a supermarket as their first choice, as these "offer a broader range of products and are often more competitively priced than convenience stores".

• Customers may switch to larger retailers with more staff to avoid delays and longer queuing time due to the increase in time taken to complete a transaction.

This concern has also emerged in other comments identified through our literature review. For instance, according to a regional network of convenience stores in Australia, plain packaging would require their stores to employ a separate cigarette console operator over and above the existing store attendant to maintain the current level of service. This is considered to be an economically un-viable option that would lead to a "situation whereby only the giants of the convenience store industry will be able to remain sufficiently profitable as to viably remain in business".[280] According to the Service Station Association under plain packaging "the damage to the 'quick and easy'" customer expectation will be significant and remove the incentive to shop [at service stations]".[281]

Security costs

Australian retailers we interviewed expressed concern over the increased potential for store theft while they search for and retrieve the requested tobacco product. Retailers cited that:

• "With their backs to the customers for a longer period of time, there may be a greater likelihood of customers stealing products at the counter or elsewhere in the store".[282]

• There could be more drive-offs from petrol pumps while the attention of service station operators is directed towards locating plain-packaged cigarettes.[283]

• Investment in increased security may be necessary to curb the opportunity for such theft (e.g. through installing more cameras or hiring additional security staff).

277 Deloitte (2010), p.5
278 See Deloitte (2010), p.5
279 Deloitte (2010), p.15
280 AA holdings (2010); p.2
281 Service Station Association (2010), p.2
282 Deloitte (2010), p.15
283 Deloitte (2010), p.15. Deloitte research has found that independent service station operators estimate that fuel theft costs
    them around AU$4,600 per year, depending on the price of fuel

Appendix B – Detailed econometric modelling

1. Methodology

This technical appendix provides a detailed breakdown of the analysis undertaken to assess the impact of potential consumption and competition effects of PSA regulation. Although focussed on PSA regulation, these results should also provide some commentary to the possible impact of PP regulation. Given the findings our research raises regarding the impact of PSA regulation, we suggest that governments consider the extent to which PP will deliver policy objectives in advance of any implementation.[284] The appendix is structured as follows:

• Section 1 – details the theoretical underpinnings for this empirical study and estimation techniques used;

• Section 2 – describes the data collected, sources of this data and any assumptions made; and

• Section 3 – outlines the results and findings of this empirical study.

To consider the impact of PSA on consumption an event study and cross-country panel model of consumption have been estimated.

Throughout this appendix it is assumed the reader has some understanding of econometric techniques. For a practical background in such techniques, see Wooldridge (2002) for panel estimation, and Enders (2010) for time series analysis.

1.1 Panel data analysis

Economic models of consumption classically define consumers' demand for cigarettes to be related to price, income and a set of other control variables. A simple model of aggregate consumption can therefore be posited as follows:

Equation 1

$$C_t = a + \sum_{k=1}^{K} \beta^k X_t^k + \varepsilon_t$$

where:

subscript t represents the time period being considered;

C_t is consumption;

ε_t is a random error term; and

X_t^k is the *kth* consumption driver, such as income or price.

This simple multivariate model of consumption can be derived from many theoretical economic models explaining observed consumption behaviour. For example, Becker, Grossman, & Murphy (1994) assume that a consumer's utility is a function of the quantity of cigarettes consumed previously, contemporaneously and in the future.
In addition, consumption is determined by income (Y_t).

Equation 2

$$U\left(C_t, C_{t-1}, C_{t+1}, Y_t\right)$$

where:

$U(...)$ is a function describing consumers utility; and

Y_t is income.

[284] However, it should be noted that PP entails complete appropriation of cigarette packs while PSA coverage levels tend to be much lower, thus potentially not capturing the impact of large changes in coverage

Assuming a quadratic utility function, and a rational utility maximising consumer, this leads to the following model of demand which is nested in the general multivariate model:

Equation 3

$$C_t = a + \beta^1 C_{t+1} + \beta^2 C_{t-1} + \beta^3 Y_t + \theta^1 \varepsilon_t + \theta^2 \varepsilon_{t-1}$$

This demand model implies consumption in previous years is a determinant of current consumption. Lagging consumption in this way, and extending to a panel equation of countries, equation 1 becomes:

Equation 4

$$C_{it} = a_i + \rho C_{it-1} + \sum_{k=1}^{K} \beta^k X_{it}^k + \varepsilon_{it}$$

where:

subscript i represents the country considered;

a_i represents country specific heterogeneities;

p represents the coefficient on lagged consumption; and

C_{it-1} represents previous period's consumption.

There are a number of procedures that can be employed to estimate this cross-country model of consumption. Of most relevance are dynamic panel approaches, such as the Arellano-Bond procedure (Arellano & Bond, 1991), given their ability to deal with lagged dependent, predetermined and endogenous variables.[285] For exogenous variables, first-differences are used as instruments while lags are used for endogenous or predetermined variables. This flexibility allows for the use of dummy variables (lags) as instruments in estimation.

1.1.1 Relationship of consumption to regulation

A number of papers have sought to use panel based econometric analysis to evaluate the impact of tobacco control regulations on consumption. This paper uses the existing literature as a starting point, seeking to improve on the methodologies developed.[286] In particular this literature includes papers by Nelson, (2003), Saffer & Chaloupka (2000) and Padilla (2009). These papers estimate models, such as Equation 4, but include indicator variables representing the level of tobacco control measures in place. These indicator variables have been constructed in a number of ways:

- Saffer and Chaloupka (2000) – included three indicator variables covering advertising bans: 'Weak Ban' covering 0 to 3 media; 'Limited Ban' 3 or 4; 'Comprehensive Ban' 5 to 7. The media bans considered included: television; radio; print; outdoor; point of purchase; movie advertising; and sponsorship bands.

- Nelson (2003) – included three indicators again covering advertising including: 'Weak Ban' covering 0 to 2 media channels; 'Limited Ban' 3 or 4; 'Comprehensive Ban' greater than 5. In addition he included further variables: count of advertising bans from 0 to 9; a binary variable equalling one for strong warning labels on packages and in advertisement and zero otherwise.

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285 Predetermined variables are correlated with errors in all previous periods, i.e. where $E(x_{it}\varepsilon_{is}) \neq 0 f\ o\!\i\!s < t$, $E(x_{it}\varepsilon_{is}) = 0 f\ o\!\i\!s \geq t$. Endogenous variables are correlated with errors in current and all previous periods, i.e. where $E(x_{it}\varepsilon_{is}) \neq 0 f\ o\!\i\!s \leq t$, $E(x_{it}\varepsilon_{is}) = 0 f\ o\!\i\!s > t$)
286 In particular it is noted that Saffer and Chaloupka (2000) was criticised in an expert witness report by Heckman (2002) for not including an appropriate country-specific time trend in their analysis, and for making a number of errors in their treatment of the data

Aside from Nelson's single indicator variable, measuring whether a strong warning is present on cigarette labels or packing, these papers have not considered in a systematic way the impact of PSA. In order to measure the impact of PSA, a variable can be included that measures the proportion of a total pack covered by text or graphic warnings. Augmenting the model in Equation 4, the impact of PSA regulation can be considered:

Equation 5

$$C_{it} = a_i + \lambda^1 PSA_{it} + \lambda^2 D_{Picture} PSA_{it} + \sum_{k=1}^{K} \beta^k X_{it}^k + \varepsilon_{it}$$

where:

$PSA_{it} \in [0,1]$ measures the level of PSA; and

$D_{Picture} = 1$ if the warning is picture based, otherwise $D_{Picture} = 0$

In this model, if PSA is effective at reducing consumption the first regulatory parameter would be $\lambda^1 < 0$. Further, if this relationship varies for graphic health warnings, $\lambda^2 \neq 0$.

In order to ensure that the model has appropriate controls for other tobacco regulation, indicator variables for advertising and smoking bans are additionally included. In order to keep the model specification parsimonious, and given these policies are not the focus of this analysis, simple count variables are constructed across media and smoking ban types to control for these regulations.

Equation 6

$$C_{it} = a_i + \lambda^1 PSA_{it} + \lambda^2 D_{Pictureit} PSA_{it} + \lambda^3 Media_{it} + \lambda^4 Public\,Smoking_{it} + \sum_{k=1}^{K} \beta^k X_{it}^k + \varepsilon_{it}$$

where:

$Media_{it} \in [0,5]$ represents the count of smoking bans across 5 advertising categories: cinema; outdoor; press; radio; and television.

$Public\,Smoking_{it} \in [0,8]$ represents the count of smoking bans across 8 categories: domestic airlines; international airlines; buses; trains; cafes/hotel/restaurants; cinemas/theatres; private workplace; and public workplace.

1.2 Event studies

The event study analysis uses time-series techniques to determine whether there have been structural breaks in either the mean or time-trend of consumption in and around regulatory events. This analysis is undertaken based on endogenously identifying structural break points, as opposed to using traditional Chow tests and testing a priori breaks. Christiano (1992) argues that pre-identifying breaks is an arbitrary process which can lead to inaccurate Chow test results. This is particularly relevant here since tobacco regulation might have lagged effects on consumption, making it difficult to identify fixed breaks.

1.2.1 Testing for structural breaks

There are a number of structural breaks tests which endogenously select the break point within a series. This appendix only provides a brief overview of the different approaches, for a more comprehensive discussion see Perron (2005).

The issue of determining whether structural breaks are present in a data series is intimately related to the study of unit root, or non-stationary processes. A non-stationary process has moments of the series, such as the mean or variance, that exhibit non-constancy across time. An example of such a process is the classic 'random walk'. If such a process is found in consumption, consumption would be related to previous consumption only and a random shift (ε_t):

Equation 7

$$\text{Implying } C_t = C_{t-1} + \varepsilon_t$$

$$11 \text{ or } C_t = C_{t-k} + \sum_{1}^{k} \varepsilon_t$$

The Zivot-Andrews test (Zivot & Andrews, 1992) is based on testing the null hypothesis of non-stationarity, against the alternative of stationarity with structural breaks in the mean and time trend:

Equation 8

$$H_0 : C_t = a + C_{t-1} + \varepsilon_t$$

$$H_1 : C_t = a_1 + a_2 D_{Level} + \delta_1 D_{Trend} + \delta_2 t + \varepsilon_t$$

Where:

$$D_{Level} = 1 \text{ and } D_{Trend} = 1 \text{ if the time period is post the hypothesised break point.}$$

The actual test, selects the break point based on estimating the following regression until the largest *t*-statistic is found on the lagged dependent variable:[287]

Equation 9

$$\Delta C_t = a_1 + \rho C_{t-1} + a_2 D_{Level} + \delta_1 D_{Trend} + \delta_2 t + \sum_{k=1}^{K} \beta^k \Delta C_{t-k} + \varepsilon_t$$

The maximum t-statistic from this rolling estimation is then compared to critical values, to determine whether the break point is significant. This approach can be iterated including and excluding the trend and mean breaks.

The Zivot-Andrews test has been employed extensively in the literature, for example see Nunes (1997) and Wu (2003). However, the procedure has a number of limitations including only being able to test for one break point; although Lumsdaine & Papell (1997) extended the approach to test for two breaks.

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287 Lagged differences of consumption are included to purge any serial correlation from the error term. The order of lags to include should be chosen based on a general to specific approach

An alternative procedure which allows for the testing of multiple breaks in the mean has been developed by Bai-Perron (1998). This procedure is similar to the Zivot-Andrews test, in that it constructs a rolling series of break tests. Rather than testing for breaks in the trend, these are F-tests for breaks in the mean or auto-regressive coefficients of a stationary timeseries. Testing the consumption series with m breaks in the mean (m+1 sets of parameters), the estimated model is:

Equation 10

$$C_t = \alpha_j + \varepsilon_t \qquad t = T_{j-1} + 1, \dots, T_j \qquad j = 1, \dots, m + 1$$

Based on this a 'supF' test can be applied to a series of individual F-tests to test for a single exogenous break. The Bai-Perron procedure generalises this idea to find the number and timing of multiple breaks in a series. In this generalisation, the test is between *m* and *m*+1 breaks SupF(m+1|m) .

2. Data

2.1 Panel data

The panel dataset covers 27 countries and 14 years from 1996 to 2009.[288] The dataset is rich by virtue of covering a broad cross-section of advanced, developing and emerging economies as listed in Table 1, and spans over a long enough time period to capture major changes in tobacco regulation, including PSA. This helps measure differential impact by regulation type and region.

Table 1. Countries covered[289]

Advanced economies	Emerging and developing economies
• Australia • Belgium • Canada • France • Germany • Greece • Italy • Japan • Korea (South) • Netherlands • New Zealand • Spain • Switzerland • United Kingdom	• Argentina • Brazil • Chile • Colombia • Egypt • Malaysia • Mexico • Nigeria • Pakistan • Poland • Romania • South Africa • Turkey

Source: IMF country classification 2010

Previous panel studies on tobacco regulation have primarily focused on OECD countries and covered advertising and public smoking regulation; for example, Saffer and Chaloupka (2000) cover 22 OECD countries from 1970-1992, and Nelson (2003) 20 OECD countries from 1970-1995. However, it should be noted that since consumption and pricing data is available on an aggregate level, it has not been possible to measure differential impact across age groups and economic strata.

2.1.1 Consumption and pricing data

Annual consumption and pricing data is provided by BAT/Oxford Economics. Since actual consumption volumes are not available, actual duty-paid shipment volumes of sticks are used.[290] The annual volumes are converted to per capita consumption using population data.[291]

Consumption of cigarette sticks has gradually declined over the last 15 years; in aggregate, decreasing at an annual rate of 1%, as illustrated in Figure 12.

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288 All data used for analysis is annual

289 The following countries are not included in the panel because of data limitations: Kazakhstan, Russia, Ukraine (data on advertising & public smoking bans is inconsistent over time and cannot be verified; there are shifts from regulation being more restrictive to less restrictive, and then becoming more restrictive again), Bangladesh, Indonesia, Saudi Arabia, Venezuela, Vietnam (the historical price and consumption data appeared to be lacking consistency), Bahrain, Denmark, Iran, Ireland, Kuwait, Oman, Qatar, Sweden, United Arab Emirates, and Uzbekistan (there is no price and consumption data available)

290 Shipment volumes might differ from actual consumption because of changing inventory levels and other seasonal factors. However, since an annual time period is being considered, the impact of such differences is likely to be reduced

291 Source: World Bank 2010

**Figure 12. Total annual consumption in the panel (billion sticks)**
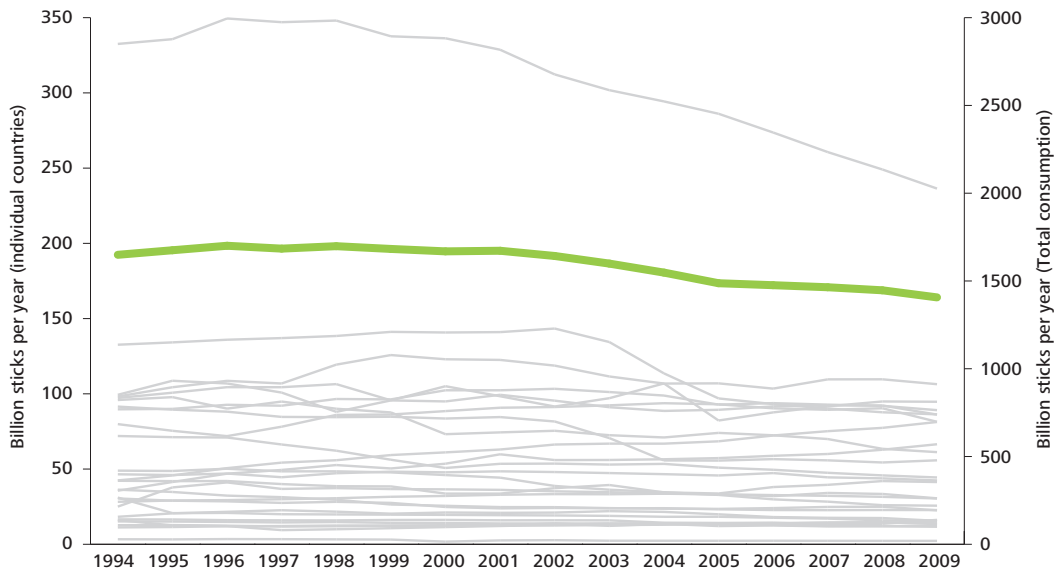
Source: Deloitte analysis of BAT data. The green line is the sum of consumption data across 27 countries

Annual retail prices per stick, in local currencies, are converted to Purchasing Power Parity (PPP) prices using the PPP conversion factors for private consumption.[292]

Cigarette prices have increased consistently over the last 15 years. In aggregate, average prices increased annually at 5%. This trend is seen across developed and emerging economies, as illustrated in Figure 13.

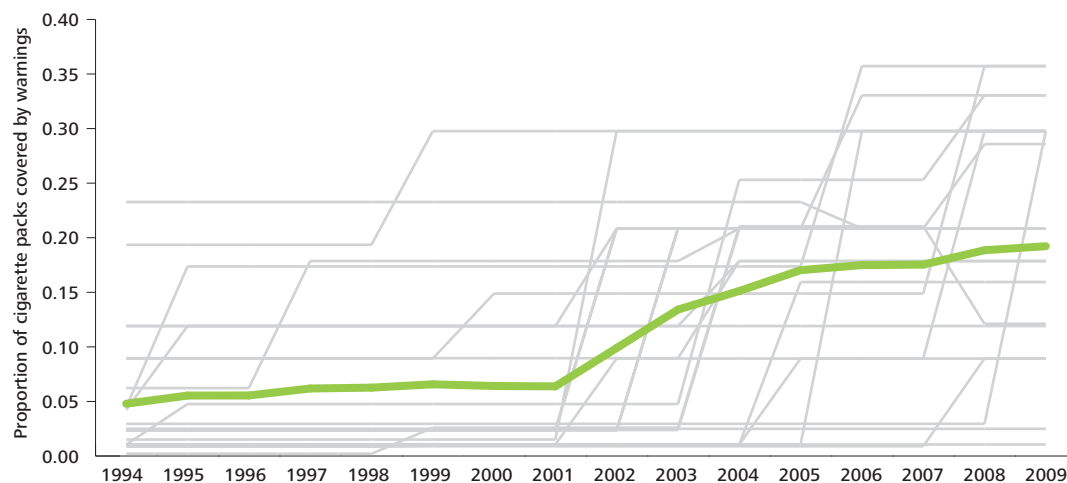**Figure 13. Weighted average price per stick (USD – PPP)**
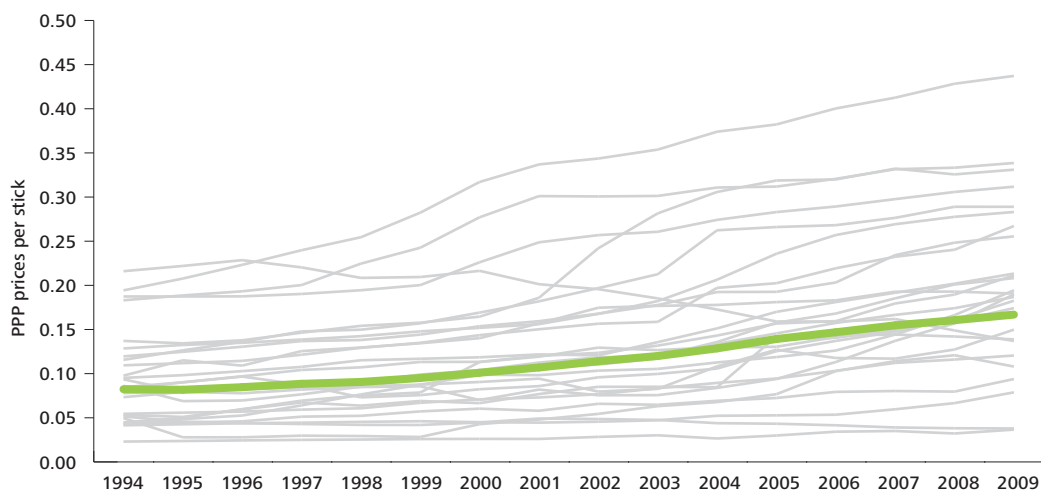
Source: Deloitte analysis of BAT data. The green line is a weighted average of price per stick where the weighting is based on annual volumes

292 Source: World Bank 2010; given as local currency units per international dollar

2.1.2 Tobacco regulation data

Tobacco regulation data has been collected on PSA, advertising bans and public smoking bans. For PSA, the key variable of interest, the percentage coverage of cigarette packs with warnings has increased substantially over the last decade, as illustrated in Figure 14.

Figure 14. PSA regulation (proportion of cigarette pack covered with warnings)

Source: Deloitte analysis of BAT and market data. The green line is a weighted average of PSA where the weighting is based on annual volumes. Total coverage of packs has been determined by weighting surface-specific coverage (front, back or side)

In order to reach a complete dataset describing PSA, some assumptions have been made, listed in Tables 2 and 3.[293]

Table 2. General PSA Assumptions

Assumptions[294]
When legislation requires text warnings without specifying percentage coverage, a warning typically found in other countries has been used to estimate coverage. If font size/height is given, it has been used to estimate coverage. Otherwise, font size with 1.5mm height is assumed.
Legislation typically specifies the percentage of coverage of a particular surface (front, back or side). These are rebased to achieve a consistent measure of total percentage coverage. Dimensions are: 30% front; 30% back; and 24% for both pack sides (based on a 20 stick pack).

Source: Deloitte analysis

In addition, in situations where information about implementation dates and warning coverage percentages is not explicit, several country-specific assumptions have been made based on interpretation of relevant legislation, to complete the dataset.

293 It should be noted that as part of the panel econometric analysis, these assumptions are varied to ensure the results remain robust to reasonable changes
294 It should be noted that the assumptions primarily relate to older warnings that are less prevalent during the period considered

Table 3: Country PSA assumptions

| Country	Assumptions
Australia	Based on state legislation passed in 1987 in Australian Capital Territory, text warnings requirements were effective in January 1990.
	Legal reference: Tobacco products (health warnings) (amendment) ordinance 1987, No. 22.
Belgium	Based on legislation in 1990 and 1992, % coverage specified (4%), would cover 4% of both the front and back of packs.
	From 2006, warnings would cover 48% of the front and 63% of the back of packs.
	Legal references: Royal Decree of 13 August 1990 relating to the manufacture and marketing of tobacco-based and similar products, Royal Decree of 13 August 1990 relating to the manufacture and marketing of tobacco-based and similar products amended by the Royal Decree of 14 April 1993.
	Website Link: http://www.tobaccolabels.ca/healthwarningimages/country/belgium.
Chile	Based on legislation in 2006, 50% of both the front and back would be covered till 2008. For 2009, no assumptions are made since information is explicit in the legislation.
	Legal reference: No. 2642,1 Valparaíso, 15 March 2006/ Amendments to Law No 19.419.
Colombia	Text warnings would cover 10% of the side of the pack (for all years from 1990 to 2009). This was based on 1986 legislation stating that 10% of the pack should be covered, and regulation documentation noting for 5 years that the side of the pack was covered.
	Legal reference: National Statute On Drugs: Law 30 of 1986, (1 January).
Germany	Based on legislation in 1991, text warnings would cover 4% of both the front and back till 2002.
	Legal reference: Verordnung ueber die Kennzeichnung von Tabakerzeugnissen und ueber Hoechstmengen von Teer im Zigarettenrauch (TabKTHmV), (Ordinance of 29 October 1991 on the labelling of tobacco products and on the maximum tar content in cigarette smoke).
Japan	Based on visual illustration in 2003 legislation, the front would be covered with warnings.
	Legal reference: Manual for Labeling of Packages, 9/12/2003.
Switzerland	From January 2008, warnings would cover 48% of the front and 63% of the back of packs.
	Legal reference: Ordonnance du DFI concernant les mises en garde combinées sur les produits du tabac (Ordinance of the Federal Department of the Interior on combined warnings on tobacco products) 10 December 2007. (Text in French and translated).
	Website Link: http://www.tobaccolabels.ca/healthwarningimages/country/switzerland.
United Kingdom	From 2008, warnings would cover 43% of the front and 53% of the back of packs.
	Website Link: http://www.tobaccolabels.ca/healthwarningimages/country/unitedkingdom.

Source: Deloitte analysis

For advertising and public smoking bans, the number of bans across various categories has been counted. For advertising, there are five categories: cinema; outdoor; press; radio; and television. For public smoking, there are eight categories: domestic airlines; international airlines; buses; trains; cafes/hotel/restaurants; cinemas/theatres; private workplaces; and public workplaces. There has been a steady increase in the number of bans in both areas, as seen in Figure 15 and Figure 16.

Figure 15. Public smoking ban regulation
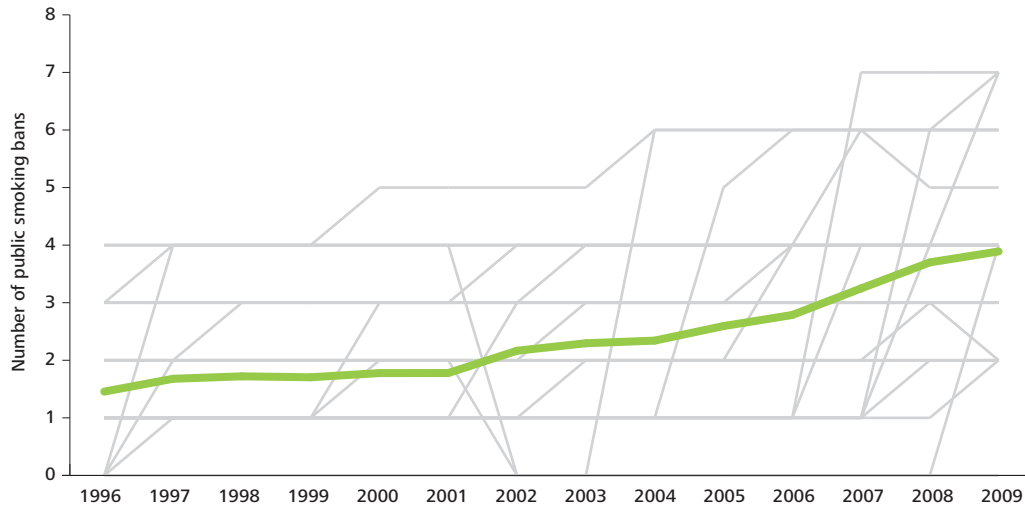
Source: Deloitte analysis of BAT and market data. The green line is a weighted average of number of public smoking bans where the weighting is based on annual volumes

Figure 16: Advertising ban regulation
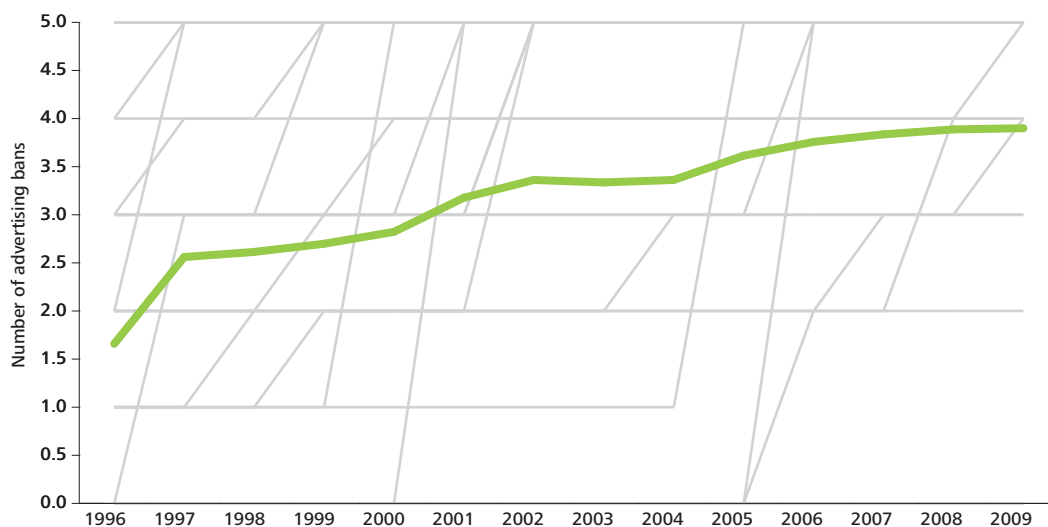
Source: Deloitte analysis of BAT and market data. The green line is a weighted average of number of advertising bans where the weighting is based on annual volumes

The primary data collection source for the count of advertising and public smoking bans has been the tobacco market overviews provided by BAT for the years 1997-2010.[295] However, there are some inconsistencies over time which cannot be verified; for example, there are shifts in regulation from being more restrictive to less restrictive, and then becoming more restrictive again. As a result, several country-specific assumptions are made, as listed in Table 4.

295 There are two advertising ban categories, point of sale and sponsorship, which have not been included due to data limitations

Table 4. Country non-PSA assumptions

Country	Regulation category	Assumptions
Colombia	Public smoking – Trains	1997 to 1998: Ban was in place based on the ban before and after these years; no information was identified indicating otherwise.
Greece	Advertising – Outdoor	2004: Restrictions were in place. This made the data consistent with previous and later years.
		2009: Ban was in place since as per BAT documentation, there was a "ban on outdoor advertising of tobacco products, effective 1 September 2009."
Italy	Advertising – Press	1997 to 1998: Ban was in place, based on the ban on national press in 1996. The ban continued in later years.
	Public smoking – Airlines domestic	1996: Restrictions were in place.
Netherlands	Advertising – Outdoor	1996, 2000 to 2001: Restrictions were in place. Market evidence indicates that the ban was introduced later in November 2002.
	Public smoking – Cinemas/Theatres	1996 to 2001: Restrictions were in place.
Pakistan	Public smoking – Buses and trains	1999 to 2001: Ban was in place, based on the ban in place before and after these years.
Spain	Public smoking – Cinemas/theatres	1997 to 2001: Restrictions were in place, based on the restrictions in place before and after these years. There were some state-level bans in place but since there was no country-wide ban, restrictions were assumed.
Switzerland	Public smoking – Cinemas/Theatres	1996 to 2001: Restrictions were in place.

Source: Deloitte analysis

2.1.3 Other data

Other variables, which might explain differences in consumption, have been included in the panel analysis. These include variables measuring income, socioeconomic conditions, and controls for the illicit market. All variables used in the panel are listed in Table 5.

Table 5. Other explanatory variables

Category	Other data	Source
Income	GDP per capita, PPP (constant 2005 international $)	World Bank. 2010. *World Development Indicators.*
	Employment to population ratio, 15+, total (%)	
Socioeconomic – health	Immunization, DPT (% of children ages 12-23 months)[296]	World Bank. 2010. *World Development Indicators.*
	Immunization, measles (% of children ages 12-23 months)	
	Life expectancy at birth, total (years)	
	Total expenditure on health, % of gross domestic product[297]	OECD. 2010. OECD. *Stat Extracts.*
Socioeconomic – general	Civil liberties score	Freedom house. 2010. *Freedom in the World.*
	Political rights score	
Illicit market controls	Corruption Perceptions Index score	Transparency International. 2010. *Corruption Perceptions Index*
	Imports of goods and services (% of GDP)[298]	World Bank. 2010. *World Development Indicators.*
	Exports of goods and services (% of GDP)	

Source: Deloitte

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296 Average immunization rates of DPT and measles were used in the panel
297 Only available for OECD countries
298 Imports and exports as % of GDP were summed to arrive at a measure to capture cross-country differences in illicit markets

2.2 Event Study data

2.2.1 Consumption data

Monthly brand-level consumption data for Australia has been provided by Nielsen. Since actual consumption volumes are not available, actual duty-paid shipment volumes have been used for analysis. Due to data limitations, notable brands with the most consistent data have been selected. Monthly volumes have been converted to a quarterly series for structural analysis.

3. Results

The results for the panel data, and event study analysis are outlined in this chapter.

3.1 Panel data analysis

This section has a detailed discussion of the panel data results, including details of different robustness checks and estimation methods. All models include cigarette consumption, prices, income and package regulation variables. All non-regulatory variables are specified in logarithmic form.

A wide range of panel based models are tested, and based upon an analysis of these, there is convergence upon three different model specifications.[299] The three models considered share a common structure but differ in the explanatory variables included. The Arellano-Bond estimation method is used, as described in Section 1.1.

- Model 1 – includes the full set of variables controlling for socioeconomic factors such as life expectancy and unemployment, price, income and tobacco regulation.

- Model 2 – excludes the statistically insignificant socioeconomic variables that were included in the Model 1, and so represents a more simplified model.

- Model 3 – includes the PSA regulation variables lagged by one year. This allows for the possibility that package regulation may have a more gradual or delayed impact on consumption.

The elasticities estimated across the three panel models, are presented in Table 6. This table also identifies which of the elasticities are found to be statistically significant from zero, as highlighted by the asterisks. In these models the percentage of PSA is captured through the variables 'Text warning pack coverage' and 'Graphic warning pack coverage'.

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299 Other models including different variables and estimation methods have been discussed in section 3.1.2 and ...

**Table 6. Panel data estimation of Models 1, 2 and 3**

Variable	Model 1	Model 2	Model 3
Previous years consumption	0.55***	0.56***	0.48***
	(0.00)	(0.00)	(0.00)
Cigarette prices	-0.25***	-0.25***	-0.27***
	(0.00)	(0.00)	(0.00)
GDP per capita	0.31***	0.29***	0.27***
	(0.01)	(0.01)	(0.01)
Employment to population ratio	-0.16	–	–
	(0.21)		
Life expectancy	-0.21	–	–
	(0.77)		
Text warning pack coverage	-0.13	-0.14	–
	(0.10)	(0.13)	
Graphic warning coverage	-0.14	-0.15	–
	(0.85)	(0.85)	
Previous years text warning pack coverage	–	–	-0.08
			(0.38)
Previous years graphic warning pack coverage	–	–	-0.09
			(0.95)
Count of advertising bans	0.01*	0.01**	–
	(0.06)	(0.04)	
Count of public smoking bans	0.002	0.001	–
	(0.74)	(0.90)	
Previous years count of advertising bans	–	–	-0.0002
			(0.97)
Previous years count of public smoking bans	–	–	-0.002
			(0.64)
Constant	1.10	-0.29	0.44
	(0.74)	(0.78)	0.73
Test of model significance			
Wald chi–squared statistic	380	364	343
Prob > chi–squared statistic	0.00	0.00	0.00

Source: Deloitte analysis. *** Indicates statistical significance at the 1% level, ** at the 5% level and *at the 10% level based on a standard t-tests. The test of the models significance overall is based on a chi-squared statistic. The p-value for each parameter is provided in parentheses

Across the three models estimated, a number of variables are found to be consistently related to consumption at a statistically significant level. Specifically, prices are negatively related to consumption, whilst previous consumption levels and GDP per capita are positively related to today's consumption. Based on the results from Model 1, the additional socio-economic variables such as employment and life expectancy are not found to be statistically significantly related to consumption.

The negative relationship between consumption and prices is illustrated in the scatter diagram of cigarette consumption provided in Figure 17. The models estimate a price elasticity of around -0.25%, this is comparable to other empirical studies which find elasticities ranging between -0.1 to -0.5.[300]

Figure 17. Scatter diagram of consumption (million of sticks) on price (USD PPP)
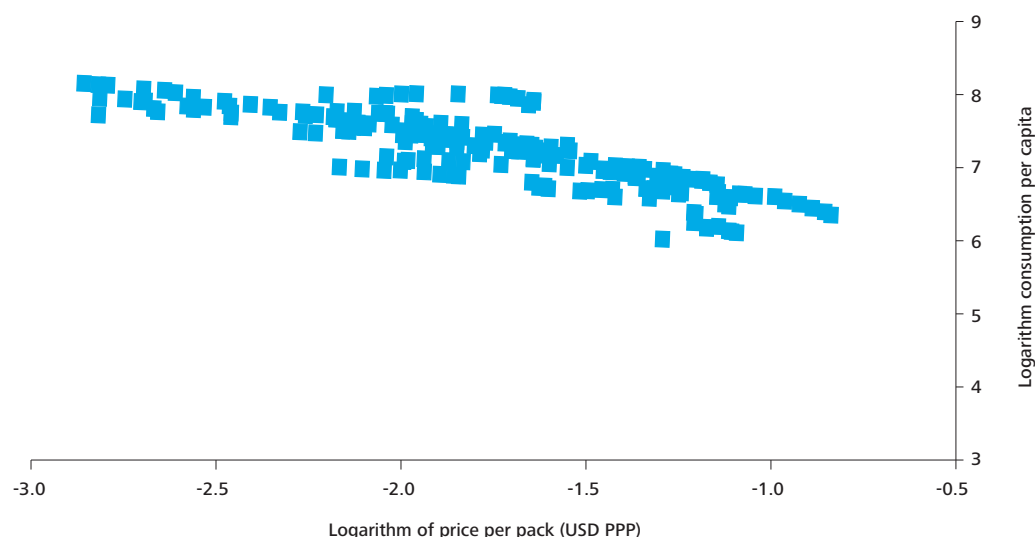
Source: Deloitte analysis based on advanced countries only, the relationship in developing countries is weaker as described in section 3.1.2

The finding that consumption increases by around 0.3%, for every 1% increase in GDP per capita is also comparable to other panel studies finding a positive relationship between income and cigarette consumption.[301] This finding suggests that richer countries consume more legal cigarettes per capita.

In order to consider the relationship between package regulation and consumption, we considered the variables 'Text warning pack coverage' and 'Graphic warning pack coverage' in Table 6. The results in this area across the three models are reported in Table 1 and did not find any statistically significant relationship at either the 1% or 5% level between the percentage of pack coverage of health warnings and consumption, whether the warnings are either text or graphic. This test suggests that across the countries and the time period considered, consumption is not related to the size of warnings displayed on cigarette packages.

This finding is consistent with the event study analysis discussed in section 3.2, and also has some precedent in the literature. Nelson (2003), for example, included a variable into his model which indicated where strong health warnings were present. He found that this variable was not statistically significantly different from zero, suggesting strong health warnings do not influence consumption. Gospodinov & Irvine (2004) found that warnings implemented in Canada in January 2001 "have not had a discernible impact on smoking prevalence" and that whilst "the evidence of their impact on quantity smoked is positive [i.e. caused a reduction], [it is] only at a relatively low level of confidence".[302]

Across some models, count of advertising bans leads to a small but significant increase in consumption. However, the relationship does not hold given small changes in the model, suggesting the relationship is likely to be spurious.

300 For example: -0.50% (Powell, Tauras, & Ross, 2005); −0.45% to −0.47% (Gruber, Senb, & Stabilec, 2003); and -0.20% for ages 24-26 (Harris & Chan, 1999)
301 For example, see Saffer & Chaloupka (2000), Becker, Grossman, & Murphy (1994), Nelson (2003), Laugesen & Meads (1991) and Baltagi & Levin (1986)
302 Gospodinov and Irvine (2004), Abstract

3.1.1 Robustness checks

This section tests the robustness of the results based on models discussed in section 7.1. Three approaches have been used for this purpose; first, in-sample predictions are generated to test the predictive power of models; second, formal tests of serial correlation are performed; and third, formal specification tests are used to ensure the models are not misspecified.

First, a check has been undertaken to determine whether the models are able to estimate relatively accurately previous levels of consumption. This test is undertaken informally in Figure 18, where total consumption estimated using Model 2 is compared to actual consumption.

Figure 18. Model predictive power within sample (billions of sticks)
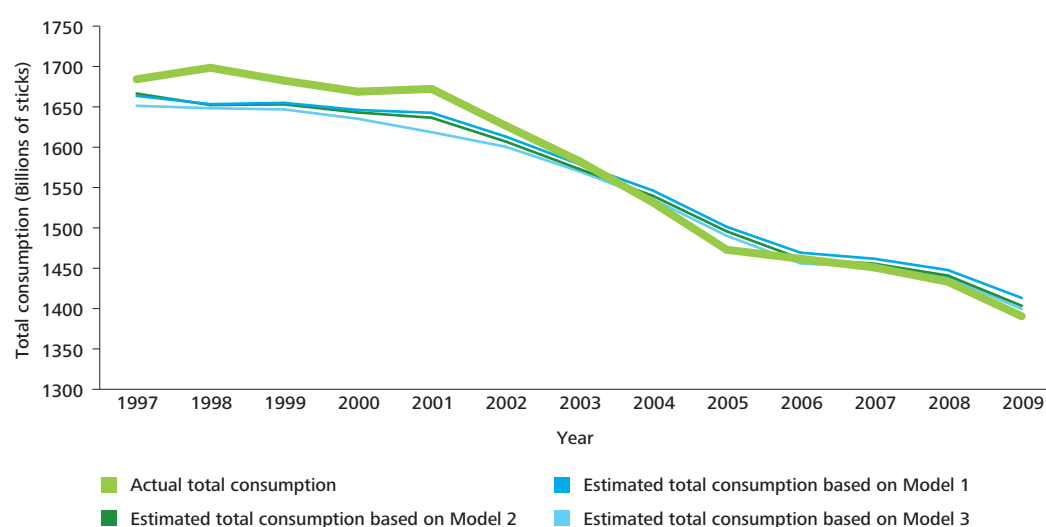
Source: Deloitte analysis

Based on this analysis, estimated consumption can be seen to be close to actual consumption. Specifically, the difference between actual consumption and the estimated level, in any year, is not more than ±3%.

Post estimation tests are conducted to ascertain whether coefficients' estimates and standard errors are robust. There is no evidence of serial correlation in the residuals[303] based on the Arellano-Bond autocorrelation test, see Table 7.

Table 7. Tests of serial correlation in first-differenced errors[304]

Order	Model 1		Model 2		Model 3	
	Test statistics	p-values	Test statistics	p-values	Test statistics	p-values
1	-2.21	0.03	-2.19	0.03	-1.98	0.05
2	-0.81	0.42	-0.92	0.36	0.54	0.59
3	1.35	0.18	1.38	0.17	1.29	0.20
4	1.51	0.13	1.61	0.11	0.64	0.52

Source: Deloitte analysis. Null hypothesis is that there is no autocorrelation; by construction the first order will exhibit serial correlation

303 Higher orders of serial correlation, i.e. over successive time periods, were also tested
304 It should be noted that first order serial correlation of first-differenced errors is consistent with statistical properties of errors. To test serial correlation, higher orders should be considered

It is also found that the one-year lag on consumption, included as an explanatory variable, is appropriate based on the Sargan specification test. These results are shown in Table 8.

Table 8. Tests of specification (Sargan specification test)

Model 1		Model 2		Model 3	
Test statistic (chi2)	p-values	Test statistic (chi2)	p-values	Test statistic (chi2)	p-values
71.33	0.66	68.46	0.75	82.16	0.32

Source: Deloitte analysis. Null hypothesis is that over identifying restrictions are valid

3.1.2 Sensitivities on model specification

To further test the results of the models presented, a number of aspects of the modelling have been varied, including alternative ways to specify tobacco regulation variables, additional socioeconomic variables, controls for the illicit market, including a time trend and running separate regressions for advanced and developing economies. Across the sensitivities tested, the finding that past package regulation does not have a statistical significant relationship to consumption is generally maintained.

• Policy variables allowing for non-linear relationships to consumption – the panel models are re-estimated, allowing for the variable describing the percentage of package covered by health warnings to have a non-linear relationship to consumption. This allows for the possibility that increasing levels of PSA may have an increasing or decreasing relationship to consumption. Results of this specification are reported in Model 4, Table 9.

• Testing sensitivity to text warnings assumptions – this sensitivity investigates whether the results in section 3.1, are sensitive to the estimates made of the percentage of the pack covered by text warnings. This sensitivity is tested in Model 5, where countries for which text warnings assumptions are made are dropped, and in Model 6 where the percentage of coverage is replaced by dummy variables. In the latter model all regulatory variables are specified to be exogenous, hence allowing estimation including variables constant across time.[305]

• Endogeneity of regulatory variables – regulation may be thought as being endogenous given the possibility that changes in consumption may drive changes to regulation, hence reversing the casualty. The Arellano-Bond estimation procedure allows for variables to be specified as predetermined or endogenous by using previously values, of variables, as instruments. Treating regulatory variables as endogenous, results are outlined in Model 7.[306]

• Economic development – separate models were estimated for advanced and developing economies, Model 8 and Model 9 respectively. Running separate models allows for any systematic differences in consumption across advanced and developing economies to be identified.

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305 The binary variables are mutually exclusive, i.e. if graphic warnings are in place, the dummy for graphic warnings has a value of 1, which in turn means that the dummy for text warnings has a value of 0
306 This sensitivity further provides an indirect check that differencing regulatory variables in the standard Arellano-Bond models isn't what is driving the results. This is further tested through the estimation of more standard random effects models in section 3.1.3

Table 9. Sensitivities on model specification

Variable	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Previous years consumption	0.56***	0.57***	0.58***	0.60***	0.53***	0.66***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Cigarette prices	-0.25***	-0.31***	-0.26***	-0.20***	-0.36***	-0.20***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP per capita	0.29***	0.37**	0.27**	0.18**	0.58***	0.23***
	(0.00)	(0.04)	(0.01)	(0.02)	(0.00)	(0.00)
Text warning pack coverage	-0.05	-0.16		-0.06	-0.11	-0.10
	(0.90)	(0.17)		(0.59)	(0.45)	(0.15)
Graphic warning coverage	-0.53	-0.12		-0.09	-0.09	-0.25**
	(0.40)	(0.41)		(0.58)	(0.85)	(0.02)
Text warning coverage dummy			0.001			
			(0.98)			
Graphic warning coverage dummy			-0.02			
			(0.68)			
Square of text warning coverage	-0.43					
	(0.75)					
Square of graphic warning coverage	1.18					
	(0.43)					
Count of advertising bans	0.01**	0.01	0.01	0.01	0.0003	0.01***
	(0.04)	(0.22)	(0.17)	(0.27)	(0.98)	(0.01)
Count of public smoking bans	0.0003	0.005	0.001	-0.003	0.004	0.001
	(0.95)	(0.55)	(0.90)	(0.53)	(0.67)	(0.75)
Constant	-0.36	-1.22	-0.20	0.65	-3.17**	-0.28
	(0.71)	(0.44)	(0.84)	(0.47)	(0.04)	(0.63)
Test of model significance						
Wald chi-squared statistic	411	324	328	337	284	209
Prob > chi-squared statistic	0.00	0.00	0.00	0.00	0.00	0.00

Source: Deloitte analysis

In developing economies there was some evidence that graphic health warnings are negatively related to consumption. This finding is not thought, however, to be robust as in developing countries there is little variation in graphic health warning in our sample. Further, the econometric techniques are not as effective when the sample size is reduced substantially. Specifically, the Arellano-Bond procedure (Arellano & Bond, 1991) requires a great cross-section of countries than a time series. For developing countries this condition is close to failing, as there are only 14 countries and 13 years in this panel. Further, there are some missing values.

3.1.3 Sensitivities on estimation procedure

Alternative panel estimation methods are explored, including random effects, fixed effects, and AR (1) disturbance models of both the random and fixed effects models. These models are presented as Models 10, 11, 12 and 13 respectively in Table 10. Models 12 and 13 both assume serial correlation is described based on an autoregressive process of order one. Results of a standard pooled ordinary least squares estimation are not presented as there is strong evidence of the existence of random effects.

Table 10. Alternative estimation models

Variable	Model 10	Model 11	Model 12	Model 13
Previous years consumption	–	–	–	–
	–	–	–	–
Cigarette prices	-0.46***	-0.41***	-0.44***	-0.41***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP per capita	0.46***	0.23*	0.53***	0.50***
	(0.00)	(0.10)	(0.00)	(0.00)
Text warning pack coverage	-0.04	0.02	-0.09	-0.11
	(0.87)	(0.95)	(0.32)	(0.20)
Graphic warning coverage	-0.29	-0.23	-0.19	-0.13
	(0.10)	(0.13)	(0.20)	(0.76)
Count of advertising bans	0.01	0.01	0.003	0.01
	(0.53)	(0.48)	(0.58)	(0.31)
Count of public smoking bans	-0.01	-0.01	-0.004	-0.004
	(0.26)	(0.26)	(0.39)	(0.42)
Constant	1.55	3.92***	0.92	1.23***
	(0.16)	(0.01)	(0.17)	(0.00)
Test of model significance				
Wald chi-squared/F statistic	56	8	209	168
Prob > chi-squared/F statistic	0.00	0.00	0.00	0.00

Source: Deloitte analysis. F statistics reported for FE models and Chi-squared for RE models

It should be noted that in the models not correcting for serial correlation, a high level of persistence is found in the error term. This is not unsurprising given that the models do not include lagged consumption; lagged consumption was excluded from these models as they are not robust to such dynamics.

3.2 Event study analysis

3.2.1 Introduction

This analysis looks at a time series of consumption in Australia and attempts to find 'break points' in the series that correspond to changes in the regulatory environment. A break point is a point in time at which the dynamic properties of consumption change – such a change could comprise a change in the level of consumption (a break in the 'mean' of the series), a change in the rate of change of consumption (a break in the 'trend' of the series, a change in the persistence exhibited by the series, or any combination of these changes. If a break point were found to coincide with a change in regulation, this would be evidence to suggest that regulation has some effect on consumption patterns.

The event study analysis uses 'endogenous structural break' techniques. This means that, rather than the researcher positing a break date and then testing whether a break occurs at that time, the analysis estimates the most likely points at which a break might occur as well as part of the testing process. There are a number of steps to be taken in conducting such an analysis:

• Firstly, any trends in the data are analysed. A trend can either be 'deterministic' or 'stochastic'. Series with deterministic trends (or 'time trends') are known as 'trend stationary' and series with stochastic trends are most commonly 'random walks' or 'random walks with drift'.[307] It is important to identify any trends at the start of the analysis as:

– the existence of a trend affects the properties of test statistics and can give misleading inference if not identified; and

307 A random walk with a drift parameter has a stochastic trend but may have the visual appearance of a deterministic trend

– different types of trends require different statistical treatment – for example a deterministic trend is typically removed using a regression on a time variable, whereas stochastic trends are usually dealt with using first differencing.

• The next step in the analysis is to test whether, if a trend exists, there are any break points that involve breaks in the trend specifically. The reason this analysis is conducted first is that, again, special statistical techniques are required in order to have valid inference in the presence of trends. In the analysis below the 'Zivot-Andrews' procedure is used to search for and test a breakpoint that involves a break in the trend in consumption.

• The third step in the analysis is to de-trend the series so that further break-point analysis can be conducted for breaks that do not involve breaks in the trend (i.e. breaks in the mean of the series or breaks in the level of persistence or both). The series is de-trended as part of the process of making it 'stationary'. This is done because the techniques that allow identification of further break points use traditional inference that is only valid when applied to stationary series.[308] The other aspect of making a series stationary involves developing a more detailed model of its dynamic properties. This is conducted below using an 'ARIMA' or 'Box-Jenkins' analysis. This provides a richer model of the persistence exhibit by consumption.

• Finally, additional breakpoints in the mean and persistence parameters of the stationary series are estimated and tested. This is conducted using the 'Bai-Perron' procedure which can test for a number of endogenous breaks in a series.

Prior to going through the steps above formally it is important to conduct a simple graphical inspection of the series. This allows for identification of the main features of a series, especially regarding likely trends, and helps to give focus to statistical testing.

3.2.2 Graphical analysis

Figure 19 displays the natural logarithm of volume over time for Australia.

Figure 19. Australia volumes over time (quarterly)
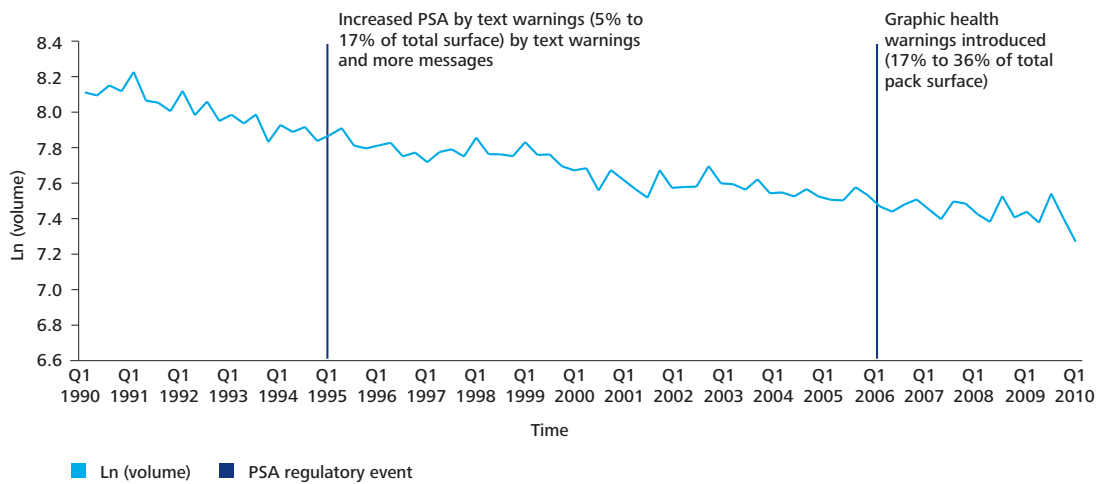
Source: Deloitte analysis, BAT data

308 By definition, a trending series is 'non-stationary'

The volume series displayed appears to have a downward trend. However, it is unclear from visual inspection whether this trend is the result of stochastic process (i.e. a 'random walk' or a 'random walk with drift') or a deterministic process (i.e. a time trend, around which the series is 'trend stationary'). The series also displays a certain amount of seasonal variation, with peaks every four quarters.[309]

There does not appear to be any obvious break in the mean or the trend of the series at points of change in PSA or indeed at any other point. However, it is possible that any breaks may be obscured from the eye by the seasonal variation, the trend in the series or other elements stochastic process that drives the series. The task of the econometric analysis below will be to decompose the series into these constituent elements and test whether there is a 'hidden' break or breaks in the series.

3.2.3 Formal consumption analysis

Identifying trends

As highlighted in section 3.2.1, the first stage in the analysis is to identify whether the downward trend observed in the consumption series is the result of a deterministic or stochastic process. This is done by testing for a 'unit root' in the series. Table 11 summarises the results of these tests.

Table 11. Unit root test results for the Australian consumption series

Test name	Lags included to adjust for serial correlation	Trend	Drift	P-value
Augmented Dickey-Fuller	8	Yes	No	0.2009
Augmented Dickey-Fuller	4	No	No	0.1890
Augmented Dickey-Fuller	4	No	Yes	0.0138**
Augmented Dickey-Fuller	4	Yes	No	0.0831*
Phillips-Perron	4	Yes	N/A	0.0000***

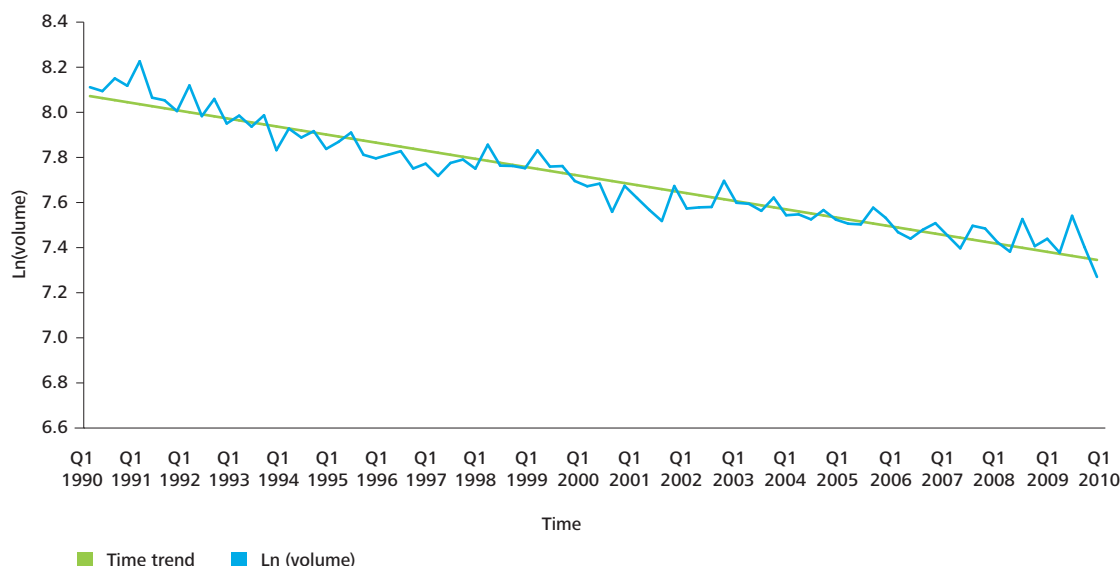Source: Deloitte analysis of BAT data. *** Indicates significance at 1% level, ** at 5% level, * at 10% level

The Augmented Dicky-Fuller test controls for residual serial correlation by including lags of the differenced dependent variable in the regress. The Phillips-Perron test deals with the same issue by using Newey-West standard errors. The number of lags (either Newey-West lags or lags of the differenced dependent variable) was chosen using a 'general to specific' approach, whereby a large number of lags is initially included and then the number is reduced using significance testing. Thus in the Dickey-Fuller regression with 8 lags, lags 5 to 8 were not significant at the 10% level. The choice of four lags is consistent with the seasonal pattern in the data observed in Figure 19.

The results indicate that a unit root with drift can be rejected at the 5% level by the Dickey Fuller test. Given the consistent downward trend displayed by the data, and the absence of drift, a model with a deterministic trend appears to be the most appropriate. Under the hypothesis of a deterministic trend, a unit root is rejected by the Dickey-Fuller test at the 10% level and by the Phillips-Perron test at the 1% level.

309 Seasonal variation is more visually apparent in monthly volume data. However, autocorrelation and partial autocorrelation analysis confirms the seasonal pattern in Figure 23

Tests for breakpoints involving a break in the trend

Figure 20. (Log) consumption series with fitted deterministic time trend

Source: Deloitte analysis of BAT data

Figure 20 shows the estimated deterministic trend for the Australian consumption series. The next question is whether the series is better fitted by a trend with a break – in slope or intercept – at some point in time. This can be tested using the Zivot-Andrews test. It is important to note that we are not particularly interested in the null hypothesis of a unit root; indeed, given the results there is reason to believe that the null hypothesis is false. The significance of this test is that the null hypothesis of a unit root allows for the correct inference[310] in testing the alternative hypothesis of a break in the time trend.[311]

Table 12 presents the results of a number of specifications of Zivot-Andrews test.[312] Figure 21 reports a Stata output showing the process of finding the likeliest break point for the first specification. In this specification the sequence of rolling tests is minimised in the third quarter of 2000 and so this is the likeliest point for a break. However, no break is found at this point.

310 Tests for a structural break in a trend require non-standard test statistics, as a regressor in the equation is, of necessity, trending.
    Standard inference, for example a t-test on an interaction dummy, is invalid in this case
311 Indeed, the fact that a unit root is unlikely makes the Zivot-Andrews procedure a powerful test for the breaking trend
312 All tests are conducted using the 'zandrews' module for Stata

Figure 21. Stata output illustrating the process of finding the breakpoint

Zivot-Andrews test for In_s_vol, Q1-1994-Q2-2007
Min breakpoint at Q3-2000
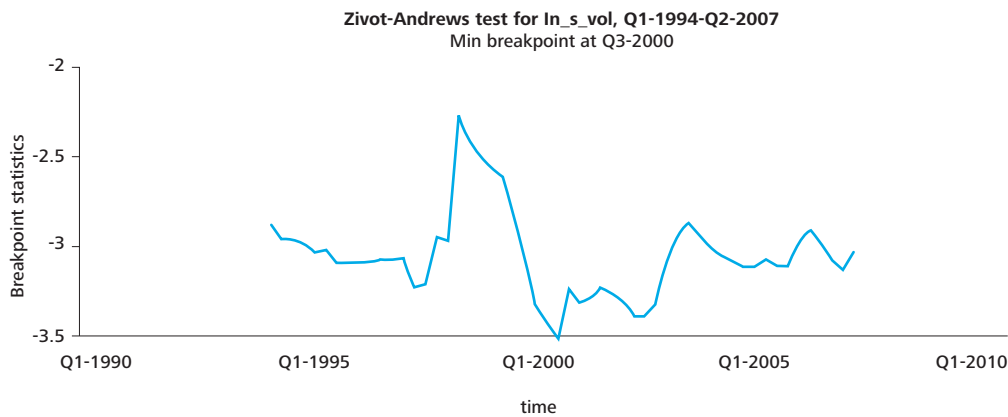
Source: Deloitte analysis of BAT data

Table 12. Zivot Andrew tests – Australia

Trend break	Intercept break	Lags≠	Most likely break date	Test statistic	1% Critical value	5% Critical value
Yes	Yes	4	Q3-2000	-3.516	-5.57	-5.08
Yes	Yes	3	Q4-1993	-3.174	-5.57	-5.08
Yes	No	4	Q4-2000	-3.380	-4.93	-4.42
Yes	No	3	Q1-1994	-3.406	-4.93	-4.42
No	Yes	4	Q3-2002	-3.585	-5.43	-4.80
No	Yes	3	Q3-2002	-2.633	-5.43	-4.80

Source: Deloitte analysis of BAT data

≠ Note: The optimum lags in the test can be determined by AIC or BIC criteria, or using a t-test procedure. The number of lags can also be determined manually. All three criteria return an optimal lag length of 3. A fourth lag was also included in some specifications given the observed seasonality.

Table 12 shows the results of tests for the presence of a break in the trend and intercept, a break in the trend only and a break in the intercept only. Under all specifications the null of a unit root cannot be rejected. As a result we can conclude that there is no break in the deterministic trend.

De-trending the series and modelling dynamics
As discussed in section 1.2.1, the Zivot-Andrews test however only tests for one break. As such we turn to the Bai-Perron procedure to now consider the possibility of multiple breaks in the mean. Before the Bai-Perron procedure can be applied, the consumption series must be stationary. In practice this means de-trending the series and applying a Box-Jenkins methodology. Figure 22 shows the de-trended[313] series and Figure 23 gives the auto-correlogram and partial auto-correlogram.
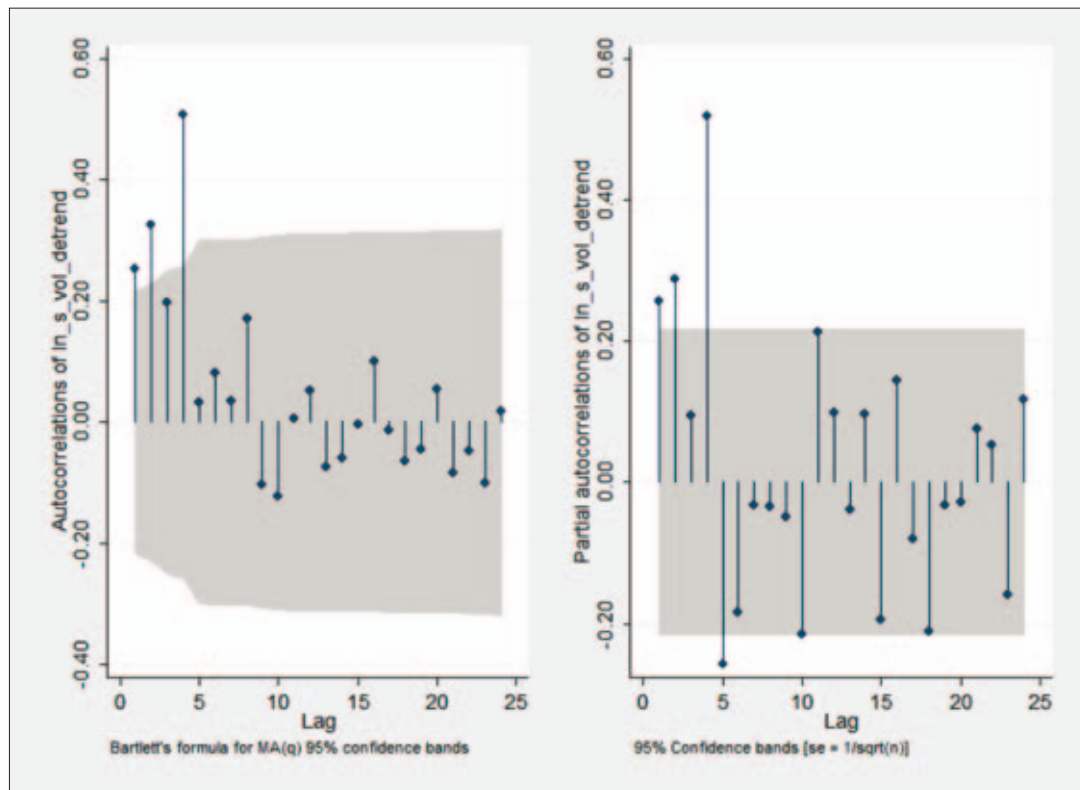
313 A unit root in the de-trended series is strongly rejected by a variety of tests

Figure 22. De-trended logged volume series, Australian data
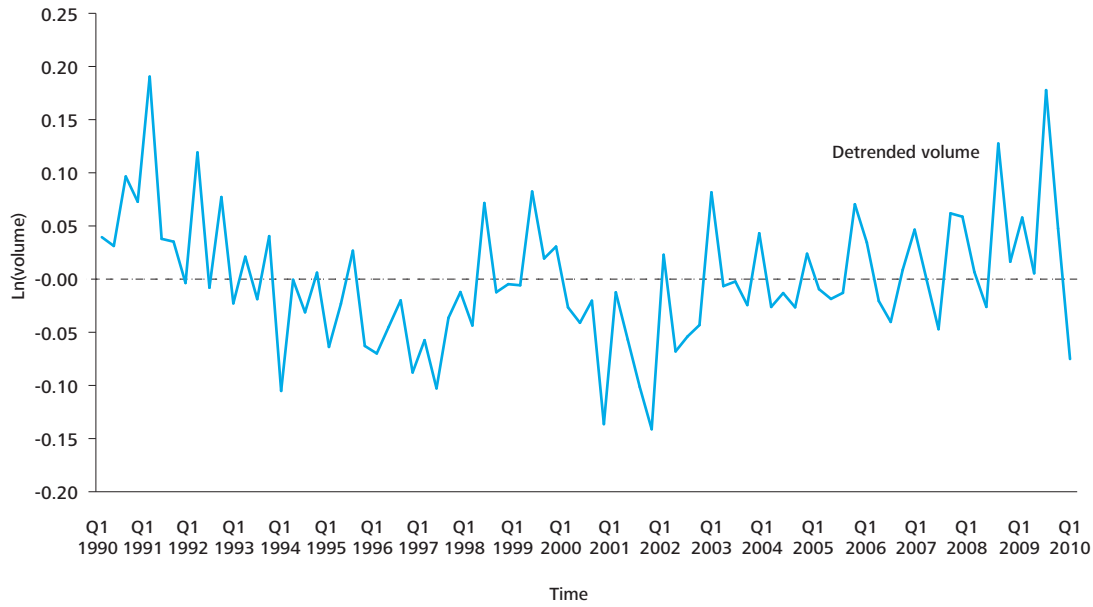
Source: Deloitte analysis of BAT data

Figure 23. Auto-correlogram and Partial Auto-correlogram for de-trended volume series

Source: Deloitte analysis of BAT data

The decaying auto-correlogram, moving in groups of four, combined with a spike in the partial auto-correlogram at the fourth lag is indicative of a Moving Average (1,4) or Moving Average (1,2,4) model, where the MA term in the fourth lag represents the seasonal element in the data. While these seem the most likely specifications from inspection of correlograms, a wide range of specifications, including AR and ARMA models, were tested. The comparative results of these tests are presented in Table 13. The table shows the BIC and AIC information criteria for each specification, as well as the P-value of a Q-statistic which tests for residual serial correlation at 4 and 8 lags.

Table 13. Box-Jenkins models – Australia

Model	BIC	AIC	P-value of Q-statistic (4 lags)	P-value of Q-statistic (8 lags)
MA(1,4)	-254.800	-245.173	0.379	0.322
AR(1) MA(4)	-249.449	-239.822	0.473	0.301
ARMA(1,1)	-232.543	-222.916	0.001	0.001
ARMA(1,(1,4))	-253.416	-241.382	0.322	0.384
MA(1,2,4)	-252.988	-240.954	0.327	0.310
AR(4) MA(1)	-252.286	-242.659	0.245	0.468
AR(1,4)	-250.629	-241.002	0.218	0.366

Source: The BIC and AIC measure the fit of the model weighting both the estimated model fit and the degrees of freedom consumed by the specification.[313] It is noted that the BIC is often preferred as it leads to more parsimonious model specifications.

As expected, the best performing model was the relatively parsimonious MA(1,4), corresponding to the equation:

Equation 11

$$C_t^* = \varepsilon_t + 0.40\varepsilon_{t-1} + 0.78\varepsilon_{t-4}$$

where C_t^* is de-trended consumption in time **t**

Figure 24 shows the fitted model for the de-trended series and Figure 25 shows how the trend, moving average and random components of the series, relate to each other.

314 The weights for the BIC follows $Schwarz = -2(Likelihood) + (k+1)Ln(N)$, **AIC is calculated as** $AIC = 2k - 2Ln(Likelihood)$

Figure 24. De-trended volume and fitted model, MA(1,4)

Detended volume   Predicted values from ma(1,4) model
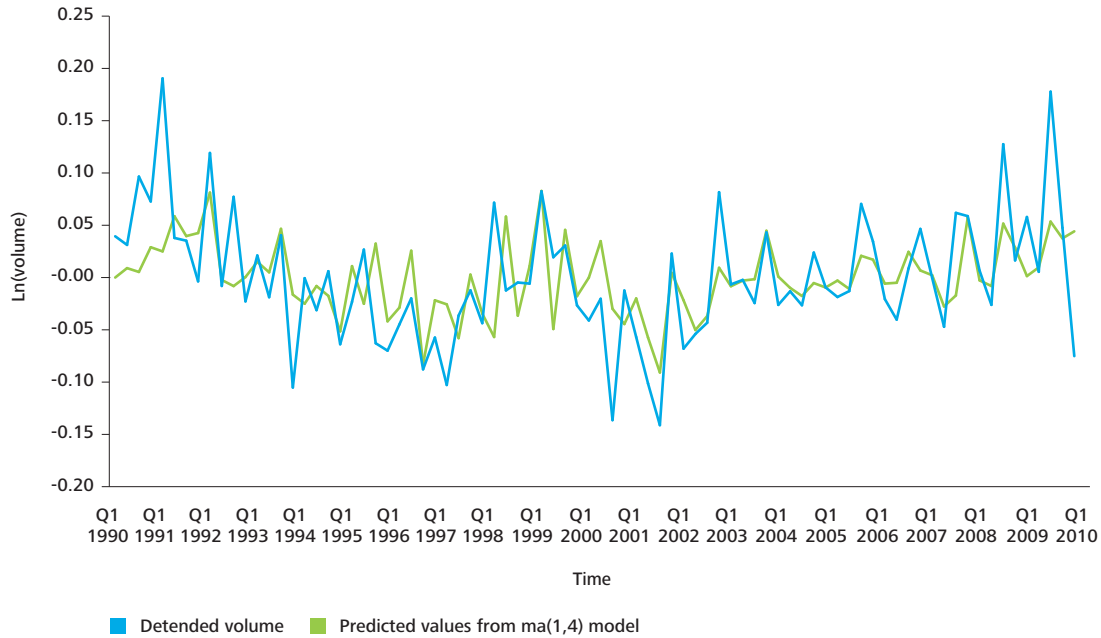
Source: Deloitte analysis of BAT data

**Figure 25. Interrelation of the deterministic trend, moving average and random components of the consumption series**

Time trend   Time trend and moving average components

Time trend, moving average and random components
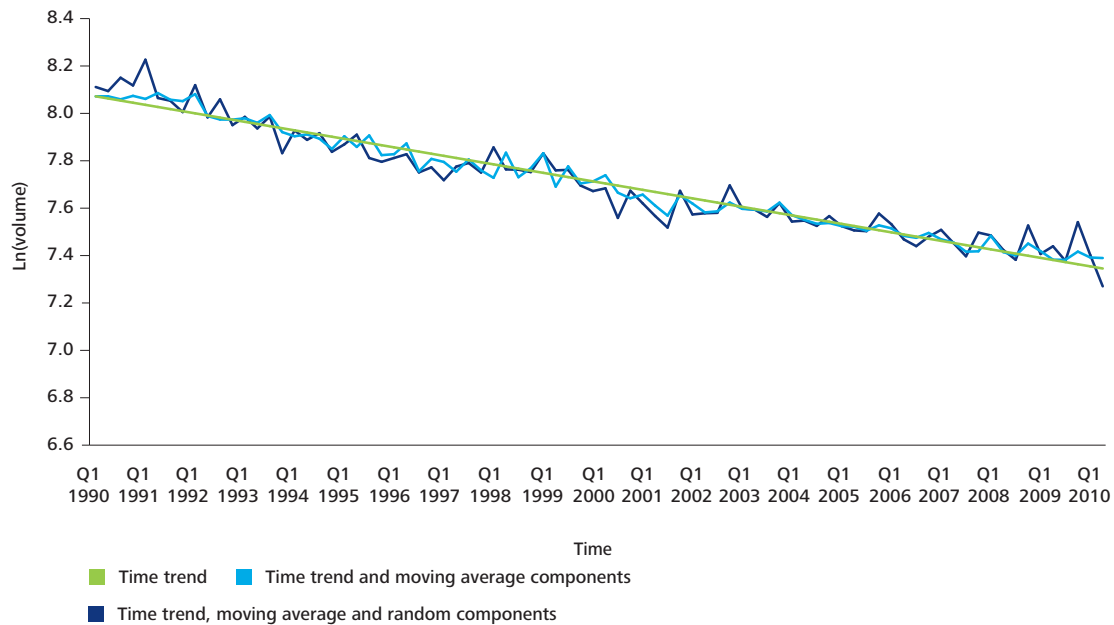
Source: Deloitte analysis of BAT data

Testing for further break points

Having established the Box-Jenkins model for the consumption series, the (stationary) residuals from the regression can be subjected to the Bai-Perron procedure[315] described in section 1.2.1. This procedure is effectively testing for a break in the mean of the de-trended consumption series $\{C_t\}$.

Figure 26[316] shows a plot of the set of F-statistics, $\{F_t\}$. The 'supF' statistic, which tests for the presence of any endogenous breaks is defined as the supremum of this set, $\sup\{F_t\}$. The 5% critical value of this statistic is displayed as a red line. Clearly the supF statistic (6.1785) is well below the 5% critical value (the p-value of the statistic is 0.15), and we cannot find any breaks.

Figure 26: Series of F-statistics testing for a break in the MA(1,4), along with the critical value of the 'supF' statistic
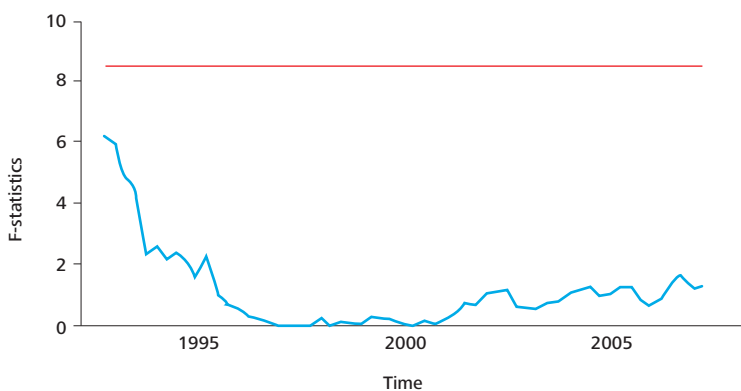
Source: Deloitte analysis of BAT data

The result is confirmed by the fact that both the BIC and the RSS select a model with no breakpoints (m=0) as the optimal specification. Figure 27 shows this result.

Figure 27. Selection of the optimal number of breaks using the BIC and RSS

■ BIC ■ RSS
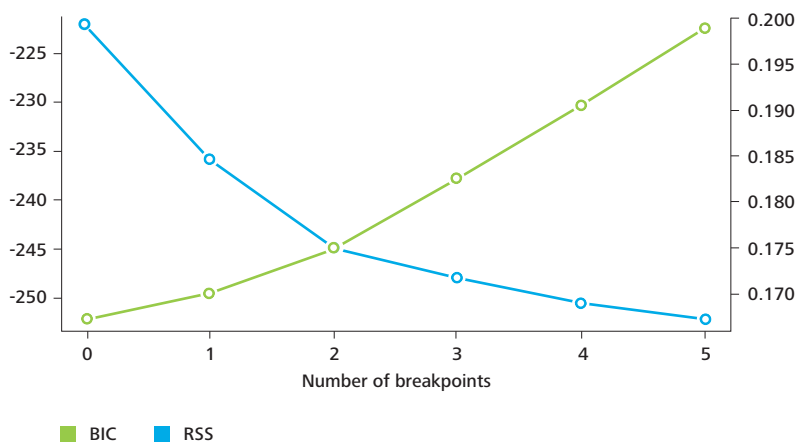
Source: Deloitte analysis of BAT data

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315 The residuals are used because no software is available for testing the coefficients of MA models
316 All testing using the Bai-Perron procedure was conducted using the mathematics software 'R' and its package, 'strucchange'.
       All output from the procedure is produced using R graphics routines

As an additional robustness check a second specification for $\{C_t^*\}$ was put through the Bai-Perron procedure. This was an AR(1,4) specification for the de-trended consumption series. In this case, rather than taking the residuals from an ARIMA model and testing for breaks in the mean, the auto-regressive specification allows for testing for breaks in the mean and lagged autoregressive coefficients of the series. In other words, the Bai-Perron procedure was used to test the model:

Equation 12

$$C_t^* = \alpha_j + \beta_j C_{t-1}^* + \gamma_j C_{t-4}^* + \varepsilon_t \qquad t = T_{j-1} + 1, \ldots, T_j \qquad j = 1, \ldots, m$$

The Bai-Perron procedure also found no breaks for this specification.

In summary the analysis indicates that consumption in Australia is on a long-run downward trend that does not appear to have been altered by changes to PSA regulation (summarised in Figure 20). A variety of types of breakpoint were tested, including the possibility of multiple breaks, and none were found. This is evidence to suggest that the incidence of changes PSA regulation have not had a significant impact on consumption patterns.

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