

# The elasticity of tobacco demand in Australia

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## **Abstract**

This paper examines the elasticity of demand of tobacco products in Australia from 2000 to 2011. The hypothesis is that the demand for cigarettes is inelastic. The alternate hypothesis is that the demand for cigarettes is elastic. The hypothesis implies that increasing tobacco tax decreases government tax revenue, while the opposite is true for a decrease in tobacco tax. This paper obtains data mainly from Australian Bureau of Statistics and Cancer Council Victoria. We find an increase in the excise rate and government revenue from tobacco products, therefore implying that the demand of tobacco products in Australia is inelastic. We find further support of this finding by examining factors such as the age and income structure of the population.

## 1. Introduction and Hypothesis

The World Health Organization recommends that every country increase their regulation of tobacco companies (WHO 2013). One of the common government regulations used to reduce tobacco consumption is the tax. Based on theory, the elasticity of demand for tobacco can be inferred by changes in revenue and price.

The hypothesis of this paper is: the elasticity of demand of tobacco products in Australia is inelastic. The alternative hypothesis is: demand of tobacco products in Australia is elastic. In order to test our hypothesis, we observed the pattern of excise tobacco tax and government tax revenue from tobacco products. Then, we make further inference on tobacco consumption based on the age and income level of the population. The hypothesis will be accepted if the increase of excise tobacco rate leads to the increase of government tax revenue from tobacco products. The alternate hypothesis will be accepted if the increase of excise tobacco rate results in a decrease in government tax revenue from tobacco products.

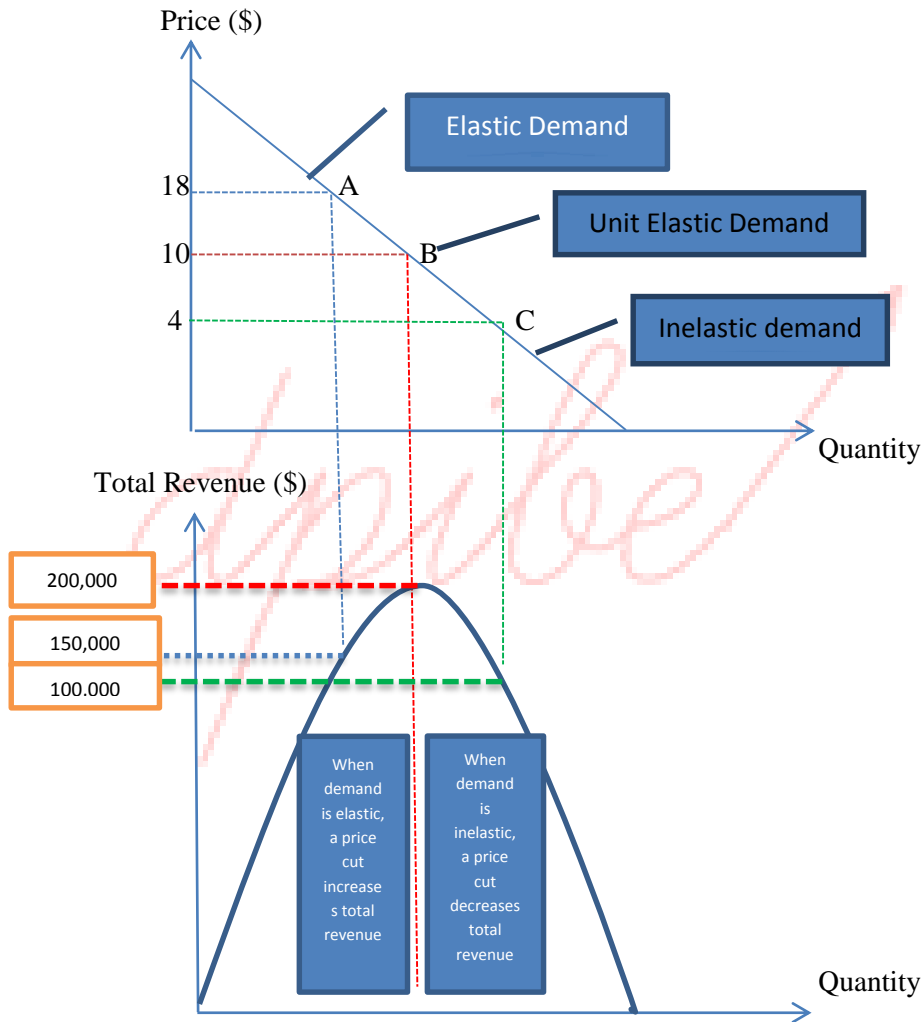
## 2. Theory

According to standard economic theory (e.g. McTaggart, Findlay and Parkin (2010, p.86-88)), the elasticity of demand is determined by the percentage changes of quantity demanded and price of the product. The formula to determine the elasticity of demand is:

$$\text{Price elasticity of demand (PEoD)} = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}$$

If the price elasticity of demand is equal to 1 (PEoD = 1), it means the demand is unit elastic. If the price elasticity of demand is between 0 (zero) and 1 (PEoD < 1) then the products is said to have an inelastic demand. If the price elasticity of demand is greater than 1 (PEoD > 1), the products is said to have an elastic demand.

Figure 1. Elasticity and Total Revenue



Source: McTaggart, Findlay and Parkin (2010, p. 88)

One can infer the elasticity of demand of a product from the increase and decrease of quantity of demand and total revenue. In line with figure 1, if the price increases from point B to point A and the result is a decrease in total revenue, we can infer that demand is elastic. On the other hand, if price increases from point C to point B and there is an increase in total revenue, we can infer that demand is inelastic.

The elasticity of demand of tobacco products can be influenced by age. Ding (2003, p. 116) asserted that there are two reasons wherein age can determine the elasticity of demand of tobacco products. These reasons are the level of addiction and peer pressures which resulted in different elasticity between youngsters and seniors. Ding (2003, p. 117) contended that youngsters are less addicted to tobacco products and smoke to socialize. From these characteristics, youngsters tend to halt smoking when the price increases. Research from Kostova, Ross, Blecher and Markowitz (2011, p. 423) resulted that the young smokers have high price responsiveness with elasticity of demand ranged from -0.7 to -1.44.

The second factor that impacts the elasticity of demand of tobacco products is income level. Sylvain (n.d.) asserted that tobacco tax might not reduce tobacco consumption in adult smokers because the tobacco tax only represents a small proportion of their income. In addition, Farrelly, Nonnemaker and Watson (2012) cited that low income groups are more sensitive to cigarette price hikes. This research aligned with Kostova, Ross, Blecher and Markowitz (2011, p. 423) who stated that low and middle income countries have more income restraints than high income countries. Hence, low income countries decrease tobacco consumption if there is an increase in tobacco price.

### **3. Literature Review**

Sunley, Yurekli and Chaloupka (n.d.) investigated the outcome of the government revenue generating from an increase of tobacco excise around the whole world. They found a 10%

increase in cigarette taxes globally would lead to a reduction of just over 3% in total cigarette consumption and an approximately 7% increase of cigarette tax revenues by collecting data of tax revenues, tax rates and prices. High-income nations experience relatively larger increase in government tobacco tax revenues while low-income and middle-income countries have a relatively smaller increase. This is because short run price elasticity of demand for cigarettes in low and middle income countries (-0.8) is relatively less inelastic than high income countries (-0.4). Meanwhile, the tobacco tax in low and middle income countries are lower than in high-income countries.

Ahsan et al. (2013) concluded that cigarette consumption was sensitive to both price and income level. They also found that an increase of tobacco tax rate by 57% and 70% will lead to an increase in government revenue by 58% and 84% respectively.

Reed (2010) revealed that the tobacco tax had a positive effect on the entire economy. They found that a 5% increase of tobacco price resulted in £10.2 billion of economy benefits and around £520m revenue gain per year in the first five years on average to the government. They also found all their price elasticity estimates were between zero and -1. This implies that an increase in the price of tobacco products always leads to an increase in revenue.

Doran et al. (2010) explored the implications on tobacco-related government tax revenue due to the increasing tax collection on tobacco in Vietnam. They used data from the General Office and the Asian Development Bank, making a conclusion that cigarette taxation growth can be regarded as an effective way to curb tobacco consumption and boost the Vietnamese government revenue simultaneously.

Callison and Kaestner (2014, p. 156) contended that an increase of tobacco excise rate will have a stronger effect on adults between 18-34 years old rather than people above 34 years old. A 10% increase of tobacco excise rate resulted in 0.3-0.7% decrease for smokers between 18-34 years old; 0.2-0.4% decrease for smokers between 35-54 years old; and 0.3-0.6% decrease

for smokers between 55-74 years old. Overall, the elasticity of demand of tobacco products remains inelastic.

#### 4. Analysis

##### 4.1 Elasticity of tobacco consumption in Australia

To test our hypothesis, we use average tobacco tax per cigarette for tobacco products which do not exceed 0.8 g per stick, average tobacco tax per kg for tobacco products that exceed 0.8 g and government tax revenue from tobacco products. We then observe the trend of both the tobacco tax (in AUD) and government tax revenue from 2000 to 2011.

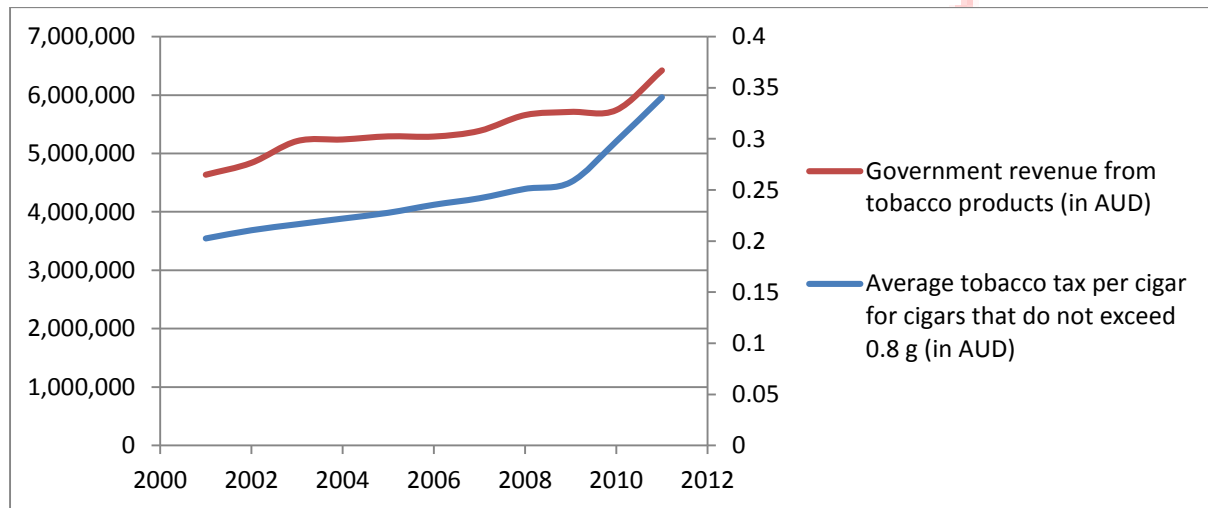
*Table 1 List of tobacco tax and government revenue from tobacco products*

Year	Average tobacco tax per cigar for cigars that do not exceed 0.8 g (in AUD)	Average tobacco tax per kg for cigars exceed 0.8 g (in AUD)	Government revenue from tobacco products (in AUD)
2001	0.2026	253.25	4,637,480
2002	0.2106	263.25	4,840,580
2003	0.21644	270.8	5,212,260
2004	0.221985	277.48	5,240,000
2005	0.22768	284.6	5,293,000
2006	0.235495	294.38	5,290,000
2007	0.24187	302.35	5,387,000
2008	0.251035	313.81	5,657,000
2009	0.25756	321.97	5,711,000
2010	0.297435	371.82	5,742,000
2011	0.340535	425.69	6,420,000

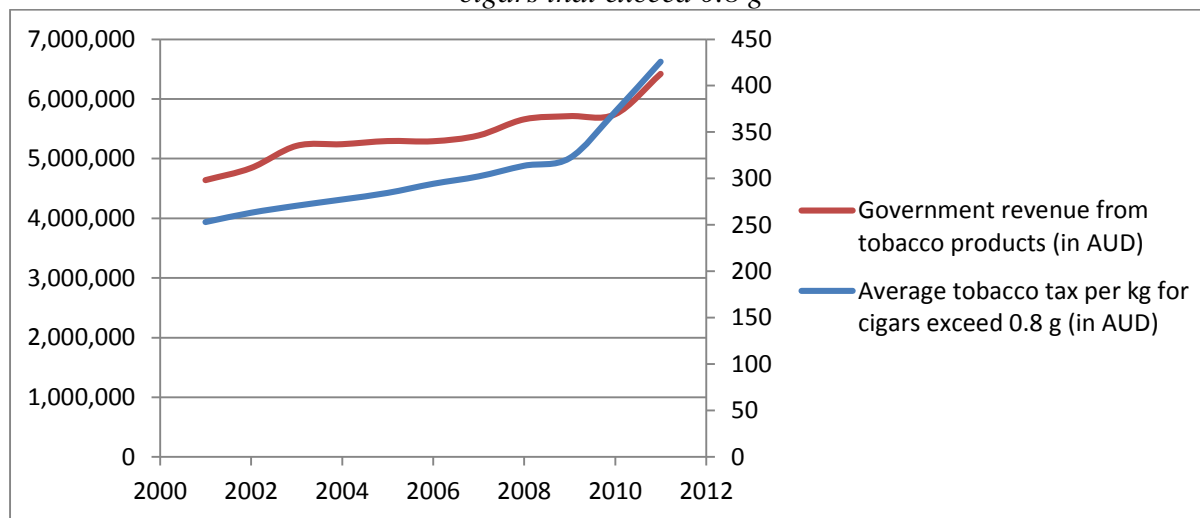
Source: Scollo and Winstanley 2012 and 2012a

Based on Table 1, Figures 2 and 3, it is noticeable that both tobacco tax increase continuously from 2000 to 2011. In the similar pattern, government tax revenue surged from around AUD 4.6 million to 6.4 million in 2001 and 2011 respectively. Looking at Table 1 in more detail, there was a slightly drop by AUD 3,000 from 2005 to 2006. However, this decrease is not significant. The result of our analysis suggests that the demand of tobacco products in Australia is inelastic.

*Figure 2. Government Revenue from tobacco products and average tobacco tax per cigar for cigars that do not exceed 0.8 g*



*Figure 3. Government Revenue from tobacco products and average tobacco tax per cigar for cigars that exceed 0.8 g*



## 4.2 Factors contributing to an inelastic demand of tobacco

To provide further support, we consider two factors which influence the elasticity of demand of tobacco products in Australia. These factors are the age and income level in society.

### (1) Age Factor

In order to evaluate whether the age factor affects the elasticity of demand of tobacco, we collected data about total consumption of cigarettes per week of five age groups in two different years: 2001 and 2010. This data is listed in Table 2. In addition, we also use the changes of price of "Craven A"s from 2001 to 2010.



*Table 2. Total number of cigarettes consumed by different age group in weekly basis*

<b>Age</b>	<b>2001 (number of cigarettes)</b>	<b>2010 (number of cigarettes)</b>
18-24	12.3	11
25-29	13.5	11.2
30-39	15.9	13.6
40-59	19.6	18
60+	17	16.9
<b>Total</b>	<b>78.3</b>	<b>70.7</b>

Source: Scollo and Winstanley 2012b

*Table 3. Price of a packet of 20 craven As, Australia, 2000-2010*

<b>Year</b>	<b>Price per pack (\$) (2000 dollars)</b>
2001	10.24
2002	10.33
2003	10.45
2004	10.39
2005	11.24
2006	11.51
2007	11.3
2008	11.31
2009	11.87
2010	12.68

Source: Scollo and Winstanley 2012c

Table 3 describes the price of a packet of 20 Craven As from 2001-2010. These prices have been adjusted with the currency in year 2000. In this paper, we will use the price of Craven As in 2001 and 2010 to generate elasticity of demand of tobacco products. The percentage change

in price (in decimal term) from 2001 to 2010 is  $0.2383 = ((12.68 - 10.24) / 10.24)$ . Then, the percentage change of quantity demanded of tobacco products (in decimal term) from 2001 to 2010 is  $-0.0971 ((70.7 - 78.3) / 78.3)$ . In calculating the price elasticity of demand, both values will be converted to absolute values which means the minus sign is eliminated.

We can calculate the price elasticity of demand of tobacco products from 2001 to 2010 is  $0.4075 (0.0971 / 0.2383)$ . We also provide the elasticity of demand of each age group in 2010.

*Table 4. The changes in quantity demanded of each different age group*

Age	% change in Q demand from 2001 to 2010 in decimal term
18-24	$(11 - 12.3) / 12.3 = -0.1057$
25-29	$(11.2 - 13.5) / 13.5 = -0.1704$
30-39	$(13.6 - 15.9) / 15.9 = -0.1447$
40-59	$(18 - 19.6) / 19.6 = -0.0816$
60+	$(16.9 - 17) / 17 = -0.0059$

*Table 5. The elasticity of tobacco products of different age group*

Age	% change in quantity demanded divided by % change in price (in decimal term)
18-24	$0.1057 / 0.2383 = 0.4436$
25-29	$0.1704 / 0.2383 = 0.7151$
30-39	$0.1447 / 0.2383 = 0.6072$
40-59	$0.0816 / 0.2383 = 0.3424$
60+	$0.0059 / 0.2383 = 0.0248$

Table 4 shows the changes in quantity of different age group from 2001 to 2010 whereas table 5 illustrates the value of elasticity of demand of tobacco products. It is clear that all of these age groups have elasticity value less than 1.

## (2) Income level

The second factor which influences the elasticity of demand of tobacco products is income level. Some researchers have made conclusions that people from different income levels will response differently in tobacco consumption after the increase of tobacco tax. This is because people in low and middle income level have higher income constraints than people with high income.

*Table 6. Average weekly expenditure on tobacco products among households in each income quintile, Australia, 2003-04 and 2009-10 as percentage of total household spending*

<b>Economic Quintile</b>	<b>Spending as a % of total household expenditure 2003-2004 (a)</b>	<b>Spending as a % of total household expenditure 2009-2010 (b)</b>	<b>Decrease in tobacco spending (%)</b>
Lowest	1.8	1.4	0.4
Second	1.9	1.5	0.4
Third	1.5	1.3	0.2
Fourth	1.2	1.1	0.1
Highest	0.8	0.5	0.3

(a) Source: Australian Bureau of Statistics 2006

(b) Source: Scollo and Winstanley 2012d

Table 6 describes five different income levels in Australia and its weekly spending for tobacco products in percentage from total income. From Table 1, excise rate for tobacco products increase continuously from 2001 to 2011. In addition, it is assumed that the price of tobacco products also increase aligned with the excise rate. Based on Table 6, it can be seen that lowest and second income level decreased tobacco consumption by 0.4% as a total of household expenditure. On the contrary, the third, fourth and highest income level decreased tobacco

consumption by equal or less than 0.3%. This shows that the lowest and second income levels are more price sensitive compared with third, fourth and highest income level. We conclude that these levels will decrease its tobacco consumption larger than higher income level if there is an increase in tobacco tax.

*Table 7. Different income level in Australia in 2009-2010*

Mean equivalised disposable household income per week (\$)			
Low income(a)	Middle income(b)	High income(c)	All households
429	721	1704	848

Source: Australian Bureau of Statistics 2012

- (a) Persons in the second and third income deciles.
- (b) Persons in the middle income quintile.
- (c) Persons in the highest income quintile

To support the hypothesis based on income level differences, we also provide total people in every different income level in 2009-2010. The percentage of people in low income level and wealth was exactly 22.6% of total population. In the opposite, there were 77.4% (17.4%+17.4%+42.6%) of people in high income level (d) which dominated the income level of Australia. As people in low income level have minor percentage of total population hence a decrease of tobacco consumption from this group will not give significant impact to tobacco demand. Combining the analysis based on Table 6 and 8, it is clear that the decrease of tobacco consumption from people in low income level will not result in a significant decline in government tax revenue.

*Table 8. Income composition and persons in low and not low economic resource group 2009-2010*  
*Source: Australian Bureau of Statistics 2011*

<b>Persons in low economic resource households, Income, wealth and expenditure - 2009-10</b>				
	LOW ECONOMIC RESOURCE GROUP	NOT LOW ECONOMIC RESOURCE GROUP		
	Low income and wealth(a)	Low wealth but not low income(b)	Low income but not low wealth(c)	Not low income and not low wealth(d)
Mean weekly equivalised adjusted disposable household income(\$)	465	1 006	494	1 264
Persons (%)	22.6	17.4	17.4	42.6

(a) Persons in the lowest two quintiles of both equivalised adjusted disposable household income (adjusted to include imputed rent) and equivalised household net worth

(b) Persons in the lowest two quintiles of equivalised household net worth and the highest three quintiles of equivalised adjusted disposable household income (adjusted to include imputed rent)

(c) Persons in the lowest two quintiles of equivalised adjusted disposable household income quintiles and the highest three quintiles of equivalised household net worth

(d) Persons in the highest three quintiles of both income and net worth

## 5. Limitations

The key limitation of this paper is the unavailability of data. When we discuss age factors, we only use tobacco consumption of different age group on weekly basis in 2001 and 2010. We also only use the price of Craven As. In terms of income level, we used data of tobacco consumption in 2003-04 and 2009-10 based on economic quintiles. This weakens our results because we only compare two periods of tobacco consumption based on one period income

structure. To provide more reliable result, we suggest analysing tobacco prices and quantities from the same tobacco brand.

## 6. Conclusion

This paper mainly investigates the elasticity of demand of tobacco products in Australia from 2001 to 2011. The result from our analysis shows that the demand of tobacco products in Australia is inelastic. This finding is supported by the increase of government tax revenue from tobacco products which was aligned with the increase of tobacco excise rate.

In order to support our hypothesis, we took age and income level factors into consideration. More specifically, tobacco consumption decreased slightly based on age group from 2001 to 2010. Based on our analysis, the elasticity of tobacco products in all age groups is less than 1 [ $<1$ ] from 2001 to 2010. At the same time, compared with smokers in the third, fourth and highest income level, those who are in the lowest and second income levels are more likely to be influenced by the increase of tobacco tax. Since people in low income level represent a small percentage of the total population, there is a little impact on the decrease of tobacco consumption. Therefore, government tax revenue from tobacco continues to increase even as taxes increase.

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