Is illicit tobacco demand sensitive to relative price?

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Abstract: A tough fiscal stance has become the norm for discouraging tobacco consumption. Tax and excise rises serve to increase the price of licit relative to illicit tobacco. Consequently there has been a rise in black market tobacco consumption. This paper investigates the degree of substitution between licit and illicit tobacco using novel survey data. We find that illicit tobacco smokers are sensitive to the price ratio between licit and illicit tobacco. This implies that high tobacco taxes have spillover effects that need to be accounted for in policy evaluation.

Keywords: illicit tobacco, vignettes, ordered probit

JEL codes: D12, H31, I18

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In a bid to reduce harmful cigarette consumption many jurisdictions have employed fiscal measures that increase the costs of smoking. Tax and excise levies raise the real price of cigarettes relative to other goods and services and so may deter consumption. But these price increases could also have the unintended effect of making the consumption of illicit tobacco more attractive: especially to those in lower income groups. Given the addictive nature of tobacco, individuals unable to pay high cigarette prices, but also unable to quit, may be pushed into the illicit market. The relative price between licit and illicit tobacco will be a key factor in determining this push.

This paper considers the importance of relative price as a driver of consumption by illicit tobacco smokers. Specifically, we look at Australia, where in 2005 the combined excise tax and Goods and Service Tax (GST\(^1\)) accounted for approximately 70 percent of the cost of a packet of cigarettes (see Jha and Chaloupka 2000 for a full international comparison of tobacco tax rates). Moreover, since the 1970s Australia’s proactive anti-smoking policies have been recognized as a success by the international community. See Bardsely and Olekalns (1999) for a full discussion of the impact of these policies, which include advertising bans, workplace bans and taxation strategies. Australia has a prevalence of smoking among adults which is among the lowest in the OECD countries. In 2007 it was ranked third with a prevalence rate of 16.6% behind Switzerland (14%) and the United States (15.4%).\(^2\)

The real question though is: what impact have levy increases had on the level of engagement with the illicit tobacco market? Australia has a substantial black market for tobacco. The cost was estimated to be AU$98 million (approx US$82 million)\(^3\) in lost revenues (Australian National Audit Office 2006). In 2007, 6.4% of all tobacco smoked was illicit, which, in terms of the size of the illicit tobacco market, places Australia in eighth position of the league table for World Bank high income countries (Joossens et al 2010). By studying the impact of relative price we may more fully understand the interdependence of the licit and illicit markets to determine if the size of the illicit market is a negative consequence of the high taxation policies imposed on licit tobacco. The findings of this study will be of interest to policy makers globally.

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\(^1\) GST is the name for the Australian value added tax (VAT) and is charged at a rate of 10 %.


In Australia illicit tobacco is known domestically as “chop-chop” and consists of finely cut unbranded tobacco that has been grown, distributed and sold outside the government’s regulation channels and taxation system. During the time of our study there were three main sources of supply: illegally grown crops in farming enterprises, suburban home grown production and raw tobacco purchased or stolen from licensed commercial growers. Illicit tobacco is usually sold in unbranded packaging in loose leaf or readymade cigarettes. It is purchased “under the counter” at street markets and a variety of independent retail outlets. In terms of the price differential, the Auditor General reported end users could purchase 100g of chop-chop for roughly AU$13 (US$10.92), compared to AU$36 r.r.p. (US$30.24) for an equivalent quantity of legal tobacco. This is a price ratio of illicit to licit tobacco of about 1:3 (Australian National Audit Office, 2006).

First principles of economics tell us that when prices rise in one market it will result in consumers seeking cheaper alternatives, but how sensitive demand is to price movements is an empirical question which has huge importance in terms of fully understanding the impact high taxation policies have in terms of total (licit and illicit) tobacco consumption. The evidence on which the policy of increasing price (through higher taxation) in order to deter consumption is based is strong. Numerous studies have shown cigarette consumption to be price sensitive (although inelastic), see for example Chaloupka and Warner (2000) who report elasticities in the region of -0.3 to -0.5. Studies have also shown that, because of the impact of addiction, the long run effect is greater than the short run effect (see for example Becker et al, 1994). It takes consumers time to cut back their consumption, quit consumption, or move to black market consumption, but nevertheless they do respond to permanent price changes of licit tobacco. The literature has also shown that prevalence rates are affected by permanent price changes. Douglas (1998) showed that a ten percent increase in cigarette prices is associated with a reduction in smoking of approximately eight percent in the long run. The evidence from Australian, after four decades of anti-smoking policies, is that the prevalence has dropped across all sociodemographic groups, and that traditional variations across these groups has remained stable. Smokers are most likely to be male and low income (see, Siahpush et al 2002). It is these smokers who are the most likely to seek cheaper (illicit) substitutes as the price differential between the licit and illicit market increases further. Kleiman and Caulkins (2001) make the additional insight that
those who carry the heaviest tax burden are also the most addicted—usually (but not exclusively) low income, elderly smokers. This has obvious implications in terms of the welfare impacts of such taxes.

The primary rationale behind encouraging individuals to quit smoking by increasing the price of cigarettes is the associated health benefits. But if these policies are simply pushing consumers into the consumption of illicit tobacco, then lower consumption targets may not be reached and the policy may even be counter productive. The medical literature concerning illicit Australian tobacco suggests that it is potentially more harmful than licit tobacco. Often, in order to increase the weight for sale, illicit tobacco is mixed with other substances (for instance twigs or grass clippings). Microbiological and bacterial tests of samples show the chop-chop often contains numerous fungal spores and moulds (Bittoun, 2004). In addition, the growing techniques employed can result in an increase in the concentration of toxic metals such as cadmium (a carcinogenic), lead and thallium (see Pappas et al, 2007 and Stephens et al, 2005). Any policy in the licit market that pushes consumers into the illicit market may therefore lead to a greater demand for health care, rather than the intended outcome of reduced health care expenditures. Indeed Aitken et al. (2009) show that past and present users of chop-chop report lower levels of health than smokers of licit tobacco. Moreover, if large volumes of smokers transfer their purchasing to the informal sector then tax revenue to support health care is also lost.

I. Data

To date there are limited detailed data available with which to study the prevalence of illicit tobacco use in Australia. The only large dataset that relates to chop-chop usage was gathered by the National Drug Strategy Household Survey of 2007. It contains just a few questions regarding usage and no questions on price. Hence, to provide a much richer dataset for investigation, it was necessary to conduct our own national survey.4 The data were collected by telephone survey during the period March to July 2007; respondents were aged 18 and over and self-identified as regular tobacco smokers. They were asked whether they had ever smoked chop-chop and were presented with a set of questions about its usage, as well as detailed questions relating to their health status and licit tobacco consumption. In total 1,621 interviews were conducted, with a

4 Full survey details and methodology can be found in Aitken et al. (2009).
response rate of 63 percent. At the time of the survey, six percent of smokers participated in the illicit market. Basic descriptive statistics tell us that 58 percent of smokers had seen or heard of unbranded illicit tobacco and, of those who reported awareness, 59 percent claimed to have smoked it. These findings are broadly consistent with those of the National Drug Strategy Household Survey which found that 45.1 percent of smokers and ex-smokers who were asked about chop-chop had smoked it more than once (Australian Institute of Health and Welfare, 2008b).

Given that the focus of this paper is on the relative price sensitivity of licit and illicit tobacco consumption it is necessary to limit our estimation sample to current users of chop-chop and this gives us 89 observations. Table 1 shows descriptive statistics for our estimation sample across a set of standard demographics and smoking behavior variables. The data tells us that smokers who are currently active in the illicit market are more likely to be male, in the labor force but of low income, and less than university educated.

TABLE 1 ABOUT HERE

Obtaining accurate price information in illicit markets by utilizing consumer surveys has proved problematic and yet this is essential information to understand price sensitivity. Abstracting from the difficulty of surveying large enough random samples to obtain a usable number of illicit substance observations, there are also difficulties associated with: (i) participants not knowing accurately the price they pay (because they do not necessarily know the weight of tobacco that they purchase) and (ii) the variability of price across dealers and across customers. Standard methodology (and best practice to date) is to ask participants the quantity they purchased and the price they paid the last time they engaged with the market. It appears that very few illicit consumers record this kind of information in surveys, either because they don’t know or are reluctant to reveal it. In our survey, respondents recorded making purchases in the following loosely defined quantities: small bags, less than a kilo, one kilo and pre-packed tubes. They then recorded the price they paid for this quantity of tobacco and because of the imprecise nature of the quantities recorded the standard deviation around the mean prices per quantity was large. For example, the majority of our sample (62%) recorded that they bought less than a kilo at an average price of AU$53.96 (US$45.34),

5 By comparison the National Household Drugs Survey 2007 had a response rate of 49.3% (see, Australian Institute of Health and Welfare, 2008a)
but with a standard deviation of AU$19.59 (US$16.46). To use this price data as the basis of any kind of statistical analysis would be extremely difficult and would produce erroneous inferences. In other illicit markets price information has been obtained from transactions with undercover police, however we know of no such publically available series in the case of illicit tobacco.

In light of these difficulties, we employ a novel approach to the collection of price information in illicit markets. We engage in a stated preference experiment utilizing hypothetical vignettes to extract relative price effects. Rather than asking participants in the illicit market about the actual prices paid, we asked them to consider a number of relative price questions. Importantly, we anchor their responses to the current price ratio of 1:3. Consumer’s current consumption is a function of the current price ratio and therefore we ask them to consider how their consumption would alter with price ratio changes. The following relative price scenarios are included in the survey. “Currently legal tobacco costs three times the price of chop-chop.

1) If the cost of legal tobacco were to change to **FOUR** times the price of chop-chop would you…
2) If the cost of legal tobacco were to change to **TWICE** the price of chop-chop would you…
3) If the cost of legal tobacco were to be the **SAME** as the price of chop-chop would you…”

Responses to these questions are categorised as decrease consumption, consumption remains the same and increase consumption. It is important to note that the question makes no assumptions about the origins of the change in the price ratio. For example, an increase in the price ratio may be generated by a rise in excise in the licit market or a fall in price in the illicit market. It was intentional to keep the question as general as possible as there are a number of policies being implemented in Australia which are likely to affect prices in both licit and illicit markets.

Answers to this set of questions will give us consumption patterns under four price ratios from which to make statistical inference about how illicit tobacco smokers respond to relative price. The first scenario represents an increase in the price ratio, the second equates to a decrease in the price ratio. The third scenario equates to a price ratio of one (zero price difference) and the fourth is when the price of legal tobacco equals three times the price of chop-chop (i.e. the current price ratio at the time of the study).
The anchoring of responses to the individual’s current level of consumption is important as it relaxes the computational complexities asked of respondents. Illicit tobacco smokers are assumed to know their current consumption and are informed of the current price ratio, all that is required of them under the different price scenarios offered is to indicate the direction in which their illicit consumption would adjust (if at all). The task is sufficiently simple that respondents should easily be able to provide accurate answers. Of our 89 current illicit tobacco smokers in the estimation sample, 81 answered all three price ratio questions and the remaining eight answered two of the three questions.

This approach allows us, in a cross-sectional data set, to obtain consumption responses to a number of relative price changes. An alternative would be to observe smokers over time, however, given that the product is illicit, participants are often unwilling to be tracked through time. Indeed, we know of no longitudinal level data that includes information on illicit tobacco smokers.

II. Methodology

As we have a sample of illicit smokers in our analysis, selection is not an issue in our econometric models. Utilizing the relative price scenarios allows us to think of the data as repeated observations. We observe each individual’s behavioral response to four different price ratios and so estimate an ordered probit model with standard errors clustered by individuals. Hence our estimating equation becomes: 

\[ y_i = \alpha + \beta P_i + \varepsilon_i, \]

with \( \varepsilon_i \sim N(0, \sigma) \), where the dependent variable denotes the expected behavioral response of the individual to the price ratio normalized on their current illicit consumption level at the current price ratio.

\[
y_i = \begin{cases} 
-1 & \text{if the individual states that they would decrease their chop-chop purchase} \\
0 & \text{if the individual states that their chop-chop purchase would remain the same} \\
+1 & \text{if the individual states that they would increase their chop-chop purchase} 
\end{cases}
\]

The explanatory variable \( P_i \) is the price ratio associated with each of the price scenarios. From a theoretical perspective, we would not expect any individual characteristics to be significant in explaining price sensitivity. Individual characteristics ought to determine current consumption, but, conditional on current consumption, individual characteristics ought not to have an effect on consumption responses to price changes. These should be identified by the price coefficient alone. To show that this is the case and, as a robustness check, we estimate a specification of the price response
equation, where we include both individual characteristics and the relative price variable. We use a set of individual characteristics which contains standard demographics (gender, age, age squared, income, education, labor force participation) and a set of smoking-related characteristics (the age the individual started smoking tobacco (licit or illicit) and whether the individual smokes roll your own cigarettes).

One might believe that those most likely to be engaged with the illicit market are low income individuals (where income is an economic driver) and those out of the labor force (who have the lowest opportunity cost of time given the search costs associated with illicit markets). To investigate the question of price versus search costs (i.e. income effects versus time effects) we also include an interaction of the price ratio with the dummy variable for being out of the labor force. Thus we test if those out of the labor force (those with the lowest opportunity cost of time) have different responses to price changes relative to the rest of the population of illicit smokers. The age at which the individual started smoking is included as a proxy for the individual’s stock of addiction (see Becker and Murphy 1988). Supply factors are controlled for by the inclusion of a Victoria dummy variable. Australia has six states and two territories. At the time of our survey, however, Victoria was the only state that allowed commercial growing of tobacco. Given that this was a source of supply to the illicit market, it is possible that consumers of chop-chop may have faced lower prices in this state.

III. Results and discussion

The results were consistent with the theory. Table 2 shows the results for the price sensitivity equation and the robustness check. A likelihood ratio test confirms that, as predicted, conditional on current consumption, only price variation matters when predicting changes in demand. Individual heterogeneity is insignificant.

TABLE 2 ABOUT HERE

By using the estimated coefficients from the price response model we are able to predict how illicit tobacco smokers will respond to changes in relative prices. These predictions are shown in Figure 1 below. The first important point to note is that between a price ratio of 1:1 and one of 1:4.25, 50 percent or more of current users state they will not alter their consumption of illicit tobacco, regardless of relative price. Other studies (Pellegrini et al, 2011) have highlighted the importance of taste factors as a motivation for participation in the illicit market, this finding may reflect that preference.
One also sees that a critical point in these results is where those who report they would decrease their consumption in the illicit market is exceeded by the number of smokers who say they would increase their consumption in the illicit market. This point occurs at a price ratio of 1:2.50 (switch point A). This point is below the current price ratio of 1:3 and suggests that further increases in the price ratio will serve to increase the consumption of illicit tobacco by current users.

While we asked respondents to consider their behavior up to a price ratio of 1:4 we have predicted, from our parameter estimates, responses up to a ratio of 1:5 and discovered another interesting finding. A price ratio of 1:4.35 is the critical ratio at which the proportion of consumers that state they will increase illicit consumption is larger than the proportions who report their consumption will stay the same or decrease (switch point B).

FIGURE 1 ABOUT HERE

In summary, this shows that further increases in the price ratio will lead to an increase in the demand for illicit tobacco from this group. From a policy perspective these findings are especially interesting. The current policy climate in Australian remains actively anti-smoking and further tax increases for the licit market have been announced since our survey. Indeed, the expected price rises in the formal sector will soon take us to switch point B (assuming that all other things remain constant). This has clear implications for the health and welfare of those individuals currently engaged in the illicit market.

Further, since our survey the Australian federal government announced a staged buyout of commercial growers. The 2006 federal government and industry-funded buyout of tobacco growers saw tobacco farming in Victoria (and Australia) phased out over the subsequent three years (Scollo and Winstanley, 2008). The cessation of tobacco growing in Australia leads to a number of interesting questions in regard to the market for illicit tobacco, given that one of the primary sources of illicit tobacco was raw tobacco purchased or stolen from licensed Australian commercial growers. The removal of this source on the supply side of the illicit market has natural consequences in terms of the demand side of the market, as a result of potential changes in price and availability. Theoretically this ought to reduce supply and hence raise the price of illicit tobacco.

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tobacco and lower the price ratio and, according to our findings, reduce demand in the illicit market. However, the delay between announcement and cessation of growing was sufficient to allow other sources of supply (e.g. home grown and small scale suburban production) to compensate, and the net result may be that little has changed on the supply side of the market.

An innovative Australian federal policy is the proposal to ban brand identity from cigarette packets.\(^7\) Given that the illicit market consists of essentially unbranded tobacco, this policy will blur the distinction in terms of the product differentiation between the two markets. Moreover, it was suggested by one of the major tobacco companies operating in Australia (British American Tobacco) that their response to this policy would be to halve the price of the legal tobacco that it sells\(^8\). Such a response would create a direct impact on the price ratio. Our analysis shows that illicit tobacco consumers are relative price sensitive, even in a highly differentiated product market. Thus one would expect the removal of branding to increase the relative price sensitivity and lead to concerns about the overall benefit of such a policy.

IV. Conclusions

Successive Australian governments have employed innovative anti-smoking policies and as such policy makers might learn from the Australian experience. So what is there to learn? This paper illustrates that illicit tobacco users are likely to increase their consumption of illicit tobacco as the price differential between licit and illicit tobacco increases. This has obvious welfare effects for these smokers because of both the associated higher health risks of licit tobacco consumption and their level of exposure to the black economy. Moreover, government excise revenues, which indirectly fund health care expenditure, are lost and the policing costs of the black market may rise.

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References


Pappas R. Steven, Gregory M. Polzin, Clifford H. Watson, and David L. Ashley. 2007. “Cadmium, lead and thallium in smoke particulate from counterfeit cigarettes compared to authentic US brands.” Food and Chemical Toxicology, 45(2): 202-209.


Table 1: Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Outcomes</th>
<th>% of current chop-chop users (N=89)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor market status</td>
<td>In the labor force (full-time or part-time)</td>
<td>66.29</td>
</tr>
<tr>
<td></td>
<td>Out of labor force (student, retired or unemployed)</td>
<td>33.71</td>
</tr>
<tr>
<td>Weekly Income*</td>
<td>Less than $500</td>
<td>41.57</td>
</tr>
<tr>
<td></td>
<td>$500-$999</td>
<td>38.2</td>
</tr>
<tr>
<td></td>
<td>$1,000+</td>
<td>20.23</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>31.46</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>68.54</td>
</tr>
<tr>
<td>Age Groups</td>
<td>18-19 yrs</td>
<td>8.99</td>
</tr>
<tr>
<td></td>
<td>20-29 yrs</td>
<td>19.10</td>
</tr>
<tr>
<td></td>
<td>30-39 yrs</td>
<td>13.48</td>
</tr>
<tr>
<td></td>
<td>40-49 yrs</td>
<td>30.34</td>
</tr>
<tr>
<td></td>
<td>50-59 yrs</td>
<td>19.10</td>
</tr>
<tr>
<td></td>
<td>60+ yrs</td>
<td>8.99</td>
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<tr>
<td>Highest level of education = University</td>
<td></td>
<td>16.85</td>
</tr>
<tr>
<td>Smokes roll-your-own cigarettes</td>
<td></td>
<td>55.06</td>
</tr>
<tr>
<td>Lives in Victoria**</td>
<td></td>
<td>48.31</td>
</tr>
</tbody>
</table>


**At the time of our survey Victoria was the only remaining Australian state to allow commercial tobacco growing.
## Table 2: Estimation Results

<table>
<thead>
<tr>
<th></th>
<th>Robustness check: Price response and individual heterogeneity</th>
<th>Price response only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>Std. Err.</td>
</tr>
<tr>
<td>Male</td>
<td>0.026</td>
<td>0.175</td>
</tr>
<tr>
<td>Age</td>
<td>0.050</td>
<td>0.035</td>
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<tr>
<td>Age squared</td>
<td>-0.001*</td>
<td>0.000</td>
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<tr>
<td>Highest level of education=University</td>
<td>-0.190</td>
<td>0.235</td>
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<tr>
<td>Lives in Victoria</td>
<td>0.059</td>
<td>0.177</td>
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<tr>
<td>Weekly income $500-$999</td>
<td>0.154</td>
<td>0.499</td>
</tr>
<tr>
<td>Weekly income $1,000-$1,499</td>
<td>0.306</td>
<td>0.465</td>
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<tr>
<td>Weekly income $1,500+</td>
<td>0.268</td>
<td>0.507</td>
</tr>
<tr>
<td>Age started smoking tobacco</td>
<td>-0.008</td>
<td>0.016</td>
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<tr>
<td>Smokes roll your own cigarettes</td>
<td>-0.003</td>
<td>0.153</td>
</tr>
<tr>
<td>Out of the labor force</td>
<td>0.455</td>
<td>0.447</td>
</tr>
<tr>
<td>Price of legal tobacco</td>
<td>0.568**</td>
<td>0.087</td>
</tr>
<tr>
<td>Out of the labor force × Price</td>
<td>0.046</td>
<td>0.135</td>
</tr>
<tr>
<td>( \alpha_1 )</td>
<td>1.475</td>
<td>0.810</td>
</tr>
<tr>
<td>( \alpha_2 )</td>
<td>3.575</td>
<td>0.832</td>
</tr>
<tr>
<td>Pseudo R-squared</td>
<td>0.161</td>
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</tr>
<tr>
<td>Number of observations</td>
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<td></td>
</tr>
<tr>
<td>Number of individuals</td>
<td>89</td>
<td></td>
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<tr>
<td>Log likelihood</td>
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</table>
Figure 1: Predicted relative price responses.