Implications of Increasing Cigarette Taxes in Peru

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Abstract

Objective. This paper aims to assess the impact of raising cigarette taxes in Peru on cigarette consumption and if this increment in taxes is regressive.

Methods. We estimate total demand price elasticity and by income groups using two datasets, quarterly data and data from a cross-sectional survey of income and expenses. We specify a functional form of the demand for cigarettes in Peru using the quarterly data set and estimate the demand price elasticity for the short and long run. Using the second data set and based on Deaton methodology, the implementation of elasticity estimation and by groups’ elasticity was done in a two-step procedure.

Results. Demand price elasticity is -0.7 implying that increasing prices by 10%, via taxes, induce a reduction of consumption of 7%. Demand price elasticity estimations by income groups suggest that poorer families are not more price sensitive than richer ones implying that increasing cigarette taxes could be regressive.

Conclusions. Increasing cigarette taxes is the most efficient policy to induce a reduction in smoking. However, in the case of Peru, this increment in cigarette taxes could be regressive.

Keywords: Peru, Taxation of the Tobacco-Derived Products, Consumption of Tobacco-Derived Products, Statistics & Numerical Data, Economics
1. Introduction

Increasing taxes on tobacco is by far the more cost-effective policy to reduce the consumption of cigarettes (1-2). There are at least two reasons for imposing higher taxes on the consumption of tobacco. On one hand, increasing taxes increases government tax revenues since smoking, being addictive, causes the number of cigarettes demanded to decrease but less than proportionally to the price increases, generated by the tax. On the other hand, the increment in taxes, by making cigarettes more expensive, reduce consumption and helps to diminish the detrimental effects on the health of smokers and non-smokers. These features support a policy of controlling the consumption of tobacco by price increases through taxes, as the double effect is to reduce consumption and increase tax collection.

However, increasing cigarette taxes could also have bad consequences: they can be regressive. Increasing cigarette taxes could result in poor people paying a higher percentage of their income in taxes than do the rich. In this case tax increases are called regressive. Regressivity is important because not only poor people could end up paying a higher percentage of their income in cigarette’s taxes but also because the argument is frequently used by the industry to oppose the implementation of a government policy of increasing cigarette taxes to reduce consumption.

In most nations, the poor smoke more than the rich (3). As a result, the poor often spend a substantially larger proportion of their income on cigarettes than do the rich bearing a disproportionate share of the burden of taxes on cigarettes. Therefore, increasing the tax will increase this disproportionate burden even more. (4-6) A tax increase may not be regressive if the poor are much more sensitive to price changes than the rich are: they are more likely to quit or reduce their consumption. If the poor reduce their consumption enough the change in tax expenditures of the poor may be less than the change in tax expenditures of the rich. Therefore, if the poor have a much larger demand price elasticity, in absolute value, than the rich then increasing cigarette taxes could not be regressive\(^1\).

\(^1\) Price elasticity measures the sensitivity of consumption to price changes. If cigarette prices increase the price elasticity tells us by how much consumption will decrease.
How much the increment in taxes reduces consumption and if it’s regressive are important empirical questions. One can design effective public policy to reduce tobacco consumption by taking into account the answers to those questions. In this work we assess empirically the impact of raising cigarette taxes in Peru on cigarette consumption and measure if this increment in taxes is regressive. We found a demand price elasticity of -0.7 implying that increasing prices by 10%, via taxes, induce a reduction of consumption of 7%. Demand price elasticity estimations by income groups suggest that poorer families are not more price sensitive than richer ones implying that increasing cigarette taxes could be regressive.

2. Materials and methods

2.1 Data
In this work, we use two alternative datasets for estimating the cigarette demand in Peru. We use a time series database comprising quarterly data going from the first quarter of 1993 to the last quarter of 2012. This database contains information on apparent consumption, average real price of cigarettes and the average monthly income per rolling quarter reported by the National Institute of Statistics and Informatics (Instituto Nacional de Estadística e Informática, INEI) of Peru.

We also estimate the demand for cigarettes using data from the most recent National Survey of Family Budgets (Encuesta Nacional de Presupuestos Familiares, ENAPREF, 2008-2009). The ENAPREF is a household survey of income and expenditure. ENAPREF includes information on the expenditure of each of the individuals composing the household on cigarettes and the quantity purchased.

2.1.1. Time Series Data
We construct the consumption of cigarettes variable from the macroeconomic identity that adds to the cigarette production the cigarette exports and subtracts the cigarette imports (called apparent consumption) using data records of the National Tax Authority in the area of customs (Superintendencia Nacional de Aduanas y de Administración Tributaria – Customs SUNAT). Currently and since 2005, the demand for cigarettes in
Peru is satisfied mainly by imports of Chilean origin, where British American Tobacco, BAT, has its production plant. The source of the cigarette price series is the consumer price index (CPI). We compute the real price of cigarettes dividing the CPI of cigarettes by the general CPI (https://www.inei.gob.pe/estadisticas/indice-tematico/price-indexes/). We transform these monthly statistics in quarterly data computing the average real price per quarter. For the series of income, we use the average monthly income per mobile quarter reported by INEI in its Permanent Employment Survey (Encuesta Permanente de Empleo, http://webinei.inei.gob.pe/anda_inei/index.php/catalog/19). This nominal income was transformed in real terms using the general CPI. Given the characteristics of the tobacco market in Peru -cigarette demand is supplied by imports- another variable that should appear as a control variable in the demand function for cigarettes is the exchange rate. The quarterly series used in this work corresponds to the average interbank exchange rate (sell) of the Central Reserve Bank of Peru (CRBP) and goes from the first quarter of 1993 and the last quarter of 2012. The average quarterly consumption is about 35 packs of twenty cigarettes with a maximum of 63 packs per quarter and a minimum of 14 packs. The real price varies between 1 and 1.75 being the real median price 1.45 over the sample. Remember that we compute this price as a ratio of two price indices that do not have an interpretation regarding the Peruvian currency. The monthly average real income in our sample is around S/. 1 600 (Nuevos Soles) with a minimum of nearly S/. 1 200 and an upper limit of about S /. 2 000. The average exchange rate in the sample is S /. 2.96 per U.S. dollar. The minimum exchange rate was S /. 1.76 and the maximum value is more than S /. 3.5.

**2.1.2 Cross-Sectional Database**

The ENAPFRE has a module containing the individual spending on cigarettes. We can identify the spending on cigarettes per person in the house, but one of the problems of the survey is that it is not possible to identify who smoke in the household. It may well be the case that the person in the home making the purchases of cigarettes is not the one who smokes, for example. In this regard, the survey can be used to characterize the percentage.
of households with at least one smoker. Of the 35000 households in the survey, there is a little less than 8% with this characteristic.

We compute the unit value as the ratio between expenditure on cigarettes and physical quantities bought. We performed the estimation of the demand for cigarettes in two ways, using the quantity of cigarettes purchased by each and the unit value of every purchase and using the same information but aggregated at the household level. We use the methodology advanced in Deaton (7) explained in the methodology section.

To measure the sensitivity of the demand for cigarettes to change in prices, those individuals who reported any spending on cigarettes and received income in the reference period of the survey were selected. Considering the individual personal spending on goods and services, 3,642 people reported having purchased cigarettes during the week of reference of the survey, and from those only 3,153 reported some income in the period. Estimations are performed using this latter group of individuals.

The survey does not identify the individual who smokes in the household, The sample used in the estimation consists of 3,153 people with spending on cigarettes. 95% of those people are male. Education categories represent 14% primary, 66% secondary education and 20% with a college education.

### 2.2 Specification of the demand for cigarettes using the time series database

Specifying a conventional demand function for cigarettes requires stationarity of the individual variables involved. If it is not the case, then the specification of the demand function depends on whether the variables contain a common trend or not. For a complete description of the functional form of the demand for cigarettes, tests and estimation procedures with time series data see Gonzalez-Rozada (8).

We identified the order of integration of each variable using the Augmented Dickey-Fuller test (ADF) (9). The ADF statistic suggests that the apparent consumption of cigarettes, the average real price, the average real income and the exchange rate are individually non-stationary variables. We used the Johansen test procedure (10-13) to check for cointegration between these series. The result of Johansen’s sequential procedure suggests that there is a cointegration relationship between the mentioned variables during the period under analysis.
The specification of the demand for cigarettes, in the long run, was established by a model for the steady-state path growth of the variables. The demand price elasticity ($\lambda_1$) states that a one percent increase in the real price of cigarettes reduces the consumption in $\lambda_1\%$, while the income elasticity ($\lambda_2$) tells us that a one percent increase in real income of consumers increases the amount consumed $\lambda_2\%$ in the long run. In the short-run, the variables may not be in the path of long-run equilibrium; therefore we specified a general model that allowed the estimation of the short-run elasticities of cigarette consumption.

The demand price elasticity for the short-term ($\beta_0$) states that a one percent increase in price causes a drop of $\beta_0\%$ in the number of cigarettes consumed in a quarter, while the short-term income elasticity ($\gamma_0$) tells us that an increase of one percent in real income of consumers produces an increase in $\gamma_0\%$ in the number of cigarettes consumed in a quarter.

### 2.3 Specification of the demand for cigarettes using the cross-sectional database

Household surveys like ENAPREF do not report the price of cigarettes. The households are asked to report not only their spending on each good but also what is the physical quantity purchased. The ratio of these two figures is a measure of price, or more accurately, a unit value. One reason the unit values are not the same as the prices is that unit values are affected by the choice of the quality of the product purchased. In the case of a pack of cigarettes a premium brand costs more than, say, a pack of cigarettes that comes from smuggling since in general smuggling cigarettes are on average of lower quality than legal cigarettes. The unit values include this quality feature. We computed unit values dividing the expenditure by the physical quantities, so that first brand cigarettes have higher unit values. As a result, and in contrast to a market price on which the consumer has no control, here, the consumer "choose" a unit value, at least to some extent. In particular, since richer households tend to buy higher quality products, unit values are positively related to income.
The basic ideas underlying the model that allows this estimation can be found in the work of Deaton (7). For a more detailed explanation of the necessary procedures in the estimation of price and income elasticity see Ramos-Carbajales et al (14).

3. Results

Here we present some of the characteristics of both datasets. Figure 1 shows the evolution of the apparent consumption of cigarettes measured in millions of packs of twenty cigarettes per quarter.

Apparent consumption is highly volatile, as is usual in these estimations because changes in exports and imports can be abrupt decisions by importers without being tied directly to cigarette smoking. It is important to note that currently in Peru there is no national tobacco industry.

Figure 1. Apparent Consumption of Cigarettes in Peru. 1993:Q1-2012Q4

Source: authors’ calculations.

Table 1 summarizes the main socio-demographic characteristics of the population in the ENAPREF survey used to estimate the sensitivity of the demand for cigarettes to change in prices.
On average, there are almost 4 people older than 13 years in the household purchasing an average of 2 cigarettes in the week of reference of the survey. The variability is large showing that there are households purchasing a maximum of 34 cigarettes in the week of reference.

### 3.1 Time Series Estimation Results

Table 2, reports that the long-run demand price elasticity of cigarette consumption is -0.689, while the long-run income elasticity of cigarette consumption is 0.658. With these figures, a 10% increase in real price reduces total cigarette consumption in the long run 6.9% and a 10% increase in real income increases total consumption of cigarettes in the long run by 6.6%. Both estimates are statistically significant at 6% significance level.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-Statistic</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln(Real cigarette prices)</td>
<td>-0.689</td>
<td>0.321</td>
<td>-2.144</td>
<td>0.035</td>
</tr>
<tr>
<td>Ln(Real income)</td>
<td>0.658</td>
<td>0.345</td>
<td>1.907</td>
<td>0.060</td>
</tr>
<tr>
<td>Ln(Exchange rate)</td>
<td>1.459</td>
<td>0.207</td>
<td>7.056</td>
<td>0.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.722</td>
<td>2.513</td>
<td>-1.083</td>
<td>0.282</td>
</tr>
<tr>
<td>Seasonal controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.5104</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-statistic</td>
<td>42.0724</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-Value</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: authors’ estimations.

Note: Least squares estimations. The sample period is from 1993 first quarter to 2012 fourth quarter. The table shows heteroskedasticity robust standard errors. Ln is natural logarithm.
The results here are similar to other time series existing studies for countries in the region (8, 15-17). Cigarette demand is inelastic to price and income, in this case, the demand price elasticity is a bit larger in absolute value than the income elasticity. That is, with a growing economy and, therefore, increasing real income of the population, it does not require a more than proportional increase in the real price to cause a fall in the demand for cigarettes.

3.2 Cross-Sectional Estimation Results

Table 3 presents the estimation of the total demand price elasticity evaluated at the average per capita household income and the same elasticity by terciles of per capita household income. The estimation included the proportion of women over 18 in the household, the proportion of individuals with university education in the household and dummy variables for the location of the home as control variables.

The first tercile corresponds to the group of families with the highest per capita spending, and the third tercile corresponds to the group of families with the lowest per capita spending. Per capita spending is a good approximation of per capita household income, then in the first tercile are grouped the richer households and in the third tercile the poorest families.

Table 3. Average Price and Income Elasticity Estimations. Peru, ENAPREF Sample

| Demand price elasticity, tercile 1 (richer) | -0.831*** (0.00048) |
| Demand price elasticity, tercile 2          | -0.762*** (0.00038) |
| Demand price elasticity, tercile 3 (poorer) | -0.619*** (0.00125) |
| Total demand price elasticity               | -0.738*** (0.0010)  |
| Income elasticity                           | 0.112*** (0.00152)  |

Source: authors’ estimations.
Note: Figures in parentheses are standard errors computed using the Delta method.
Statistical significance: * 10%, ** 5%, *** 1%.
Table 3 shows an average demand price elasticity of -0.738 and an income elasticity of 0.112, both statistically significant at 1%. The income elasticity appears to be lower in magnitude than those found in the literature. The demand price elasticity is similar to the one found with time series estimation. The demand price elasticity by terciles of per capita household income shows an increasing pattern. As per capita income increases the demand price elasticity is larger in absolute value. This evidence suggests that richer households are more sensitive to price changes than the poorest households, contrary to what is assumed and found in the literature for developed countries (18). If unit values are a good approximation of cigarettes prices, these estimates suggest that an increase in cigarette taxes could be regressive.

To see if the unit values are good approximation for prices we estimated the demand price elasticity following the methodology of Deaton (7). We performed estimations using households and individuals as our unit of analysis. Both estimations included control variables. Among the variables associated with the household we had: the number of people in the household, the proportion of men and women older than 18 years. Among the variables related to the individual we included: the household head age, age squared, and a set of categorical variables indicating gender, whether or not approved a university level and whether or not approved a secondary level.

Table 4 shows the estimates of the demand price elasticity, the total expenditure elasticity with respect to the number of cigarettes consumed and the total expenditure elasticity with respect to the unit value. The demand price elasticity for the total sample has a magnitude ranging from -0.675 to -0.800 and is statistically significant at 1% level. These values are similar to both the demand price elasticity estimated assuming unit values reflect prices and the one estimated using time series data. This evidence generates certain robustness for our results. If we consider the breakdown by terciles of per capita household expenditure the picture is similar to the one presented above. This evidence seems to suggest that poorer households (or lower per capita expenditure) do not have a larger elasticity in absolute value than households in the first tercile of per capita spending. Thus, tax increases on the consumption of cigarettes are very likely to be regressive in the sense that the burden of the tax increase would fall more in poor than in rich households.
Table 4. Demand Price Elasticity and Household Total Expenditure. Peru, ENAPREF Sample

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Terciles of per capita expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>First</td>
</tr>
<tr>
<td>Demand price elasticity</td>
<td>-0.800***</td>
<td>-0.870***</td>
</tr>
<tr>
<td></td>
<td>(0.198)</td>
<td>(0.160)</td>
</tr>
<tr>
<td>Total expenditure elasticity</td>
<td>0.190***</td>
<td>0.240***</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td>(0.070)</td>
</tr>
<tr>
<td>Expenditure elasticity of quality</td>
<td>0.090***</td>
<td>0.090*</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.050)</td>
</tr>
</tbody>
</table>

By households estimation

|                                |       | First | Second | Third |
| Demand price elasticity        | -0.675*** | -0.810*** | -0.570*** | -0.750*** |
|                                | (0.212) | (0.142) | (0.068) | (0.142) |
| Total expenditure elasticity   | 0.218*** | 0.250** | 0.170 | 0.230*** |
|                                | (0.030) | (0.100) | (0.230) | (0.070) |
| Expenditure elasticity of quality | 0.088*** | 0.013 | 0.130 | 0.050** |
|                                | (0.018) | (0.060) | (0.110) | (0.020) |

Source: authors’ estimations.
Note: Figures in parenthesis are standard errors computed by the bootstrapping procedure for the demand price elasticity and by the Delta method for the rest of the estimates. Statistical significance: * 10%, ** 5% y *** 1%.

The elasticity of total expenditure is in between 0.19 and 0.22. Both estimates are statistically significant at 1% level and suggest that a 10% increase in total spending increases cigarette consumption by approximately 2%. The estimate of the quality elasticity with respect to the total expenditure is about 0.09 and is statistically significant for the full sample at the 1% level. Both panels of Table 4 show that the quality elasticity is statistically significant for those with the lowest total household expenditure per capita. This result is expected since when total expenditure decrease one expects the poor to be more inclined to reduce quality.

4. Discussion

4.1 Conclusions and Policy Recommendations

In this paper, we tried to answer two empirical questions. How much increasing cigarette prices through taxes reduce consumption and is increasing cigarette taxes regressive? The
study has some limitation. Our time series analysis consider apparent consumption which is highly volatile, because changes in exports and imports can be abrupt decisions by importers without being tied directly to cigarette smoking. The sample participating in the cross-section ENAPREF survey does not allow us to analyze particularities of certain groups separately by gender, or geographic area that could be relevant. In spite of these limitations and potential sources biases the fact that both time series and cross section results are similar suggest that our estimations are robust to these kind of problems.

Increasing cigarette taxes is important public policy to reduce the use of tobacco. The appeal of increasing cigarette taxes is obvious. Since smoking is bad for one’s health and for that of others as well, increasing taxes will induce people to quit or cut back smoking improving their health. However, increasing cigarette taxes could also have bad consequences: they can be regressive. Increasing taxes could result in poor people paying a higher percentage of their income in taxes than do the rich.

Using two information sets we estimated the total demand price elasticity to be -0.7 implying that an increment of 10% in the price of cigarettes reduces consumption by 7%. In Peru, there is a specific Selective Consumption Tax (ISC) of S/. 0.07 per unit of imported cigarette established by Supreme Decree 004-2010-EF posted on January 14, 2010. Therefore, it implies an ISC of S/. 1.40 per pack of twenty cigarettes. Hence, to increase the retail price of cigarettes one should increase this selective tax and the total demand price elasticity estimate provides an answer to the first question. For the second question, we used the cross-sectional database and estimated the demand price elasticity by income and expenditure groups. Demand price elasticity estimations by income groups suggest that poorer families are not more price sensitive than richer ones implying that increasing cigarette taxes could be regressive.

Overall, the evidence found in this paper suggests that implementing an effective policy of increasing taxes to reduce consumption should be complemented with public health policies targeted towards the poor in an attempt to reduce the adverse effects of the additional resources they have to spend on cigarette taxes.
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References


