The relationship between price of tobacco and smoking

Ruben Conner

A thesis
submitted in partial fulfillment of the
requirements for the degree of
Master of Public Health

University of Washington
2014

Committee:
Joe Dieleman
Marie Ng
Emmanuela Gakidou

Program authorized to offer degree:
University of Washington School of Public Health

University of Washington

Abstract

The relationship between price of tobacco and smoking
Ruben Conner

Chair of the Supervisory Committee:
Acting Assistant Professor Joe Dieleman
Global Health Department

Background: Tobacco is well documented as being extremely harmful to health. Prior studies have shown that the price of cigarettes can be one of the best deterrents from smoking. However, most studies have taken place only in high income countries. I assemble a large panel dataset that includes low/middle countries and analyze the effect of price on smoking.

Methods: Our overall goal is to estimate the price elasticity of tobacco. To do this, I employ two main models: a within-between estimator and a first difference model. The within-between estimator allows us to see the effect of cigarettes both cross-sectionally and within specific countries. The first difference model is excellent for looking at change over time but shows only the effect within countries.

Results: Across countries, I find an elasticity of -.19, equivalent to a -1.9% decrease in consumption for a 10% increase in price. This cross-sectional estimate is slightly lower than estimates by other studies. I do not find a within country effect using multiple specifications of the model. We also do not find significant results for models that use prevalence rather than consumption as an outcome.

Conclusion: We have found estimates for the price elasticity of tobacco that are lower than other studies. However, our analysis is hampered by a short panel and a lack of variation between countries.

Aim:

To estimate the price elasticity of demand for tobacco between and within countries across an international panel dataset.

Background and significance:

The ill effects of tobacco are well documented. At an individual level, it limits the ability to breathe fully through bronchitis and asthma.[1] It also takes a toll on the heart, hardening arteries and inducing coronary heart disease.[2] Finally, it causes cancerous growths to form in the lungs and elsewhere and spread throughout the body.[3] The toll of this is ten fewer years lived for the average smoker.[4] At a population level, tobacco causes the premature death of millions with the global toll still rising.[5] If current trends continue, we may expect one billion deaths from tobacco in the 21st Century, ten times what was observed in the 20th Century.[6]

Financial prudence may be one of the most powerful weapons in the public health response to tobacco. While appeals to health and hygiene have been inconsistent in their effectiveness, increases in price seem to reliably help people quit or reduce their smoking. Multiple studies have demonstrated a strong responsiveness to changes in the price of tobacco.[7,8,9] To compare the effectiveness, most studies estimate the price elasticity of demand, an economic term which refers to how responsive individuals are to changes in price. A meta-analysis of the price elasticity found that the prevalence of smoking can be reduced by 4.8% for a 10% increase in price.[10] However, this analysis was largely based on studies from high-income countries.

It is not clear whether the same price elasticity will hold in low/middle income countries. Broadly generalizing, in low/middle income countries prevalence is lower than in high income countries

but the number of smokers is increasing rather than declining. In addition, cigarettes, although cheaper in absolute terms, are less affordable for an average person in a low income country.[11] To date, there have been highly varied estimates of price elasticity for low/middle income countries, with some studies finding higher elasticities than in high income countries[12], some finding lower[13], and others observing no difference. [14] Many of the studies only look at a single country or infer causation from cross-sectional data. The study most similar to mine is an international panel analysis conducted by Blecher et al.[14] This study used cigarette consumption per capita and the price relative to income to estimate the cross-sectional elasticity and found a 5.3% reduction in cigarettes smoked for a 10% increase in price, with no difference between developed and developing countries. I follow a similar approach to this study, but with more robust measures of cigarette prevalence and consumption and utilizing more advanced econometric techniques. Since a consensus has not yet been reached on the price elasticity in low/middle income countries, this paper will aim to provide the best estimates to date by using the largest sample of developing countries yet analyzed.

Finally, the policy relevance of elasticity should be emphasized. Policy-makers have been increasingly interested in using price as a tool to curb smoking.[15,16] The appeal of the approach is obvious: reducing smoking by increasing the price allows for revenue generation while simultaneously reducing burden of disease. However, there is also evidence that cigarette taxes, as a flat tax, act in a regressive way and may put undue tax burden on lower class sectors of the economy.[17] If the goal is to increase population health while avoiding regressive taxation, precise estimates of the elasticity will help guide policy-makers in deciding how much tax is desirable.

Data:

The data on smoking prevalence comes from a recent paper, "Smoking Prevalence and Cigarette Consumption in 187 countries, 1980-2012".[18] This paper, produced Marie Ng and colleagues at the Institute for Health Metrics and Evaluation, synthesizes and standardizes 2,102 country-years of data and then uses spatial-temporal and gaussian process regressions to produce continuous estimates for 187 countries and 23 years. I utilize estimates of age-standardized smoking prevalence & consumption from this dataset.

Measuring changes in smoking prevalence is interesting because it shows the ultimate goal: the number of smokers quitting or being prevented from initiating smoking. In addition, measuring decreases in prevalence is the more traditional measure of elasticity, since data on consumption has been so scarce. However, from an economic perspective, we might expect smokers to respond to a price increase by decreasing their consumption, not by quitting. By separating these two metrics, I will be able to see whether a change in price causes smokers to consume fewer cigarettes or reduces the number of people smoking overall.

I collected data on prices from Euromonitor, a market research group.[19] This data series offers total retail sale prices in 210 countries from 2008 – 2013. Retail sale prices capture the total amount of money spent on cigarettes, which is then divided by the total quantity of packs sold (also provided by Euromonitor). This creates price per pack in local, nominal currency. I then apply two currency conversions. First, I adjusted for inflation by deflating the local currencies to 2012 equivalence. Second, I adjusted for purchasing power by converting into international dollars. These first two steps are necessary to provide comparability across countries and time.

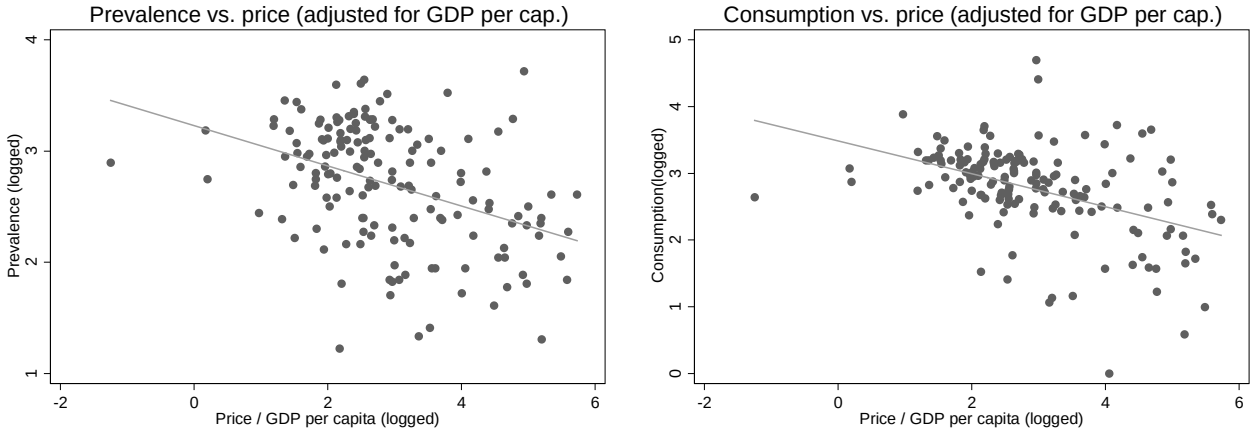
To give an accurate assessment of price, we must be aware of the difference between nominal and real price. When people refer to the price of a pack of cigarettes, they are usually referring to the absolute price. Yet from an economic perspective, what matters more for purchasing decisions is the price relative to income. For example, if, we saw the absolute price of cigarettes rise in a specific country, we might expect fewer cigarettes to be purchased there. However, if, over that same time period, there had been an even faster increase in the income per capita in that country, than cigarettes would actually have become relatively cheaper for the average person. In this scenario, we would see a rise in the absolute price, accompanied by an increase in the prevalence of smoking, the exact opposite relationship as we would expect. Another way of thinking about the relationship between prices and smoking is that income per capita can be thought of as a confounder that we need to control or adjust for. This adjustment can be done in two ways: by adjusting the dependent variable to a relative price term or by controlling for income in our regression.[11, 20] I have taken the first approach and shown a relative price term in Figure 1. However, in the regressions, I simply include gross domestic product (GDP) per capita as a control. Results for all regressions using a relative price term are shown in Appendix Section I.

I have four primary variables of interest: two dependent variables (smoking prevalence and consumption), one independent variable (price per pack in international dollars) and one control (GDP per capita). Our final dataset has 698 observations across 157 countries, covering the time period 2008 to 2012. Table 1 shows basic descriptive statistics for all variables and the wide variability in indicators across countries. Figure 1 shows the downward trend between cigarette consumption or prevalence and the price adjusted for income, an observational result that suggests they may be related.

Table 1: Descriptive statistics (all years)

Statistic	Prevalence	Consumption	Price per pack	GDP per capita
Mean	17.4	19.3	4.4	14,707
Standard dev. (between)	8.3	12.5	2.7	14,833
Median	16.8	18.5	3.9	9,228
Standard dev. (within)	0.4	0.6	0.5	919
Minimum	3.4	1.0	0.2	435
Maximum	42.8	111.4	16.9	80,589
Total observations	698	698	698	698

Fig 1: Cross-sectional relationships of variables (2011)



Methods:

To estimate the price elasticity of tobacco, I employ the within-between estimator.[21,22] For this technique, panel variables are included in two terms, the country-specific average across time and the difference between that average and each individual observation. The inclusion of two terms is useful because it allows for interpretation of both the change within countries through time (the within country effect) and the cross-sectional effect (the between country effect). A country-level random effect is also included in the estimator. Bell & Jones argue that the within-between estimator is the best solution to modeling data with temporal hierarchies because it addresses the "main criticism of [random

effects], the correlation between covariates and residuals" while also retaining the ability to interpret time invariant effects.[21] Essentially, the model keeps the flexibility of a random effect while reducing the chance of bias and allowing us to see cross sectional effects.

In the equations below, subscript *t* is a year, subscript *i* is a country, p is the price per pack in international dollars, μ_i is the random effect on country, GDP_{it} is the gross domestic product per capita, μ_t is a set of indicators for year and ε_{it} is the error term. The independent and dependent variable are logged. As mentioned, I include the country-level average of a given independent variable ($\bar{p}_i$ & $\overline{GDP_i}$) as well as the demeaned variable. I also include an autoregressive form for the residual to take into account the correlation between repeated observations from the same country (not shown).

Within-between models:

1) $Prevalence_{it} = \beta_1 + \beta_2\bar{p}_i + \beta_3(p_{it} - \bar{p}_i) + \beta_4\overline{GDP_i} + \beta_5(GDP_{it} - \overline{GDP_i}) + \mu_t + \mu_i + \varepsilon_{it}$

2) $Consumption_{it} = \beta_1 + \beta_2\bar{p}_i + \beta_3(p_{it} - \bar{p}_i) + \beta_4\overline{GDP_i} + \beta_5(GDP_{it} - \overline{GDP_i}) + \mu_t + \mu_i + \varepsilon_{it}$

I also wanted to test the results using a different specification, namely a first difference model. First differencing involves measuring the change between observations over time. It is an excellent way of reducing the problems of autocorrelation, although it can be vulnerable to measurement error.[23] The equations for the first difference models are as follows.

First difference models:

3) $(Prevalence_{i(t)} - Prevalence_{i(t-1)}) = \beta_1 + \beta_2(p_{i(t)} - p_{i(t-1)}) + \beta_3(GDP_{i(t)} - GDP_{i(t-1)}) + \varepsilon_{it}$

4) $(Consumption_{i(t)} - Consumption_{i(t-1)}) = \beta_1 + \beta_2(p_{i(t)} - p_{i(t-1)}) + \beta_3(GDP_{i(t)} - GDP_{i(t-1)}) + \varepsilon_{it}$

Results:

Results for the within-between models are shown below. In the within-between framework, the coefficient on the average shows the effect of prices across countries & the coefficient on the demeaned variables shows the effect within specific countries. I find that a 10% increase in price causes an insignificant decrease in prevalence but a significant 1.9% decrease in consumption (CI: decrease of .5% to 3.4%). These results are consistent with the idea that smokers prefer to reduce their consumption of cigarettes in response to a change in price rather than actually quitting. Oddly, I find a positive elasticity for the within term in our prevalence equation. This is unexpected since it would lead us to conclude that a price increase causes smoking prevalence to rise, although only by a miniscule amount. The reason for this is unclear. Our year effects (not shown) are all significant and decrease over time, suggesting that prevalence and consumption are both decreasing.

Table 2: Results from within-between models

Variables	Model (1) Prevalence vs. price	Model (2) Consumption vs. price
Price (between term)	-0.0199	-0.193**
	(0.0684)	(0.0745)
Price (within term)	0.00951*	-0.0127
	(0.00462)	(0.00733)
GDP (between term)	0.185**	0.261**
	(0.0288)	(0.0439)
GDP (within term)	0.0187	0.0274
	(0.0131)	(0.0395)
Constant	1.090**	0.708
	(0.246)	(0.382)
Observations	698	698
Number of groups	157	157

Robust standard errors in parentheses
** p<0.01, * p<0.05

To further examine the significance of within-country effects, I also tested a different functional form, namely a first difference regression. I take the difference with respect to time, so all variables would be interpreted as the change in one year. All models fail to find a significant effect within countries. With an r-squared of less than .01, these regressions do not appear to be meaningfully explaining much of the variation in the data. Specification of the models without robust standard errors and with non-logged variables made little qualitative difference.

Table 3: Results from first differences model

Variables	Model (3) Prevalence vs. price	Model (4) Consumption vs. price
Price (year to year change)	0.00692	-0.00794
	(0.00500)	(0.00764)
GDP (year to year change)	0.0214**	0.0167
	(0.0105)	(0.0401)
Constant	-0.00286***	-0.00765***
	(0.000658)	(0.00120)
Observations	541	541
R-squared	0.009	0.003

Robust standard errors in parentheses
** p<0.01, * p<0.05

Overall, I find an insignificant .1% (CI: -1.5% to 1.1%) decrease in prevalence and a significant 1.9% (CI: -3.4% to -.5%) decrease in consumption in response to a 10% increase in price. These estimates are both lower than the estimate of 4.8% found in a meta-analysis and the Blecher et al. estimate of 5.3%. It's possible that this reduction in elasticity may be due to the inclusion of more low/middle income countries. To test this possibility, I performed a sub-group analysis splitting up low/middle income countries and high income countries (as defined by the World Bank) and reran the prevalence and consumption regressions (shown in Appendix Section II). The elasticity estimates for the

separate regressions were not significantly different from each other or from the combined estimate. As such, I cannot safely conclude that the lower elasticity is due to the more internationally representative mix of our sample. The reason for the lower elasticity is not entirely clear.

The effect within countries also remains unclear. Our within-between models show evidence for a very small within country effect but in the opposite direction we would expect. Respecifying as a first difference model finds no significant within country effects. To further test for within effects, I also ran a random effects model (detailed in Appendix Section III) but found null or very small effects. This is unfortunate since a within effect would be far more instructive for a country considering policy changes. The effect across countries could be caused by other factors. Since I cannot show that the same relationship persists within countries, I cannot conclude that a relationship exists between the price of cigarettes and consumption or prevalence for a specific country. Reasons for this lack of a relationship are discussed below.

Discussion & limitations:

The analysis is limited by four major factors. The first is our inability to control for other factors that could influence smoking behavior and would also be related to price. These factors include harsher laws around smoking in certain countries, such as indoor smoking bans and limiting sales to minors, and cultural attitudes towards tobacco. If price is related to these factors, we would expect our analysis to be confounded by the omission of these variables. Controlling for these factors completely is not possible but I have explored some possible relationships using the World Health Organization's MPOWER dataset (see Appendix Section IV). My second limitation is that the price data is total retail sales, not the price for a specific brand of cigarette. This is desirable in some ways, since it captures the mix of cigarettes being consumed. However, if people change their smoking behavior over time by, for example, switching to more expensive cigarettes, this should be seen as an increase in the total price of cigarettes. Since brand loyalty is high with cigarettes, I assume this is not a major concern[24]. The third limitation is the possibility of reverse causality. In this analysis, I assume that prevalence is determined by prices and not vice versa. However, if tobacco companies respond to changes in prevalence, for example by lowering prices when prevalence is decreasing, this would confound the analysis. The final limitation is the short panel of this dataset. With only five years of price data, I may not observe sufficient change in prevalence or price within countries. This is particularly concerning since the prevalence dataset was constructed using smoothing techniques, which may reduce the variability within a country. A longer panel of prices would help offset this problem.

Conclusion:

In an international analysis of tobacco smoking and price, I found cross-sectional estimates of elasticity of -.01% (CI: -.15% to .11%) for the change in prevalence and .19% (CI: -.34% to -.05%) for the change in consumption, both of which are significantly lower than a prior meta-analysis. Low elasticities suggest that cigarette price changes are less effective at curtailing smoking than expected. In fact, with our elasticity of 1.9%, even a 50% worldwide increase in cigarette prices (from $4.43 per pack to $6.64) would reduce the number of cigarettes consumed by less than 10%. The finding of a significant effect for consumption but not for prevalence also suggests that smokers respond to price increases by reducing the number of cigarettes smoked, not by quitting, another useful policy finding.

The elasticity estimates mentioned above are cross-sectional and our ability to infer causation is therefore limited. The effect observed across countries could be due to differences in cultural attitudes towards smoking, differing laws regarding tobacco or other factors unexplained by this model. An effect within countries would be far more convincing of causality but, across multiple model specifications, I found either no significant effects or extremely small effects. This could be interpreted as a lack of a causal relationship between smoking and prices, a conclusion in the null, but our data is too limited for this strong conclusion. I employ a short panel (five years) and have far more variation between countries than within them. In addition, as mentioned in the limitations section, the smoothing done during the generation of the prevalence and consumption data series would also potentially lessen the within country effect. Both of these issues would bias us towards the null. A longer panel of price data with more in-country variability will be required to determine the international elasticity with precision.

Appendix

Section I

Using price relative to income in within-between regression, rather than absolute price. Note that our coefficients on price are very similar to the absolute price model. This is because price relative to income is created by dividing absolute price by GDP per capita, but we already include GDP per capita as a control in our model. Therefore, any variation in relative price that is not seen in absolute price is due to the GDP adjustment and is picked up by the GDP term in our regression.

Table A1: Within-between model, relative price

Variables	Model (1) Prevalence vs. relative price	Model (2) Consumption vs. relative price
Relative price (between term)	-0.0185	-0.195**
	(0.0686)	(0.0746)
Relative price (within term)	0.00951*	-0.0127
	(0.00462)	(0.00732)
GDP (between term)	0.166**	0.0662
	(0.0635)	(0.0682)
GDP (within term)	0.0282*	0.0147
	(0.0134)	(0.0408)
Constant	1.285*	2.763**
	(0.758)	(0.802)
Observations	698	698
Number of groups	157	157

Robust standard errors in parentheses
** p<0.01, * p<0.05

Section II

Since part of the purpose of our analysis was to explore the different elasticities between low/middle income countries and high income countries, I ran these two groups as separate sub analyses. Results

are below. In the prevalence models, the effect of prices remains insignificant for both low/middle income countries and high income countries. In the consumption models, our price between term for low/middle income countries is significant and slightly higher than the pooled model. The within term in high income countries is insignificant, likely due to a low sample size and suggesting that our pooled results are mostly driven by the effect in low/middle income countries.

Table A2: Within-between model, low income countries

Variables	Low income: Prevalence vs. price	Low income: Consumption vs. price
Price (between term)	-0.0201	-0.223**
	(0.0908)	(0.0857)
Price (within term)	0.0143*	-0.0184
	(0.00767)	(0.0120)
GDP (between term)	0.236**	0.300**
	(0.0415)	(0.0638)
GDP (within term)	0.00576	0.0583*
	(0.0118)	(0.0293)
Constant	0.689*	0.432
	(0.353)	(0.560)
Observations	482	482
Number of groups	111	111

Robust standard errors in parentheses
** p<0.01, * p<0.05

Table A3: Within-between model, high income countries

Variables	High income: Prevalence vs. price	High income: Consumption vs. price
Price (between term)	0.0398	-0.113
	(0.0883)	(0.0755)
Price (within term)	0.00555	-0.0111*
	(0.00418)	(0.00449)
GDP (between term)	0.0851	-0.345**
	(0.220)	(0.129)

GDP (within term)	0.0435	-0.0897
	(0.0673)	(0.0644)
Constant	1.972	6.836**
	(2.414)	(1.316)
Observations	216	216
Number of groups	46	46

Robust standard errors in parentheses
** p<0.01, * p<0.05

Section III

To check for within country effects, I also ran two random effects models. We found a null result for the effect on prevalence and a significant -.3% (CI: -.06% to -.01%) reduction in consumption for a 10% increase in price. This is again a very small effect and did not assist in showing stable or clear effects within countries.

Table A4. Random effects models

Variables	RE model: Prevalence vs. price	RE model: Consumption vs. price
Price (logged)	0.000421	-0.0362*
	(0.00711)	(0.0142)
GDP per capita (logged)	0.0571	0.0972**
	(0.0299)	(0.0274)
Constant	2.196**	1.959**
	(0.267)	(0.255)
Observations	698	698
Number of country_num	157	157

Robust standard errors in parentheses
** p<0.01, * p<0.05

Section IV

To explore the possibility of laws as a confounder in our analysis, we tested the effects of a few smoke free laws. Data was available only cross-sectionally and was frequently missing. As such, we tested the

effect of each law independently for 2010 using our consumption data. Results are shown below. The only smoking intervention that we found to be significant was the warning labels on cigarette packs, which decreased consumption by .4% (CI: -.68% to -.15%). Our price variable remains significant in all regressions except smoke free places, in which the number of observations is dramatically reduced by the missingness of this data series. Since the development of smoking laws may be correlated with both development and prevalence of smoking, a panel dataset would be far more helpful in exploring the effect of laws.

Table A5. Effect of different laws in 2010 on cigarette consumption

Variables	(1) Smoke free places	(2) Advertising bans	(3) Warning labels on pack
Price (logged)	-0.170	-0.204*	-0.222**
	(0.114)	(0.0994)	(0.0836)
GDP per capita (logged)	0.399**	0.299**	0.302**
	(0.0717)	(0.0561)	(0.0421)
Smoke free index	-0.0508		
	(0.0272)		
Ad bans index		0.0128	
		(0.0318)	
Warning labels on pack			-0.415**
			(0.135)
Constant	-0.371	0.174	0.709*
	(0.551)	(0.447)	(0.344)
Observations	81	98	148
R-squared	0.298	0.266	0.272

Standard errors in parentheses
** p<0.01, * p<0.05

References

[1] Troisi, R. J., F. E. Speizer, B. Rosner, D. Trichopoulos, and W. C. Willett. "Cigarette Smoking and Incidence of Chronic Bronchitis and Asthma in Women." *Chest* 108.6 (1995): 1557-561. Web.

[2] Hjermann, I., and I. Holme. "Effect of Diet and Smoking Intervention on the Incidence of Coronary Heart Disease." *The Lancet* 318.8259 (1981): 1303-310. Web.

[3] "Health Effects of Cigarette Smoking." *Center for Disease Control and Prevention*. Fact Sheets & Statistics, n.d. Web.

[4] Doll, R. "Mortality in Relation to Smoking: 50 Years' Observations on Male British Doctors." *BMJ* 328.7455 (2004): n. pag. Web.

[5] Lim, Stephen S., Theo Vos, and Abraham D. Flaxman. "A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors and Risk Factor Clusters in 21 Regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *The Lancet*380.9859 (2012): n. pag. Web.

[6] Jha, Prabhat, and Richard Peto. "Global Effects of Smoking, of Quitting, and of Taxing Tobacco." *New England Journal of Medicine* 370, no. 1 (2014): 60–68. doi:10.1056/NEJMra1308383.

[7] Gallus, S. "Price and Cigarette Consumption in Europe." *Tobacco Control* 15.2 (2006): 114-19. *British Medical Journal*. Web.

[8] Guindon, G. E. "Trends and Affordability of Cigarette Prices: Ample Room for Tax Increases and Related Health Gains." *Tobacco Control* 11 (2002): *British Medical Journal*. Web.

[9] "WHO Technical Manual on Tobacco Tax Administration". Geneva: World Health Organization, 2010.

[10] Gallet, Craig. "Cigarette Demand: A Meta-analysis of Elasticities." *Health Economics* 12.10 (2003): Web.

[11] Blecher, Evan, and Corne P. Van Walbeek. "Cigarette Affordability Trends: An Update and Some Methodological Comments." *Tobacco Control – British Medical Journal* 10 (2009): Web.

[12] Yuanliang, Bai, and Zhang Zongyi. "Aggregate Cigarette Demand and Regional Differences in China." *Applied Economics* 37.21 (2005): 2523-528. Web.

[13] Lance, Peter M. "Is Cigarette Smoking in Poorer Nations Highly Sensitive to Price?: Evidence from Russia and China." *Journal of Health Economics*23.1 (2004): 173-89. Web.

[14] Blecher, E. H. "An International Analysis of Cigarette Affordability." *Tobacco Control* 13 (2004): 339-46. *British Medical Journal*. Web.

[15] Chaloupka, F. "Effectiveness of Tax and Price Policies in Tobacco Control."*Tobacco Control* 20 (2011): 235-38. *British Medical Journal*. Web.

[16] *WHO Framework Convention on Tobacco Control*. Geneva, Switzerland: World Health Organization, 2003. Web.

[17] Sammartino, Frank. "Federal Taxation of Tobacco, Alcoholic Beverages, and Motor Fuels". Washington, D.C.: Congress of the United States, Congressional Budget Office, 1990. Online.

[18] Ng Marie, Freeman MK, Fleming TD, and et al. "Smoking Prevalence and Cigarette Consumption in 187 Countries, 1980-2012." JAMA 311, no. 2 (January 8, 2014): 183–192.

[19] "Cigarettes- Retail Value RSP - Current Prices." Tobacco. Euromonitor Passport, n.d. Web.

[20] Lal, A., and M. Scolla. "Big Mac Index of Cigarette Affordability." *Tobacco Control* 11 (2002): 280-86. *National Institute for Health*. Web.

[21] Bell, AJD & Jones, K, "Explaining Fixed Effects: Random Effects modelling of Time-Series Cross-Sectional and Panel Data". Political Science Research and Methods (2014). doi: 10.1017/psrm.2014.7

[22] Mundlak, Yair, "On the Pooling of Time Series and Cross Section Data", Econometrica (1978), 43(1)

[23] Stock, James H., and Mark W. Watson. *Introduction to Econometrics*. Boston, MA: Addison Wesley, 2003. Print.

[24] Nelson, Siegel M. "The Extent of Cigarette Brand and Company Switching: Results from the Adult Use-of-Tobacco Survey." *American Journal of Preventive Medicine* 12.1 (1996): Web.