5. THE STABILITY OF PRICE ELASTICITY OF DEMAND ESTIMATES

Many factors can affect the stability of the price elasticity estimates—different price points (location on the demand curve), time horizon (short run versus long run), the method of measuring demand, and availability of close substitutes. Each is discussed in turn below.

i. Price Point Impact

Even with a linear demand curve, price elasticity for any product (including tobacco) varies as the price for that product varies. Demand tends to be relatively inelastic at lower price levels (due to smaller income effects), but grows more elastic as price increases. Consider Table 5 and Figure 2 below, which illustrate this effect: at lower price levels, demand is price-inelastic, while at higher price levels, this effect reverses completely. The source of this change in the price elasticity of demand along a linear demand curve is due to the arithmetic properties in the price elasticity of demand calculations as can be seen in the table.

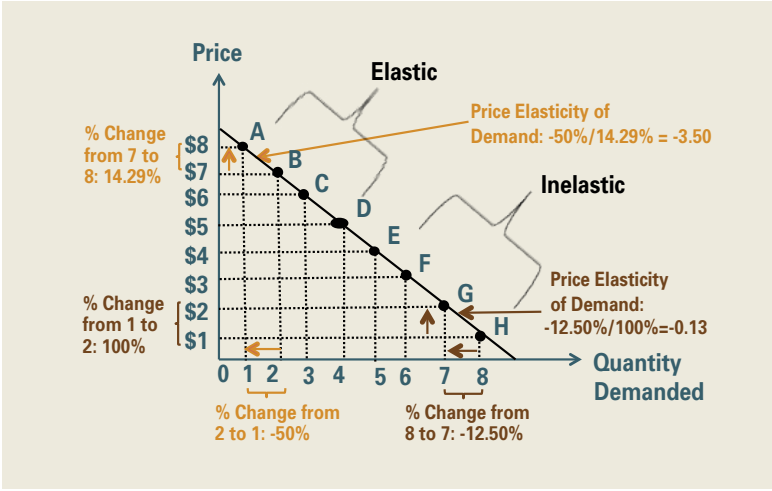
Table 5

Price Elasticity of Demand at Different Price Levels

Price Effect		Quantity Demanded		Price Elasticity of Demand	
Price	% Change in Price	Quantity Demanded	% Change in Quantity Demanded		
$1	-	8	-	-	-
$2	100.00%	7	-12.50%	(-12.5/100) =	-0.13
$3	50.00%	6	-14.30%	(-14.3/50) =	-0.29
$4	33.30%	5	16.70%	(-16.7/33.3) =	-0.5
$5	25.00%	4	-20.00%	(-20.0/25.0) =	-0.8
$6	20.00%	3	-25.00%	(-25.0/20.0) =	-1.25
$7	16.70%	2	-33.30%	(-33.3/16.7) =	-2
$8	14.30%	1	-50.00%	(-50.0/14.3) =	-3.5

Figure 2

Price Elasticity of Demand at Different Price Points



ii. Time Horizon

Not only does the price elasticity of demand change at different price points along the demand curve, but the price elasticity also changes over time. In the short run, the price elasticity of demand is normally less elastic than in the long run; consumers can compensate for a higher price in the short term by drawing down savings or consuming less of other goods.

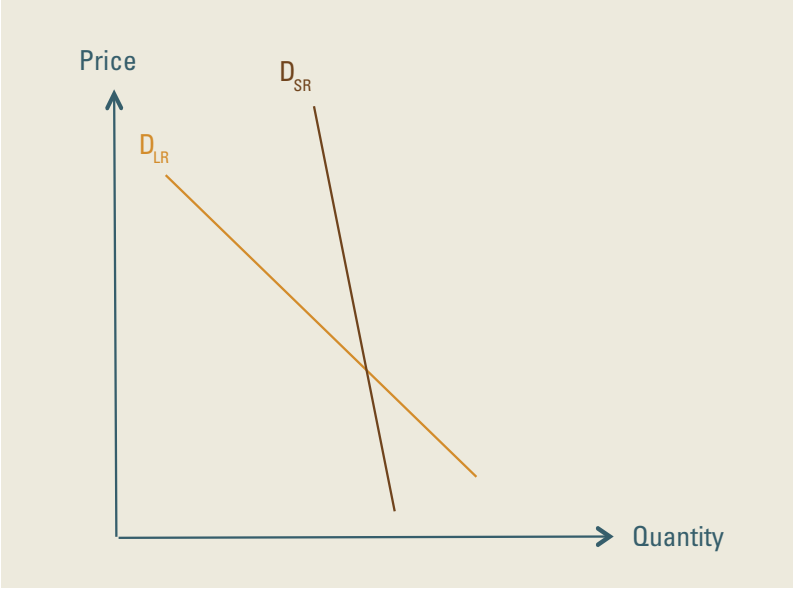
A compelling explanation for time-inconsistent elasticities of demand is habit formation.[54] Given consumption "habits", a sharp, sudden decrease in consumption of one of these goods is much more painful than a more gradual decline. As such, if there is a permanent price increase, consumers may adjust their consumption over time, rather than all at once[55]—leading to "sticky"[56] short-run consumption and greater long-run price elasticity.

In economics, "short-run" implies that at least one factor is fixed, such as wages or capital; "long run" implies that every factor is flexible—prices can fluctuate, wages can adjust, and expectations shift accordingly. In the long run then, a price increase (which reduces real purchasing power) will motivate consumers to substitute

consumption—either by replacing a more expensive product with a cheaper one, reducing or eliminating consumption entirely. Figure 3 demonstrates this concept, with D_{SR} representing short-run demand (which is less price-elastic), and D_{LR} representing long-run demand (which is more price-elastic). Comparing the slopes of the two demand curves, it is clear that a change in price will result in much greater change in own quantity demanded in the long-run versus the short-run.

Figure 3

Demand Curves Over Different Time Horizons



The empirical evidence is consistent with this theory: meta-analysis returned median point estimates of -0.40 for short run price elasticity, compared with -0.44 for long run price elasticity.[57] Chaloupka, Hu, Warner, Jacobs, and Yurekli (2000)[58] find in their survey that many academic papers estimate a long run elasticity that is double that of the short run elasticity when using an economic model of addiction. Using Canadian data, Gospodinov and Irvine (2005) find that the long run price elasticity is -0.31 for cigarettes, in contrast to their short run estimate of -0.11,[59] indicating that a 10 percent

increase in cigarette prices yields a decrease in the quantity demanded for cigarettes of 3.1 percent in the long run, versus a 1.1 percent decrease in the short run. Meanwhile, Hu and Mao (2000) use Chinese cigarette consumption data from 1980 to 1996 and find that the short run elasticity at their sample mean is -0.35, while the long run price elasticity of demand at their sample mean is -0.66.[60]

For policymakers, understanding these implications is crucial. While increasing taxes on tobacco may increase government tax revenue initially, over time, consumers will likely adjust their behavior to compensate for the increased tax burden, which may reduce or offset the initial government tax revenue increase.

iii. Method of Measuring Demand (Demand Specification)

When discussing the price elasticity of tobacco demand, it is important to understand the manner in which demand is measured, as this will characterize the specific meaning of the estimated price elasticity.

Aggregate time series data are frequently employed, such as the total quantity of cigarettes legally sold in a country. The resulting elasticity of demand is very relevant for finance officials, as it helps to predict total legal sales (and thus government tax revenues)—yet if the objective is to predict the public health impact, this measure of elasticity may be much less relevant, for instance because total sales may grow or decline as a result of demographic changes. This factor can be properly accounted for by measuring demand as per capita sales, thereby controlling for population changes. Additionally, measuring the price elasticity of demand based on legal sales can be misleading in that declines in legal cigarette consumption do not necessarily imply a reduction (or cessation) in smoking, but could actually be due to substitution with other legal or illicit products.

An estimated price elasticity of -0.5, for example, indicates that a 10 percent price increase reduces average per capita sales by 5 percent, but it does not reveal whether this is due to a 5 percent reduction in the *number* of smokers, or a 5 percent reduction in the *amount smoked,* with the absolute number of smokers remaining constant. From a public health point of view, these outcomes are not likely to be equally preferable. Furthermore, this type of measure also fails

to account for illicit, cross-border, and duty-free cigarette sales—as well as non-cigarette tobacco sales—all of which influence measurements for price elasticity of demand.[61] To measure the price elasticity of consumption, all of these other forms of tobacco consumption need to be included in the demand equation.[62]

Many other studies instead are based on data collected at the individual or household level, e.g., based on interviews or surveys. Assuming consumers accurately disclose their smoking habits, micro-level data allow us to distinguish between a shift in smoking prevalence (percentage of people smoking) versus smoking intensity (daily number of cigarettes consumed), as well as capturing any relevant substitution effects. The caveat to this, however, is that micro-data are much more difficult and expensive to obtain, and can be less reliable, as they rely on honest and accurate reporting by individual participants.

Meta-analysis of individual microeconomic panel data (data gathered over time and across geographical locations) yield more inelastic estimates for price elasticity of cigarette demand,[63] consistent with the increased substitution of non-taxed (illicit or illegal) tobacco products discussed previously. More generally, the same meta-analysis reported mean price elasticity of demand of -0.48, but with a rather large standard deviation (0.43). As would be expected, the range of estimates is similarly large, varying between -3.12 and 1.41—suggesting variation in price elasticity of demand is not only large, but country-dependent as well. This reinforces the idea that supposed outliers are likely not outliers at all, and considerable attention should be given to obtaining precise estimates for individual countries, rather than using the oft-cited estimate of -0.4.

In addition to the manner in which the data were gathered, modeling also plays a role in the variation of elasticity estimates. The "almost ideal demand system" allows the price elasticity of tobacco demand to be estimated in a way which accounts for consumers changing their preferences and habits over time,[64] which tends to produce more elastic estimates for price elasticity of cigarette demand.[65] The almost ideal demand system helps account for consumers who stop smoking following an excise tax increase, but may not follow through with that decision over time.

For policymakers, understanding how demand is measured is thus vital in order to interpret the precise meaning of the price elasticity. Four separate price elasticity measurements should be considered: the elasticity of aggregate tax-paid demand (to estimate the impact of tax and price changes on tax revenues), the elasticity of aggregate consumption (to estimate the impact on illicit trade and cross-border sales), and the elasticity of both smoking prevalence and smoking intensity (to understand the impact of tax and price changes on individual smoking behavior). Based on our research, we are not aware of any country having in place a systematic survey to measure all relevant elasticities and how they evolve over time, even though these are fundamental parameters to establish a well-founded tax policy for public health and tax revenue purposes.

iv. Availability of Close Substitutes

As with any good, the presence of close substitutes will increase the price elasticity of demand for tobacco. The intuition behind this is simple: if there are two easily-interchangeable goods (A and B), and if A becomes more expensive relative to B (due to higher taxes being imposed on good A, but not good B, for example), then consumers are incentivized to switch from good A to good B. This isn't a purely theoretical exercise—depending on consumer preferences, if cigarettes and cigarillos are subject to different tax rates, efforts to reduce the incidence of tobacco consumption by targeting only one of these products may be much less effective than anticipated. The more substitutes there are for cigarettes, the more elastic the demand for cigarettes will be, as consumers switch to alternative products rather than reducing tobacco consumption.

The following table illustrates how the price elasticity varies both with the level of prices (the "income effect", or "affordability")[66] as well as with the availability of substitutes. As explained by footnote 66, higher values of PRI indicate reduced affordability. As observed in Table 6, countries that face relatively elastic price demand for tax paid cigarettes (i.e., the UK and Ireland), tend to have reduced cigarette affordability, and either a large share of other tobacco products consumed (UK) or a large share of non-domestic consumption (Ireland).

Table 6

Price Elasticity in Select Countries, in Relation to Affordability and the Availability of Substitutes

Country	Price Elasticity of Tax Paid Cigarettes Demand	Affordability of Tax Paid Cigarettes	Share of Non-Domestic Product (%)		Share of Other Tobacco Products (%)
			Legal	Illicit	
Japan	-0.26	1.2 %	0 %		0 %
Singapore	-0.58	1.9 %	25.6 %		5.2 %
France	-0.74	1.9 %	5.3 %	15.8 %	19.0 %
UK	-1.05	3.1 %	2.7 %	10.1 %	15.5 %
Ireland	-3.6	2.6 %	9.9 %	17.8 %	6.1 %

**Source: Source: Price elasticity estimates for Japan, Singapore, and France are PMI estimates, based on latest available data. Price elasticity estimate for the UK is from the 2010 HMRC report, "Econometric Analysis of Cigarette Consumption in the UK". Price elasticity estimate for Ireland is from the 2011 MoF report, "Economics of Tobacco: Modelling the Market for Cigarettes in Ireland". Illicit trade estimates are from the 2013 KPMG report, "Project Star: 2012 Results".*

Interestingly, alcoholic beverages have been shown to have some substitutability with tobacco products—the price elasticity for cigarettes is larger (more elastic) when cigarette demand is estimated jointly with alcohol demand.[67] This particular topic will be further discussed in Subsection B, which details the cross-price elasticity of demand relationship between tobacco products.

6. THE CHALLENGES OF ACCURATELY ESTIMATING THE PRICE ELASTICITY OF TOBACCO DEMAND

One challenge in estimating the price elasticity of tobacco demand relates to parameter identification and simultaneity when using aggregated data:[68] price and quantity data, typically assumed to reflect movement along the demand curve (Figure 4), may be indicative of simultaneous movement of both the supply and demand curves instead (Figure 5).

Figure 4

Price Elasticity of Demand - Identification Problem 1

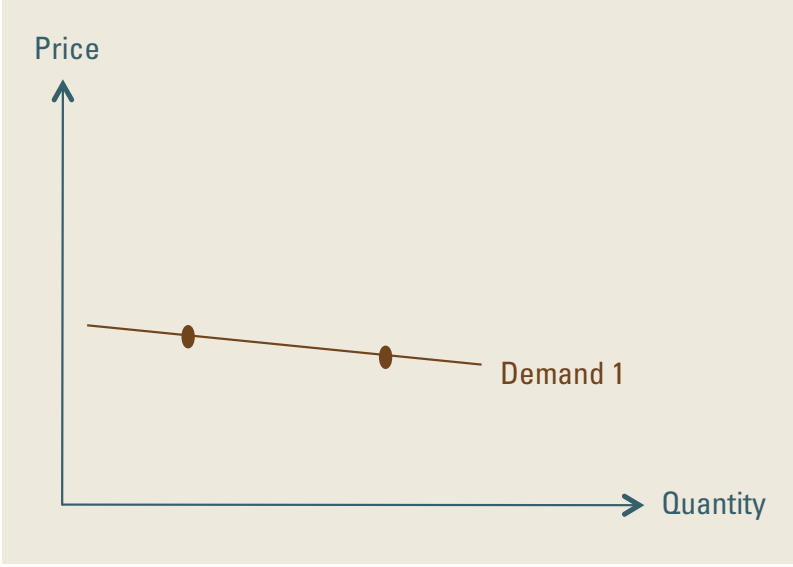
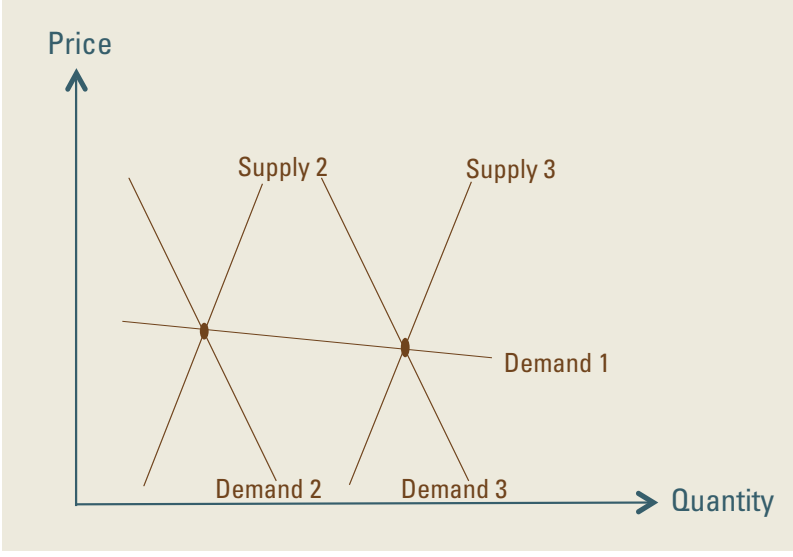


Figure 5

Price Elasticity of Demand - Identification Problem 2



In Figure 4, the two points that are depicted represent two points obtained from price and quantity data, which are then connected to form a possible demand curve. In the literature surrounding the price elasticity of tobacco demand, Figure 4 depicts the price elasticity of demand—i.e., mapping demand by connecting two points of data. However, as Figure 5 displays, Figure 4 is not the only potential outcome—if the data points gathered are not actually obtained from demand curve 1, but instead from demand curve 2 and 3,[69] then the price elasticity of demand estimates will be greatly inaccurate. Ignoring this identification problem can lead to biased estimates for the price elasticity of demand, which, in turn, can lead to faulty policy recommendations.

Correcting for simultaneity is quite difficult, however. In fact, in many cases, the solutions can result in the same problems as the simultaneity, mainly by biasing the estimates, especially when analyzing across different countries.[70] An alternate approach is to implement an instrumental variable (IV) in lieu of the price,[71] such as cigarette taxes. However, if there is very little variability in the data, this methodology will not provide reasonable estimates—and, even with a high level of variability, such variation must stem from otherwise homogenous products to be useful to IV estimation e.g., if price variation is due to underlying product differences, such as length, production size, type, or quality, IV estimation will not be effective.

Despite these shortcomings, some U.S. studies have implemented econometric techniques to improve the simultaneity bias of estimated price elasticities of demand. Interestingly, after correcting for the simultaneity bias, the price elasticity of cigarette demand was found to be as elastic as -0.71 when using U.S. data from 1955 to 1990—much higher than the often quoted price elasticity estimate of -0.4 for developed countries.[72] In a more recent study using U.S. data from 1961 to 2002, the price elasticities of cigarette demand prior to and following a correction for simultaneity was -0.21 and -0.41, respectively.[73]

B. Cross-Price Elasticity of Demand

Consumption decisions aren't made in a vacuum—in addition to being influenced by the price of the specific good under consideration, the relative price of potential substitute goods factor in as well. For policymakers, it is important to consider the potential impact of shifts in tobacco price on the consumption of other goods, and vice-versa.

1. ECONOMIC EXPLANATION OF THE CROSS-PRICE ELASTICITY OF DEMAND

The change in the quantity demanded for a product not only depends on price and income, but can also depend on the change in the price of another good. Mathematically:

$$Cross-Price\ Elasticity\ of\ Demand = \frac{Percent\ change\ in\ quantity\ demanded\ of\ product\ A}{Percent\ change\ in\ price\ of\ product\ B}$$

$$Cross-Price\ Elasticity\ of\ Demand = \frac{(P_{b1}+P_{b2})}{(Q_{a1}+Q_{a2})} * \frac{(\Delta Q_a)}{(\Delta P_b)} = \frac{\partial Q_a}{\partial P_b} * \frac{P_b}{Q_a}$$

The cross-elasticity of demand measures this concept by calculating the percentage change in quantity demand of good A, given a percentage change in the price of good B.

If the increase in the price of good B is associated with an increase in demand for good A, then the two goods are considered substitutes—and the cross price elasticity of demand will be positive. For example, if consumers find that Pepsi-Cola and Coca-Cola products are substitutable, then an increase in the price of Pepsi-Cola, keeping everything else unchanged, will result in an increase in the quantity demanded for Coca-Cola. This essentially implies that as the price of one good increases, consumers are more likely to substitute the cheaper alternative good for the relatively more expensive good. The more willing consumers are to substitute between two goods, the larger the cross-price elasticity between the two products.

Conversely, if an increase in the price of good A is associated with a reduction in demand for good B, then the cross price elasticity of demand will be negative. Goods that display this sort of relationship are considered complementary goods, such as hot dogs and mustard, or tea and sugar. If the price of hot dogs increases, we would expect a decrease in the demand for mustard, as the two goods are frequently consumed together.

Lastly, if the cross-elasticity of demand is zero, then the two goods are considered completely independent of each other. For example, we would not expect that an increase in the price of tea (good A) would have an immediate impact on the quantity demanded for sneakers (good B), or vice versa. Broad estimates for cross-price elasticities tend to be a bit tricky, however: when income is held constant, there will tend to be a bias toward positive estimates for the cross price elasticity of demand, due to the substitution effect (as a specific product becomes more expensive, alternate forms of consumption are preferred). Conversely, when relative prices are held constant, negative estimates of cross-price elasticity are more common, due to the income effect (as income increases, consumption increases for all goods). In the short run, incomes are typically assumed to be stationary—and, accordingly, for a price increase in a price inelastic product, individuals will tend to change their consumption patterns for all goods and services in order to offset the increased expenditure for the inelastic products.

2. APPLICATION OF THE CROSS-PRICE ELASTICITY OF DEMAND TO TOBACCO PRODUCTS

As prices increase for one type of tobacco, we would expect demand for other forms of tobacco to increase proportionately, as different types of tobacco products are generally considered substitutes and have positive cross price elasticities of demand. Unfortunately, relative to the price elasticity of demand, there is far less analysis in the economics literature on the cross-price elasticity of demand for different tobacco products,[74] yet there is some evidence that estimates are positive and statistically significantly different from zero, at least when using U.S. data.[75] In fact, cigars[76] and other forms of smoking tobacco have a positive estimate for the cross elasticity of demand with cigarettes in both the short and long run, suggesting that cigars and cigarettes are substitutes. However, as Table 7

indicates, Da Pra and Arnade's results find that cigarettes and chewing tobacco are complementary goods in both the short and long run. (Estimates highlighted in dark blue indicate a complementary relationship, while estimates highlighted in light blue indicate that the two goods are substitutes.)[77]

Table 7

Cross-Price Elasticities of Demand for Various Tobacco Products Using U.S. Data[78]

	Cigarettes	Cigars	Chewing Tobacco	Smoking Tobacco
Short Run				
Cigarette Price	-1	0.4	-0.4	1.8
Cigar Price	0.01	-0.5	-0.5	-1.2
Chewing Tobacco Price	-0.02	-0.7	0.1	-1.1
Smoking Tobacco Price	0.01	-0.2	-0.1	-0.6
Long Run				
Cigarette Price	-1.02	0.98	-0.32	1.6
Cigar Price	0.1	0.12	-0.33	-1.06
Chewing Tobacco Price	-0.16	-1.58	-0.21	-0.98
Smoking Tobacco Price	0.08	-0.54	-0.11	-0.61

In a more recent study using data from New Zealand, roll-your-own tobacco was frequently substituted for cigarettes over the period 1991 to 2011.[79] The results indicate that a 1 percent increase in the price of manufactured cigarettes corresponds to a 0.87 percent increase in the demand for roll-your-own products.[80] Additionally, pipe and hand-rolling tobacco are both substitutes to cigarettes in Finland—a 10 percent increase in real cigarette prices will increase pipe and hand-rolling consumption by 17.3 percent.[81] Interestingly, a study using UK data found that a 10 percent increase in the price of duty-paid cigarettes increased the total demand for smuggled tobacco by 4.5 percent to 15 percent, depending on the model specification.[82]

In a study analyzing price differentials and ratios in the Netherlands from 1985 to 1995, the authors found the following: (1) that a 10 percent increase in the price difference between manufactured

cigarettes and hand rolled cigarettes decreased manufactured cigarette consumption by 6 percent; and, (2) for every 10 percent decrease in the ratio between manufactured and hand rolled cigarette prices,[83] hand rolled cigarette consumption fell by -10.3 percent.[84] These results from the Netherlands imply that the prices of hand rolled cigarettes must be kept on par with manufactured cigarettes in order to prevent substitution.

It is important to analyze the cross elasticity of demand across different countries; consumers in different regions may be more or less likely to substitute cigarettes with other forms of tobacco. If different forms of tobacco are highly substitutable (i.e., they have cross-elasticity of demand that is large and positive), specifically-targeted policy measured may be less effective than anticipated.

3. APPLICATION OF THE CROSS-PRICE ELASTICITY OF DEMAND BETWEEN TOBACCO PRODUCTS AND ALCOHOL PRODUCTS

In addition to the cross elasticity of demand for different tobacco products, it is natural to also consider the cross elasticity of demand between tobacco and alcohol, as they may be consumed together (complementary goods), or in place of each other (substitute goods). We are interested in analyzing the effect on alcohol demand given increasing tobacco prices, as well as the effect on tobacco demand from increasing alcohol prices. Such analysis is especially important fiscally in countries that also legislate excise taxes on alcohol purchases.

Using Canadian data, an increase in cigarette prices was found to have a negative effect on beer consumption, with a cross price elasticity of -0.10[85]—indicating the two goods are complementary.[86] Using data from Sweden, the cross-price elasticity for the two goods was estimated at 0.79, suggesting that in this country, cigarettes and alcohol are substitutes, rather than complements (as a reminder, a cross-price elasticity of 0.79 indicates a 1 percentage increase in tobacco prices will yield a 0.79 percent increase in alcohol consumption).[87] A change in tobacco consumption in response to an increase in the price of alcohol was considered as well, and, interestingly, the estimate for cross-price elasticity came in at -0.31. This suggests that, if the goal for policymakers is to reduce tobacco consumption, it could be effective to increase alcohol taxes as well.

Table 8

Cross-Price Elasticities Estimates for Alcohol and Tobacco

Countries/ Authors	Data/Year	Cross-Price Elasticity (Alcohol Response to Price Change in Tobacco)	Cross-Price Elasticity (Tobacco Response to Price Change in Alcohol)
Canada Gruber, Sen, Stabile (2003)	Canadian Survey of Family Expenditure quartile data 1982-1998	-0.1	NA
Italy Pierani, Tiezzi (2009)	Time series data 1960-2002	-0.18	-0.39
Spain Jimenez, Labeaga (1994)	Cross section of individual data Spanish Family Expenditure Survey 1980-1981	NA	-0.78
Sweden Bask, Melkersson (2004)	Aggregate annual time series 1955-1999	0.79	-0.31
UK Jones (1989)	Aggregate quarterly data 1964-1983	-0.46	-0.46
U.S. Goel, Morey (1995)	Pooled data 1959-1982	0.33	0.1
U.S. Decker, Schwartz (2000)	Individual data 1985-1993 from Behavior Risk Factor Surveillance System	0.5	-0.14

The results summarized in Table 8 demonstrate the internationally inconsistent relationship between tobacco and alcohol, indicating the need for careful consideration when determining tax levels on a country by country basis. In both the U.S. and Sweden, the data indicate tobacco and alcohol tend to be viewed as substitutes, in which case policymakers should consider increasing taxes on both products if they wish to reduce overall consumption of both goods. In Canada, Italy, and the UK, the two are complementary goods instead, which means that increasing the tax of one product can be a way to reduce consumption for

both. This highlights the need for country specific measurement of cross-price elasticities as well as country specific tax policy decisions to reflect these differences in market realities between countries.

C. Income Elasticity of Demand

Income elasticity of demand—the change in consumption resulting from a change in income—is another relevant factor for policymakers to consider. This section addresses both the basic economic theory underlying this concept, as well as its application to tobacco products.

1. ECONOMIC EXPLANATION OF THE INCOME ELASTICITY OF DEMAND

Income elasticity of demand describes the percentage change in demand resulting from a percentage change in income.

$$Income\ Elasticity\ of\ Demand = \frac{Percent\ change\ in\ demand}{Percent\ change\ in\ income}$$

$$Income\ Elasticity\ of\ Demand = \frac{(Y_1 + Y_2)}{(Q_1 + Q_2)} * \frac{(\Delta Q)}{(\Delta Y)} = \frac{\partial Q}{\partial Y} * \frac{Y}{Q}$$

Importantly, we are most interested in relative (rather than absolute) income—e.g., if a consumer's income doubles, but so do the prices on all of his consumption goods, the consumer is no better or worse off than before. If, however, prices increase—either for all goods, or even just one[88]—without a corresponding increase in income, the consumer is worse off than before—the same as if he or she had income dropped while prices remained constant. Similar to the price elasticity of demand, if a 1 percent increase in income yields a 2 percent increase in demand for a product, then the income elasticity of demand is 2.

A positive income elasticity of demand indicates that the product is a so-called "normal" good, demand increases in response to income increasing, whereas a negative income elasticity of demand indicates the product is a so-called "inferior" good, demand decreases in re-

sponse to income increasing. If the income elasticity of demand is positive, there are several different potential classifications of goods, dependent on their specific value, refer to Table 9. Goods with income elasticities greater than 1 are "luxury" goods, as their demand increases proportionately more than the percentage change in income. Conversely, goods with income elasticity between 0 and 1 are "necessities", as the percentage change in quantity demanded is positive, but proportionately smaller than the change in income. Lastly, goods with income elasticity of 0 are "sticky", as the quantity demanded is rigid and independent from income.

Table 9

Income Elasticity of Demand

Sign of Income Elasticity of Demand Estimate	Value of Income Elasticity of Demand Estimate	Direction of Percentage Change in Quantity Demanded (Given a Positive Percentage Change in Income)	Size of Percentage Change in Quantity Demanded Relative to Percentage Change in Income	Type of Good	Example of Goods
Positive	Greater than 1	An Increase	Proportionately Larger	Luxury (Normal)	Private Jets, Yachts, Jewelry
Positive	1	An Increase	Equal	Unitary (Normal)	No concrete example
Positive	Between 0 and 1	An Increase	Proportionately Smaller	Necessity (Normal)	Basic Food, Clothing
Zero	0	No Change	Not Applicable	Sticky	Salt
Negative	Less than 0	A Decrease	Not Applicable	Inferior	Margarine, Public Transportation, Canned Soup, Fast Food

Similar to price elasticity, income elasticity of demand is likewise non-constant over a range of income levels. For example, a bicycle might be a normal good for one person (middle income brackets), a luxury good for another person (lower income brackets), and finally, an inferior good for a third person (higher income brackets).

Furthermore, if consumer preferences shift over time, the income elasticity of demand for any affected product will shift as well. For example, while tobacco was once considered a luxury good, shifting attitudes towards to-

bacco have led to similar shifts in its income elasticity.

2. APPLICATION OF THE INCOME ELASTICITY OF DEMAND TO TOBACCO PRODUCTS

Unlike the price elasticity of demand for tobacco products (which is generally considered inelastic), the estimates for the income elasticity of demand for tobacco products vary.

Although the mean estimate for the income elasticity of demand for cigarettes is 0.42 i.e., a normal, necessity good, it varies from -0.80 (an inferior good) to 3.03 (a luxury good), depending on the country.[89,90] Furthermore, the income elasticity of demand for cigarettes tends to be between 0.13 to 0.19 lower for short run estimates relative to long run estimates, indicating that income elasticity changes over different time horizons i.e., consumption habits are more flexible in the long run, as discussed previously.

Income elasticity of demand has been estimated at 1.25 in Canada,[91] indicating tobacco is a luxury good—however, in the U.K., income elasticity was estimated at 0.3,[92] indicating tobacco is viewed as a necessity good.

In addition to this evidence that the income elasticity depends on the geography, there is also evidence that income elasticities evolve over time within a country. In the U.S., between 1944 and 2004, tobacco went from being a normal to an inferior good[93]—and further research indicates this transition took place sometime between the 1970s and 1980s.[94]

It is also likely that the income elasticity of demand is different for different tobacco products. A fine cigar would be expected to be a luxury good, whereas fine-cut tobacco to hand-roll cigarettes is more likely a necessity normal good or perhaps an inferior good. In New Zealand, the evidence suggests that hand-roll tobacco is an inferior good, at least over the period of 1991 to 2011—a 1 percent increase in average weekly income corresponds to a 0.8 percent decline in hand-roll tobacco demand.[95] Similarly, the

income elasticity of pipe and hand-rolling tobacco demand in Finland ranges from -0.836 to -1.257 over the period from 1960 to 2002; in the Netherlands, this estimate ranges from -0.485 to -0.690 over the period of 1980 to 2009—both countries' results vary based on the model specification and indicate that pipe and hand-roll tobacco are inferior products.[96]

Policymakers should be aware of the income elasticity of demand in their country when formulating their tax policy. Even in countries where tobacco consumption is income-inelastic i.e., a normal, necessity good, declines in income imply a decline in tobacco demand. During economic recessions and periods of high unemployment—when incomes are under pressure—one should expect declines in tobacco demand which will negatively impact government excise tax revenues. In fact, Spain experienced this during the most recent financial crisis, particularly from 2009 to 2012 as Table 10 demonstrates. Over this period, real GDP growth[97] contracted annually (less 2011),[98] while the release for consumption of cigarettes declined by -32 percent over these four years.[99] As such, government excise tax revenues from cigarettes began to slow down, until 2011, when they actually contracted from the previous year and continued to do so in 2012.[100] From 2009 to 2012, government excise tax revenues fell by -5.7 percent.

Table 10

Spain's GDP, Cigarette Government Excise Tax Revenue, and Consumption—In Euros

Year	Cigarette Excise Tax Revenue (in millions)	Cigarette Excise Tax Revenue (% Change from Previous Year)	Release for Consumption of Cigarettes (in 1000 pieces)	Release for Consumption of Cigarettes (% Change from Previous Year)	GDP (Annual % Growth Rate, Constant)	Inflation (Annual % Change)
2002	5,144.87	-	88,600,500	-	2.7	3.06
2003	5,537.12	7.62	93,711,449	5.77	3.1	3.04
2004	5,836.32	5.40	95,305,513	1.70	3.3	3.04
2005	6,150.76	5.39	92,699,536	-2.73	3.6	3.37
2006	6,414.59	4.29	90,097,578	-2.81	4.1	3.52
2007	7,169.73	11.77	89,102,765	-1.10	3.5	2.78
2008	7,371.30	2.81	90,288,827	1.33	0.9	4.08
2009	7,452.83	1.11	81,356,510	-9.89	-3.8	-0.29
2010	7,681.34	3.07	72,430,751	-10.97	-0.2	1.80
2011	7,390.57	-3.79	60,260,720	-16.80	0.1	3.20
2012	7,027.65	-4.91	55,065,569	-8.62	-1.6	2.45

Alternatively, if the income elasticity of tobacco demand is negative, wealthier individuals are expected to consume fewer tobacco products compared to poorer individuals, and both groups would consume less as their incomes increase. Conversely, when the income elasticity of tobacco demand is above 1 (i.e., tobacco is a luxury good), then wealthier individuals will not only consume more tobacco products relative to poorer individuals, they will also have a higher share of income that is spent on tobacco.[101] Generally speaking, in countries where the income elasticity is positive, growth in tobacco consumption and incomes are positively correlated. From a public health perspective, linking tobacco taxes to income growth could provide reductions in tobacco consumption in such cases.

Clearly, the data indicate that it is not possible to make global generalizations with regard to the income elasticity of tobacco products (Table 11)—instead, income elasticity should be assessed on a country-by-country basis, to best determine optimal tobacco tax policy within each country.

Table 11

Estimates of the Income Elasticities for Tobacco Demand

Countries	Authors	Data/Year	Income Elasticity Tobacco
High Income Countries	Sayginsoy, Yurekli (2010)	Time series data, multiple periods collected from multiple sources	0.37
High Income Countries	Gallet, List (2003)	Meta-analysis	-0.80 to 3.03, mean at 0.42
China	Gale, Huang (2007)	2002 - 2003	0.36 to 1.03
Canada	Gospodinov, Irvine (2005)	Quarterly 1972Q1-2000Q4	1.25 (long run)
Europe	Townsend (1988)	1986-1988	0.5
Italy	Gallus et al. (2003)	1970 - 2000	0.1
Spain	Fernandez et al. (2004)	1965 - 2000	0.42
U.K.	Andrews, Franke (1991)	Meta-analysis	0.4
U.K.	Duffy (2006)	Quarterly aggregate time series data 1964Q2-2002Q3	0.3
U.S.	Hamilton (1972)	Cross section 1954 and 1965	0.726 to 0.821
U.S.	Andrews, Franke (1991)	Meta-analysis	0.5
U.S.	Cheng and Kenkel (2010)	Cross sectional time series 1944 to 2004	-0.286 to -0.047

III. GOVERNMENT REVENUE OBJECTIVES

A. Ramsey Rule

Around the world, excise taxes on products such as alcohol, petrol, and tobacco are an important source of revenue, with excises in OECD countries representing typically between 2.72 percent and 18.31 percent of total government revenues as of 2012 see Table 12.[102] The ease and perceived low cost of excise tax collection for the state has always been a practical advantage of selecting these products for revenue purposes,[103] certainly compared to direct taxes (such as income tax)—these products were taxed long before public health or environmental concerns played a role in tax policy formulation.

Table 12

Excise Tax Revenue as a Percentage of Total Tax Revenue (in percent by year)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Australia	9.21	9.40	9.07	8.50	8.19	7.64	7.36	6.97	7.42	7.60	7.42	6.74	
Austria	5.98	5.84	6.06	6.24	6.36	6.26	5.94	5.81	5.58	5.62	5.65	5.79	5.59
Belgium	5.05	4.86	4.93	5.11	5.29	5.28	4.93	4.83	4.57	4.85	4.92	4.71	4.55
Canada	4.72	4.93	5.42	5.52	5.34	4.94	4.62	4.44	4.45	4.65	4.73	4.46	4.31
Chile	10.33	10.72	10.49	9.98	8.62	7.76	6.26	6.31	5.93	7.52	7.20	6.80	6.96
Czech Republic	9.25	9.19	8.90	9.11	9.35	9.83	10.03	10.16	10.11	10.81	10.75	11.21	11.16
Denmark	10.36	10.41	10.69	10.27	10.11	9.67	9.73	9.51	8.86	8.31	8.60	8.65	8.57
Estonia	9.59	10.83	10.45	10.05	11.88	11.99	11.10	11.42	10.38	14.12	12.66	13.59	13.97
Finland	8.99	9.10	9.31	9.66	9.03	8.63	8.40	7.79	7.73	7.97	8.27	8.88	8.85
France	6.19	5.98	6.35	6.15	6.02	5.67	5.53	5.31	5.26	5.56	5.50	5.48	5.39
Germany	7.46	8.07	8.51	8.95	8.62	8.37	7.96	7.28	7.04	7.18	7.03	6.88	6.47
Greece	9.00	9.42	8.71	8.71	8.48	8.19	7.90	7.93	7.20	8.45	10.56	11.76	
Hungary	10.38	9.83	9.77	9.93	9.80	9.70	10.25	9.62	9.42	9.51	9.19	9.29	9.37
Iceland	9.27	7.85	8.50	9.07	8.84	9.19	9.00	8.63	7.43	7.87	8.65	8.57	8.57
Ireland	13.49	12.17	12.48	11.78	11.24	10.87	10.00	10.09	10.49	10.70	10.35	10.14	
Israel	3.52	3.47	3.96	4.32	4.39	4.49	4.64	4.55	5.15	5.61	5.86	5.60	5.60
Italy	6.26	5.96	5.70	5.87	5.60	5.56	5.31	4.90	4.58	4.92	4.86	4.97	5.43
Japan	7.23	7.24	7.46	7.63	7.40	6.94	6.65	6.41	6.23	6.67	6.51	6.44	
Korea	13.32	15.09	13.44	13.03	12.74	12.00	10.98	10.78	10.41	9.32	10.66	7.94	8.33
Luxembourg	12.03	10.95	11.60	11.82	12.95	11.79	11.11	10.50	10.31	9.75	9.40	9.50	9.12
Mexico	8.49	10.58	12.61	9.33	6.17	3.32	2.24	2.35	2.38	3.37	3.50	3.34	
Netherlands	8.29	8.46	8.21	8.35	8.65	8.52	8.55	7.97	8.00	8.13	8.02	7.85	
New Zealand	5.40	5.49	5.33	4.79	4.21	3.88	2.74	2.54	2.63	2.84	2.85	2.77	2.72
Norway	8.69	8.25	8.35	8.41	8.06	7.41	7.10	7.18	6.62	7.17	7.04	6.58	6.30
Poland	11.15	11.39	11.97	12.61	13.16	12.71	11.85	11.99	12.98	11.94	13.26	12.77	
Portugal	11.46	12.14	12.40	12.33	12.66	12.14	12.08	10.80	10.05	10.28	10.50	9.52	8.89
Slovak Republic	9.14	8.22	8.87	9.44	10.48	11.62	9.81	11.99	9.18	9.65	10.36	10.07	9.70
Slovenia	8.39	9.28	9.33	9.19	9.35	9.03	8.98	9.18	9.55	11.46	11.49	11.56	12.40
Spain	7.51	7.24	7.19	7.18	6.87	6.39	5.94	5.83	6.26	6.79	6.62	6.41	6.24
Sweden	6.03	6.34	6.71	6.62	6.31	6.10	5.84	5.73	5.80	6.17	6.04	5.80	5.69
Switzerland	5.48	5.52	5.13	5.41	5.54	5.37	5.22	4.84	5.09	4.94	5.13	4.78	4.63
Turkey	11.72	11.16	16.04	19.16	19.64	21.17	19.85	19.26	18.17	18.59	19.90	17.77	18.31
UK	10.50	9.92	10.06	9.72	9.41	8.78	8.14	8.01	8.07	9.16	8.89	8.52	8.61
U.S.	3.72	3.86	4.23	4.25	4.07	3.86	3.70	3.52	3.55	4.20	4.06	3.94	3.91

Although practicality may have been an initial incentive for the introduction of excise taxes, economic theories were eventually developed that provided additional justification, with the Ramsey Rule, arguing that, for inelastic products, the government could impose a relatively

high tax rate without being a source of market distortion (creating an inefficient allocation of resources). Unfortunately, however, increasing taxes on inelastic goods still distorts consumer choice—although the quantity demanded for the inelastic good is relatively stable in response to price increases, consumers will reduce their consumption of other goods as a result of lower relative income. This also has fiscal implications: increasing the tax on one good may increase the own tax revenue for that good, but the tax revenue for other goods may decline as a result, as the consumption of these goods will have also declined. This illustrates one of the main limitations of implementing the Ramsey Rule in practice.

A further point to be made about the Ramsey Rule is that it assumes the product tax is independent of the factors of production—that is, that a consumption tax only impacts consumers, not producers. However, as a shift in consumption works its way through the economy, it leads to a price change for these other goods, which shifts the price of factors of production, which shifts the supply and demand curves. If, for example, a tax increase leads to a decline in quantity demanded (which requires a shift in the supply curve to maintain equilibrium), the firm's revenues decline—causing the firm to lower costs, typically in the form of wages. Consequently, a product tax may act indirectly as a factor tax; with respect to tobacco (as these products are generally inelastic), excise taxation often acts as factor taxes in other industries, as consumers reduce their consumption of alternative goods and services.

A third issue stems from the large number of inelastic goods—which are the best candidates for excise taxation? Price elasticity of demand for gasoline is estimated to be between -0.33 and -0.47,[104] and the median price elasticity of demand for alcohol -0.535, with beer even less price sensitive than other alcoholic beverages, see Table 13 on the following page.[105] Eggs, cereals, and dairy have price elasticities of demand of -0.27, -0.60, and -0.65, respectively[106]—should each of these be subject to excise taxation as well? Given the broad range of goods that appear to have low price elasticity of demand estimates, the Ramsey Rule fails to provide a practicable indication of which goods should be subject to excise taxation and which ones should not. As Cnossen notes: "*the price elasticity of tobacco demand is not so low that significantly higher-than-average tax rates are warranted on inverse elasticity grounds.*"[107]

Table 13

Price Elasticities Estimates for Food, Beverage, and Oil Demand

Product Category	Mean Price Elasticity			
	U.S.[108]	U.K.[109]	China[110]	India[111]
Food away from home	-0.81 (-0.23 to -1.76)	-	-	-
Soft drinks	-0.79 (-0.13 to -3.18)	-0.37 (-0.06 to -1.28)	-	-
Isotonic, sport drinks	-2.44 (-1.01 to -3.87)	-	-	-
Juice	-0.76 (-0.33 to -1.77)	-	-	-
Beef	-0.75 (-0.29 to -1.42)	-0.69 (-0.43 to -0.96)	-0.38 -	
Pork	-0.72 (-0.17 to -1.23)	-	-1.125 (-1.59 to -0.66)	
Fruit	-0.7 (-0.16 to -3.02)	-0.29 (-0.10 to -0.48)	-0.91 (-0.94 to -0.88)	-0.917* (-0.928 to -0.893)
Poultry	-0.68 (-0.16 to -2.72)	-	-0.89 (-1.28 to -0.5)	
Dairy	-0.65 (-0.19 to -1.16)	-0.36 (-0.15 to -0.56)	- -	
Cereals	-0.6 (-0.07 to -1.67)	-0.4 (-0.20 to -0.61)	-0.265* (-0.37 to -0.16)	-0.031 (-0.309 to -0.127)
Milk	-0.59 (-0.02 to -1.68)	-	-	-1.035 (-1.076 to -0.820)
Vegetables	-0.58 (-0.21 to -1.11)	-0.66 (-0.53 to -0.79)	-0.455 (-0.48 to -0.43)	-0.917* (-0.928 to -0.893)
Fish	-0.5 (-0.05 to -1.41)	-0.8 (-0.49 to -1.10)	-0.51 (-0.67 to -0.35)	-0.82* (-0.908 to -0.779)
Fats/oils	-0.48 (-0.14 to -1.00)	-0.75 (-0.53 to -0.98)	-0.495 (-0.58 to -0.41)	-0.377 (-0.476 to -0.332)
Cheese	-0.44 (-0.01 to -1.95)	-0.35 (-0.10 to -0.60)	-	-
Sweets/sugar	-0.34 (-0.05 to -1.00)	-0.79 (-0.53 to -1.05)	-	-0.010 (-0.083 to -0.036)
Eggs	-0.27 (-0.06 to -1.28)	-0.28 (-0.56 to 0.00)	-1.36 (-1.81 to -0.91)	-0.82* (-0.908 to -0.779)
Alcohol	-0.18 to -0.86 (Short Run) -0.26 to -1.27 (Long Run)	-0.56 (Beer) -0.90 (Wine) -0.75 (Spirits)	Near 0 (Beer) -0.12 (Liquor)	-1.032 (Rural) -0.867 (Urban)
Gasoline	-0.061 (Short Run) -0.453 (Long Run)	-0.068 (Short Run) -0.182 (Long Run)	-0.35 (-0.497 to -0.196)	-0.264 (-0.319 to -0.209)

** Denotes the following for each country:*
China: Cereals elasticity estimate is based on grains
India: Fruit and Vegetables are estimated together, therefore have the same estimate. Fish and Eggs are also estimated together along with "Meat", and are estimated using a different price elasticity model.

B. Laffer Curve

The Laffer Curve illustrates the relationship between tax rates and government tax revenues, and provides an explanation for why this relationship is not always positive. At times, increases in the tax rate may actually result in a decline in government tax revenues, and, as such, the Laffer Curve is an important conceptual tool for policymakers formulating tax policies. While originally developed and popularized in the context of income tax rates, this same concept may also be applied in other areas, such as excise taxation.

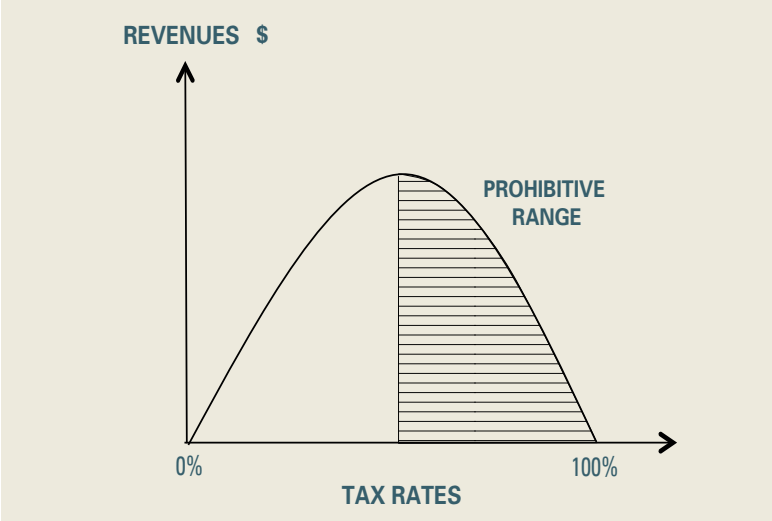
1. BASIC ECONOMIC EXPLANATION OF THE LAFFER CURVE

As discussed previously, the Laffer Curve describes the relationship between tax rates and tax revenues. Broadly speaking, changes in tax rates have two effects on revenues: arithmetic and economic. Arithmetically, if tax rates decline, tax revenues per dollar of tax base will similarly decrease. Economically, however, lower tax rates further incentivize labor, output, employment, and consumption, thereby *increasing* the tax base. Raising tax rates has the opposite economic effect by penalizing participation in the taxed activities. The arithmetic effect and economic effect are opposing forces therefore, when the two are combined, the consequences of the change in tax rates on total tax revenues are no longer quite so obvious.

Revisiting Figure 6, at a tax rate of 0 percent, the government will not collect any tax revenues, no matter the size of the tax base. Similarly, with a tax rate of 100 percent, the government is also not able to collect tax revenues since no individual would be willing to work for an after-tax wage of zero. Likewise, no cigarette manufacturer would be willing to operate if 100 percent of every sale was collected as tax revenue. Between these two extremes, there are two different scenarios that will collect the same amount of tax revenue: a high tax rate on a small tax base, and a low tax rate on a large tax base. The latter structure is more efficient, generating fewer distortions in the market.

Figure 6

The Laffer Curve

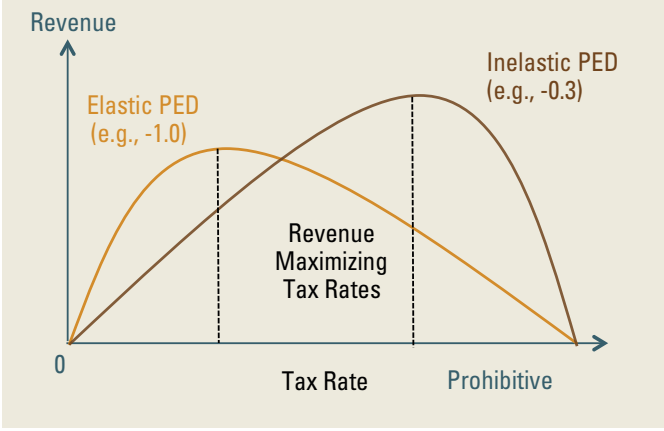


The Laffer Curve does not automatically indicate whether a reduction in tax rates will lead to an increase in tax revenues—only that it is possible for such an interaction to occur. If tax rates are past the peak on the curve in Figure 6 (i.e., in the Prohibitive Range), a tax cut will generate higher tax revenues, that is, the economic effect of the tax cut outweighs the arithmetic effect.

The price elasticity of tobacco demand will impact the shape of the Laffer Curve and revenue maximizing tax rate: if elastic, then the revenue maximizing tax rate will be lower, as consumers will be more sensitive to price increases; if inelastic, the revenue maximizing tax rate will be higher, refer to Figure 7. To further illustrate, if demand is more elastic, (the lighter curve in Figure 7) consumers will respond to price increases by decreasing their consumption much more than they would for a good with much more inelastic demand (the darker curve in Figure 7) and, as such, the revenue-maximizing tax rate will be lower for more elastic goods than it is for more inelastic goods.

Figure 7

Laffer Curves for Inelastic and Elastic Price Elasticities of Demand



Additionally, it is important to bear in mind that the tax rate at which government revenues are *maximized* (the highest point on the Laffer Curve) is not automatically the point at which tax policy is *optimized*. If, for instance, illicit trade and its impact on crime, or the regressive impact of excise taxes on lower incomes are serious concerns, these may be reasons to enact tax rates below the revenue maximizing level. Conversely, if the objective of reducing tobacco consumption for public health reasons is seen as the sole objective, tax rates may correspondingly be above the revenue maximizing point. The optimal tax rate from a revenue perspective is thus not automatically equal to the optimal tax rate from a broader policy perspective.

As discussed earlier, tax revenue responses to a tax rate change rely on a series of factors: the relative size of the tax increase, the tax system in place, the time period being considered, the ease of transitioning into illicit or illegal alternatives, the level of tax rates already in place, the prevalence of legal enforcement loopholes, and the proclivities of the productive factors.

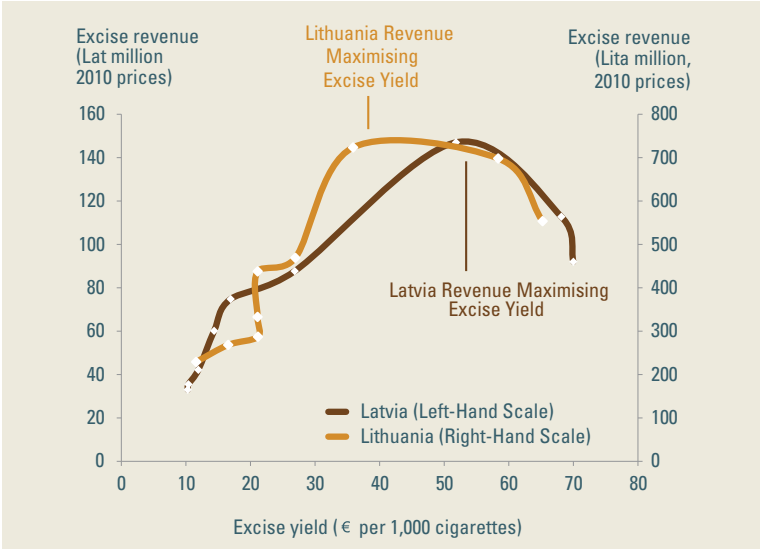
2. THE LAFFER CURVE APPLIED TO THE TAXATION OF TOBACCO

Most of the time, when tobacco tax rates are increased, tax revenues for the government increase, as well. However, there are growing examples of countries whose tax rates have entered the Prohibitive Range of the Laffer Curve. Latvia and Lithuania are two such examples, as can be seen in Figure 8 on the following page. When joining the European Union, both countries were required to increase cigarette tax levels substantially—from about €10 per 1000 cigarettes when they joined the EU, to the €60 per 1000 cigarette level as was then the EU minimum norm.[112] Initially, tax revenues increased in both countries, but eventually consumers started to shift to buy illicit product

instead and, as a result, government tax revenues started to decline. As can be seen in Figure 8, Lithuania's revenue maximizing excise yield occurs at approximately €38 per 1000 cigarettes, versus approximately €55 per 1000 cigarettes for Latvia.[113]

Figure 8

Laffer Curves for Lithuania and Latvia



Source: International Tax & Investment Center (2012), The Impact of Imposing a Global Excise Target for Cigarettes: Experience from the EU Accession Countries; Oxford Economics and Industry Data

Latvia and Lithuania both have below-average income levels when compared with the rest of the EU, and, as such, are unable to support EU level excise taxation. These results illustrate the challenge to establish regional excise tax rates, due to the international variation in economic fundamentals and, as such, determining a universal optimum for excise taxation is an impossibility.

These are not the only countries where excise revenues started to decline—it has become a more common phenomenon particularly in the EU. Over the past 10 years or since joining the EU, 25 out of the 27 EU countries have experienced yearly declines in revenue from taxes on manufactured tobacco on at least on one occasion (Table 14). Nine countries, namely: Cyprus, Denmark, Germany, Greece, Ireland, Latvia, Portugal, Sweden, and the United Kingdom experience three or more yearly declines in tobacco tax revenue based on data from the EC DG TaxUD Data. Romania and Slovenia were the only countries not to experienced a decline in revenues from tobacco. This suggests that many countries in the EU currently apply excise levels that are close to the revenue maximizing level.

Table 14

Revenue from Taxes on Manufactured Tobacco Other than VAT

in mio EUR		2002	2003	2004	2005	2006
AUSTRIA	AT	1,296.9	1,328.7	1,317.9	1,339.7	1,408.5
% ch.			2.5%	-0.8%	1.7%	5.1%
BELGIUM	BE	1,255.0	1,617.0	1,640.8	1,657.0	1,727.2
% ch.			28.8%	1.5%	1.0%	4.2%
BULGARIA	BG					
% ch.						
CYPRUS	CY			144.7	134.6	185.1
% ch.					-7.0%	37.6%
CZECH REP.	CZ			664.4	837.5	1,110.6
% ch.					26.1%	32.6%
DENMARK	DK	1,032.3	1,032.9	945.1	967.1	988.0
% ch.			0.1%	-8.5%	2.3%	2.2%
ESTONIA	EE			58.7	76.4	77.1
% ch.					30.2%	1.0%
FINLAND	FI	592.6	584.8	593.1	600.5	617.5
% ch.			-1.3%	1.4%	1.2%	2.8%
FRANCE	FR	8,629.0	8,828.0	9,244.0	9,851.0	9,437.0
% ch.			2.3%	4.7%	6.6%	-4.2%
GERMANY	DE	13,758.0	14,094.8	13,631.3	14,247.1	14,374.5
% ch.			2.4%	-3.3%	4.5%	0.9%
GREECE	GR	2,127.0	2,248.0	2,241.0	2,257.0	2,415.5
% ch.			5.7%	-0.3%	0.7%	7.0%
HUNGARY	HU			703.8	706.8	858.7
% ch.					0.4%	21.5%
IRELAND	IE	1,140.0	1,157.0	1,058.0	1,079.5	1,103.3
% ch.			1.5%	-8.6%	2.0%	2.2%
ITALY	IT	7,854.0	8,061.0	8,713.0	8,998.0	9,723.3
% ch.			2.6%	8.1%	3.3%	8.1%
LATVIA	LV			40.9	62.3	82.6
% ch.					52.3%	32.5%
LITHUANIA	LT			62.8	74.8	102.1
% ch.					19.1%	36.5%
LUXEMBOURG	LU	406.5	467.7	568.1	598.1	485.6
% ch.			15.1%	21.5%	5.3%	-18.8%
MALTA	MT			59.3	62.4	64.5
% ch.					5.1%	3.4%
NETHERLANDS	NL	1,805.1	1,848.2	2,120.4	1,866.6	2,175.0
% ch.			2.4%	14.7%	-12.0%	16.5%
POLAND	PL				2,408.3	2,909.1
% ch.						20.8%
PORTUGAL	PT	1,159.7	1,224.0	1,027.0	1,322.7	1,426.9
% ch.			5.5%	-16.1%	28.8%	7.9%
ROMANIA	RO					
% ch.						
SLOVAKIA	SK			188.8	289.6	301.9
% ch.					53.4%	4.3%
SLOVENIA	SI			226.6	247.8	291.0
% ch.					9.4%	17.4%
SPAIN	ES	5,226.0	5,621.0	5,936.0	6,267.0	6,527.1
% ch.			7.6%	5.6%	5.6%	4.1%
SWEDEN	SE	815.0	787.1	763.7	771.3	810.1
% ch.			-3.4%	-3.0%	1.0%	5.0%
UNITED KINGDOM	UK	12,958.8	12,299.1	11,477.8	11,428.2	11,666.4
% ch.			-5.1%	-6.7%	-0.4%	2.1%
Total		60,055.87	61,199.82	63,427.51	68,153.61	70,871.36

Source: EC DG TaxUD - Excise Duty Tables (Tax receipts - Manufactured tobacco)

2007	2008	2009	2010	2011	2012
1,446.2	1,424.5	1,457.6	1,502.0	1,575.0	1,620.8
2.7%	-1.5%	2.3%	3.0%	4.9%	2.9%
1,820.2	1,756.1	1,787.3	1,986.8	1,644.1	1,922.1
5.4%	-3.5%	1.8%	11.2%	-17.3%	16.9%
688.6	876.9	904.0	777.3	1,380.0	1,189.4
	27.3%	3.1%	-14.0%	77.5%	-13.8%
191.0	202.3	195.9	198.7	221.2	212.0
3.2%	5.9%	-3.1%	1.4%	11.3%	-4.2%
1,707.4	1,422.6	1,405.6	1,615.7	1,792.2	1,842.9
53.7%	-16.7%	-1.2%	14.9%	10.9%	2.8%
971.9	966.6	990.4	1,105.0	1,004.3	1,100.7
-1.6%	-0.5%	2.5%	11.6%	-9.1%	9.6%
97.5	97.2	133.4	114.7	144.5	158.2
26.3%	-0.3%	37.3%	-14.1%	26.1%	9.5%
616.6	622.3	681.6	691.1	732.6	746.8
-0.1%	0.9%	9.5%	1.4%	6.0%	1.9%
9,380.0	9,550.4	9,894.5	10,358.7	10,943.3	11,135.4
-0.6%	1.8%	3.6%	4.7%	5.6%	1.8%
14,247.6	13,513.1	13,355.7	13,477.6	14,403.7	14,130.4
-0.9%	-5.2%	-1.2%	0.9%	6.9%	-1.9%
2,581.3	2,516.2	2,566.2	2,913.0	3,044.5	2,707.0
6.9%	-2.5%	2.0%	13.5%	4.5%	-11.1%
1,011.9	1,074.7	1,137.2	925.2	1,034.9	1,105.1
17.8%	6.2%	5.8%	-18.6%	11.8%	6.8%
1,192.1	1,146.0	1,216.5	1,159.6	1,126.1	1,072.3
8.0%	-3.9%	6.1%	-4.7%	-2.9%	-4.8%
10,051.8	10,388.0	10,495.6	10,621.5	10,934.2	10,921.9
3.4%	3.3%	1.0%	1.2%	2.9%	-0.1%
106.3	205.5	160.9	129.7	149.7	149.5
28.7%	93.3%	-21.7%	-19.4%	15.5%	-0.1%
118.0	198.2	199.9	160.5	186.4	202.3
15.5%	67.9%	0.9%	-19.7%	16.2%	8.5%
500.5	517.4	478.2	488.4	524.0	538.0
3.1%	3.4%	-7.6%	2.1%	7.3%	2.7%
58.7	62.1	64.8	70.0	71.0	75.3
-9.1%	5.9%	4.4%	8.0%	1.4%	6.1%
2,202.9	2,277.8	2,318.0	2,407.0	2,525.0	2,502.0
1.3%	3.4%	1.8%	3.8%	4.9%	-0.9%
3,521.6	3,737.6	3,856.5	4,249.7	4,082.9	4,561.8
21.1%	6.1%	3.2%	10.2%	-3.9%	11.7%
1,224.7	1,295.9	1,140.0	1,428.7	1,446.7	1,353.6
-14.2%	5.8%	-12.0%	25.3%	1.3%	-6.4%
918.7	1,081.2	1,261.5	1,345.3	1,531.3	1,741.9
	17.7%	16.7%	6.6%	13.8%	13.8%
685.8	388.5	507.3	613.5	627.5	640.4
127.1%	-43.4%	30.6%	20.9%	2.3%	2.1%
300.6	342.8	362.5	391.0	429.3	442.3
3.3%	14.0%	5.8%	7.9%	9.8%	3.0%
7,301.2	7,585.9	7,641.1	8,023.2	7,849.5	7,644.6
11.9%	3.9%	0.7%	5.0%	-2.2%	-2.6%
902.2	845.9	787.2	852.0	1,008.1	1,024.5
11.4%	-6.2%	-6.9%	8.2%	18.3%	1.6%
11,952.5	11,022.5	9,134.9	10,152.6	11,049.4	11,915.2
2.5%	-7.8%	-17.1%	11.1%	8.8%	7.8%
75,800.94	75,119.89	74,135.14	77,758.96	81,463.52	82,656.75

IV. PUBLIC HEALTH OBJECTIVES

A. Pigou

An additional argument for excise taxes is that of externalities—that the price of a good may not be reflective of the full costs of its consumption. Automobiles, for example, generate pollution when operated—and these costs are inflicted on the population as a whole, not just those who drive. As such, automobiles (or better: petrol) would be a strong candidate for a "Pigouvian tax",[114] one designed to correct for the presence of any negative externalities and their associated market failures.

Unfortunately, the efficiency of the Pigouvian framework requires a perfectly competitive market, a theoretical construct rarely observed in practice, especially in relation to tobacco markets. In the presence of monopolies, oligopolies, or imperfect competition, Pigouvian taxation generates market distortion, which may result in under-production, increased prices, or reduced employment. Furthermore, government intervention via taxation may not be the most efficient system to correct for externalities,[115] and may be more appropriate as a last resort, after bargaining fails at the individual level.[116] The government can also correct for externalities by other means than a Pigouvian tax, such as by regulatory policies.

Tobacco products are typically viewed as prime candidates for a Pigouvian tax, due to the health consequences of their consumption. Net externalities generated from smoking have been estimated at $0.15 per pack of cigarettes in 1986,[117] ($0.32 in 2013 dollars), and were updated in 1995 to $0.33 ($0.49 in 2013 dollars)[118]—both of which are below the federal and state excise tax in place at the time ($0.76 in 2001, equivalent to $1.00 in 2013).[119]

Alternatively, governments can opt for a regulatory based approach. For instance, by banning smoking from public places, the external costs of secondhand smoke are reduced or eliminated as a result of this regulatory measure, taking away the need to introduce a Pigouvian tax to address this aspect. Similarly, if insurers can differentiate between smokers and non-smokers, the health care costs of tobacco

use can be accurately reflected in insurance premiums, taking away the need to address external costs through excise taxes. Of course, such a solution is not applicable in countries with socialized health care.

Based on these principles, within the U.S., there would seem to be no justification to increase the excise tax level on tobacco, as the existing tax level already exceeds the estimated external costs, and non-tax solutions to reduce consumption, such as public smoking bans and the ability of insurers to charge different rates based on smoking practice, are in effect as well.

B. Bhagwati Theorems and Unintended Consequences of Tobacco Taxation

Jagdish Bhagwati is a world renowned international trade theorist whose work on the optimization of economic policy while accounting for non-economic objectives, such as reducing consumption of certain products e.g., for health reasons, is particularly relevant for this book. Bhagwati addresses three potential policies in order to constrain consumption levels; a production or factor tax-cum-subsidy, a tariff, or a consumption tax-cum-subsidy.[120]

Since subsidies are essentially negative taxes, this book will therefore focus on taxes. A production tax is levied on firms, which causes the prices producers face to increase and as a result, the production of the taxed good will decline, causing the relative price for the taxed good to increase.[121] Production taxes generally come in the form of taxes on labor or on capital, since both increase producer prices. Social security taxes function as a labor tax, while corporate taxes and property taxes function as taxes on capital. Labor taxes vary across countries, with countries such as Afghanistan and Bangladesh imposing no labor tax (as a percentage of commercial profits using 2012 data), to countries such as Russia, Italy, and France imposing a tax on labor as high as 41.2 percent, 43.4 percent, and 51.7 percent of salaries, respectively.[122]

A tariff is a tax imposed on imported goods, thus raising the price of imported goods relative to domestically produced goods to domestic consumers and to producers if the good is an input of production.

Tariff rates also vary across different countries; in 2011, the weight mean tariff rate across all products was as low as 0 percent for Switzerland, and as high as 21.8 percent for Iran.[123]

When used to protect domestic industry, a tariff can generate market distortions and cause efficiency loss since it can lead to overcapacity in the domestic production of the importable good. It is therefore important for policymakers to exercise caution when imposing tariffs on imported goods, as implementing a tariff without sound economic reason can lead to unintended consequences.

The 2002 U.S. steel tariff is an example of a bad tariff policy decision since it was mainly implemented to protect U.S. producers of steel, rather than to correct for a trade imbalance.[124] The tariff on imported steel products ranged from 8 percent to 30 percent, based on the type of steel product.[125] As a result, steel consuming manufacturers, that is, U.S. producers who rely on steel as an input of production, could no longer effectively compete on the international market due to the high steel prices, therefore losing customers and being forced to lay off laborers.[126] In fact, 224,400 jobs were lost in 2002 in the metal manufacturing, machinery and equipment manufacturing, and transportation equipment and parts manufacturing sectors.[127]

Finally, as its name indicates, consumption taxes are levied on goods or services, and are paid by the consumer. Consumption taxes will increase the relative price of the taxed good to consumers, which can be used as a tool to correct for a consumption problem. Value added taxes, commodity taxes, retail sales taxes, and excise taxes are all examples of consumer taxes. As a percentage of total tax revenue, the taxes on goods and services vary by country from 0.3 percent in Kuwait, to 56.3 percent in Turkey using data from 2011.[128]

From the three options described above to constrain consumption levels, the policy that is least optimal is the production or factor tax-cum-subsidy policy because it does not directly apply to the non-economic objective of the government; it is a producer solution to a consumer problem, which makes it relatively ineffective. The second least optimal policy intervention is that of a tariff—again, this does not directly impact the objective to constrain consumption; instead it affects the levels of trade by increasing the price of

the foreign good relative to the domestic good. The most optimal government intervention policy in order to curb consumption of a particular good is a tax policy, as consumption taxes directly impacts consumption levels, which is the non-economic objective.[129]

The consequences of choosing a sub-optimal policy can be dire—Bhagwati notes that pursuing the wrong economic policy can result in a peculiar situation where economic growth can potentially lead to a country being worse off than it was prior to the policy action being introduced, a situation he coined as "immiserizing growth".[130] Therefore, if the economic target is to constrain consumption, then policies such as production or factor taxes and tariffs should be avoided.

In many instances, governments use economic policies in order to achieve non-economic outcomes that are welfare improving rather than technically efficient.[131] The taxation of tobacco is an example of this, as governments typically intervene in the Pareto-optimal free market in order to pursue non-economic objectives of reducing tobacco consumption. Although policy interventions are rarely economically efficient, when the policymaker has non-economic objectives, the Bhagwati Theorems can be used to analyze and rank different policy decisions in order to minimize the cost to the overall economy and reduce the distortionary impacts on the market.[132] As previously emphasized, since the non-economic policy of the government for tobacco is often to reduce the consumption of tobacco products, the Bhagwati Theorems advocate that the most direct and cost efficient way to constrain the consumption of tobacco is through a consumption response, rather than via a trade or production response.

In order to achieve a consumption response, the government can choose among the following options:

1. Tax the targeted behavior;
2. Subsidize desirable behavior; or,
3. Spend money to reduce the targeted behavior in some way.

Traditionally, taxing the targeted behavior has been the policy measure many governments have pursued to bring about a consumption response. Governments tend to favor taxing certain consumption

products (as an indirect way of taxing the targeted behavior) since it can generate government tax revenue (assuming the tax level is not set too high), whereas the other two options require additional spending on the government's part. Products that have been specifically taxed in order to reduce consumption include alcohol, gasoline, firearms, gambling licenses, and, of course, tobacco. However, taxes on products such as soda and "junk" food are quickly becoming the center of political discussions as candidates for excise taxation, especially in countries that face a severe obesity problem, such as Mexico and the U.S.

Although the latter two consumption response options alone are not discussed by Bhagwati, they do merit some attention since they are valid policy measures. The government could subsidize desirable behavior by offering payments to individuals to incentivize the encouraged behavior, thus promoting the government's non-economic goal. For instance, in the context of reducing tobacco consumption, the government could subsidize quitting tobacco use via payments to former smokers to no longer smoke. Of course, there is the cost of administering this sort of a subsidy (as there is for administrative taxation or other negative policies), since some evidence would need to be documented that individuals have indeed stopped consuming tobacco products.

The third policy option involves the government using funds to reduce the targeted behavior. This could be accomplished through public service ads, offering information via technology or through pamphlets, or funding programs that focus on reducing the targeted behavior. With tobacco products, this could involve the government spending funds on programs directed toward tobacco cessation, such as funding programs that disseminate health information or that provide cessation tools.

Rather than choosing among these three options, policymakers could instead use a combination of these three fiscal policies in order to accomplish their non-economic goals.

The Importance of Considering the Economic Tax Incidence and Tax Burden

In considering excise tax structure, it is also important for policymakers to consider the economic tax incidence[133] and burden, that is, where the tax is placed versus who really feels the effect of the tax. Although Bhagwati recommends a consumption solution to a consumption problem, it is not clear that 100 percent of the tax burden will fall on consumers—hence why discussion of the economic tax incidence and tax burden is crucial.

The economic tax incidence accounts for the own-market economic effects of the tax—this would be the same as the tax statute if tobacco demand was perfectly price-inelastic. Given perfect price inelasticity, a price increase would yield no change in the quantity demanded, and, consequently, tobacco supply would not be impacted. If demand is not perfectly inelastic, however, tax incidence diverges from the tax statute—an increase in price leads to a decrease in quantity demanded, and suppliers of tobacco respond to the decreases in the quantity demanded by decreasing output. As a result, the demand for inputs used to produce tobacco also decline.

In contrast, the tax burden considers the revenue effects on other markets and can paint a more complete picture of the results of tax increases. Knowing on whom a tax is placed doesn't mean that entity actually bears the burden of the tax. In truth what happens is that in any tax structure those factors of production that are either unable or unwilling to vary their work effort in response to price changes will always bear the lion's share of the burden of taxation. In more technical terms, the greater the factor's supply elasticity the smaller will be its burden from a given tax no matter where that tax is placed. And conversely the less elastic a factor's supply elasticity the greater will be that factor's burden no matter where the tax incidence is placed.

In addition to tax incidence and burden it is also true that the further away from optimal taxation an economy tax structure is the greater will be the damage done by any absolute amount of taxation.

In extreme circumstances where the tax on a factor is already in or close to the prohibitive range of the Laffer Curve, any additional

increase in that tax, by definition, will elicit large withdrawals of that factor from the productive economy. Again, if the tax were already in the prohibitive range, the large loss of productive services of that factor would more than offset the tax increase and result in less tax revenue. The end result would be a whole lot of damage to the economy and little if any additional tax receipts.

Additionally, given a tax increase and assuming tobacco demand is inelastic, consumers have less income to spend on other goods and services. This, in turn, impacts the market for other goods and services vis-à-vis the quantity demanded, the output, and the market clearing price. Therefore, even in the extreme case of perfectly inelastic tobacco demand, the tax burden will never be the same as the tax statute.

As this book has documented, the price elasticity of tobacco demand is not constant and is not completely insensitive to price changes. As such, some reduction in tobacco demand will occur for a given price increase, which can also indirectly shift the burden onto other industries or factors. For instance, once the reduction of tobacco output becomes significantly large enough, resources will be reallocated from tobacco production to other industries, displacing tobacco laborers (or their wages) and affecting the markets of these other industries, which will now face more supply, reducing the market price *ceteris paribus*. Ideally, the excise tax would be passed onto the consumer in the form of higher prices since it is a tax on consumption rather than on factors; however, this is not always the case, as suppliers may absorb some of the cost through reductions in the factors of production. As such, policymakers should be aware of these dynamic effects to fully understand how tax changes in one market spill over to others.

We could go on in rather technical detail, but the important point to bear in mind is that just because consumers literally pay the excise tax does not mean they are the only ones affected by the tax. Governments must keep this in mind as they set policy, or else unintended consequences are bound to transpire.

V. HOUSEHOLD INCOME EFFECTS

A. Affordability: Theoretical Considerations

Affordability is an important consideration for anticipating total revenues, even with very price-inelastic goods. When a good becomes too expensive, consumers may discontinue its consumption, or turn to illicit products, or instead reduce the consumption of other goods in order to continue consuming the highly taxed product. Taxes create a financial opportunity for illicit trade, but this is not a sufficient condition in and of itself. The potential profits for smugglers (and savings for consumers) from illicit trade must be weighed against the likelihood and consequences of enforcement. Consequently, it is not just high tax rates that indicate whether illicit trade activity will be a problem, but rather high tax rates coupled with low affordability and enforcement.

1. THE FOUNDATION OF AFFORDABILITY ANALYSIS: PRICE AND INCOME

Affordability is an important aspect of taxation policy, particularly as it provides a method for comparing price and tax levels internationally. In order to properly analyze the economics of affordability on an international scale, it is first necessary to discuss the two components of affordability—price and income. Global prices, even when expressed in a common currency,[134] diverge from one another due to taxes, transport costs, tariffs, and other trade barriers. Income, on the other hand, is the consumption constraint (one can't consume more than what is earned and saved) and provides a scale to determine how low or high prices are to different consumers—$100 is a relatively smaller sum of money for an individual with an income of $500,000 compared to an individual with an income of $50,000. Affordability plays a large role in the likelihood of tobacco smuggling, since high taxes alone do not necessarily imply larger incentives for illicit trade. In fact, it is both the tax and affordability components that determine the likelihood of smuggling and other illicit trade activities, as illustrated in Figure 15 on the following page.

Table 15

Likelihood of Illicit Trade

	Relatively Unaffordable	Relatively Affordable
High Taxation	High	Moderate
Low Taxation	Moderate	Low

The discussion in this section provides the theoretical foundation in order to better understand these concepts of price and income, and how they relate to affordability and the taxation on tobacco.

i. Price Theory—Law of One Price, the Big Mac Index, and PPP

Given the option between two identical goods, consumers will prefer the cheaper of the two (all else held equal). If the prices of these goods are different in different places, there exists the possibility for arbitrage—buying where prices are low, and selling where prices are high. Indeed, this is largely the basis on which international trade has flourished, and these behaviors are the fundamental basis for price theory.

Law of One Price

The law of one price is an important concept for not only linking price levels in different countries to their exchange rates, but also for understanding affordability given price deviations across different countries. In a theoretically ideal world, where transportation costs, tax differences, and barriers to trade do not exist, the law of one price states that identical goods should sell for the same price in different countries when their prices are expressed in a common currency. For example, if the U.S. dollar per British pound exchange rate is $1.50 per pound, then a shirt that sells for $30 in New York City will have to sell for £20 in London. Any deviations from the law of one price should be quickly arbitraged away.

Consider from the previous example that the exchange rate is now $1.45 per pound, which means that an individual could purchase the same shirt as before in London by converting $29 into £20 via the

foreign exchange market. Therefore, the dollar price of the shirt in London is now $29, rather than $30. However, assume that the price for the shirt remains $30 in New York City. In the theoretically ideal world, U.S. importers and British exporters will be incentivized to buy shirts in London and ship and sell them in New York City. As a result, prices for the shirt in London will rise given the increase of the quantity demanded, while the price will decline in New York City given the increase of the quantity supplied. This continues until the price of the shirt is equalized in both locations.

The law of one price can be summarized formally by the following equation: $P^i_{US} = (E_{\$/£}) \times (P^i_{UK})$, where P^i_{US} is the U.S. dollar price of good i when it is sold in the U.S., $E_{\$/£}$ is the exchange rate represented as the amount of U.S. dollars required to purchase 1 British pound, and P^i_{UK} is the British pound price of good i when it is sold in the U.K. The formal representation of the law of one price is important to understand, as it will provide the foundation for PPP.

The law of one price is important for understanding affordability across different countries. For instance, assuming incomes are identical in both countries, if a pack of cigarettes is $6 in Minnesota, and the exchange rate between the U.S. dollar and Canadian dollar is 0.95 i.e., it takes 0.95 U.S. cents to buy 1 Canadian dollar, then the law of one price states that the price per pack of cigarettes in Canada should be about CAD$6.32. If the price is actually CAD$6.10, then cigarettes are more affordable in Canada, thus the incentive to cross the border and purchase cigarettes is high (for individuals living in Minnesota). If the price is higher than CAD$6.32, then the converse is true, Canadians are incentivized to purchase cigarettes in Minnesota, where they are more affordable.

Competitive forces should then equalize prices, in theory, according to the law of one price. If the prices do not equalize, then usually the cost of transport and retailing (excluding taxes) are thought to explain the price gap. However, with cigarettes, the value of the product relative to the weight of the product is high, implying that transportation costs are not a large contribution to any price differences.[135] Likewise, retailing costs for cigarettes are thought to be low when excluding taxes, which indicate that retailing costs do not provide a large contribution to price gaps. Therefore, the variations

of cigarette prices across different countries are most likely due to variations in taxes.

Given that taxes are generally thought to drive cigarette price wedges across different countries, and the fact that legislation typically requires that taxes are paid in the destination country, thereby prohibiting traders to arbitrage on tax differences (indeed—this is smuggling!), the law of one price will likely not hold in the case of tobacco products. As a result, the divergence from the law of one price due to different cigarette tax policies will help explain one aspect of the variation of affordability across the globe (other aspects being differences in income and regulatory barriers to trade).

The Big Mac Index

Perhaps the most well-known application of the law of one price is the Big Mac Index, which was introduced by the *Economist* magazine in 1986. Since Big Macs are sold across the world and are consistent in terms of their recipe, one would expect that the dollar prices of a Big Mac would be similar across the different countries. If the dollar price of a Big Mac deviates across different countries, then foreign currencies are thought to be under or overvalued relative to the U.S. dollar—overtime the price for an identical good like the Big Mac should, in theory, equalize via the competitive market mechanism discussed in the previous subsection. For example, in July 2013, the average price of a Big Mac in the U.S. was $4.56 while the average price in Norway for a Big Mac was $7.51.[136] This indicates that the Norwegian Kroner was overvalued by nearly 65 percent relative to the U.S. dollar at that time.[137] Therefore, the exchange rate that would result in a Big Mac costing the same in the U.S. as Norway would be 10.10, rather than the actual rate of the time, which was 6.13.[138] Of course, these deviations in price can also be attributed to other factors, such as transportation costs, government regulations, product differentiation i.e., few substitutes exist in some markets, allowing McDonald's to price to market in certain locations, labor costs, rental costs, etc, and let's not

forget that in practice arbitrage will not work for Big Mac's, as they are rapidly perishable goods.

As a law of one price exercise, Lal and Scollo (2002) calculate the dollar price of cigarettes relative to the price of a Big Mac.[139] In countries with high cigarette prices, the expectation is that one Big Mac equates to fewer cigarettes, holding all else equal. However, there is no reason to expect high Big Mac prices to be correlated to high cigarette prices. In Table 16 below, the results from Lal and Scollo's 2002 study are reproduced, where the trend of higher cigarette prices corresponds to a lower amount of cigarettes is observed.[140] The table also shows that the relation between tax incidence and price (expressed both as a percent of retail sales price, as well as the cost of cigarettes in relation to the cost of a Big Mac), is not so clear-cut. For instance, the tax incidence in Britain, Denmark and Portugal seem broadly comparable, but lead to very different price levels, both nominally and in Big Mac equivalents. This indicates that tax incidence is probably not a good benchmark to compare fiscal policies internationally.

Table 16

Cigarette Prices, Cigarette Taxes, and the Big Mac Index of Cigarettes

Country	Price of 20 Cigarettes (USD)	Total Tax Incidence (percent)	Cigarettes per Big Mac
Britain*	$6.33	79.5	9
Ireland*	$4.46	79	12
USA*‡	$4.30	27.7	12
Australia*	$4.02	68.9	9
Singapore**	$3.99	53	9
Hong Kong*	$3.97	52	7
New Zealand*	$3.88	74.5	10
Canada	$3.80	71.1	11
Denmark*	$3.77	81.7	17
Sweden*	$3.64	70.5	15
Finland*	$3.53	79	15
France*	$2.76	75.5	20
Germany*	$2.76	68.9	18
Belgium*	$2.63	73.8	21
Netherlands*	$2.56	73	19
Austria*	$2.37	73.7	20
Japan**	$2.18	61	19
Luxemburg*	$1.94	67.7	30
Italy*	$1.93	74.7	24
Greece*	$1.79	72.8	22
Spain*	$1.66	71.2	28
Portugal*	$1.63	80.7	26
Malaysia**	$1.21	34	22
South Korea**	$1.02	68	50
Poland**	$0.92	69	32
Taiwan**	$0.91	44	45
Thailand**	$0.80	56	32
Brazil**	$0.57	75	50
Philippines**	$0.44	41	59
Indonesia**	$0.43	48	86
Average	**$2.54**	**65.50**	**24.97**

Based on the most popular price category.
*Sources: *Smoking and Health Action Foundation; **Ash UK.*
†Sales weighted average (reflects 17 June 2002 increase); ‡average of highest (New York) and lowest (Kentucky).

Absolute and Relative PPP

Purchasing power parity, or PPP, is often used when analyzing international prices in a common currency and is commonly used in studies, rather than exchange rates, to convert local currency prices into a common price. Using PPP accounts for the variation in the costs of living, but it is important to note that adjusting based on PPP does not account for variations in income since it is a price measure.

Absolute PPP is an economic theory that states that the exchange rate between two countries is equal to the ratio of the countries' price levels, where the price level is defined as the monetary value of a reference basket of goods and services.[141] Absolute PPP differs from the law of one price in that it uses the overall price level of a country, rather than the price for a single good or service.

To understand absolute PPP, assume that country A's price level increases. The increase of the price level implies that the purchasing power of country A will decrease, since consumers now require more money to purchase the same reference basket of goods and services. As a result of the decreased purchasing power, country A's currency will undergo a proportional currency depreciation against other currencies.

To formalize, using the U.S. and the U.K. as an example, absolute PPP can be expressed as the following equation to predict the dollar-pound exchange rate: $E_{\$/£} = P_{US}/P_{UK}$, where P_{US} is the U.S. dollar price of a reference basket sold in the U.S. and P_{UK} is the British pound price of the same reference basket sold in the U.K. For example, if the reference basket costs $100 in the U.S. and £80 in the U.K., then absolute PPP states that the exchange rate between the dollar and pound is $1.25 per 1 pound. If prices double in the U.S., that is if the reference basket now costs $200, then the absolute PPP implied exchange rate would be $2.50 per 1 pound, which is a depreciation of the U.S. dollar relative to the British pound.

Rearranging the equation above yields an important interpretation of absolute PPP, which states that price levels across all countries are equal when measured in a common currency: $P_{US} = E_{\$/£} \times P_{UK}$. This is

the case since the right hand side of the equation represents the dollar price of the reference basket in the U.K., which must be equal to the dollar price of the same basket in the U.S if absolute PPP holds. Therefore, at the prevailing exchange rate, absolute PPP holds that every currency's domestic purchasing power is the same as its foreign purchasing power.

Relative PPP is a weaker statement than what is implied by absolute PPP as relative PPP states that changes in price levels across different countries are always equal, at least over time. Therefore relative PPP between the U.S. and the U.K. can be written as the following:

$$E_{\$/£,t}/E_{\$/£,t-1} = (P_{US,t}/P_{US,t-1})/(P_{UK,t}/P_{UK,t-1})$$

where t is the time period and $t-1$ is the time period preceding t. Since the measures developed by national statistical agencies for consumer prices are generally reported as indexes relative to a base year, absolute PPP cannot be calculated since the overall price level is not reported. However, it is easy to calculate relative PPP from published consumer prices, which is often why empirical studies rely on relative PPP despite it being a weaker statement compared to absolute PPP. Even still, the reference basket of goods and services is often not identical in each country, leading to some mismeasurement of relative PPP. Understanding these concepts of PPP will prove useful when analyzing affordability, as there is evidence of a positive relationship between national incomes and price levels.

Blecher and van Walbeek (2008) review the PPP concept to study affordability. They find that the price of cigarettes is three to four times more expensive in developed countries relative to developing countries in absolute terms. However, when using PPP, they find that cigarettes are less than twice as expensive in developed countries compared to developing countries.[142] In other words, comparing absolute prices is not meaningful, as we need to put the price of tobacco in the context of the general prices level within a country. Furthermore, as we will see later, price (whether absolute or relative) in itself is in any case not a good measure of affordability since it does not account for varying levels of income, which is the next topic for discussion.

ii. Defining Income: Broad Versus Narrow, Income Distribution, and the Gini Coefficient

In order to provide a comprehensive analysis of affordability, it is necessary to also discuss income because it allows policymakers to compare international prices as they relate to various income levels. The economic definition of income is carefully constructed, as this book will address in this subsection. Furthermore, there are different measures of income, and each method has different implications when calculating affordability. These theoretical issues are the focus of this subsection, with practical concerns being reserved for Part II of this book.

Income from an Economic Perspective

Measurements of household income and expenditure are surprisingly contentious among economists, and there exist several more metrics for such data than one might expect. Fortunately, however, they tend to be broadly divisible into two categories, and the relative merits of each group are widely acknowledged.

Microeconomic measurements, such as the Current Population Survey (CPS) or Consumer Expenditure (CE), tend to give a very representative view of income distributions, which can be especially useful if income distributions tend to be subject to large skew or dispersion. Unfortunately, there are corresponding disadvantages as well: micro data doesn't effectively capture non-cash sources of income, such as employers covering a portion of health insurance costs, or matching pension contributions, which have become an increasing component of household income in developed countries.[143] Furthermore, as micro data tends to be self-reporting (i.e., consumer surveys), use of micro data is intrinsically less accurate than macro data; consumers tend to accurately report large static or infrequent purchase, such as rent, utilities, or vehicle expenditures, but are much less reliable for "sin" consumption (e.g., cigarettes or alcohol) and small, frequent purchases, such as food or clothing.

Conversely, macroeconomic measurements, such as per capita GDP or National Income & Product Accounts (NIPAs), tend to be more accurate (as they do not rely on individual reporting) and more

complete (as they more accurately capture non-wage income). Additionally, GDP per capita is attractive in that it is easier to obtain a comparable measurement across different countries, as it is far less sensitive to each country's tax and welfare policies. Furthermore, the methodology for calculating GDP per capita is well established, making it an ideal candidate to compare average income or living standards across different countries. Unfortunately, unlike microeconomic measurements, per capita GDP ignores income distribution since GDP per capita is an average, if the distribution of income is heavily skewed, then the overall income picture it represents is not accurate. Similarly, countries with a heavy export component in GDP may find per capita GDP an inaccurate or inappropriate measure of household income, as high exports tend to correlate with more skewed income distributions. In general, whether narrower, microeconomic or broader, macroeconomic measurements are chosen for income, the measurement should account for both cash and non-cash forms of welfare for a more complete representation.

Income Distribution: Inequality, the Gini Coefficient, and Constructing Lorenz Curves

Although GDP per capita is a useful measure of income, it can give the wrong picture when comparing two countries with very different income distributions. The more unequal the income distribution is, the more necessary it is to know the incomes of smokers in order to develop tax policy accordingly. Therefore, when examining issues concerning affordability and economic equity, it is helpful to divide the population into income quintiles, as illustrated in Table 17.

Table 17

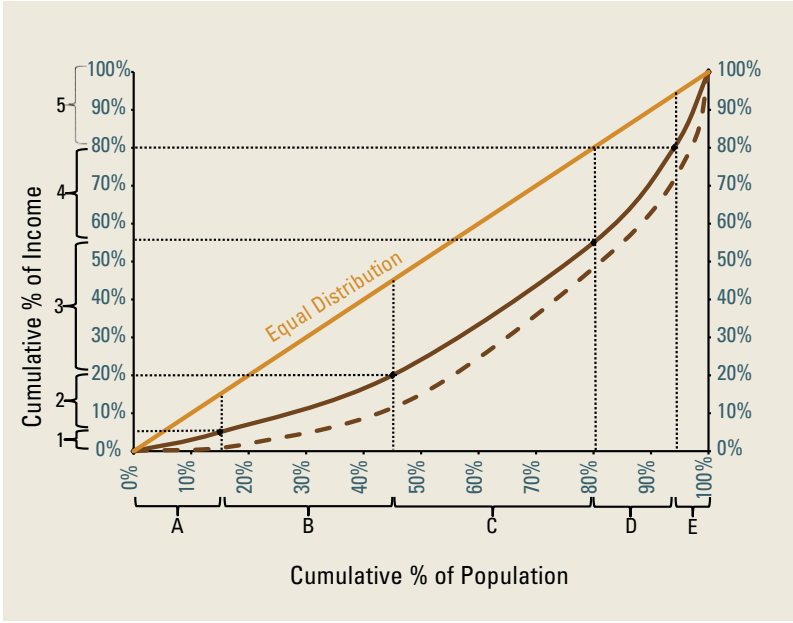
2011 U.S. Census Bureau: Income, Poverty, and Health Insurance Coverage in the United States

	Total	Lowest fifth (Low Income)	Second fifth (Lower Middle Income)	Middle fifth (Middle Income)	Fourth fifth (Higher Middle Income)	Highest fifth (High Income)	Top 5 percent
Number of Households (in 1000s)	121,084	24,217	24,217	24,217	24,217	24,217	6,057
Lower Quintile Boundary (in $)	0	0	20,260	38,515	62,434	101,577	186,000

Another approach to map income distribution is to construct a Lorenz curve, three of which are provided in Figure 9 on the following page. A Lorenz curve maps the cumulative share of individuals, ordered by income from lowest to highest along the x-axis, against the cumulative share of income (y-axis). For example, in Figure 9, when considering the solid black Lorenz curve for the bottom 15 percent of all households, the share of total income earned from that segment is about 5 percent. The dotted black Lorenz curve represents an even less equal distribution- in that example, the bottom 15 percent of households earn roughly 2 percent of total income. The straight, diagonal blue line represents perfect equality, since each individual would then earn the same income—that is, the bottom 15 percent of all households earn 15 percent of the total income.

Figure 9

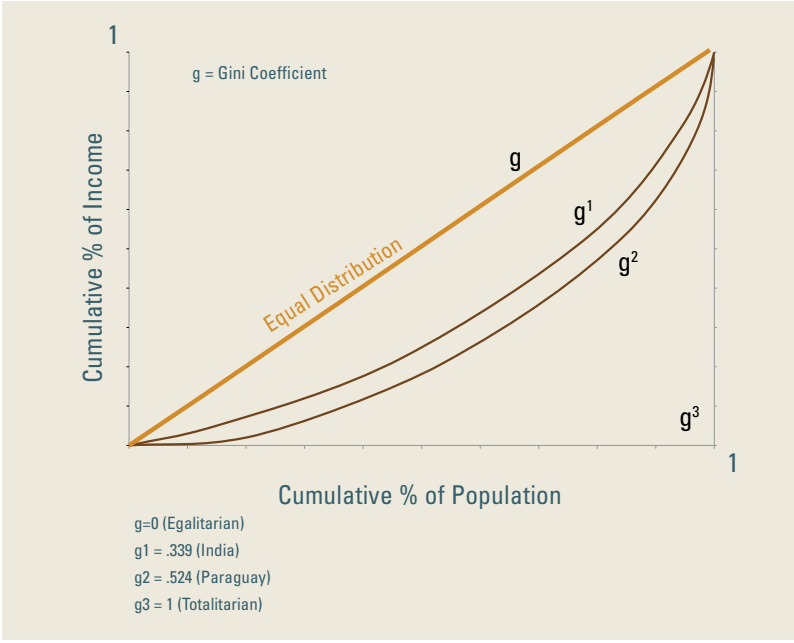
Lorenz Curve



A concept related to the Lorenz curve, is the Gini coefficient of inequality, which measures the degree of inequality by comparing the area between the Lorenz curve and the line of equality with the total area under the line of equality. Essentially, the Gini coefficient measures the degree that an economy's income distribution deviates from a perfectly equal distribution. The Gini coefficient ranges from 0 to 1, where 0 represents complete equality and where 1 represents complete inequality i.e., one household holds all income, refer to Figure 10.

Figure 10

Lorenz Curves with Gini Coefficient



The Gini coefficient becomes an important estimate when comparing the impact excise tax increases will have on a country's population. Gini coefficient values closer to 1 will indicate high inequality, which therefore implies that an increase in excise tax rates could be particularly damaging to low income individuals who consume the targeted product, as their after-tax income distribution will be negatively affected.

This is especially relevant in relation to excise taxation of inferior goods,[144] which are disproportionately consumed by the poor. Excise taxes on price inelastic, inferior goods tend to be regressive—that is, the tax burden falls more heavily on lower income consumers. Further issues relating to regressivity are addressed in Subsection B.

In lieu of obtaining estimates for both the income and price elasticities of tobacco demand, policymakers can analyze the smoking prevalence for each income bracket in order to determine which seg-

ments of the population would be most impacted by tobacco excise tax increases. In fact, in a study conducted by Franks et al (2007),[145] the results indicate that the smoking prevalence gap between different income brackets has increased from 1984 to 1996, the proportion of smokers in the lowest income bracket was 27.7 percent while the same figure was 23.9 percent for all other income brackets. However, this gap widened over the period 1997 to 2004, as the lowest income figure grew to 28.6 percent while the higher income group declined to 21.6 percent; thus, the difference in smoking prevalence between low and high incomes increased from 3.8 percent points to 7 percent points.[146] Therefore, tax increases on tobacco products may further distort the distribution of income, as lower income consumers may be most affected by tobacco excise increases.

2. DEFINING AND MEASURING AFFORDABILITY

For policymakers, accounting for affordability is essential when developing tobacco excise tax policies, as simultaneous interaction between prices and income directly impact consumption decisions. Failing to properly consider affordability can lead to policies that fail to meet excise tax revenue expectations and that incentivize the illicit trade of tobacco. In the next subsections, the measures of affordability are discussed from a theoretical perspective—these measures include (1) the price relative to income, (2) the minutes of labor required to purchase a pack of cigarettes; and, (3) the percentage of daily income required to purchase a pack of cigarettes.

i. The Price Relative to Income (PRI)

Developed by Blecher and van Walbeek[147] in 2004, price relative to income (PRI) is a broad affordability measure that determines the percentage of GDP per capita needed to purchase 100 packs of cigarettes (with increased PRI indicate lower cigarette affordability). PRI can be expressed as the following equation, where RSP_{Pack} is the retail sales price per pack of 20 cigarettes and $GDP_{capita,nom}$ is the nominal GDP per capita:[148]

$$PRI = RSP_{Pack} * 100 \,/\, GDP_{capita,nom}$$

When examining price relative to income, it is important to consider what price is being used for the analysis. The relative merits of several different approaches are outlined briefly in Table 18.