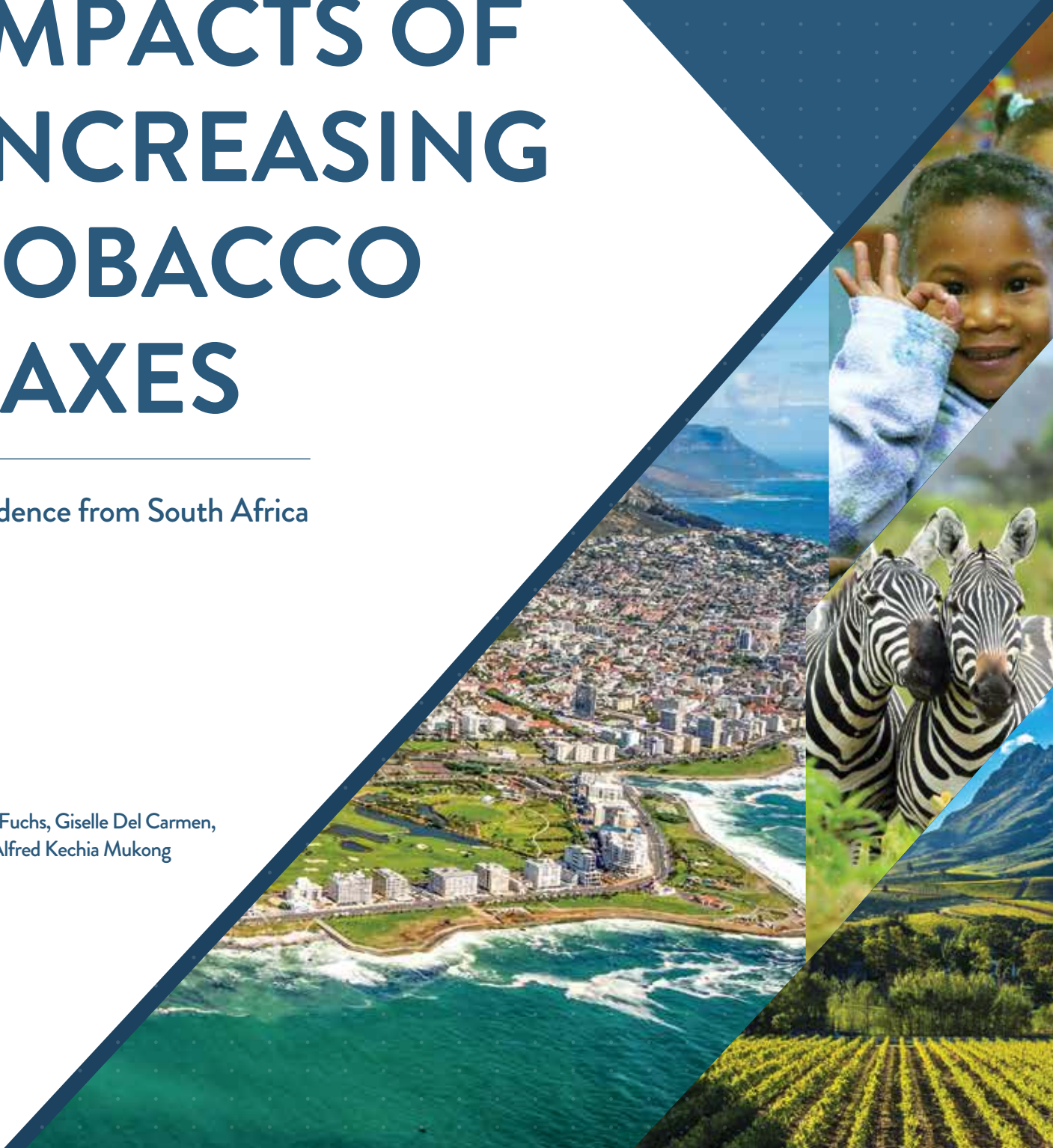
WORLD BANK GROUP

LONG-RUN IMPACTS OF INCREASING TOBACCO TAXES

Evidence from South Africa



Alan Fuchs, Giselle Del Carmen,
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Long-Run Impacts of Increasing Tobacco Taxes

SOUTH AFRICA

Alan Fuchs, Giselle Del Carmen, and Alfred Kechia Mukon[1]

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ABSTRACT

Tobacco taxes are considered an effective policy tool to reduce tobacco consumption and produce long-run benefits that outweigh the costs associated with a price increase. Through this policy, some of the most adverse effects and economic costs of smoking can be reduced, including shorter life expectancy, higher medical expenses, added years of disability among smokers, and the effects of secondhand smoke. Nonetheless, tobacco taxes are often considered regressive because low-income households tend to allocate a larger share of their budgets to purchasing tobacco products. This paper uses an extended cost-benefit analysis to estimate the distributional effect of tobacco taxes on household welfare in South Africa. The analysis considers the effect on household income through an increase in tobacco prices, changes in medical expenses, and the prolongation of working years. Results indicate that a rise in tobacco prices initially generates negative income variations across all groups in the population. If benefits through lower medical expenses and an expansion in working years are considered, the negative effect is reduced, particularly in medium- and upper-bound elasticities. Consequently, the aggregate net effect is progressive and benefits the bottom deciles more than the richer ones. Overall, tobacco tax increases exert a small, but positive effect in the presence of low conditional tobacco price elasticity. If the population is more responsive to tobacco price changes (or participation elasticity estimates are included) then they would experience even more gains from the health and work benefits. More research is needed to clarify the distributional effects of tobacco taxation in South Africa.

JEL Codes: H23, H31, I18, O15

Cover photos: Clockwise from left: Cape Town. Photo by Ben1183/iStock.com. Farmer's child at daycare. Photo by Trevor Samson/World Bank. Zebras. Photo by Lisa H/Unsplash.com. A vineyard in Stellenbosch. Photo by jamespenry/iStock.com

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The findings, interpretations, and conclusions in this research note are entirely those of the authors. They do not necessarily represent the views of the World Bank Group, its Executive Directors, or the countries they represent.

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1 Fuchs: Poverty and Equity Global Practice, World Bank (email: **afuchs@worldbank.org**); Del Carmen: Poverty and Equity Global Practice, World Bank (email: **gdelcarmen@worldbank.org**); Kechia Mukong: Economics of Tobacco Control Project, SALDRU, University of Cape Town (email: mukalf83@gmail.com). Support in the preparation of this report has been provided by the World Bank's Global Tobacco Control Program, co-financed by the Bill and Melinda Gates Foundation and Bloomberg Philanthropies. The authors are grateful to the International Development Research Centre (IDRC), the Medical Research Councils (MRC) of South Africa, Corne van Walbeek, Patricio Marquez, Paolo Belli, Marek Hanusch, Ingrid Woolard, Gabriela Inchauste and Nicole Vellios for providing comments and support. The findings, interpretations, and conclusions in this research note are entirely those of the authors. They do not necessarily represent the views of the World Bank Group, its Executive Directors, or the countries they represent.

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1 INTRODUCTION

Tobacco is the second leading cause of death and disability worldwide, accounting for 6.3 percent of the total burden (Ng et al. 2014). Moreover, smoking is among the major preventable causes of disease and premature death globally (Doll and Hill 1956; Wynder and Graham 1950). Diseases associated with tobacco use include lung cancer, stroke, ischemic heart disease, and respiratory diseases (DHHS 2004). The World Health Organization (WHO 2017) estimates that tobacco kills more than 7 million people worldwide each year. Low- and middle-income countries, including South Africa, harbor nearly 80 percent of the world's smokers and are less likely to be informed about the adverse health effects of tobacco use relative to individuals in high-income countries. In South Africa, over 170,000 deaths annually, equivalent to 36 percent of all adult deaths in 2015, were attributed to tobacco use (Stats SA 2017; see table 3).

The proportion of regular smokers among adults in South Africa has shown a marked decline over the past two decades (31.0 percent in 1994 and 18.2 percent in 2012). This is largely attributed to the country's aggressive tobacco tax policy, one that has made South Africa a global leader in tobacco control. In 1994, the government announced it would increase the tax on tobacco, the excise tax, and the value added tax combined, from 32 percent of the retail price to 50 percent.[2] By 1997, the target had been achieved, and the excise tax was adjusted annually until 2005 to maintain the 50 percent threshold. In 2006, the total tax burden (specific excise tax + VAT) on the average pack of 20-cigarettes was increased to 52 percent and has remained unchanged since. Overall, cigarette sales declined by a third, and government revenue from tobacco taxes rose from R 1 billion in 1993 to R 9 billion in 2009 (ACS 2012). Furthermore, in 1993, with the Tobacco Products Control Act, health warnings were introduced on cigarette packs, and advertising material and smoking was banned in public transport. In 1999, the original legislation was further strengthened: tobacco advertising, smoking in all indoor public areas, and the sale of tobacco to minors were all prohibited.

Even though increasing taxes on tobacco seem to be one of the most efficient measures for reducing tobacco consumption and increasing government revenue, its effectiveness largely depends on how the tax increase impacts the final price paid by consumers (IARC

2 In South Africa the excise tax is levied as a specific tax, that is, a certain amount per pack of cigarettes. During the 1970s and 1980s, the excise tax on tobacco was not adjusted for inflation, resulting in a 56 percent decrease in the real value of the excise tax, ultimately eroding its effect on real cigarette prices. The value added tax has remained at 14 percent of the retail price since 1994.

2011; World Bank 1999). In South Africa, the tobacco industry enhanced the impact of the excise tax and the industry's profitability- by raising the real retail price by more than the increase in the real excise tax. British American Tobacco has been the dominant cigarette producer and distributor in the country and, prior to 2010, the undisputed price setter. Between 2001 and 2010, the real price of cigarettes rose by 64 percent. Post-2010, the high profits earned by multinationals attracted small cigarette producers that sold at prices significantly lower than the economy brands of their competitors.[3] This changed substantially South Africa's cigarette market: the real price of cigarettes remained relatively constant after 2010. These changes have made passing excise tax increases onto consumers more difficult, rendering cigarettes more affordable and ultimately resulting in a less effective tool to reduce tobacco consumption (Linegar and van Walbeek 2017).[4]

Over 340,000 children and more than 5 million adults consume tobacco in South Africa every day (ACS and WLF 2010).[5] Despite the progress of the past two decades, smoking rates are still high among men. Fewer than 8 percent of South African women ages 15 or older smoke relative to 35 percent of men. Similarly, colored adults exhibit a higher smoking prevalence (45 percent) than white adults (25 percent), Indians (20 percent), or black Africans (17 percent).[6] Yet, daily smoking rates in South Africa remain comparable with those in countries of the Organisation for Economic Co-operation and Development, 19.0 percent and 18.2 percent, respectively (OECD 2017).

Tobacco taxes are often considered regressive because the share of household budgets allocated to tobacco products is larger among low-income households than among high-income households. This paper argues that if indirect effects, especially on health, are taken into account, this is no longer valid. The long-run benefits of not smoking offset the costs associated with tobacco taxes among low-income groups and the overall population. Potential benefits include a reduction in medical expenditures and an increase in healthy life years, factors that translate into economic benefits that outweigh the losses created by tax increases if consumers stop or never start smoking.

This paper describes and quantifies the effects of tobacco tax increases on aggregate household welfare through three channels. The first implies that higher tobacco prices

3 British American Tobacco's market share shrank from 91 percent in 2005 to 74 percent in 2016 (Euromonitor International 2017). Its main competitors prior to 2010 were other multinationals (Philip Morris International, Japan Tobacco International, and Imperial Tobacco).

4 Other than in 2010, despite industry claims that a growing illicit cigarette market in South Africa undermines government revenue, there is no evidence of a sustained expansion in illicit trade or that such a trade has undermined tobacco control policy in South Africa (Blecher 2011; Linegar and van Walbeek 2018). Estimates suggest that the illicit trade made up 3–12 percent of the total cigarette market in 2009, well below the industry claims of 20 percent.

5 There are other calculations that estimate more than 7 million tobacco consumers in South Africa: *https://www.iol.co.za/the-star/about-8-million-adults-in-sa-smoke-27-billion-cigarettes-a-year-9429417*

6 Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

because of higher taxes induce a behavioral response involving a reduction in tobacco consumption that is manifest particularly among people who discontinue smoking and younger individuals who do not start smoking. The second channel is associated with a reduction in medical expenses, and the third is a rise in incomes because of gains in years of employment. To assess the impact of these effects, this paper estimates the price elasticity of tobacco, simulates upper- and lower-bound scenarios, and calculates the welfare gains among various income groups.

The study is structured as follows. Section 2 briefly reviews the literature on the health effects of tobacco, the economic costs associated with tobacco-related diseases, tobacco tax policies, and price elasticities. Section 3 describes the methodology. Section 4 presents an overview of the data used to forecast the impact of the tobacco tax. Section 5 examines the estimation results. The final section concludes with a discussion on policy implications.

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2 LITERATURE REVIEW

Blecher and van Walbeek (2008) estimate cigarettes became more affordable in developing countries between 1997 and 2006. This means these countries are more likely to bear the major health impacts of tobacco consumption. Furthermore, low- and middle-income countries are experiencing a rise in non-communicable diseases. This has negative consequences on human capital development and imposes an increasing economic burden because smoking decreases earnings potential and labor productivity (WHO 2015a). Atun (2014) estimates that the incidence of premature disability and mortality could be reduced by a fifth in South Africa if the risk factors associated with non-communicable diseases are addressed. Approximately 40 percent of deaths in South Africa are related to non-communicable diseases, and a high prevalence is attributed to avoidable risk factors such as tobacco use (WHO 2013). In 2015, over 12,000 deaths of individuals ages 15 or older who smoked were attributed to cardiovascular diseases, and over 16,000 to respiratory diseases (OECD 2017).

Several studies have quantified the economic cost of smoking, though most have been carried out in high-income countries. Annual tobacco-related health costs are estimated at US$81 billion in the United States, nearly US$7 billion in Germany, and US$1 billion in Australia (Guindon et al. 2007). Goodchild, Nargis, and Tursan d'Espaignet (2018) find that tobacco-related diseases accounted for 5.7 percent of global health expenditure in 2012 and that the total economic costs of smoking, including health expenditure and productivity losses, were equivalent to 1.8 percent of the world's gross domestic product (GDP) (US$1.85 trillion in purchasing power parity U.S. dollars). The highest share, according to these authors, was in high-income countries (US$1.12 trillion in purchasing power parity dollars), where the tobacco epidemic is the most advanced.[7] Nearly 40 percent of these costs are concentrated in developing countries, reflecting the substantial burden experienced by this group of countries. Earlier estimates of Lightwood et al. (2000) indicate that the gross health cost of tobacco in high-income countries is between 0.1 percent and 1.0 percent of GDP. Likewise, Pichón-Riviere et al. (2014) estimate the annual direct cost of tobacco-related disease in the Chilean health system at approximately 0.6 percent of GDP.

7 Goodchild, Nargis, and Tursan d'Espaignet (2018) estimate the economic cost of smoking-attributable diseases at US$15 billion in low-income countries, US$359 billion in lower-middle-income countries, and US$354 billion in upper-middle-income countries, all in purchasing power parity U.S. dollars.

Tobacco price increases are also associated with expansion in productive life years. Verguet et al. (2015) analyze the health effects of a price increases in China and conclude that a 50 percent rise in prices would result in 231 million life years gained over 50 years and would have a significant impact amongst the poor. In contrast, Pichón-Riviere et al. (2014) estimate that tobacco use in Chile would reduce life expectancy for smokers by nearly 4.0 years among women and 4.3 years among men.

Similarly, exposure to secondhand smoke has a strong relationship with many respiratory diseases among children and adults (DHHS 2004, 2014; Mason, Wheeler, and Brown 2015; Öberg et al. 2011). According to the World Health Organization, secondhand smoke is responsible for over 890,000 premature deaths per year (WHO 2017). In the United States, exposure to secondhand smoke costs an estimated US$5 billion annually in direct medical costs and over US$5 billion more in indirect medical costs, that is, disability and lost wages (Behan, Eriksen, and Lin 2005). In the state of Indiana, the health-related costs of secondhand smoking have been estimated at more than US$1.3 billion annually (Mason, Wheeler, and Brown 2015). In contrast, McGhee et al. (2006) estimate the cost of direct medical care, long-term care, and productivity losses because of secondhand smoke exposure in Hong Kong at approximately US$156 million annually. Results from the 2011 Global Youth Tobacco Survey in South Africa indicate that 3 students ages 11–18 in 10 live in homes where someone smokes, and 4 in 10 are around others who smoke in places outside the home.

Tobacco taxation has been recognized as one of the most effective strategies to decrease smoking. In high-income countries, a 10 percent increase in the price of cigarettes is associated with a decrease in the demand for cigarettes of approximately 4 percent (World Bank 1999). In low- and middle-income countries, an equivalent increase is associated with an average 6 percent reduction in cigarette consumption (IARC 2011). Higher taxes have the additional benefits of reducing exposure to secondhand smoke and increasing government revenues.

In South Africa, the 1994 excise tax-induced increase in cigarette prices led to significant reductions in tobacco use (Chaloupka et al. 2000; van Walbeek 2002a). Chelwa, van Walbeek, and Blecher (2017) estimate that, by 2004, per capita cigarette consumption was 36 percent lower than it would have been without South Africa's strong tobacco tax policy. Similarly, van Walbeek (2005) finds that price increases in 1990–2000 reduced the regressivity of the cigarette excise tax in South Africa. Stacey et al. (2018) argue that more aggressive excise tax policies on tobacco in South Africa could lead to improvements in health and revenue. They estimate that an excise rate of 60 percent on tobacco would result in a gain of 858,923 life years.

Other tobacco control interventions are also relevant in decreasing demand, but have a smaller impact on tobacco consumption. Several studies have found that health publicity has contributed to a reduction in cigarette use, but the impact has generally been small and, in some cases, temporary.[8] Levy et al. (2012) estimate that the vast reduction in tobacco use in Brazil was mostly caused by higher tobacco prices (46 percent of the impact) and, to a lesser extent, by smoke-free policies (14 percent). The World Health Organization argues that smoke-free environments are the only way to mitigate the harmful impacts of secondhand smoking (WHO 2015b). As part of South Africa's Tobacco Products Control Act, tobacco advertising, smoking in all indoor public areas, and the sale of tobacco to minors were all prohibited in 1999. The impact of the tobacco control interventions can be seen in the decrease in mortality rates associated with tobacco-related diseases in South Africa, such as ischemic heart disease, lung cancer, chronic obstructive pulmonary disease, and asthma (Nojilana et al. 2016; Peer et al. 2009).

Price elasticities are crucial in the design of effective tobacco taxation systems. With these, policy makers can determine the sensitivity of demand to a change in tobacco prices. Tax increases tend to generate more impact on tobacco consumption in low- and middle-income countries relative to high-income ones (WHO 2015b). There is an extensive literature estimating the relationship between tobacco prices and consumption. Chaloupka and Grossman (1996) and Lewit and Coate (1982) estimate the elasticity among the under-18 population in the United States at between −1.44 and −1.31 and, among adults ages 18 years or older, at between −0.27 and −0.42. Gallus et al. (2006) estimate a price elasticity of −0.46 for 52 countries in Europe. Cigarette price elasticities across income groups in India range from −0.83 for the lowest income group and −0.26 for the highest (Selvaraj, Srivastava, and Karan 2015). In the United Kingdom, price elasticity is estimated at −0.5 and, in Hungary, between −0.44 and −0.37 (Szilágyi 2007; Townsend, Roderick, and Cooper 1994). Denisova and Kuznetsova (2014) estimate price elasticities in Ukraine by income deciles, ranging from −0.44 for the lowest income group to −0.11 for the highest. Fuchs and Meneses (2017a) also estimate decile-level price elasticities in Ukraine and find a higher average price elasticity (−0.45), ranging from −0.33 for the richest income group and −0.59 for the poorest. Similarly, Krasovsky et al. (2002) estimate an average price elasticity of −0.24 for Ukraine, with variations by income group and age.

The average price elasticity of cigarettes in South Africa ranges from −0.5 to −0.87 (Boshoff 2008; Reekie 1994; van der Merwe and Annett 1998; van Walbeek 2000). Van Walbeek (1996) finds evidence of long-run price elasticities ranging from −0.53 to −1.52 based on data from

8 Atkinson and Skegg (1973); Bardsley and Olekalns (1999); Stavrinos (1987); Sumner (1971); Townsend (1987); Townsend, Roderick, and Cooper (1994); Witt and Pass (1981).

1970–90. Van Walbeek (2002b) estimates prices elasticities across income quartiles, controlling for income changes, and finds elasticities of –1.39 and –0.81 for the poorest and richest income quartile, respectively. These estimates are a bit above of the expected price elasticity for developing countries (–0.4 and –0.8) (Chaloupka et al. 2000).None of these have relied entirely on household data to estimate price elasticities; instead, they use annual or quarterly data on aggregate tobacco prices and consumption.[9] Moreover, these estimates likely do not reflect the reality in South Africa because smoking prevalence has decreased significantly in the past two decades.

Age and income are two key factors in determining tobacco price elasticities. Individuals in low-income groups and young adults are more responsive to price changes relative to their peers. This makes them particularly susceptible to tobacco tax increases because they tend to be less dependent on nicotine, more affected by peer effects, and possess less disposable income (Jha and Peto 2014). Several studies in the United States have consistently shown that younger groups show higher elasticities relative to older ones (CDC 1998; Chaloupka and Grossman 1996; Lewit and Coate 1982).

9 Even though van Walbeek (2002b) uses the South African Income and Expenditure Survey to estimate tobacco price elasticities by income group, the average retail price of cigarettes is applied to all households. Thus, no distinction is made in cigarette quality or price variations by brand.

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3 MODEL

The impact of rising tobacco taxes in South Africa is estimated using an extended cost-benefit analysis as in other studies (Pichón-Riviere et al. 2014; Verguet et al. 2015). The paper analyzes three factors to estimate how tobacco taxes could affect household income. First, assuming tobacco consumption does not change, tobacco taxes directly affect household income as the share of household budgets allocated to tobacco purchases increases with the rise in taxes. Second, household medical expenses could decrease as a result of reduced tobacco consumption. Finally, households could also experience a positive income change because of additional years of labor recovered through the extension of life expectancy. The aggregate effect of a tax policy is estimated as follows:

Income effect = change in tobacco expenditure (A) + lower medical expenses (B) + rise in income (C) (1)

A partial equilibrium model is used to assess the distributional effects of a tobacco tax. This approach is used to evaluate the change in prices and relies mainly on household expenditure patterns. This decision implies that only first-order effects are assessed; furthermore, behavioral changes of economic agents such as increases in the consumption of other goods are excluded from the analysis. The model therefore estimates the effects of the short-term response. Moreover, productivity gains from improvements in health deriving from the reduced use of tobacco products are not incorporated in the model primarily because data on the number of days lost or on the depreciation of human capital as a result of tobacco diseases are not readily available. Thus, the estimated income effect should be considered a lower-bound estimate.

The model uses the share of tobacco consumption in household budgets relative to price increases. The loss of real income arising from price increases in products $i = 1, \ldots, n$ is obtained by:

$$\sum_{i}^{n} (\omega_i + \Delta\omega_i) * \frac{\Delta p_i}{p_{i,o}}, \qquad (2)$$

where ω_i is the share of product i in total household expenditure; Δp_i is the percent price increase, and $\Delta\omega_i$ is the change in consumption of the taxed good that depends on the price elasticity of the product.[10] For example, if 10 percent of the total budget is destined for cigarettes, for example, and the price of cigarettes increases by 10 percent, the real loss in income amounts to 1 percent.

10 For a detailed discussion of the methodology, see Coady et al. (2006); Kpodar (2006).

Change in tobacco expenditure

To estimate the variation in tobacco consumption after the tax increase, the model considers the change in prices (ΔP), tobacco price elasticity (ε) for decile i, and tobacco expenditure as a proportion of total household expenditure of decile i in period 0 ($Expenditure_{i,0}$).

$$\Delta\ Tobacco\ Expenditure_i = ((1 + \Delta P)(1 + \varepsilon_i * \Delta P) - 1) * Expenditure_{i0}^{11} \quad (3)$$

The change in tobacco expenditure is divided by the total expenditure for each decile group i, thereby obtaining a comparable per household measure of the change in tobacco expenditure relative to the total expenditure of each decile group.

$$\Delta\ Prop.\ Tobacco\ Expenditure = \frac{((1+\Delta P)(1+\varepsilon_i * \Delta P)-1) * Expenditure_{i0}}{Total\ Expenditure_i} \quad (4)$$

Medical expenses

The change in medical expenses from tobacco-related diseases is estimated using equation (5), where the cost of treatment of tobacco-related diseases for income decile i is obtained from administrative data and adjusted according to the expenditure survey. The cost of tobacco-related medical expenses is distributed across income decile i according to the share of households that consume tobacco in decile i. Equation (5) shows the income gains associated with the reduction of medical expenses because of reduced tobacco consumption in the long term.

$$\Delta\ Prop.\ Medical\ Exp. = \frac{((1+\varepsilon_i * \Delta P)-1) * \text{Cost Treat.Tobacco Related Diseases}_i}{\text{Total Expenditure}_i} \quad (5)$$

A reduction in tobacco consumption in the long run would be strongly related to a reduction in tobacco-related diseases. The model assumes that the health effects of tobacco-related diseases will immediately diminish with the reduction in tobacco consumption.[12] Even though this assumption is implausible in the short term because changes in the effects of tobacco-related diseases take some time to materialize, it provides an upper-bound estimate of the effects of tax increases.

Increase in working life years

Finally, the model estimates the impact on income arising from the increase in working years (equation 7). To estimate the increase in working years, the years of life lost (YLL) from tobacco-related diseases are distributed across deciles (i) proportionately to the

11 Another expression might be Δ Expenditure = $\Delta C \Delta P + \Delta CP_0 + \Delta PC_0$

12 Other studies have estimated the pass-through between the decline in tobacco consumption and the effect on medical expenditures. These estimates may also differentiate the effect associated with people who stop consuming tobacco versus people who do not start at all because of the tax policies (Verguet et al. 2015). Because of data restrictions, these assumptions are not included in the analysis.

number of households that consume tobacco (equation 6).[13] Subsequently, the income lost is estimated as the average income per household in decile *i*. Overall, the model anticipates that incomes will increase as the number of years lost because of premature deaths from tobacco consumption decline.

$$Working\ Years_i = (YLL\ TR_i * Share\ of\ Smokers_i)/Population_i \quad (6)$$

$$\Delta\ Income_i = \frac{\left((1 + \varepsilon * \Delta P) - 1\right) * Working\ Years_i * Total\ Expenditure_i}{Total\ Expenditure_i} \quad (7)$$

Lastly, the total income gains in each income group are estimated by adding the results of the increase in tobacco expenditures, the reduction in medical treatments, and the gains in working years (equation 1).

13 Life expectancy of 65.6 for women and 58.5 for men are used to estimate years of life lost in South Africa (World Development Indicators).

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4 DATA AND DESCRIPTIVE STATISTICS

Tobacco prices

Data on household consumption of and expenditure on tobacco products in South Africa come from the National Income Dynamic Study (NIDS), a survey that has been collected in four waves since 2008[14] The survey asks households how much on "average [was] spent in the last 30 days on cigarettes and tobacco" and, on "average [how many] cigarettes [were] smoked per day." These questions allow us to estimate the average price paid by households for tobacco products at four points in time and to estimate individual-level price elasticities by income group.[15] Moreover, the NIDS also has the advantage of being a panel study that follows the same individuals over time and thus allows us to control for individual unobserved heterogeneity to estimate tobacco price elasticities.[16]

Table 1 shows significant variation across deciles in cigarette prices. For instance, the poorest decile in 2015 paid an average R 6.65 for 20 cigarettes, whereas the richest decile spent R 20.14. Even though the cigarette prices obtained from the survey are lower than those shown by Statistics South Africa, they follow the same market trend for the available years (figure 1). Moreover, these differences are likely caused by the phrasing of the relevant questions in the NIDS, household recall error (Biedman 2010) and that using household expenditure on tobacco accounts for the illicit market. In addition, there is significant price variation by cigarette brand; the most expensive sold at an average price of R 39, and the cheapest at R 18.7 in 2015.[17] It is crucial to account for these variations to estimate tobacco price elasticities; thus, applying the same price for all households would not reflect the differences evident in table 1.

14 The South African Income and Expenditure Survey was considered; however, the survey does not include quantity information on tobacco products, limiting the analysis that could be derived from the survey.

15 The quantity of cigarettes is converted to monthly terms to estimate monthly prices (expenditure on cigarettes/quantity).

16 Income deciles were created using the latest available dataset, wave 4 (2014/15).

17 Cigarette price data were provided by Statistics South Africa; because of data restrictions, product brands are not referenced in the analysis.

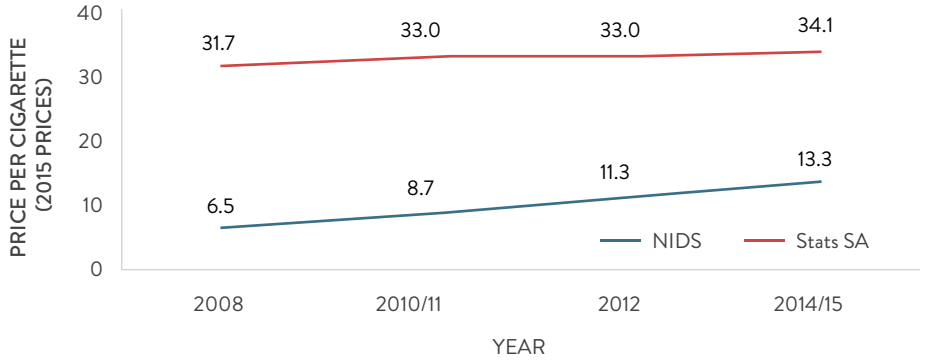
TABLE 1: AVERAGE PRICE PAID BY HOUSEHOLDS FOR A 20-CIGARETTE PACK, LAST 30 DAYS (2008–15)

YEAR	1	2	3	4	5	6	7	8	9	10	AVERAGE
2008	3.52	4.35	4.70	4.22	4.11	5.93	4.95	7.09	9.40	10.73	6.48
	0.24	*0.32*	*0.23*	*0.21*	*0.18*	*0.26*	*0.24*	*0.40*	*0.42*	*0.35*	*0.13*
2010/ 2011	3.89	4.43	4.88	5.64***	6.57***	7.24***	6.811***	11.69***	12.48***	12.48	8.66***
	0.17	*0.24*	*0.40*	*0.28*	*0.55*	*0.39*	*0.40*	*0.61*	*0.52*	*0.59*	*0.21*
2012	7.18***	10.18***	6.97***	8.60***	9.39***	8.87***	12.05***	12.75	15.68	15.90	11.26
	0.27	*0.49*	*0.24*	*0.34*	*0.41*	*0.33*	*0.50*	*0.52*	*0.60*	*0.96*	*0.20*
2014/ 2015	6.65	10.81	8.889***	10.3***	10.17	13.69***	16.41***	13.57	16.10	20.14***	13.34***
	0.29	*0.39*	*0.35*	*0.45*	*0.38*	*0.59*	*0.97*	*0.48*	*0.63*	*1.19*	*0.25*

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, waves 1–4, 2008–15.

Note: Prices are in 2015 real Rand. The average excludes the bottom and top 5 percent to correct for outliers. Refer to annex B for median prices. Standard errors are reported in italics below average prices: *** reports 95% statistically different from previous year.

Figure 1: Average Price Paid by Households for 20 Cigarettes, by Year and Data Source



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, waves 1–4, 2008–15; official data of Statistics South Africa, price statistics compilation, for a pack of 20 cigarettes.

Note: Prices reported in 2015 real rand.

Tobacco price elasticity by decile

Unlike previous tobacco price elasticity estimates on South Africa, this study uses the NIDS individual-level datasets for relevant estimates by income decile. Tobacco price elasticity estimations using national aggregate time series data on production and sales could face several problems. First, it is difficult to differentiate among the number of cigarettes sold, the number consumed, the number coming from illicit trade, or the price paid. Moreover, estimates are typically produced with a small number of observations and often lack granularity. A longitudinal panel reflecting repeated observations of individuals in both purchases and the prices paid over time for tobacco products is the ideal dataset. The NIDS allows us to conduct such an analysis and control for unobserved heterogeneity

among individuals for four waves from 2008 to 2015. Another advantage of using this survey is that one may detect the price paid by consumers and account for promotions, sales, or even the purchases of illicit cigarettes.

Nonetheless, the NIDS suffers from nonresponse and attrition as most surveys do. Similarly, the sample size is also reduced when using a balanced panel.[18] In addition, Kacker (2016) finds that the NIDS data do not match information from other South African surveys and appears to oversample rural areas, the less well educated, and college-educated individuals. Despite these limitations, Kacker (2016) recognizes that the survey is clearly internally consistent and that there is no reason to doubt the reliability of the data. Caution is recommended in drawing conclusions from the survey because the NIDS appears to be biased toward the part of South Africa that has improved the most.[19]

Although several models have been tested to estimate decile-level elasticities, the random effects in a near balanced panel is the preferred model. (See annex A for more on the methodology and the various iterations of the estimation of tobacco price elasticities by decile.)

The estimated average tobacco price elasticity in South Africa is –0.25, which is lower in absolute terms than the elasticities found in the literature for developing countries (–0.4 and –0.8), as well as those previously estimated for South Africa (–0.5 and –0.87) (Boshoff 2008; Chaloupka et al. 2000; Reekie 1994; van der Merwe and Annett 1998; van Walbeek 2000).[20] Nonetheless, all models tested for this study estimate an average elasticity between –0.23 and –0.28 (See annex A, table A2). Moreover, as noted above, to the best of our knowledge, previous estimates of tobacco price elasticities in South Africa have not relied entirely on data on households or individuals, and few rely on income groups. In addition, most of these estimates have been calculated in years prior to the more profound changes in tobacco policy in South Africa. Previous elasticities were also estimated at a time when smoking prevalence was significantly higher in South Africa; as of 2015, fewer than a fifth of the households interviewed reported spending money on cigarettes, relative to over 40 percent in 1995.[21]

As expected, lower income deciles exhibit higher elasticities relative to richer deciles. For instance, the poorest decile has a medium-bound elasticity of –0.36, whereas the richest has an elasticity of –0.22 (table 2). The standard error of these estimates is approximately

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18 The NIDS was first undertaken in 2008 among approximately 28,000 individuals in around 7,000 households. The aim of the survey is to collect repeated information over a wide range of social and economic behaviors among the same set of households. Over time, approximately 17,264 individuals consistently responded during all four waves.

19 As per official data from Stats SA, GDP per capita is stagnant, unemployment rate is constant, labor force participation and employment rate falls: these are all opposite to what the NIDS data shows.

20 Lower price elasticities are likely a result of using reported tobacco prices (expenditure on tobacco). Thus, the price elasticities in this paper are conditional elasticities. Kechia-Mukong and Ngeh (2018) estimate total tobacco price elasticity of 0.52 to 0.61 by merging annual price data to the NIDS dataset.

21 Estimates using the 1995 and 2015 Income and Expenditure Surveys in South Africa.

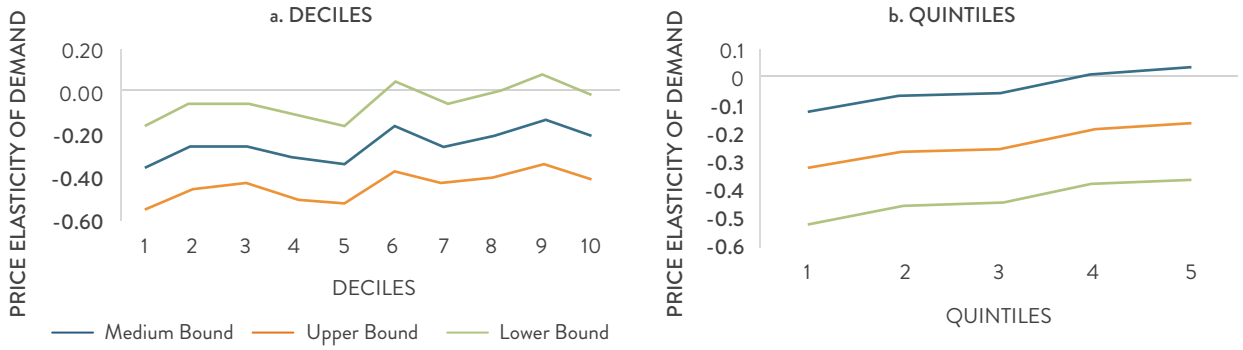
TABLE 2: TOBACCO PRICE ELASTICITIES, BY DECILE

	DECILE									
Price Elasticity	1	2	3	4	5	6	7	8	9	10
Lower bound	−0.16	−0.06	−0.04	−0.11	−0.14	−0.03	−0.04	−0.01	0.07	−0.02
Medium bound	−0.36	−0.26	−0.24	−0.31	−0.34	−0.17	−0.24	−0.21	−0.13	−0.22
Upper bound	−0.56	−0.46	−0.44	−0.51	−0.54	−0.37	−0.44	−0.41	−0.33	−0.42

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, waves 1–4, 2008–15.

Note: Lower- and upper-bound elasticities show on average differences of –0.2 and +0.2, respectively, with the medium-bound elasticity. Random effects estimates reported using near balanced panel data, where only individuals present in all four waves are kept but some are dropped due to missing observations in the relevant tobacco expenditure questions.

Figure 2: Tobacco Price Elasticity, South Africa



Source: Estimates based on the National Income Dynamics Study, waves 1–4, 2008–15.

Note: Deciles and quintiles were created using per capita household expenditure. Lower- and upper-bound elasticities show differences of –0.2 and +0.2, respectively, with the medium-bound elasticity. Random effects estimates reported using near balanced panel data, where only individuals present in all four waves are kept but some are dropped due to missing observations in the relevant tobacco expenditure questions.

0.10, producing a 95 percent confidence interval of –0.20, +0.20.[22] To show the effect of a tax increase under different scenarios, we simulate a lower- and an upper-bound elasticity for each decile. The former tends to reflect income groups that would not change consumption patterns, such as rural residents or older individuals, while the latter tends to show a longer-term scenario, reflecting the effect the tobacco tax would have on younger individuals. After a few decades, only these would still be alive; the total average effect of the price increase would therefore be approximated more accurately by the upper-bound price elasticity.

Lastly, in South Africa, because the wealth distribution does not vary substantially across the bottom deciles, which largely rely on government subsidies and transfers, price elasticities were also estimated for quintiles as a robustness check (Inchauste et al. 2017) (figure 2, panel b).

22 In order to maintain comparability with similar studies, the same average upper and lower-bounds has been applied to all deciles. Applying individual bounds by decileresulted in minimal changes to the results.

Mortality and morbidity

Statistics South Africa has information on mortality and causes of death in South Africa in 2015. The data is disaggregated according to the smoking status of the deceased (table 3), where a smoker is defined as someone who had smoked any form of tobacco on average for more than six months a year or four or more days a week five years previously. Approximately 36 percent of all deaths in 2015 (173,241) were associated with tobacco-related diseases.[23] Of these, over 7,000 were women and nearly 25,000 were men (tables 3 and 4). Though a large share of deaths in South Africa (46 percent) are recorded with the smoking status unknown, the incidence of tobacco-related deaths appears to be higher among smokers. For instance, in 2015, even though there were roughly the same number of cases of chronic obstructive pulmonary disease among smokers (4,348) and nonsmokers (4,270), smokers represented fewer than 20 percent of the South African population. Pillay-van Wyk et al. (2016) find that mortality by disease is severely underreported in the South African data; the results presented using these numbers will thus provide lower-bound estimates of tobacco-related deaths.

Estimates of the working years lost to tobacco-related deaths are obtained using mortality data of Statistics South Africa. Approximately 244,000 potential years of life were lost in South Africa in 2015 because of active smoking, mostly among men. Given the large share of deaths associated with smoking status unknown, we also estimate years of life lost for all tobacco-related deaths: 1,311,411 (table 5). These are equally lower-bound estimates since they rely on underreported mortality data (Pillay-van Wyk et al. 2016).

To estimate Years of Life Lost we take the midpoint of every age range, subtract life expectancy and multiply by the number of deaths for that year. For example, for ages 15-24, midpoint is 19.5-65.6 (life expectancy for women) * 107 deaths for smokers, equivalent to 4,933 years of life lost. The same applies for the following columns, though we do not report the number of deaths without limiting to smokers (this is reported in the mortality tables above and in the annex).

Data on morbidity are obtained from the Global Burden of Disease Study (table 6). Chronic respiratory diseases, ischemic heart disease, and tuberculosis are among the most prevalent diseases among men and women in South Africa. In 2015, approximately 1.3 million cases of tobacco-related disease were reported.

Tobacco-related medical costs

The most recent study that analyzes the medical costs of tobacco consumption in South Africa occurred in 1988. Yach, McIntyre, and Saloojee (1992) estimate the cost of smoking-related diseases at R 3.64 billion (US$1.3 billion in 2015 prices), equivalent to 1.82 percent

23 If only individuals with known smoking status are considered (32,767), the share drops to 7 percent.

TABLE 3: TOBACCO-RELATED DEATHS BY SMOKING STATUS, 2015

SMOKER						NON-SMOKER					UNKNOWN								
	15–24	25–34	35–54	55–74	75+	15–24	25–34	35–54	55–74	75+	0–1	2–5	6–14	15–24	25–34	35–54	55–74	75+	Total
Tobacco-related deaths	*332*	*2,304*	*10,364*	*15,030*	*4,725*	*1,894*	*5,629*	*15,272*	*22,834*	*23,041*	*3,922*	*748*	*961*	*1,416*	*4,699*	*16,734*	*25,066*	*18,270*	*173,241*
COPD	8	70	819	2,613	833	90	206	701	1,801	1,466	73	55	65	62	197	1,123	3,191	1,706	15,079
Tuberculosis	175	1,291	3,910	2,314	309	885	2,828	5,391	2,748	834	261	138	269	622	2,248	5,556	2,538	518	32,835
Ischemic heart disease	4	47	596	1,159	363	23	62	606	1,864	2,167	2	1	2	23	76	873	2,336	1,999	12,203
Lung cancer	–	–	1	1	–	–	–	–	2	1	–	–	–	–	–	2	3	1	11
Upper aero-digestive cancers	–	2	80	200	28	4	6	52	110	58	–	1	2	3	8	125	291	65	1,035
Digestive, urinary, cervical cancer	3	37	515	1,251	276	30	90	796	1,964	1,285	15	10	18	26	111	1,061	2,709	1,240	11,437
Stroke and other vascular conditions	57	297	2,136	5,150	2,236	311	872	4,069	10,975	13,925	399	135	176	258	769	4,308	10,537	10,058	66,668
Other respiratory diseases	56	401	1,589	1,650	565	361	1,122	2,577	2,309	2,672	2,993	347	313	296	921	2,453	2,220	2,159	25,004
Other medical conditions	29	159	718	692	115	190	443	1,080	1,061	633	179	61	116	126	369	1,233	1,241	524	8,969
Other causes of death	3,175	8,676	17,488	13,765	3,868	7,656	15,896	29,800	28,624	22,846	36,946	3,418	4,501	6,293	14,101	30,124	30,316	19,604	**297,097**
Total	3,507	10,980	27,852	28,795	8,593	9,550	21,525	45,072	51,458	45,887	40,868	4,166	5,462	7,709	18,800	46,858	55,382	37,874	**470,338**

Source: Stats SA 2017.

Note: A smoker is defined as someone who smoked any form of tobacco on most days (an average of more than six months a year, or four or more days a week), five years previously. If smoking started less than five years before death, the answer is No. If smoking started more than five years before death, but for less than six months, then the answer is No. Smoking status is only reported for individuals ages 15 or older.

TABLE 4: TOBACCO RELATED DEATHS BY GENDER AND AGE GROUPS, 2015 (BROAD GROUPS, LIMITED TO SMOKERS)

	WOMEN						MEN					
	15–24	25–34	35–54	55–74	75+	Total	15–24	25–34	35–54	55–74	75+	Total
Tobacco-related deaths	107	393	1,692	3,639	2,099	7,930	225	1,911	8,672	11,391	2,626	24,825
COPD	1	16	198	734	286	**1,235**	7	54	621	1,879	547	**3,108**
Tuberculosis	74	229	484	346	84	**1,217**	101	1,062	3,426	1,968	225	**6,782**
Ischemic heart disease	2	8	83	281	163	**537**	2	39	513	878	200	**1,632**
Lung cancer	-	-	-	-	-	**-**	-	-	1	1	-	**2**
Upper aero-digestive cancers	-	2	15	34	12	**63**	-	-	65	166	16	**247**
Digestive, urinary, cervical cancer	-	5	100	288	98	**491**	3	32	415	963	178	**1,591**
Stroke and other vascular conditions	9	49	438	1,478	1,197	**3,171**	48	248	1,698	3,672	1,039	**6,705**
Other respiratory diseases	15	54	252	325	210	**856**	41	347	1,337	1,325	355	**3,405**
Other medical conditions	6	30	122	153	49	**360**	23	129	596	539	66	**1,353**
Other causes of death	340	1,035	2,754	3,390	1,757	**9,276**	2,835	7,641	14,734	10,375	2,111	**37,696**
Total	554	1,821	6,138	10,668	5,955	**17,206**	3,285	11,463	32,078	33,157	7,363	**62,521**

Source: Stats SA 2017.

Note: A smoker is defined as someone who smoked any form of tobacco on most days (an average of more than six months a year, or four or more days a week), five years previously. If smoking started less than five years before death, the answer is No. If smoking started more than five years before death, but for less than six months, then the answer is No. Annex C reports mortality by smoking status and gender.

TABLE 5: YEARS OF LIFE LOST, BY GENDER, 2015

	TOTAL TOBACCO-RELATED DEATHS (SMOKERS)			TOTAL YEARS OF LIFE LOST (SMOKERS)			TOTAL YEARS OF LIFE LOST (ALL)		
	Women	Men	Total	Women	Men	Total	Women	Men	Total
15-24	107	225	332	4,933	8,775	13,708	100,452	57,057	157,509
25-34	393	1,911	2,304	14,187	55,419	69,606	232,412	179,626	412,038
35-54	1,692	8,672	10,364	35,701	121,408	157,109	355,240	357,476	712,716
55-74	3,639	11,391	15,030	4,003	-	4,003	29,149	-	29,149
75+	2,099	2,626	4,725	-	-	-	-	-	-
Total	7,930	24,825	**32,755**	58,824	185,602	**244,426**	717,252	594,159	**1,311,411**

Source: Stats SA 2017.

Note: Deaths are limited to smokers. Years of life lost are estimated using data for life expectancy at birth from the World Development Indicators database for South Africa; among women, life expectancy in 2015 was 65.6 years, and among men, 58.5 years. To estimate Years of Life Lost we take the midpoint of every age range, subtract life expectancy and multiply by the number of deaths for that year. For example, for ages 15-24, midpoint is 19.5-65.6 (life expectancy for women) * 107 deaths for smokers, equivalent to 4,933 years of life lost. The same applies for the following columns, though we do not report the number of deaths without limiting to smokers (this is reported in the mortality tables above and in the annex).

TABLE 6: TOBACCO-RELATED EVENTS BY GENDER, 2015

	ALL	WOMEN	MEN
Bladder cancer	1,987	731	1,256
Cerebrovascular disease	48,615	29,012	19,603
Cervical cancer	10,686	10,686	
Chronic obstructive pulmonary disease	827,424	419,888	407,536
Colon and rectum cancer	5,168	2,434	2,734
Esophageal cancer	4,112	1,330	2,782
Ischemic heart disease	101,858	45,908	55,949
Larynx cancer	1,017	141	876
Leukemia	2,081	1,049	1,033
Lip and oral cavity cancer	2,043	747	1,296
Liver cancer due to other causes	499	105	394
Nasopharynx cancer	267	82	185
Other pharynx cancer	338	75	262
Stomach cancer	1,832	767	1,065
Tracheal, bronchus, and lung cancer	6,750	2,081	4,669
Tuberculosis	252,926	121,242	131,684
Total tobacco-related events	**1,267,605**	**636,280**	**631,324**

Source: GBD Results Tool (database), Global Burden of Disease Study 2016, Global Health Data Exchange, Institute for Health Metrics and Evaluation, Seattle, http://ghdx.healthdata.org/gbd-results-tool.

Note: Incidence is defined as the number of new cases of a given disease during a given period in a specified population. It is also used for the rate at which new events occur in a defined population. It is differentiated from prevalence, which refers to all cases, new or old, in the population at a given time.

of GDP. The cost of health care and lost productivity because of admission to hospital and premature mortality the cost was estimated at between R 1.39 million and R 2.45 million in 1988. Even though these estimates are specific to tobacco-related illnesses, they are far too outdated to represent the current reality in South Africa and cannot be used in the analysis.

Another option is to use cost data from private hospitals in South Africa. To the best of our knowledge, there are no recent studies that have estimated tobacco-related costs in South Africa for the public sector or administrative data that would allow for these estimations. While a middle income country, South Africa's health system is associated with higher private health spending (51.8 percent) than most high income countries of the Organisation for Economic Co-operation and Development; yet, only 17 percent of the population can afford private insurance.[24] Lorenzoni and Roubal (2016) estimate the average price of 28 case types using data from private hospitals from several large medical schemes in South Africa in 2011–13.[25] Of these 28 case types, four may be categorized as tobacco-related: heart failure, malignant neoplasm of bronchus and lung, pneumonia, and acute myocardial infarction, and, for two, we also have information on the number of cases in 2015: bronchus and lung cancer and ischemic heart disease (table 7).[26]

Nonetheless, using only private sector information for two tobacco-related diseases provides severe underestimates of the effects on reduced medical expenses. To mitigate some of these limitations, the analysis could be complemented by using medical costs from countries with a health system similar to South Africa's health system. However, few countries have available medical cost information for tobacco-related diseases.

An alternative is to use the aggregate cost estimates of Goodchild, Nargis, and Tursan d'Espaignet (2018), who apply a cost-of-illness approach to estimate the economic cost of smoking-attributable diseases in 152 countries in 2012.[27] For the purpose of this study, we limit this to direct health care expenditures and exclude indirect costs such as productivity losses from morbidity and mortality.[28] Ideally, we would want disaggregated cost estimates by disease to have a more accurate estimate of these costs. Nonetheless, given

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24 As of 2017, government expenditures on health amounted to R 170.9 billion (8.8 percent of GDP) or US$1.2 billion. Public expenditure on health rose from 3.4 percent of GDP in 1995 to 4.2 percent in 2014, similar to private expenditures on health (4.6 percent of GDP). Moreover, 48.2 percent of health expenditure in South Africa comes from public funds. Out-of-pocket health expenditure has been decreasing over the years and was at 6.5 percent of total health expenditure in 2014. See WDI (World Development Indicators) (database), World Bank, Washington, DC, *http://data.worldbank.org/products/wdi.*

25 "'Case type' refers to categories of hospital services that are similar from a clinical perspective and in terms of their consumption of resources. … The term 'price' relates to the amount paid to health care providers from risk pools, savings accounts, and out-of-pocket rather than the amount claimed. Payments to all private provider types are included" (Lorenzoni and Roubal 2016, 12).

26 Ischemic heart disease is also referred to as coronary artery disease or coronary heart disease. It occurs if arteries are narrowed and increases the chances of heart failure (Cleland and McGowan 1999). Myocardial infarction is one of the manifestations of ischemic heart disease; the cost of myocardial infarction is thus used for ischemic heart disease (Manfroi et al. 2002).

27 Goodchild, Nargis, and Tursan d'Espaignet (2018) group countries according to the country income status classification of the World Bank and the World Health Organization region. The World Bank classifies South Africa as an upper-middle-income country. See "South Africa," World Bank, Washington, DC, *https://data.worldbank.org/country/south-africa.*

28 "Health care expenditures are those incurred from the diagnosis and treatment of smoking-attributable diseases (hospitalization, physician services, medications, etc.), while non–health care expenditures are incurred outside of the health system (e.g., property loss from fires caused by cigarettes)" (Goodchild, Nargis, and Tursan d'Espaignet 2018, 2).

TABLE 7: PRIVATE MEDICAL COSTS AND TOBACCO-RELATED EVENTS, SOUTH AFRICA

	AVERAGE PRICE	NUMBER OF TOBACCO-RELATED EVENTS (2015)	MEDICAL COST (MILLIONS)
M01 acute myocardial infarction	R 71,367	101,858	R 7,269
M04 heart failure	R 32,138	-	
M05 malignant neoplasm of bronchus and lung	R 29,311	6,750	R 198
M07 pneumonia	R 21,897	-	
Total private medical cost			R 7,467
Total medical cost			R 14,415

Source: Lorenzoni and Roubal 2016; tobacco-related events data: GBD Results Tool (database), Global Burden of Disease Study 2016, Global Health Data Exchange, Institute for Health Metrics and Evaluation, Seattle, http://ghdx.healthdata.org/gbd-results-tool; consumer price index: "Table B: CPI Headline," Stats SA, Pretoria, http://www.statssa.gov.za/publications/P0141/CPIHistory.pdf.

Note: Consumer price index data of Statistics South Africa were used to convert to 2015 prices. Admissions with procedures are excluded. Total medical costs assume that private medical costs represent 51.8 percent of total tobacco-related medical costs. To estimate the economic cost of treating tobacco-related diseases, we multiply the average price of each treatment by the number of events related to tobacco (assuming that most individuals were treated at some point).

the data available, the aggregate estimate of Goodchild, Nargis, and Tursan d'Espaignet (2018) is the best alternative. The estimated medical costs in South Africa are R 18.9 billion, equivalent to US$1.4 billion in 2015 prices. More research is needed to obtain more accurate estimates of the economic costs of treating each tobacco-related disease in South Africa.

Table 8 summarizes the most important indicators, including total monthly household expenditures and the share of expenditures on tobacco products. The share of household expenditures on tobacco rises with income until the eighth decile, but decreases for the last two deciles. Thus, tobacco consumption prevalence is concentrated in South Africa's middle class. Meanwhile, poorer households are less likely to have smokers: 18 percent do among the poorest decile, and fewer than 30 percent do in the top two deciles.

TABLE 8: BASELINE DESCRIPTIVE RESULTS, NATIONAL INCOME DYNAMICS STUDY, 2014–15

	DECILE									
	1	2	3	4	5	6	7	8	9	10
Avg. household monthly expenditure (US$)	99	127	155	160	190	215	251	363	577	1,664
Proportion of tobacco expenditure[a]	1.0	1.1	0.9	1.3	1.3	1.5	1.6	1.6	1.1	0.6
Households with tobacco expenditure (%)	17.7	24.6	25.9	27.4	28.4	34.3	33.2	35.7	30.6	30.1
Age, household head	51	50	49	46	45	44	41	40	41	46
Household with a child age 3–6 (%)	59	48	46	34	30	21	16	13	13	5
Average household size	9.4	7.2	6.9	5.5	4.9	4.5	3.8	3.8	3.1	2.7

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: Deciles were created using per capita household expenditure. Exchange rate for 8/31/2015 (Rand to US$), South African Reserve Bank.

a. Proportional to total budget per household in each decile; households that smoke = 1 if a household member reports spending on tobacco products.

TOBACCO USE IS THE SINGLE MOST PREVENTABLE CAUSE OF DEATH IN THE WORLD. GLOBALLY, IT IS ESTIMATED THAT IN 2017, TOBACCO USE WILL CLAIM MORE LIVES THAN

5 RESULTS

To analyze the distributional effects of an increase on tobacco taxes, we estimate the effect on prices and medical expenditures, aggregating these two into a single measure. The price elasticities estimated in table 2, including the lower- and upper-bound elasticities, will allow us to understand how the results could change under different assumptions.

Tobacco price increase

Income changes that arise from an increase in tobacco prices are estimated for each decile based on low-, medium-, and upper-bound elasticities. With equation (4), the price elasticities, and the share of household expenditure on tobacco by decile, we can simulate the effects of an increase in tobacco prices. To show the effect of the elasticities on prices, table 9 also includes estimates of a complete pass-through scenario, whereby the increase in prices is completely transferred to consumers without a reduction in consumption. For instance, if we assume that the prices for tobacco products rose by 25 percent, given the medium-bound elasticity (–0.36) in table 2 and the proportion of tobacco expenditures for the bottom decile (1 percent) in table 8, the expected decrease in household expenditures would be 0.20 percent (table 9). This represents a loss in welfare because consumers would devote a higher share of their incomes to purchase the same amount of tobacco, thereby reducing the consumption of other goods. These results hold for all analyzed scenarios. Nonetheless, the effect of the price increase is relatively progressive, that is, it affects upper-income groups in a larger proportion up to the ninth decile, though the top decile is affected less than the poorest one (figure 3).

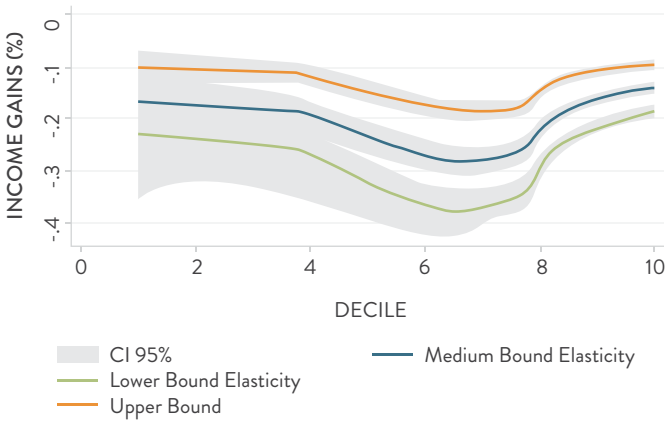
TABLE 9: DIRECT EFFECT OF PRICE INCREASE THROUGH TAXES (%)

	DECILE									
Price shock under	1	2	3	4	5	6	7	8	9	10
Complete pass-through	−0.25	−0.29	−0.22	−0.32	−0.33	−0.37	−0.40	−0.40	−0.27	−0.15
Low-bound elasticity	−0.20	−0.27	−0.21	−0.28	−0.27	−0.39	−0.38	−0.40	−0.29	−0.15
Medium elasticity	−0.14	−0.19	−0.15	−0.20	−0.19	−0.30	−0.28	−0.30	−0.22	−0.11
Upper-bound elasticity	−0.07	−0.12	−0.10	−0.12	−0.11	−0.20	−0.18	−0.20	−0.16	−0.07

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table shows the share of total consumption for each decile. Complete pass-through refers to elasticity equal to zero; consumers pay all the increased prices, and this does not affect the quantity purchased. Estimates assume a price shock of 25 percent.

Figure 3: Income Gains: Direct Effect of Tobacco Taxes (Increase in Expenditure because of tobacco taxes)



Source: Estimates based on data of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

Medical expenses

Table 10 and figure 4 report the income effect of a reduction in medical expenses. As noted above, the model assumes that the health effects of tobacco-related diseases will immediately diminish with the reduction in tobacco consumption.[29] Even though this assumption is implausible in the short term because changes in the effects of tobacco-related diseases take some time to materialize, it provides an upper-bound estimate of the effects of tax increases. Moreover, because the costs of tobacco-related diseases are likely underreported given the available data for the estimates, the results are also likely to underestimate the potential benefits of reduced medical expenditure. The overall results indicate that the reduction in medical expenditures is highly progressive, disproportionally benefiting lower-income groups. This derives from two factors: (1) the higher price elasticity and (2) a lower income base that massively benefits from the reduction in medical costs.

A potential concern with these results comes from South Africa's health financing architecture, where most health services are free for the poor. Although the poor might not pay large amounts of out of pocket health care, there are still intangible costs associated with a household member being sick due to tobacco related use. If we assume that the overall health budget remains the same, the fiscal saving from lower tobacco-related illness would allow for improved health care services to all households, either through lower wait times or through better services.[30] As a robustness check we've allocated a uniform compensation—due to the reduction in total medical costs—as an improved future benefit to

29 Other studies have estimated the pass-through between the decline in tobacco consumption and the effect on medical expenditures. These estimates may also differentiate the effect associated with people who stop consuming tobacco versus people who do not start at all because of the tax policies. Because of data restrictions, these assumptions are not included in the analysis.

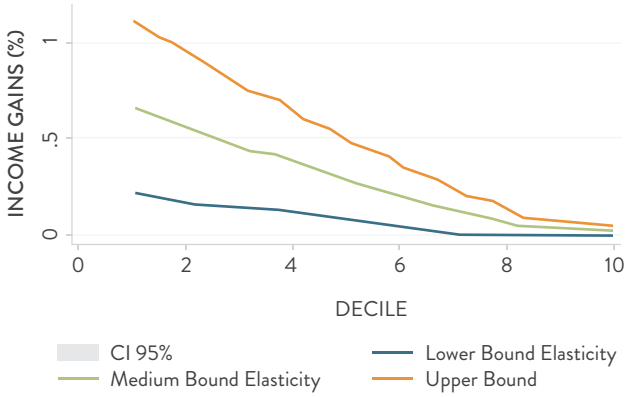
30 As noted earlier, we were not able to obtain out of pocket health expenditures by income level or specific costs of treating tobacco related diseases for the public sector.

TABLE 10: REDUCTION IN MEDICAL COSTS (% OF TOTAL CONSUMPTION)

	DECILE									
Price shock under	1	2	3	4	5	6	7	8	9	10
Lower-bound elasticity	0.40	0.13	0.07	0.15	0.15	-0.03	0.03	0.00	-0.01	0.00
Medium elasticity	0.91	0.57	0.41	0.43	0.36	0.16	0.16	0.09	0.03	0.01
Upper-bound elasticity	1.42	1.00	0.76	0.71	0.57	0.35	0.29	0.18	0.07	0.03

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.
Note: The table reports the share of total consumption for each decile.

Figure 4: Income Gains: Medical Costs of Tobacco Taxes (Reduction in Medical Expenditures)



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

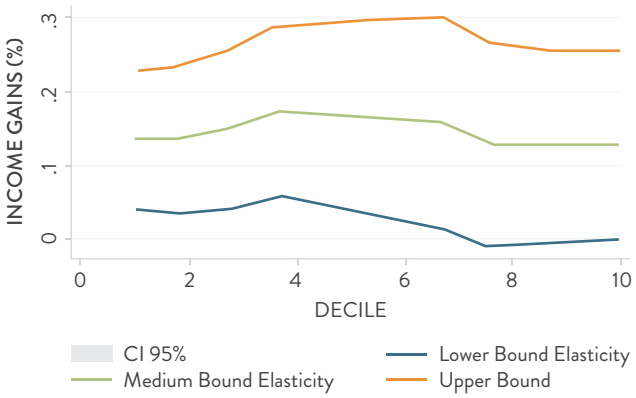
all households. This implies that the long-run impact of tobacco taxation remains progressive since higher health spending will be progressive in relative terms, and the estimates on productive life will continue to be progressive (see annex D).

Income gains deriving from an increase in working life years

We estimate the cost of working life lost because of tobacco consumption, assuming that the impact of lower tobacco use on health and work-generated income is direct. The 1.3 million deaths attributed to tobacco consumption are distributed using the occurrence of mortality profile. For each death, working years lost are divided across deciles proportionately to the number of households that consume tobacco in each income group. Using equation (6) and table 5, we can calculate the results of the tax increase. The results show that the reduction in tobacco consumption and the expected reduction in work years lost have positive impacts on welfare. Overall, the gains are evenly distributed across income groups; however, elasticities vary across deciles, generating an important impact on lower-income groups (figure 5; table 11).[31]

31 Years of life lost were also estimated using a 3 percent discount rate (980,421 years) and the results do not vary.

Figure 5: Income Gains: Production During Years Lost, by Decile



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: Estimates assume a price shock of 25 percent. Years of life lost have been estimated using all deaths from tobacco-related diseases. Because nearly half of 2015 mortality data in South Africa did not report the smoking status of the deceased, all deaths from tobacco-related diseases are included in the simulation.

TABLE 11: YEARS OF WORKING LIFE LOST (%)

	DECILE									
Price shock under	1	2	3	4	5	6	7	8	9	10
Lower-bound elasticity	0.06	0.03	0.02	0.07	0.08	-0.02	0.03	0.01	-0.04	0.01
Medium elasticity	0.13	0.13	0.13	0.18	0.21	0.12	0.17	0.16	0.08	0.14
Upper-bound elasticity	0.21	0.24	0.24	0.30	0.33	0.27	0.31	0.31	0.21	0.27

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table reports the share of total consumption for each decile. Years of life lost have been estimated using all deaths from tobacco-related diseases. Because nearly half of 2015 mortality data in South Africa did not report the smoking status of the deceased, all deaths from tobacco-related diseases are included in the simulation.

Net effects: total distributional impact

The aggregate effect of an increase on tobacco taxes is highly progressive; in the long run, poorer deciles benefit more than richer ones from the tax increase (table 12; figure 6). The positive effect of reduced medical expenses and years of life gained, diminish the negative price effect across all deciles in all three elasticity scenarios. Moreover, the benefits are amplified if we compare the lower-bound elasticity with the upper-bound elasticity as in the latter case total effects are positive for all deciles.

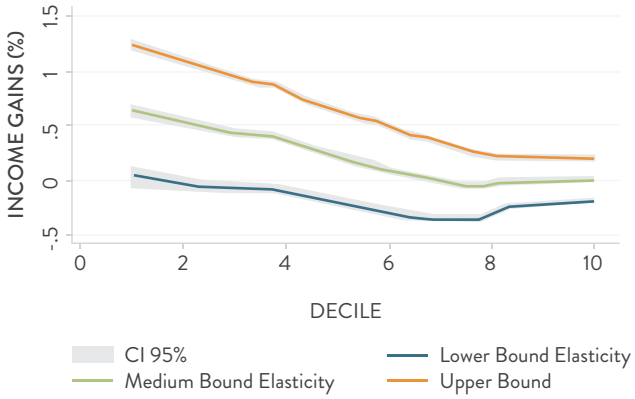
The same analysis was conducted for income quintiles to mitigate potential bias given South Africa's wealth distribution (see section 4). The results are robust for different group-

TABLE 12: NET EFFECT ON HOUSEHOLD EXPENDITURES (%)

	DECILE									
Price shock under	1	2	3	4	5	6	7	8	9	10
Lower-bound elasticity	0.26	−0.10	−0.12	−0.06	−0.04	−0.44	−0.33	−0.38	−0.35	−0.14
Medium elasticity	0.91	0.51	0.39	0.42	0.37	−0.01	0.05	−0.04	−0.11	0.04
Upper-bound elasticity	1.55	1.11	0.90	0.90	0.79	0.41	0.42	0.30	0.12	0.22

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.
Note: The table reports the share of total consumption for each decile.

Figure 6: Total Income Effect: Direct and Indirect Effects of Tobacco Taxes (Tobacco Price Increase, Medical Expenditure, and Working Years Gained)



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

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ings (see annex E).

DISCUSSION

Despite the wealth of research on the negative effects of tobacco consumption and on the benefits of various public policy mechanisms aimed at reducing tobacco use, questions remain about the progressivity or regressivity that these entail. The implementation of tobacco taxes, is considered one of the most effective ways to discourage tobacco use. Nonetheless, this policy has a direct impact on household incomes, especially among low-income households that are more likely to smoke, have limited access to health insurance and adequate health care. Moreover, the net effect of an increase in tobacco taxes depends on the price elasticity of this product across different sectors of the population. The price elasticity determines the magnitude of the income shock and the benefits gained from the decline in tobacco consumption.

To assess the net welfare gains from this policy, one must look beyond the direct impact on household income and consider other benefits of lower tobacco consumption, including a reduction in medical costs and an increase in the potential working years associated with good health. Thus, it is critical to justify the maintenance or intensification of the use of tobacco taxes by means of a demonstration of the aggregate monetary gains or losses generated. Moreover, the policy should focus on low-income households that are more likely to smoke and, hence, tend to be the most affected by consumption taxes. One of the main motivations of this study is to weigh the main costs and benefits of tobacco taxation to determine if, in the end, the policy is regressive.

The results indicate that the aggregate effect of an increase on tobacco taxes is highly progressive. If we include the benefits through lower medical expenses and an increase in working years, the negative effect from an increase in prices is eliminated. Overall, the net effect shows an aggregate welfare gain among the bottom five deciles relative to the medium-bound elasticity and among all income groups relative to the upper-bound elasticity scenario.

These results are partly driven by lower tobacco price elasticities relative to what has been previously estimated for developing countries (–0.25 estimated elasticity for South Africa; –0.4 and –0.8 for developing countries) (Chaloupka et al. 2000). Earlier estimates for South Africa have relied on national aggregate time series data on the production and sales of tobacco products. With such data, it is difficult to differentiate between the number of cigarettes sold, how many were consumed, the price paid, or how many come from illicit trade. Instead, this study uses a longitudinal panel whereby there are repeated observations on

individuals on both purchases and the prices paid over time for tobacco products.

South Africa's low price elasticities may also be explained by the country's experience with tobacco control policies and the changing structure of the tobacco market in 2010. Moreover, these estimates likely capture the illicit cigarette market. Following the profound changes produced by tobacco legislation, smoking prevalence decreased by over 10 percentage points. People who continued to smoke are probably more addicted and possibly less sensitive to price changes.[32] To test our hypothesis, we applied the tobacco price elasticities by income quartiles estimated by van Walbeek (2002b) to these simulations.[33] These elasticities are much higher than the ones used in this study (−0.25 versus −1.1) and were also estimated at a time when smoking prevalence was significantly higher in South Africa. As of 2015, less than a fifth of households report spending money on cigarettes, compared with over 40 percent in 1995.[34] As expected, the results of a tobacco tax increase using higher elasticities, such as that of van Walbeek (2002b), indicate a positive and highly progressive effect of an increase in tobacco prices, one that, in magnitude, is larger than the results presented in table 12 (see annex F for simulation results). Overall, tobacco tax increases have a small effect in the presence of a low tobacco price elasticity. Thus, a population that is not as sensitive to tobacco price changes, as is the status quo in South Africa, will not reduce consumption sufficiently to experience even more gains from the health and work benefits.

In Chile, Moldova, and Ukraine, the authors find evidence that tobacco price increases are also a progressive policy in favor of low-income groups (Fuchs and Meneses 2017a, 2017b, 2018). Nonetheless, these countries present much higher smoking prevalence rates and higher tobacco price elasticities than South Africa and do not have the same history of substantial tobacco control policies.[35] These low price elasticities indicate that a uniform increase in tobacco taxes should not be the only policy in place to reduce tobacco consumption in South Africa further.

In addition, we hypothesize that limited data availability on the medical costs of tobacco-related diseases accounts for a lower-bound estimate of the potential benefits of reduced medical expenses. The medical costs of treating tobacco-related diseases must be investigated further in South Africa to have more accurate estimates of the distributional effects of tobacco taxation in the country. Similarly, Pillay-van Wyk et al. (2016) indicate that mortality by disease is severely underreported in the South African data, presenting yet

32 Since the paper uses reported (expenditure on tobacco) prices, total elasticity for the different deciles cannot be estimated. Thus, the price elasticities in this paper are conditional elasticities.

33 Van Walbeek (2002b) uses the Income and Expenditure Survey of 1990 and 1995 and applies the same aggregate price across all households to estimate elasticities by income group.

34 Estimates using the 1995 and 2015 Income and Expenditure Survey.

35 Smoking prevalence among adult males in Chile was 40.0 percent in 2015, 45.7 percent in Moldova, and 49.4 percent in Ukraine, compared with only 31.0 percent in South Africa. See WDI (World Development Indicators) (database), World Bank, Washington, DC, *http://data.worldbank.org/products/wdi.*

another lower-bound indicator for estimating aggregate wealth effects. Moreover, most low-income households in South Africa still have very limited access to specialist care; when they get cancer, heart attacks or strokes, they simply perish with little or no care. Thus, the impact of increased life expectancy and reduced morbidity would probably be much more significant than the impact of medical costs reductions for the poor

These three factors combined highlight that more research is needed if we are to understand the distributional effects of tobacco taxation in South Africa.

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ANNEX

A. Tobacco Price Elasticity by Decile[36]

Let Q_{id} be defined as the average quantity smoked per day by individual *i* in income decile *d; P* the average price per cigarette (unit value of tobacco use); I_{id} the real household per capita income per adult equivalent of individual *i;* and X_{id} the individual level characteristics. Then, the smoking intensity equation is written as follows:

$$lnQ_{id} = \beta_0 + \beta_1 lnP + \beta_2 lnI_{id} + \beta_3 X_{id} + \mu_{id} \qquad \text{(A1)}$$

The empirical analysis of equation (A1) assumes a log-log relationship among smoking intensity, price, and income. lnQ_{id} is observed if and only if the individual from a given decile *d* is a current smoker. The corresponding Hausman test does not reject the null hypothesis that the differences between the random effects model and the fixed effects model estimates are not systematic [$Chi^2(15) = 105{:}34$; $p = 0{:}000$]. Therefore, the fixed effects model is the consistent model because it controls for unobserved heterogeneity. However, if time-invariant variables such as gender, race, and religion are regarded as significantly important in explaining the outcome variable (smoking intensity) and if the degree of variability of our main variable(s) (within variation) is lower, then the random effect model is preferred to the fixed effects model, that is, using the fixed effects model will then produce less efficient estimates (Plümper and Troeger 2007).

The NIDS uses the following questions to measure individual smoking behavior. For current smokers, do you smoke cigarettes? For nonsmokers, did you ever smoke cigarettes regularly? Both smokers and ex-smokers were asked the age at which they first smoked cigarettes, but only ex-smokers were asked when they last smoked cigarettes regularly. Finally, individuals were asked to indicate, on average, the number of cigarettes they smoke per day. Only individuals who smoke cigarettes remain in the sample for estimating smoking intensity, while nonsmokers and former smokers are excluded. A smoker is defined as someone who consumes some positive amounts of cigarettes at the time of the interview. Smoking intensity is defined as the average number of cigarettes an individual smokes per day. Cigarette prices (unit value) are real household per capita expenditure on tobacco per day. These values are deflated using the consumer price index so that each cigarette price is in 2010 prices.

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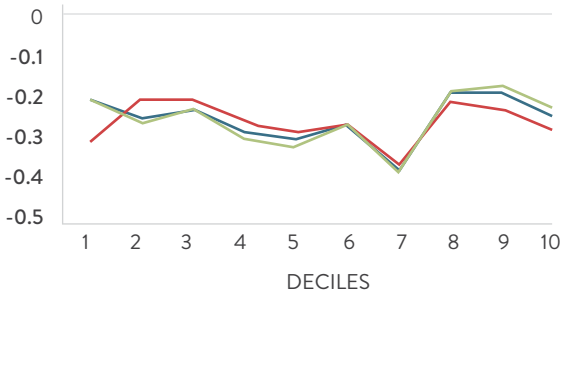
36 Developed by Alfred Kechia Mukong of the University of Cape Town.

Figure A1: Tobacco Price Elasticities Using a Near Balanced Panel, by Model

Figure A2: Tobacco Price Elasticities Using an Unbalanced Panel, by Model



Source: Estimates based on data of the National Income Dynamics Study, waves 1–4, 2008–15.

Note: Unbalanced panel data retain individuals who answered at least two waves of the study. The near balanced panel is balanced by design, but unbalanced because of missing observations.

Since the paper uses reported (expenditure on tobacco) prices, total elasticity for the different deciles cannot be estimated. Thus, the price elasticities in this paper are conditional elasticities.

Several models were tested before deciding the final elasticities to use in the model (tables A3–A14). Both a balanced and unbalanced panel were considered. Despite the large number of observations that are dropped in using a balanced panel, this allows us to control for individual time invariant effects (table A1). Moreover, coefficients for all deciles remain statistically significant at the 95 percent level if a balanced panel with random effects is used (table A3).

TABLE A1: NUMBER OF OBSERVATIONS, BY PANEL TYPE

DECILE	UNBALANCED	BALANCED
1	446	115
2	501	92
3	565	131
4	818	221
5	889	263
6	767	204
7	527	122
8	486	102
9	430	87
10	257	70

Source: Estimates based on data of the National Income Dynamics Study, waves 1–4, 2008–15.

TABLE A2: AVERAGE TOBACCO PRICE ELASTICITY, BY MODEL

	DECILE								QUINTILE						
	Balanced Panel				Unbalanced				Balanced Panel				Unbalanced		
	RE	FE	OLS		RE	FE	OLS		RE	FE	OLS		RE	FE	OLS
1	-0.36*	-0.45*	-0.36*	1	-0.22*	-0.32*	-0.22*	1	-0.33*	-0.31*	-0.33*	1	-0.27*	-0.28*	-0.27*
2	-0.26*	-0.09*	-0.26*	2	-0.26*	-0.21*	-0.27*	2	-0.27*	-0.24*	-0.27*	2	-0.30*	-0.28*	-0.30*
3	-0.24*	-0.26*	-0.24*	3	-0.24*	-0.22*	-0.24*	3	-0.26*	-0.27*	-0.26*	3	-0.31*	-0.30*	-0.31*
4	-0.31*	-0.27*	-0.31*	4	-0.3*	-0.27*	-0.31*	4	-0.19*	-0.22*	-0.14*	4	-0.29*	-0.30*	-0.29*
5	-0.34*	-0.34*	-0.35*	5	-0.31*	-0.3*	-0.33*	5	-0.17*	-0.19*	-0.17*	5	-0.19*	-0.21*	-0.19*
6	-0.17*	-0.13*	-0.19*	6	-0.28*	-0.28*	-0.28*	Avg.	**-0.24***	**-0.17***	**-0.23***	Avg.	**-0.27***	**-0.27***	**-0.28***
7	-0.24*	-0.19*	-0.27*	7	-0.39*	-0.38*	-0.4*								
8	-0.21*	-0.26*	-0.16*	8	-0.2*	-0.22*	-0.19*								
9	-0.13*	-0.16*	-0.12*	9	-0.2*	-0.24*	-0.18*								
10	-0.22*	-0.15*	-0.22*	10	-0.26*	-0.29*	-0.24*								
Avg.	**-0.25***	**-0.23***	**-0.25***	Avg.	**-0.27***	**-0.27***	**-0.27***								

Source: Estimates based on data of the National Income Dynamics Study, waves 1–4, 2008–15.

Note: Unbalanced panel data retain individuals who answered at least two waves of the study. The near balanced panel is balanced by design, but unbalanced because of missing observations.

Balanced Panel Results, by Decile

TABLE A3: REGRESSION RESULTS, RANDOM EFFECTS, BY DECILE

	DECILE									
	1		2		3		4		5	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lnunit_value	-0.34***	-0.36***	-0.27***	-0.26***	-0.24***	-0.24***	−0.33***	-0.31***	-0.28***	-0.34***
	(0.06)	(0.07)	(0.06)	(0.09)	(0.04)	(0.05)	(0.03)	(0.04)	(0.03)	(0.04)
lnincome		0.07		0.14		0.13**		0.14**		0.17***
		(0.10)		(0.14)		(0.06)		(0.07)		(0.06)
Observation	132	115	108	92	160	131	256	221	304	263
Number of pid	33	33	27	27	40	40	64	64	76	76

TABLE A4: REGRESSION RESULTS, FIXED EFFECTS BY DECILE

	DECILE									
	1		2		3		4		5	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lnunit_value	-0.39***	-0.45***	-0.18***	-0.09	-0.24***	-0.26***	−0.31***	-0.27***	-0.29***	-0.34***
	(0.07)	(0.09)	(0.07)	(0.10)	(0.05)	(0.05)	(0.04)	(0.04)	(0.03)	(0.04)
lnincome		-0.06		-0.25		0.14*		0.05		0.12*
		(0.13)		(0.20)		(0.07)		(0.10)		(0.06)
Observation	132	115	108	93	160	134	256	223	304	265
R-Squared	0.23	0.36	0.09	0.23	0.18	0.38	0.27	0.34	0.26	0.36
Number of pid	33	33	27	27	40	40	64	64	76	76

TABLE A5: REGRESSION RESULTS, POOLED OLS, BY DECILE

	DECILE									
	1		2		3		4		5	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lnunit_value	-0.33***	-0.36***	-0.30***	-0.26***	-0.24***	-0.24***	−0.33***	-0.31***	-0.25***	-0.35***
	(0.06)	(0.07)	(0.06)	(0.09)	(0.05)	(0.05)	(0.03)	(0.04)	(0.03)	(0.04)
lnincome		0.07		0.14		0.13**		0.15**		0.22***
		(0.10)		(0.14)		(0.06)		(0.07)		(0.06)
Observation	132	115	108	92	160	131	256	221	304	263
R-Squared	0.19	0.37	0.18	0.41	0.14	0.42	0.34	0.36	0.15	0.37

Note: Wave 4 is used as the basis for categorizing individuals into their respective deciles and using near balanced panel data (balanced by design and unbalanced because of missing observations). Unit value (price) is the only control in the first column of each decile; demographic controls are included in the second column (age, gender, education, religion, and alcohol use).

	DECILE									
	6		7		8		9		10	
Variables	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
lnunit_value	-0.16***	-0.17***	-0.20***	-0.24***	-0.17***	-0.21***	-0.11**	-0.13**	-0.23***	-0.22***
	(0.04)	(0.04)	(0.05)	(0.06)	(0.05)	(0.07)	(0.05)	(0.06)	(0.04)	(0.05)
lnincome		0.00		0.09		0.28***		0.06		0.10
		(0.06)		(0.08)		(0.11)		(0.09)		(0.08)
Observation	232	204	136	122	120	102	96	87	80	70
Number of pid	58	58	34	34	30	30	24	24	20	20

	DECILE									
	6		7		8		9		10	
Variables	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
lnunit_value	-0.15***	-0.13***	-0.19***	-0.19***	-0.22***	-0.26***	-0.16**	-0.16**	-0.25***	-0.15**
	(0.05)	(0.04)	(0.06)	(0.07)	(0.06)	(0.07)	(0.06)	(0.07)	(0.05)	(0.07)
lnincome		-0.07		0.07		0.36**		0.32**		-0.09
		(0.07)		(0.09)		(0.15)		(0.13)		(0.14)
Observation	232	204	136	122	120	102	96	87	80	70
R-Squared	0.06	0.23	0.10	0.26	0.15	0.36	0.09	0.32	0.34	0.41
Number of pid	58	58	34	34	30	30	24	24	20	20

	DECILE									
	6		7		8		9		10	
Variables	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
lnunit_value	-0.18***	-0.19***	-0.20***	-0.27***	-0.06	-0.16**	-0.04	-0.12**	-0.18***	-0.22***
	(0.04)	(0.04)	(0.05)	(0.06)	(0.07)	(0.08)	(0.05)	(0.06)	(0.05)	(0.05)
lnincome		0.09		0.03		0.34***		0.04		0.14*
		(0.07)		(0.08)		(0.11)		(0.08)		(0.07)
Observation	232	204	136	122	120	102	96	87	80	70
R-Squared	0.08	0.34	0.10	0.39	0.01	0.37	0.01	0.44	0.13	0.56

Unbalanced Panel Results, by Decile

TABLE A6: REGRESSION RESULTS, RANDOM EFFECTS, BY DECILE

	DECILE									
	1		2		3		4		5	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lnunit_value	-0.22***	-0.22***	-0.25***	-0.26***	-0.21***	-0.24***	−0.31***	-0.30***	-0.28***	-0.31***
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
lnincome		0.19***		0.03		0.09**		0.02		0.10***
		(0.04)		(0.04)		(0.04)		(0.04)		(0.03)
Observation	600	446	690	501	763	565	1,053	818	1,157	889
Number of pid	234	232	271	267	292	284	396	393	427	425

TABLE A7: REGRESSION RESULTS, FIXED EFFECTS, BY DECILE

	DECILE									
	1		2		3		4		5	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lnunit_value	-0.20***	-0.32***	-0.23***	-0.21***	0.23***	-0.22***	−0.30***	-0.27***	-0.27***	-0.30***
	(0.03)	(0.05)	(0.03)	(0.04)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
lnincome		0.16**		-0.07		0.06		0.04		0.06
		(0.07)		(0.07)		(0.05)		(0.06)		(0.04)
Observation	600	446	690	503	763	574	1,053	822	1,157	893
R-Squared	0.10	0.26	0.14	0.17	0.17	0.24	0.25	0.25	0.21	0.24
Number of pid	234	232	271	268	292	287	396	394	427	425

TABLE A8: REGRESSION RESULTS, POOLED ORDINARY LEAST SQUARES, BY DECILE

	DECILE									
	1		2		3		4		5	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lnunit_value	-0.22***	-0.22***	-0.26***	-0.27***	-0.21***	-0.24***	−0.32***	-0.31***	-0.28***	-0.33***
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
lnincome		0.19***		0.04		0.09**		0.03		0.14***
		(0.04)		(0.04)		(0.04)		(0.04)		(0.04)
Observation	600	446	690	501	763	565	1,053	818	1,157	889
R-Squared	0.12	0.21	0.16	0.23	0.12	0.24	0.26	0.29	0.17	0.26

Note: Wave 4 is used as the basis for categorizing individuals into their respective deciles and using an unbalanced panel, where individuals are present in at least two waves. Unit value (price) is the only control in the first column of each decile; demographic controls are included in the second column (age, gender, education, religion, and alcohol use).

	DECILE									
	6		7		8		9		10	
Variables	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
lnunit_value	-0.29***	-0.28***	-0.33***	-0.39***	-0.24***	-0.20***	-0.16***	-0.20***	-0.27***	-0.26***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.04)	(0.04)
lnincome		0.06		0.04		0.09**		0.13***		0.11**
		(0.03)		(0.04)		(0.04)		(0.04)		(0.05)
Observation	980	767	698	527	641	486	529	430	331	257
Number of pid	362	360	275	265	242	238	202	200	127	124

	DECILE									
	6		7		8		9		10	
Variables	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
lnunit_value	-0.29***	-0.28***	-0.34***	-0.38***	-0.23***	-0.22***	-0.18***	-0.24***	-0.28***	-0.29***
	(0.02)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)	(0.05)
lnincome		0.00		0.09		0.09		0.21***		0.02
		(0.05)		(0.06)		(0.06)		(0.06)		(0.08)
Observation	980	767	698	529	641	489	529	430	331	258
R-Squared	0.21	0.23	0.27	0.36	0.16	0.23	0.12	0.25	0.22	0.30
Number of pid	362	360	275	267	242	238	202	200	127	124

	DECILE									
	6		7		8		9		10	
Variables	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
lnunit_value	-0.28***	-0.28***	-0.32***	-0.40***	-0.23***	-0.19***	-0.13***	-0.18***	-0.21***	-0.24***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)
lnincome		0.08**		0.04		0.10**		0.10**		0.17***
		(0.03)		(0.04)		(0.04)		(0.04)		(0.05)
Observation	980	767	698	527	641	486	529	430	331	257
R-Squared	0.20	0.31	0.18	0.36	0.12	0.29	0.04	0.30	0.06	0.34

Unbalanced Panel Results, by Quintile

TABLE A9: REGRESSION RESULTS, RANDOM EFFECTS, BY QUINTILE

	QUINTILE									
	1		2		3		4		5	
lnunit_value	-0.25***	-0.27***	-0.28***	-0.30***	-0.29***	-0.31***	−0.27***	-0.29***	-0.17***	-0.19***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
lnincome		0.14***		0.09***		0.13***		0.12***		0.21***
		(0.02)		(0.02)		(0.02)		(0.02)		(0.03)
Constant	0.35***	-0.12	0.23***	-0.31**	0.26***	-0.07	0.59***	-0.05	1.47***	0.66
	(0.08)	(0.18)	(0.06)	(0.15)	(0.06)	(0.16)	(0.08)	(0.24)	(0.09)	(0.63)
Observations	1,648	1,295	2,208	1,780	2,513	2,022	1,599	1,270	1,013	831
Number of pid	675	670	862	855	956	952	636	623	399	394

TABLE A10: REGRESSION RESULTS, FIXED EFFECTS, BY QUINTILE

	QUINTILE									
	1		2		3		4		5	
lnunit_value	-0.24***	-0.28***	-0.29***	-0.28***	-0.29***	-0.30***	−0.27***	-0.30***	-0.19***	-0.21***
	(0.02)	(0.03)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
lnincome		0.06		0.04		0.07**		0.08**		0.12***
		(0.04)		(0.03)		(0.03)		(0.03)		(0.04)
Constant	0.43***	-2.99	0.20**	0.95	0.27***	-2.47	0.56***	1.06	1.41***	1.08
	(0.11)	(2.47)	(0.08)	(1.86)	(0.08)	(1.72)	(0.09)	(2.14)	(0.10)	(2.53)
Observations	1,648	1,295	2,208	1,780	2,513	2,022	1,599	1,270	1,013	831
R-Squared	0.14	0.18	0.24	0.26	0.21	0.23	0.21	0.25	0.12	0.18
Number of pid	675	670	862	855	956	952	636	623	399	394

TABLE A11: REGRESSION RESULTS, POOLED ORDINARY LEAST SQUARES, BY QUINTILE

	QUINTILE									
	1		2		3		4		5	
lnunit_value	-0.25***	-0.27***	-0.28***	-0.30***	-0.29***	-0.31***	−0.25***	-0.29***	-0.13***	-0.19***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
lnincome		0.14***		0.10***		0.17***		0.14***		0.24***
		(0.02)		(0.02)		(0.02)		(0.02)		(0.03)
Constant	0.33***	-0.12	0.24***	-0.34**	0.27***	-0.17	0.66***	0.02	1.70***	0.86*
	(0.08)	(0.18)	(0.07)	(0.15)	(0.07)	(0.16)	(0.08)	(0.22)	(0.11)	(0.52)
Observations	1,648	1,295	2,208	1,780	2,513	2,022	1,599	1,270	1,013	831
R-Squared	0.15	0.20	0.21	0.25	0.19	0.25	0.14	0.20	0.03	0.21

Note: Wave 4 is used as the basis for categorizing individuals into their respective deciles and using an unbalanced panel, where individuals are present in at least two waves. Unit value (price) is the only control in the first column of each decile; demographic controls are included in the second column (age, gender, education, religion, and alcohol use).

Balanced Panel Results, by Quintile

TABLE A12: REGRESSION RESULTS, RANDOM EFFECTS, BY QUINTILE

	QUINTILE									
	1		2		3		4		5	
lnunit_value	-0.31***	-0.33***	-0.30***	-0.27***	-0.23***	-0.26***	−0.18***	-0.19***	-0.16***	-0.17***
	(0.04)	(0.05)	(0.03)	(0.03)	(0.02)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
lnincome		0.17**		0.15***		0.14***		0.19***		0.18***
		(0.07)		(0.05)		(0.04)		(0.06)		(0.05)
Constant	-0.00	0.09	0.19	-0.33	0.57***	0.33	1.12***	0.96	1.74***	1.09
	(0.25)	(0.60)	(0.14)	(0.36)	(0.14)	(0.42)	(0.20)	(0.66)	(0.18)	(0.88)
Observations	240	208	416	357	536	469	256	224	176	157
Number of pid	60	60	104	104	134	134	64	64	44	44

TABLE A13: REGRESSION RESULTS, FIXED EFFECTS, BY QUINTILE

	QUINTILE									
	1		2		3		4		5	
lnunit_value	-0.28***	-0.31***	-0.28***	-0.24***	-0.24***	-0.27***	-0.21***	-0.22***	-0.20***	-0.19***
	(0.05)	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
lnincome		-0.08		0.09		0.05		0.13**		0.16*
		(0.11)		(0.06)		(0.05)		(0.07)		(0.09)
Constant	0.14	-1.83	0.28*	-1.16	0.53***	-1.88	0.98***	-3.48	1.54***	-3.28
	(0.29)	(6.79)	(0.16)	(3.89)	(0.15)	(3.01)	(0.20)	(3.82)	(0.18)	(6.18)
Observations	240	208	416	357	536	469	256	224	176	157
R-Squared	0.15	0.24	0.23	0.29	0.16	0.24	0.13	0.26	0.18	0.24
Number of pid	60	60	104	104	134	134	64	64	44	44

TABLE A14: REGRESSION RESULTS, POOLED ORDINARY LEAST SQUARES, BY QUINTILE

	QUINTILE									
	1		2		3		4		5	
lnunit_value	-0.31***	-0.33***	-0.30***	-0.27***	-0.22***	-0.26***	−0.12***	-0.14***	-0.06	-0.17***
	(0.04)	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
lnincome		0.17**		0.17***		0.24***		0.26***		0.22***
		(0.07)		(0.04)		(0.05)		(0.06)		(0.05)
Constant	-0.04	0.09	0.15	-0.32	0.62***	0.10	1.41***	0.95*	2.19***	2.19***
	(0.25)	(0.60)	(0.14)	(0.34)	(0.15)	(0.36)	(0.22)	(0.55)	(0.20)	(0.72)
Observations	240	208	416	357	536	469	256	224	176	157
R-Squared	0.18	0.30	0.26	0.31	0.12	0.27	0.03	0.21	0.01	0.40

Note: Wave 4 is used as the basis for categorizing individuals into their respective deciles and using a near balanced panel data (balanced by design and unbalanced because of missing observations). Unit value (price) is the only control in the first column of each decile; demographic controls are included in the second column (age, gender, education, religion, and alcohol use).

B: Median Price Paid by Households for a 20-Cigarette Pack, Last 30 Days, 2008–15

	DECILE										
Year	1	2	3	4	5	6	7	8	9	10	MEDIAN
2008	1.6	2.0	2.8	2.4	2.8	4.6	3.8	6.7	11.1	13.5	4.97
2010/11	1.6	2.7	2.7	4.3	5.3	6.4	5.3	10.7	11.4	12.0	7.41
2012	5.0	7.5	5.9	7.1	7.3	6.5	10.6	11.7	14.9	17.0	9.75
2014/15	4.1	6.9	6.7	6.9	6.7	11.4	13.8	11.5	13.8	20.1	10.71

Note: Wave 4 is used as the basis for categorizing individuals into their respective deciles and using a near balanced panel data (balanced by design and unbalanced because of missing observations). Unit value (price) is the only control in the first column of each decile; demographic controls are included in the second column (age, gender, education, religion, and alcohol use).

C: Tobacco-Related Deaths, by Smoking Status and Gender, 2015 (broad groups)

	ALL			WOMAN			MAN			TOTAL
	Smoker	Nonsmoker	Unknown	Smoker	Nonsmoker	Unknown	Smoker	Nonsmoker	Unknown	
Tobacco-related deaths	32,755	68,670	71,816	7,930	41,499	34,489	24,825	27,171	37,327	173,241
COPD	4,343	4,264	6,472	1,235	2,245	2,750	3,108	2,019	3,722	15,079
Tuberculosis	7,999	12,686	12,150	1,217	6,838	4,738	6,782	5,848	7,412	32,835
Ischemic heart disease	2,169	4,722	5,312	537	2,528	2,208	1,632	2,194	3,104	12,203
Lung cancer	2	3	6	-	1	2	2	2	4	11
Upper aero-digestive cancers	310	230	495	63	101	171	247	129	324	1,035
Digestive, urinary, cervical cancer	2,082	4,165	5,190	491	2,220	2,198	1,591	1,945	2,992	11,437
Stroke and other vascular conditions	9,876	30,152	26,640	3,171	20,151	14,908	6,705	10,001	11,732	66,668
Other respiratory diseases	4,261	9,041	11,702	856	5,483	5,699	3,405	3,558	6,003	25,004
Other medical conditions	1,713	3,407	3,849	360	1,932	1,815	1,353	1,475	2,034	8,969
Other causes of death	46,972	104,822	145,303	9,276	61,224	68,314	37,696	43,598	76,989	297,097
Total	79,727	173,492	217,119	17,206	102,723	102,803	62,521	70,769	114,316	470,338

Source: Stats SA 2017

Note: A smoker is defined as someone who smoked any form of tobacco on most days (an average of more than six months a year, or four or more days a week), five years previous to the interview. If smoking started less than five years before death, the answer is No. If smoking started more than five years before death, but for less than six months, then the answer is No.

D. Simulation Applying Uniform Compensation: Reduction in Medical Expenditure

In South Africa most health services are free for the poor. Although they might not pay large amounts of out of pocket health care, there are still intangible costs associated with a household member being sick due to tobacco related use. If we assume that the overall health budget remains the same, the fiscal saving from lower tobacco-related illness would allow for improved health care services to all households, either through lower wait times or through better services. As a robustness check we've allocated a uniform compensation of 0.1- due to the reduction in total medical costs- as an improved future benefit to all households. The long-run impact of tobacco taxation remains progressive (see table D1-D2; figure D1-D2).

TABLE D1: REDUCTION IN MEDICAL COSTS (%)

	DECILE									
Price shock under	1	2	3	4	5	6	7	8	9	10
Lower-bound elasticity	0.66	0.15	0.08	0.16	0.15	-0.02	0.02	0.00	-0.01	0.00
Medium elasticity	1.48	0.66	0.46	0.45	0.36	0.13	0.14	0.08	0.03	0.01
Upper-bound elasticity	2.31	1.17	0.84	0.74	0.58	0.29	0.25	0.15	0.07	0.03

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table reports the share of total consumption for each decile. Uniform compensation of 0.1 is applied to all deciles for assumed reduction in medical expenditure.

Figure D1: Income Gains: Medical Costs of Tobacco Taxes (Reduction in Medical Expenditures, Uniform Compensation)

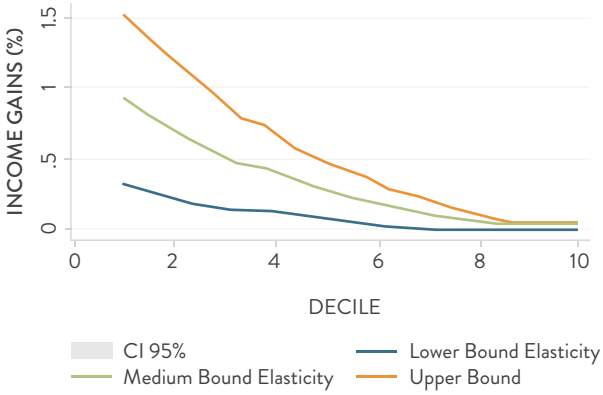
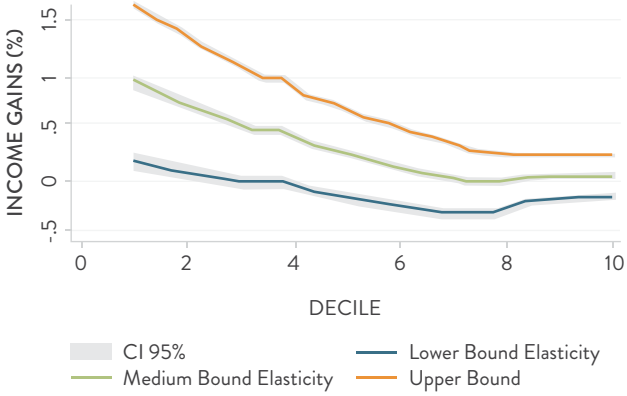


Figure D2: Total Income Effect: Direct and Indirect Effects of Tobacco Taxes (Tobacco Price Increase, Medical Expenditure, and Working Years Gained)



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: Estimates assume a price shock of 25 percent. Uniform compensation of 0.1 is applied to all deciles for assumed reduction in medical expenditure.

TABLE D2: NET EFFECT ON HOUSEHOLD EXPENDITURES (%)

	DECILE									
Price shock under	1	2	3	4	5	6	7	8	9	10
Lower-bound elasticity	0.52	-0.08	-0.11	-0.05	-0.04	-0.43	-0.33	-0.38	-0.35	-0.14
Medium elasticity	1.48	0.60	0.44	0.44	0.38	-0.04	0.02	-0.06	-0.12	0.04
Upper-bound elasticity	2.44	1.29	0.98	0.93	0.80	0.36	0.38	0.26	0.12	0.22

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table reports the share of total consumption for each decile.

Simulations using Quintiles

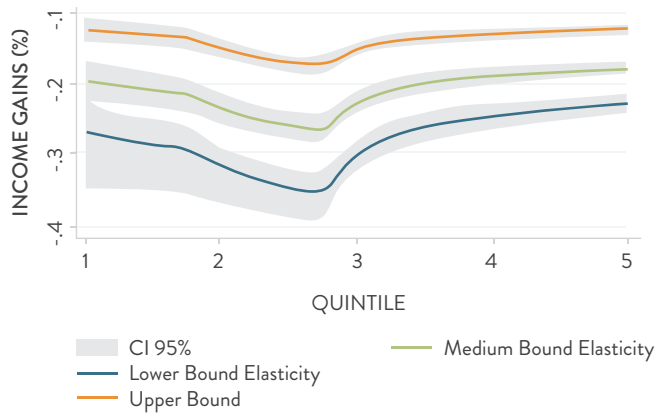
TABLE E1: DIRECT EFFECT OF PRICE INCREASE OF TAXES (%)

	QUINTILE				
Price shock under	1	2	3	4	5
Complete pass-through	-0.27	-0.28	-0.36	-0.40	-0.18
Low-bound elasticity	-0.23	-0.25	-0.33	-0.41	-0.19
Medium elasticity	-0.16	-0.18	-0.24	-0.31	-0.14
Upper-bound elasticity	-0.09	-0.12	-0.15	-0.21	-0.10

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table shows the share of total consumption for each quintile. Complete pass-through refers to elasticity equal to zero; consumers pay all the increased prices, and this does not affect the quantity demanded.

Figure E1: Income Gains: Direct Effect of Tobacco Taxes (Increase in Expenditure because of Tobacco Taxes)



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: Estimates assume a price shock of 25 percent.

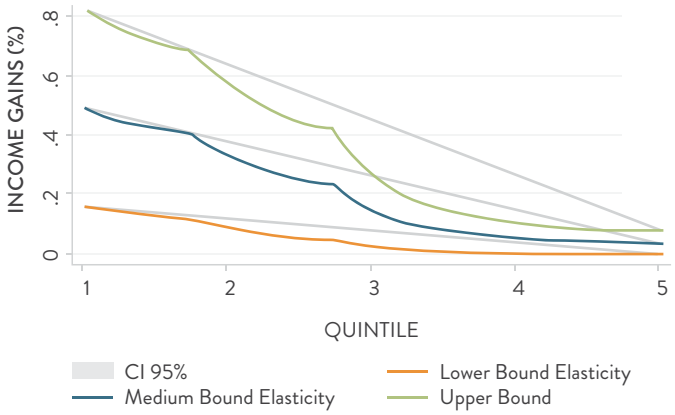
TABLE E2: REDUCTION IN MEDICAL COSTS (%)

	QUINTILE				
Price shock under	1	2	3	4	5
Lower-bound elasticity	0.30	0.11	0.06	-0.01	0.00
Medium elasticity	0.77	0.41	0.26	0.10	0.02
Upper-bound elasticity	1.24	0.72	0.46	0.21	0.04

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table reports the share of total consumption for each quintile.

Figure E2: Income Gains: Medical Costs of Tobacco Taxes (Reduction of Medical Expenditures)



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

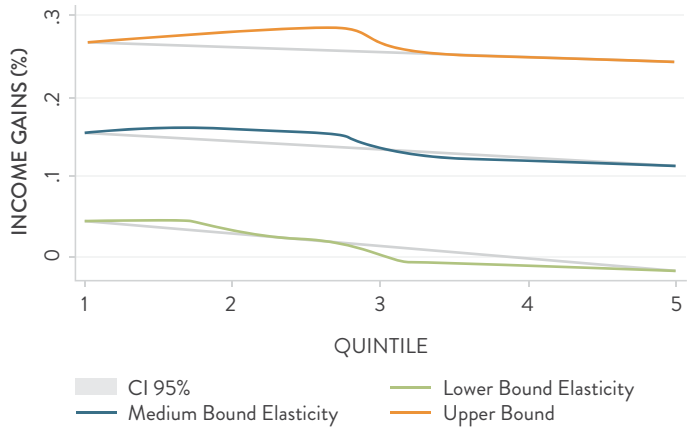
TABLE E3: YEARS OF WORKING LIFE LOST (%)

	QUINTILE				
Price shock under	1	2	3	4	5
Lower-bound elasticity	0.06	0.04	0.04	-0.01	-0.02
Medium elasticity	0.15	0.15	0.17	0.14	0.11
Upper-bound elasticity	0.24	0.27	0.31	0.28	0.23

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table reports the share of total consumption for each quintile.

Figure E3: Income Gains: Production During Years Lost



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

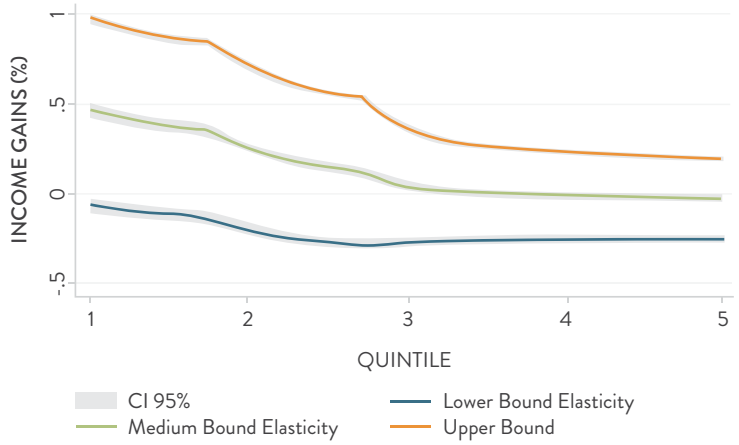
TABLE E4: NET EFFECT ON HOUSEHOLD EXPENDITURES (%)

	QUINTILE				
Price shock under	1	2	3	4	5
Lower-bound elasticity	0.13	-0.11	-0.23	-0.42	-0.21
Medium elasticity	0.76	0.38	0.19	-0.07	-0.02
Upper-bound elasticity	1.39	0.87	0.61	0.28	0.17

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table reports the share of total consumption for each quintile.

Figure E4: Total Income Effect: Direct and Indirect Effects of Tobacco Taxes (Tobacco Price Increase, Medical Expenditure, and Working Years Gained)



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

F. Simulations Using van Walbeek (2002b) Quartile Elasticities

TABLE F1: PRICE ELASTICITIES, BY QUARTILE

	QUARTILE			
Price Elasticity	1	2	3	4
Lower bound	−1.19	−0.93	−0.88	−0.61
Medium bound	−1.39	−1.13	−1.08	−0.81
Upper bound	−1.59	−1.33	−1.28	−1.01

Source: van Walbeek 2002b.

Note: Lower- and upper-bound elasticities have differences of −0.2 and +0.2, respectively, with the medium-bound elasticity.

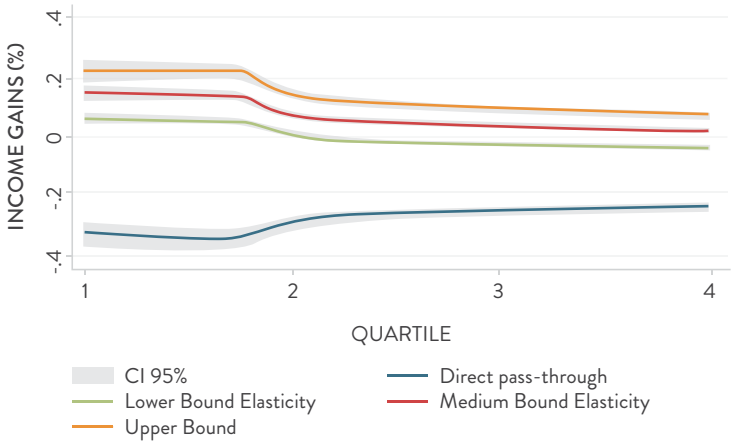
TABLE F2: DIRECT EFFECT OF PRICE INCREASE OF TAXES (%)

	QUARTILE			
Price shock under	1	2	3	4
Complete pass-through	−0.26	−0.31	−0.37	−0.20
Low-bound elasticity	0.13	0.05	0.04	−0.05
Medium elasticity	0.19	0.13	0.13	0.00
Upper-bound elasticity	0.25	0.21	0.22	0.05

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table shows the share of total consumption for each quartile. Complete pass-through refers to elasticity equal to zero; consumers pay all the increased prices, and this does not affect the quantity demanded.

Figure F1: Income Gains: Direct Effect of Tobacco Taxes (Increase in Expenditure because of Tobacco Taxes)



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

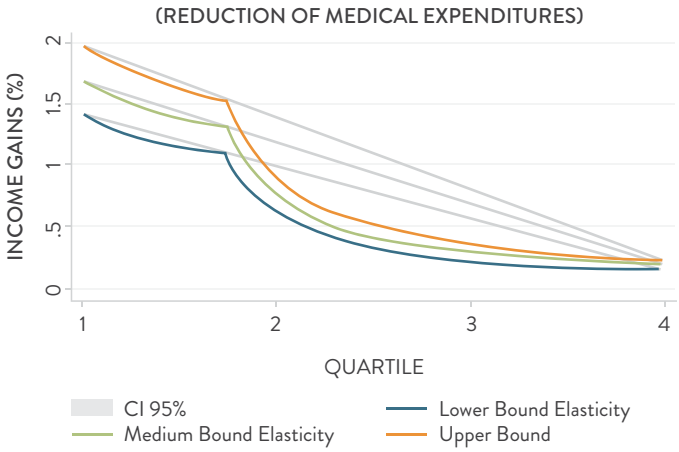
TABLE F3: REDUCTION IN MEDICAL COSTS (%)

	QUARTILE			
Price shock under	1	2	3	4
Low-bound elasticity	2.64	1.17	0.61	0.07
Medium elasticity	3.08	1.42	0.75	0.10
Upper-bound elasticity	3.52	1.68	0.89	0.12

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table reports the share of total consumption for each quartile.

Figure F2: Income Gains: Medical Costs of Tobacco Taxes



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

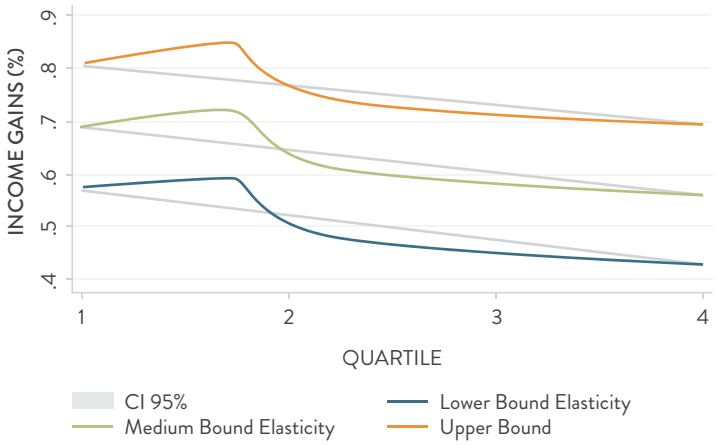
TABLE F4: YEARS OF WORKING LIFE LOST (%)

	QUARTILE			
Price shock under	1	2	3	4
Low-bound elasticity	0.56	0.55	0.64	0.40
Medium elasticity	0.66	0.67	0.78	0.53
Upper-bound elasticity	0.75	0.78	0.92	0.66

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15.

Note: The table reports the share of total consumption for each quartile.

Figure F3: Income Gains: Production During Years Lost



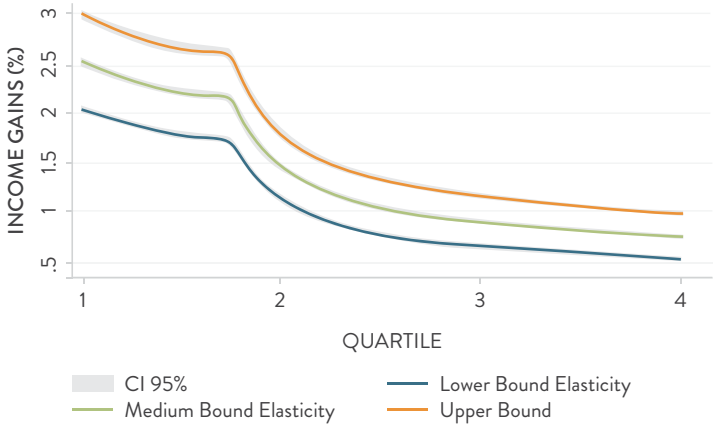
Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

TABLE F5: NET EFFECT ON HOUSEHOLD EXPENDITURES (%)

	QUARTILE			
Price shock under	1	2	3	4
Low-bound elasticity	3.32	1.77	1.29	0.43
Medium elasticity	3.92	2.22	1.67	0.63
Upper-bound elasticity	4.53	2.67	2.04	0.84

Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: The table reports the share of total consumption for each quartile.

Figure F4: Total Income Effect: Direct and Indirect Effects of Tobacco Taxes (Tobacco Price Increase, Medical Expenditure, and Working Years Gained)



Source: Estimates based on harmonized datasets by World Bank staff of the National Income Dynamics Study, wave 4, 2014–15. Note: Estimates assume a price shock of 25 percent.

TOBACCO USE IS THE SINGLE MOST PREVENTABLE CAUSE OF DEATH IN THE WORLD. GLOBALLY, IT IS ESTIMATED THAT IN 2017, TOBACCO USE WILL CLAIM MORE LIVES THAN