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Working Paper

Own- and Cross-Price Elasticity Estimates for Cigarette Consumption in Pakistan

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Social Policy and Development Centre

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Acronyms

FBR	Federal Board of Revenue
FED	Federal Excise Duty
GATS	Global Adults Tobacco Survey
GST	General Sales Tax
HIES	Household Integrated Economic Survey
ICT	Islamabad Capital Territory
JHU	Johns Hopkins University
OLS	Ordinary Least Squares (OLS)
PBS	Pakistan Bureau of Statistics
PSUs	Primary Sampling Units
SPDC	Social Policy and Development Centre
SUR	Seemingly Unrelated Regression
PIDE	Pakistan Institute of Development Economics

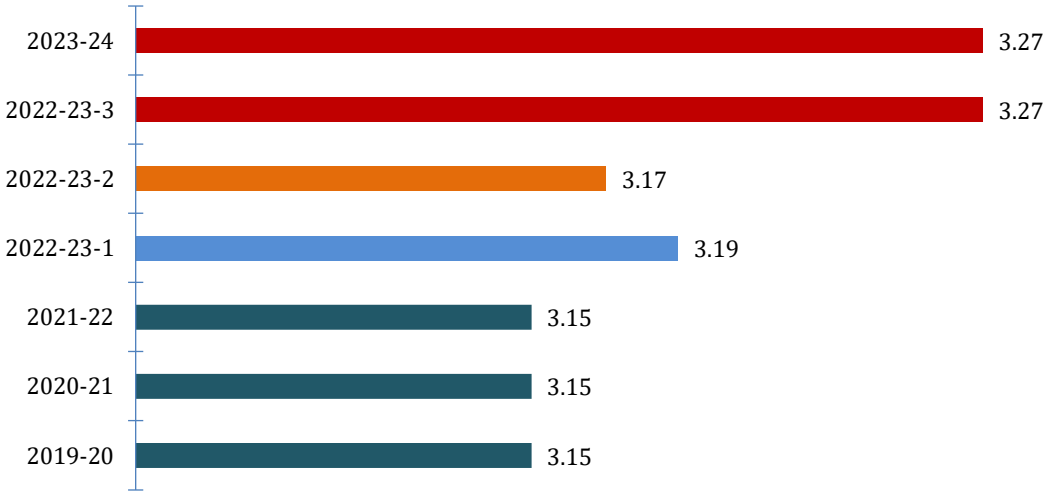
1 Introduction

Smoking remains a significant global public health concern, contributing to substantial healthcare burdens, economic losses due to reduced productivity, and premature mortality. Higher taxation is a well-established strategy, as well as the most effective one, to discourage tobacco use and generate revenue for public health initiatives (Chaloupka et al., 2019; Yurekli & Fong, 2012). However, the effectiveness of these policies hinges on understanding consumer responses to price changes, measured through price and income elasticity of demand. While higher taxes generally lead to reduced cigarette consumption, the magnitude of this effect varies. A higher price elasticity indicates a significant potential public health benefit from a tax increase due to reduced consumption. In contrast, the same tax increase with a lower price elasticity would yield a smaller relative decrease in consumption while generating larger revenue. Therefore, country-specific elasticity estimates are crucial for designing effective tobacco taxation policies.

In Pakistan, the primary tobacco tax instrument, the Federal Excise Duty (FED) on manufactured cigarettes, operates under a two-tier system that exhibits significant disparities in tax rates between the tiers (Figure 1). Upper-tier (high-priced/premium) brands are taxed more than lower-tier (low-priced/economy) brands. From July 2019 to June 2022, the tax rates for both tiers remained unchanged, maintaining a ratio of 3.15 between the upper and lower tiers. However, during the fiscal year 2022-23, the FED on cigarettes was revised thrice after a three-year hiatus. The first adjustment was effective from July 1, 2022, when the FED rates for premium and economy brands were increased by 13.5 percent and 12.1 percent, respectively. The second change, announced on August 23, 2022, raised the FED by a weighted average of 10.7 percent. Effective February 14, 2023, the third revision introduced a massive increase in FED rates—46 percent for economy brands and 154 percent for premium brands. In Rupee terms, the rate of FED per 20-cigarette pack is Rs 101 and Rs 330 for economy and premium brands, respectively. Based on average prices, the respective excise tax share in retail price is 47.7 percent and 68.3 percent for economy and premium brands.

The disparity between the tax tiers has widened significantly, with both tiers experiencing cumulative tax increases exceeding 200 percent. The upper- to lower-tier tax rate ratio has risen to 3.27 (Figure 1). This complexity, combined with a substantial illicit cigarette market—estimated to account for up to 20 percent of total consumption (CTFK, 2019; FFO, 2019; Iqbal et al., 2020; Sabir et al., 2022)—poses considerable challenges to the accuracy of policy simulations based on average cigarette prices.

Figure 1: Ratio of FED rate of upper-tier to lower-tier brands – (%)



Source: SPDC estimates based on FBR tier-wise tax rates

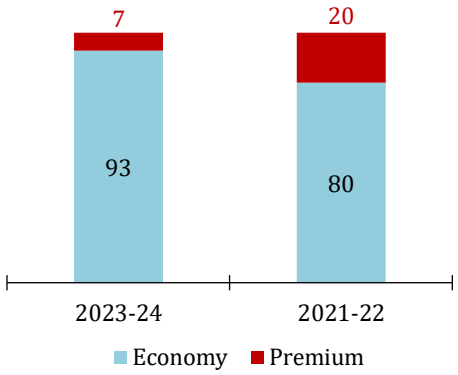
There is a critical need for tier-wise price and income elasticity estimates of cigarette demand to inform policymaking in Pakistan. Existing literature lacks this crucial information. Previous studies, such as Nayab et al. (2018), estimated overall price elasticity but relied on household unit values rather than actual cigarette prices. Similarly, Burki et al. (2013) and Mushtaq et al. (2011) focused on short- and long-run elasticities using average price indices. While these studies provide valuable insights into general cigarette demand, the limitations lead to a potential overestimation of demand elasticity in existing research. Consequently, simulations based on these studies may overestimate the public health benefits from tax increases while underestimating potential revenue generation. This research addresses this gap by estimating tier-wise price elasticity based on data directly reflecting cigarette consumers' reported prices and consumption patterns.

RESEARCH CONTEXT

The SPDC Smokers' Surveys for 2021-22 and 2023-24 provide critical insights into cigarette consumption patterns in Pakistan. A nationwide survey of 7,500 households was conducted in 2021-22, where 6,283 smokers were interviewed (Jamal et al., 2023). Similarly, after a substantial increase in cigarette prices in February 2023, mainly due to tax increases, a survey of 9,000 households was conducted in 2023-24, in which 5,242 smokers were interviewed (Iqbal et al., 2024). In the 2023-24 Survey, cigarette prices were also collected from vendors in the surveyed locations (referred to as the Retailer Survey hereafter).

The survey data reveals a detailed breakdown of cigarette consumption across various tiers, highlighting significant trends in consumer preferences. Notably, economy brands emerged as the dominant choice among consumers. The share of economy brands increased from 80 percent in 2021-22 to 93 percent in 2023-24. This shift suggests a pronounced movement from premium brands towards more affordable options, driven by recent tax increases and corresponding price hikes coinciding with the survey periods.

Figure 2: Share of premium and economy brands – (%)



Source: SPDC Smokers Survey 2021-22 & 2023-24

Additionally, the survey reveals a noteworthy pattern in consumption behaviour among smokers. Follow-up questions regarding smoking habits in response to price increases suggest that cigarette consumption is sticky. Many respondents indicated that they continued smoking despite the higher costs; however, they either reduced their daily consumption or switched to cheaper brands (Iqbal et al., 2023). This behaviour demonstrates significant adaptation among consumers in response to financial pressures, underscoring the dynamics of cigarette consumption amid economic changes.

This pattern underscores the importance of estimating switching and smoking intensity elasticity to understand smokers' responses to price changes better. Such estimates are crucial for assessing the impact of changes in tax rates and corresponding prices on cigarette demand and their implications for tax revenues. For instance, the government typically estimates revenues based on existing market shares; however, the growing tax disparity between premium and economy cigarette brands may prompt smokers to switch from high-priced to low-priced products, which could lead to substantial revenue losses, even if overall cigarette consumption remains unchanged.

RESEARCH OBJECTIVE

This study's primary objective is to estimate the tier-wise price elasticity of cigarette demand in Pakistan. An econometric analysis of price and income elasticity was employed, using data from the smokers' survey 2023-24 (referred to as Smokers Survey 2023-24 hereafter). The resulting elasticity estimates can be used to simulate the impact of changes in tier-wise tax rates on tax revenue and public health outcomes. Additionally, these estimates can facilitate analyses to explore potential revenue implications associated with transitioning from the current two-tier system to a single tax rate structure.

2 Literature Review

Estimating price and income elasticity of demand has long been of interest to empirical economists. Globally, a plethora of research estimates the country-wide, regional, and local price elasticity of demand. These studies can be divided into three streams of literature: time-series estimation, cross-section estimation based on household-level income and expenditures, and cross-section estimation based on individual data. Considering the research scope, this section covers the most relevant study that relied on cross-section and panel individual-level data to estimate the own and cross price elasticity of cigarette demand.

Shimul & Hussain (2022) used a three-stage analytical framework to estimate the tier-wise price and income elasticities in Bangladesh. Their analytical framework begins with smoking participation or the choice to smoke or not. Afterwards, they moved to estimate the brand choice model for those who smoke. Finally, they estimated econometric models for cigarette consumption per day. They used logit and probit for the first two stages and ordinary least squares (OLS) for the third stage. In the later estimation, they used a seemingly unrelated regression (SUR) model, considering the simultaneity of decisions on brand choice and consumption per day.

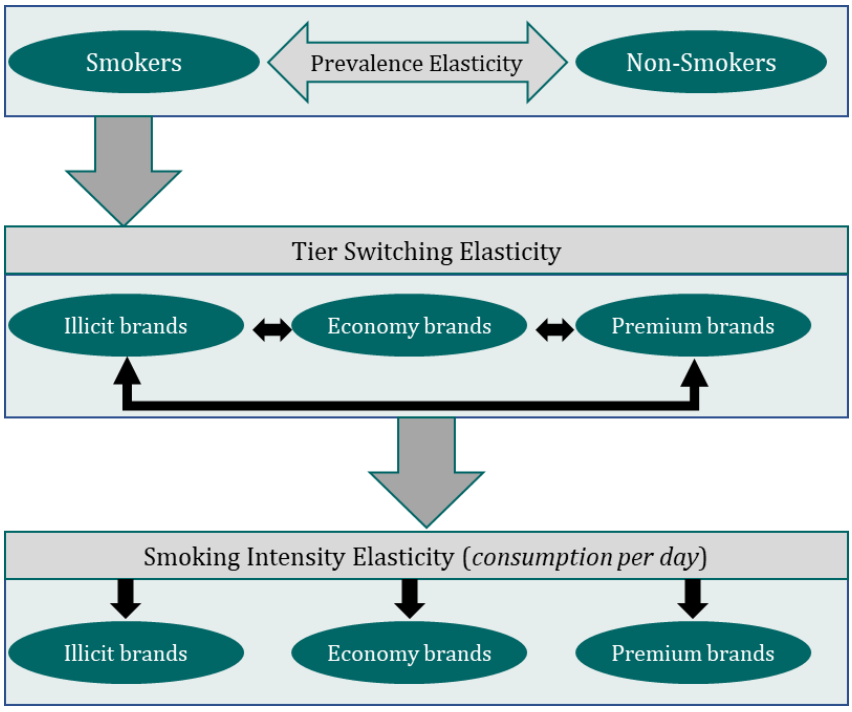
This study illustrates the complexity of estimating price elasticity in the context of tiered markets while also offering a framework to navigate these complexities. It emphasises the importance of individual-level data for capturing nuanced consumer behaviour. Additionally, it provides valuable insights for policymakers seeking to understand the implications of tax changes on cigarette consumption patterns and revenue generation. We relied heavily on this study to estimate both own and cross-price elasticity by tiers.

3 Methodology

The analytical framework heavily relies on the methodology outlined in Shimul & Hussain (2022), employing a structured three-step approach to estimate the own-price elasticity, cross-price elasticity, and income elasticity of cigarette demand. Figure 3 depicts all three steps.

The first component quantifies the price elasticity of cigarette demand by examining how changes in cigarette prices, categorized into three tiers (economy, premium, and illicit), affect smoking prevalence. These tiers are defined based on Federal Excise Duty (FED) rates. Economy and premium brands are based on FED tiers I and II, respectively. The third category, illicit brands, comprises cigarette packs sold below the legal minimum price.[1] It bears mentioning that the term illicit used in this report covers the price only and does not consider other indicators of illicit trade, such as packaging compliance, tax stamps, etc. By analyzing tier-wise price sensitivity, we can determine the relative responsiveness of the smokers of various brand segments.

Figure 3: Analytical Framework



[1] At the time of the survey, the minimum price was Rs 127 per 20-cigarette pack (including GST).

The second component addresses brand switching elasticity, which centers on the decision to switch between different cigarette tiers. It estimates elasticity by evaluating consumers' shifts between illicit, economy, and premium brands in response to relative price changes. The final component of the framework estimates smoking intensity elasticity, i.e. the quantity of cigarettes smoked. This step calculates elasticity based on the decision to smoke and the choice of low- or high-priced brands and determines daily cigarette consumption.

SMOKING PREVALENCE ELASTICITY

To estimate the price elasticity of smoking prevalence, we employ the following regression model to predict the probability of being a smoker.

Model 1: $$\Pr(\text{Smoker}_i = 1|P^I, P^E, P^P, \mathrm{Z}_i, \epsilon_i) = \alpha_i + \beta_I P^I + \beta_E P^E + \beta_P P^P + \beta_{in} Inc_i + \beta_i \mathrm{Z}_i + \epsilon_i$$

The dependent variable is a binary indicator: 1 for smokers and 0 for non-smokers. The independent variables include tier-wise prices for illicit cigarettes (P^I), economy brands (P^E), and premium brands (P^P), income level of individuals (*Inc*), and a vector of control variables (Z). Control variables include age, education level, employment status, rural/urban residence, and marital status for each respondent (i). This specification enables the analysis of price effects on smoking prevalence across all three tiers, providing a comprehensive understanding of tier-wise price impacts.

TIER-SWITCHING ELASTICITY

Tier-switching elasticity is estimated by running three separate logit regressions. These regressions model the probability of a smoker belonging to each cigarette tier, incorporating potential determinants of cigarette demand such as price, income, and individual socio-demographic characteristics (vector of control variables).

The brand choice models for premium, economy, and illicit cigarette brands are specified as follows:

Model 2: $$\mathrm{P}(\mathrm{BC}_i^P = 1|\mathrm{P}_i^I, \mathrm{P}_i^E, \mathrm{P}_i^P, \mathrm{Z}_i, \in_i^P) = \alpha_P + \beta_I \mathrm{P}_i^I + \beta_E \mathrm{P}_i^E + \beta_P \mathrm{P}_i^P + \beta_{in} Inc_i + \beta_i \mathrm{Z}_i + \varepsilon_i^P$$

Model 3: $$\mathrm{P}(\mathrm{BC}_i^E = 1|\mathrm{P}_i^I, \mathrm{P}_i^E, \mathrm{P}_i^P, \mathrm{Z}_i, \in_i^E) = \alpha_E + \beta_I \mathrm{P}_i^I + \beta_E \mathrm{P}_i^E + \beta_P \mathrm{P}_i^P + \beta_{in} Inc_i + \beta_i \mathrm{Z}_i + \varepsilon_i^E$$

Model 4: $$\mathrm{P}(\mathrm{BC}_i^I = 1|\mathrm{P}_i^I, \mathrm{P}_i^E, \mathrm{P}_i^P, \mathrm{Z}_i, \in_i^E) = \alpha_I + \beta_I \mathrm{P}_i^I + \beta_E \mathrm{P}_i^E + \beta_P \mathrm{P}_i^P + \beta_{in} Inc_i + \beta_i \mathrm{Z}_i + \varepsilon_i^I$$

Where:

$\mathrm{BC}^{\mathrm{P}}_{\mathrm{i}}$ = 1 if an individual smoker reported smoking a premium brand and 0 otherwise.

$\mathrm{BC}^{\mathrm{E}}_{\mathrm{i}}$ = 1 if an individual smoker reported smoking an economy brand and 0 otherwise.

$\mathrm{BC}^{\mathrm{I}}_{\mathrm{i}}$ = 1 if an individual smoker reported smoking a brand below the FBR notified price (illicit brand) and 0 otherwise.

Inc denotes the income level of individual i.

Z_{i} represents a vector of control variables including age, education level, employment status, rural/urban residency, and marital status for individual i.

P^P, P^E, and P^I represent the prices of premium, economy, and illicit brands, respectively. In each model, α, β(I, E, P, Inc and i), and εi represent coefficients estimated for the specific tier model (premium, economy, illicit).

SMOKING INTENSITY ELASTICITY

Cigarette intensity elasticity is estimated using ordinary least squares (OLS) regressions and seemingly unrelated regressions (SUR).

OLS Regressions

The following four separate OLS models are specified to capture the determinants of daily cigarette consumption, considering both aggregate and brand-specific effects.

Model 5: $\mathrm{CPD}_i^I = \delta_i^I + \gamma_0^I \mathrm{P}_i^I + \gamma_0^E \mathrm{P}_i^E + \gamma_0^P \mathrm{P}_i^P + \gamma_{in} Inc_i + \gamma_i \mathrm{Z}_i + \varepsilon_i^I$

Model 6: $\mathrm{CPD}_i^E = \delta_i^E + \gamma_0^I \mathrm{P}_i^I + \gamma_0^E \mathrm{P}_i^E + \gamma_0^P \mathrm{P}_i^P + \gamma_{in} Inc_i + \gamma_i \mathrm{Z}_i + \varepsilon_i^E$

Model 7: $\mathrm{CPD}_i^P = \delta_i^P + \gamma_0^I \mathrm{P}_i^I + \gamma_0^E \mathrm{P}_i^E + \gamma_0^P \mathrm{P}_i^P + \gamma_{in} Inc_i + \gamma_i \mathrm{Z}_i + \varepsilon_i^P$

Models 5, 6 and 7 (brand-specific consumption) are estimated for illicit, economy, and premium brands, respectively. These models utilize brand-specific prices to estimate the smoking intensity elasticity within each brand category. P^P, P^E, and P^I represent the prices of premium, economy, and illicit brands, respectively. Inc_i and Z_i represent individual income levels and a vector of control variables (age, education level, employment status, rural/urban residency, and marital status), respectively. δ and γ are estimated coefficients, and ε is the error term.

The seemingly unrelated regressions (SUR) model is employed to address the potential correlation between the error terms of the brand-specific models (Models 6-8). This may occur if unobserved factors influence consumption across different cigarette tiers.

4 Results

This section is divided into two components: descriptive statistics and empirical analysis. The descriptive statistics segment provides an overview of cigarette prices captured in the Retailer Survey and outlines the salient characteristics of the smokers included in our analytical sample. The empirical analysis section presents the estimated cigarette price elasticities derived from econometric models.

DESCRIPTIVE ANALYSIS

Retailer Survey and cigarette prices

In Pakistan's tobacco market, cigarette prices are primarily determined exogenously by the cigarette manufacturing firms. The overall prices for economy and premium brand cigarettes are set at the factory level, and they include FED (applicable based on the tier price) and General Sales Tax (GST),[2] which are collected at the manufacturing stage. Consumer prices (at the retail sale level) exhibit slight variations across different regions, perhaps due to transportation costs and vendor margins.

As mentioned earlier, SPDC conducted a Retailer Survey to capture these variations in the same Primary Sampling Units (PSUs) where smokers were surveyed. The survey collected prices for the most sold brands in each category that provide a reasonable approximation of the price distribution in the market. The prices were cross-validated with the smokers' survey data.

Table 1: Price per pack of 20 cigarette sticks (Rs)

Brands	Observations	Mean	Std. dev.	Min	Max
Illicit	496	102.62	11.917	50	125
Economy	496	197.16	27.279	128	280
Premium	496	532.94	35.268	480	650

Source: SPDC Retailer Survey 2023-24

This retailer-level price data enabled us to estimate the price elasticity of cigarettes using econometric models that treated prices as exogenous variables. At the analysis stage, we averaged prices at the PSU level for each brand category: illicit, economy, and premium. Table 1 presents descriptive statistics based on PSU-level averages. The price data was collected from 496 PSUs. The average price for a 20-stick pack of illicit cigarettes was Rs 103 (range Rs 50–125). The average price per pack of economy brands was Rs 197 (range Rs 128–280), and that of premium brands was Rs 533 (range Rs 480–650).

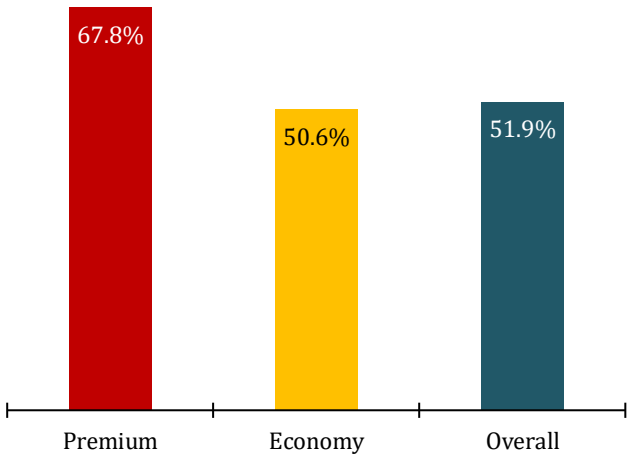
[2] GST is levied at the rate of 18 percent of the price inclusive of FED.

Tier-wise weighted average FED share in printed prices

The household and retailer survey also collected photographs of cigarette packs, providing information on FED, GST, and final printed consumer prices. Using this evidence, we estimated the weighted average share of FED in the final printed prices for economy and premium brands. We calculated the FED share for each brand by dividing the FED amount by the final printed price, using the applicable FED rates and printed prices. Then, we derived the weighted average FED share for each tier by multiplying the FED share of each brand by its consumption share.

The weighted average FED share in retail price is 50.6 percent for economy brands and 67.8 percent for premium brands, while the overall weighted average of FED share is 51.9 percent. These findings highlight substantial differences in tier-specific FED rates, underscoring the importance of considering tier-wise price elasticities. Given the variation in tax burdens and corresponding price levels, economy and premium brands are likely to exhibit distinct responses to changes in FED rates and prices.

Figure 4: Share of FED in printed retail price (%)



Source: Smokers Survey 2023-24

Key survey characteristics

Table 2 summarizes the key characteristics of the respondents in the Smokers Survey 2023-24. On average, respondents reported an annual income of Rs 738,900 with a high standard deviation, indicating significant income variability. The average age of the respondents was almost 42 years, while the respondents, on average, had 11 smoking friends/acquaintances in their regular social circle.

Table 2: Descriptive statistics (Continuous variables)

Variable	Observations	Mean	Std. dev.	Min	Max
Household Income (000 Rs)	8,997	738.90	699.392	15	24,000
Age (years)	8,997	41.79	13.267	15	96
Number of friends who are smokers	8,997	8.69	7.337	0	20

Source: Smokers Survey 2023-24

Table 3 presents the descriptive statistics for other covariates used in the study. Most daily smokers (73.8 percent) reside in urban areas. Geographically, Punjab has the highest representation (46.8 percent), followed by Sindh (26.0 percent), Khyber Pakhtunkhwa (15.2 percent), Balochistan (5.97 percent), and Islamabad Capital Territory (ICT) (6 percent). The sample overwhelmingly consists of male respondents (95.7 percent). Regarding marital status, a significant proportion (81.3 percent) of smokers was married.

Regarding education, a substantial proportion (35.3 percent) has no formal education, while 17.8 percent have completed primary education. The employment profile is diverse, with 11.2 percent not working and 14.1 percent each engaged in agriculture and as daily wagers. Government employees comprise 7.8 percent of the sample, while 17.6 percent are private sector employees. Self-employed individuals represent the largest group (24.8 percent), followed by other occupations (10.2 percent) and unpaid helpers (0.2 percent).

Table 3: Descriptive Statistics Analytical Sample

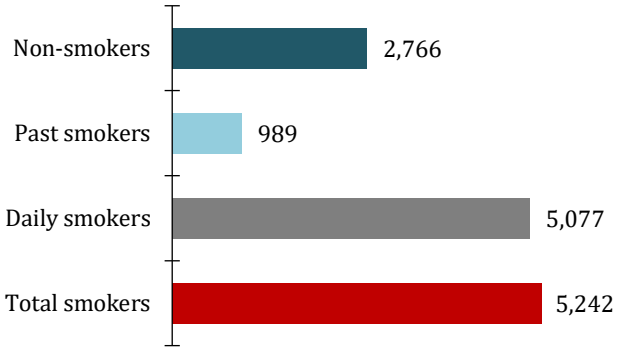
Variable	Observations	(%)	Variable	Observations	(%)
Place of residence			**Education Levels**		
Urban	6,640	73.80	No formal education	3,179	35.33
Rural	2,357	26.20	Primary	1,600	17.78
Province			Secondary	2,910	32.34
Punjab	4,212	46.82	Tertiary	1,308	14.54
Sindh	2,340	26.01	**Employment Categories**		
Khyber Pakhtunkhwa	1,368	15.21	Not working	1,003	11.15
Balochistan	537	5.97	Agriculture	1,270	14.12
ICT	540	6.00	Daily wager	1,264	14.05
Gender			Government employee	705	7.84
Female	386	4.29	Private employee	1,587	17.64
Male	8,611	95.71	Self-employed	2,227	24.75
Marital Status			Unpaid helpers	20	0.22
Unmarried	1,313	14.59	Others	921	10.24
Married	7,290	81.03			
Divorced	50	0.56			
Widowed	344	3.82			

Source: SPDC Smoker Survey 2023-24

Analytical samples

Figure 5 depicts the distribution of respondents from the Smokers Survey 2023-24 based on their smoking status. The survey covered 8,997 respondents, including 5,242 smokers (5,077 of whom were daily smokers), 989 past smokers, and 2,766 non-smokers. The analytical sample for estimating prevalence elasticity comprises 7,843 respondents, combining daily smokers and non-smokers. To test the sensitivity of the results, an alternative model includes all smokers at a later stage.

Figure 5: Distribution of respondents by smoking status

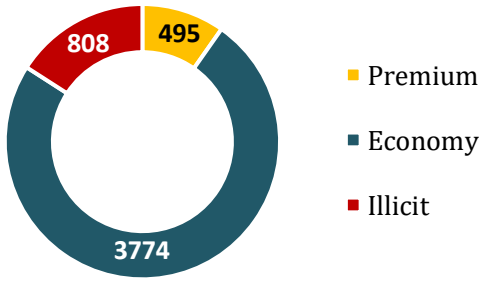


Source: Smokers Survey 2023-24

The analytical sample for the switching elasticity models consists of 5,077 daily smokers, defined as individuals who smoked at least one cigarette per day in the past month. This group is crucial for analyzing the price elasticity of switching between cigarette tiers, as their consistent smoking practice provides a reliable foundation for measuring switching patterns.

The analytical sample for estimating the elasticity of smoking intensity comprises daily smokers broken down into specific cigarette tiers. Figure 6 illustrates the distribution of daily smokers across these tiers. The number of smokers in categories of economy, premium and illicit is 3,774, 495 and 808, respectively.

Figure 6: Distribution of daily smokers by tiers



Source: Smokers Survey 2023-24

The Impact of price hikes in February 2023 on cigarette consumption

In February 2023, the government substantially increased the rate of FED on cigarettes. The FED for economy brands rose from Rs 41 to Rs 101 per 20-cigarette pack, while for premium brands, it increased from Rs 130 to Rs 330. These significant hikes in FED rates led to a substantial increase in the prices of both these tiers of cigarettes. The prices of illicit cigarettes also increased. To assess the impact of these price changes on cigarette consumption among current smokers, smokers were asked about their daily cigarette consumption – current and after February 2023. Daily consumption was converted into monthly consumption based on the reported number of smoking days.

As shown in Table 4, cigarette consumption has declined in all categories. A notable reduction was observed in premium brands (25.7 percent), followed by economy brands (21.1 percent) and the illicit category (12.8 percent). The significant decline in premium brand consumption highlights the effectiveness of the initial price increase in curbing smoking within this tier. It is likely that the remaining premium brand smokers represent a less price-sensitive group, as those most affected by the price hikes may have already reduced their consumption or switched to lower-cost alternatives.

Table 4: Average weighted consumption of cigarettes per month

	Before 2023	Current	% Change
Premium	396	294	-25.7%
Economy	430	339	-21.1%
Illicit	554	483	-12.8%
By Income Groups			
High income	490	409	-16.5%
Middle income	442	357	-19.3%
Low income	473	373	-21.1%

Note: Income Groups: High (top 20 percent), Middle (middle 60 percent), Low (bottom 20 percent)
Source: Smoker Survey 2023-24

When analyzed by income group, low-income smokers exhibited the largest decrease of 21.1 percent, followed by middle-income smokers (19.3 percent) and high-income smokers (16.5 percent). These patterns suggest that price increases had a disproportionately greater impact on lower-income groups, who are likely to be more sensitive to changes in cigarette costs.

These findings challenge the common belief that cigarette consumption is rigid or inelastic. The self-reported responses indicate that cigarette consumption is, in fact, price-sensitive, particularly for economy brands. However, a low sensitivity among high-income consumers suggests that the intensity or switching elasticities for this group may be low or statistically nonsignificant. This implies that while initial price hikes prompt substantial reductions in consumption, the remaining high-income smokers are less likely to further reduce their consumption or switch to other tiers in response to additional price increases.

EMPIRICAL RESULTS

As described in the methodology section, the empirical analysis comprises three primary components: estimation of prevalence elasticity, tier-switching elasticities, and consumption intensity elasticities across different tiers. Logistic regression is selected as the base model

for estimating prevalence and tier-switching elasticities due to its flexibility in handling binary outcomes and its widespread use in similar studies.

For robustness checks, the same model is also estimated using a probit framework, which provides a complementary approach by assuming a normal distribution of the error term. Additionally, multilevel logit and probit models are employed because tier-wise prices remain constant within households in the same PSU. These models account for potential clustering within PSUs, thereby addressing any intra-cluster correlation that might otherwise bias standard errors or estimates.

The consumption intensity elasticities are analyzed using SUR, which is particularly suitable for handling multiple equations with correlated error terms and enables a more efficient estimation of elasticities across tiers.

Econometric models for prevalence elasticity

Table 5 presents the logit regression results for two models, each with a binary dependent variable: one for daily smokers and the other for all smokers, where non-smokers are coded as zero in both models.

The estimated coefficients for cigarette prices reveal distinct effects on the likelihood of smoking among daily smokers. The price of illicit cigarettes has a small, statistically nonsignificant negative relationship with smoking likelihood, suggesting that price changes in the illicit market do not significantly impact smoking behaviour. Similarly, the price of economy cigarettes shows a negligible and statistically nonsignificant effect on smoking likelihood. However, the price of premium cigarettes is statistically significant ($p < 0.05$) and is negatively related to smoking behaviour, with a coefficient of -0.0034. This indicates that higher prices for premium cigarettes reduce the probability of smoking among daily smokers.

Household income (measured in thousands of Rupees) is positively and significantly related to smoking behaviour ($p < 0.01$), with a coefficient of 0.00036. This suggests that higher household income slightly increases the likelihood of smoking among daily smokers. This finding aligns with previous research indicating a positive correlation between income and tobacco consumption, possibly due to increased disposable income enabling greater access to cigarettes.[3]

[3] For example, estimates based on Pakistan's Household Integrated Economic Survey (HIES) 2018–19 indicate that tobacco is consumed in 45.5 percent of households in the country—the ratio is 48.8 percent and 37.9 percent in poor and rich households, respectively (Saleem & Iqbal, 2021).

Table 5: Logit model estimates for prevalence elasticity		
	Daily Smokers	**All smokers**
Price per pack of 20 cigarette sticks (Rs) by tiers		
Price illicit	-0.0042	-0.0036
Price economy	0.001	0.001
Price premium	-0.0034**	-0.0035**
Income and Demographic Factors		
Income (000 Rs)	0.0004***	0.0004***
Age (years)	0.0243	0.02
Age-square	-0.0002	-0.0001
Gender	2.2979***	2.3531***
Married	-0.0814	-0.0819
Number of friends/acquaintances who smoke	-0.1923***	-0.1908***
Geographical Factors		
Urban	-0.2373**	-0.2301**
Sindh	-0.2501**	-0.2394**
Khyber Pakhtunkhwa	0.1649	0.1765
Balochistan	2.4685***	2.5107 **
ICT	-0.9377***	-0.8980***
Education		
Primary	-0.176	-0.1888
Secondary	-0.2432*	-0.2533*
Tertiary	-0.2412	-0.2772
Employment/Occupations		
Agriculture	0.4234*	0.3998*
Daily wager	0.5200**	0.4741*
Government employee	0.2668	0.2656
Private sector employee	0.2935	0.2933
Self-employed	0.1593	0.1222
Unpaid helpers	0.3101	0.227
Others	-0.0351	-0.0675
Intercept	1.5405	1.607
Number of observations	**7,843.00**	**8,008.00**
Pseudo R-squared	**0.33**	**0.33**
*** p<.01, ** p<.05, * p<.1		

The estimates of geographical factors indicate that urban residents are less likely to smoke compared to their rural counterparts (with a coefficient value of -0.237 and p<0.05). This finding corroborates earlier studies. For instance, the Global Adult Tobacco Survey-Pakistan (GATS, 2024) found that tobacco smoking in Pakistan was higher in rural areas (13.9

percent) than in urban areas (10.0 percent). Similarly, Nayab et al. (2021) estimated that tobacco use in rural areas was 19.8 percent compared to 18.4 percent in urban areas.[4]

Age and its squared term show positive but statistically nonsignificant effects on smoking likelihood. In contrast, gender plays a significant role, with males exhibiting a higher likelihood of smoking. The value of gender coefficient is 2.298 ($p < 0.01$), indicating that men are significantly more likely to smoke than women. GATS (2014) and Nayab et al. (2021) also found that smoking prevalence is substantially higher in Pakistani males.[5] As per the estimates, marital status does not show a significant relationship with smoking. The presence of friends/acquaintances who smoke is significantly associated with smoking behaviour. However, the negative coefficient (-0.192, $p < 0.01$) indicates that individuals with friends/acquaintances who smoke are less likely to smoke. This finding is counterintuitive, as one might expect that having friends who smoke would increase the likelihood of smoking.

None of the coefficients of education categories is significant. Employment status has a varied impact on smoking behaviour. According to estimates, individuals employed in agriculture (coefficient of 0.423, $p < 0.1$) and daily wage labour (coefficient of 0.520, $p < 0.05$) are more likely to smoke compared to others. The coefficients of other employment categories are statistically nonsignificant.

The estimation results are consistent across both models, with slight and negligible variations in the magnitude of the estimated coefficients. The key relationships observed in both models are similar, reinforcing the robustness of the findings. Similarly, we tested the robustness by estimating the daily smoker through probit and multilevel logit models; the results are consistent. The results from the daily smoker model serve as the foundation for estimating elasticities in the subsequent sections.

Econometric models for tier-switching elasticities

Table 6 reports the logit regression results for three categories of cigarette tiers: illicit, economy, and premium. The dependent variable is a binary indicator set to 1 if the respondent primarily consumes the specified category of cigarette brands and 0 otherwise. The estimates show that higher prices of economy brands are positively associated with demand for low-price or illicit brands. The coefficients for premium and illicit brands turned out to be statistically nonsignificant.

[4] However, Nayab et al. (2021) did not find considerable urban-rural differences in the prevalence of smoking tobacco.

[5] According to Nayab et al. (2021), smoking prevalence in males was 16.13 percent compared to 0.62 percent in females. Similarly, GATS (2014) show smoking prevalence in males and females to be 19.4 percent and 1.0 percent, respectively.

The analysis reveals a negative and statistically significant association between household income and the consumption of illicit brands, while a positive relationship exists with premium brands. This suggests that higher-income individuals are more likely to purchase premium brands. Additionally, age positively correlates with illicit brand consumption but negatively with economy brands. Marital status does not show a statistically significant association with any cigarette category relative to the baseline.

Table 6: Logit model estimates for switching elasticity

	Illicit	Economy	Premium
Price per pack of 20 cigarette sticks (Rs) by tiers			
Price illicit	-0.0038	-0.0005	0.0106
Price economy	0.0064***	-0.0047**	-0.0043
Price premium	-0.0006	0.0013	-0.0029
Income and Demographic Factors			
Income (000 Rs)	-0.0008***	0.0001	0.0005***
Age (years)	0.0220***	-0.0168***	0.0035
Gender	-1.0172*	0.8925*	1.2047
Married	-0.0851	0.0635	0.091
Number of friends/acquaintances who smoke	0.0249*	-0.0214*	0.0085
Geographical Factors			
Punjab	-0.1716	0.2379**	-0.3967*
Islamabad	-1.6851***	-0.0075	0.1865
Urban	-0.6362***	0.1369	1.1927***
Education			
Primary	-0.3796**	0.4057***	0.0443
Secondary	-0.4966***	0.3258**	0.9140***
Tertiary	-1.1243***	-0.1483	1.8099***
Employment/Occupations			
Agriculture	0.6122**	-0.4221*	-0.7636*
Daily wager	0.1996	-0.0354	-0.6021
Government employee	-0.3388	0.1524	-0.0273
Private employee	-0.0805	-0.0908	0.2773
Self-employed	0.1389	-0.0402	-0.1719
Unpaid helpers	0.1677	-0.1001	0.136
Others	0.2884	0.0236	-0.6007
Intercept	-1.1686	0.9599	-4.3897**
Number of observations	**5,240**	**5,240**	**5,240**
Pseudo R-squared	**0.11**	**0.03**	**0.22**

*** p<.01, ** p<.05, * p<.1

Smoking intensity SUR estimates

Table 7 presents the seemingly unrelated regression (SUR) model estimates, highlighting the factors influencing cigarette consumption intensity (number of cigarettes consumed per day) across different tiers. The price coefficients in the SUR model represent the impact of changes in cigarette prices on consumption intensity.

Table 7: Seemingly unrelated regression (SUR) estimates

	Illicit	Economy	Premium
Price per pack of 20 cigarette sticks (Rs) by tiers			
Price illicit	-0.0478***	0.0016	0.0084**
Price economy	0.0145***	-0.0097**	-0.002
Price premium	0.0013	-0.0019	0.0009
Income and Demographic Factors			
Income (000 Rs)	-0.0008***	0.0001	0.0005***
Age (years)	0.0220***	-0.0168***	0.0035
Gender	-1.0172*	0.8925*	1.2047
Married	-0.0851	0.0635	0.091
Number of friends/acquaintances who smoke	0.0249*	-0.0214*	0.0085
Geographical Factors			
Urban	-2.2857***	0.4848*	0.2774**
Sindh	1.6231***	-1.8242***	0.1449
Khyber Pakhtunkhwa	-1.7820***	-2.2529***	0.2613*
Balochistan	0.6660*	-3.8500***	-0.6579***
ICT	-1.3740***	-1.4825**	0.3261
Education			
Primary	-1.3420***	0.8629**	0.0085
Secondary	-1.4418***	-0.0371	0.4015***
Tertiary	-1.3576***	-1.4004***	1.9938***
Employment/Occupations			
Agriculture	1.8421***	0.4357	0.2692
Daily wager	-0.6633	1.0044*	0.0444
Government employee	-0.6855	1.6261**	0.5156**
Private employee	-0.5852	1.1840**	0.3859*
Self-employed	-0.2418	1.8891***	0.6382***
Unpaid helpers	2.7805	0.2294	0.2372
Others	-0.2019	0.8158	0.22
Intercept	9.1817***	7.1190**	-1.4133
Number of observations	**5,240**	**5,240**	**5,240**
R-squared	**0.14**	**0.04**	**0.10**

*** p<.01, ** p<.05, * p<.1

The negative coefficient of the price of illicit cigarettes (-0.048) indicates that higher prices are associated with lower consumption. The negative coefficient of the price of economy cigarettes (-0.0097) also suggests that higher prices lead to lower consumption. However, the magnitude of this effect is smaller than that of illicit brands. The nonsignificant coefficients of the price of premium brands in all three categories suggest that price changes would have minimal or no impact on consumption.

The results show that higher income is significantly associated with lower consumption of illicit brands and higher consumption of premium brands. The coefficient of economy brands is not statistically significant.

The results for other variables indicate that older individuals are more likely to consume illicit cigarettes. On the other hand, the age coefficient is negative and significant for economy brands but nonsignificant for premium brands. Smokers in urban areas have a higher consumption of economy and premium brands compared to rural areas, while rural smokers have a higher consumption of illicit brands.

As per the estimates, higher education levels are associated with lower consumption of illicit and economy brands but higher consumption of premium brands. Agricultural workers are more likely to consume illicit brands, while daily wagers, government employees, and self-employed individuals show higher consumption of economy and premium brands.

ELASTICITY ESTIMATES

Prevalence elasticities

Table 8 presents the prevalence elasticities derived from the logit, probit, and multilevel logit (melogit) models, which provide insights into the responsiveness of smoking prevalence to changes in cigarette prices across the three tiers (illicit, economy, and premium) as well as to income changes.

Own-price elasticities

Illicit brands: The own-price elasticity of illicit cigarettes is small and statistically nonsignificant across all models. This suggests that changes in the price of illicit cigarettes have little to no impact on smoking prevalence. This result aligns with the observation that users of illicit cigarettes are less price-sensitive (see Table 4), possibly because illicit cigarettes are already the cheapest option and price increases may not meaningfully alter their affordability.

Economy brands: The own-price elasticity for economy cigarettes is positive but statistically nonsignificant. While this result is somewhat unexpected, it may reflect noise in the data or

the possibility that some smokers in the economy tier are switching to other brands rather than quitting entirely in response to price changes.

Premium brands: The own-price elasticity for premium cigarettes is negative, substantial, and statistically significant (at the five percent level) across all models (-0.566 for logit and -0.564 for probit and melogit). This result implies that a one percent increase in the price of premium cigarettes reduces the prevalence of smoking by approximately 0.566 percent.

Table 8: Estimates of prevalence elasticity

	Logit	Probit	Melogit
Price illicit	-0.134	-0.135	-0.135
SE	(0.1540)	(0.1600)	(0.1600)
Price economy	0.061	0.045	0.045
SE	(0.1180)	(0.1240)	(0.1240)
Price premium	-0.566**	-0.564**	-0.564**
SE	(0.2620)	(0.2760)	(0.2760)
Income (000 Rs)	0.075***	0.065***	0.065***
SE	(0.0180)	(0.0180)	(0.0180)

*** p<.01, ** p<.05, * p<.1, standard errors in parenthesis

Income elasticity

Income elasticity is positive and statistically significant (at the one percent level) across all models. This indicates that a one percent increase in income would lead to an approximately 0.075 percent increase in smoking prevalence. The strong positive relationship highlights that higher income enables greater participation in smoking, underscoring the role of affordability in driving smoking behaviour.

The consistency of results across the logit, probit, and melogit models underscores the robustness of the findings, with minimal differences observed between the models. Given the similarity of the results, only the logit and OLS estimates will be reported in subsequent sections for simplicity and clarity. These estimates effectively capture the key price and income sensitivity dynamics in smoking prevalence.

Tier-switching elasticities

Table 9 shows the estimates of tier-switching elasticities, providing insights into how changes in cigarette prices in one tier (illicit, economy, or premium) influence the likelihood of switching between different tiers. These elasticities capture smokers' substitution or complementarity patterns across tiers in response to price changes.

Table 9: Tier-switching elasticity			
	Illicit	**Economy**	**Premium**
Price illicit	-0.309	-0.014	1.03
SE	(0.4230)	(0.1280)	(0.6870)
Price economy	1.004***	-0.259**	-0.816
SE	(0.3480)	(0.1070)	(0.6120)
Price premium	-0.236	0.186	-1.449
SE	(0.9370)	(0.2660)	(1.6000)
Income (000 Rs)	-0.459***	0.023	0.307***
SE	(0.1110)	(0.0190)	(0.0690)
*** p<.01, ** p<.05, * p<.1, standard errors in parenthesis			

Price of illicit brand cigarettes

The own-price elasticity of illicit cigarettes is negative but statistically nonsignificant, suggesting that price increases for illicit cigarettes do not have a statistically significant impact on consumption.

The cross-price elasticity of economy and premium tiers with respect to illicit cigarette prices is statistically nonsignificant. This indicates little to no tier-switching from economy or premium tiers to illicit cigarettes when illicit cigarette prices change.

Price of economy brand cigarettes

A significant and positive elasticity indicates tier-switching behaviour. When the economy cigarette prices increase, some smokers are likely to substitute low-priced illicit cigarettes. This result supports the notion that affordability plays a critical role, as smokers in the economy tier seek cheaper alternatives when prices rise.

The own-price elasticity for the economy tier is negative and significant, confirming that higher prices reduce the likelihood of smoking economy brand cigarettes. Smokers in this tier are price-sensitive and either reduce their consumption or switch to other brands.

The cross-price elasticity for premium-tier smoking with respect to economy-tier prices is negative but statistically nonsignificant, which supports the fact that premium brand users are unlikely to switch to economy brands in response to an increase in economy brand prices.

Price of premium brand cigarettes

The cross-price elasticity with respect to illicit cigarettes is negative but statistically nonsignificant, indicating no strong evidence of smokers switching to illicit cigarettes when

premium cigarette prices increase. The cross-price elasticity with respect to the economy tier is positive but nonsignificant, suggesting that increases in premium cigarette prices may not lead to any significant tier-switching.

The own-price elasticity for premium-tier smoking is negative but statistically nonsignificant. While the large magnitude reflects a potential reduction in premium cigarette consumption due to price increases, the lack of statistical significance greatly limits the reliability of this conclusion.

Income elasticity

A significant and negative elasticity (-0.459) indicates that higher income reduces the likelihood of smoking illicit cigarettes. The income elasticity for the economy tier is positive but statistically nonsignificant, suggesting that income changes have little to no effect on smoking behaviour in this segment. In the case of premium brands, a positive and significant elasticity (0.307) indicates that higher income increases the likelihood of smoking premium brand cigarettes. This result aligns with the understanding that premium cigarettes are a normal good, with consumption rising as income increases.

Smoking intensity elasticities (SUR estimates)

The consumption intensity elasticities presented in Table 10 show the sensitivity of smokers to changes in prices and income. The own-price elasticity value (-1.96) indicates that consumers of illicit cigarettes are highly price-sensitive. A one percent increase in price would lead to almost two percent decrease in the smoking intensity of illicit cigarettes.

Table 10: Smoking intensity elasticity (SUR estimate)

	Illicit	Economy	Premium
Price illicit	-1.96***	1.153***	0.275
SE	(0.3260)	(0.2730)	(0.6020)
Price economy	0.021	-0.24**	-0.126
SE	(0.1310)	(0.1110)	(0.2470)
Price premium	0.95**	-0.448	0.526
SE	(0.4680)	(0.3950)	(0.8810)
Income (000 Rs)	-0.145***	0.023	0.734***
SE	(0.0460)	(0.0190)	(0.0770)

*** p<.01, ** p<.05, * p<.1, standard errors in parenthesis

The own-price elasticity for economy cigarettes is also negative with a relatively low magnitude (-0.24), indicating that a one percent increase in price still leads to a 0.24 percent decrease in consumption. Own-price elasticity is nonsignificant for premium cigarettes,

indicating that consumers are relatively insensitive to price changes within this tier. This could be due to factors such as brand loyalty, perceived 'quality', or higher disposable income among premium cigarette consumers.

The positive cross-price elasticity between economy and illicit cigarettes (1.15) suggests a strong substitution effect. When illicit cigarette prices rise, consumers may switch to economy brands. The income elasticities indicate that illicit cigarette consumption is negatively associated with income, suggesting that it is considered an inferior good. On the other hand, premium brand cigarette consumption is positively associated with income, suggesting it to be a normal or luxury good.

Total elasticity

Table 11 presents total elasticities derived from prevalence elasticity (Table 8) and intensity elasticities from the SUR model (Table 10) across three cigarette tiers: illicit, economy, and premium. The total elasticities are the sum of statistically significant values from both prevalence and intensity elasticities, presented in Table 11.

Table 11: Total Elasticity (SUR estimates)

	Total Elasticity		
	Illicit	**Economy**	**Premium**
Price Illicit	-1.96	1.153	-
Price Economy	-	-0.24	-
Price Premium	0.95	-	-0.566
Income	-0.07	0.075	0.809

Illicit brand cigarettes

The own-price elasticity for illicit cigarettes is -1.96, indicating a highly elastic response where a one percent increase in the price of illicit cigarettes would reduce consumption by approximately two percent. This suggests significant sensitivity to price changes within this segment, likely due to the affordability that attracts price-sensitive consumers. The positive cross-price elasticity of 0.95 suggests that an increase in premium cigarette prices would lead to a moderate increase in the consumption of illicit cigarettes.

Economy brand cigarettes

The own-price elasticity of -0.24 suggests a moderate decrease in consumption with an increase in the price of economy brand cigarettes. This reflects that smokers in this tier are somewhat price-sensitive, although not as much as those consuming illicit cigarettes.

The statistically significant positive cross-price elasticity of 1.153 indicates strong tier-switching behaviour. When the price of illicit cigarettes increases, there is a notable shift towards economy brands. This underscores the fact that illicit cigarettes are inferior substitutes for economy brands.

Premium brand cigarettes

The own-price elasticity of -0.566 reflects those smokers in this tier are more price-sensitive compared to those who consume economy brands and less price-sensitive compared to illicit cigarette smokers. It is important to note that these estimates are driven by prevalence elasticity, suggesting that the users of premium brands are likely to remain smokers or opt to quit instead of switching to cheaper brands.

Income elasticities

Consumption of premium brand cigarettes is highly income-elastic (0.809). As income rises, consumers shift towards premium brands. Economy brands show a modest positive income elasticity (0.075) while illicit brands have a negative income elasticity (-0.07); as income increases, the demand for illicit cigarettes declines.

The results emphasize distinct consumer behaviour across cigarette tiers, with illicit cigarettes showing high price sensitivity and being income-inferior, while premium brands are less price-sensitive but significantly influenced by income. The substitution effects between tiers, especially between illicit and economy cigarettes, underline the interconnected dynamics of these markets. This warrants targeted tax and pricing policies to influence consumption patterns effectively. Overall, the magnitudes of elasticity estimates are comparatively on the lower side. For example, the estimates from low-income and middle-income countries suggest that price elasticity of demand varies between −0.50 to −1.00 (Chaloupka et al. 2000).

5 Conclusion and Policy Implications

The elasticity estimates for illicit, economy, and premium cigarette tiers offer a comprehensive perspective on the dynamics of cigarette consumption and the potential impacts of taxation policies.

The magnitudes of own-price elasticity are relatively low but significant in economy brands, which constitute a major component of total tobacco consumption. Therefore, a notable increase in the FED rate would reduce cigarette consumption and generate more revenue for the national exchequer. Currently, the share of taxes on economy brands in the retail price is well below the widely accepted benchmark of 70 percent. Policymakers have hesitated to increase tax rates on economy cigarettes due to concerns over potential revenue losses. However, the elasticity estimates directly and emphatically challenge this assumption. There is very wide latitude to increase taxes on the economy tier and continue to generate substantial gains in revenue while reaping large public health rewards.

For premium brand smokers, the own-price elasticity of -0.566 indicates that a ten percent increase in the tax rate would result in a 5.66 percent reduction in consumption. This decline represents a direct health gain, as it reduces smoking prevalence. At the same time, the remaining consumption would contribute to higher government revenues, demonstrating a win-win situation: improved public health outcomes and enhanced fiscal resources.

The high price sensitivity of illicit cigarettes (-1.96) underscores the need to eliminate the price advantage enjoyed by non-tax-paid products. The observed substitution from illicit to economy cigarettes with rising illicit cigarette prices, alongside the reduction in illicit cigarette consumption as incomes rise, strongly suggests that illicit cigarettes are inferior goods. Consumers largely opt for illicit brands due to their low prices driven by tax evasion. This price distortion significantly undermines tax revenues and public health efforts.

To address this issue, it is critical to bring illicit cigarettes into the tax net. Achieving this requires a multifaceted strategy that effectively implements track-and-trace systems at domestic production facilities, ports, and other export-import channels. Comprehensive cigarette production and distribution tracking would help ensure compliance with tax regulations and reduce the prevalence of non-tax-paid products. Pakistan's government has already begun this process and thorough implementation of such remedies will only enhance both the public health and fiscal rewards of higher cigarette excise taxes.

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Annexure

Table A 1: Other Model Estimates for Prevalence Elasticity

	Probit	Melogit
Price per pack of 20 cigarette sticks (PKR) by tiers		
Price Illicit	-0.0022	0.0001
Price Economy	0.0004	0.0026
Price Premium	-0.0018**	-0.0031**
Income and Demographic Factors		
Income (000 PKR)	0.0002***	0.0001
Age (years)	0.0124	-0.0058
Age-square	-0.0001	0.0002
Gender	1.3177***	2.2070***
Married	-0.0342	-0.4706***
Number of smokers friends	-0.1123***	-0.2158***
Geographical Factors		
Urban	-0.1280**	-0.2225**
Sindh	-0.1328**	0.0162
Khyber Pakhtunkhwa	0.137	0.9288***
Balochistan	1.3811***	2.5165***
ICT	-0.5353***	-0.6204***
Education		
Primary	-0.0926	-0.3007***
Secondary	-0.1372*	-0.3970***
Tertiary	-0.1181	-0.4848***
Employment/Occupations		
Agriculture	0.2276*	0.4746***
Daily Wager	0.2616*	0.6405***
Government Employee	0.1414	0.7795***
Employee	0.143	0.4912***
Self-Employed	0.0834	0.5357***
Unpaid helpers	0.1077	-0.5248
Others	-0.0316	0.5885***
Intercept	0.8825	1.5524
var(_cons[psuid])		**0.589**
Number of observations	**7,843**	**7,843**
Pseudo R-squared	**0.33**	
χ^2	**1,072**	**1,688**

*** p<.01, ** p<.05, * p<.1

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