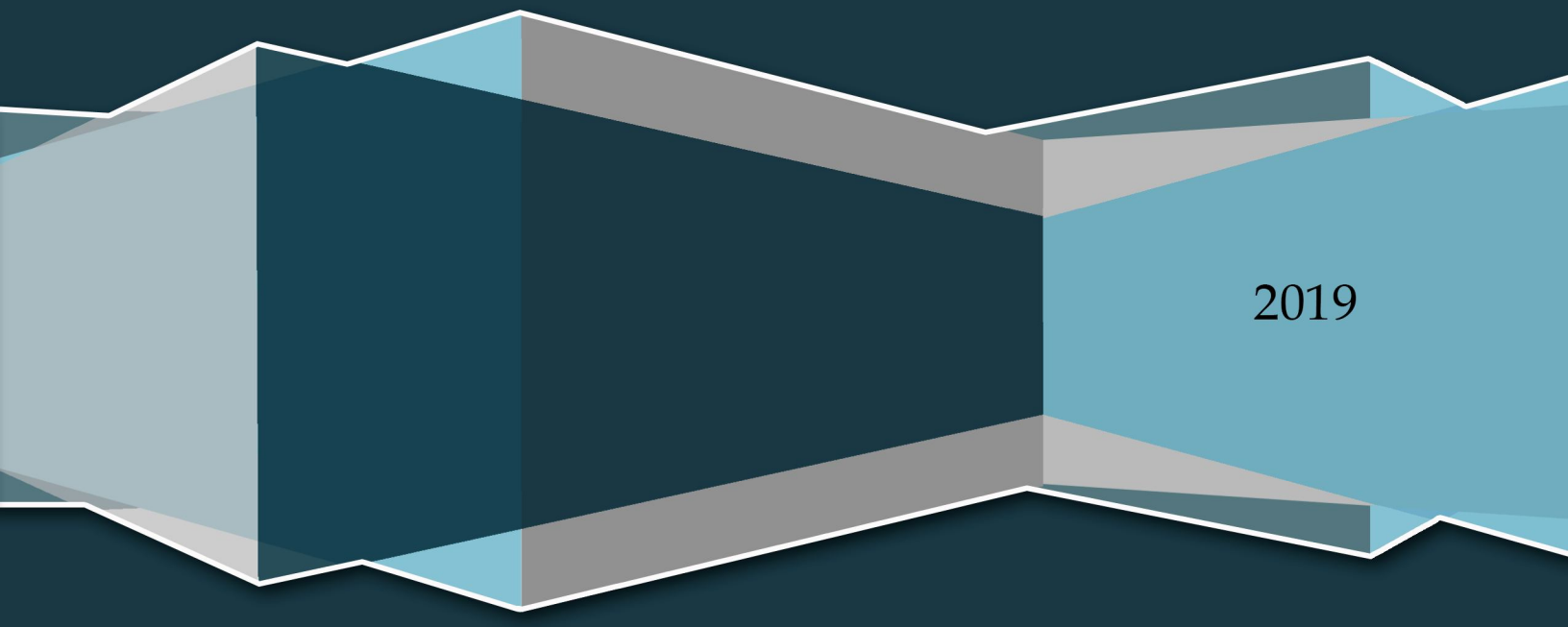
SPDC

Research Report

Quantifying the Potential Tax Base of Cigarette Industry in Pakistan



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Research Report

Quantifying the Potential Tax Base of Cigarette Industry in Pakistan

Social Policy and Development Centre

November 2019

The University of Illinois at Chicago's (UIC) Institute for Health Research and Policy is funding a group of economists to develop evidence-based policy support for effective tobacco tax policies in low- and middle-income countries with the highest rates of tobacco consumption. The global collaboration on the economics of tobacco is facilitated through Tobacconomics, a web-based platform. UIC is a partner of the Bloomberg Initiative to Reduce Tobacco Use.

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Acronyms

CES	Constant Elasticity of Substitution
FBR	Federal Board of Revenue
FED	Federal Excise Duty
GATS	Global Adult Tobacco Survey
GST	General Sale Tax
HIES	Household Integrated Economic Survey
KTC	Khyber Tobacco Company
LFS	Labour Force Survey
PBS	Pakistan Bureau of Statistics
PMPK	Philip Morris Pakistan
PSIC	Pakistan Standard Industrial Classification
PTC	Pakistan Tobacco Company
Rs	Pakistani Rupee
RTO	Regional Tax Office
SEMP	System for Electronic Monitoring of Production
SPDC	Social Policy and Development Centre
UIC	University of Illinois at Chicago

I Introduction

Tobacco consumption is one of the leading causes of preventable death particularly in developing world. Pakistan is not an exception, where the prevalence of tobacco use has emerged as a serious public health challenge. Globally, tobacco taxation is considered one of the crucial elements of tobacco control strategy with its dual objective of public health promotion and revenue generation. On the one hand, tobacco taxation contributes to reducing tobacco consumption through increased prices as a result of higher taxes, and on the other, it generates sizeable revenue for the government, which can be used to promote public health objectives.[1]

The effectiveness of this tool, however, depends heavily on the mechanisms of tax collection. Research shows that weak tax administration, poor enforcement, presence of informal distribution networks along with corruption results in tax evasion.[2] In a nutshell, an effective tax collection system with proper production tracking and multilevel monitoring is likely to generate substantial revenues.

A look into Pakistan's tax collection mechanism, particularly taxation of cigarettes, reveals various loopholes that are likely to encourage tax evasion. The Federal Board of Revenue (FBR) is the main tax collection authority that deals with taxes on cigarettes in Pakistan. It collects the Federal Excise Duty (FED) and General Sales Tax (GST) on domestic production of cigarettes. Both taxes are collected at the manufacturing stage.

Despite the fact that the number of large manufacturers is small – over 90 percent of the market share is captured by only two firms in Pakistan – FBR relies on self-assessment (a voluntary declaration of production by the manufacturers) to determine the tax liability of the firms. There is no track and trace system installed at factories to monitor the actual production of cigarettes in the country, nor are supplies monitored at the wholesale and retail stages. In the absence of an integrated information system or effective audit, self-declaration methods may lead to inefficiencies in tax collection by creating an incentive for tax evasion (Ahmed, 2010; Sabir, 2017; Bukhari and Haq, 2012).

Despite the fact that the number of large manufacturers is small, FBR relies on self-assessment.

[1] A review of more than 100 international studies concluded that significant increases in tobacco taxes are a highly effective tobacco control strategy and can lead to significant improvements in public health (Frank et al, 2012).

[2] See for example, McClellan (2013) and Kate (2018).

Guided by the above discussion, this study aims to quantify the extent of tax evasion – if it exists – in the cigarette industry through measurement of the extent of under-reporting of cigarette production in Pakistan. The study is primarily based on quantitative methods and relies mainly on secondary sources of data, particularly the data on the industry-level linkages between input and output.

The Research Context

There is ample evidence in the literature indicating that consumption of cigarettes is higher than the declared production of cigarettes in Pakistan. The gap between declared production and consumption is generally referred to as illicit trade. Several studies have highlighted and documented various quanta of illicit trade in Pakistan. For instance, Oxford Economics (2017) indicates consumption of more than 37 billion non-duty-paid cigarettes in 2016, which include 27 billion domestically produced and 10 billion imported cigarettes. Similarly, Euromonitor International (2019) claims that more than 34 percent of the cigarettes consumed in Pakistan were non-duty-paid in 2018. In absolute terms, it indicates consumption of more than 27 billion cigarettes. [3] These reports largely claim that the non-duty-paid consumption impairs formal production of cigarettes in Pakistan. Considering these claims, the estimated revenue loss to FBR would be more than Rs 30 billion in 2018.

FBR is also cognizant of the tax evasion, tax avoidance and illicit trade in the country. The tax collection authority uses various tools to curb supply of non-duty-paid cigarettes. However, they also recognize that the existing self-assessment system contains a built-in incentive to under-report production to evade taxes. Moreover, anecdotal evidence also supports the presence of an under-reporting phenomenon. For instance, in 2017, a newspaper reported:

Evidence in the literature indicates that consumption of cigarettes is higher than declared production in Pakistan.

> "Regional Tax Office (RTO) Rawalpindi has detected alleged evasion of sales tax and federal excise duty (FED) by a Karachi-based multinational cigarette manufacturing company and also exposed an undeclared warehouse which was being misused for storage and sale of undeclared/concealed production of non-tax paid cigarettes." [4]

[3] According to Oxford Economics, total consumption of cigarettes in Pakistan in 2017 was 77.8 billion sticks. Total consumption was calculated by adding four components: legal domestic consumption, non-domestic legal consumption, non-domestic illegal consumption and domestic illicit consumption. The first component (legal domestic consumption) was obtained by subtracting legal outflows to other markets from legal domestic sales. Primary source for estimating illicit consumption was empty pack surveys.

[4] RTO detects tax evasion case against cigarette manufacturing firm. *Business Recorder, June 3, 2017*

This realization is not recent. In 2005, FBR planned to use modern technologies to curb under-reporting of cigarettes for the first time. The proposed alternative mechanism consisted of affixing security stamps on each cigarette pack to stop tax evasion in the formal sector. However, due to strong resistance from leading producers of cigarettes, the plan was never implemented. In 2014, FBR launched a new initiative with the name 'System for Electronic Monitoring of Production' (SEMP). However, it was also opposed for being restricted to the monitoring of certain specified goods and ignoring the supply chain. In 2015-16, the government made changes in the proposed system to address the criticism. The proposed mechanism contained all desirable features to track production, sales, clearances, stocks and supplies, with the option of using tax stamps, banderols, stickers, labels, and barcodes (Baloch, 2017).

In 2017, FBR issued an invitation for bids regarding electronic monitoring (track and trace system) of tobacco products. However, not much progress was made until very recently when FBR, in October 2019, awarded a 5-year contract to a firm for establishing, maintaining and operating the track and trace system.[5] Outcomes of this initiative are yet to be seen.

In this context, this study is an attempt to search for alternative tools and methods to estimate the quantum of tax evasion through under-reporting of duty-paid production of cigarettes.

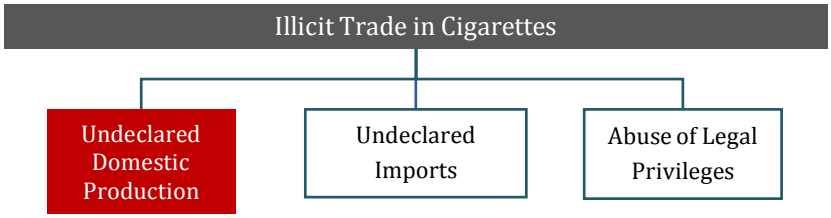
Objectives and Scope of Research

The overall objective of the study is to estimate the potential levels of output by the cigarette industry to measure the extent of tax evasion on the domestic production of cigarettes in Pakistan. Specific objectives are: to review the existing data on input supplies to the tobacco industry from various sources (including financial statements of firms and international trade statistics); analyze linkages between input supplies and production of cigarettes; quantify the extent of under-reporting of cigarette production; measure the quantum of tax evasion; and propose specific policy recommendations to enhance tobacco tax compliance and reduce tax evasion.

Undeclared production is part of illicit trade. As shown in Figure 1, illicit trade can be divided into three components: 1) undeclared domestic production, 2) undeclared imports, and 3) abuse of legal privileges. The scope of this research is limited to undeclared domestic production to quantify the extent of tax evasion, particularly in 2016-17.

[5] Track and trace system: FBR decides to award contract to lowest bidder. *Business Recorder*, October 16, 2016.

Figure 1: Categories of illicit trade



Source: Adapted from Allen (2013).

Structure of the Report

The report is organized in five sections. Section 2 presents a brief profile of the cigarette industry in Pakistan. Section 3 provides analysis of linkages between cigarette production and taxation. A literature review is presented in section 4, and results of the estimation of under-reporting are discussed in Section 5. Lastly, Section 6 concludes and presents policy recommendations.

II A Brief Profile of Cigarette Industry in Pakistan

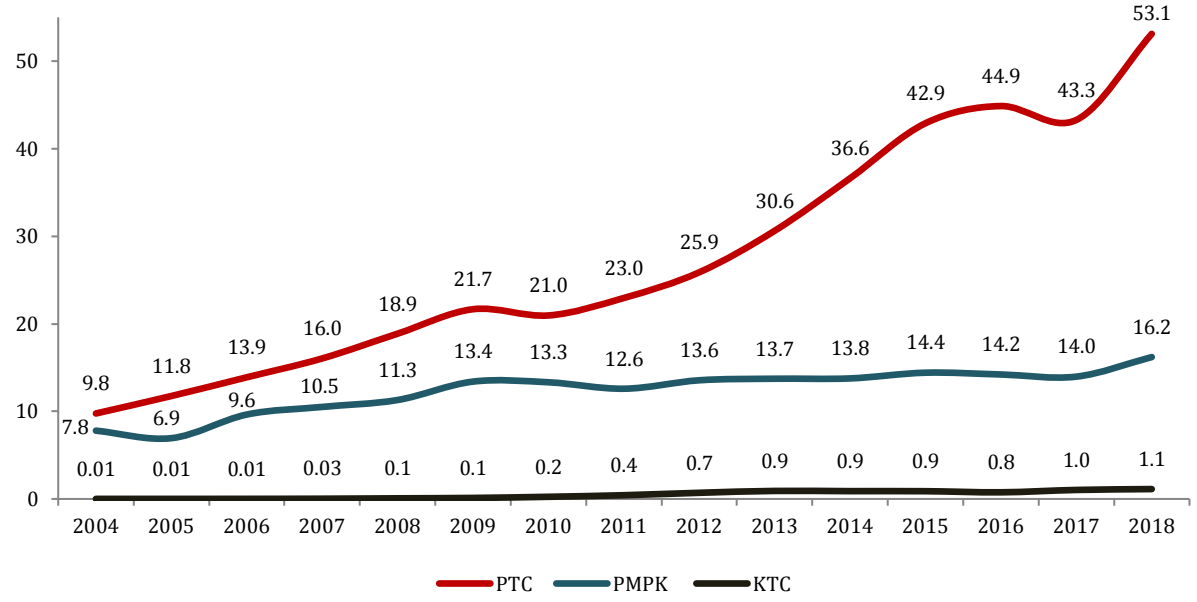
The cigarette industry is one of the large-scale manufacturing industries of Pakistan. However, only three firms are listed on the Karachi Stock Exchange: Pakistan Tobacco Company (PTC), Philip Morris–Pakistan (PMPK) and Khyber Tobacco Company (KTC). This section presents the key indicators abstracted from the annual reports of these companies. Primarily, it focuses on trends in input, value-added, output, and profitability of these companies over a period of fifteen years.

Market Structure

The cigarette manufacturing industry is largely dominated by PTC, followed by PMPK and KTC. In other words, it is an example of an imperfect market. Annual reports of each firm contain both gross and net turnover. While gross turnover shows the revenue from total sales including taxes, net turnover consists of revenues from sales excluding taxes and trade discounts (in some cases). Figure 2 presents the net turnover of the firms from 2004-2018. Three important observations emerge from the data. First, turnover has increased from Rs 17.6 billion in 2004 to Rs 70.4 billion in 2018 indicating that size of the industry has increased more than four-fold. With PTC taking the lead, all three firms have shown growing trend in their turnover with some degree of variation.

The cigarette industry in Pakistan is dominated by three large firms, which is an example of imperfect market.

Figure 2: Net turnover of the firms *Billion Rs*

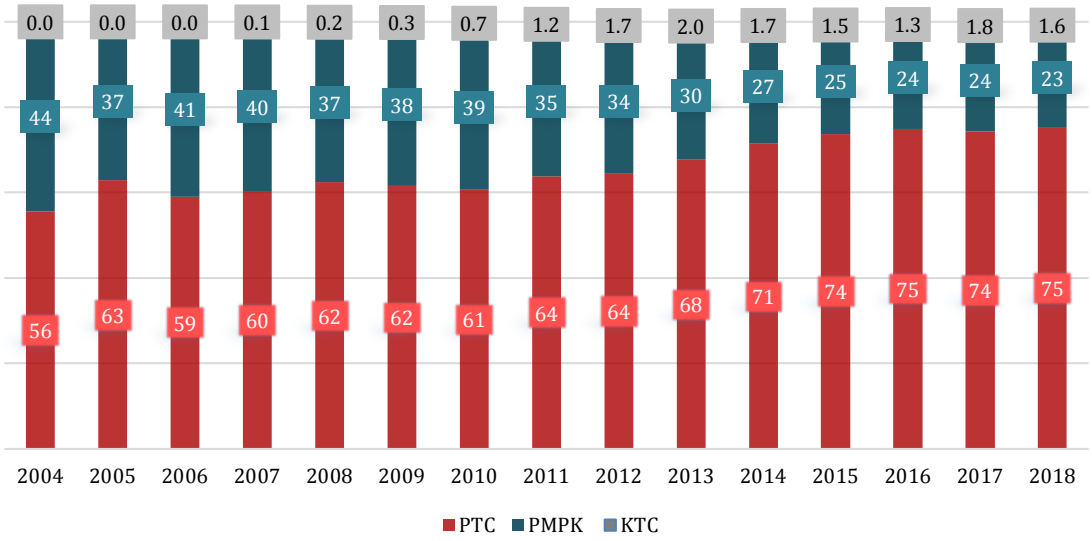


Source: Annual Reports of the firms (2004 to 2018).

Second, turnover of both PTC and PMPK declined in 2017, while that of KTC increased marginally. The decline in PTC's turnover occurred after consistent growth for seven consecutive years. It was only the second decline in the 15-year history of the firm. In contrast, the growth path of PMPK is quite flat, particularly after 2010. Third, all three firms had positive growth in 2018. Interestingly, these trends show an association with the changes in the rates of FED, which will be discussed in next section.

Figure 3 shows the market share of each listed firm in the cigarette industry. It indicates that the market share of PTC has increased from 56 percent in 2004 to 75 percent in 2018. Similarly, after having some fluctuations, the market share of KTC increased from negligible to almost 2 percent during the same period. In contrast, the market share of PMPK has observed a decline from 44 percent to 23 percent during the same period; the decline is more pronounced after 2010.

Figure 3: Market share of the firms (%)



Source: Annual Reports of the firms (2004 to 2018).

Cost of Sales

Cost of sales of each firm is comprised of input costs along with value-added of the firm excluding gross profit. Figure 4 shows that the cost of sales of each firm has increased in nominal terms. However, increase in the cost of sales is less than the increase in net turnover of the firms. For instance, the cost of sales of PTC increased from Rs 6.3 billion in 2004 to Rs 29.8 billion in 2018, indicating 4.8 times increase in the cost of sales. During the same period, net turnover of PTC increased to 5.4 times (see Figure 2). Similarly, the growth of the net turnover of KTC is much higher than the cost of sales. However, in the case of PMPK cost of sales and net turnover have almost similar growth during the period.

Another notable message from the trend is higher growth in cost of sales during 2018. For instance, the cost of sales of PTC increased from Rs 23.1 billion in 2017 to Rs 29.8 billion in 2018 and that of PMPK increased from Rs 8.9 billion to Rs 10.2 billion. This sharp increase in cost of sales is an impact of the massive depreciation of the Pakistani Rupee against the US Dollar, which indicates heavy dependence of the cigarette industry on imported inputs. Finally, the growth of cost of sales in 2017 of PTC and PMPK is puzzling as the companies had a decline in turnover and its work force.

Figure 4: Trend in cost of sales

Year	Nominal values (Billion Rs)			Growth (%)		
	PTC	PMPK	KTC	PTC	PMPK	KTC
2004	6.3	4.6	0.01			
2005	7.2	2.9	0.01	15.1	-37.4	13.9
2006	8.4	5.5	0.01	15.7	91.1	49.8
2007	9.5	6.0	0.02	14.0	10.2	127.1
2008	11.6	7.0	0.1	21.7	16.0	247.5
2009	13.4	8.4	0.1	15.9	20.8	71.3
2010	14.7	9.0	0.2	9.7	6.2	69.4
2011	16.7	9.5	0.3	13.3	5.6	56.1
2012	17.4	9.7	0.5	4.3	2.9	78.2
2013	20.0	10.1	0.8	14.8	3.3	67.1
2014	22.8	9.9	0.7	13.8	-2.1	-21.0
2015	24.4	9.6	0.7	6.9	-3.0	5.0
2016	22.1	8.2	0.6	-9.3	-14.3	-15.0
2017	23.1	8.9	0.6	4.4	8.5	8.9
2018	29.8	10.2	0.6	29.3	14.5	-0.4

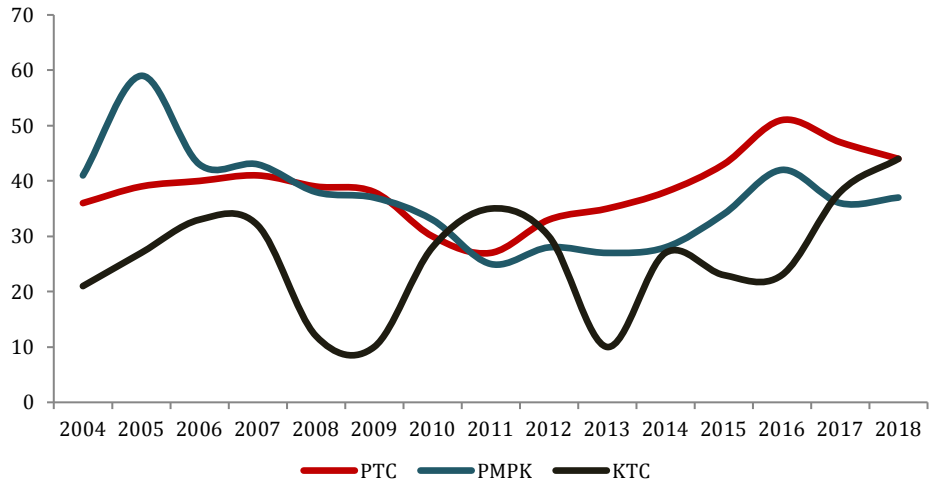
Source: Annual Reports of the firms (2004 to 2018).

Profitability of the Firms

Tobacco firms usually argue that higher FED causes a decline in their sales and profitability. Figure 5 presents profit margins of the firms, which is defined as gross profit of the firm as a percentage of the net turnover. During the last four years, when tobacco firms reported a decline in their sales, profit margins remained substantially higher compared to the previous years. For instance, during 2010 to 2014, the profit margins of PTC, PMPK and KTC hovered around 32 percent, 28 percent, and 26 percent, respectively. However, profit margins substantially increased afterwards. In fact, in 2017 – a year of substantial decline in production – profit margins were 47 percent, 36 percent, and 38 percent for PTC, PMPK, and KTC, respectively. Even in 2018, profit margins of PMPK and KTC were at a higher level, and PTC's did not drop significantly.

Profit margin remained higher in the years when the firms reported a decline in sales.

Figure 5: Trend in the profit margin (%)



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
PTC	36	39	40	41	39	38	30	27	33	35	38	43	51	47	44
PMPK	41	59	43	43	38	37	33	25	28	27	28	34	42	36	37
KTC	21	27	33	32	12	10	28	35	30	10	27	23	23	38	44

Source: Annual Reports of the firms (2004 to 2018).

Appearance of New Categories in Accounts

A look into various annual reports of both PTC and PMPK indicates appearance of two new categories since 2015. For instance, PMPK introduced a new category of trade discounts in their annual report of 2015. Figure 6 shows the magnitude of trade discounts along with other components. Previously, net turnover was simply the difference of gross turnover and taxes – both FED and GST. However, since 2015, it also includes trade discounts that reached to more than Rs 1 billion in 2018.

Figure 6: Appearance of trade discount in PMPK accounts (Million Rs)

Years	Gross turnover	Trade discount	FED	GST	Net turnover	Cost of sales
2014	38.046	0	18.448	13.764	13.764	9.853
2015	40,157	244	19,368	14,661	14,417	9,562
2016	40,343	810	19,167	15,023	14,213	8,192
2017	30,144	933	10,965	14,900	13,967	8,888
2018	36,103	1,070	13,594	17,270	16,200	10,176

Source: Annual Reports of the firms (2014 to 2018).

In contrast, PTC has introduced a new category named severance benefits in 2015. Severance benefits refer to an amount paid to employees who leave employment unwillingly. This category is in addition to the category, namely, salaries, wages including benefits. It is very unlikely that the company did not pay severance benefits prior to 2015. Whereas, it is

probable that severance benefits were clubbed into wages and benefits and the new category could be an outcome of improvements in financial reporting of the company.

The trend analysis of the number of employees, severance benefits and salaries, wages (including benefits) supports this view. As shown in Figure 7, there is a drastic reduction of 26 percent in the company's work force in 2012 but severance benefits are not mentioned. After 2015, severance benefits are shown as a regular expense with varied amount. For instance, even in 2018 when the company's workforce grew by almost 8 percent, company paid Rs 172 million under severance benefits.

Severance benefits are particularly important since the estimation is based on financial data of more than 20 years. If these were previously included in the salaries, wages including benefits then ignoring this cost after 2015 will result in under-estimating the extent of under-reporting. Another constraint is that the severance benefits for production workers are required for the analysis but these are not reported separately – the amount includes production and other workers. Therefore, the share of production workers in salaries, wages including benefits has been applied to calculate severance benefits of these workers. Given the absence of disaggregated data, it can provide the most appropriate approximation (the results of estimation of econometric models are presented in Section V).

Figure 7: Appearance of severance benefits in PTC accounts

Years	Employees		Severance benefits	Salaries, wages including benefits (Million Rs)			
	Number	Growth (%)	Million Rs	Production	Others	Total*	Growth (%)
2004	1,745			648	193	841	
2005	1,818	4.2		643	205	848	0.8
2006	1,698	-6.6		821	249	1,071	26.3
2007	1,668	-1.8		915	266	1,181	10.4
2008	1,655	-0.8		1,094	304	1,397	18.3
2009	1,573	-5.0		1,069	386	1,454	4.1
2010	1,597	1.5		1,206	421	1,627	11.9
2011	1,543	-3.4		1,367	491	1,857	14.1
2012	1,136	-26.4		1,427	573	2,000	7.7
2013	1,250	10.0		1,477	689	2,166	8.3
2014	1,269	1.5		1,708	908	2,616	20.8
2015	1,237	-2.5	466	1,742	1,005	3,213	22.8
2016	1,205	-2.6	182	2,155	1,036	3,374	5.0
2017	1,029	-14.6	2,168	1,867	1,089	5,123	51.9
2018	1,109	7.8	172	2,060	1,176	3,408	-33.5

*Including severance benefits.
Source: Annual Reports of the firms (2004 to 2018).

In summary, the financial data of the firms in cigarette industry highlights some interesting phenomena. It shows that the decline in sales volume of the firms did not have much impact on their profit margin. Similarly, cost of sales did not have close association with net turnovers. Finally, one of the large firms introduced severance benefits as a new category in 2015 and the other introduced trade discounts in the same year. While this may be a co-incidence, there are some linkages with the higher FED regime.

III Linking Cigarette Production and Taxation

As mentioned earlier, domestically produced cigarettes are subject to two major taxes, FED and GST – where the FED accounts for almost 80 percent of the revenue from the sector. During the past two decades, FBR has implemented various reforms to the FED on cigarettes including changes in the FED structure and rates. The structure of the FED on cigarettes has historically been a complicated mix of a specific tax on low-priced brands, an ad valorem tax on high-priced brands, and a combined specific and ad valorem tax on mid-priced brands. In 2013, the ad valorem tax was withdrawn, and a two-tier structure of specific taxes based on the range of retail prices was introduced. Changes have been made in the tier structure and tax rates since then. These tax policy interventions have often generated debates about whether the objective of taxation on cigarettes was achieved or not. In this context, this section provides a trend analysis of the effective FED[6] in relation to the production and prices of cigarettes as well as an analysis of firm-specific production growth and profitability. These analyses will help set a basis for further analysis presented in the next sections.

Cigarette Production, Prices and the FED: Macro Perspective

Two major types of data sets are used in this research. The first is data published by government agencies such as the Pakistan Bureau of Statistics (PBS) and FBR, which includes aggregate production of cigarettes, prices and the FED. This data is reported as per the fiscal year, which is from July to June. The other data set (including production, profits, etc.) is extracted from annual reports of the companies which provide data on the basis of the calendar year.

Figure 8 shows the annual declared production, index of prices of cigarettes and the effective FED rate in Pakistan from 2004-05 to 2017-18. Three key messages emerge from the trend. First, a continuous increase in the prices of cigarettes and the FED rate is observed until 2016-17; afterwards both the prices and the FED rate declined massively by more than 21 percent and 41 percent, respectively. Second, the high growth in the FED rate did not fully correspond with growth in prices, particularly until 2011-12. For instance, in 2011-12, the effective FED rate grew by 20 percent while prices grew only by 6 percent. A similar pattern can be noticed in 2006-07, 2008-09, and

High growth in FED rate did not fully correspond with growth in prices, particularly till 2011-12 but the trend changed afterwards.

[6] This is average tax rate of FED calculated by dividing total revenue by the volume of sales (number of sticks).

2009-10. This could be due to one or a combination of various factors including: a) an incomplete tax pass-through where increase in FED is not fully shifted to consumer price, b) growth in cost of production is higher than growth in FED, and c) profit margin of the firms is reduced. However, in the later years, after 2011-12, prices appear to be more sensitive to the FED rate where the growth pattern of both indicators is more or less similar. This reflects a complete pass-through of the FED in prices along with similar growth in production cost or profit margin.

Figure 8: Trend in production, prices and effective FED on cigarettes - macro data

Fiscal Years	Production	Growth rate	Prices	Growth rate	Effective FED	Growth rate
	Billion sticks	%	Index	%	Rs/cigarette	%
2004-05	61.1	10.3	82.3	13.5	0.35	8.3
2005-06	64.1	5.0	86.3	4.8	0.36	0.9
2006-07	66.0	2.9	95.2	10.4	0.43	20.4
2007-08	67.4	2.2	100.0	5.0	0.42	-1.8
2008-09	75.6	12.1	108.7	8.7	0.49	15.3
2009-10	65.3	-13.6	138.1	27.0	0.68	40.4
2010-11	65.4	0.2	164.0	18.7	0.71	4.6
2011-12	62.0	-5.3	173.9	6.0	0.86	20.1
2012-13	67.4	8.8	193.3	11.1	0.92	6.6
2013-14	64.5	-4.3	229.8	18.9	1.11	21.0
2014-15	62.7	-2.8	274.0	19.2	1.31	18.1
2015-16	53.5	-14.6	345.1	26.0	1.69	29.4
2016-17	34.3	-35.8	387.6	12.3	1.93	14.1
2017-18	59.1	72.0	303.4	-21.7	1.14	-41.1

Sources:
i) FBR Yearbook, Federal Board of Revenue, Government of Pakistan, various issues.
ii) Economic Survey, Government of Pakistan, various issues.

Third, with the exception of 2008-09, the production of cigarettes remained fairly stable between 61-67 billion sticks until 2014-15. However, massive fluctuation in production is evident in the last three years. Declared production reached the lowest level in 2016-17 with massive decline of 36 percent. In absolute terms, the production of the industry decreased by 19.2 billion sticks in one year. This decline can be attributed to the consistent increase in prices of cigarettes largely due to the increase in the FED rate. In 2017-18, the federal government introduced a three-tier FED structure – with a new tier for the low-priced brands. The effective FED rate was slashed by 41 percent, which resulted in a 22 percent reduction in the prices of cigarettes. Interestingly, this decline in prices corresponded with a massive growth of 72 percent in production of cigarettes. In absolute terms, production bounced back to almost 60 billion sticks. This peculiar trend in

Considerable fluctuation in the production is evident after 2014-15.

production of cigarettes coinciding with the variation of the FED raises concerns over the validity of declared production.

Cigarette Production, Prices and the FED: Micro Perspective

Figure 9 shows the annual sales, average price of cigarettes including taxes, and the effective FED rate in Pakistan from 2010 to 2018. A similar trend is observed from the analysis of the micro data (annual reports of the firms). However, it is important to note that the firms report data on the basis of the calendar year instead of the fiscal year. The trend reflects a continuous increase in prices of cigarettes and the effective FED rate until 2016, with both declining afterwards. Also, a strong positive correlation exists between prices and the FED rate, indicating that the effect of the FED on prices of cigarettes is more prominent than the effect of input prices. Interestingly, the ratio of prices to the FED rate reflects a complete pass-through of FED in prices except for the last two years – 2017 and 2018.

Figure 9: Trend in production, prices and effective FED on cigarettes - micro data

Years	Sales	Growth rate	Average price	Growth rate	Effective FED	Growth rate	Ratio of price to FED
	Billion sticks	%	Rs/cigarette	%	Rs/cigarette	%	
2010	75.5		1.25		0.61		2.0
2011	62.2	-17.5	1.60	28.0	0.80	31.0	2.0
2012	63.8	2.6	1.74	9.0	0.87	9.2	2.0
2013	65.2	2.1	1.93	11.0	0.97	10.9	2.0
2014	61.6	-5.5	2.36	22.1	1.18	22.1	2.0
2015	58.6	-4.8	2.82	19.5	1.41	19.2	2.0
2016	48.3	-17.5	3.51	24.4	1.74	23.4	2.0
2017	45.4	-6.1	3.12	-11.1	1.37	-21.3	2.3
2018	60.4	33.1	2.87	-8.1	1.27	-7.3	2.3

Source: Annual Reports of the firms (2010 to 2018).

IV Literature Review

A look into available literature reveals various approaches to estimate the magnitude of the tax gap and illicit trade. However, the focus of these approaches is to estimate the quantum of illicit trade without differentiating under-reporting of production by domestic/local manufacturers. This lack of differentiation adds substantial challenge due to a complete vacuum of such research. Therefore, in line with objective of this research, the scope of literature review is expanded to add other industrial studies including production function estimation.

Estimating Illicit Trade: An Insight from the Literature

Reuter and Majmundar (2015) provide a good review of various methods to estimate the illicit trade of cigarettes. They divide these methods into three broad categories: residual methods, direct measurement and expert opinion. According to them residual methods are based on more than one source of data and include trade gap analyses, comparisons of self-reported consumption and tax-paid sales, and econometric modeling. In contrast, direct measurement estimates "are based on such methods as empty pack collections and pack observation, return, and swap surveys, which are typically conducted in neighborhoods or cities" (p. 78). Finally, estimates based on expert opinion are relied on "polls of a number of informed sources to compile data from which an estimate can be extrapolated" (p. 78).

In another interesting methodological guide, Ross (2015) divides estimation of non-duty-paid cigarette consumption into five categories. She begins with "survey of tobacco users" as a direct method of obtaining estimates of the tax avoidance. However, this method is relatively expensive and like other self-reported survey-based methods, has validity concerns. The second approach relies on examination of cigarette packs that is likely to capture both tax avoidance and tax evasion. However, examining cigarette packs is a tricky business that requires additional information or involvement of experts.

The third category is gap analysis, which requires comparison of consumption and sales of cigarettes. This method is based on secondary data and simple arithmetic estimation and is relatively less expensive and transparent as compared to other survey-based methods. However, this method does not provide estimates of tax evasion and avoidance separately. It is primarily used to detect deviations from the trend instead of estimating

tax avoidance and evasion. The fourth category is econometric modeling that is largely based on estimation of the demand function based on different determinants. According to Ross, this method can assess sensitivity of tax avoidance/evasion by testing various hypotheses. The fifth and last category contains residual methodologies including key informant interviews along with variation in gap analysis.

In line with the scope of research, this study focuses only on those studies that used some form of gap analysis – the difference between duty-paid sales of cigarettes and consumption of cigarettes. Another method is the use of econometric modeling to estimate the quantum of illicit trade.

A review of econometric methods identified various studies including Becker et al. (1994), Thursby and Thursby (2000), Merriman (2000), Farrelly et al. (2003), Czubek and Johal (2010), and Yürekli and Sayginsoy (2010). These studies provide various econometric models for estimating the magnitude of illicit trade. These studies largely rely on household level data for such estimation that includes demographic and income variables. In these studies, various models are used that employ the given characteristics of the underlying population and region to estimate the consumption/demand of cigarettes. However, none of these studies link the reported input and output for estimation of the actual output and under-reporting at firm level.

In the case of Pakistan, Household Integrated Economic Survey (HIES) reports consumption expenditure on tobacco at household level, therefore, consumption of individuals cannot be estimated. Apart from this limitation, to the authors' knowledge, research that links input to output to estimate the firm level quantum of illicit trade does not exist.

The Production Function

A comprehensive review of the literature on the production function is beyond the purview of this study. Four studies that are most relevant for estimation of the production function are described below.

Ringstad (1971) exemplifies the use of various statistical methods to estimate sector specific production functions for both mining and manufacturing industries. The study is based on the CES (constant elasticity of substitution) production function estimated for Norway. The study provides a step-by-step guide to estimate the production function including tobacco manufacturing. The size-regression results of the study suggest that the average productivity of labour, the capital-labour ratio, the materials-labour ratio and materials' share in gross production are lower for large units as compared to that of smaller ones. On the other hand, large

units seem to pay higher wages and also seem to be more labour-intensive than smaller units.

Ackerberg et al. (2015) examine some of the recent literature on the estimation of production functions. They argue that some popular techniques of estimating production functions may suffer from a functional dependency problem; they suggest an alternative approach. According to them, their approach produces consistent estimates under alternative data generating processes. They referred their production function estimation as ACF, which is an abbreviation of the names of authors.

Grieco et al. (2016) propose an alternative method to estimate production functions in the presence of input price dispersion when intermediate input quantities are not observed. They find that the traditional approach to deal with unobserved input quantities – using deflated expenditure as a proxy – substantially biases the production estimates. In contrast, as per their claim, their method controls for heterogeneous input prices by exploiting the first-order conditions of the firm's profit maximization problem and consistently recovers the production function parameters. Using their preferred method, they provide empirical evidence of significant input price dispersion and even wider productivity dispersion than is estimated using proxy methods.

Mahmood, Ghani, & Din (2006) investigate the efficiency of the large-scale manufacturing sector of Pakistan using the stochastic production frontier approach. A stochastic production frontier is estimated for two fiscal years (1995-96 and 2000-01) for 101 industries at the 5-digit PSIC. The results show that there has been some improvement in the efficiency of the large-scale manufacturing sector, though the magnitude of improvement remains small. The results are mixed at the disaggregated level: whereas a majority of industrial groups have gained in terms of technical efficiency, some industries have shown deterioration in their efficiency levels. The study finds that the tobacco industry is the most inefficient industry in 1995-96 and in 2000-01.

In summary, despite the fact that a sizeable literature is available on estimating illicit trade of cigarettes, thus far, to the best of the authors' knowledge, no study focuses specifically on under-reporting of cigarette production by domestic firms. In the absence of such literature, alternate production function and related microeconomic theoretical models can be used to link firm production and its use of inputs. Other microeconomic-based econometric techniques also provide an alternative choice.

V Estimation of Under-reporting

The estimates of the possible extent of under-reporting by the cigarette industry in Pakistan are presented in this section. We relied on two approaches: 1) supply function - annual and monthly, and 2) analysis based on financial time series and panel data. We assume that this multiplicity will likely contribute to generating a plausible and robust range of extent of under-reporting. For the financial time series analysis and estimation of the production function, we relied on financial statements of two largest tobacco companies, namely, Pakistan Tobacco Company (PTC) and Phillip Morris Pakistan (PMPK).

Supply Functions Estimates

To estimate the extent of under-reporting, two time series functions were estimated. The first supply function is based on annual data of production and price of cigarettes, while the second is based on monthly data (see Technical Annexure for methodology).

Supply Function – Annual Time Series Model

The supply function estimates the relationship between prices and quantity supplied. In this case, it is the relationship between the output of the industry, that is, the annual production of cigarettes and the price index of cigarettes.

Figure 10: Relationship between prices and output of cigarettes

Source: Annual Reports of the firms (various issues).

Figure 10 shows the relationship between the price index of cigarettes and total supply of cigarettes. The chart shows that there is a nonlinear relationship between the price index of cigarettes and the output/supply of cigarettes, indicating that as prices of cigarettes increase, firms supply more cigarettes in the market. However, after reaching a peak, further increases in prices lead to a decrease in the supply.

The equation below is the supply function which relates the output with prices:

Y_t=f(P_t) ……….(1)

Based on the relationship as indicated in Figure 10, the following equation is estimated:

$$lnCig_t = \alpha + \beta_1 * (lnprice)_t + \beta_2 * (lnprice)_t^2 + \gamma * T + \delta * lnCig_{t-1} + \varepsilon_t \text{ ......(2)}$$

Where

$lnCig_t$= log of cigarette production in year t

$(lnprice)_t$ = log of weighted cigarette price index at base 2007-08=100 in year t

$(lnprice)_t^2$= square of log of weighted cigarette price index at base 2007-08=100 in year t

T= time trend with value of =0 for year 2007-08.

$lnCig_{t-1}$ = log of cigarettes production in year t-1.

The estimation of equations yields the following results:

$$lnCig_t = \underset{(0.005)}{8.23} - \underset{(0.032)}{1.175} * (lnprice)_t + \underset{(0.068)}{0.0831} * (lnprice)_t^2 + \underset{(0.005)}{0.044} * T + \underset{(0.000)}{0.588} * lnCig_{t-1}$$

The above estimated equation confirms a nonlinear relationship between the production and prices of cigarettes. Further, it shows that cigarette production in the current year significantly depends upon that of the previous year. Given that the production is based on the lag value, two years (2016 and 2017) are predicted. $lncig_t$^ is the predicted value of cigarette production for year 2016 that is used in the prediction of 2017. Figure 11 gives the values used for prediction for the year 2017.

Figure 11: Values used for prediction

Fiscal Year	lncig	lnprice	lnprice^2	time	lncigt-1	lncigt^
2016-17	10.44412	5.959897	35.52037	9	10.88785	10.98049

Sources:
i) Pakistan Economic Survey, various issues.
ii) Monthly Bulletin of Statistics, Pakistan Bureau of Statistics, various issues.

Figure 12 presents the declared and estimated production of cigarettes for three consecutive fiscal years, 2015-16 to 2017-18. The results indicate that given the price level and previous behavior of the cigarette industry, the declared output of cigarettes in 2016-17 was 71 percent lower than the estimated output. It is important to note that in terms of declared output, 2016-17 is an unusual year when decline in the production was 36 percent, which is exceptionally high keeping in view the trend since 2004-05 (see Figure 8). For the other two years, the extent of under-reporting remained close to 20 percent. In absolute terms, it indicates under-reporting of 10.6 billion and 13.5 billion cigarettes in 2015-16 and 2017-18, respectively.

Figure 12: Extent of under-reporting: estimates based on supply function (annual time series model)

Fiscal Years	Output (Million sticks)			Under-reporting (%)
	Declared	Estimated	Under-reported	
2015-16	53,522	64,154	10,632	19.9
2016-17	34,342	58,717	24,375	71.0
2017-18	59,058	72,511	13,453	22.8

Sources:
i) Pakistan Economic Survey, various issues.
ii) Monthly Bulletin of Statistics, Pakistan Bureau of Statistics, various issues.

Supply Function – Monthly Time Series Model

Pakistan Bureau of Statistics (PBS) collects and publishes monthly data on the production of cigarettes and market prices of tobacco products. This data enables identification of the months in which the extent of under-reporting is higher, and thus, controlling for the seasonality in the production of data. Equation 3 is the general equation of the model:

$$lnCig_t = \alpha + \beta_1 * (lnprice)_t + \beta_2 * (lnprice)_t^2 + \gamma * T + DM * \delta` + \varepsilon_t \quad \text{.....(3)}$$

$lnCig_t$= log of cigarette production in month t

$(lnprice)_t$ =log of weighted cigarette price index at base 2007-08=100 in month t

$(lnprice)_t^2$= square of log of weighted cigarette price index at base 2007-08=100 in month t

T= time trend with value of =1 for January 2011.

DM= is vector of monthly dummies

$\delta`$ = is a vector of monthly dummies coefficient

Figure 13 presents the results of estimated equation 3. Like the previous model, out-of-sample forecasting method is used. Monthly data is used to estimate the above equation and then the estimated coefficients are used to predict monthly output. The result shows that there is a negative (and statistically significant) relationship between price and production of cigarettes. The time trend variable is also statistically significant.

Estimates from financial time series show the extent of under-reporting in the range of 13–27 percent during 2016 and 2018.

Monthly coefficients provide variation in production in relation to December as it is the base year. It is important to observe that estimated production is lower in only two months, June and July, as compared to rest of the months. In contrast, January, March, April and May have relatively higher production compared to rest of the months. This indicates that apart from January, in the months before the announcement of the federal budget, the cigarette industry increases its production, but in June, when the budget is announced and most tax policy changes take place, the cigarette industry reduces production significantly.

Figure 13: Regression model for monthly cigarette production

Variable	Coefficients
Intercept	19.77 *
Lnprice	-2.25 *
Time	0.0253 ***
Dummy Variable for January	0.204 **
Dummy Variable for February	0.103
Dummy Variable for March	0.229 *
Dummy Variable for April	0.282 *
Dummy Variable for May	0.149 ***
Dummy Variable for June	-0.703 ***
Dummy Variable for July	-0.0452
Dummy Variable for August	0.0471
Dummy Variable for September	0.053
Dummy Variable for October	0.006
Dummy Variable for November	-0.041

Sources:
i) Pakistan Economic Survey, various issues.
ii) Monthly Bulletin of Statistics, Pakistan Bureau of Statistics, various issues.

The monthly estimates corresponding to each fiscal year are aggregated to calculate the output for three years, 2015-16 to 2017-18. As shown in Figure 14, the extent of under-reporting in 2016-17 is the highest among three years. The estimated production in 2016-17 is around 50 billion sticks whereas the declared production was only 34 billion sticks, which indicates under-reporting of 47 percent.

Figure 14: Extent of under-reporting: estimates based on supply function (monthly time series model)

Fiscal Years	Output (Million sticks)			Under-reporting (%)
	Declared	Estimated	Under-reported	
2015-16	53,522	56,580	3,058	5.71
2016-17	34,342	50,533	16,191	47.1
2017-18	59,058	74,699	15,641	26.5

Sources:
i) Pakistan Economic Survey, various issues.
ii) Monthly Bulletin of Statistics, Pakistan Bureau of Statistics, various issues.

Extent of Under-reporting – Exploration through Financial Data

The financial data analysis begins with the analysis of cost structure in relation to net turnover. This step helps identify inconsistencies in data. This is followed by a time-series and panel data model used to estimate the extent of under-reporting.

Trend in Key Inputs in Relation to Output

Like other industries, the cigarette industry uses a variety of inputs to generate output. In addition to labour and capital, the key inputs in the cigarette industry are raw material as intermediary inputs that largely include raw tobacco, filters, packaging materials, fuel and energy, transport, insurance, and other similar services. In terms of incurring costs, the financial statements of the tobacco companies provide an aggregate category consisting of salaries, wages and other benefits as labour costs and depreciation as a cost of capital. Other key categories of costs include cost of raw and packing material, and fuel and energy charges. Another cost component is cost of stores and spares consumed.

Figure 15: Key cost components as a percentage of net turnover

Year	Salaries, wages including benefits	Raw and packing material	Stores and spares consumed	Fuel and power	Depreciation
2004	6.5	41.8	2.4	1.6	2.5
2005	6.5	50.6	2.4	1.7	3.8
2006	6.2	45.3	2.0	1.6	3.0
2007	5.4	37.4	1.8	1.2	2.4
2008	6.6	49.7	2.0	1.9	2.8
2009	5.9	51.4	2.2	1.8	2.6
2010	6.7	55.6	2.1	2.2	2.9
2011	7.4	51.3	2.4	2.3	2.8
2012	7.2	50.1	2.6	2.5	2.3
2013	7.4	51.7	3.2	2.6	2.3
2014	7.4	47.5	2.6	3.7	2.2
2015	7.6	42.1	2.2	2.5	2.6
2016	7.3	29.1	2.3	1.6	2.6
2017	10.4	32.7	2.0	1.5	3.1
2018	6.1	39.1	2.2	1.4	2.8

Source: Financial Statements of PTC and PMPK (2004 to 2018).

Figure 15 shows the trend in key cost components in relation to net turnover. In other words, it shows the contribution of each cost component in output value. The trend clearly shows that raw material and cost of labour are the

An increase in the salaries and benefits at the time of low production is not understandable.

key components contributing, on an average, more than half of the net turnover. Apart from the salaries and raw material, the three other cost components show different trends particularly after 2014. For instance, the share of expenditure on fuel and power has continuously declined after reaching its peak at 3.7 percent in 2014. This sharp decline indicates that companies have either gradually become more energy efficient or shifted towards less expensive energy sources.

In contrast, the cost of depreciation has consistently increased from 2.2 percent in 2014 to 3.1 percent in 2017, though it declined to 2.8 percent in 2018. The growing cost of capital may be an indication of fresh investment with accelerated depreciation. Finally, expenditures on stores and spares indicate management of inventories including spare parts. The share of stores and spares consumption is fairly stable after reaching its peak at 3.2 percent in 2013.

As far as the trend of the two largest cost components (that is, salaries and raw material) is concerned, the share of raw material consistently declined from 51.7 percent in 2013 to 29.1 percent in 2016 and then increased again to 39.1 percent in 2018. While the increase in share of raw material can be attributed to a sharp decline of the Pakistani Rupee in relation to major currencies in 2018, an increase of the share in 2017 is unexplainable. Similarly, an increase in salaries and benefits at the time of low production is also not understandable.

Production Function Methodology

Theoretically, the production function estimates the relationship between inputs and outputs by using various functional forms. One of the challenges in the estimation of production is the identification of the functional form. The three most commonly used are Cobb Douglass production function, constant elasticity of substitution (CES) and translog production function. The recent discussions in production functions highlighted various challenges in the estimation of aggregate production functions due to heterogeneity in cost of capital and labour. Alternatively, a production function can be estimated by using financial data of input costs and value of outputs.

The following equation is a general form for the firm production function:

$$Y_{i,t} = \alpha + \beta_1 L_{i.t} + \beta_2 K_{i.t} + \delta' Z_{i.t} + \mu_{i.t} \quad \text{.....(4)}$$

Where

Y = potential level of value of output,
L = wage bills,
K = cost of capital (depreciation),
Z is a vector of other inputs i.e. raw material, fuel, energy and power and the like, and subscript i, and t denotes industry and year.

The estimated equation will provide the coefficient linking input and output for each firm. This coefficient will be used to estimate the production of cigarettes at a given level of inputs for each firm. In the next step the extent of under-reporting will be estimated by computing the difference between the actual and estimated level of output.

Financial Time Series Analysis

Based on the methodology discussed in the previous section, this section provides estimates of under-reporting by estimating a financial production function. This allows estimation of the production function of the cigarette industry and uses the out-of-sample forecasting method to estimate the potential level of output for a given set of inputs. This will lead to estimation of output of the firm based on the cost structure of that firm (see Technical Annexure).

The financial statements of the tobacco firms provide information about the production-related costs and the sales. Consistent data was collected for the tobacco firms from 1995 to 2018 from the annual reports of the firms for the analysis. The following regression equation is estimated:

$$lnCig_t = \alpha + \beta_1(lnwage)_t + \beta_2(lnraw)_t + \beta_3(lnfuel)_t + \beta_4(lnstore)_t + \gamma * T + \varepsilon_t \ldots (5)$$

Where;

$lnCig_t$= log of (sales of the cigarette industry/ price index of cigarettes) in year t.

$lnwage_t$= log of (wage bill of production staff/consumer price index) in year t.

$lnraw_t$= log of (raw material cost / wholesale price index) in year t.

$lnfuel_t$= log of (energy and fuel cost / consumer price index) in year t.

$lnstore_t$= log of (store related cost / wholesale price index) in year t.

T= time trend with value =1 in year 1995

Given that macro data is collected and reported according to the fiscal year while firm specific financial data is reported according to the calendar year, 100 percent accuracy is not possible. To estimate comparable results, equation 5 is estimated by using data from 1995 to 2015 and the value of 2016, 2017 and 2018 is predicted based on the estimated production function.

Estimated results are as follows:

$$\underset{}{lnCig_t} = \underset{(0.093)}{-7.498} + \underset{(0.005)}{1.15} * \underset{}{(lnwage)_t} + \underset{(0.000)}{0.665} * \underset{}{(lnraw)_t} - \underset{(0.123)}{0.368}\ \underset{}{(lnfuel)} + \underset{(0.144)}{0.201} * \underset{}{(lnstore)} - \underset{(0.055)}{0.033} * \underset{}{T}$$

(Coefficient's P values are given in parentheses)

Estimates from financial time series show the extent of under-reporting in the range of 13–27 percent

The above model shows that wage and raw material has a positive and significant impact at the one percent level of significance on the sales of cigarette industry. Fuel cost and store cost both turn out to be insignificant at 10 percent level of significance. The result shows that a one percent increase in employment will lead to 1.15 percent increase in real sales/ production of the industry and one percent increase in raw material use will lead to 0.66 percent increase in production of the industry. The values used for the analysis are provided in Statistical Annexure (Table A.3).

Figure 16 gives the declared and estimated value of sales of the cigarette industry in 2016, 2017 and 2018. There are two main reasons for estimation of sales for three years. Firstly, due to differences in budget year (July to June) and financial year (January to December), the decline in sales spread out in the last six months of a particular year and first 6 months of the next year. Secondly, estimates are based on the value of sales instead of production. Actual production may differ from sales due to inventory or stock of the previous years that industry is supplying in current period. The results reveal that overall the firms have most likely under-reported their production in the range of 13–27 percent during 2016 and 2018.

Figure 16: Extent of under-reporting: estimates based on production function (financial time series)

Years	Output (Million sticks)			Under-reporting (%)
	Declared	Estimated	Under-reported	
2016	48,339	54,594	6,255	12.9
2017	45,411	57,771	12,360	27.2
2018	60,431	73,695	13,264	22.0

Sources:
i) Monthly Bulletin of Statistics, Pakistan Bureau of Statistics, various issues.
ii) Financial Statement of PTC and PMPL, various issues.

Financial Panel Data Analysis

One of the problems with above data is that it is based on aggregates of firms to construct a time series. While this aggregation has its own advantages, it ignores firm-specific variations. Alternatively, the panel data estimation has taken into account both time series and firm-specific variations. For the estimation purposes, panel data is constructed using company-level information. We have used financial data for PTC and PMPK. These two companies together have a share of more than 90 percent of the market. Subscript i is added in equation 5 to highlight the firm-specific nature of the data in equation 6 for panel data estimation.

$$lnCig_{it} = \alpha + \beta_1(lnwage)_{i.t} + \beta_2(lnraw)_{i.t} + \beta_3(lnfuel)_{i.t} + \beta_4(lnstore)_{i.t} + \gamma * lnCig_{it-1} + \varepsilon_{it} \text{.....(6)}$$

$lnCig_t$= log of (sales of the cigarette industry/ price index of cigarettes) in year t for company i.

$lnwage_{i.t}$= log of (wage bill of production staff as % of sales) in year t for company i.

$lnraw_{i.t}$= log of (raw material cost as % of sales) in year t for company i.

$lnfuel_{i.t}$= log of (energy and fuel cost as % of sales) in year t for company i.

$lnstore_{i.t}$= log of (store related cost as % of sales) in year t for company i.

$lnCig_{it-1}$ = log of previous years sales for company i.

A fixed effect model is used to estimate the above equation. The estimated equation is given below:

$$lnCig_{it} = \underset{(0.0)}{11.86} - \underset{(0.001)}{0.515}(lnwage)_{i.t} + \underset{(0.020)}{0.381}(lnraw)_{i.t} - \underset{(0.017)}{0.489}(lnfuel)_{i.t} + \underset{(0.77)}{0.025}(lnstore)_{i.t} + \underset{(0.022)}{0.236}lnCig_{it-1}$$

The results show that salaries and wages costs, raw material costs, fuel costs and previous production of cigarettes has a significant relationship with current-year's production. One percent increase in salaries and wages costs as a percentage of sales leads to a reduction in sales by 0.5 percent. Similarly, a one percent increase in fuel costs as a percentage of sales leads to 0.5 percent decrease in sales. In contrast, a one percent increase in raw materials costs as a percentage of sales leads to 0.4 percent increase in sales. Figure 17 gives the extent of under-reporting estimated from the above equation. The estimates of panel data model are almost same as that of the time series model except for 2017.

Figure 17: Extent of under-reporting: estimates based on production function (financial panel data)

Years	Output (Million sticks)			Under-reporting (%)
	Declared	Estimated	Under-reported	
2016	48,339	54,594	6,255	12.9
2017	45,411	63,351	17,940	39.5
2018	60,431	73,426	12,995	21.5

Sources:
i) Monthly Bulletin of Statistics, Pakistan Bureau of Statistics, various issues.
ii) Financial Statement of PTC and PMPK, various issues.

Summary of Results

The above analysis provides estimates of the extent of under-reporting by the cigarette industry in Pakistan, which is summarized in Figure 18.

Two econometric approaches have been used in this study. The first approach is based on macro data of the production of cigarettes, index of prices, and other variables (discussed above), reported by fiscal year: July to June. Under this approach, the supply function was estimated using two data series: a) annual time series, and b) monthly time series. Estimates using annual time-series (col 1) show that the tobacco industry under-reported cigarette production by approximately 20% in fiscal year 2015-16, 71% in 2016-17 and 23% in 2017-18. As discussed earlier (see Figure 13), declared monthly production has linkages with the expectation of firms regarding changes excise tax policy. The analysis is supplemented by using monthly time-series which controls for monthly variations in cigarette production. Using the monthly time-series, under-reporting in cigarette production is estimated at approximately 6%, 47%, and 27% in fiscal years 2015-16, 2016-17, and 2017-18, respectively.

Figure 18: Extent of Under-reporting: summary of various estimates

Fiscal Years	Supply function		Years	Production function (financial)	
	Annual	Monthly		Annual	Panel
2015-16	19.9	5.71	2016	12.9	12.9
2016-17	71.0	47.1	2017	27.2	39.5
2017-18	22.8	26.5	2018	22.0	21.5

Source: Figures 12, 14, 16 and 17.

The second approach is based on financial data of the firms, which is available on a calendar year basis. Two models were estimated in the second approach: a) annual time series based on combined data of the firms and b) panel data. Both models indicate similar trends with deviation in magnitudes for only one year (2017): Under-reporting of cigarette production is estimated to be approximately 13% in 2016 and 22% in 2018. In 2017, under-reporting was estimated to be 27% using annual data and 40% using panel data. Even though the results are similar for both models in the second approach, panel data estimates are more robust as they capture the firm specific characteristics.

A direct comparison of the estimates discussed above requires caution as the estimates are based on two different methodologies and use different data sets. The first approach is based on aggregated data publicly reported by the Pakistan Bureau of Statistics, while the second approach used cost

information obtained from annual reports of the firms. Secondly, the time-period considered is different: fiscal year vs. calendar year. Thirdly, in the second approach, sales have been used as a proxy for production, which likely differs from actual production in a given time-period.

Together, the estimates provide three important observations for policy. The most important observation is that overall results of all the four estimated models confirm the presence of under-reporting of cigarette production by the industry, which has significant negative implications for government tax revenue. Second, on an average, the estimated production of cigarettes in the last three years is close to the historical average of declared production from 2004-05 to 2014-15, which reflects the robustness of estimates. Third, the estimates of all models show the highest extent of under-reporting in 2016-17 and the lowest in 2015-16 – a common trend where the extent of under-reporting increased in second year of the analysis, as compared to the first year, and then decreased in the third year. As discussed earlier, 2016-17 is an exceptional year in terms of reported production.

VI Conclusions and Policy Recommendations

The cigarette manufacturing industry of Pakistan is an example of an imperfect market where only three firms dominate the total domestic production. Despite the fact that the number of large manufacturers is small, FBR relies on self-declaration of production by the manufacturers to determine the tax liability of the firms. Self-declaration leads to inefficiencies in tax collection by creating an incentive for tax evasion.

This study estimates the potential levels of output by the cigarette industry to measure the extent of under-reporting of domestic production of cigarettes in Pakistan. The methodology is based on quantitative analysis with two alternate approaches: a supply function - annual and monthly; and analysis based on financial time series and panel data.

Analysis of the industry profile provides interesting insights. The aggregate size of firms selected for the analysis increased more than four-fold during last decade or so, as the net turnover went up from Rs 17.6 billion in 2004 to Rs 70.4 billion in 2018. Among the three firms, the market share of PTC increased from 56 percent to 75 percent during this period. The analysis also shows that the increase in net turnover is more than the increase in the cost of sales. Interestingly, during the last four years under analysis, tobacco firms reported a decline in their sales while profit margins remained substantially higher as compared to previous years. Thus, the decline in sales did not have much impact on profit margins, and also the cost of sales did not have a close association with net turnover.

As far as the linkage between the FED rate and the prices of cigarettes, high growth in the FED rate did not fully correspond with growth in prices, particularly until 2011-12; however, the trend changed afterwards. Particularly, the ratio of prices to the FED rate reflects a complete pass-through of the FED in prices except for the last two years – 2017 and 2018. The production of cigarettes remained fairly stable between 61-67 billion sticks until 2014-15, whereas considerable fluctuation is evident in the last three years.

The various econometric analyses presented in the report provide evidence of a considerably high level of under-reporting of cigarette production by the firms. The estimates of all the four models show highest extent of under-reporting in 2016-17 and the lowest in 2015-16. The estimates based on monthly time series (supply function) suggest that under-reporting was 47.1

percent in 2016-17. Similarly, under-reporting for calendar year 2016, based on financial panel data (production function), is estimated to be 39.5 percent.

Policy Implications/Recommendations

The large fiscal imbalances in Pakistan require greater tax revenues. Tobacco taxation can positively contribute to government revenues. Simultaneously, these taxes will also help in promoting public health objectives. The following major policy implications can be drawn from the analysis presented in the report:

- *Link the FED with multi-stage taxes*: At present FED is collected at factory level on declared production, which provides an incentive to under-report the production. If the FED is linked with GST and GST is collected in VAT mode, it will help reduce tax evasion. GST should be collected at three stages – factory, distributors, and wholesalers/retailors.

- *System for Electronic Monitoring of Production (SEMP):* While FBR is already in the process to implement SEMP, it is suggested that implementation process should follow the existing best practices particularly from developing countries.

- *Link financial data with production:* The present analysis offers an opportunity to monitor tax evasion by analyzing the financial data of the companies. Such analysis will help build a robust tax collection mechanism for future.

- *Reduce seasonality in production:* The analysis shows seasonality in reported production. The production is generally high during the months before the announcement of federal budget. This is largely an outcome of uncertainties in tax policy. It is suggested that a medium-term tax policy guideline should be followed to avoid major changes in tax rates.

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TECHNICAL ANNEXURE

A.1 Firm's Supply Function

The supply function of a firm gives the quantity that it will produce as a function of product's price. In perfectly competitive factor markets, the quantity supplied is also a function of factor prices. A supply function of a profit-maximizing firm can be derived from the first-order conditions for profit maximization. The supply curve of the firm may be derived by the points of intersection of its marginal cost (MC) curve with successive demand curves. The supply function is the inverse of the MC function when MC is equated with produce price. Under the assumption of perfect competition in the product market and perfect competition in the factor markets, the theoretical framework of supply function can be derived as follows:

$$Max\pi = PQ - C(W,Q)$$

π = the profit the firm receives,

P = the cigarette prices

Q = the quantity of cigarettes produced and

W = the factor prices

Thus, the first order conditions for profit maximization can be written as follow:

$$\frac{d\pi}{dQ} = P - \frac{\partial C(W,Q)}{\partial Q} = P - MC(Q)$$

The above equation is the short run supply equation of the firm at a given level of factor prices. The equation is solved to find inverse supply function.

$$Q^{*} = MC^{-1}(P)$$

Where $MC^{-1}(P)$ is the inverse of the marginal cost function.

The presence of fixed factors in the short run makes it likely that marginal cost increases with the level of output. The conceptual model used in this study was designed to illuminate the relationship between number of cigarette sticks produced by tobacco industry and price of the

cigarette. The general equation that has used for this analysis is given below:

$$Q_t = \alpha + \beta_1 P_t + \beta_2 TimeTrend + \delta Q_{t-1} + \varepsilon_t$$

Where

Qt= the production of cigarettes in year t.

P_t = Retail price of cigarettes in year t.

Time Trend = Time trend variable

Q_{t-1}= the production of cigarettes in year t-1

A.2 Firm's Production Function

Production function relates the inputs with output. A Production Function (PF) is a description of a production technology that relates the physical output of a production process to the inputs or factors of production. A general representation is:

Q = f (L,K, R,E OIN)

Q = production of cigarettes

L = Amount of labor

K = Amount of Capital

R = Quantity of Raw material

E = Units of Electricity used

OIN = Other inputs used in production

Cobb Douglas (CD) production function is the mostly used production function. We have also used the CD production.

$$Q_t = AL^a K^{b_1} Raw^{b_2} E^{b_{-3}} OIN^{b_4}$$

By taking the log of the above equation, the above equation can be estimated as:

$$\ln Q_t = A + a \ln L + b1 \ln K + b2 \ln Raw + b3 \ln E + b4 \ln OIN$$

We have estimated the above equation by using standard econometric technique.

STATISTICAL ANNEXURE

A.1 – Supply Function: Annual Time Series

Dependent variable: log of annual production of cigarettes.

	Coef.	Std. Err.	t stats	P > |t|
Log of price	-1.17531	0.40366	-2.91	0.007
(Log of price)^2	0.08313	0.03695	2.25	0.032
Time Tend	0.04420	0.01058	4.18	0.000
First lag of log of production	0.58789	0.11269	5.22	0.000
Intercept	8.23366	2.02872	4.06	0.000

Number of observations	=	34
F(4, 29)	=	110.25
Prob > F	=	0.0000
R-squared	=	0.9196
Root MSE	=	0.08649

Sources:

i) Pakistan Economic Survey, various issues.

ii) Monthly Bulletin of Statistics, Pakistan Bureau of Statistics, various issues.

A.2 – Supply Function: Monthly Time Series

Dependent variable: log of monthly production of cigarettes.

	Coef.	Std. Err.	t stats	P > |t|
Log of price	-2.251	1.063	-2.120	0.039
Time Tend	0.025	0.013	1.920	0.061
Dummy for Jan	0.204	0.098	2.070	0.044
Dummy for Feb	0.103	0.102	1.020	0.314
Dummy for Mar	0.230	0.088	2.610	0.012
Dummy for Apr	0.282	0.094	2.990	0.004
Dummy for May	0.150	0.086	1.730	0.089
Dummy for Jun	-0.703	0.380	-1.850	0.070
Dummy for Jul	-0.045	0.079	-0.580	0.568
Dummy for Aug	0.047	0.095	0.500	0.621
Dummy for Sep	0.053	0.072	0.740	0.460
Dummy for Oct	0.006	0.063	0.100	0.923
Dummy for Nov	-0.041	0.071	-0.580	0.562
Intercept	19.775	5.307	3.730	0.000

Number of observations	=	66
F(13, 52)	=	6.99
Prob > F	=	0.00
R-squared	=	0.5571
Root MSE	=	0.3202

Sources:

i) Pakistan Economic Survey, various issues.

ii) Monthly Bulletin of Statistics, Pakistan Bureau of Statistics, various issues.

A.3 – Financial Time Series

Dependent variable: log of real sales.

	Coef.	Std. Err.	t stats	P > |t|
Log of wages	1.15287	0.34258	3.37	0.005
Log of raw material	0.66454	0.11782	5.64	0.000
Log of fuel	-0.36829	0.22411	-1.64	0.123
Log of storage	0.20103	0.13006	1.55	0.144
Dummy for 2008	-0.26791	0.05375	-4.98	0.000
Time trend	-0.03301	0.01578	-2.09	0.055
Intercept	-7.49861	4.15819	-1.80	0.093

Number of observations	=	21
F(5, 14)	=	.
Prob > F	=	.
R-squared	=	0.9688
Root MSE	=	0.0844

Source: Financial Statements of PTC and PMPK (2004 to 2018).

A.4 – Financial Panel Data

Dependent variable: log of real sales.

	Coef.	Std. Err.	t stats	P > |t|
Log of wages as % of sales	0.38059	0.15527	2.45	0.020
Log of raw material as % of sales	-0.51508	0.14579	-3.53	0.001
Log of fuel as % of sales	-0.48315	0.19230	-2.51	0.017
Log of storage as % of sales	0.02484	0.08620	0.29	0.775
Dummy for 2007 Phillip Morris	-0.38812	0.14061	-2.79	0.009
First lag of real sales of cigarettes	0.23623	0.09801	2.41	0.022
Intercept	11.86440	1.29745	9.14	0.000

Number of observations	=	40
F(6, 32)	=	89.890
Prob > F	=	0.0000

R-squared: within =0.9940; between=1.0000; overall=0.5894

Sources:

i) Monthly Bulletin of Statistics, Pakistan Bureau of Statistics, various issues.
ii) Financial Statement of PTC and PMPL, various issues.

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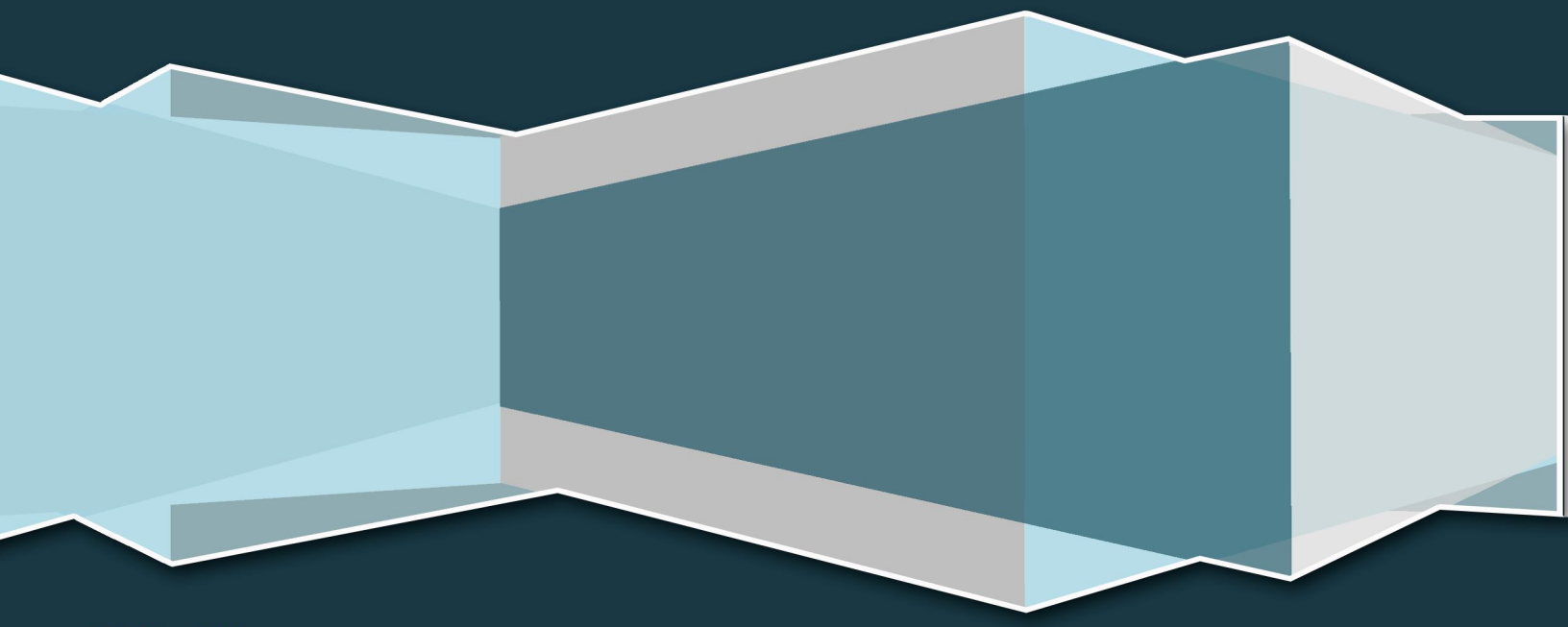

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