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Tracking the Track-and-Trace: two waves of cigarette pack surveys on tax administration in Pakistan

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ABSTRACT

Introduction Pakistan implemented the Track and Trace System (TTS) to administer cigarette tax in July 2022. We assessed its implementation by examining the presence and validity of tax stamps (evidence of tax collection) on cigarette packs and how these varied by manufacturer and over time.

Methods We collected cigarette packs from points-of-sale (POS) in two waves: August 2023 (POS=648) and October 2024 (POS=718). POS were located within a stratified random sample of 72 enumeration blocks (EBs) within purposively selected nine districts of Pakistan. Within each EB, we collected one cigarette pack per brand variant. These were examined for the presence and validity of digital tax stamps using the TransAct mobile app.

Results We collected 1617 and 2278 cigarette packs in waves I and II, respectively. The presence of tax stamps was higher on the cigarette packs manufactured by the local subsidiary of British American Tobacco, Pakistan Tobacco Company (PTC) (2023: 89.9% (295/328) and 2024: 97.7% (428/438)) and Philip Morris International (PMI) (2023: 79.0% (207/262) and 2024: 83.7% (302/361)) than those manufactured by local companies (2023: 1.9% (17/893) and 2024: 3.9% (56/1440)). Between 2023 and 2024, the proportion of packs bearing valid tax stamps increased from 53.2% (157/295) to 77.6% (332/428) ($p<0.001$) for PTC and from 56.0% (116/207) to 79.1% (239/302) ($p<0.001$) for PMI; for local manufacturers, the increase from 52.9% (9/17) to 80.4% (45/56) was non-significant ($p=0.10$).

Conclusion Within 2 years of TTS implementation, cigarette tax administration improved significantly for the two leading multinational manufacturers, but not for local manufacturers.

INTRODUCTION

Tobacco use remains a major public health concern in Pakistan with an estimated 163 600 tobacco-related deaths every year.^{1,2} Cigarette smoking is the most prevalent form of tobacco consumption, with 10.5% of those aged 15 years and over (19.4% men, 1.0% women) smoking regularly.³ Since ratifying the WHO's Framework Convention for Tobacco Control (FCTC) in 2004, Pakistan has introduced several tobacco control measures, including raising cigarette taxes.^{4,5} However, cigarette tax evasion, primarily driven by the under-reporting of cigarette production, remains significant.⁶ During 2018–2019 and 2020–2021, under-reporting averaged 8.1%, resulting in a cumulative tax loss of

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ In the absence of a functioning tax administration system, cigarette tax collection relies on manufacturers' reports often leading to tax evasion and revenue loss.
- ⇒ Track and Trace System (TTS) can improve cigarette tax administration and reduce tax evasion.

WHAT THIS STUDY ADDS

- ⇒ After the introduction of the TTS, multinational cigarette manufacturers were far more compliant than local manufacturers.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ The difference between the local and the multinational cigarette manufacturers' responses to a robust tax administration system has implications for revenue protection, illicit tobacco trade and public health.

29.5 billion Pakistani Rupees (PKR) (approximately US\$0.18 billion).⁷ Beyond revenue losses, cigarette tax evasion due to weak tax administration has substantial public health implications: smoking-attributable diseases cost Pakistan an estimated PKR 615 billion (approximately US\$3.85 billion) in 2018–2019,⁸ underscoring the importance of strengthening tax enforcement to reduce tobacco use and related healthcare costs.

The FCTC and Protocol to Eliminate Illicit Trade in Tobacco Products (ITP) mandate using Track and Trace System (TTS) to combat tax evasion.^{9,10} As of 2024,¹¹ 35 of 62 countries (57%) signatory to ITP have implemented TTS.¹¹ Evidence from early adopters has shown that TTS can reduce tax evasion.¹² In Kenya, TTS increased legal cigarette sales by 76%, with tax revenue rising 20% annually from 2013 to 2016.^{13,14} In Turkey, TTS increased tobacco tax revenue by 83% between 2006 and 2011.¹² However, little is known of the effect of TTS in countries where cigarette production is dominated by a few multinational manufacturers with other local manufacturers operating alongside under inadequate regulatory supervision.

Pakistan's cigarette tax structure is complex, consisting of a two-tiered ('economy' segment, ie, low-tier and 'premium' segment, ie, high-tier) Federal Excise Duty (FED) system and a General Sales Tax.¹⁵ FED, which accounts for the majority of tobacco tax revenue, varies by segment: PKR 101



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per pack for the economy tier and PKR 330 for the premium tier, with a threshold price of PKR 180. The minimum excise tax burden is 60% of the retail price, equivalent to PKR 108 per pack.¹⁶ These fiscal measures aim to increase tax revenue, reduce the affordability of cigarettes and curb cigarette tax evasion, even in the 'economy' segment, which dominates the market. However, TTS's impact is weakened by enforcement gaps, including widespread regulatory non-compliance and the persistence of single-stick sales despite a legal ban (26.4% of participants who smoke reported loose purchases).¹⁷ Alongside the absence of real-time production monitoring prior to TTS, these factors limit the effectiveness of tax and price policies. Pakistan signed the ITP in 2018,¹⁸ approved the TTS in 2019 and implemented it in July 2022.¹⁹ Research conducted prior to full TTS implementation found weak regulatory compliance among cigarette manufacturers in Pakistan.^{17 20} We assessed the implementation of TTS in Pakistan by comparing the presence and validity of cigarette tax stamps between local and multinational manufacturers.

METHODS

Study design, period, settings and sampling strategy

We adopted an observational design for cigarette pack analysis. Cigarette packs were collected in two waves, Wave one (WI) in August 2023 and Wave two (WII) in October 2024, within nine districts: the Federal Capital Territory of Islamabad and two purposely selected districts (one urban and one rural) from each of Pakistan's four provinces. Using proportional (to population size) stratified (by district) random sampling, 72 enumeration blocks (EBs) were selected, each comprising approximately 200–250 households. Within each selected EB, consecutive sampling was used to identify points-of-sale (POS), aiming for a total sample of 720 POS (10 per district). Eligible POS included general stores, petrol stations, *paan* shops, grocery and tobacco shops, discount outlets, mobile vendors and stationary carts. All POS that met the inclusion criterion of selling any tobacco products and/or nicotine pouches were recruited until the target of 10 POS per EB was achieved. Cigarette packs were collected from 648 POS in WI and 718 POS in WII. Further methodological details are available elsewhere.^{21 22}

Pack collection

Cigarette packs were collected using the Tobacco Pack Surveillance System (TPackSS) unique pack sampling process, capturing brand and pack diversity rather than market share.²³ Within each EB, only one new and unopened cigarette pack per brand variant was collected; where two packs differed for the same brand variant, for example, in terms of stick count or pack design, both were collected.

Pack analysis and tax stamp validation

A product inventory form was developed using TPackSS resources,²⁴ and all packs were visually examined for packaging and labelling requirements. To assess TTS implementation, we documented the presence of tax stamps on each pack and verified their authenticity using an electronic real-time monitoring system, TransAct: FBR Pakistan (V.1.6.0), which verifies tax stamps on cigarette packs. The application enables users to authenticate tax stamps and detect counterfeits. First, the presence of a tax stamp was checked. For stamped packs, we scanned the barcode using TransAct. A valid stamp triggered a verification message displaying the manufacturer's name and stamp code, which were cross-checked with pack details (product name

and size) (online supplemental figure S1). Invalid stamps were indicated with a red 'not verified' sign. Results were recorded in the database alongside a screenshot of the verification outcome. If a stamp failed verification, it was rescanned up to three times to rule out connectivity issues; persistent failures were recorded as invalid.

Statistical analysis

For each wave, we compared the number and proportion of cigarette packs with tax stamps and those with validated tax stamps by manufacturer based on the highest legal market share, that is, Pakistan Tobacco Company (PTC), a subsidiary of British America Tobacco (74.5%); Philip Morris International (PMI) (20.8%); and 'other' local manufacturers (4.8%).²⁵ Point estimates with 95% confidence intervals (CIs) were calculated using robust standard errors, clustering by EB. Differences in TTS implementation between waves were assessed using the adjusted Wald F-test. All analyses were exploratory and conducted in STATA V.18.0.²⁶

RESULTS

Sample and manufacturer distribution

A total of 1617 cigarette packs were collected in WI and 2278 in WII. Of these, 1483 packs (91.7%; 95% CI 89.2 to 94.2) in WI had identifiable manufacturer details, which increased significantly in WII to 2239 packs (98.3%; 95% CI 97.6 to 98.9). Unless otherwise specified, all subsequent analyses refer to packs with identifiable manufacturer information. In WI, 22.1% (328/1483; 95% CI 19.0 to 25.3) were from PTC and 17.7% (262/1483; 95% CI 15.5 to 19.9) from PMI. Corresponding figures in WII were 19.6% (438/2239; 95% CI 16.5 to 25.3) for PTC and 16.1% (361/2239; 95% CI 14.2 to 18.1) for PMI. Manufacturers categorised as 'other' had 60.2% (893/1483; 95% CI 55.5 to 64.9) WI and 64.3% (1440/2239; 95% CI 59.8 to 68.8) in WII (online supplemental table S1).

Tax stamp presence and validated tax stamps by manufacturers

In our sample across both waves, approximately 35% of cigarette packs carried tax stamps (WI: 35.0%; 95% CI 29.5 to 40.4; WII: 35.1%; 95% CI 30.3 to 40.0). Proportion of validated tax stamps increased significantly from 54.3% in WI to 78.4% in WII ($p=0.000$). Tax stamp presence was highest among PTC cigarette packs, rising from 89.9% (295/328; 95% CI 86.2 to 93.7) in WI to 97.7% (428/438; 95% CI 95.7 to 99.8) in WII ($p<0.001$). For PMI, tax stamp presence was also high but the increase between waves from 79.0% (207/262; 95% CI 72.7 to 85.3) to 83.7% (302/361; 95% CI 78.7 to 88.6) was not statistically significant ($p=0.205$). Cigarette packs from other manufacturers rarely carried tax stamps (WI: 1.9%; 17/893; 95% CI 0.8 to 3.0; WII: 3.9%; 56/1440; 95% CI 2.7 to 5.1; $p=0.004$) (online supplemental table S1). Among cigarette packs with tax stamps, the proportion with validated stamps increased significantly for both PTC (WI: 157/295; 95% CI 45.6 to 60.9; WII: 332/428; 95% CI 72.2 to 82.9; $p<0.001$) and PMI (WI: 116/207; 95% CI 47.9 to 64.2; WII: 239/302; 95% CI 73.4 to 84.9; $p<0.001$) between the waves (figure 1). While the proportion of validated stamps also increased among local manufacturers, this increase was not statistically significant (WI: 9/17; 95% CI 24.3 to 81.6; WII: 45/56; 95% CI 69.5 to 91.2; $p=0.10$).

DISCUSSION

Our findings show a distinct manufacturer-specific pattern: multinational manufacturers exhibited higher TTS compliance

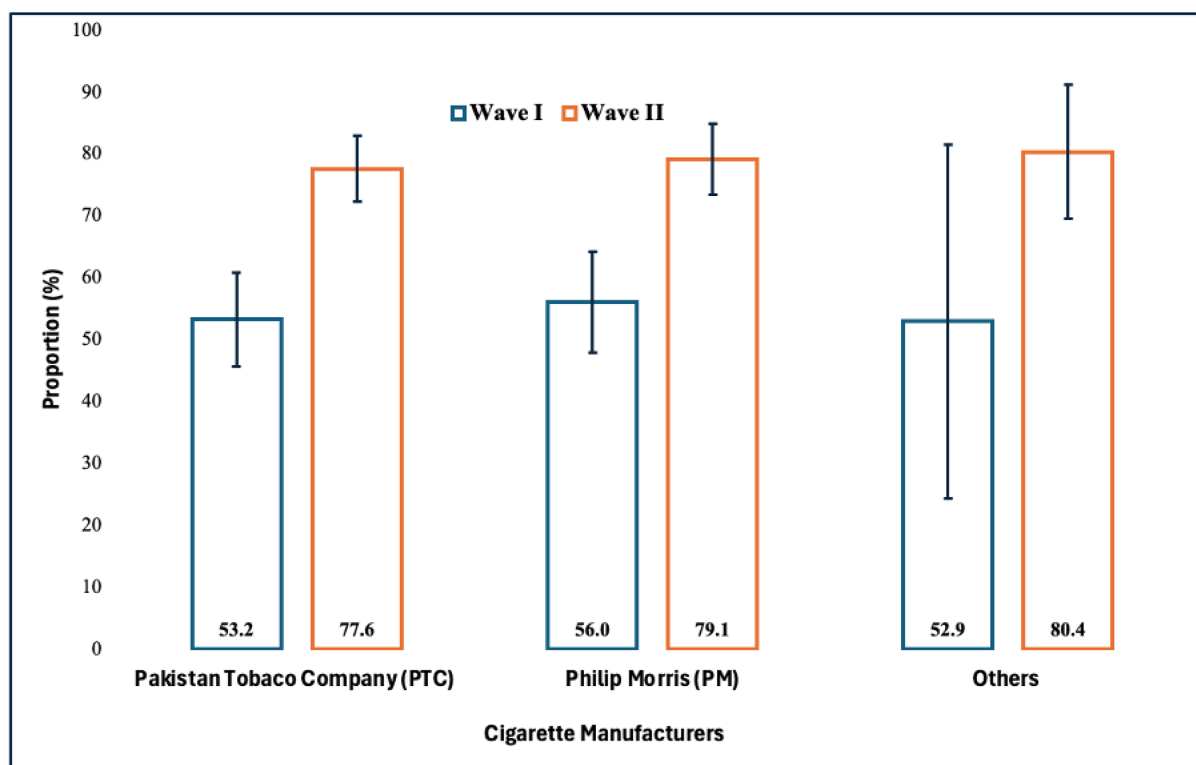


Figure 1 Proportion of cigarette packs with validated tax stamps by manufacturers across waves.

than local manufacturers. This extends the two previous studies from Pakistan on TTS implementation.^{19 27} A national survey of people who smoke in 2023 found no tax stamps on 45.0% of cigarette packs,²⁷ with another study in 2023 finding that 32.4% of discarded cigarette packs lacked tax stamps¹⁹; neither study examined the validity of tax stamps or disaggregated findings by manufacturers. Using a unique pack sampling approach, which captures brand and pack diversity rather than market share, we found 35% packs carried tax stamps in our sample. Of the packs with tax stamps, 54.3% in WI and 78.4% in WII had validated tax stamps. These estimates should therefore be interpreted cautiously, as unique pack sampling methods cannot predict market-representative prevalences.

Our findings show nearly all cigarette packs by PTC and most by PMI carried tax stamps, but local manufacturers exhibited poor compliance, reflecting enforcement predominantly applied to multinationals, leaving smaller local producers unregulated.^{12 28} Similar results have been previously reported in Pakistan, and comparable disparities among manufacturers have been documented in Bangladesh and India.^{19 29–33} In these countries, small-scale, local and unregistered manufacturers often exhibited high levels of non-compliance.^{19 29–33} In our sample, registered manufacturers accounted for 56.1% (907/1617; 95%CI 53.7 to 58.5) of packs in WI, declining to 48.1% (1096/2278; 95%CI 46.1 to 50.2) in WII, while the share of unregistered manufacturers increased from 43.9% (710/1617; 95%CI 41.5 to 46.3) to 51.9% (1182/2278; 95%CI 49.8 to 53.9). It indicates that a substantial and growing proportion of the cigarette market operates outside formal registration, where TTS compliance is weakest.

The observed increase in valid stamps among major manufacturers suggests that digital verification systems can enhance enforcement over time, aligning with international evidence.^{12 32 33} Nonetheless, around 20% of all cigarette packs

carried invalid tax stamps 2 years post TTS enforcement, underscoring persistent monitoring and implementation challenges. Experiences from Brazil (TTS named ‘Scorpions’ implemented in 2007) and Kenya (TTS named Excisable Goods Management System implemented in 2013) demonstrate that such limitations are typical in early phases of TTS rollout and can improve with stricter enforcement and sustained oversight.^{12 34 35} However, the limited coverage of validated tax stamps in Pakistan may partly stem from the implementation of TTS for tobacco after other commodities. Unlike many countries that introduced TTS with a clear tobacco-first enforcement strategy,⁷ Pakistan applied TTS to other commodities (cement and sugar) before cigarettes. This unconventional approach might have diluted the enforcement capacity for cigarettes during the early roll-out.

Disparities in TTS implementation between local and multinational manufacturers in Pakistan highlight structural governance issues: fragmented production, weak inspection capacity and political economy dynamics influenced by industry lobbying. Pakistan must enforce uniform TTS compliance through stricter penalties and consistent monitoring to yield fiscal and public health benefits. Full adherence could recover substantial lost revenue, estimated at PKR 29.5 billion (approximately US\$0.18 billion) between 2018 and 2021,⁷ while reducing cigarette tax evasion. While TTS strengthened tax administration for multinational manufacturers in Pakistan, it cannot by itself eliminate tax evasion. Effective control requires licensing of manufacturers and distributors, regulating the supply chain and strengthening border enforcement. Integrating TTS within the broader regulatory framework is essential to comprehensively address illicit cigarette trade in Pakistan.

Pakistan’s TTS primarily functions as a tax-stamp-based verification mechanism to support tax compliance and counterfeit detection, rather than as a comprehensive end-to-end supply-chain tracking system. It relies on unique identification markings

on cigarette packs, which can be authenticated using the government authorised TransAct digital application to verify stamp validity and manufacturer registration in real time. However, it does not track product movement throughout the supply chain; hence, it lacks complete traceability from production to the point of sale. These design features are important for interpreting our findings, as these reflect enforcement of tax stamp application and verification rather than comprehensive control over distribution or cross-border flows. Consistent with existing evidence,¹⁹ while Pakistan has made progress towards meeting WHO FCTC ITP obligations,¹⁰ the current system is not yet a fully protocol-compliant TTS and requires complementary enforcement measures.

Our findings should be interpreted cautiously due to the following limitations. Packs were collected from purposely selected districts, limiting national representativeness. Only unique packs were sampled per EB, meaning findings may not reflect market-level distributions. Although we estimated the proportion of invalid tax stamps, we could not trace their supply chain or verify counterfeit status. Another limitation was the loss of manufacturer-identifying information for a small proportion of packs in WI. Although the overall proportion of packs with identifiable manufacturer details increased between waves, it is possible that missing manufacturer information was not random. Packs without tax stamps or from local manufacturers may have been more likely to lack identifiable information, which could have led to some under-representation of non-compliant products in the manufacturer-specific analyses. However, given the relatively small proportion of packs affected and the large observed differences between manufacturers, this is unlikely to fully explain the patterns observed. Our analysis focused solely on cigarettes, excluding other tobacco products. Despite these limitations, our study provides critical evidence on TTS implementation and identifies key enforcement gaps. Future research should integrate unique pack analysis with volume-based sampling and revenue data to comprehensively evaluate TTS implementation.

CONCLUSION

The two major multinational manufacturers showed high TTS compliance, and packs with valid tax stamps increased between 2023 and 2024 in Pakistan. However, over one in five stamps was invalid, which indicates the likely presence of counterfeit stamps and revenue loss. TTS compliance among local manufacturers remains low. With strong governance, prioritisation of tobacco enforcement and targeted regulation, Pakistan could substantially increase compliance and reduce cigarette tax evasion, as seen in other countries that have enforced TTS.

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Contributors SMA, KS, MF and AK contributed to the planning of the study. SA and MF developed the study tools. KS, AK, CM and HR reviewed the tools. MF, AK and SA supervised the data collection. TK collected the packs, checked the packs for tax stamps using the TransAct app, entered the data in the database and cleaned the data under the supervision of MF and SA. SMA and SA conducted the analysis with support from HR and MK. KS, MK, AS, HR and CM provided technical inputs throughout the study. SMA completed the first draft of the manuscript, subsequently reviewed by KS, AS, AK, CM, HR, MK and FS. All co-authors provided their inputs on all the versions of the manuscript and approved the final version. SMA acted as guarantor.

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