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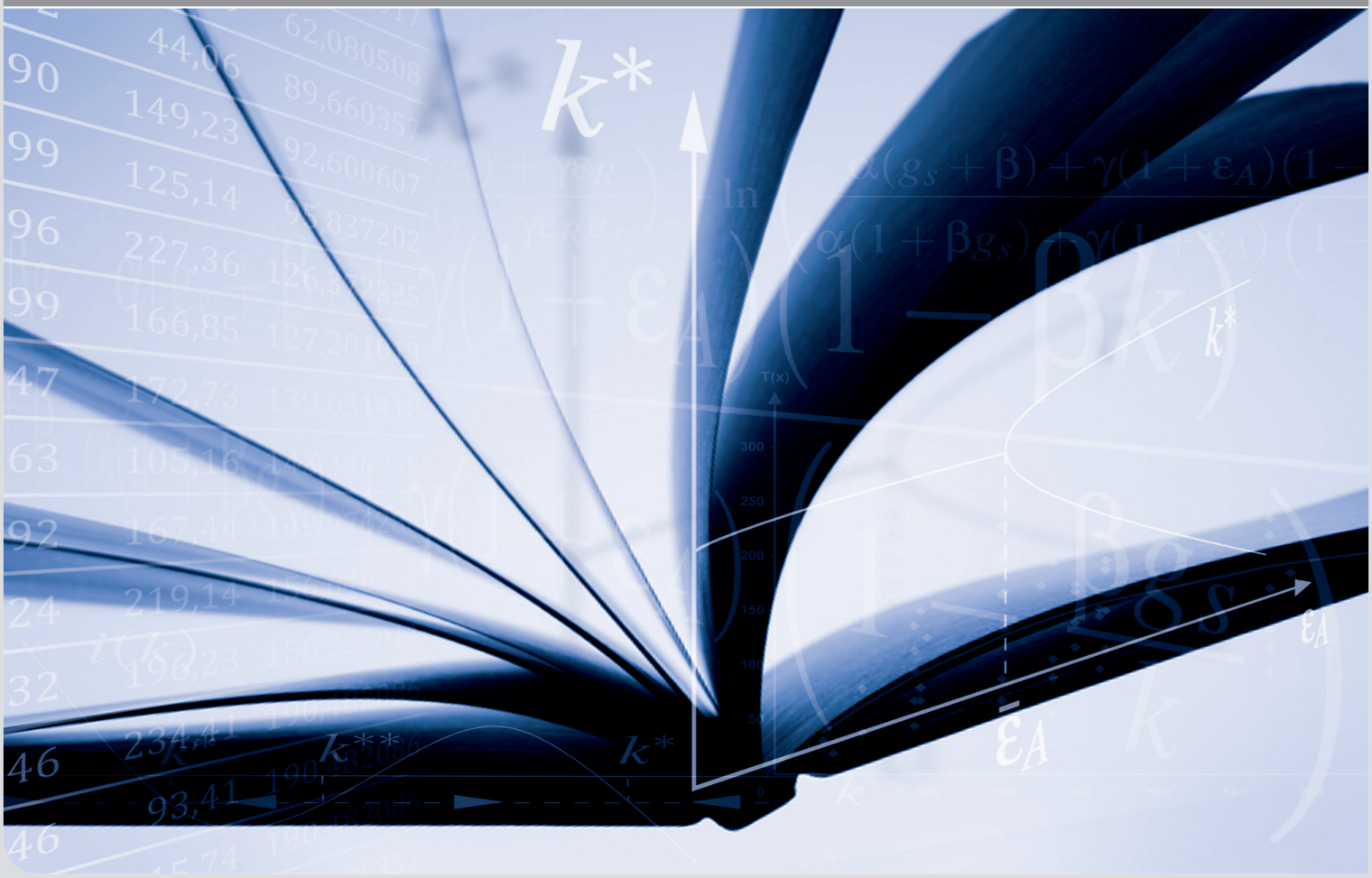

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Rethinking Tobacco Control: The Global Case for Differentiated Regulation of Smoke-Free Alternatives

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Abstract

Over the past years, governments have made substantial progress in tobacco control through higher taxes, advertising bans, and public smoking restrictions. Yet, in many advanced economies, smoking rates have stopped falling despite these strong measures. This stagnation suggests that traditional approaches, focused solely on discouraging all nicotine use, may have reached their limits.

Simultaneously, the emergence of novel nicotine delivery systems – such as e-cigarettes, heated tobacco products, and nicotine pouches – has introduced a new dynamic. Although these products are not risk-free, they are generally associated with a significant reduction in toxicant exposure relative to conventional cigarettes. Policy responses to this technological development vary: some countries have adopted regulatory frameworks that differentiate products based on their relative health risks, while others apply uniform restrictions across all nicotine-containing products.

This study analyzes the effect of these divergent regulatory frameworks on smoking prevalence across a cohort of 42 highly developed countries (Human Development Index (HDI) > 0.83). Using Ordinary Least Squares (OLS) regression models controlling for development levels (measured by HDI index) and taxation levels, the findings indicate that countries adopting a differentiated, risk-proportionate policy exhibit smoking rates approximately 7 percentage points lower than those maintaining non-differentiated regulatory regimes. Furthermore, the analysis reveals that in this high-HDI cohort, differences in taxation levels alone no longer explain the variance in smoking prevalence, highlighting the importance of product substitution toward lower-risk nicotine products in sustaining progress in tobacco control.

1. Introduction

Over the past two decades, countries worldwide have implemented a range of tobacco control measures, including excise taxation increases, advertising restrictions, plain packaging requirements, and public smoking bans. While these measures were effective in reducing initiation and encouraging cessation in the past, they have not universally resulted in sustained declines in smoking prevalence in recent years. In fact, in several high-income countries, smoking rates have plateaued, even in the presence of stringent regulatory frameworks (Peruga et al., 2021). These stagnations suggests that conventional tobacco control strategies, focused primarily on suppressing all forms of nicotine consumption, may have reached diminishing returns, reflecting a potential hardening of the remaining smoker population for whom price-based and social deterrents are no longer effective cessation motivators.

Economic theory and empirical evidence suggest that price and tax instruments function effectively only when consumers have access to viable product substitutes. In the absence of such options, high excise taxes cease to operate as a behavioral incentive and instead disproportionately burden nicotine-dependent populations. Furthermore, excessive taxation without a regulated substitution pathway can inadvertently stimulate illicit market activity, as consumers transition toward unregulated and lower-priced products rather than abstaining altogether (Chaloupka et al., 2012).

Against this backdrop of policy saturation, the emergence of novel nicotine delivery systems – such as heated tobacco products, e-cigarettes, and nicotine pouches – has generated new possibilities for demand-side intervention. Although not without health risk, these products are generally associated with substantially lower toxicant exposure relative to conventional cigarettes (Lietzmann & Moulac, 2023; FDA, 2020). Therefore, they provide the close substitutes necessary to restore an incentive structure of fiscal and regulatory policy in the nicotine market.

Regulatory responses to these emergent products vary widely across countries, creating a natural experiment in policy effectiveness. Some countries have adopted differentiated regulatory frameworks, in which product categories are treated according to their relative risk profiles. For instance, the United Kingdom has experienced a sustained decline in smoking prevalence following its policy decision to support e-cigarettes as a cessation aid – a policy stance explicitly endorsed by national government health agencies (Public Health England, 2015; McNeill et al.,

2018). In such differentiated countries, alternatives are often subject to lower excise tax rates and fewer access restrictions.

Conversely, other countries, including Australia and several EU member states, maintain uniform policy environments, restricting access to alternatives or taxing them equivalently to cigarettes, conditions that are frequently associated with more limited progress in reducing conventional cigarette consumption.

This study employs a comparative policy analysis combined with econometric modelling to assess the relation between regulatory heterogeneity and smoking prevalence. The study examines fiscal and regulatory frameworks across a benchmark group of 42 high-HDI countries, refined to a core group of 31 very highly developed countries to ensure comparability. Countries are categorized into three regulatory types – 'Red', 'Blue', and 'Green' – based on the degree of differentiation in their treatment of lower-risk nicotine products. To estimate the potential effects of policy types on smoking prevalence, the paper applies Ordinary Least Squares (OLS) regressions, controlling for development and taxation levels.

2. Literature Review and Theoretical Framework

The regulatory discourse surrounding tobacco control has undergone a significant conceptual re-evaluation in recent years, driven by the recognition that population-level behavioral change often reflects a process of product substitution rather than a binary transition from use to abstinence. For decades, public health policy has relied on the assumption that increasing the monetary or non-monetary cost of a harmful product – through tax increases, access restrictions, and advertising bans – would inevitably lead to a reduction in demand (Chaloupka et al., 2012). While this approach, rooted in Pigouvian tax theory, has proven effective among price-sensitive consumers, recent economic research indicates that it encounters a ceiling effect, when applied to addictive goods characterized by low demand elasticity, such as conventional cigarettes (IARC, 2011). In these markets, price increases alone yield marginal behavioral responses when consumers are presented only with distant substitutes, such as nicotine replacement therapies, that fail to replicate the sensory and ritualistic components of smoking. This stagnation, observed in several developed economies (Peruga et al., 2021), implies that without close substitutes capable of absorbing displaced consumption, persistent smokers are unlikely to alter deeply ingrained consumption patterns.

This dynamic is formalized in the economic literature, specifically by Kosonen, Jysmä, and Savolainen (2020), who examine the conditions under which consumption taxes generate substantive shifts in demand. Their two-good framework emphasizes that a consumer's response to a tax increase depends not only on the product's price but also on the availability, perceived similarity, and quality of an untaxed or lower-taxed alternative. A central finding is that the relation between substitutability and demand elasticity is non-linear; elasticity remains low when substitutes are partial or distant but increases sharply in the presence of close substitutes that replicate salient product attributes at lower cost (Kosonen et al., 2020). The study illustrates this through Finland's tax reform on sugar-sweetened beverages, where differential taxation shifted consumption toward non-taxed sugar-free beverages, while total beverage consumption remained stable. The broader policy implication is that effective regulation must integrate price-based disincentives with the provision of an accessible, functionally similar alternatives that allow consumers a low-friction transition path.

The requirement of accessible substitution pathways finds additional support from other domains, particularly environmental and transportation policy, underscoring strong external validity. For instance, evidence from Stockholm’s congestion pricing scheme demonstrates that financial disincentives to private car use reduced traffic volumes only when implemented alongside investments in public transportation, providing a viable mobility alternative (Eliasson et al., 2009). Similarly, research on solid waste management in Israel (Lavee, 2010) demonstrates that regulatory bans on unregulated landfills were largely ineffective until complemented by state subsidies covering transport costs to regulated sites, effectively offering an economic substitute for non-compliant disposal. Lavee provides a further example regarding the deposit law: the collection of small beverage containers, supported by a clear financial refund mechanism (a substitute for discarding), achieved significantly higher rates than the voluntary targets set for large bottles, where no direct incentive or substitute mechanism existed (Lavee, 2010).

This distinction between distant and close substitutes is reflected in clinical evidence on smoking cessation. The Cochrane Review, a benchmark in evidence-based medicine, concludes with high certainty that nicotine-containing e-cigarettes are more effective for smoking cessation than traditional nicotine replacement therapies (Lindson et al., 2025). Similarly, the Royal College of Physicians in the UK notes that e-cigarettes are likely to be at least 95% less harmful than conventional tobacco while providing a more effective bridge for smokers (Royal College of Physicians, 2016). These findings validate the economic premise: products preserving the bio-

behavioral feedback mechanism of smoking (close substitutes) yield higher substitution success than pharmaceutical tools addressing only chemical dependence (distant substitutes).

Translating this clinical evidence into market-level outcomes, several policy experiments support the substitution-based framework. The Swedish case is widely cited as a leading example: Sweden' approach to allowing oral tobacco (snus) has been closely linked to its almost smoke-free status, often defined as smoking prevalence below 5% (Ramström, 2019). Cross-country comparisons with nordic neighbors such as Finland and Denmark, which enforce stricter restriction on oral tobacco, reveal substantial divergence: while Sweden and Norway (both permitting snus) experienced substantial declines in smoking rates, Finland and Denmark exhibited more gradual reductions, isolating the availability of the substitute as a key explanatory factor (Ramström et al., 2016; Fagerström, 2022).

A parallel contrast emerges between New Zealand and Australia. Both countries have implemented strong tobacco control measures, including plain packaging and high taxation. However, their paths diverged regarding lower-risk products: New Zealand regulated vaping as a consumer good to support cessation, whereas Australia maintained a prescription-based model. Recent data indicates that New Zealand has achieved a significantly faster decline in daily smoking rates compared to Australia, further validating the efficacy of the substitution strategy (ASH NZ, 2023).

Complementing these regional comparisons, the Japanese market offers an additional contemporary example of substitution driven by technological innovation. Since the national rollout of heated tobacco products around 2016, retail cigarette sales fell by over 40% within five years, despite the absence of new statutory tobacco control measures (Cummings et al., 2020). This sharp structural shift underscores the potential of market-based substitution effects in reducing conventional cigarette consumption.

Finally, policy formulation requires balancing retrospective evidence with prospective risk modeling, particularly regarding the concern that substitute availability might attract new users, such as youth (the gateway effect). Mendez and Warner (2021) address this through a comprehensive simulation model estimating the net public health impact of lower-risk nicotine products under varying behavioral assumptions. Even under pessimistic scenarios incorporating increased youth uptake, the simulations found that health benefits from adult substitution far outweighed potential harms to non-smokers, projecting large net gains in population health. The

authors conclude that policies encouraging substitution could save millions of life-years, and thus that regulations restricting access to alternatives in the name of youth protection may inadvertently generate net harm by perpetuating smoking among the adult population (Mendez & Warner, 2021). These findings emphasize the need for differentiated frameworks that balance initiation deterrence with adult substitution incentives.

Despite this evidence and supportive theoretical contributions, the current literature remains largely fragmented and country-specific. Existing studies predominantly analyze single-market cases, such as Japan or Sweden, or focus on clinical efficacy rather than macro-level policy evaluation. To the best of our knowledge, there is no comprehensive econometric study that examines how substitute-oriented tobacco control policies affect national smoking prevalence across advanced countries. This study seeks to fill this gap. By constructing a cross-sectional dataset of highly developed countries and classifying them based on their regulatory treatment of alternatives, we aim to quantify the specific effect of the policy regime on national smoking prevalence, controlling for standard variables such as development and taxation.

3. Methodology and Data

3.1 Research Design and Sample Selection

To accurately isolate the impact of regulatory frameworks on smoking behavior, it is essential to control for the confounding effects of socioeconomic development. Smoking rates are known to correlate negatively with development indicators; higher income and education typically foster higher health literacy and better access to cessation support. Therefore, comparing highly developed economies with developing countries would introduce significant noise into the analysis.

To mitigate these distortions, this study employs a targeted cross-sectional design focusing exclusively on high-HDI countries. The HDI was selected over purely economic metrics like gross domestic product because it offers a more holistic view of a country's capabilities. Composed of three key dimensions – long and healthy life (life expectancy), education and knowledge (expected and mean years of schooling), and a decent standard of living (gross national income per capita) – the HDI serves as a superior proxy for state capacity, institutional stability, and the effectiveness of public health systems.

The selection of this cohort is further justified by the strong negative correlation observed between HDI and smoking prevalence, particularly at the upper end of the index. By restricting the sample to countries with very high HDI, we effectively control for these structural factors, allowing us to treat the remaining variance in smoking rates as largely attributable to policy differences rather than developmental disparities.

As for sample stratification the analysis uses two nested datasets from 2021 (For a full list of countries included in each sample, see **Appendix A**):

- **The Core Sample (N=31):** Restricted to countries with an HDI greater than 0.875. This group represents the global "tier one" economies, offering the rigorous "apples-to-apples" comparison required for policy evaluation.
- **The Extended Sample (N=42):** Broadens the threshold to countries with an HDI greater than 0.83 to test the robustness of the findings across a slightly wider spectrum.

3.2 The Independent Variable – Policy Classification

The primary explanatory variable is the regulatory policy regime. Unlike continuous variables such as tax rates, regulatory stance is multifaceted. We classified each country into one of three distinct categories based on their fiscal and legislative treatment of lower-risk nicotine products – specifically e-cigarettes and heated tobacco products. (For the detailed classification of each country, see **Appendix A**).

- **Green Countries** (Risk-Proportionate / Substitution Strategy) have adopted a policy of differentiation, utilizing both fiscal and regulatory levers to encourage switching.
  Regarding fiscal policy, a substantial excise differential is implemented, taxing lower-risk products at rates significantly below those applied to conventional cigarettes, thereby creating a price-based incentive for substitution.
  With respect to regulatory policy beyond taxation, formal supportive mechanisms within national health strategies are implemented.
  For example, the United Kingdom and New Zealand integrate lower-risk nicotine products into their official cessation frameworks, endorsing vaping as a route of cessation (McNeill et al., 2018). Likewise, Japan differentiates in marketing regulation by maintaining advertising restrictions for cigarettes while allowing promotion of heated tobacco products, generating a commercial incentive structure favoring substitution.

- **Blue Countries** (Mixed / Ambivalent Strategy) typically permit the sale of alternatives and may apply some degree of differential taxation but lack a coherent strategy to leverage them for public health.

  The regulatory environment is often "laissez-faire", with limited strategic alignment between fiscal and health policy domains. While alternatives are legally available, they are not institutionally endorsed, and while some tax differentiation may exist, they are insufficiently calibrated to influence consumer behavior.

  For example, Germany (in the analyzed period) allowed the sale of e-cigarettes and heated tobacco products under moderate regulatory controls, without integrating these products into formal cessation or substitution policies.

- **Red Countries** (Prohibitionist / Equalizing Strategy) maintain non-differentiated regimes that seek to discourage all nicotine consumption equally, either through restrictive market prohibitions or through regulatory equalization that removes incentives for product switching.

  Policies in this group either prohibit the sale of certain lower-risk products (e.g., total bans on vaping or heated tobacco) or impose equivalent excise and marketing restrictions across all nicotine delivery systems, effectively nullifying potential substitution effects (e.g., Australia, Brazil).

3.3 Variable Definitions and Data Sources

The study uses standardized data from international reports to construct the regression model.

- Dependent Variable: Smoking prevalence defined as the age-standardized prevalence of current tobacco smoking among persons aged 15 and older. Data taken from WHO Report on the Global Tobacco Epidemic, 2023 (reporting 2021 data).
- Control Variable 1: Human Development Index (HDI), a composite index described above (2021 values). Data taken from United Nations Human Development Report.
- Control Variable 2: Taxation level defined as the total tax share (specific excise, ad valorem, and VAT) as a percentage of the retail price of the most sold brand of cigarettes. This variable is crucial to test the hypothesis that in high-income markets high prices alone are no longer the primary driver of cessation. Data taken from WHO Global Tobacco Epidemic Report, 2023.
- Control Variable 3: Aggregate regulatory intensity (MPOWER Score) to assess the impact of traditional policies. The WHO MPOWER framework monitors six key tobacco control

measures: Monitoring tobacco use; Protecting people from tobacco smoke; Offering help to quit; Warning about the dangers of tobacco; Enforcing bans on advertising; and Raising taxes.

For this study, we constructed a composite strictness index. The WHO assigns a score to each of the six measures on a scale of 0 to 3:

- 0: No or minor policy implementation (e.g., no bans).
- 1-2: Moderate implementation.
- 3: Full implementation (e.g., comprehensive bans, highest taxation bracket).

By summing these scores, we created an aggregate variable ranging from 0 to 18. This composite score serves as a proxy for the overall intensity of the "traditional" regulatory environment in each country, allowing us to test whether stricter adherence to standard WHO guidelines correlate with lower smoking prevalence in high-income countries.

Data are taken from WHO Report on the Global Tobacco Epidemic, 2023. (For the detailed MPOWER score breakdown by country, see **Appendix B**).

3.4 Statistical Approach

We estimate the impact of the policy regime on smoking prevalence using an Ordinary Least Squares (OLS) multivariate regression model:

$$Smoking_i = \alpha + \beta_1 Green_i + \beta_2 Blue_i + \beta_3 HDI_i + \beta_4 Tax_i + \epsilon_i$$

Where $Green_i$ and $Blue_i$ are dummy variables (with "Red" serving as the reference baseline). β_1 and β_2 represent the average percentage-point difference in smoking prevalence attributable to the respective policy regimes relative to the "Red" baseline, holding income and tax levels constant.

4. Results

The empirical analysis presented in this section moves beyond descriptive cross-country comparisons to isolate the primary drivers of effective tobacco control policies. While socioeconomic factors (such as the HDI) provide a baseline for understanding smoking rates, our data reveals that traditional instruments – specifically high taxation and uniform regulatory restrictions – have reached a point of diminishing returns in many developed economies. In this context, the analysis aims to determine whether differentiated regulatory frameworks, which

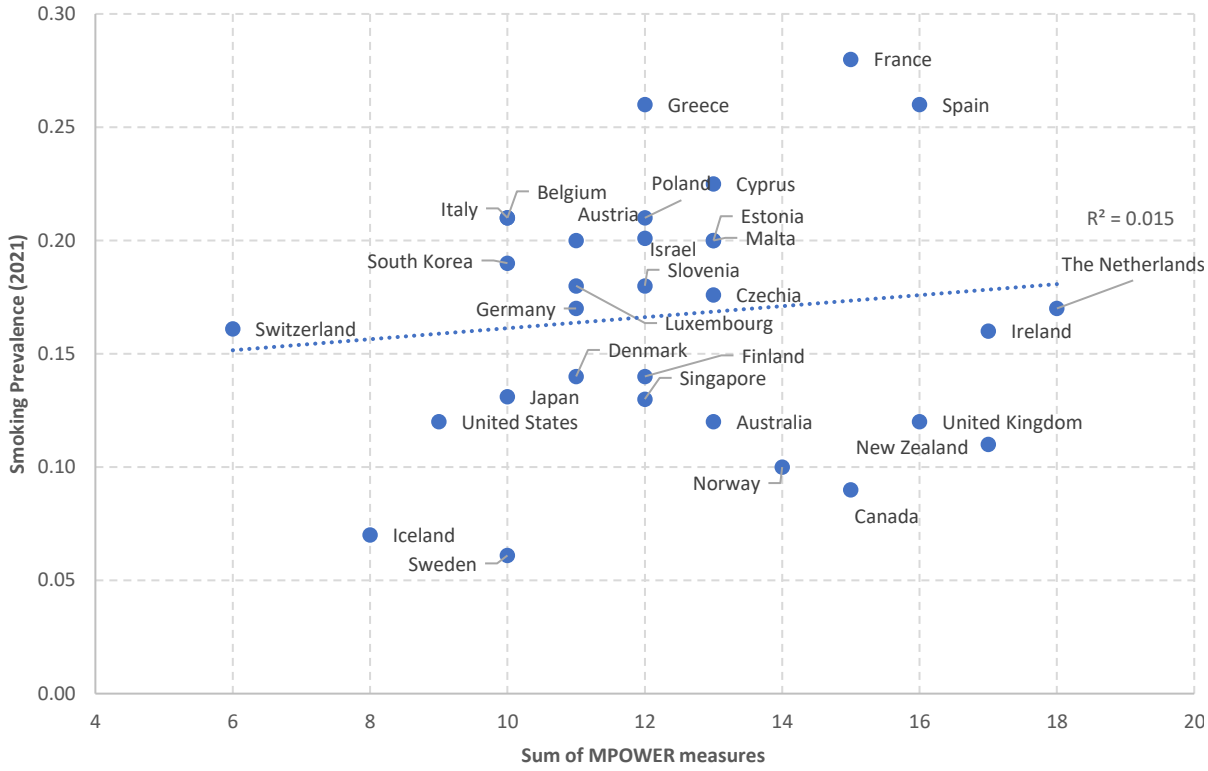
accommodate product substitution toward lower-risk alternatives, account for a greater share of the observed cross-country variation in smoking prevalence.

The following analysis proceeds in two stages: First, descriptive statistics examine the relation between tobacco control intensity and smoking prevalence, illustrating an emerging "efficiency gap": countries maintaining high taxation and other strict controls do not uniformly exhibit lower smoking prevalence. Second, an OLS regression rigorously isolates the policy variable, confirming that the adoption of a differentiated, risk-proportionate regulatory framework ("Green" policy) is currently the most significant predictor of lower smoking rates, explaining the variance that traditional indicators fail to capture.

4.1 Descriptive Analysis

When examining benchmark countries, the cross-sectional association between conventional tobacco control intensity, proxied here by the aggregate WHO MPOWER score (including taxation components), and smoking prevalence is very weak. As illustrated in Chart 1, plotting prevalence against the sum of MPOWER measures reveals only a limited relation, indicating that MPOWER intensity does not explain the variation in smoking prevalence across countries in this sample. This finding should be interpreted narrowly – it does not imply that MPOWER policies are ineffective within countries. Rather, it is consistent with the view that changes in specific MPOWER measures over time may have contributed to reductions in smoking prevalence within a given country, even if aggregate MPOWER differences do not account for cross-country differences at a point in time.

Chart 1: Smoking prevalence by regulation and taxation levels
(Sum of MPOWER measures)

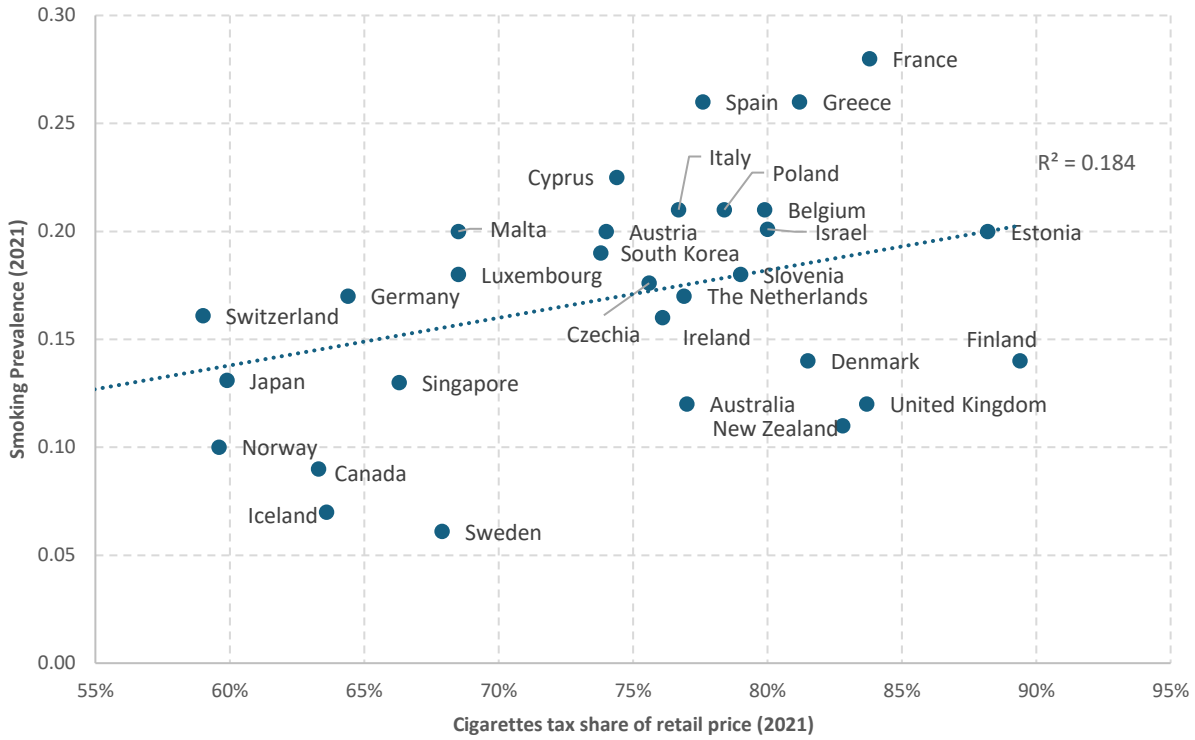


Data source: Analysis of 2023 WHO report data. Smoking prevalence data is reported by a one-year delay in relation to the other measures.

A similar pattern emerges when isolating the role of taxation. Standard economic theory predicts an inverse relation between taxation and consumption levels. However, when smoking prevalence is compared with the tax share of the retail cigarette price, the empirical relation appears weak and partially counterintuitive. In the benchmark comparison, the correlation is modestly positive, with taxation explaining only a small fraction of the cross-country variance in smoking prevalence ($R^2 = 0.184$), as depicted in Chart 2.

A plausible interpretation is that high-tax jurisdictions often correspond to countries that historically faced higher smoking prevalence, prompting governments to adopt higher tax rates as corrective policy response. In such cases, elevated taxation may partly reflect policy adjustment to an entrenched public health burden rather than a sufficient determinant of prevalence. Hence, high tax shares can coexist with relatively high smoking rates, indicating that taxation intensity alone does not reliably account for cross-country differences in smoking prevalence within this sample of advanced economies.

Chart 2: Smoking prevalence by cigarette taxation level

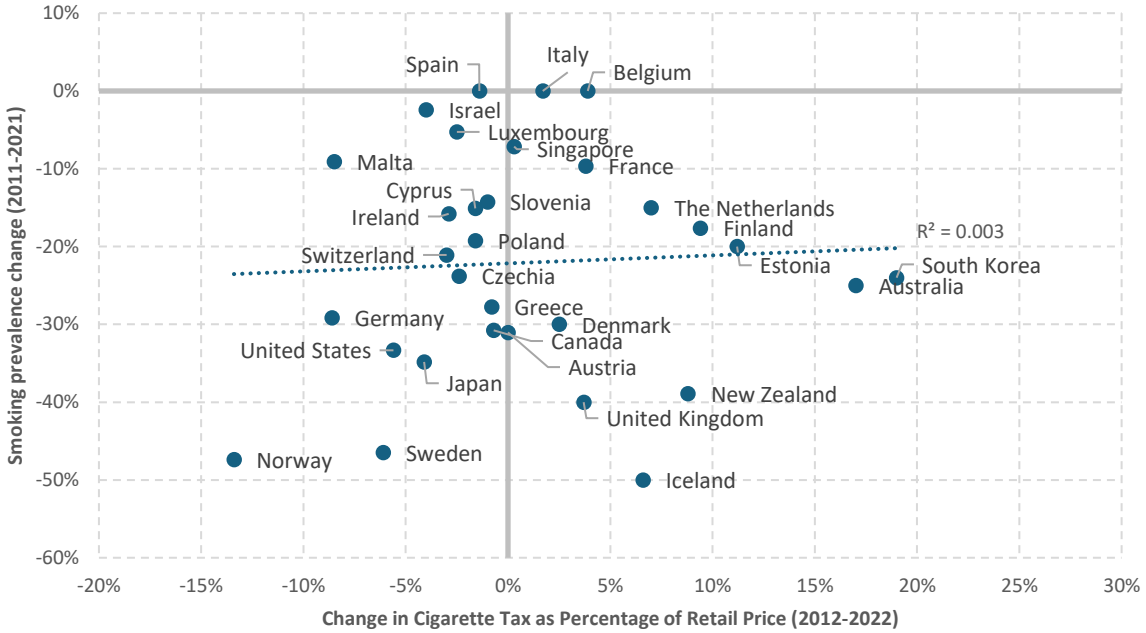


Data source: Analysis of 2023 WHO report data. Smoking prevalence data is reported by a one-year delay in relation to the other measures.

Importantly, the same conclusion holds when shifting from levels to changes over time. If taxation were the dominant determinant of smoking behavior, countries that substantially raised tax rates over the past decade would be expected to exhibit the largest reductions in smoking prevalence. Yet, when the ten-year change in prevalence is compared with the change in the tax share of the retail cigarette price, the relation is effectively negligible ($R^2 = 0.003$), indicating that variations in tax share are not systematically associated with changes in smoking rates across benchmark countries during 2011-2021 (Chart 3).

The implication is not that taxation lack effect, but rather that among residual smoker populations in advanced economies – where demand is comparatively inelastic and nicotine dependence remains entrenched – further increases in price-based policy instruments yield limited marginal impact unless complemented by other mechanisms that reduce the practical and behavioral frictions of switching away from conventional cigarettes.

Chart 3: Change in smoking prevalence by change in tax rate, 2011–2021



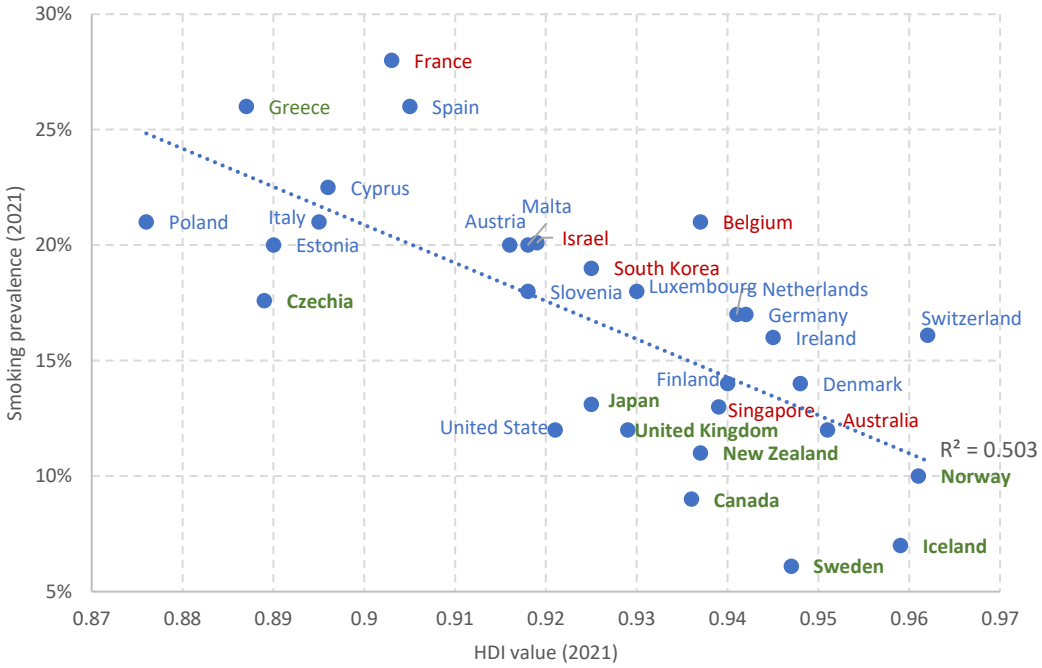
Data source: Analysis of 2023 WHO report data. Smoking prevalence data is reported by a one-year delay in relation to the other measures. Some changes in the cigarette tax as a percentage of the retail price are driven by fluctuations in the retail price, without any changes to the tax calculation method.

Given that neither aggregate MPOWER intensity nor taxation sufficiently explains the dispersion in smoking prevalence across countries, it becomes necessary to account for baseline cross-country comparability, that is to account for broader socioeconomic determinants. Accordingly, the HDI is used as the principal control variable, as it captures wealth, education, and health standards and is widely used to benchmark structural development conditions.

Chart 4 illustrates a strong negative relation between HDI and smoking prevalence, with the regression explaining approximately half of the observed variance within the benchmark sample ($R^2 = 0.503$). This supports the methodological decision to restrict comparison to countries with similar development profiles, as HDI alone accounts for a substantial portion of cross-country differences in smoking prevalence. At the same time, roughly half of the variance remains unexplained even after conditioning on HDI, directing attention to policy-related factors that may shape outcomes beyond socioeconomic baseline conditions. To connect this discussion to the policy dimension examined below, countries in Chart 4 are color-coded by policy group (Green: risk-proportionate, incentivizing substitution; Blue: mixed / ambivalent; Red: prohibitionist / equalizing). The color-distribution reveals clustering relative to the fitted line: "Green" jurisdictions typically lie below the predicted values (indicating lower prevalence than expected given their HDI), whereas several "Red" jurisdictions appear above it (exhibiting higher prevalence than predicted).

This visual pattern is consistent with the hypothesis that, beyond structural socioeconomic conditions, regulatory differentiation toward lower-risk nicotine products may contribute to cross-country differences in smoking prevalence.

Chart 4: Smoking prevalence by the HDI value

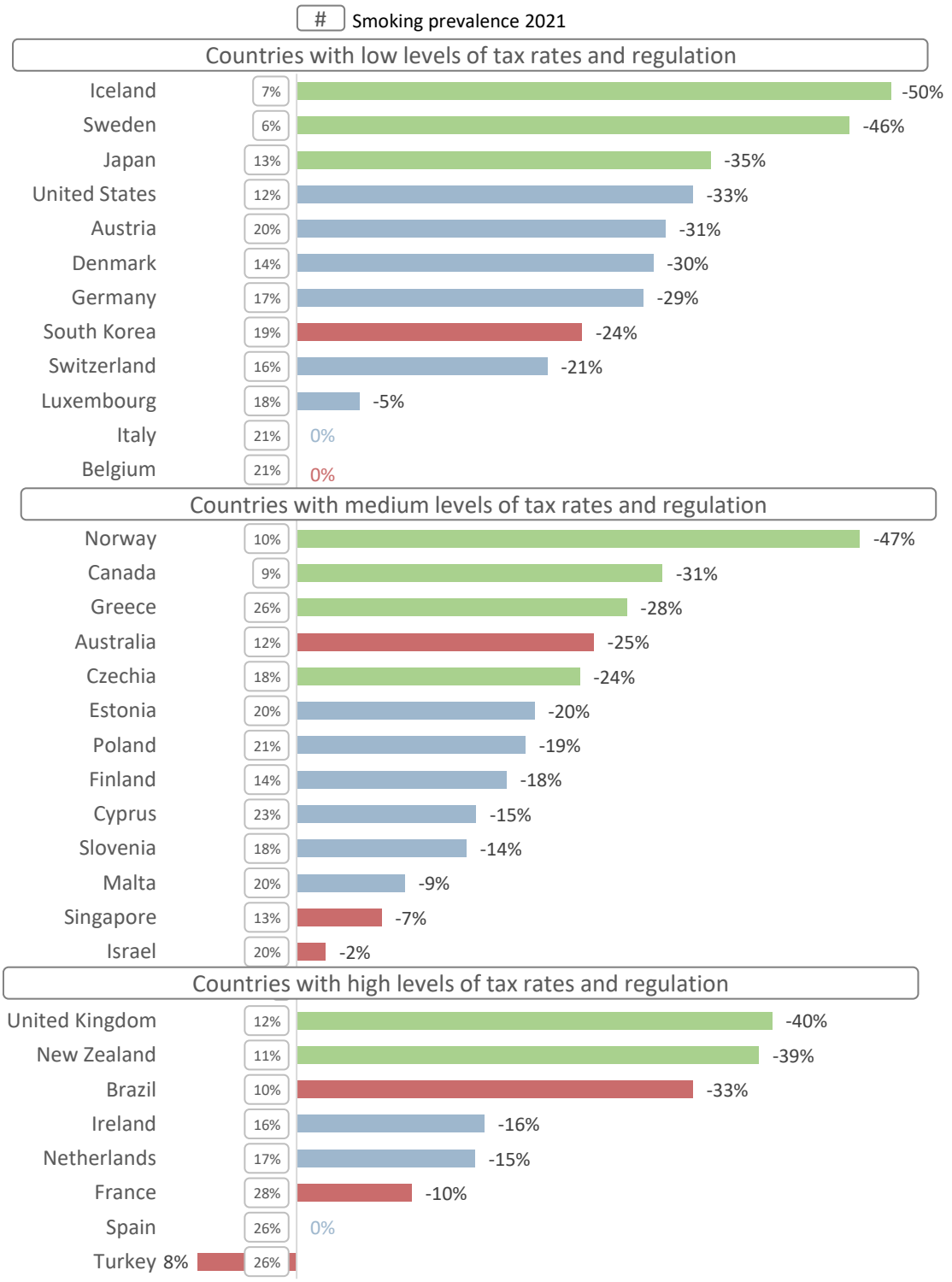


Data source: UN – HDI 2021; and the WHO – smoking prevalence standardized by age 2020.

Taken together, these descriptive results, alongside the dispersion that remains around the HDI trend line, justify examining an additional policy dimension: the regulatory stance toward lower-risk nicotine products and, by extension, the availability of a viable substitution pathway away from conventional cigarette consumption. The underlying rationale is that, in developed-country settings, where remaining smoker populations exhibit relatively inelastic demand, conventional price- or restriction-based instruments may exert limited marginal influence. In contrast, differentiated regulatory frameworks may shape outcomes by facilitating behavioral switching toward products that serve as close functional substitutes to conventional cigarettes.

To present this pattern descriptively, countries are stratified into three tiers of overall MPOWER implementation and simultaneously classified into policy groups based on their regulatory treatment of lower-risk products. Chart 5 reports the change in smoking prevalence between 2011 and 2021 across MPOWER tiers, with countries color-coded by policy group.

Chart 5: Change in smoking prevalence in % during 2011–2021
by regulation and taxation levels (MPOWER)



Data source: WHO – smoking prevalence is standardized by age 2020. The change in the smoking prevalence is presented as a change in %.

* This analysis further includes Brazil and Turkey, two countries recognized by the WHO for their exemplary implementation of the MPOWER measures.

The descriptive pattern carries clear policy relevance. "Green" jurisdictions, those whose regulatory frameworks are explicitly designed to facilitate substitution toward lower-risk nicotine products, tend to exhibit larger reductions in smoking prevalence over time. "Blue" jurisdictions, characterized by a mixed or ambivalent stance, show intermediate outcomes, while "Red" jurisdictions, which pursue uniform or prohibitionist approaches toward product alternatives, are generally associated with smaller declines in smoking prevalence.

Taken together, this distribution suggests that, beyond the overall policy intensity captured by the MPOWER index, variation in regulatory direction, specifically, whether frameworks enable or restrict substitution, may help account for heterogeneity in prevalence trajectories across the benchmark countries.

Table 1: Change in smoking prevalence (2011-2021) and 2021 prevalence, by policy group

Group Definition	Average Decline (2011–2021)	Average Prevalence (2021)
"Green" countries Countries that incentivize smokers' transition to alternative products	-38%	12%
"Blue" countries Countries which have certain regulatory and taxation relief for alternative products compared to conventional smoking products	-18%	17%
"Red" countries Countries that oppose to the use of alternative products either banning them or regulating and taxing them as strictly, or even more strictly, than conventional smoking products	-12%	19%

Data source: Analysis of WHO global tobacco epidemic reports (2013–2023).

On average, "Green" countries experienced the largest reduction in smoking prevalence and the lowest prevalence level by 2021, relative to both "Blue" and "Red" groups. Even if, in some jurisdictions, survey-based measures partially misclassify certain users of smoke-free products within smoking statistics, the relative ordering across policy groups remains informative for this benchmark comparison. Taken together, Chart 5 and Table 1 motivate the regression analysis that follows, which tests whether policy-group differences retain explanatory power after accounting for baseline socioeconomic conditions and other covariates.

4.2 Regression Analysis

To rigorously test whether these observed differences are statistically significant when controlling for development and taxation level, we estimated an Ordinary Least Squares (OLS) model. Table 2 presents the results for the core sample (N=31

, HDI > 0.875) and the extended sample (N=42, HDI > 0.83).

Table 2: The effect of policy classification on smoking prevalence (cross-sectional analysis)

	(1)	**(2)**
	High HDI (>0.875)	**Mid-High HDI (>0.83)**
Red country	Ref.	Ref.
Blue country	-0.0132	-0.0284*
	(0.0158)	(0.0132)
Green country	-0.0577**	-0.0699***
	(0.0179)	(0.0165)
HDI index	-1.456***	-1.652***
	(0.314)	(0.182)
Taxation level	0.0807	0.0736
	(0.0604)	(0.0598)
Constant	1.479***	1.679***
	(0.298)	(0.171)
R^2	0.719	0.850
N	31	42

*Note: Robust standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05.*

Reference category is "Red Country". Coefficients represent percentage point differences.

The regression analysis provides robust empirical confirmation of the descriptive trends observed earlier, establishing a clear hierarchy in public health outcomes based on regulatory policy. The primary finding is the substantial and statistically significant impact of the "Green" policy classification. Across both the core and extended samples, holding development and taxation levels constant, countries adopting a risk-proportionate regulatory framework exhibit a smoking prevalence approximately 5.8 to 7.0 percent lower than the "Red" baseline group. Given the cross-

sectional nature of this analysis, this result should be interpreted as identifying the facilitation of substitution pathways as a strong independent factor of lower national smoking prevalence. Furthermore, the extended sample (Model 2) reveals a graduated effect, where "Blue" countries – those with a mixed or ambivalent approach – also show a statistically significant reduction compared to the "Red" group, though the magnitude is less than half that of the "Green" group. This validates the hypothesis of a policy continuum: moving away from strict prohibition (Red to Blue) yields marginal gains, whereas the comprehensive adoption of risk-differentiated frameworks (Green) yields a substantive and measurable shift in smoking prevalence.

A critical finding, which warrants precise interpretation, is the lack of statistical significance for the taxation level variable ($p > 0.05$) within this specific cohort. This result does not imply that taxation has no impact on demand within a specific country over time; rather, it indicates that in a cross-sectional comparison of high-income countries, differences in taxation levels do not explain the observed differences in smoking prevalence. Most countries in this benchmark group already impose high taxes on cigarettes, suggesting that at these elevated levels, the price elasticity of demand for cigarettes encounters a ceiling effect. Consequently, further marginal variations in tax burdens are not the primary drivers of the variance in smoking rates observed between these countries.

Ultimately, the model demonstrates high explanatory power, with an R^2 ranging from 0.719 to 0.850, indicating that the combination of socioeconomic development (HDI) and regulatory policy explains most of the variance in smoking rates. The variance that remains unexplained by development levels is best accounted for by the presence or absence of accessible alternatives (the Green/Red distinction). This evidence supports the conclusion that while high taxation and socioeconomic development constitute necessary structural conditions for effective tobacco control, they are not sufficient to explain the superior performance of leading countries without the complementary influence of differentiated, substitution-enabling regulation.

5. Discussion

The empirical results of this study offer strong validation for the economic theory of substitution, mirroring findings from environmental and transport economics discussed earlier. Just as congestion charges failed to reduce traffic without accessible public transit (Eliasson et al., 2009), and waste regulations failed without recycling infrastructure (Lavee, 2010), our data demonstrates that tobacco taxes encounter a ceiling of effectiveness in the absence of alternatives.

The regression analysis reveals that the classification of countries based on their approach to substitutes ("Green" vs. "Red") explains the variance in smoking prevalence significantly better than traditional metrics like taxation levels or regulatory strictness. The finding that "Green" regulatory environments are associated with significantly lower smoking prevalence suggests that the demand for conventional cigarettes is not inherently rigid. Rather, the perceived rigidity is a result of a lack of options. Once a close substitute is introduced, the demand curve becomes more elastic and consumers respond to incentives.

This study highlights a critical limitation in the traditional uniform regulatory approaches commonly endorsed by global health institutions, such as the WHO's MPOWER framework. The lack of statistical significance for the taxation level variable indicates that in mature, high-income markets, the price elasticity of demand for cigarettes has diminished. Smokers in these demographics tend to be highly nicotine-dependent and relatively unresponsive to incremental price increases on cigarettes. Consequently, the strategy of continually raising excise taxes appear to have reached a point of exhaustion.

Conversely, the high cross-price elasticity implied by the performance of "Green" countries indicates that these same consumers are responsive to relative price differentials when lower-risk alternatives are made accessible and affordable, both in monetary and behavioral terms. Thus, in contemporary tobacco control, the dominant mechanism of behavioral change appears to be substitution or displacement, rather than outright cessation alone.

The statistical data is reinforced by observing divergent outcomes in culturally similar jurisdictions that have adopted opposing strategies. The contrast between New Zealand and Australia is particularly instructive. Both nations share similar demographics and have historically implemented aggressive tobacco control measures (e.g., plain packaging). However, their regulatory paths diverged with respect to their stance toward lower-risk nicotine products.

Australia ("Red") maintains a restrictive regulatory stance toward e-cigarettes, requiring medical prescriptions for legal access. Despite this strict framework, the decline in smoking prevalence has slowed and a significant illicit market for unregulated vapes has emerged (Mendelsohn, 2022).

New Zealand ("Green") adopted a risk-proportionate framework, legalizing and regulating vaping products as consumer goods while simultaneously enforcing smoke-free goals. Following this

policy shift, New Zealand witnessed an accelerated decline in daily smoking rates, outperforming its neighbor (ASH NZ, 2023; Ministry of Health NZ, 2022).

Similarly, the United Kingdom has explicitly integrated e-cigarettes into its tobacco control strategy. Supported by reviews from Public Health England (McNeill et al., 2018), the UK government differentiates between products in both taxation and public messaging. This approach has correlated with sustained reductions in smoking prevalence, validating the regression model's prediction that "Green" regulatory regimes are associated with superior outcomes.

A frequently cited concern regarding the authorization of lower-risk nicotine products is the gateway hypothesis – the concern that alternative products might act as a bridge to smoking for non-users. If this theory were valid at the population level, one would expect "Green" countries to exhibit slowing declines in smoking rates or even reversals.

Our data contradicts this hypothesis. The most compelling evidence comes from Sweden, the pioneer of the "Green" approach through the widespread use of snus (oral tobacco). Despite the high prevalence of alternative product use, Sweden boasts the lowest smoking prevalence in Europe, at approximately 5.6% (European Commission, 2021). Longitudinal analyses suggest that these alternatives function primarily as an exit strategy for established smokers rather than an entry point for non-users (Ramström, 2019). The negative coefficient for "Green" countries in our regression analysis further supports the common liability or diversion hypothesis, that availability of regulated alternatives diverts potential nicotine users away from cigarettes.

The analysis also highlights the hidden risks of the "Red" approach. When governments impose high taxes and strict regulations on all products uniformly, they inadvertently create a vacuum. Economic theory suggests that if legal demand cannot be satisfied by a regulated substitute, it may shift to an unregulated one. In "Red" jurisdictions, smokers facing elevated tax burdens and restricted legal access to affordable alternatives are often driven to the black market for traditional cigarettes or unregulated vapes. This not only erodes tax revenue but also keeps consumers using the most harmful product with no regulatory oversight. In contrast, "Green" policies retain these consumers within the legal market. By offering a tax-differentiated, regulated alternative, the state maintains control over quality and age verification while ensuring that any price advantage aligns with lower relative health risk.

While these findings are robust across two sample specifications, causal interpretation requires nuance. As a cross-sectional analysis of 2021 data, the study captures a snapshot of the correlation between policy regimes and prevalence. It is possible that unobserved cultural factors influence both policy adoption and smoking rates. However, the magnitude of the coefficient and the distinct clustering of "Green" countries suggest that policy is a significant independent factor. Future research utilizing longitudinal panel data would further clarify the temporal sequence of these effects.

6. Conclusion and Policy Recommendations

6.1 Conclusion

The stagnation in smoking prevalence across many developed countries is not an inevitable plateau but a reflection of policy inertia – a failure to adapt regulation to evolving market and behavioral dynamics. This study demonstrates that the uniform or one-size-fits-all model of tobacco regulation, which treats cigarettes and novel nicotine products as equivalent in risk, is empirically less effective than a risk-proportionate, substitution-based framework.

Data from 42 highly developed economies reveals a clear pattern: countries that actively facilitate access to lower-risk substitutes achieve significantly lower smoking rates than those relying primarily on restrictive or uniform measures. The absence of statistical significance for taxation levels in isolation further underscores that price-based instruments have reached a ceiling of effectiveness in mature markets unless complemented by accessible lower-risk alternatives that facilitate behavioral substitution.

Applying the regression estimates from this analysis yields illustrative projections for selected markets: Israel currently classified as a "Red" country with a smoking prevalence of 20%. The model predicts that adopting a "Green" policy framework could reduce prevalence to approximately 14%. This reflects a relative reduction of 29% in the number of smokers. Germany currently classified as a "Blue" country with a smoking prevalence of 17%. Moving to an active substitution-enabling strategy is projected to lower prevalence to 12%, reflecting a relative reduction of 30% in the number of smokers[1].

[1] Predicting the OLS regression model with Israel’s and Germany's parameters and a dummy variable for “green” instead of “red" or "blue".

6.2 Policy Recommendations

To break the current impasse in tobacco control and accelerate the transition away from conventional tobacco products, policymakers should adopt the following evidence-based strategies:

1. **Adopt Differential Taxation (The Economic Lever):** Establish a significant and sustained tax gap between cigarettes and lower-risk nicotine products. This relative price signal encourages smokers to substitute toward less risky options while preserving high fiscal disincentives for cigarette use.
2. **Implement Risk-Proportionate Regulation:** Move beyond binary regulatory models ("permitted" vs. "banned") toward a continuum of risk differentiation. While all nicotine-containing products should be regulated to prevent youth access and ensure quality, lower-risk products should operate within separate, proportionate regulatory channels, with allowance for accurate communication of comparative health risks to enable informed consumer choice.
3. **Integrate Substitution Principles into National Tobacco-Control Strategies:** Governments currently exhibiting ambivalent policy orientations should progress toward formal inclusion or regulated lower-risk products as cessation or substitution options for adults unwilling or unable to quit nicotine entirely.
4. **Mitigate Unintended Consequences:** Policymakers must recognize that banning alternatives or over-taxing them does not eliminate demand but instead diverts it to the illicit market. Maintaining a regulated, accessible, and quality-controlled supply of alternatives is therefore the most effective means to safeguard public revenue and consumer protection.

In summary, progress toward smoke-free societies will be accelerated not through additional prohibitions but through evidence-based diversification of lower-risk options. By embracing the economics of substitution and proportional regulation, policymakers can reinvigorate the decline in smoking prevalence and realize substantial public-health gains within the framework of sustainable, data-driven governance.

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Appendices

Appendix A: U.N.'s HDI for the Benchmark Countries and their Classification

Classification according to Differences in the Regulation and Taxation of Combustible Smoking Products versus Alternative Products

HDI Ranking	Country	HDI 2021	Classification
1	Switzerland	0.962	Blue
2	Norway	0.961	Green
3	Iceland	0.959	Green
4	Australia	0.951	Red
5	Denmark	0.948	Blue
6	Sweden	0.947	Green
7	Ireland	0.945	Blue
8	Germany	0.942	Blue
9	The Netherlands	0.941	Blue
10	Finland	0.940	Blue
11	Singapore	0.939	Red
12	Belgium	0.937	Red
13	New Zealand	0.937	Green
14	Canada	0.936	Green
15	Luxembourg	0.930	Blue
16	United Kingdom	0.929	Green
17	South Korea	0.925	Red
18	Japan	0.925	Green
19	United States	0.921	Blue
20	Israel	0.919	Red
21	Slovenia	0.918	Blue
22	Malta	0.918	Blue
23	Austria	0.916	Blue
24	Spain	0.905	Blue
25	France	0.903	Red
26	Cyprus	0.896	Blue
27	Italy	0.895	Blue
28	Estonia	0.890	Blue
29	Czechia	0.889	Green
30	Greece	0.887	Green
31	Poland	0.876	Blue
32	Lithuania	0.875	Blue
33	Portugal	0.866	Red
34	Latvia	0.863	Blue
35	Andorra	0.858	Blue
36	Croatia	0.858	Blue
37	Chile	0.855	Red
38	Slovakia	0.848	Blue
39	Hungary	0.846	Blue
40	Argentina	0.842	Red
41	Turkey	0.838	Red
42	Montenegro	0.832	Red

Appendix B: MPOWER score breakdown by country (Core Sample)

Country	Smoke-free environment: smoking bans	Cessation programs	Health warning labels regulation	Mass media campaigns against tobacco	Marketing and advertising bans	Taxation level	**Index sum**
Netherlands	3	3	3	3	3	3	18
Turkey**	3	3	3	3	3	3	18
Ireland	3	3	3	3	2	3	17
New Zealand	3	3	3	3	2	3	17
Brazil**	3	3	3	1	3	3	16
Spain	3	2	3	2	3	3	16
United Kingdom	3	2	3	3	2	3	16
France	1	2	3	3	3	3	15
Canada	3	3	3	2	2	2	15
Norway	3	2	2	3	2	2	14
Cyprus	2	2	3	2	2	2	13
Czech Republic	1	3	3	1	2	3	13
Malta	3	2	3	0	2	3	13
Australia	3	2	3	0	2	3	13
Estonia	0	2	3	3	2	3	13
Greece	3	2	2	0	2	3	12
Poland	1	2	3	1	2	3	12
Slovenia	1	2	3	0	3	3	12
Israel	1	3	2	3	*0	3	12
Finland	0	2	3	1	3	3	12
Singapore	1	3	3	1	2	2	12
Austria	1	3	3	0	2	2	11
Luxembourg	1	3	3	0	2	2	11
Germany	0	2	3	2	2	2	11
Denmark	0	3	3	0	2	3	11
Italy	0	2	3	0	2	3	10
Belgium	0	2	3	0	2	3	10
South Korea	0	3	2	3	0	2	10
Japan	1	2	2	3	0	2	10
Sweden	0	3	3	0	2	2	10
Uunited States	3	2	0	3	0	1	9
Iceland	0	1	2	0	3	2	8
Switzerland	0	2	2	0	0	2	6

*Although cigarette advertising is banned in Israel, there is an exception for print media (which is expected to be cancelled by 2029), therefore the value for this measure according to the WHO is at the lowest level, despite the many existing prohibitions included in the law.
** Countries that are not in the core sample.

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