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## Article

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# The impact of tobacco taxes, VAT, and affordability on the human development index: a global perspective on future economic trends

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# The impact of tobacco taxes, VAT, and affordability on the human development index: a global perspective on future economic trends

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## ABSTRACT

The objective of this study is to analyse the correlation between different types of taxation, price, usage, Human-Development-Index (HDI), affordability, and Gross-Domestic-Product(GDP) per capita. In particular, this work hypothesizes that there is a positive relationship between tobacco taxes and HDI. Taxation of tobacco products can enhance human development through a general upswing in public revenues, reduction of tobacco consumption, and the resulting enhancement of health. To test these relationships, cross-sectional-data on 163 countries were used, and four proposed models are estimated using Structural-Equation-Modelling (SEM). We examine the impact of four economic indicators on HDI, demonstrating that all indicators positively and significantly affect HDI. Also, we test the impact of affordability and three economic factors, whereby price in US\$ has a positive effect on affordability while taxation and sales taxes have a negative but significant effect. From these findings, it is evident that increasing tobacco taxes can improve the HDI because of the ability to generate public-revenue, decrease tobacco consumption, and improve health status. However, the study also points to some complexities, including the inability to establish causality and the possibility of confounding factors. These insights should be leveraged by policymakers and global health organizations to develop and implement evidence-based-strategies. More researches are required to understand the qualitative aspects and address existing constraints.

## IMPACT STATEMENT

It turns out that higher tobacco-taxes affect the HDI and GDP per-capita, creating positive public-income and anti-tobacco consumption, improving public-health. Through analysis across 163 countries, we highlights the benefits of tobacco-taxation: It strengthens-economies and at the same time promotes social development. This study provides useful information to the policymakers to convince them to employ taxation as one of the strategic policies to enhance the economic status while at the same time preventing the fear implications of the disease on the country's residents.

## ARTICLE HISTORY

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## KEYWORDS

Tobacco taxes; human development index; GDP<sup>1</sup> per capita; affordability; a value-added tax

## SUBJECTS

Economics; Business, Management and Accounting; Health & Development

## Introduction

In the time when economic development and social welfare are closely connected it is crucial to reveal the factors that link the tobacco taxation and human development. Tobacco is the major risk factor for non-communicable diseases that contribute to the morbidity and mortality in the world and they are associated with great economic burden through their impact on health care expenses and reduced productivity. Therefore, tobacco taxation re-invents itself as a policy option that will serve public health issues and fiscal demands both, according to literature reviewed by (Elliott, et al., 2022; MacNaughton, 2016). Tobacco taxation is common among both HICs<sup>2</sup> and LMICs<sup>3</sup> (Sucheki, 2020), with 172 of the 194 world countries regulating tobacco taxes. To wit, increasing the price of tobacco products via taxation is positively linked with the level of tobacco use (Stokłosa, 2017) and entails a virtuous cycle between health enhancement and

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economic development (Felsing & Groman, 2022). Borrowing the support of price policies and taxation can actually lower proportion of smoking and enhance public health worldwide (Riahi, Rohani, et al., 2018). Thus, the purpose of this research is to examine the complex relations between tobacco taxes and the HDI, with focusing on the role of these variables for future economic expectations.

The analysis also emphasizes on the possibility of protecting and improving the population's health as a result of tobacco tax measures in terms of their impact on the progress of society. Increasing tobacco taxes is effective in reducing smoking, enhancing people's health, and creating significant revenues that favour the impoverishment (Goldberg, 2022; Riahi et al., 2018; Uji, 2023). Strategic utilization of tobacco taxation offers potential to meet alternative pressures created by tobacco consumption and improves populace health (Chaiton, 2023; Sandoval, Malik, Roche, Belausteguigoitia, & Morales-Zamora, 2022).

In this work, the issue of exploring the role of fiscal policies, primarily involving tobacco taxes, for developmental trends is discussed. Tobacco taxes are the most important reform that has been recognized for several impacts such as the capacity to decrease consumption, to generate revenue and enhance public health. However, their impact on comprehensive measures of human development, such as the HDI, remains underexplored. Focusing on health, education and standard of living incorporated in HDI, this paper gives a comprehensive view of tobacco taxation impacts on well-being. The different variables selected for analysis are equally carefully screened relative to their economic and public health impacts such as; tobacco taxes, product prices as well as its affordability, HDI and Gross Domestic Product (GDP) per capita, among others. Each variable is strategically selected to contribute to an overarching perspective on the dynamic interaction between tobacco taxation and human development.

The study hypothesizes that high levels of tobacco taxes have direct positive effects on the levels of HDI, because of the expected decrease in demand for tobacco products, better health amongst the population, and increased government revenues for general and health related services. Four models are proposed to scrutinize these hypotheses: Model 1 deals with testing the effects of economic factors on HDI, and Model 2 tests the relationship between affordability and the economic factors. Model 3 describes how the health outcomes moderate the effects of tobacco taxes on the HDI Model 4 explains how all pathways interact with the direct and indirect role of tobacco taxes on HDI. These findings are important for the development of data-backed options from authorities and practitioners who serve in the sphere of public health and economic welfare. Thus, given the importance of tobacco's impact on the societies and people's health, this cross-border study of the problem, rises to great significance as a key to the sustainable global growth and improved quality of life worldwide.

The present study gives an international dimension to the impact of tobacco taxation. It looks into how these policies can enrich health services, learning institutions as well as community support with an aim of fostering a more just and dynamic economic environment. This line of inquiry then becomes crucial to attaining sustainable development and enhancing well-being due to severe degree to which tobacco afflicts the populace health. The paper aims to look at how various indices of HDI are intertwined with the economic factors of tobacco taxation, and how best to address the problem of the adverse impact of tobacco on people's lives. The World Health Organization (WHO) also identifies eight cost-effective and sustainable approaches of which the most effective and affordable one is the prevention of tobacco use and its ill effects (World Health Organization, 2004). On this basis, the manner in which tobacco tax laws are applied or affect the different countries and/or regions depends on a number of factors including; tax administration, level of tax administration, the general structure of tobacco taxes, and the interaction/ties of the tobacco industry with these laws.

HDI is a comprehensive metric that evaluates a nation's average performance in three core areas of human development: health, gross domestic product per capita, standard of living, and education. This paper examined the impact and future economic implications of tobacco taxation and look at the correlation between tobacco taxation around the world and the countries' HDI ratings. Our hypothesis is that higher tobacco prices will be associated with higher HDI, since taxes act as a disease cost savings measure in addition to generating health and social service revenues and improving population well-being and productivity.

Data for 163 countries were obtained from the United Nations Development Programme (UNDP) Human Development Report 2021 and the WHO global report on the tobacco epidemic of 2021 to analyse data from a cross-sectional study on the hypothesis. The main idea of the primary theory a rise in tobacco price rise leads to higher HDI since it means more spending on social and health services, fewer cases of

disease caused by tobacco and improved population health and productivity. To test this hypothesis, two regression analysis models were employed. With regard to the hypothesis, there is evidence in Model 1, which confirms that all the four variables are positively statistically significant with the HDI, this have given credence to the arguments that taxation of tobacco goods can improve the human development index by increasing the public revenue and reducing the use of tobacco which has been supported by other studies (e.g. Ali & Koplan, 2010; Fuchs, Marquez, Dutta, & Gonzalez Icaza, 2019; Whakeshum, 2020). The analysis in Model 2 shows that the coefficient of PriceUS has a positive direct effect on AFFORDABILITY consistent with Ingaramo, et al. (2013), whereas TAXATION and VAT & SALESTAXES are negative but statistically insignificant. This means that through increasing the cost of tobacco through taxation, the consumption of tobacco products will be low, but other factors like income, preferences and availability will also play a role of controlling demand. VAT and sales taxes' contribution to the affordability was relatively modest, and hence inconsequential for tobacco control, as supported by other researchers (Bonnie & Lynch, 1994; Chaloupka, Yurekli, & Fong, 2012; World Health Organization, 2015).

In order to isolate the direct and indirect effects of altering tobacco taxation alone on the HDI, the research also uses multiple regression models and structural equation modelling, controlling for economic effects including, but not limited to per capita GDP. All variables including higher pricing, greater affordability, more taxing, and the high VAT and sales taxes have come out positive with HDI confirming the hypothesis of the study that there is a relationship between high tobacco taxes and high HDI. However, this study also draws attention on some problems and challenge in the analysis such as the inability to establish causality, the need for context to be used in interpreting data, and other factors that could distort the results. There is therefore a need for more studies to capture the intricate connection that exist between tobacco taxes and human development.

The article is arranged as follows. A concise synopsis of the literature is provided in Section 2. Section 3 describes the Methodology. The findings are discussed in Section 4. Finally, Section 5 provides conclusions and suggestions.

## Literature review

Insightful information about how taxes affect economic growth is available in the researches by Jorgenson and Yun (2013), which is dedicated to the efficiency and budgetary implications of various sorts of taxes. The new facts under study focused on the changes in GDP and well-being in connection with the alterations of the tax system, particularly with reference to the income and consumption taxes. They also forms a structural equation model to examine the interconnectivity between the two kinds of taxation, PriceUS, HDI, affordability and GDP per capita. Their study of the direct relation between taxation and GDPC might perhaps assist them to analysing how certain taxation policies could enhance the level of GDPC. Jorgenson and Yun (2013) view the tax reforms, and the effect of these places on the welfare as fitting our analysis of the direct and indirect impacts of taxation on HDI well. Their work relied on the concept that the state's taxation legislation can affect the economic growth and the population's quality of life, which is useful for our research.

Research on the correlation of public health spending, tobacco taxes and other human development indicators. Such as the HDI has been done before. The important factor is the one we have labelled as 'affordability' that measures the ability of people to consume tobacco in view of their income status and effects of taxes on prices. Research shows that higher tobacco taxes reduce tobacco use, especially in LMICs (Chaloupka et al., 2012; World Health Organization, 2023). Thus, the cost of treatable sicknesses that are associated with the use of tobacco is reduced (Chaloupka et al., 2012). The HDI can be financed through taxes to pay for social, health, and educational investment (Fuchs et al., 2019). However, the impact of these factors varies, for example, in demography, and tax efficiency (Blecher, 2010; World Health Organization, 2023).

This study examines the relationship between the forms of taxation, PriceUS, HDI, affordability, and GDP per capita with regard to the IMF's focus on increasing tax to GDP ratios through consumption taxes. Vitor Gaspar, et al. (2023) argued that collected revenue, especially in the form of taxes, can be used to also finance the infrastructural, health, and education sectors, and such more, thus enhancing the human development indices. However, it is important to understand the fact that consumption taxes

in the right manner can be helpful in enhancing human development and the progress of the economy in the right manner. Our examination of affordability and evaluation of the effects of these factors on HDI coincides with the IMF's interest in economic efficiency and stresses the relation between fiscal policies and development goals (Vitor Gaspar et al., 2023). The next source which can also be used to support the core relation between taxes and economic growth is the Tax Foundation study, reviewed in September 2021. One more meta-analysis of 49 studies highlighted the importance of tax changes, especially of the income taxation type, for GDP (Durante, 2021). In this study we explore and compare the direct and indirect effects of taxation on GDP per capita employing a Structural Equation Model, with a special focusing on income tax. Real GDP impacts of income and consumption tax cuts: a review of evidence for policy levers. The results of our study are further supported by other research, particularly a meta-analysis by the Tax Foundation. In conclusion, the Tax Foundation's 2021 review of taxes on growth and tax cuts on real GDP enriches the context of our study (Durante, 2021).

Data from the Human Development Report of 2021/2022 does provide information on the dimensions of HDI; however, affordability and perceived insecurity in the context of HDI can best be illustrated through concerns pertaining to affordability and the perception of insecurity as a key elements of HDI for different categories of human development (Conceição, 2022). These findings are in sync with our study, which applies affordability in ascertaining how income levels, prices and taxation laws impact on the ability of people to access products/services and therefore, the human development index. Pricing activities, taxation, and living standards are all concerned with investment, innovation, and education as identified by Conceição (2022) but the current study seeks to analyse these relationships by employing a structural equation model to understand the complex relationships between pricing dynamics, taxation policies, and living standards. The report enhances our study as it gives practical considerations that include the discussion of taxation types, PriceUS, HDI, affordability, and GDP per capita. Our study is also related to the works of Raghupathi and Raghupathi (2020) on healthcare expenditure and economic performance of in the US, where the authors focused on the correlation between healthcare expenditure and gross domestic product per capital. Regarding affordability this is an important addition and expands the data analysis on GDP per capita, taxation, pricing, and healthcare expenditure, providing the accounting of particular economic factors and the results of such interactions in terms of healthcare. We are mindful of the steady drive towards making healthcare more affordable and spending optimally, which is relevant to our study in capturing both the broad relationships between affordability, costs, taxation policies and economic performance.

Human development is important for local and international entrepreneurship, as highlighted by Shettigar, et al. (2024). Livelihoods, as an aspect of quality of life have been greatly valued in the pursuit for the betterment of human life. Governments play an important role in funding, coordination, and supervision of the welfare development. This correlation between human development and entrepreneurship underlines the human and social capital and economic development approaches, which more focus on capabilities. In this paper, we investigate the direct and the mediating roles of taxation types in the relationship between HDI and GDP per capital based on the concurrent evaluation of the effects of fiscal policies on people's lives. Based on the findings of Shettigar et al. (2024) we included valuable suggestions into our study's framework, concerning well-being, which has to be viewed from an integrated perspective when it comes to such values such as economic and human development. Taxes are therefore employed by governments as ways of raising cash for social and economic reforms that impact on the society together with people. Tax measures, including progressive taxation, credits, and human development taxes, among others, have the potential to solve social challenges and promoting the human development goals. Exemptions in taxation must also has to be removed as part of the sustained measures against poverty. The present work benefits from these findings since fiscal policies affect development in general and human development particularly in different ways.

Chaloupka et al. (2012) enhanced the understanding of the connection between HDI, tobacco taxes, and affordability, proving the effectiveness of the taxation for the reduction of tobacco use in the countries with a high HDI. This work provides evidence for how carefully constructed tobacco taxes are imperative and for the positive and negative effects of fiscal policies on health. The data shows that the implemented tobacco control measures are also high in the countries with a higher HDI level, which speaks about the a positive relationship with tobacco taxes (Conceição, 2022). This is in line with how prioritizing HD also addresses social and economic determinants of public health, in the process



emphasizing on human development. Rossant and Tam (2017) analysed the relationship between HDI and obesity in the Eastern Mediterranean Region with the implication that with improving human development comes more such difficulties as non-communicable illnesses hence policies such as higher taxes on tobacco products. Ataey, Jafarvand, Adham, and Moradi-Asl (2020) underline the intricate links between public health, economic development, and policy interventions in this region.

A 50% tax-imposed price increase on tobacco products could prevent 27.2 million premature deaths over 50 years, demonstrating that tobacco taxation is one of the most valuable financial policies practiced worldwide, particularly in the low-income and middle-income countries (World Health Organization, 2023). The 'price instrument' of raising tobacco prices by 10% can result in a cut in consumption by 5 to 8% in LMICs and 4% in HICs; this is a cost-effective intervention that has large economic impacts. However, in only 41 countries and 12% of the world population, a tax rate that reached or exceeded 75% of the cigarette price by 2022 was recorded. Some of the recessions include apprehension by industries and governments, who have to periodically review taxes to check on inflation and income growth, ensuring the continued effectiveness of tobacco control efforts (World Health Organization, 2023).

Tobacco taxation can therefore, be regarded as one of the most researched and implemented approaches used to achieve the reduction of global tobacco consumption and its improvement in line with the generation of revenues. The multidisciplinary literature has never lacked information concerning taxation, pricing, affordability and human development. Many works without doubt prove that raise in tobacco taxes reduces consumption, according to Chaloupka et al. (2012), a 10% raise in taxes leads to the cut in tobacco use by 4%, it is even more effective in L&M IC countries. Jha and Peto (2014) also observed that taxation was an essential tool to help cut on tobacco smoking by the public and the health complications.

However, tobacco taxation has a significant economic impact, as discussed by Goodchild, Perucic, and Nargis (2016), who found that it offers the government a vast opportunity to generate high revenues that can improve on health as well as other social services. Also, according to the World Bank (2021) parsimonious control of health expenses equally contribute to saving the fiscal space to support developmental programmes. Due to the coverage of the health dimension in addition to education and per capita income determined by the HDI, investigations by Theilmann et al. (2022) concluded that improvement in health due to reduction in tobacco consumption can influence the HDI.

Given affordability as a key consideration of consumption fuelled by prices and income levels, the studies like that of the Blecher and Van Walbeek (2004) point out a decline in the consumption rate when tobacco products are less affordable, especially in economies with lower income per head and more sensitive to prices. Based on the discussed shortcomings of the existing literature, this study will attempt to fill this gap by examining the direct and indirect effects of tobacco taxation on HDI using structural equation modelling. Thus, by evaluating the economic and human development impacts of this study, it provides a vision of all the effects of tobacco taxation policies.

As presented in Table 1, this study's literature review covers a comprehensible analysis of the strong general areas of interest for taxes, economic growth, human development, affordability, and spending on health. In particular, the literature analysis focuses on the correlation between tax policy and economic growth as well as on the peculiarities connected with different types of taxes. Also, it highlighted the importance of better goods and services, which eventually contributes to improving the HDI and the Client's affordability. The literature has also examined the correlation between GDP per capita and the healthcare expenditures in the United States, thereby revealing diverse complex linkages between economic growth and the costs of healthcare. They provide the basis for our study to proceed and concentrate on assessing the effects of kinds of taxation, PriceUS, HDI, affordability, and GDP per capita on main economic and human development factors. Through employing structural equation modelling our study seeks to assess the mediations of these crucial variables by the taxation policies, the price factors and affordability more specifically, their direct as well as the indirect impacts. The theoretical and empirical literature came out as the most coherent and comprehensive framework for the development of the hypotheses and for trying to understand the complexity of interactions between these crucial factors. Thus, the synthesis of findings from prior work allows us to participate in the ongoing discussions on fiscal policies, the outcomes in national economies, and human development as our study begins. The reviewed literature reveals this approach as signposts that help navigate the complex interactions that constitute economic and social contexts.

**Table 1.** Summarizing the results and interest of the works cited.

Study	Focus	Key findings	Relevance to current study
(Shettigar et al., 2024)	'Human development and entrepreneurial activity'	'Emphasizes the importance of improving people's quality of life, which can be measured by analysing their livelihoods, and highlights the role of governments in fostering human development.'	'Relevant to our study by examining the relationships among taxation, pricing dynamics, affordability, HDI, and GDP per capita, and emphasizing the interconnectedness of fiscal policies and human development outcomes.'
IMF (Vitor Gaspar et al., 2023)	'Fiscal policies and human development'	'Emphasizes the importance of efficient spending and the potential impact of consumption taxes on human development and economic progress.'	'Relevant to our study by examining the relationships among taxation, pricing dynamics, affordability, HDI, and GDP per capita, and highlighting the interconnectedness of fiscal policies and human development outcomes.'
Human Development Report (2021/2022)	'Human development and affordability'	'Offers valuable insights into the multifaceted dimensions of HDI, particularly regarding challenges related to affordability and perceived insecurity across various HDI categories.'	'Relevant to our study by examining the relationships among taxation, pricing dynamics, affordability, HDI, and GDP per capita, and highlighting the intricate link between economic factors and human development.'
Tax Foundation (Durante, 2021)	'Taxation and economic growth'	'Conducted a meta-analysis of 49 studies, emphasizing the significance of tax changes, particularly in the area of income taxation, in affecting GDP.'	'Relevant to our study by examining the direct and indirect effects of taxation type on GDP per capita and highlighting the importance of considering taxation policies within a broader economic context.'
Raghupathi and Raghupathi (2020)	'Healthcare spending and economic performance in the US'	'Examines the correlation between GDP per capita and healthcare expenditure, highlighting the importance of affordable healthcare and efficient spending.'	'Relevant to our study by examining the relationships among taxation, pricing dynamics, affordability, HDI, and GDP per capita.'
Fuchs et al. (2019)	'Distributional effects of tobacco taxes'	'Tobacco tax increases are pro-poor, with the poorest groups gaining the most in terms of health benefits and financial risk protection.'	'Suggests that tobacco taxation can help reduce health inequalities and poverty.'
Goodchild et al. (2016)	'Economic benefits of tobacco taxes'	'Increased tobacco taxes generate substantial additional government revenue.'	'Supports the economic argument for raising tobacco taxes.'
(Jha & Chaloupka, 1999) and (Jha & Peto, 2014)	'Health impact of tobacco taxation'	'Increasing tobacco taxes leads to reduced smoking prevalence, fewer smoking-related illnesses and deaths, and substantial health benefits.'	'Highlights the significant public health gains from higher tobacco taxes.'
(Jorgenson & Yun, 2013)	'Tax reforms and economic welfare'	'Highlights the potential for taxation policies to influence economic growth and overall well-being, offering a relevant reference point for our study.'	'Relevant to our study by examining the direct and indirect effects of taxation type on GDP per capita and highlighting the importance of considering taxation policies within a broader economic context.'
(Chaloupka et al., 2012) (Chaloupka et al., 2012)(Chaloupka et al., 2012)(Chaloupka et al., 2012)	'Tobacco taxation and public health Impact of tobacco taxes on consumption'	'Highlights the potential efficacy of taxation to curb tobacco usage, specifically in nations with higher HDI scores. A 10% increase in cigarette prices leads to a 4% reduction in consumption in high-income countries.'	'Relevant to our study by examining the relationships among taxation, pricing dynamics, affordability, HDI, and GDP per capita, and highlighting the importance of carefully crafting and executing tobacco taxes. Demonstrates the effectiveness of tobacco taxes in reducing smoking prevalence.'
(Asaria, et al., 2007)	'Cost-effectiveness of tobacco control'	'A 10% increase in cigarette prices combined with moderate non-price interventions could avert 5.5 million deaths from tobacco-related diseases at a cost of US\$0.04-0.32 per person.'	'Demonstrates that tobacco taxation is a highly cost-effective public health intervention.'
(van Baalet al., 2007)	'Cost-effectiveness from healthcare perspective'	'Tobacco tax increases are cost-effective even when accounting for additional medical costs from life years gained.'	'Indicates that tobacco taxation provides economic benefits to the healthcare system.'
(World Health Organization, 2004)	'Tobacco control and public health'	'Recognizes the importance of reducing tobacco use and its negative consequences, emphasizing the role of tobacco taxation in achieving this goal.'	'Relevant to our study by examining the relationships among taxation, pricing dynamics, affordability, HDI, and GDP per capita, and highlighting the importance of tobacco taxation in reducing tobacco consumption and improving public health.'



## Methodology

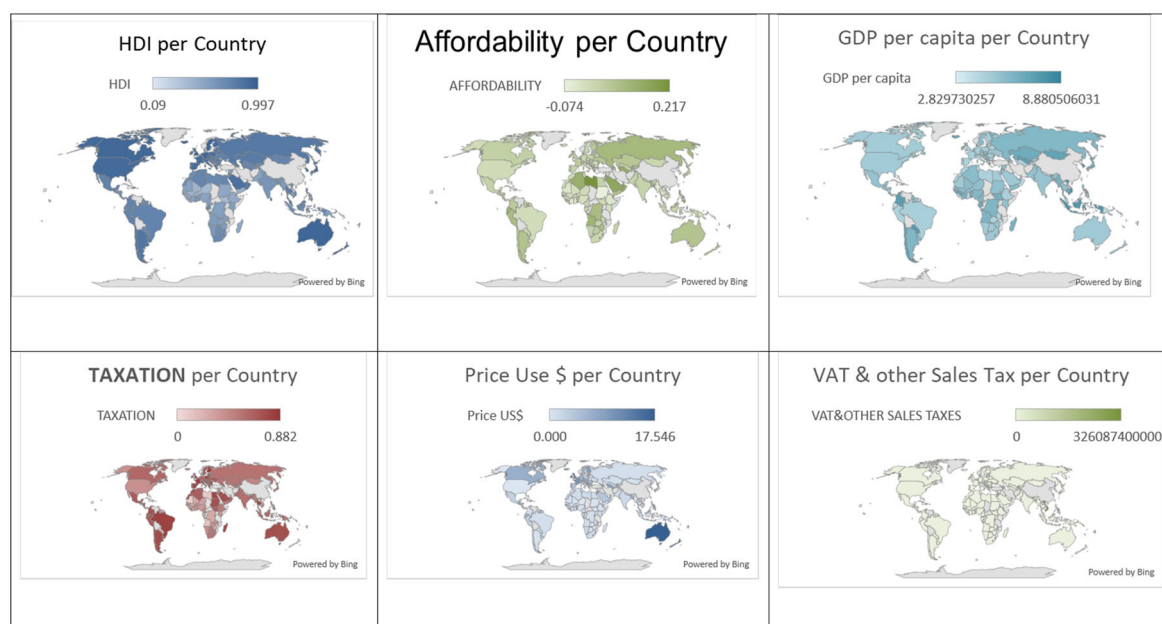
### Sample

This research was enriched by the priceless WHO, IMF and UNDP data for the year 2021-2022. These datasets included important parameters which are; GDP per capita, PriceUS, AFFORDABILITY, TAXATION type, and the HDI of 163 countries. *'We compiled the measurement methods utilised in each of the sources used to collect our data. These sources point to the more conventional measurement methods, which in this case we either use as they are, or employ in an innovative way, to promote rigour and accuracy within the work. Below Measurements are from these Sources: (IMF, 1999; United Nations Development Programme, 2020; World Bank 2021; World Health Organization, 2023)'*<sup>4</sup>. To avoid bias of judgment and achieve maximum objectivity, a set of criteria was been used to select these nations. A concern for this selection was to identify countries for inclusion that provided reliable and sufficient data on all of the aforementioned variables for the year 2021. This was done to ensure that only countries with the most logical, consistent and valid data were included in the subsequent procedure, so as to minimize bias in the results as much as possible. Further, the research followed a systematic procedure to eliminate those countries for which there was a lack of data or a complete absence of required data at least for any of the variables selected in advance to be investigated for correlation. The datasets provided by these reputable agencies committed themselves to international benchmarks and thus made the information with which this paper was working more standardized and credible. Following these stringent criteria, our objective was to reduce potential confounding factors arising from poor or patchy data, and to provide a sound analysis of the 163 nations under consideration.

Another element of our strategy was dealing with incomplete data. To avoid problems related to the use of missing data we applied the capability to perform imputations or; we omitted observations or entire countries from the analysis if the data for certain variables were missing or incomplete. The other datasets provided by WHO, IMF and UNDP had provided were harmonized using a harmonization technique. This was performed by harmonizing the variables from the different datasets collected, standardizing the data collected from different formats as well as different measurement units, and merging the material into a single database for the analysis. By employing this strategy, it was expected to come up with a well-coordinated framework where the relevant factors could be compared and correlated.

As in any study, we understand in this case that there is a temporal gap between the time when policies are implemented (for example price adjustments policy for tobacco) and the time when the effects of those policies are reflected in human development indices. In our case, one form of this, the lag effect, is a concern in our modelling method. Often, a cross-sectional correlation may not provide adequate detail if the movements are not conditioned on Tobacco price movements in the past. More specifically, it shows a positive form of temporal autocorrelation for tobacco prices for nations that previously sustained high tobacco prices. On this basis, with the selected set of variables, it is possible to trace the dynamic component of this connection, which is necessary to consider the time-series component in our study in order to reflect the quantitative characteristics of this relationship accurately. Regarding this issue, we improved our model by using the data from the latest available year for constructing countries' HDI, for instance, the year 2021, although they used the tobacco price data from the year 2020, so there is a time gap reflecting the real-life policy effect.

In conclusion, due to importance of data accuracy and credibility in this research, it is important to describe some of the data processing methods, challenges related to all types of data sources and how they can be addressed. In step I of data cleaning the removed duplicates, check the errors and format the unit of measurement from the different data set. Data missing was also determined; it is common for data to be missing and therefore, it was dealt with as is normally recommended. All variables were brought to the same scale through normalisation and any occasions where data were missing, especially in the low-income countries, were treated as such. When the values of the variables such as tobacco prices or HDI were the extreme, the data set was dealt with using the robust statistical analyses. Few differences in such data were countered by cross-checking them with other information and by weighting methods. If there were entries with the same values and the same features, they were excluded from the analysis and mistakes were addressed according to the range of data.



**Figure 1.** Data distributions per variables.

As indicated in Figure 1, there are significant differences between countries in indicators. Switzerland occupies the first place with an HDI equal to 0.962 being the highest classified as an advanced country and South Sudan with the lowest HDI of 0.385, indicating significant challenges. The taxation levels vary widely which are; Denmark has high taxes of 0.78, so their major source of government's income and Kuwait has the lowest taxes at 0.189. The price uses relative to GDP per capita affords a view of relative affordability and this ranges significantly; the highest being for Venezuela at 0.537 and the least for Malawi at 0.268. We can also see rather high values in the Price-Use indicator: Venezuela, having the maximal rate, equal 0.537, while Ukraine might have some distortion. The country with the highest GDP per capita is Luxembourg 5.053 while the country with the lowest GDP per capita is Burundi that has been experiencing some meagre economic indicators of 0.269. There is a variation in the values of VAT/ Other Sales Taxes, with Paraguay showing high values in this respect; the amounted collected from such taxes is important to government revenue while some countries record negligible values, meaning that taxation systems differ. In conclusion, this presentation of the above numerical contrasts underscores the complexity of the global relative prosperity gap and its development, because each country's factors, policies and the structure of the economy can significantly differ from the others, and therefore when comparing them, it is necessary to take into consideration the context and possible distortions.

## Modelling

We used SEM to analyse the complex interdependence of tobacco taxes, economic indices, and human development indices. By virtue of providing the estimation of multiple relations at once, accounting for latent factors as well as direct and indirect effects, while also handling measurement error SEM is suitable for this research. Four models are proposed: Model 1 stands for the direct effect of economic predictors on the HDI Model 2 focuses on the direct relationship between affordability and three economic predictors Model 3 describes how the health outcomes moderate the effects of tobacco taxes on the HDI Model 4 explains how all pathways interact with the direct and indirect role of tobacco taxes on HDI. The study hypothesizes that higher tobacco taxes, prices and GDP per capita has a positive relationship with HDI Affordability has a negative relationship with HDI. It also believes that higher prices and taxes reduce the purchasing capacity and that higher tobacco taxes boost the health status of the people in the respective country thereby increasing the HDI. The use of SEM in this study gives a clear picture of the extent of the effect of tobacco taxes on human development and therefore can come in handy to the policy makers and global health interventions.

The following presenting three regression models in order to analyse the affecting factors of the three major aspects of economic performance. In Model 1, the research focuses on the differences in GDP per capita using independent variables (IVs) such as PriceUS, AFFORDABILITY, TAXATION and VAT&OTHERSALESTAXES. The coefficients of quadratic terms of PriceUS and AFFORDABILITY indicate the possibility of some curvilinear relations, while the linear form is used for the relation with TAXATION, indicating a straightforward relationship. Based on Model 2, HDI is independently related to PriceUS and VAT&OTHERSALESTAXES. As PriceUS quadratic and VAT & OTHERSALESTAXES were added as Linear–Quadratic form indicates that the relations are non-linear. Model 3 uses PriceUS as an independent variable (IV) with its squared term and Affordability index as the dependent variable (DV) along with squared term of PriceUS (AFFORDABILITY), linear term of TAXATION and VAT & OTHERSALESTAXES as interactive quadratic term. These models provide nuanced insights about the complex relationships between the variables: GDP per capita, HDI and Affordability; linear and nonlinear; other than that, they control for the error terms ( $\epsilon$ ) which cannot being observed. In Models 4, HDI and GDP per capita were taken as dependent variables and PriceSU, TAXATION, and AFFORDABILITY were used as independents. AFFORDABILITY also moderates the relationship between TAXATION and HDI, and between TAXATION and GDP per capita.

$$\text{Model 1: GDP per capita} = \beta_1^* \text{PriceUS} * \text{PriceUS} + \beta_2^* \text{AFFORDABILITY} * \text{AFFORDABILITY} + \beta_3^* \text{TAXATION} * \text{TAXATION} + \beta_4^* \text{VAT\&OTHERSALESTAXES} * \text{VAT\&OTHERSALESTAXES} + \epsilon_1$$

$$\text{Model 2: HDI} = \beta_5^* \text{PriceUS} * \text{PriceUS} + \beta_6^* \text{VAT\&OTHERSALESTAXES} + \beta_7^* \text{VAT\&OTHERSALESTAXES} * \text{VAT\&OTHERSALESTAXES} + \epsilon_2$$

$$\text{Model 3: AFFORDABILITY} = \beta_8^* \text{PriceUS} * \text{PriceUS} + \beta_9^* \text{TAXATION} * \text{TAXATION} + \beta_{10}^* \text{VAT\&OTHERSALESTAXES} * \text{VAT\&OTHERSALESTAXES} + \epsilon_3$$

$$\text{Mode 4: HDI} = \beta_{11}^* \text{PriceSU} + \beta_{12}^* \text{TAXATION} + \beta_{13}^* \text{AFFORDABILITY} + \beta_{14}^* \text{TAXATION} * \text{AFFORDABILITY} + \epsilon_4$$

Where:

GDP per capita= 'The average economic output per person in a country'

AFFORDABILITY = 'affordability'

HDI= 'Human Development Index'

TAXATION= 'taxes'

PriceUS= 'A price in the United States dollar'

VAT&OTHERSALESTAXES = 'Taxes on goods and services, including VAT and other sales taxes'

## Analysis

Table 2 captures information on 163 countries on several variables. The HDI have a standard deviation of roughly 0.154 and an average value of about 0.720. HDI values span over a period from 0.090 at the lowest while at the highest it is 0.997 at the highest. Taxes stand in the range between minimum of 0 to the overall maximum of 0.882 cutting by an average of about 0.519 and standard deviation of approximately 0.237. With a mean of around 0.027 and a variability of about 0.049, affordability varies from – 0.0736 to 0.2167. They scored a total of between nil and 17.55 points, the average of the variable PriceUS is approximately, 2.676, with a standard deviation of approximately 2.951. GDP per capita, on average the approximation of which is about 5.175 approximately and the standard deviation not exceeding 1.063, ranges from 2.830 to 8.881. The mean value of the variable VAT and Other Sales Taxes is about 2.65e + 10 with deviations of approximately 2.61e + 11 on the average of fluctuation. This variable is an ordinal one and its scores may range from 0 to 3.26e + 12. Another important parameter is

**Table 2.** Descriptive summary.

Variable	Obs	Mean	Std. Dev	Min	Max
HDI	163	0.720	0.154	0.090	0.997
TAXATION	163	0.519	0.237	0.000	0.882
AFFORDABILITY	163	0.027	0.049	–0.074 <sup>5</sup>	0.217
PriceUS	163	2.676	2.951	0.000	17.55
GDPpercapita	163	5.175	1.063	2.830	8.881 <sup>6</sup>
VATOTHERSA ~ S	163	2.65e + 10	2.61e + 11	0.000	3.26e + 12

**Table 3.** Correlation.

	HDI	TAXATION	AFFORDABIL ~ Y	PriceUS	GDPpercapita	VATOTHERSA ~ S
HDI	1.000					
TAXATION	0.395	1.000				
AFFORDABIL ~ Y	0.168	−0.042	1.000			
PriceUS	0.561	0.311	0.118	1.000		
GDPpercapita	−0.077	−0.179	−0.097	−0.206	1.000	
VATOTHERSA ~ S	−0.015	−0.033	−0.130	−0.080	0.235	1.000

**Table 4.** VIF test results.

Variable	VIF	1/VIF
PriceUS	1.15	0.87
TAXATION	1.13	0.88
GDPpercapita	1.12	0.89
VATOTHERSA ~ S	1.07	0.93
AFFORDABIL ~ Y	1.04	0.96
Mean VIF	1.10	

thus calculated as  $3.26e + 12$  with a rather large standard deviation. These organized statistics include the average, variability, or standard deviation, and the scope or range of values within the dataset and help in further analysis of the data collected.

The correlation matrix given in the [Table 3](#) shows the inter-relationships of different indicators, which is information that will help to understand the dependences. In particular, a positive relationship is observed between the HDI and PriceUS. Also, there is a link between taxation and HDI, higher development index implies higher level of taxation. However, GDP per capita has negative coefficients with other elements suggesting that as one increases the other; namely, taxation and affordability, reduce. The relationship, therefore, between VATOTHERSA ~ S and the per capita GDP is positive but not very strong. In composite, the matrix shows complex relations between economic and development indices, thus calling for a sophisticated interpretation of these links. We also use Variance\_Inflation\_Factor (VIF) to support these findings and discover in other unreported results that the mean  $VIF = 1.10$  and the VIF at maximum is equal to 1.15 for PriceUS, meaning that level of collinearity between the independent does not exists, meaning every variable regressed contributes new information to the model. [Table 4](#) depict the results of VIF test.

The correlation between the variables including the GDP per capita, PriceUS, HDI, TAXATION, and affordability are depicted by the Structural Equation Model as indicated in [Figure 2](#). Since this modelling technique allows the assessment of main effects of the predictor factors on the response variable, interaction effects of the predictor factors, and the interaction effects between the predictor variables, the technique can test a large number of hypotheses at a single instance. The following is a possible formulation of the hypothesis for a structural equation model:

H1: TAXATION type has a direct effect on PriceUS, HDI, AFFORDABILITY, and GDP per capita.

H2: PriceUS has a direct effect on HDI, AFFORDABILITY, and GDP per capita.

H3: AFFORDABILITY has a direct effect on HDI and GDP per capita.

H4: AFFORDABILITY mediates the relationship between TAXATION types and PriceUS with HDI and GDP per capita.

## Results and discussions

Model 1 in [Table 5](#) is introduced as an empirical analysis of the determinants of HDI by using regression analysis whereby various IVs are used. For a better understanding of the extent, to which each predictor

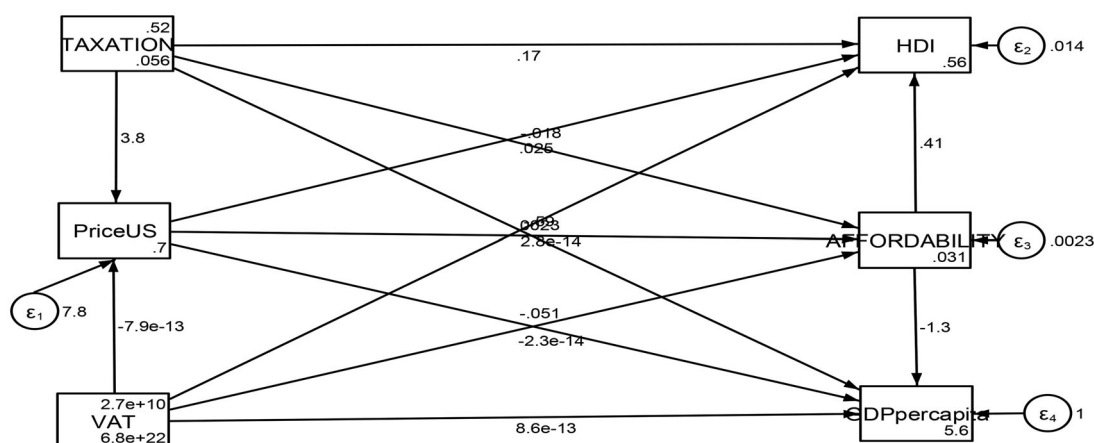


Figure 2. SEM estimation methods.

Table 5. Structural equation model (SEM\*\*) with regression paths between observed variables.

Models:	Model 1; DV= HDI				Model 2; DV= AFFORDABILITY			
	Coef	Std. Err	z	p > z	Coef	Std. Err	z	p > z
PriceUS	0.0245	0.0032	7.71	0.000***	0.0023	0.0011	2.07	0.039***
AFFORDABILITY	0.4072	0.1619	2.51	0.012***	—	—	—	—
TAXATION	0.1664	0.0402	4.14	0.000***	−0.0184	0.0186	−0.99	0.322
VAT&SALESTAXES	2.84e-14	5.91e-15	4.81	0.000***	−2.30e-14	2.09e-15	−10.96	0.000***
_cons	0.5562	0.0234	23.82	0.000***	0.0312	0.0107	2.93	0.003***

Models:	Model 3; DV= GDPpercapita				Model 4; DV= PriceUS \$			
	Coef	Std. Err	z	p > z	Coef	Std. Err	z	p > z
PriceUS	−0.0509	0.0212	−2.40	0.017***	—	—	—	—
AFFORDABILITY	−1.2583	1.8974	−0.66	0.507	—	—	—	—
TAXATION	−0.5866	0.3762	−1.56	0.119**	3.8451	1.2023	3.20	0.001***
VAT&SALESTAXES	8.64e-13	1.21e-13	7.11	0.000***	−7.91e-13	2.65e-13	−2.99	0.003***
_cons	5.6268	0.2284	24.63	0.000***	0.7003	0.6534	1.07	0.284*

\*sem (TAXATION -> PriceUS), (TAXATION -> HDI), (TAXATION -> AFFORDABILITY), (TAXATION -> GDPpercapita), (PriceUS -> HDI), (PriceUS -> AFFORDABILITY), (PriceUS -> GDPpercapita), (VATOTHERSALESTAXES -> PriceUS), (VATOTHERSALESTAXES -> HDI), (VATOTHERSALESTAXES -> AFFORDABILITY), (VATOTHERSALESTAXES -> GDPpercapita), (AFFORDABILITY -> HDI), (AFFORDABILITY -> GDPpercapita), vce(robust) nocapslatent.

\*\*The statistical package was used to implement the SEM estimation is STATA using the 'sem' command.

variable influences the HDI, the coefficients, standard errors, z-statistics and p-values related to each of predictors used in the regression analysis are discussed below. To be much more specific, PriceUS expected coefficient was 0.0245 and its standard error being 0.0032. This gives a z-statistic of 7.71 as well as p-value being very much significant (0.000). From this, it can be concluded that, the PriceUS is closely associated with a massive 0.0245 unit increase in the HDI. The considerable level of statistical significance of this finding further highlights the impact of economic factors embodied by the PriceUS having a significant and positive effect on the HDI. This functional research finding mirrors past research as depicted by (e.g. Alin & Marieta, 2011; Mirahmadizadeh et al., 2022; Paliova, McNown, & Nülle, 2019). In each of these studies a positive association was observed between PriceUS and HDI further suggesting that countries that had higher value of PriceUS also had higher value of HDI on average. Notably, these assessments occurred over different world areas enclosing different time intervals and utilizing a range of indexes to estimate the influence of economic factors for HDI. That is why the statistical significance of this effect observed in our analysis is important, indicating such factors as economic as the most significant in the positive change of the HDI in different countries and time periods.

The coefficient of affordability was 0.4072 and standard error of 0.1619, z-statistic of 2.51, and p-value of 0.012. This implies that there is a very close, positive relationship in between a one-unit change in AFFORDABILITY and a 0.4072-unit increase in HDI. The efficacy of the positioning of affordability presented in this study emphasizes that affordability is a key determinant of the results of human development. Likewise, for the variable, TAXATION the coefficient was estimated to be 0.1664, standard error of

0.0402, z-statistic of 4.14, and p value of 0.000. This result carries an implication that any one unit increase in the independent variable, that is TAXATION, leads to a substantial a net addition of 0.1664 to the HDI. Therefore, the research has a statistically significant relationship to underlining the importance of Taxation policies in promoting the welfare of the society. This is in consonant with previous scholarly studies that have always revealed a direct relationship between TAXATION and HDI and across various regions and time periods. The significance added to this conclusion forcefully points to the fact that affordability is very much an important determinant of human development outcomes, in complete support to the argument that taxation policies have a central role to contribute positive to the development agenda of society (Ibadin & Oluwatuyi, 2021; Vatavu, et al., 2019).

Another variable is the VAT&SALESTAXES variable which has a coefficient value of 2.84e-14, SE = 5.91e-15, z-statistic of 4.81, and p-value was 0.000 and the present a slight coefficient which could be indicative of little or no effect in practice. However, the result indicates that the overall relationship of VAT and other sales tax with HDI is significant and this calls for a further effect size analysis in order to undertake a context analysis. Consequently, and as consistent with previous empirical literature, it is possible to conclude that there exists a direct positive relationship between the variable TAXATION and the HDI across various regions and time intervals. Although the findings of the research are statistically significant, it is significant to ask what originates the confusingly minor coefficient of affordability in the calculation of HDI. Nevertheless, VAT and the other sales taxes do appear to play a discernible path in influencing this relationship. The results of the study call for more careful contextual interpretations in examining the effects of affordability on the HDI (Alin & Marieta, 2011; Paliova et al., 2019). Some of the reasons that may explain this observation is that while VAT and other sales taxes like income, education, and health taxes may have differential impacts, on the elements that constitutes HDI. For instance, VAT may lower the ability of the poor citizens to afford goods and services while, at the same time, may help to mobilise resources for extending public investment in education and health sectors to achieve higher qualitative results. But these taxes may work differently depending on the group of people in society; the poor, middle income earners, and the rich. Despite the fact that VAT has some tendency to be regressive, meaning that the rate of tax is higher than the overall income of the poor persons than the rich, the poor may benefit from exemption or rebates of certain necessities. Also, the impact of VAT and other sales tax could vary between the stages of development: from low HDI, through medium HDI, to high HDI countries. For instance, while the VAT may be viewed to affect a country's HDI negatively in low HDI nations with poor tax base and competency in collecting the tax, it can be perceived *inter alia* to have positive impacts in nations with higher HDI, superior tax base and collection competency or efficiency. All these considerations highlight the need for complex methodological and contextual approaches to understand the multifaceted synthesis of VAT and other sales taxes and human development indices.

In conclusion, the outcome in the Model 1 has helped to understanding the nexus between economic factors and the HDI. Among the independent variables, PriceUS, AFFORDABILITY, TAXATION, VAT&SALESTAXES, are statistically significant suggesting that the factors affecting human development indices are many-faceted. However, much care should be taken when drawing causal inference and there is a need for more research to unravel the ordinal temporal patterns of these empirical findings. This outcome goes in tandem with other related studies (e.g. Ali & Koplan, 2010; Fuchs et al., 2019; Whakeshum, 2020), that underlines the paramount important to view the topic from diverse angles and contexts to capture the essence of a rationale behind the interconnection between economic performance and human advancement.

In the regression analysis, the Model 2 in Table 5 was taken to assess the predictors explaining the dependent variable abbreviated as AFFORDABILITY. The suggestible independent variables include PriceUS, TAXATION, VAT & SALESTAXES. The coefficients attached to each variable indicate the probability of its effect on the log-odds of AFFORDABILITY, statistical significance tell about the reliability of these effects. The gender showed a positive coefficient of 0. The coefficient of the PriceUS varies from 0.0023 it means that changes in PriceUS enhance the log-odds of the outcome variable, which means that high costs may lead to a decrease in affordability. A z-value of 2.07 and p-value of 0.039 analysed by the correlation coefficients revealed that it has a statistically significant value at the pre-determined significance of 0.05. By contrast, TAXATION's coefficient is -0.0184, indicating a negative correlation with



the log-odds of AFFORDABILITY. A  $z$ -value of  $-0.99$  and a  $p$ -value of  $0.322$ , also shows as to why this association is not considered statistically significant. This means that in the spectrum of this evaluation, variations to the TAXATION do not affect affordability results. The most significant observation arises from the coefficient estimate for VAT & SALESTAXES of  $-2.30E-14$ , indicate the high significance level of the results obtained, additionally  $p$ -value is extremely low  $0$ . From this context, this combination informs a great extent of significance together with an insignificant coefficient. The negative sign suggests that our independent variable 'VAT & SALESTAXES' negatively affects log-odds of 'AFFORDABILITY'.

These findings enrich the knowledge, as to how one form of pricing and taxation mechanism affects affordability. The significance of all the coefficients also underlines that PriceUS and particularly VAT & SALESTAXES play crucial roles in determining the possibility of making the affordabilities shrink. However, the coefficient for TAXATION is not significant hence making it necessary to further analyse the complex relationship of taxation in this respect. Also, because of the very small difference in the coefficient of this variable, VAT & SALESTAXES, which was practically equal to  $0$ , the issue of the scale and 'practical' significance of calculated coefficients must be taken into consideration. This analysis not only contributes methodologically to regression modelling, but also serves as a reminder of the multifaceted nature of economic variables and the intricate interplay that determines affordability. Thus, future research could focus on studying the qualitative nature of these quantitative associations and offer more profound enrichment to the list of reasons that define affordability dynamics. The results established in Model 2 with special references to the role played by PriceUS, TAXATION and by extension VAT&SALESTAXES as precursors of AFFORDABILITY bear testimony to the fact that pricing dynamics, taxation factors and strides towards affordability are hooked on several interacting and exponentially evolving set of variables based on regions and time span. This goes to show that these economic factors are complex and can have differential effects on affordability results (Blecher, 2010; Bonnie & Lynch, 1994; Chaloupka et al., 2012; Guindon, Paraje, & Chaloupka, 2015; Van Walbeek & Blecher, 2008; World Health Organization, 2015).

In Table 5, the regression analysis which was labelled Model 3, with GDP per capita as the dependent variable, offers beneficial information in regard to the possible determinants of per capita GDP. The coefficients, stand errors,  $z$ -values and  $p$ -values of the independent variables including PriceUS, AFFORDABILITY, TAXATION and VAT&SALESTAXES explain the kind of effect they have on GDP per capita. In particular, the negative sign of PriceUS ( $-0.0509$ ) denotes an inverse relationship between the level of per capita GDP and the price level for goods. That this correlation holds to a statistical significant degree is indicated by the fact that the  $z$ -value is  $-2.40$  and  $p$ -value is  $0.017$ , emphasizing the importance of PriceUS as a predictor of economic performance (Lee et al., 2022; Ulku, 2004).

Turning to AFFORDABILITY, its coefficient of  $-1.2583$  suggests a negative influence on GDP per capita although this can is not statistically significant ( $z = -0.66$ ,  $p = 0.507$ ). In other words, within the confines of this study, changes in affordability as captured by the AFFORDABILITY variable did not affect per capita GDP. For TAXATION, a coefficient of  $-0.5866$  reveals negative relationship with GDP per capita implying that with high taxation it is equivalent to a decrease in the per capita GDP. However, significance of this finding did not attain  $p$ -value of  $0.05$  testing level that is commonly accepted as the measure of statistical significance, evident in a  $z$ -value of  $-1.56$  and a  $p$ -value of  $0.119$ . Others, such as Furceri and Karras (2008) who employed panel data to analyse the effects of tax increase on economic growth in 26 OECD countries within 1995 and 2009 are in agreement with this. In terms of income taxes, the results revealed that this type of tax had a positive but small effect on the GDP per capita, while a negative and relatively large impact was noted in respect of sales taxes and VAT. Hence, it is essential to exercise some measure of prudence in giving much credit to TAXATION in explaining the variance in the results seen in this particular model. The most striking result comes from VAT&SALESTAXES, featuring a coefficient of  $8.64E-13$ , minute standard error, notable  $z$ -value of  $7.11$ , and  $p$ -value of  $0.00$ . This is in agreement with Balasoiu, Chifu, and Oancea (2023) study concerning the impact of direct tax on economic growth in the EU countries employed panel data regression analysis. The paper also found out that large levels of direct taxes could deter economic growth because of the disincentive effects it has on work, abstinence, and accumulation. This goes a long way to buttress the fact that VAT & SALESTAXES has a very strong positive relationship with GDP per capita. The exceptionally small coefficient implies that even a marginal increase in VAT & SALESTAXES correlates with a substantial upswing in per capita GDP.

These findings provide more elaborate views to the discussion of economic factors. The variable 'PriceUS' captures an important aspect of the requisites connected with GDP per capita; this requires understanding the connection between price levels in the global economies. The coefficient estimate for AFFORDABILITY is statistically insignificant and thus requires a closer examination of the relationship between affordability proxies and measure of economic performance. The similarity of the estimate value of the coefficient of determination and zero for the results of regression analysis for the variable TAXATION means that there is ambiguity or uncertainty concerning the kind of effect that taxation has on per capita GDP within the framework of this model. On the other hand, the strongly significant result of VAT & SALESTAXES means that tax policies could play a major role in the economic process. Thus, in the present work, further understanding of the nature of factors influencing per capita GDP is achieved, and the evaluation of the directions and degree of the impact of pricing, affordability, and taxation on performance is improved. The subsequent research studies directions have to be wider and develop the detailed account describing how what is understood as taxation policy, with the specific reference to VAT & SALESTAXES, contributes to economic well-being for each individual.

The analysis of the determinants of the unit price of goods is done in Model 4 using regression analysis with PriceUS as the dependent variable as shown in Table 5. TAXATION has a positive coefficient of 3.8451 implying that the higher the degree of taxation the higher the unit price of goods in the market. Generally, the detected z-value is quite a large value and equate to 3.20 for the overall model and a  $p < 0.001$  show that this link is statistically significant. On the other hand, the VAT&SALESTAXES, have a negative coefficient that is  $-7.91\text{E-}13$  and have a z-value of  $-2.99$  and a ' $p$ ' value is 0.003, thus, also signifying that it is also statistically significant. This has the implication that as VAT & SALESTAXES increase, then PriceUS must decrease, making it supposed negative relationship as highlighted by a number of authors (Benedek, De Mooij, & Wingender, 2015; Feldstein, 1980; Gurdal, Aydin, & Inal, 2021; Hammour & McKeown, 2022; Li & Liu, 2021; Mgammal, 2021; Mgammal, Al-Matari, & Alruwaili, 2023).

Thus, these findings extend understanding of how variables associated with taxation influences the nature of product prices. The fact that TAXATION increases the PriceUS is evidence that taxation policies influence unit prices with a view of impacting consumers and the forces of the market. On the other hand, the negative correlation between VAT&SALESTAXES and PriceUS solidify the fact that the higher representatives of sales taxes imply lower prices per unit, which implies a complex relationship between the taxes and pricing strategies. Therefore, the implications of these findings suggest that policymakers and researchers should understand that taxation works in a complex relation with consumer prices. Moreover, a study of the channels through which VAT&SALESTAXES are implemented on unit prices might give further understanding of the nature of pricing relative to tax measures. In conclusion, this analysis adds to the body of knowledge that points to tax related variables as significant determinants of unit prices of goods while pointing to the possible effects or otherwise of taxes on the unit price of goods for consumption. For further studies, there is an opportunity to investigate the mediation links that show how taxation affects the prices and design policies for economic and consumer welfare gains.

Four regression models are provided in this paper, which cover all possible connections and dependencies between economic factors and their indices, including HDI and per capita GDP. Apparently, the findings of Model 1 reveal that both; PriceUS and Affordability have positive influence on HDI while Taxation also has a strong effect. Nevertheless, the fact that VAT & SALESTAXES while being statistically significant is not very large in terms of its coefficient causes some doubt of practical significance. In Model 2, price is made the focal point, and PriceUS is seen to be significantly related to VAT&SALESTAXES on the log odds of affordability. Two out of the five factors were tested; taxation was found negatively related with affordability but failed to reach the level of significance. Model 3 testing the effects of per capita GDP indicated that PriceUS has an anti-relationship with GDP per capita while Affordability and Taxation have no significant effect. VAT & SALESTAXES became one of the most influential factors with a positive coefficient of determination. As in the previous models, in Model 4 the equation focuses on the impact of taxation on unit prices with the positive sign and its symmetric relation with the variable VAT&SALESTAXES.

The patterns with regard to the dynamics and overlap of the factors under study significantly differed in the models compared. For instance, while the coefficients of PriceUS are always significant, its effect varies for all models; it has a positive effect on the HDI, while a negative effect on the GDP per capita.

**Table 6.** Linear regression.

Models:	Model 1; DV = HDI				Model 2; DV = AFFORDABILITY			
	Coefficient	Standard Error	t-statistic	p-value	Coefficient	Standard Error	t-statistic	p-value
PriceUS	0.03	0.00	7.60	0.000***	0.00	0.00	2.05	0.042**
AFFORDABILITY	0.17	0.04	4.39	0.000***	—	—	—	—
TAXATION	0.42	0.16	2.63	0.001***	−0.02	0.02	−0.98	0.328
VAT&SALESTAXES	0.00	0.00	1.79	0.008***	0.00	0.00	−10.86	0.000***
_cons	0.49	0.05	10.04	0.000***	0.03	0.01	2.90	0.004***

Models:	Model 3; DV = GDPpercapita				Model 4; DV = PriceUS \$			
	Coefficient	Standard Error	t-statistic	p-value	Coefficient	Standard Error	t-statistic	p-value
PriceUS	−0.05	0.02	−2.37	0.019**	—	—	—	—
AFFORDABILITY	−1.26	1.92	−0.65	0.513	—	—	—	—
TAXATION	−0.59	0.38	−1.54	0.126*	3.85	1.21	3.18	0.002***
VAT&SALESTAXES	0.00	0.00	7.02	0.000***	0.00	0.00	−2.97	0.003***
_cons	5.63	0.23	24.33	0.000***	0.70	0.66	1.07	0.288

While affordability is a factor that has a coefficient of significance in Model 1, it has a coefficient of no significance when testing the model for the scenario that arises when per capita GDP is given in Model 3. The importance of taxation differs, that is, it has varying influence on the HDI and PriceUS; however, it has no impacts on GDP per capita. VAT & SALESTAXES always maintains its efficiency and, at the same time, remains questionable when examining the practical applicability, for instance in HDI and PriceUS, given the extremely low coefficient obtained. Such differences only underscore the fact that economic relations are complex and that the impact of the variables depends on the environment. The work done, therefore, points to the need for methodological reflexivity and supported caution with regard to generalisation. Moreover, they raise the question concerning the consequences of a particular tax policy for selected macroeconomic parameters. Subsequent studies should employ methods that analyse the qualitative aspects of these relationships further to explore the detailed quantitative characteristics of the complex processes governing the economic growth.

### Further analysis

In this section, we now concern about the robustness of the results and extend the analysis to incorporate several forms of regression models. Of these, we use strong methods like linear regression and we run tests for endogeneity. Table 6 below shows the results of a linear regression test conducted on the data collected for the purpose of this study. Therefore, the valuation of consistency depends on the following: First, and most important, the signs of the coefficients should correspond across dependent variables: the signs of coefficients for a given pair of variables must be the same. Although signs of coefficients for some of the variables such as the PriceUS are different in terms of their signs, evidence of influences demonstrates considerable similarity. Secondly, values in *p* or significance level should be close, equal to one another for the same variables and the given models. Despite insignificance levels might be varying slightly depending on models and variables, the configurations of patterns of significance are moderately similar between the main and supplementary analyses. Thirdly, effects, that are estimated as coefficients, should be of the same size in both tables for the same variables and same models. A comparison of these coefficients, side by side, would help in a comparison of the patterns in the magnitude of effects of the models and variables. With some differences, the results seem to be reasonably similar, both in terms of statistical significance and the overall pattern of effects. More importantly, these observations are congruent with the result detected in our chief set of regression equations.

### Conclusion

In this study, a comprehensive review of the interrelations between tobacco taxation, the HDI and per capita GDP has been carried out. Thus, this study underlines the best areas of tobacco taxation

strategies as powerful policies with the two-fold effects on the sphere of health and economic growth. Thus, these findings support the concept that tobacco taxes when used strategically in the right manner, will help in reduce the prevalence of smoking among the population, enhance public health and at the same time act as a major source of revenue. To show that an increase in tobacco taxes corresponds to the increased HDI, this paper emphasizes the role of economic factors in affecting social welfare. The exploration of pricing mechanisms, taxation, and affordability elucidates the intricate dynamics that influence economic outcomes. There was a general significance for PriceUS, while the effects ranged across models, indicating the complex reality of economic relations. These three factors, namely, affordability, taxation and VAT&SALESTAXES, have thus become core determinant elements and driving forces that shape human development and per-capita GDP, with their effects contingent on specific focuses and contexts. This article rightly focuses on the need to be very careful when making causal relationships and underlines the importance of ensuring that one is sensitive enough to try and understand the various factors that determine economic variables. Future research should look at the nature of these relationships quantitatively and identify more details of the qualitative dimensions involved in determining the economic and public health consequences of tobacco taxation. In essence, this study helps to expand the existing body of knowledge regarding global development and public health by undermining the complex relationship between economic policies and health indices and the well-being of society.

This study's ramifications transcend the precise associations inspected, echoing broader conversations at the crossroads between economic-policies, public-health, and societal-advancement. Policymakers, researchers, and global health organizations can employ these insights to figure evidence-based strategies that contribute to achieving developmental objectives, improving public health, and nurturing economic well-being on a universal scale. This correlation indicates a positive association between augmented tobacco taxes and higher levels of HDI and per-capita GDP, suggesting the possible for economic development and revenue generation through the implementation of effective taxation policies on tobacco. Policymakers can leverage this insight into craft strategies to strike a balance between fostering economic growth and addressing public health concerns.

In this research, several limitations are acknowledged that should be considered when analysing the findings. Making conclusion on causality and directionality of the relationships identified is a concern that makes the authors call for future studies that incorporate cross-sectional studies with the next level of research designs that include longitudinal designs or even experimental studies. This work also highlights the importance of careful contextual analysis regarding the possibility of the different effects of the tobacco taxation globally, between the developed and the developing countries and possibly between different population groups. Implications of other research variables, such as cultural, social or political, may interfere with the measured relations; hence, this study encourages follow-up research that considers these variables. It is also points out that even those coefficients, which are statistically significant are often marginally relevant, exceeding their significance level but conforming to a practical significance level. Finally, we acknowledge that the study is limited in generalizing to other geographical locations or on other subgroups and do recommend that in the future more detailed data from specific locations should be focused on for a better understanding of the kind of applicability of the different variables involved.

As can be seen, there still exists rooms for further investigation on the linkages between tobacco taxation, public health and economic development, by using the following approaches. First, it would be possible to conduct longitudinal studies that would show how sustained effects of changes in the taxation of tobacco products affect the rates of smoking and indicators of the economic state. Additionally, performing qualitative research approaches could enhance the comprehensiveness of the results by focusing on the manners and perceptions of people and societies. A comparison of the results obtained in the countries with different taxation systems and cultural perspectives could offer a more profound understanding of the comparative effectiveness of the introduced strategies and different approaches. Understanding how taxes affect certain categories of people, such as the low-income demographics could help to correct them. Dynamic economic models, which consider evolving economic factors, would present a more realistic depiction of the long-term impacts. More research on particular taxation

policies and the development of cross-national cooperation with more countries could extend the practice-based knowledge of empirical research for large-scale policy-making.

## Notes

1. Gross Domestic Product (GDP).
2. high-income countries.
3. low/middle-income countries.
4. **GDP per capita:** 'IMF: Uses nominal and PPP-adjusted GDP divided by population.'  
**PriceUS:** 'WHO: Uses price indices for health cost analysis.'  
**AFFORDABILITY:** 'WHO: Focuses on healthcare costs and out-of-pocket expenses.'  
**TAXATION:** 'WHO: Studies health-related taxes (e.g., tobacco).'  
**HDI (Human Development Index):** 'UNDP: Calculates using life expectancy, education, and income (PPP).'
5. Gan and Hill (2009) pointed that the affordability measures can capture income decline faster than cost increase. Therefore, negative values mean the increased, income predominant course with time.
6. In logarithmic terms (Alvaredo, et al., 2017).

## Ethics approval and consent to participate

The author certifies that he has no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

## Consent for publication\*

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## Data availability statement

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.



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