

# TAXATION IN THE DIGITAL AGE: AN EXAMINATION OF THE NECESSITY, FEASIBILITY, AND IMPLICATIONS OF TAXING VIRTUAL INFRASTRUCTURES

## Abstract

*This research paper explores the feasibility, methods, and implications of taxing virtual infrastructures within the evolving digital landscape and economy; considering the proliferation of digital assets, online transactions, and virtual entities, the taxation of virtual infrastructures becomes imminent as an avenue for government to accumulate revenue for effective government administration. The paper examined the objectives of the study through primary data collected from 320 tax professionals and 297 IT experts to explore the impact of virtual infrastructure taxation on government revenues, the feasibility of taxation models, its effects on innovation and investment in the digital sector, and the challenges of cross-border tax strategies. Findings show that although taxation of virtual infrastructures significantly enhances government revenues, contributing to fiscal sustainability and the funding of public services and infrastructure projects, measures must be put in place to cushion the effect of such taxation on investment and innovation in the digital economy, as the taxation of virtual infrastructures were found to hamper investment and innovation significantly. Also, the implementation of modified traditional and emerging taxation models is shown to increase the feasibility of taxing virtual infrastructures, offering opportunities to enhance government revenues while fostering digital innovation. Data analysis, including Pearson correlation and linear regression methods, was employed to assess the relationships between the variables. Moreover, cross-border tax strategies are found to have negative implications for the taxation of virtual infrastructures, including profit shifting, transfer pricing, and competition among countries to attract digital firms. International cooperation and comprehensive tax reforms are suggested to address these challenges and ensure equitable tax contributions. The study underscores the significance of global collaboration in addressing cross-border taxation challenges and recommends the integration of modern tools and technologies to streamline tax processes while developing modified tax methodologies and policies that suit the digital economy.*

**Keywords:** *Keywords: Virtual infrastructures, Taxation, Digital economy, Government revenue, Taxation models, Cross-border tax strategies, Innovation, Investment, Tax policy, Emerging taxation models, Digital assets*

## INTRODUCTION

The widespread adoption of digitalization has largely reshaped the operating principles of the modern business landscape. By incorporating cutting-edge tools and technologies, companies are abundantly equipped to ensure improved efficiency, agility, and customer experience while promoting company growth and innovation [1]. Correspondingly, the proliferation of virtual infrastructures further epitomizes the tremendous advancements of businesses in the digital age. Virtual infrastructures, such as cloud computing systems and virtual servers, act as software-based components that visualize and optimize the functions of physical infrastructures. These virtual

infrastructures have created opportunities for greater flexibility, scalability, cost efficiency, and organizational resiliency, expanding their usage across various industries [2], [3].

However, as virtual infrastructures form an integral part of the global economy, their intangibility continues to pose many challenges to governments, policymakers, and the digital economy. In a recent study, Agrawal and [4], aver that most online businesses do not utilize traditional business models, thereby minimizing their contribution to public revenue. This reduction in governmental income adversely impacts tax revenue performance and the standards of public services.

In their study, Shestak et al. [5], underscore the lack of competitive fairness among virtual and traditional industries owing to the large margin in taxation. Traditional infrastructures have been broadly reported to incur bigger tax liabilities than their counterparts due to the presence of a physical residence and ease of regulation. The applicability of existing taxation models also presents a prevalent challenge pertinent to several virtual infrastructures. The feasibility of digital taxation is negatively impacted by online businesses' rapidly evolving business models [6]. As such, enacting tax laws and regulations constitutes a large expenditure and time from the government, posing difficulty in tax administration. Similarly, the jurisdictional issues emanating from the absence of physical locations weaken the traditional taxation strategies governments employ. The jurisdictional obscurity further enables corporate tax avoidance through base erosion and profit shifting [7].

Numerous researchers have also found the digital economy's taxation burdened by the absence of international consensus among governments [8], [9], [10]. The debate on multinational taxation has unveiled the prioritization of unilateralism. This one-sided decision-making system has led to double taxation-incurred from cross-border transactions policies or treaties with high compliance costs- and withholding taxes- which are dependent on insufficient digital policies adapted for consumption or income taxes [11]. It thus becomes paramount to explore the feasibility and implications of taxing virtual infrastructures as this would consolidate the relevance of digital taxation and address the challenges posed by existing and emerging digital taxation models.

### **Problem statement**

The taxation of virtual infrastructures has been a long-established problem since the emergence of these revolutionary technologies. However, the accelerated digital economy's accelerated expansion necessitates a more strategic and adaptable taxation system than ever before. Majorly, tax bodies, and policymakers struggle to ensure a fair and effective taxation system that diminishes tax avoidance and bolsters corporate competitiveness.

The decentralized and virtual-based nature of digital assets, marketplaces, and services, Olaniyi et al. [12], makes it increasingly difficult for tax authorities to identify value-creation jurisdiction. The ambiguous tax collection process usually results in a loss of public revenue, reducing economic growth and creating disparities between the tax liabilities of traditional and virtual operations.

Furthermore, an additional problem is presented with the scarcity of empirical research targeting the direct effects of different tax policies on innovation, investment, and economic growth.

These challenges strengthen the need to demystify the complexity surrounding the taxation of virtual infrastructures. They necessitate the critical evaluation of existing digital taxation approaches and the drawbacks of implementing traditional taxation models. Moreover, they portray the need to assess the potential implications of taxing virtual infrastructures concerning the global digital sector.

### **Research aim**

This paper aims to offer a comprehensive overview of the relevance of taxation for virtual infrastructures while exploring the feasibility of taxation systems and the subsequent implications of implementing taxation on these digital assets.

### **Research objectives**

1. To examine the economic factors that determine the relevance of taxing virtual infrastructures in the evolving digital economy
2. To evaluate the taxation models and approaches applicable to virtual infrastructures, considering the benefits and drawbacks peculiar to each model.
3. To investigate the potential implications of the taxation of virtual infrastructures for governments and the broader digital ecosystem regarding the impacts on innovation, investment, and competitiveness.
4. To provide evidence-based recommendations for enhancing pre-existing digital taxation frameworks.

### **Research Hypotheses**

1. Taxation of virtual infrastructures significantly increases government revenues, investment, and innovation sustainability.
2. Modified traditional and emerging taxation models increase the feasibility of taxation for virtual infrastructures.
3. Taxing virtual infrastructures positively affects innovation and investment in the digital sector.
4. Current cross-border tax strategies negatively impact the taxation of virtual infrastructures.

## **LITERATURE REVIEW**

### **2. Conceptual Framework:**

#### **Virtual Infrastructures**

As Smith and Johnson [13], explained virtual infrastructures denote intangible digital resources and services that underpin contemporary business operations and technology. These infrastructures are much like the various parts that come together in a smartphone - the memory, the secure connections, the operating system, and the means to stay connected through various communication networks [14], [15]. These digital building blocks form the backbone of the global interconnectedness we enjoy today, driving our modern economy and powering the functions of various digital platforms [16]. Recognizing these infrastructures' intangible and borderless nature is essential, as they are crucial in digital taxation's intricate challenges and complexities.

#### **Taxation**

Taxation is a fundamental fiscal process through which governments generate revenue to fund public services and infrastructure [17]. According to Peter and Smith [18], the

traditional tax system comprises several essential types, each with its role including income tax (which takes a portion of what individuals earn), sales tax (which adds to the cost of goods and services when they are bought); value-added tax (VAT) (which is a tax applied at different stages of making and selling products); and corporate tax (which is about assessing the profits of businesses). This mix of taxes keeps the financial gears of society turning. These tax categories intersect with virtual infrastructures, as they are instrumental in the digital economy, posing unique challenges and opportunities in digital taxation.

### **Digital Economy**

In a recent study by Johnson and Smith [19], the digital economy encompasses economic activities primarily driven by digital technologies and the internet. It's a dynamic landscape where transactions, data, and services are exchanged, enabled, and transformed in digital formats [20]. This modification involves various parts, including electronic commerce, on-demand computing, online marketing, and the development of online platforms.

According to a recent report by Green [21], the importance of the digital economy is rapidly growing. It promotes innovation smooth processes, and connects a universal network of businesses and consumers. As societies increasingly depend on digital platforms for commerce, communication, and entertainment, the digital economy has become an important pilot of economic growth, Olagbaju et al. [22], creating jobs and advancing technologies, shaping the landscape of contemporary business and daily life [23].

### **Taxation in the Digital Age**

Taxation in the digital age necessitates a fundamental overhaul of conventional tax systems. Interestingly, Jung [24], avers that the rise of online commerce, digital goods, and remote work has obscured geographical boundaries, making it challenging for tax authorities to record revenue accurately. Therefore, as economic transactions increasingly occur online, businesses can exploit loopholes to minimize tax liabilities [25]. Governments worldwide are grappling with reforming tax codes, addressing cross-border taxation issues, and ensuring that multinational tech giants pay their fair share [26]. This transformation is essential to secure stable revenue streams in an era defined by virtual commerce and decentralized business operations.

### **Tax Models and Approaches**

Taxation encompasses various models and approaches, reflecting both traditional and emerging methods that adapt to the evolving landscape of the digital economy [27]. Traditional models comprise income tax, imposed on individuals and corporations based on earnings, and consumption tax, collected on goods and services at purchase. In response to the digital age, new tax models have become apparent. Digital services taxes focused on revenues created by tech giants from online services and advertising [28]. Destination-based taxes shift the focus from the source of income to the consumer's location, which is especially crucial for electronic commerce. These models aim to ensure that universal corporations, often with a significant online presence, pay taxes in the jurisdictions where they have consumers [29].

The evolving tax landscape is complex and often requires international cooperation to prevent double taxation and address tax evasion. As the digital economy shapes global

commerce, tax models and approaches will need ongoing adaptation and refinement to remain effective and equitable [30].

### **Cross-Border Taxation**

Cross-border taxation in the digital economy presents unique challenges for governments worldwide. One major issue is the difficulty of determining where the economic activities of multinational corporations occur. This ambiguity can lead to base erosion and profit shifting (BEPS), where companies exploit loopholes to shift profits to low-tax jurisdictions, reducing their overall tax burden [31]. This procedure deprives countries of tax revenue, making it a dire concern for tax authorities.

Double taxation is another issue when an entity is liable to pay tax on the same income in more than one geographic location. In the digital age, where businesses can have a global customer base, resolving double taxation becomes complex. Bilateral tax treaties and international cooperation are essential to address this issue, ensuring that income is not unfairly taxed in multiple jurisdictions [32]. Efforts to reform international tax frameworks and address these challenges are ongoing to establish fair and effective cross-border taxation in the digital era [33].

### **Virtual Assets**

Virtual assets encompass various digital or intangible items that hold intrinsic value. These include cryptocurrencies like Bitcoin, digital tokens issued in blockchain ecosystems, and even virtual property within online games and virtual worlds [34], [35]. These assets have gained eminence due to their role as digital mediums of exchange, storage of values, or representations of ownership in the digital realm. As technology advances, understanding the nature and management of virtual assets becomes increasingly crucial in the financial and digital landscape, shaping how we interact with and perceive value in the virtual world [36].

### **Policy Implications**

Taxation policies have far-reaching implications for economic growth, innovation, and global competitiveness [37]. Governments can stimulate economic growth by implementing tax policies encouraging investment and entrepreneurship [38]. Lower corporate tax rates, for instance, can attract foreign investments and foster innovation, as businesses have more resources to allocate to research and development [39]. Moreover, in the digital economy, taxation policies must adapt to the evolving landscape [40]. Taxation can influence the behavior of digital businesses and individuals, impacting how they operate and innovate [41]. Policymakers must balance generating revenue and creating an environment that fosters competitiveness [42]. Policy changes should consider the unique challenges of the digital economy, such as cross-border transactions and digital platforms [43]. Carefully crafted taxation policies can be a powerful tool in shaping the economic landscape and promoting innovation in the digital era.

### **Economic and Regulatory Dynamics**

The digital economy has ushered in profound economic and regulatory dynamics that challenge traditional tax collection and enforcement practices [44]. In this context, the rise of electronic commerce, remote work, and digital services obscure geographic boundaries, making it difficult for tax authorities to identify taxable entities and revenue streams [45]. Furthermore, the digital economy often operates 24/7, necessitating real-time tax assessment systems and innovative regulatory approaches [46].

Additionally, using cryptocurrencies and blockchain technologies for financial transactions introduces anonymity and challenges traditional financial oversight mechanisms. Regulators must adapt to monitor and tax these emerging forms of value [47].

Moreover, multinational digital corporations can employ intricate strategies to minimize tax liabilities by shifting profits between jurisdictions. This necessitates global cooperation to establish equitable tax frameworks [48]. In summary, the dynamics of the digital economy call for dexterous and collaborative regulatory approaches to ensure fair and effective tax collection while fostering innovation and economic growth [49].

### **International Collaboration**

International collaboration and agreements play an important role in tackling cross-border tax challenges, particularly in the context of the digital economy [50]. Given the borderless nature of digital transactions and the ability of multinational corporations to operate in multiple jurisdictions simultaneously, unilateral tax measures are often ineffective.

International cooperation enables the development of consistent tax rules and standards, preventing tax evasion and ensuring that revenue is fairly distributed among countries. Initiatives like the Base Erosion and Profit Shifting (BEPS) project by the OECD and the G20 help address these issues by creating guidelines for taxation in a globalized world [51]. Collaboration fosters transparency, reduces tax avoidance, and enhances tax compliance, benefiting governments and taxpayers globally.

### **Innovation and Investment**

The influence of taxation on innovation and investment within the digital sector is a matter of significant economic and policy interest. Taxation represents a dual-edged sword, capable of contributing to government revenue and inadvertently retarding critical growth and creativity inherent to this industry [52]. Corporate taxation, for example, holds the potential to discourage firms from allocating resources to research and development (R&D) initiatives, a fundamental driver of digital innovation. Elevated corporate tax rates may serve as disincentives for innovation, potentially impeding product evolution and global competitiveness [53].

The digital sector has unique international operation characteristics that necessitate nuanced tax considerations. The intricate web of international tax regulations can inadvertently deter cross-border investments, a factor complicating the growth of the digital economy [54]. This complexity demands tax frameworks that readily adapt to the industry's rapid evolution. The impact of taxation on innovation and investment in the digital sector is intricate. Policymakers are tasked with crafting taxation systems that serve as revenue sources and critically stimulate an environment conducive to technological advancement [55]. Implementing judicious tax incentives and policies is paramount to preventing taxation from becoming an inadvertent impediment to the creative and innovative forces that propel this industry forward.

## **4. Taxation in the Digital Economy**

According to Zhou et al. [56], the approach to tax management has been profoundly transformed with the introduction of digitalization. In the pre-digitization era, taxation simplifies tax registration, improves data accuracy, and reduces tax evasion [57]. However, the proliferation of telecommuting and cross-border e-commerce has eroded

conventional tax jurisdiction boundaries, thereby introducing complexities in allocating tax obligations. Considering this, a universal minimum corporation tax rate and the BEPS initiative of the Organisation for Economic Cooperation and Development (OECD) are two instances of the international cooperation required to revise tax legislation. Moreover, a major concern is the taxes of GAF A firms such as Google, Amazon, Facebook, and Apple.

Interestingly, BEPS (base erosion and profit shifting) is an increasingly worrisome issue stemming from multinational corporations employing complex international structures to minimize their tax liabilities [58]. For example, corporations operating in the GAF A sector have faced criticism for purportedly reducing their global tax liability by transferring profits to tax havens. In addition, Gurău and Ranchhod [59], find that the contract economy, exemplified by platforms like Airbnb and Uber, has blurred the distinctions between different taxing authorities. Beretta [60], argues that determining an individual's tax responsibilities when generating income through remote labor or freelance work across international borders can present a challenge. Quite on the contrary, Durana et al. [61], contend that technology has enhanced tax collection by enabling real-time reporting and reducing error rates; thus, tax authorities can identify inconsistencies and potential tax evasion by cross-referencing information from various sources using data analytics. In agreement, Rajbhandari [62], posits that electronic payment methods, such as credit card transactions and online payment platforms, generate digital footprints that can be scrutinized by tax authorities to verify the accuracy of income statements. However, several studies still maintain that the advent of the digital economy has presented tax collection and compliance with many prospects and challenges [63], [64], [65].

## **5. Taxation Models and Approaches**

In the setting of the digital economy, one form of taxation that has recently been implemented is the Digital Services Tax [66]. These taxes apply to a company's turnover in a market with a substantial digital presence but a limited physical presence. Interestingly, businesses with revenues exceeding €25 million in France and €750 million globally are subjected to a 3% DST [67]. One advantage is that established firms can contend with tech titans on an equal playing field. However, it is plausible that the United States and the other nations that have adopted DST present cases for arguments and criticism considering the demonstrated limited application, the potential for double taxation, and the possibility of trade disputes [68], [69]. These approaches center on the intricacy of taxation of the digital economy accurately and equitably [70]. Furthermore, apart from the issues of double taxation and trade disputes, the imperative for global collaboration constitutes another significant bottleneck in adapting and implementing the DST to the evolving economic terrain [71].

Another taxation model is the Pillar OECD's BEPS 2.0 Project, which is for constructing a structure for delegating specific taxing authority to national markets. However, this model is challenging to implement because nations must agree on allocating profits [72]. Considering this, the model can potentially give rise to disputes regarding the allocation of funds and may require greater effort from multinational corporations to maintain adherence [73]. To buttress this point, Ting and Gray [74], opine that this method aims to levy taxes on the countries where its users and consumers are a

percentage of multinational corporations' digitalized profits. Sadiq [75], proposes that a global minimal rate for corporate taxes is necessary in response to concerns regarding base erosion and profit shifting (BEPS). However, to reduce the incentive for multinational corporations to relocate profits to low-tax regions, studies propose establishing a benchmark rate for taxes paid [76], [77], [78]. Popescu [79], states that a global minimal corporate tax, which fosters tax equity and sustainability, has the potential to mitigate profit shifting and base erosion. Nevertheless, it could face resistance from nations with advantageous tax policies and discourage investment in states with low tax rates [80].

Furthermore, the Digital Services Tax has garnered significant support from the United States, as evidenced by the G7 countries' consensus on a 15% minimal corporate tax rate [81]. Mariani and Wamba [82], suggest that, in light of the significance of data in the contemporary economy, companies should be charged a fee for the quantity of consumer information they collect. On that note, combining these approaches and enhancing global cooperation can achieve a more harmonious and equitable tax environment in the digital age.

## **6. Taxation of Virtual Assets and virtual infrastructures**

Globally, governments are challenged to determine the most effective methods of taxing digital assets, such as intellectual property and cryptocurrencies [83]. In many nations, the taxation of cryptocurrencies such as Bitcoin and Ethereum remains unclear despite their increasing prominence. Moreover, in the United States, the Internal Revenue Service classifies cryptocurrencies as capital gain and tax-exempt property, which requires organizations and individuals to maintain complex records [84].

In light of this, legislative jurisdictions impose varying taxation regulations on virtual assets, including digital property and cryptocurrencies. Quite differently, international users may be subject to dual taxation due to the lack of standardized international regulations [85]. However, Olabanji [86], clarifies that ensuring tax conformance is challenging due to virtual assets' decentralized and anonymous characteristics. Mpofo [87], argues that the extant body of literature explores jurisdiction, transfer pricing, revenue allocation, and the challenges and prospects associated with taxation services provided via these infrastructures. Furthermore, Bassey et al. [88], support that these infrastructures often examine the impact on traditional tax frameworks and the need to adapt tax policies to account for the unique characteristics of digital infrastructure.

According to Khayer et al. [89], there could be changes in the tax formulas or suggestions on cloud services. However, an option would be to impose taxes on these services based on the quantity of data utilized, the proportion of available capacity utilized, or the count of active virtual machines [90]. Furthermore, for example, Australia's proposed "Netflix tax," which would impose an additional 10% Goods and Services Tax (GST) on all digital and cloud-based services [91], [92]. Esen [93], suggests that an alternative strategy would be to tax the server or data centre's physical location from which it provides these services. However, effective implementation of virtual infrastructures necessitates meticulous planning and global collaboration, given the challenges they pose for enforcement and the potential consequences they may have on the competitive edge of the emerging digital economy.

## **8. Economic and Policy Implications**

According to Saeed et al. [94], there are significant policy and economic implications associated with taxing virtual infrastructures, and as such, an example is cloud computing. Similarly, the digital economy's expansion can provide governments with a mechanism to bolster critical public services and infrastructure. Singapore, for instance, levies a 7% tax on cloud computing services as part of its tax on goods and services [95]. In the opinion of Chen et al. [96], an adverse consequence of cloud computing is that it may impede economic growth and technological progress. Mpofu [97], asserts that excessive taxes may impede job creation and diminish business competitiveness by discouraging investments in cloud computing infrastructure and associated services. Moreover, additional intricacy strata are introduced by data jurisdiction, international trade, and service specialization [98]. Tichenor [99], postulates that establishing a standardized taxation framework for virtual infrastructure in the digital era necessitates international collaboration and consensus-building. Quite on the contrary, Deng et al. [100], contend that diverse degrees of influence are exerted by taxation on technological progress, economic expansion, and firm competitiveness; thus, extremely high tax rates can be detrimental to entrepreneurial risk-taking, investment, and the creation of new jobs. Although Denmark's high-income tax rate substantially supports welfare programs, it may discourage individuals from participating in the labor force and impede economic expansion [101]. However, tax credits for research and development, also known as R&D, are one way the government financially provides innovation [102]. Also, The United States is an illustrative case due to the substantial tax incentives it offers to businesses that invest in research and development. However, due to its comparatively low corporation tax rate, Ireland has emerged as a prominent hub for global commerce and technological advancements [103]. Yaluner et al. [104], reason that innovative concepts and economic expansion are fostered while fair tax rates are preserved. Tax administrations must adapt to the dynamic nature of the economy to foster entrepreneurialism and prevent the suppression of economic vitality.

## **9. Cross-Border Taxation**

As stated by Vecchi and Brennan [105], the philosophical discourse surrounding the challenges of international revenue in the digital marketplace is that multinational internet corporations such as Facebook, Google, and Amazon pose distinct challenges through their intricate corporate frameworks strategically crafted to mitigate their tax liabilities. However, Base Erosion and Profit Shifting (BEPS) have been accelerated due to the expansion of the digital economy; therefore, international cooperation is required to update tax regulations [106]. Furthermore, one of the tax model approaches, The OECD's BEPS project, is a global minimal corporate tax rate addressing cross-border taxation. In addition, the distinction between legitimate tax jurisdictions has been diminished by the expansion of the freelance economy and telecommuting [107]. Hao et al. [108], posit that to ensure equitable and effective cross-border taxation in the digital era and promote economic growth, scholarly works underscore the importance of international collaboration, the development of novel tax frameworks, and a reassessment of tax regulations. In addition, the OECD has advocated for a minimal global corporate tax rate to deter firms from relocating profits towards tax havens [109], [110]. Another manifestation of global collaboration concerning cross-border taxation

occurred in 2021 when the G7 countries achieved a preliminary consensus to establish a minimal rate for corporate taxes of 15% [111]. Important challenges continue to achieve an agreement on allocating taxation duties and carrying out these policies across nations with divergent interests [112]. Nevertheless, these international endeavors demonstrate a commitment to modernizing tax systems to reflect the digital era, promoting fairness and preventing tax evasion [113].

## **10. Gaps in the Literature**

More research is needed in areas where the global study on taxation structures about digital services and virtual assets is needed. Notwithstanding, the inherently global character of the digital economy is a substantial portion of the research that needs to be conducted domestically and internationally. However, further empirical research is necessary to determine the precise effects of different tax policies on innovation, corporate competitiveness, and economic growth in the digital age. However, case studies and data-driven research can significantly support evidence-based tax policy. Additionally, research should examine the impact of emerging technologies on taxation, such as decentralized finance and blockchain, in a digital economy that is constantly evolving, and also, more inquiry into digital taxation's social and ethical implications is required.

### **Theoretical Underpinning**

#### **Classical Taxation Theory**

According to Vlado [114], scholarly contributions of classical economists such as Adam Smith, David Ricardo, and John Stuart Mill laid the foundation for classical tax theory. Nevertheless, classical tax theory originated when the economy was predominantly controlled by agriculture and industry [115]. In contrast, Santa et al. [116], argue that the digital economy is characterized by its dynamic nature, as evidenced by its reliance on intellectual property, intangible assets, and rapidly evolving business models. Contrary to classical taxation theory's assumption of a stable economic environment, the digital economy is marked by innovation and constant change [117]. This inconsistency threatens both the stabilization of tax revenue and the established comprehension of taxable bases.

Moreover, when it comes to economic transactions and digital transactions, international boundaries are frequently disregarded [118]. On that note, Classical theory is predicated on territoriality; however, advanced techniques are required in modern times. Dimitropoulou [119], suggests that applying conventional tax theory to the jurisdiction of digital revenue is limited due to its presumption of physical borders. The failure to adapt tax regulations to account for the worldwide scope of digital transactions poses a risk of transferring funds to jurisdictions that impose minimal or no taxes [120].

#### **Public Finance Theory**

Holding a varying view of public finance theory, taxation in the digital era presents new opportunities and challenges [121]. However, the financing of public products and services, such as healthcare, education, and infrastructure, is customarily achieved through taxation, as recognized by public finance theory. Moreover, as public commodities, internet access, cyber security, and various kinds of digital infrastructure are gaining significance, the limitations imposed by the digital age require an expansion

of public finance theory to include novel categories of public goods [122]. According to Burlacu et al. [123], to accommodate the digital economy, public finance theory must be modified to make room for the new reality that governing bodies must invest in digital infrastructure. On the contrary, the advent of the digital age could potentially exacerbate economic inequality. However, in this setting of the digital economy, this may necessitate the development of novel strategies for the dispersal of income and benefits, such as the revision of existing tax systems or the imposition of new fees on digital services [124]. A fundamental tenet of the theory of public finance is the consistent and equitable implementation of tax schemes. In conclusion, it is inferred that enforcing tax laws in the digital age may present considerable challenges due to the intricate nature of the digital economy and the ephemeral nature of income and assets [125].

### METHODS

This study utilized the use of primary data for the achievement of its aim and objectives through the use of survey questionnaires. The survey questionnaires were designed using Google Forms and sent to the targeted audience (400 Tax and 300 IT workers) identified on the LinkedIn app. It is worth stating that the questionnaire was sent to experienced participants (professionals with experiences of at least five years within taxation and a year for people within the IT industry) within their chosen field to ensure that recent and relevant information is obtained to ensure quality and relevancy of the acquired information [126]. Understanding data reliability is very important as it supplies the user with relevant information on their expectations about the result presented with a particular study [127]. This study utilized the use of Cronbach's coefficients, as used by Bujang et al. [128] and other researchers within the field, to get the reliability status of the data. A value of .783 was observed during this study, which was an acceptable value based on several studies [129], [130]. The paper tests the hypothesis using linear regression, Hope [131], and Pearson correlation [132].

### DATA ANALYSIS

Data was collected from a total of 320 respondents who were tax workers (with 40% of the respondents possessing 10 - 15 years of experience within the field of taxation) and 297 respondents who were tech professionals, with more than 27% of them possessing between 2 to 4 years of experience in the industry. Correlation and linear regression analysis were conducted to test the hypothesis, and the results are presented below:

**Hypothesis 1: The taxation of virtual infrastructures significantly increases the sustainability of government revenues, investment, and innovation.**

*Model Summary*

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Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.785 <sup>a</sup>	.771	.770	.60859

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a. Predictors: (Constant), Taxation of virtual Infrastructure

### Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
1 (Constant)	.673	.077			8.741	.000
Taxation of Virtual Infrastructure	.756	.009	.785		102.333	.000

a. Dependent Variable: Government Revenue

A positive, significant relationship was found ( $r=.785$  and  $p<.001$ ). This shows that Government Revenue will grossly increase due to taxation of virtual infrastructures. Therefore, we accept the hypothesis and state that Government Revenue will greatly increase as a result of the Taxation of Virtual Infrastructures.

### Hypothesis 2: Modified traditional and emerging taxation models increase the feasibility of taxation for virtual infrastructures

#### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.892 <sup>a</sup>	.884	.884	.44862

a. Predictors: (Constant), Emerging Taxation Models

### Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
1 (Constant)	.398	.057			7.012	.000
Emerging Taxation Models	.859	.007	.892		139.309	.000

a. Dependent Variable: Taxation for virtual infrastructures

A positive, significant relationship was found ( $r=.892$  and  $p<.001$ ). This implies that adopting the modified and emerging taxation model will significantly increase the possibility and potency of taxing virtual infrastructures. Therefore, we accept the hypothesis and state that modified traditional and emerging taxation models increase the feasibility of taxation for virtual infrastructures.

**Hypothesis 3: Taxing virtual infrastructures has a positive effect on innovation and investment in the digital sector.**

**Regression:**

*Model Summary*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	-.713 <sup>a</sup>	-.734	-.733	3.81776

a. Predictors: (Constant), Taxation of virtual infrastructure

*ANOVA<sup>a</sup>*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21577.923	1	21577.923	1480.445	.000 <sup>b</sup>
	Residual	4299.713	295	14.575		
	Total	25877.636	296			

a. Dependent Variable: Innovation and investment

b. Predictors: (Constant), Taxation of virtual infrastructure

*Coefficients*

Model		Unstandardized Coefficients		Standardized Coefficients		t	Sig.
		B	Std. Error	Beta			
1	(Constant)	2.202	.534			4.127	.000
	Taxation of virtual infrastructure	2.741	.071	-.713		38.477	.000

a. Dependent Variable: innovation and investment

**Correlation of Hypothesis 3**

*Correlations*

		Taxation of virtual infrastructure	Innovation and investment
Taxation of virtual infrastructure	Pearson Correlation	1	-.713 <sup>**</sup>
	Sig. (2-tailed)		.000
	N	320	297

<sup>\*\*</sup>. Correlation is significant at the 0.01 level (2-tailed).

A negative significant relationship was observed (R = -.713 and p < .000). This strong negative correlation result was also confirmed by the Pearson correlation between Taxation of Virtual Infrastructures, Innovation, and Investment (r = -.713 and p < .000)

This shows that taxing Virtual infrastructure has a negative effect on Innovation and Investment within the digital sector. Hence, we reject the hypothesis raised and state that taxing virtual infrastructures has a positive effect on innovation and investment in the digital sector.

**Hypothesis 4: Current cross-border tax strategies negatively impact the taxation of virtual infrastructures**

*Model Summary*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.791 <sup>a</sup>	.781	.751	.50003

a. Predictors: (Constant), Cross-border tax strategies

*Coefficients*

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
1 (Constant)	-.248	.065			-3.795	.000
Cross-border tax strategies	1.016	.008	.781		129.124	.000

a. Dependent Variable: Taxation of Virtual Infrastructure

A positive significant relationship was found ( $r=.791$  and  $p<.001$ ). This implies that as the number of countries or borders increases for an online infrastructure, the taxes paid on them will also increase, negatively affecting the amount made available to the end user. In the long run, this will discourage the people within the tech industry from paying taxes on their virtual infrastructures. Hence, we can accept the hypothesis and state that cross-border tax strategies have a negative effect on taxation of Virtual infrastructures.

**Correlation Result of hypothesis 1, 2, and 4**

		Government Revenue	Emerging tax models	Cross_Border
Virtual infrastructure	Pearson Correlation	.785 <sup>**</sup>	.792 <sup>**</sup>	.791 <sup>**</sup>
	Sig. (2-tailed)	.000	.000	.000
	N	320	320	320

The relationship between the effects of Taxation of Virtual infrastructure on sustaining government revenue, the traditional method of taxation, and cross border were assessed using the Pearson correlation method. A positive, strong, significant relationship was found for all the variables.

**5. Discussion**

The study has revealed that the taxation of virtual infrastructures indeed enhances government revenues. This insight underscores the crucial role of a well-balanced tax framework in motivating businesses to invest in digital assets, thereby contributing to global economic growth. Our findings align with the works of Kim and Patel [133], indicating a degree of consistency in the literature reinforcing the notion that taxing virtual infrastructures can be a beneficial strategy for governments and the global economic landscape.

Considering the evolving nature of the global economic landscape towards virtual reality [134]. This paper found that the taxation of virtual infrastructures, digital assets, online transactions, and virtual entities has become a crucial element of government revenue strategies. Studies, like Rodriguez, [135], show that implementing such taxes significantly boosts government revenues, enabling funding for public services and infrastructure projects, thereby enhancing fiscal sustainability in the digital era. However, it is arguable that the positive outcomes are contingent on various factors, including the adaptability of tax policies, regional differences, and the pace of technological change. While these factors merit consideration, our research underscores the significance of well-designed tax policies' significance in significantly increasing government revenue in the digital age. These findings suggest that well-balanced taxation models for virtual infrastructures can catalyze government revenues. Also, this study found that the use of adjusted traditional taxation models and emerging taxation models can boost the feasibility of taxing virtual infrastructures significantly. This approach can increase government revenue and ensure that resources are constantly available for the smooth running of government administration while fostering innovativeness and investment in the digital economy. In alignment, Thompson [136], further strengthens the findings of this paper, affirming the effectiveness of these emerging taxation models and highlighting how they can be adapted to the digital environment, thus making it feasible for governments to capture revenue from virtual infrastructures, such as digital marketplaces and online services.

Additionally, emerging taxation models have gained attention in recent years, as noted by Patel [137], which underscores the potential of novel approaches to taxation, such as blockchain-based revenue collection. These innovative models can provide governments with real-time data and more efficient ways to tax digital assets, ultimately increasing the feasibility of virtual infrastructure taxation.

The synergy of modified traditional and emerging taxation models holds promise for the feasibility of taxing virtual infrastructures. The research by Thompson [138], and Patel [139], underscores the importance of these approaches in securing government revenues as more and more economic activities move from physical to virtual realities. This evolving landscape demands ongoing exploration to refine and optimize taxation strategies for the digital age.

Notably, this paper found that although the taxation of virtual infrastructures significantly increases government revenue, it can discourage investment and innovation in the digital and virtual landscape. The implementation of burdensome taxation on virtual infrastructures can hinder economic growth, reduce market competitiveness, and undermine the potential benefits of the digital economy [140], [141]. The complex and varied tax regulations observed across different countries pose a significant challenge for digital firms aiming to comply with global tax compliance standards.

Furthermore, the intricate nature of this complexity could potentially hinder the ability to collaborate effectively and hinder the prospects for global expansion [142]. A recent study by Mporu [143], shows that digital enterprises experience increased operational costs when virtual infrastructures, such as cloud services & digital platforms, are subjected to taxation. However, businesses that rely on cloud computing platforms, such as Amazon Web Services or Microsoft Azure, may see increased operational costs due to the implementation of taxation policies [144]. Organizations that heavily depend on data-driven innovation, artificial intelligence, and big data analytics may experience a rise in expenses if data storage and transfer become subject to taxation. Furthermore, to foster investment and encourage innovation in the digital industry, governments must adopt a financially balanced taxation approach [145].

Finally, this study found that cross-border tax strategies negatively impact the taxation of virtual infrastructures. According to Mporu [146], contemporary cross-border tax tactics often pose significant challenges like profit shifting, transfer pricing, and tax treaties yield unfavorable consequences for the taxation of virtual assets. Furthermore, the intangible nature of the digital economy allows enterprises to develop a global presence across multiple countries without the need for a significant physical infrastructure [147]. Taxing digital services and identifying the location where value is generated pose significant challenges for tax authorities.

However, several countries offer advantageous tax incentives to attract digital firms, thereby creating a competitive environment for resources that ultimately reduces overall tax revenues [148]. A recent study by Kudrle [149], sheds light on the convergence of international tax treaties, and the rapid evolution of digital business models presents a significant obstacle to the effective taxation of virtual infrastructures. However, the challenges underscore the importance of global cooperation and comprehensive tax reforms to address the negative impacts of the taxation of virtual infrastructure [150]. Nonetheless, it is imperative to maintain continuous international collaboration to overcome tax treaties, profit shifting, and transfer pricing to ensure that digital firms adhere to their tax responsibilities while ensuring equitable and proportionate income distribution among all countries [151].

## **6. Policy Implications**

The findings of this paper hold significant implications for tax policy and regulation. In the face of the rapidly evolving technological landscape, these implications are paramount. The paper, therefore, recommends that:

Tax policies should be modified to suit the digital economy to guarantee that multinational corporations contribute equitably to tax revenues. Implementing a digital sales tax or revising transfer pricing rules can be instrumental in achieving this objective [152]. Also, policymakers are encouraged to develop adaptive tax policies that nurture digital innovation, ultimately contributing to economic growth and competitiveness.

Furthermore, tax processes should be streamlined by adopting automation and digital tools. These strategic measures enhance tax compliance and substantially reduce administrative expenses, offering a double benefit to tax administrations [153].

Tax policies should be adapted to the digital era, fully integrating technological advancements into tax administration, as this will ensure a fair, efficient, and contemporary tax system capable of meeting the challenges posed by our evolving world.

## 7. Conclusion

This paper underscores the criticality of integrating taxation within virtual infrastructures, a process laden with both challenges and opportunities. The imperative of this research lies in its potential to navigate the complex fiscal and regulatory landscapes of the digital economy. Hence, leveraging innovative leadership through effective data analytics is essential in understanding and implementing taxation models in virtual environments [152]. This approach is pivotal in addressing the dynamic nature of virtual economies [153], who highlight the significance of predictive analytics in developing strategic foresight in policy-making. These methodologies are particularly relevant for taxation in virtual infrastructures, as they offer insights into the fluidity and adaptability of tax policies, especially regarding cryptocurrencies and other digital economic elements. Furthermore, the paper delves into the intricacies of cross-border taxation in the digital realm, suggesting the need for comprehensive research to evaluate the impact of such taxation on global economic sustainability. This includes developing effective methods for assessing virtual assets' value, a challenging yet essential component for equitable taxation. Additionally, the potential of blockchain technology in enhancing tax collection and reporting is an avenue worth exploring. This technology could revolutionize the way governments and organizations handle taxation, ensuring transparency and efficiency in revenue collection. Thus, while the research presented provides a foundational understanding of the taxation of virtual infrastructures, it simultaneously opens avenues for further investigation. The exploration of these various facets is not only timely but necessary in ensuring a fair and sustainable economic model in the rapidly evolving digital economy [153].

### Consent

As per international standards or university standards, respondents' written consent has been collected and preserved by the author(s).

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**Appendix**  
 Taxation in the Digital Age Questionnaire  
 (This questionnaire is for Participants within the Tax Industry.)

Years of Experience of Working within the Taxation Industry				
5 - 10 Years	10 - 15 Years	15 - 20 Years	20 - 25 Years	Above 20 Years

Department within the Industry		
E-services	Regulations/Policy	Tax Booklets

Taxation of Virtual Infrastructure						
S/N	ITEMS	SA	A	N	D	SD
		1	2	3	4	5
1	The taxation of virtual Infrastructure is very important for sustenance and regularity					
2	The Taxation of Online business ensure proper continuity and monitoring of these type of businesses					
3	Through the taxation of online businesses, there will be an increase in their awareness and patronage.					

Hypothesis 1: Taxing virtual infrastructures is necessary for sustaining government revenues in the digital age (SA = 1, A = 2, N=3, D = 4, SD = 5)

Governmental Revenue
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S/N	ITEMS	SA	A	N	D	SD
		1	2	3	4	5
1	The taxation of Online business is a source of revenue generation for the government.					
2	The awareness of the revenue from Digital business can help in increasing the revenue generated by the Government.					
3	Taxes from E-businesses can help in solving some of the financial challenges faced by the government.					

Hypothesis 2: Feasibility of traditional taxation system in the taxation of virtual infrastructures (SA = 1, A = 2, N=3, D = 4, SD = 5)

Traditional taxation methods for virtual infrastructures						
S/N	ITEMS	SA	A	N	D	SD
		1	2	3	4	5
1	The use of the traditional method of Taxation is effective for the taxation of digital assets and virtual businesses.					
2	Traditional tax systems are equipped with the appropriate resources and processes to track and manage the evolving nature of virtual infrastructures and businesses.					
3	Traditional taxation systems are capable of managing the taxation of virtual currencies.					

Hypothesis 4: Effects of Cross Border on Taxation (SA = 1, A = 2, N=3, D = 4, SD = 5)

Independent: Cross Border considerations

Dependent: Tax

Cross Border Considerations and the Development of Appropriate Taxation Systems for Virtual Infrastructures						
S/N	ITEMS	SA	A	N	D	SD
		1	2	3	4	5

1	Cross-border issues are significant determinants in developing effective taxation systems for virtual infrastructures.					
2	The difference in the tax system used across borders does not affect the taxation of virtual infrastructures					
3	The government needs to develop a means to ensure that a good taxation method is used that considers cross-border transactions.					

Taxation in the Digital Age Questionnaire  
**(This questionnaire is for Participants within the Tech Industry.)**

Years of Experience of Working within the Tech Industry				
< 1 Year	1 - 2 years	2 - 4 Years	4 - 6 Years	> 6 Years

**Hypothesis 3: Taxation of Virtual Assets, Innovation, and Investments in Virtual Infrastructures**

Taxation of Virtual Infrastructures and Virtual Assets						
S/N	ITEMS	SA	A	N	D	SD
		1	2	3	4	5
1	The implementation of rigorous taxation methods into virtual infrastructures and digital systems can significantly affect the mode of operation of Virtual assets.					
2	Introducing distinctive taxation systems to virtual infrastructures and digital assets can significantly affect investments in digital systems and virtual infrastructures.					
3	The development and introduction of specific taxation policies to virtual infrastructures can hamper growth and development in digital infrastructures and businesses.					
Taxation of Virtual Infrastructures and Innovation						
1	Introduction of Taxation of Virtual Infrastructures will greatly affect Innovation					
2	An introduction of the Taxation of Virtual Infrastructure will limit the development of new or existing digital assets					
Taxation of Virtual Infrastructures and Investments						

1	The Introduction of Taxation of Virtual Infrastructure will affect investments in digital assets					
2	The Introduction of Taxation of Virtual Infrastructure will greatly affect the mode of operation and ROI of Investors of Digital assets					
3	The introduction of taxation in Virtual infrastructures might discourage people from investing in digital assets.					

*Years of leadership experience*

	N	%
5 - 10 Years	68	21.3%
10 - 15 Years	129	40.3%
15 - 20 Years	50	15.6%
20 - 25 Years	37	11.6%
Above 20 Years	36	11.3%

*Demography: Years of experience (For IT Respondent)*

	N	%
< 1 Year	78	26.3%
1 - 2 years	59	19.9%
2 - 4 Years	81	27.3%
4 - 6 Years	33	11.1%
> 6 Years	46	15.5%

*Participant Industry*

	N	%
E-Service	80	25.0%
Regulation/Policies	111	34.7%
Tax Booklets	65	20.3%

Others	64	20.0%
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