

Solvency constraint implications for tax liability targeting of banks in Ghana

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Abstract

This paper examines the implications of solvency constraints on the tax liability targeting in the Ghanaian banking sector. The analyses are based on 15-year annual data spanning 2008 to 2022 interpolated into monthly data frequency using the Denton procedure. The Dynamic OLS (DOLS) estimator, residual-based stationarity test, delay, and half-life techniques were employed in the estimations. The solvency constraint scenario exhibits a cointegration relationship with the tax liability target. The study finds evidence of a high speed of adjustment or convergence to tax liability targets in response to solvency constraints, with a high degree of persistence across the various solvency constraint proxies. The solvency constraint has deleterious tax revenue implications for the government and risk-adjusted tax

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savings for banks in Ghana. It is recommended that the government reorients its general policy to ensure stability in the Ghanaian banking sector to achieve favourable tax revenue from the sector, as uncertainties may trigger a deleterious tax-targeting scheme. Investors and financial analysts could use tax liability trends as a baseline to identify stressing scenarios, including solvency constraints.

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1.1 Introduction

Taxation has been the mainstay of civilisation since ancient times, and without taxes, no government or public office can function properly. Tax revenue collected are important government revenue stream in modern economies. Data from the International Centre for Tax and Development indicates that in approximately half of the world's countries, tax revenues comprise over 80% of government income, while in almost all countries, they account for more than 50% [1]. Taxes differ from other sources of revenue in that they are compulsory levies and unrequited [2], [3].

Tax targets and total tax revenues collected by countries around the globe are not the same due to the varying tax laws, tax administration, and tax targets of the tax authorities. A country's development is often tied to the level of tax revenue that the country can mobilise. This means that a country's development could be impeded when it experiences a decrease or stagnated tax revenue mobilisation [4]. Ideally, countries would prefer to increase their tax revenue mobilisations, but for some country-specific challenges, most countries observe a decrease in tax revenues. Countries in sub-Saharan Africa and Asia are the biggest culprits.

It is commonly recognised that developed or wealthy countries have a distinct advantage when it comes to tax revenue collection, far surpassing that of less developed nations. This differential tax performance is reflected in Figure 1. The vertical axis in Figure 1 measures tax performance as a share of gross domestic product (GDP), whereas the horizontal dimension represents GDP per capita, adjusted for purchasing power parity across countries, providing a clearer visual representation of the relationship. Figure 1 also employs a logarithmic scale by default to facilitate easier interpretation of the correlation. It can be observed from Figure 1 that the African continent performs the least in tax revenue. It is further evident in Figure 1 that rich and advanced countries such as France, Germany, the

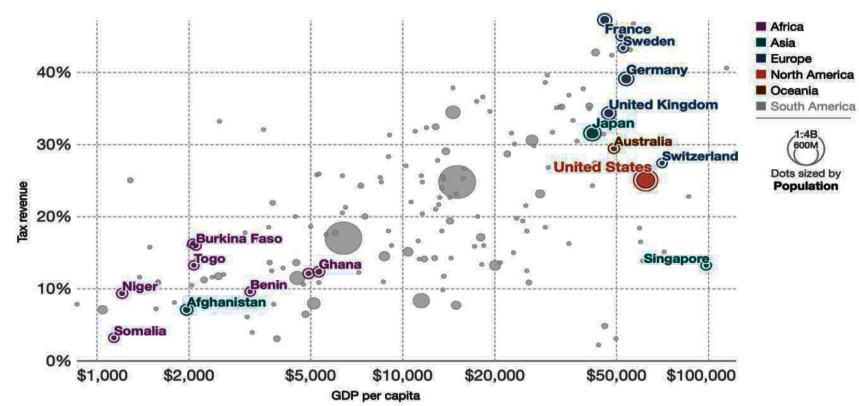


Figure 1
Tax Revenue and GDP per Capita Analysis

Source: ICTDU/UNU-WIDER Government Revenue

United Kingdom, Australia, and the United States, typically generate substantially higher tax revenues compared to less affluent countries or economies. The visualisation offers additional insight into the strength and scope of this correlation

Recent data from the Organisation for Economic Cooperation and Development (OECD) affirmed poor tax performance in Africa. The [5] presents data on the tax-to-GDP ratio for countries all over the world. In comparison, the average tax-to-GDP ratios in Africa, Asia and the Pacific, Latin America, and the Caribbean, and the OECD were 16.0%, 19.1%,

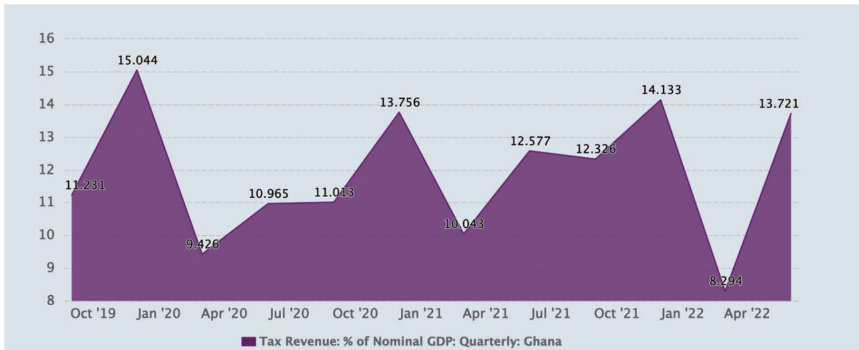


Figure 2
Ghana's Tax Revenue Trend (October, 2019 to April, 2022)

Source: CEIC Data (2023)

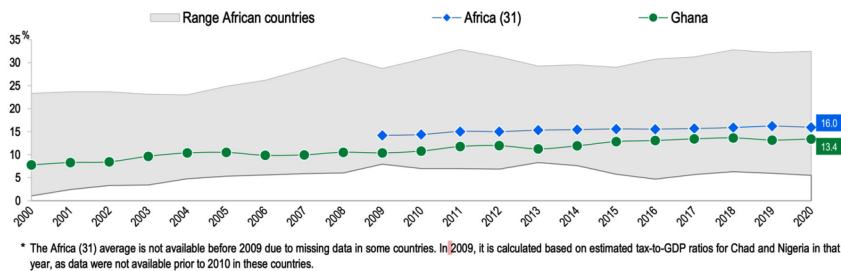


Figure 3

Ghana's tax-to-GDP compared with the African average

Source: OECD (2022)

21.9%, and 33.5%, respectively, in 2020 [5], [3]. Intra-African tax performance analyses also show that the Ghanaian economy suffers from a tax revenue deficit. The recent trend in tax revenue within the Ghanaian tax administration landscape is disturbing. As observed in Figure 2, the quarterly tax performance from October 2019 to April 2022 is in the range of 9.43% to 15.04% of GDP. In fact, recent data showcased by April 2022 stands at 13.72%.

In continental Africa, Ghana is lagging in terms of tax revenue performance. Mapping Ghana's tax-to-GDP ratio in 2020 (13.4%) to Africa reveals that Ghana's tax performance falls short of the African average by 2.5 percentage points, with the latter standing at 16.0%. This is not a one-off poor tax revenue discrepancy, but a worrying trend, as shown in Figure 3.

The implication is that although some African countries show improved tax revenue performance, Ghana has consistently fallen short of the African averages. Ghana needs to catch up with its peers to close the tax revenue to the GDP gap. To do so, Ghana requires improvement in all aspects of tax revenue mobilisation. One fundamental tax handle that has remained a significant part of tax revenue mobilisation in Ghana is the corporate income tax. According to [2], developing countries, such as Ghana, generate high tax revenues from corporate income taxation. Thus, the relevance of corporate taxes in developing countries cannot be overemphasised. However, emerging evidence suggests that while tax authorities are continuously reviewing tax policies and implementing strategies to increase tax revenue mobilisation, taxpayers are also exploring tax avoidance opportunities to minimise tax exposure [6], [4] which may result in the practice of tax liability targeting. Tax liability targeting from

the taxpayer's perspective is a strategic outcome of tax avoidance or planning activities that offer opportunities for a taxpayer to minimise tax liability within the tax compliance framework through a liability target with inherent asymmetric adjustments to reach the target. The tax liability target may have accounted for the growing poor tax performance in Ghana. This is critical given the fact that the Ghanaian economy continues to witness aggressive tax administration with widespread reportage of a hostile tax environment between tax officials and firms [7], [8].

Following [4], tax liability targeting may be more pronounced when taxpayers are financially constrained. Thus, in addition to hostile tax administration, financial constraints could exasperate tax targeting. Tax liability targeting through organised tax avoidance schemes is a good incentive to deepen cash savings amid financial constraints. A firm is financially constrained when it is pressured by the increasing external financing cost or when it experiences difficulty in securing the desired external funding [9], [10]. It is increasingly asserted that financial constraints are strong catalysts for tax avoidance or planning activities. The inclination to deepen tax savings amid financial constraints reflects the assumptions of the extended parallel process model (EPPM). Borrowing from the tenets of EPPM, when firms recognise severity of threat of financial constraints and the likelihood of their occurrence, they are rationally expected to minimise the impact through varying responses [11], [12] including tax avoidance.

These intuitive assertions, coupled with other theoretical considerations, might have contributed to the growing interest in the empirical literature exploring the taxation-financial constraints nexus [13], [14], [4], [15], [16]. However, these existing empirical studies have predominantly explored the experiences of developed economies and non-financial firms [13], [14], [17] with relatively few studies within the financial sector [4], [15]. The evidence from studies in advanced economies and cross-border study settings may not be relevant to developing economies, such as Ghana, due to distinct differences in development trajectories, tax administrations, and compliance environments [18]. The implication is that consistent with the features of taxation, tax avoidance activities, and the underlying motivations may exhibit heterogeneous characteristics and thus, vary significantly across different countries and sectors.

In light of Ghana's persistent tax revenue woes, there is a need for targeted research on the banking sector within the context of tax and constraints [3].

This study contributes to the taxation-financial constraint literature in the Ghanaian banking sector by emphasising tax liability targeting and solvency constraints. The solvency constraint provides immediate evidence of a threat to both regulatory sanctions and the survivorship of banks. Solvency is a critical regulatory issue as it bothers on capital and risk fundamentals [19] It is expected that a solvency constraint scenario can cause banks to reorganise their activities to minimise exposure to liabilities, including tax exposure, to remain afloat for going-concern. Thus, a solvency constraint scenario can lead to tax-liability targeting. However, the causality between these constructs cannot be inferred [20], therefore, this assertion is scientifically confirmed through empirical investigation. This makes the empirical assessment of the solvency constraints-tax liability targeting nexus not only useful for theory but also for policy and practice. Surprisingly, the current empirical literature lacks a specific examination of tax liability targeting-solvency constraint scenarios

Of closer relevance to this paper is [4]. Similar to [4], this study also investigates financial constraints (solvency constraints) and tax activities within the Ghanaian banking sector. However, the present study differs from the existing studies in that instead of focusing primarily on the predictability of tax liability from solvency constraints, it further explores how banks can use the predictability of tax liability targets to generate risk-adjusted tax savings amidst solvency constraint scenarios. Thus, the consequence of tax liability targeting from solvency constraints may show the speed in adjusting tax liability to reflect the information solvency constraints that create such a prediction. This underscores the need to understand the analytical dynamics of speed of adjustment (SOA) and delay critical. Therefore, this study extends the current literature on constraint-tax liability beyond cointegration to delay-to-convergence and SOA. This research extends existing tax literature and offers three novel insights. First, it is the first study to extend firm-level targeting models to the tax literature. Although the tax literature provides a comprehensive understanding of tax planning dynamics, little is known about whether taxpayers extend this approach to tax liability targeting within the banking sector. Evidence from this analysis would showcase implicit premeditated tax-hidden activities, which is a significant tax policy concern, especially in Ghana, where the recent domestic debt exchange has resulted in huge tax losses in the banking sector.

Second, the study extends the asymmetric adjustment pattern to tax research. To integrate the asymmetric dimension, the current study adopts analytical procedures similar to [21] and [4] to construct and manipulate

solvency constraint scenarios and observe the adjustment pattern of target liability targets. The findings would provide comprehensive insight into firm-level (banks) tax behaviour as the optimal tax liability target dynamically moves in response to the solvency constraint scenario.

Third, this study further explores the delay in convergence in tax liability targeting and the SOA of tax targets to solvency constraints. The analysis of delay and persistence would provide evidence that a tax liability target exhibits 'paradoxical effect or two-edge sword' behaviour where: it benefits the taxpayer but simultaneously erodes government revenue which may require a sharp regulatory response to minimise tax revenue leakages. The study also employs novel delay and half-life estimation approaches to estimate how fast banks offset or correct deviations from the tax liability target [22], [23], [24], [6], [4] contrary to the traditional partial adjustment model (PAM) [2], [21], [25], [26], [27]. Unlike PAM, which follows strict assumptions of a symmetric pattern in the SOA with equal adjustment costs and homogeneity in SOA among firms, delay and half-life techniques do not follow these strict assumptions. In fact, banks are likely to incur varying adjustment costs depending on the position of the tax target and the degree of the solvency constraint. Moreover, these banks may also exhibit unequal adjustment, as this may be influenced by their position on the tax target, leading to possible heterogeneity rather than being homogenous. Banks facing different patterns of solvency constraints may also take different adjustment paths to restore optimal tax targets. Thus, the empirical evidence emanating from this study could provide significant implications for policy and practice with respect to solvency constraints-tax nexus. The remaining sections of this study are presented as: theoretical underpinning, prior research effort, hypothesis development, data, variable description and measurements, estimation strategy and specifications, empirical results, and implications, and conclusions and recommendations.

2.1 Theoretical Underpinning, Prior Research Effort, and Hypothesis Development

Theoretically, this study follows the extended parallel process model (EPPM). Although several theories may be useful in drawing relationships, not all are appropriate to situate the solvency constraint-tax liability targeting relationship in theoretical context. [12] propounded this theory. Traditionally, EPPM posits that economic units, including individuals and firms, are rational, and their actions are influenced by threat or risk

exposure, the likelihood of occurrence, and the severity of impact [12]. When individuals or firms are exposed to a threat, they would rationally evaluate the threat to determine the likelihood of occurrence and the extent of impact if the said threat occurs. It is believed that when there is a high probability that the threat will occur and the impact or severity of such occurrence is moderate or high, the individual would reorganise resources to either prevent or minimise the impact [28]. Some contributors [29], [30] have also argued that an individual/firm is motivated to take protective measures when there is a perceived significant risk or threat, and, simultaneously there is an effective alternative measure to avoid or minimise the consequences of the threat.

Therefore, the EPPM explains how individuals, firms, organisations, and businesses react when confronted with fear-stricken scenarios. The model identified four behavioural outcomes based on perceived threat and perceived efficacy. The EPPM was developed in response to significant inconsistencies in the literature on fear appeal, and it is an extension of previous fear appeal models [12]. People's motivation to act is determined by the extent they feel threatened. It has also been argued that people will only take action under threat when they feel capable of implementing successful risk-reduction strategies and are convinced of their effectiveness. This implies that when people believe a threat is harmful and they are at risk, they will take effective interventions to either avoid or minimise the exposure to the threat so long as they have efficacy [31]. Drawing from EPPM theory, economic agents' decision on perceive threat (individuals and entities) is based on the risk profile, which analyses the likelihood of occurrence and the perceived impact.

Relatedly, banks are more likely to react when they determine a perceived threat and the severity or impact of the that threat. This suggests that the first step is the determination that the bank is susceptible to a specific threat. The second evaluation is the perceived severity. Perceived severity is the degree to which a person considers a threat to be serious [32]. According to the EPPM, fear causes an individual or bank's behavioural change to the recommended action [33]. In general, if the threat is perceived to be irrelevant or trivial, people disregard the risk message as well as the advice to take the necessary action.

Banks would consider a solvency constraint scenario a very serious fear-evoking message that could actually threaten the very survivor of the bank. Borrowing from EPPM, evidence of solvency constraints would necessitate quick remedial action, since the impact is more severe. Besides the threat of not meeting their obligations due to the solvency problem, it

may lead to panic withdrawal, regulatory sanctions, and, in most instances, liquidation of the bank. In this situation, management is likely to plan out of danger control because the severity is high, and they will be determined to do anything to sustain themselves, including engaging in tax-planning activities to reduce their tax liability and increase tax savings.

Some may be more aggressive to the extent that they can take deliberate action to implement a tax-targeting framework to provide reasonable assurance of tax savings. The severity of the exposure may cause banks to take less time to readjust to the tax target after engaging in rigorous tax planning activities. Banks may prefer to use tax savings to sustain their operations through tax targeting rather than paying taxes because it provides not only a cheap source of finance but also an opportunity to save cash inflow. This reflects the assumptions of EPPM, as cash-tax savings through targeting is considered one of the obvious sources of funds because traditional debt and equity markets are non-existent, more expensive, difficult, or take a long time to access during periods of solvency constraint.

In addition to these theoretical considerations drawn from the EPPM, some empirical studies have explored the taxation-financial constraints nexus [34], [35], [36], [17], [37], [38], [39]. Some of these studies have demonstrated that tax planning allows financially constrained businesses to increase internally generated funds [40], [41] [17], [42]. [41] consistently observed that entities that exhibit financial constraints pursue aggressive planning or tax reduction activities both now and in the future. [40] also explored the financial constraint–tax avoidance nexus and observed a positive financial constraints-tax avoidance relationship. [37] discovered that the association is significantly stronger for companies that use aggressive tax-cutting strategies. Furthermore, [43] discovered that financial constraints drive tax-evasion activities.

The studies, however, largely have developed economies and non-financial firms as the study settings [40], [14], [4]. Only relatively few of these studies have extended the implications to the financial sector [4], [15]. The evidence from studies in advanced economies and cross-border study settings may not be relevant to developing economies, such as Ghana, due to distinct differences in development trajectories, tax administrations, and compliance environments [44]. The implication is that consistent with the features of taxation, tax avoidance activities, and the underlying motivations may exhibit heterogeneous characteristics and thus, vary significantly across different countries and sectors. In light of

Ghana's persistent tax revenue woes, there is a need for targeted research on the banking sector within the context of tax and constraints [3].

Moreover, although the financial constraint literature has operationalised the terms of varying proxies of choice in situating the subject within the banking sector, [4] segregated the term into liquidity and solvency constraints. It is argued that banks' reactions to solvency constraints are swift and persistent. This study follows a similar approach to assess Ghanaian banks' tax liability targeting responses with respect to solvency constraints.

Consolidating these lessons and implications, this study argues that banks in Ghana are more likely to engage in aggressive tax planning activities, resulting in tax liability targeting in both the short and long term because it presents the cheapest route and perceived convenience for banks to save cash inflows without much stress. Consequently, this study contends that solvency constraints may drive tax liability targeting. Therefore, this study presents its working hypothesis (H_w) as follows:

H_{w1} : Solvency constraints have a significant influence on the tax liability targeting of banks in Ghana.

Although tax adjustment in response to solvency constraints is useful for both tax policy and practice, the speed of tax adjustment to the constraint scenario is more critical for tax policy because it determines the regularity of tax leakages for tax revenue mobilisation at one end and the sustainability of tax savings for the management of banks. Thus, estimation of the SOA of tax liability targeting to solvency constraints would not only be an important contribution to theory, but also useful for tax policy and practice. Since solvency constraints could lead to regulatory sanctions and threaten liquidation, information on solvency constraints could trigger a high-speed adjustment to increase savings through tax liability targeting. Therefore, this study postulates that:

H_{w2} : Tax liability targeting of banks in Ghana has a high speed of adjustment (low delay to convergence) to solvency constraint scenarios.

3.1 Data, Variables Description and Measurements

The underlying data for the investigation are based on the audited financial statements of the banks. This study considered all universal banks in Ghana, with a total population of 23. The target population

comprises universal banks that have been licensed and operated from 2008 to 2022. The choice of 2008 as the starting point for data collection was based on the fact that it was the full operation year when Ghana changed its financial reporting regime to International Financial Reporting Standards (IFRS) [6], [45]. Therefore, to minimise the implications of the change from the Ghana National Accounting Standards (GNAS) to IFRS, the study focuses on financial reports pertaining to IFRS regimes. Moreover, 2022 is the terminal period during which bank data are readily available. This resulted in a target population of 20 banks, all of which were considered for the study with a 15-year data span. Three banks in the total population were excluded from the target population because they did not meet the criterion. These are the First National Bank Ghana Limited operated since 2015, OmniBSIC Bank Ghana Limited since 2019, and Consolidated Bank Ghana Limited since 2018.

The data used are publicly available data sourced from banks' websites, the Bank of Ghana, and the Ghana Stock Exchange. The annualised data were interpolated into high-frequency data (monthly frequencies) using the Denton procedure to estimate relationships. The data were used to measure the variables of interest: solvency constraints and tax liability targeting variables.

Tax liability targeting is the outcome of tax planning activities that offer opportunities for a taxpayer to minimise tax liability. Under a constrained scenario, the most important need is cash offset: minimising cash outflow and improving cash inflow. Therefore, among tax planning proxies, the cash effective tax rate (CETR) is one of the most suitable proxies for tax liability targeting [13], [36]. Therefore, this study measures a tax liability target using the CETR as a point of reference. In terms of empirical specifications, the adoption of a proxy for a targeting variable often follows two main approaches: unobservable and observable target levels [46], [7]. The unobservable approach estimates a target from the residuals of selected firm-specific attributes, which are often criticised as not exhaustive or arbitrary [47], [48]. According to [7], this approach renders the target inherently unstable, especially with the introduction of new firm-specific variables, as this could change the target level. Therefore, this study follows an observable approach by measuring tax liability targets using the actual level of CETR [7], [46]. With this approach, the mechanism for adjusting the target reflects how the actual level of CETR is restored to the target level.

To measure the solvency constraint variables, it is important to identify constrained banks. [21] reveal that it is often impracticable to use

public data alone to classify an entity as constrained or unconstrained. This is more so for the financial sector as such knowledge could lead to panic withdrawal and collapse in the spur of the moment. In this regard, many existing studies follow a simulation approach to build constraint scenarios for the measurement of study variables. This study employs a similar simulation-based methodology to model a constrained environment and to assess its consequences on the tax liability-targeting activities of the selected banks [18], [41]. Consistent with the existing literature, this current paper employs this methodology and uses three constraint metrics as proxies for solvency constraints: the Herfindahl-Hirschman (HP) index, White and Wu (WW) index, and Z score [21], [49], [50], [4], [51].

The HP index was developed by [49] as an update of the index by [14]. The HP index is a composite measure derived from three variables: size, the square of firm size, and age. It is a widely used proxy for assessing constraints [21]. The solvency constraint is further captured by the WW index. The WW index reflects the assertion that a solvency-constrained bank is unable to develop investment opportunities even if they are profitable. It is further assumed that a solvency-constrained bank exhibits high gearing, poor cash flow, and negative sales growth. These assumptions are integral to the WW index [52]. Therefore, it is useful to include this index to demonstrate the sensitivity of tax targeting to these dynamics. Z-score (ZS) is another proxy for this study. The ZS is a traditional index or model for predicting corporate failure [53]. It has been favoured as an important metric for solvency and going-concern problems [21], [54], [4]. Faced with solvency constraints, banks may choose voluntary liquidation over forced closure by regulatory bodies, as experienced during Ghana's banking crisis. Consequently, banks identified as high-risk through Z-score assessments are inclined to engage in proactive tax planning and other corrective actions to improve their solvency.

Since a tax target is a tax planning outcome, it is likely to be influenced by some firm attributes that may induce targeting other than solvency constraint parameters. Therefore, this study controls for these variables. These are bank size (BS), leverage (BL), age (BA), and tangibility (TA). The BS is measured using the natural log of total assets. Large firms have the capacity to structure and implement complex and sophisticated schemes for tax planning and achieve minimal tax liability targets and high tax savings [55], [56], [3]. Thus, when the BS is controlled in the specification, this study can observe the true behaviour of a tax liability target under a solvency-constrained scenario. The study also considered age as a control

variable. It is assumed that aged banks have a better understanding of the banking sector and tax environment to engage in tax planning activities. Moreover, in Ghana, finance costs or interest expenses are tax deductible; therefore, it automatically provides a tax shield. Thus, it is important to control for the existing leverage of the banks [57], [45]. Leverage is measured using the ratio of long-term debts to total assets. Table 1 presents the summary of the study variables and their measurements is captured in Table 1.

Table 1
Variable description and measurement

Variables	Description	Measurements	Apriori
TLT CETR	Tax Liability Targeting Cash effective tax rate	$\frac{\text{Cash Tax Paid}}{(\text{Pre Tax Income} - \text{Special Items})}$	n/a
HP	HP index	$-0.737 \times \text{Size} + 0.043 \times \text{Size}^2 - 0.040 \times \text{Age}$	-
WW	WW index	$-0.091 \times (\text{IB} + \text{DPAT}) - 0.062 \times \text{Dividend paying indicator} + 0.021 \times \text{DLTTAT} - 0.044 \times \text{Ln(AT)} + 0.102 \times \text{Avg industry sales growth} - 0.035 \times \text{Sales growth}$	-
ZS	Zscore index	$-1 \times \left\{ 3.3 \times \left(\frac{\text{PI} + \text{XINT}}{\text{AT}} \right) + 1.2 \times \left(\frac{\text{WCAP}}{\text{AT}} \right) + \left(\frac{\text{SALE}}{\text{TA}} \right) + 1.4 \times \left(\frac{\text{RE}}{\text{TA}} \right) + 0.6 \times \left(\text{CSHO} \times \frac{\text{PRCCF}}{\text{LT}} \right) \right\}$	-
BS	Bank Size	Log of Total Assets	+
BA	Bank Age	Age of bank	-
BL	Bank Leverage	Long-Term Liability to Assets	-

- Cash effective tax rate is adjusted by extraordinary items

Source: Authors' construct developed from varying literature

3.2 Estimation Strategy and Specifications

The study adopts a panel estimation strategy to establish the relationship between the tax liability target and solvency constraint dimensions. Since the study seeks to explore the relationship and the mechanisms for adjustments, including the persistence and SOA, it specifies the panel model to explore first the long-run relationship between solvency constraints and tax liability targets. The generalised panel specifications are expressed as follows.

$$Y_{it} = \pi_0 + \sum_{j=n}^p \gamma_j X_{it} + \sum_{k=i}^q \theta_k H_{it} + \varepsilon_{it} \quad (1)$$

Where:

‘Y’ is the tax liability target and denotes the response or dependent variable

‘X’ is the solvency constraint variable and represents the independent variables

‘H’ is the vector of the control variables built from firm-specific attributes

‘i’ and ‘t’ are the cross-sectional and the time-series (longitudinal) dimensions respectively

‘ π ’ is the intercept or the constant

‘ γ_1 ’ are the magnitudes or the coefficients of the parameters

‘e’ is the error term.

The long-run estimation is conducted using Dynamic Ordinary Least Squares (DOLS). DOLS is an alternative to traditional techniques such as the Johansen method [17], [6], [58]. [58] proposed this cointegration approach. [37] dynamic OLS is a robust single-equation technique that uses leads and lags to correct the endogeneity problems of regressors. DOLS copes well with a small size and dynamic sources of bias. The use of DOLS avoids the risk of losing the originality of the data under the stationarity problem through a differencing series. DOLS estimation mitigates simultaneity bias and extends the standard OLS model by introducing dynamic specifications [58]. The specifications are presented as:

$$Y_{it} = \alpha + \gamma_j X_{it} + \sum_{k=-1}^i \Delta x_{it-1} + \varepsilon_{it} \quad (2)$$

The study follows the investigation framework to operationalise Equation (2) into the empirical specification by substituting the proxies of

the study variables and controls. This is expressed in Equation (3) as follows:

$$\begin{aligned}
 CETR_{it} = & \alpha_i + \gamma_1 HP_{it} + \gamma_2 WW_{it} + \gamma_3 ZS_{it} + \gamma_4 BS_{it} + \gamma_5 LeV_{it} + \gamma_6 Age_{it} \\
 & + \sum_{k=-i}^i \gamma_7 \Delta CETR_{it-i} + \sum_{k=-i}^i \gamma_8 \Delta HP_{it-i} + \sum_{k=-i}^i \gamma_9 \Delta WW_{it-i} + \sum_{k=-i}^i \gamma_{10} \Delta ZS_{it-i} \\
 & + \sum_{k=-i}^i \gamma_{11} \Delta BS_{it-i} + \sum_{k=-i}^i \gamma_{12} \Delta LeV_{it-i} + \sum_{k=-i}^i \gamma_{13} \Delta Age_{it-i} + \varepsilon_{it}
 \end{aligned} \quad (3)$$

Where

α_i is the constant term or the intercept of the estimation model

γ_1 to γ_6 are the coefficients or beta of the variables.

(1) and (-1) are the lead and the lag operators, respectively

ε_{it} is the residual error of the regression.

The rest remains as have been described in the table

The lag operator in the specification is based on the minimum Akaike information criterion (AIC) value, which is obtained through an unrestricted vector autoregressive (VAR) operation system. The integration of the leads and lags of the different variables of interest eliminates the simultaneity bias within a sample [6]. The estimates from the DOLS estimation form the basis for conducting delay-to-convergence, persistence and SOA.

As discussed earlier, to estimate the SOA, this study employs a half-life approach with the estimation of the delay model as the baseline. Historically, the half-life approach for estimating SOA is traced back to the natural sciences, where it is used to estimate the time required to reduce one-half (1/2) of radioactivity [24], [6], [42]. Several studies have used this technique in corporate finance and economics to estimate the time required for the effects of innovation to dissipate to one-half (1/2) [59], [24]. This study employs half-life and delay approaches ahead of the PAM, which has also been used in several studies [13], [59], [50], [26], [27] because of some strict assumptions and limitations of PAM.

PAM assumes that SOA follows a symmetric trajectory with equal adjustment costs. The validity of this assumption is doubtful, as firms at different adjustment levels are likely to incur different adjustment costs [31], [60], [11], [16] and this could create doubt in the results and conclusions from such estimations. PAM further assumes homogeneity in SOA among corporate firms. However, firms could make different

adjustments based on their actual position on the target, this could lead to heterogeneity in SOA among firms. [11] opined that “PAM fails to recognise that firms facing differential patterns of adjustment could also respond by taking different paths of adjustment to restore the targets that could make SOA heterogeneous for different firms” (p.127). Additionally, PAM uses residuals from multiple regression specifications to estimate a target, which is called the unobservable approach. This could render the target inherently unstable, especially with the introduction of new firm-specific variables, which could change the target level.

However, the half-life approach does not require these assumptions. It does not require a strict sequential order of adjustment or dissipation, consistent with the assumption of the dynamics of firms’ movement through the stages of targeting. A unique feature of half-life is its ability to estimate SOA in units of time. For technical analyses in applying the half-life and delay measures, the study follows [43], [22], [11], [60], [61]. The paper first constructs the delay measure using the delay model of [23] specified in Equation (4) with the DOLS estimates of the variables of interest (i.e., solvency constraint proxies) as the baseline values. The delay is expressed as

$$d = \frac{1}{(1+e^{-\theta})} \quad (4)$$

Where:

d is the delay

e is constant and

$$\theta = \frac{\sum_{k=1}^n \delta_{i,k}}{\sum_{k=0}^n \delta_{i,k} + \sum_{k=0}^n \gamma_{i,k}}$$

Equation (4) determines the delay in reversing deviations from the tax target. Finally, the time required to decompose half of the final delay is estimated. Following some of the existing studies [43], [22], [32], and [11], the half-life is estimated by substituting the final delay in Equation (4) into the half-life model specified in Equation (5) as:

$$d(t)_f e^{-\beta\tau} = \frac{1}{2} d(t)_f \quad (5)$$

Where:

τ was the half-life and

$d(\tau)_f$ was the final delay.

4.1 Descriptive Statistics

Table 2 displays the descriptive statistics for the variables used in the analysis (the dependent and independent variables). Table 3 also presents the descriptive statistics of the control variables. The mean value of cash-effective-tax rate (CETR) is 0.3129 (31.29%). This is higher than the general average corporate income tax rate of 25%. However, there is some relatively high dispersion in the individual observations, as evident in the high standard deviation in relation to the mean. Nevertheless, the high mean score affirms that the banking sector contributes significantly to Ghanaian tax revenue. This could however be exposed to aggressive tax targeting under a solvency constraint scenario. The strong, high-compliance culture in this sector is also shown in Figure 4. It can be observed from Figure 4 that the mean CETR has never been zero (0). In the 15 years trend, it can be observed that for most of the years, the tax contribution has been above the 25% average. However, after 2018, the average CETR has been falling, even though it is still positive. The relatively sharp downward trend in the post 2018 periods reflects the Ghanaian banking crisis in 2017-2018. Thus, the uncertainty arising from solvency and liquidity may have triggered a downward trend.

In addition to CETR, Table 2 reports the results of descriptive statistics of the solvency constraint proxies: HP, WW, and ZS. These variables have negative mean scores. The negative means reflect the solvency constraint scenario [49], [51].

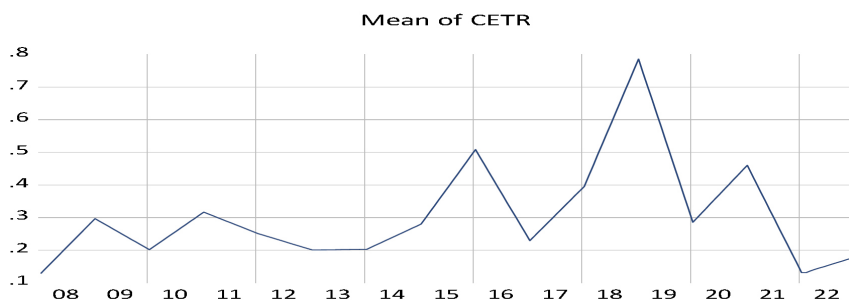


Figure 4
Time-Varying Mean Trend of Cash Effective Tax Rate (CETR) of Banks in Ghana

Source: Generated from Eviews version 12.0

Table 2
Descriptive Statistics of Response and Explanatory Variables

	CETR	HP_INDEX	WW_INDEX	Z_SCORE
Mean	0.3129	-4.3717	-0.0059	-0.3076
Median	0.2686	-4.0562	-0.0088	-0.3453
Maximum	0.8066	0.0000	0.1050	2.7443
Minimum	-1.9509	-10.3105	-0.1270	-7.9775
Std. Dev.	0.6416	1.0951	0.0358	0.5739
Obs	3600	3600	3600	3600
<i>Source: Generated from Eviews version 12.0</i>				

Table 3 also displays the descriptive results for the control variables: age, leverage, and bank size. It can be seen from Table 3 that the average age of the banks within the sample is 31 years, while banks' leverage (long-term liability) is about 8% of their total assets. The bank size, denoted by the total assets, stands at an average score of 35.7 billion Ghana cedis.

Table 3
Descriptive Statistics of Control Variables

	AGE	BL	BS
Mean	31.28001	0.089659	3.57E+09
Median	23.20833	0.060113	2.34E+09
Maximum	126.0000	0.628910	2.58E+10
Minimum	1.000000	0.000000	0.000000
Std. Dev.	25.59880	0.080949	3.79E+09
Observations	3600	3600	3600
<i>Source: Generated from Eviews version 12.0</i>			

4.2 Multicollinearity Diagnostics

It is widely known that a model that requires simultaneous estimation of multiple predictors often suffers from what has been popularised as a 'multicollinearity problem.' When a multicollinearity problem is identified but not corrected, it makes the regression spurious. Therefore, this study conducts a diagnostic test to check for a multicollinearity problem using a correlation matrix. When the correlation coefficient is 0.9, then there is

certainty in the presence of a multicollinearity problem [62], [45]. The correlation matrix is presented in Table 4. It can be observed from Table 4 that there is no multicollinearity problem, as all correlation coefficients between the variables are less than 0.9.

Table 4
Correlation Matrix of Independent and Control Variables

	HP	WW	ZS	AGE	BL	BS
HP	1					
WW	0.1371	1				
ZS	-0.0158	0.0133	1			
AGE	-0.8178	-0.0308	-0.0120	1		
BL	0.0196	0.4695	0.0081	0.1074	1	
BS	-0.3180	-0.0455	-0.1726	0.3898	0.0943	1

Source: Generated from Eviews version 12.0

4.3 Estimation of Optimal Lag Length

To estimate DOLS, it is important to determine the optimal lags and leads. This study estimates the optimal lag length using the sequential modified LR test statistic (LR), final prediction error (FPE), AIC, Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ). The study follows AIC in the choice of the optimal lag, as it is widely recognised to exhibit the correct optimal lag even under a small sample size. Table 5 captures the results of the estimation with Lag 3, which is considered the optimal lag for the DOLS estimation.

Table 5
Optimal Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-7569.225	NA	1.76e-07	4.310796	4.3231	4.3152
1	54922.04	124698.1	6.53e-23	-31.21823	-31.1200	-31.1832
2	79259.86	48467.92	6.50e-29	-45.03833	-44.8542*	-44.9726*
3	79348.13	175.4284	6.35e-29*	-45.06067*	-44.7906	-44.9643
4	79382.43	68.0301*	6.41e-29	-45.0523	-44.6963	-44.9253

* indicates lag order selected by the criterion

Source: Generated from Eviews version 12.0

4.4 Empirical Results and Implications: DOLS, Delay and Half-life

Table 6 presents the empirical estimation results. The estimation follows the results of the pre-diagnostic tests and is conducted using DOLS. It can be observed that the model explains about 61% of the variation in the tax liability. All the solvency constraint proxies have significant coefficients of 99% confidence level. Although the primary focus is on the SOA of the tax liability target amidst solvency constraints, the directions of the coefficients other than the HP index are negative, suggesting that solvency constraints are deleterious to a positive tax target. Thus, solvency constraints could lead to aggressive tax planning to minimise exposure to the threat of going-concerns. The positive coefficient of HP suggests reorganisation of the use of assets to improve constraints and deepen efficiency.

Table 6
Solvency Constraints and Tax Liability Targeting: DOLS Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP	0.2329	0.0251	9.2796	0.0000
WW	-0.7714	0.1186	-6.5055	0.0000
ZS	-0.0213	0.0085	-2.5040	0.0123
LAGE	-0.1407	0.0377	-3.7349	0.0002
LBS	0.0878	0.0114	7.7068	0.0000
BL	-0.6731	0.0563	-11.9608	0.0000
R-squared	0.7302	Mean dependent var		0.3319
Adjusted R-squared	0.6102	S.D. dependent var		0.6681
S.E. of regression	0.4171	Sum squared resid		392.0779
Long-run variance	0.1182			
<i>Source: Generated from Eviews version 12.0</i>				

To determine the target reverting and speed of such adjustments, the baseline coefficients in the DOLS should exhibit evidence of cointegration. This study tests the presence of cointegration using a residual-based approach common to DOLS. The test results are presented in Table 7 and confirm the evidence of cointegration. The residual-based cointegration through ADF is not accessed in isolation but is matched to the critical values. Similar to all estimations in this study, the EViews estimation

followed the inherent probability values from the MacKinnon response surface simulation results. It can be observed that the null hypothesis is rejected because the p-values are less than 1%. The implication is that the residuals from DOLS have no unit root; therefore, the coefficients in Table 6 are cointegration estimates.

Table 7
Unit Root of the Residuals

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-10.3382	0.0000
ADF - Fisher Chi-square	195.477	0.0000
PP - Fisher Chi-square	221.561	0.0000
<i>Source:</i> Generated from Eviews version 12.0		

Although the evidence of cointegration in this study suggests that solvency constraints in Ghanaian banks predict tax liability targets, cointegration is not sufficient to determine the severity of the consequences of solvency constraints on tax targeting and tax policy implications. The severity of the deleteriousness of solvency constraints through tax liability targeting is dependent on how fast banks can use the solvency constraint scenario to generate risk-adjusted tax savings [34], [4]. This suggests that the implication of solvency constraints in terms of achieving a tax target (i.e., savings) may be assessed in terms of the delay or the SOA of the tax liability target to the solvency constraint scenario, which creates the predictability. This makes further analysis of SOA crucial. This study extends the analysis beyond cointegration with SOA.

The study builds on the DOLS estimates to estimate the delay-to-convergence using the delay model and SOA using the half-life. Table 8 reports the delay, half-life, and SOA values. Table 8 demonstrates that it takes One (1) month and One (1) day for half of the HP-based solvency constraint information to be fused into the tax target. Additionally, it takes three (3) months and 19 days for half of the WW-based solvency constraint information to be integrated to achieve convergence to banks' tax targets. Furthermore, it can be seen that it takes 1month and 13 days for half of the information of z-score based solvency constraint scenario to be incorporated to achieve the banks' tax target. It is clear that the speed of adjustment to solvency constraints is high in all three scenarios.

Table 8
Delay Measure, Half-Life and Speed of Adjustment

Variable	Coefficient	Delay	Half-Life	*SOA Rate per Month	*SOA in Months
HP	0.2329	0.5579	1.0460	95.6%	1month, 1 day
WW	-0.7713	0.3161	3.6434	27.4%	3months, 19days
ZS	-0.0213	0.4946	1.4233	70.3%	1month, 13days
Delay to convergence or Speed of adjustment <i>Source:</i> Generated from Eviews version 12.0					

These findings suggest that Ghanaian banks would engage in aggressive tax targeting (i.e., tax cash savings schemes) in response to solvency threats. These banks are likely to engage in tax-targeting activities by increasing tax avoidance at high speed between two (2) to six (6) months. This evidence corroborates the proposition that when banks are financially constrained, they are more likely to engage in tax avoidance activity as an alternative to generate cash savings [13], [29] to support economic viability projects and improve their survivorship.

A further implication of the evidence is that managers of banks in Ghana with solvency constraint foresight are likely to develop tax avoidance schemes to increase cash inflows during periods of constraints. This explains the high convergence speed. It also affirms the assumptions of the EPPM, which suggest that banks will be inclined to deepen tax savings by minimising exposure to the constraints. Thus, situating the evidence within the tenets of EPPM, the banks recognise the severity of the threat of solvency constraints and, as expected, rationally react actively and swiftly to minimise the impact through varying responses [11], [12] including tax targeting through tax planning or avoidance.

The findings of high SOA or convergence to tax targets in response to solvency constraints also reflect the sensitivity of solvency to both regulatory sanctions and the survivorship of banks. This evidence implies that solvency constraints matter in tax liability targeting. The evidence builds on and makes new contributions to the tax literature. The findings show that it is not only practicable but also relevant to extend firm-level targeting models to the tax literature. The findings of high convergence (i.e., less delay measure) from the analyses imply implicit premeditated hidden tax activities among Ghanaian banks, which is a significant tax policy concern. This is also consistent with the huge tax losses reported in

the banking sector in 2022, in response to the threat of domestic debt restructuring in Ghana.

The dynamics of the evidence remain similar, even under different solvency scenarios (i.e., HP, WW, and ZS). This implies persistence in tax liability targeting in response to the solvency constraints. Although this may sound favourable for the banks (i.e., taxpayers), the persistence also demonstrates a possible drain to government tax revenue, which may require a sharp regulatory response to minimise tax revenue leakages. The solvency constraint has deleterious tax revenue implications for the government and risk-adjusted tax savings for banks in Ghana. As an important taxpayer but sensitive to the threat of solvency, the government is expected to reorient its general policy to ensure stability in the Ghanaian banking sector in order to achieve favourable tax revenue from the sector.

5.1 Conclusion and Recommendation

This study contributes to the literature on taxation-financial constraints in the Ghanaian banking sector. Specifically, it investigates the implications of solvency constraints for tax liability targeting among banks in Ghana. The analyses are based on annual data extracted from the audited financial statements of banks in Ghana, spanning from 2008 to 2022, interpolated into high data frequencies (monthly frequencies) to estimate the dynamics. This study followed an observable approach to measure tax targeting using the cash effective tax rate and solvency constraint measured by the HP index, WW index, and ZS. The DOLS estimator and residual-based stationarity are used to establish evidence of a cointegration relationship between solvency constraint scenarios and tax targeting. Delay and half-life techniques are also employed to determine the delay to convergence and the speed at which solvency constraint information is adjusted in the firm-level tax liability target (i.e., banks). It is concluded from the findings that solvency constraints could lead to aggressive tax planning to minimise exposure to solvency threats. Thus, the solvency constraint scenario within the Ghanaian banking sector is deleterious to government tax revenue because the banks are likely to engage in tax liability targeting to generate risk-adjusted tax savings. This study also finds evidence of the high speed of adjustment or convergence to tax targets in response to solvency constraints. This reflects the sensitivity of banks' solvency to regulatory sanctions and their survivorship. The evidence in this study implies that solvency constraints really matter in tax liability targeting. The findings of high convergence

(i.e., less delay measure) from the analyses imply implicit premeditated hidden tax activities among Ghanaian banks, which is a significant tax policy concern. This also corroborates the huge tax losses reported in the banking sector in 2022, in response to the threat of domestic debt restructuring in Ghana. It is recommended that the government reorients its general policy to ensure stability in the Ghanaian banking sector so as to achieve favourable tax revenue from the sector, as uncertainties that could threaten solvency may trigger deleterious tax targeting schemes. Moreover, government and tax authorities should conduct periodic stress tests on the expected tax revenue mobilisation using solvency constraint scenarios in and across different industries to identify and minimise possible exposures. Investors and financial analysts could use the tax liability trend as a baseline to identify stressing scenarios, including solvency constraints.

Author Contributions

Kwakyee Boateng, Kwame Bosiako Omane-Antwi and Yaw Ndori Queku contributed significantly to this study. Boateng and Queku were involved in the conception and design, analysis and interpretation of the data and the drafting of the paper. Omane-Antwi supervised and revised the draft critically for intellectual content and the final approval of the version to be published. All authors agree to be accountable for all aspects of the work.

Disclosure Statement

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Data Availability Statement

Raw data were generated from banks audited financial statements. The derived data supporting the findings of this study are available from the corresponding author [YNQ] on request.

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