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Permanent Revenue in an Energy-Exporting Economy: A New Test for Fiscal Equilibrium

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ABSTRACT

Fiscal disequilibrium arises when permanent expenditures (PEXP) exceed permanent revenue (PREV), a frequent risk in energy-exporting economies reliant on volatile windfall revenues. However, existing research lacks a clear measure of these concepts and an empirical test for fiscal equilibrium. We address these gaps by developing a novel measure of PREV—combining non-energy revenue with trend energy revenue—and integrating it into a cointegration-based test for fiscal equilibrium. Applying this framework to Trinidad and Tobago (T&T), a small, open, energy-exporting economy, we establish its effectiveness and demonstrate its broader applicability to similar economies. The results confirm weak-form fiscal equilibrium, with an adjustment parameter below one, and remain robust across specifications and structural breaks. We further investigate asymmetries in the permanent budgetary components using a non-linear autoregressive distributed lag (NARDL) analysis, which confirms asymmetry in both the short and long-run. Specifically, while a positive long-run relationship exists between PREV and PEXP, short-run responses vary due to pre-defined budgetary allocations and time lags. To progress toward strong-form fiscal equilibrium, we recommend gradually decoupling PEXP from energy revenues, strengthening institutional frameworks, and reallocating resources toward economic diversification. We also propose an energy revenue deviation rule to guide fiscal adjustments and mitigate budgetary imbalances.

JEL Classification: E62, Q43, Q48

1 | Introduction

The macroeconomic performance of economies dependent on energy resources[1] such as oil, gas, and other hydrocarbons is primarily shaped by fluctuations within the energy sector. In fact, different facets of the energy sector, including price changes, production levels, and export activity, can significantly influence gross domestic product (GDP) (Pekarčíková et al. 2022) through increased economic activity and revenue generation. However, this dependence also exposes such economies to large shocks, leading to severe macroeconomic imbalances (Agboola et al. 2024), including budget deficits and economic recessions. The impact of these shocks is often more severe and prolonged in emerging market economies (EMEs) compared to developed counterparts (see, e.g., Dąbrowski et al. 2022) due to their greater external vulnerabilities. Furthermore, downturns tend to have a more pronounced effect than upswings. For instance, in energy-dependent Iran, economic contractions during bust periods have had a more severe and lasting impact than the modest stimulation experienced during boom periods (Emami and Adibpour 2012). Mehrara (2008) similarly finds a negatively skewed asymmetric relationship between oil price shocks and economic activity in 13 oil-exporting nations.

Beyond these macroeconomic consequences, the energy sector plays a crucial role in government revenue and the overall budgetary process. A significant portion of government income is derived from energy sector taxes and royalties, making government revenues highly sensitive to energy price movements; so favorable shocks generate substantial revenues, but unfavorable shocks create budgetary shortfalls. This volatility complicates budgetary planning and can lead to inefficient expenditure patterns. For example, revenue windfalls from favorable shocks often drive inelastic investment spending alongside elastic consumption of luxury goods, ultimately reinforcing economic dependence on the energy sector and hindering diversification efforts (Heidarian and Green 1989). Another key challenge is the efficient allocation of energy revenues, particularly in economies with weak institutional frameworks and governance (Durand-Lasserve and Karanfil 2023; Moshiri 2015). Weak institutional quality can prevent the effective implementation of windfall management policies, leading to economic instability despite revenue booms. As a result, some energy-dependent developing economies continue to experience slow and volatile growth despite periods of high energy revenues (Agboola et al. 2024).

Since government revenue in energy-exporting economies is heavily influenced by the energy sector, understanding the expenditure-revenue relationship is essential. The budgetary process plays a crucial role in this dynamic, particularly in small, open economies (Pieschacón 2012), where the expenditure-revenue nexus has been widely studied (Narayan and Narayan 2006; Saunoris and Payne 2010). However, much of this research has focused on economies where the energy sector does not play a dominant role (Dizaji 2014). Even when the expenditure-revenue relationship is analyzed in energy-dependent economies, it is often overshadowed by broader macroeconomic indicators such as GDP and exchange rates, limiting the depth of fiscal analysis. Given that the energy sector is typically the single largest contributor to government revenue, export earnings, and foreign exchange reserves, an explicit investigation of this nexus is necessary.

Existing studies have attempted to differentiate between energy and non-energy revenue (Al Jabri et al. 2022) and between current and capital expenditures (CAPs) (Farzanegan 2011). However, they fail to consider the distinction between permanent and transitory revenue, which is crucial for assessing fiscal equilibrium. This distinction is critical since, as Tanzi (1982) argues, fiscal equilibrium is not simply achieved when total revenue equals total expenditure. In fact, a balanced budget on paper may often conceal deeper, underlying imbalances. True fiscal equilibrium depends on aligning permanent revenue (PREV) with permanent expenditure (PEXP)[2]. When non-permanent (or transitory) revenue sources, such as asset sales, windfall gains, or one-time tax receipts, are used to finance PEXPs, this creates a mismatch that can lead to fiscal disequilibrium. Tanzi (1982) also identifies key contributors to fiscal disequilibrium in energy-exporting nations, including the destabilizing effects of export booms on government revenue and the influence of political pressures and weak institutions on expenditure patterns. These factors are particularly relevant for small, open, energy-exporting economies that face frequent energy sector shocks and implement procyclical fiscal policies (see, e.g., Rahaman and Mahadeo 2024).

Despite extensive research on energy-exporting economies and their macroeconomic linkages (Al Jabri et al. 2022; Bjørnland and Thorsrud 2019; Durand-Lasserve and Karanfil 2023; García-Albán et al. 2021), there remains a clear gap in the literature concerning fiscal equilibrium. Most studies focus on aggregate revenue and expenditure, or on energy revenue and expenditure, but they fail to assess fiscal equilibrium through the lens of PREV and PEXP, which is particularly important for energy-exporting nations. This paper seeks to bridge this gap by making two key contributions. First, while Tanzi (1982) introduced and described the concept of fiscal equilibrium, the work remains largely theoretical, with no formal empirical framework for testing its validity. Moreover, no existing study has proposed a measure for fiscal equilibrium or a methodology for its empirical examination.

To address this, we introduce a robust and effective measure of PREV for energy-exporting economies and propose a cointegrated approach to test the existence and strength of fiscal equilibrium. Specifically, we build on the export-boom scenario and incorporate the concept of a "neutral revenue trend", as outlined in Mansfield (1980), to differentiate between permanent and transitory budgetary components. Given the volatility of energy revenues, capturing their structural component requires a method that smooths out temporary fluctuations while preserving the underlying long-term pattern. Statistical filters such as those developed by Hodrick and Prescott (1997) and by Hamilton (2018) are well-established in the macroeconomic literature for this purpose. We apply these tools to extract the trend component of energy revenue, which is essential for identifying a long-run fiscal signal for energy-exporting economies.

We then combine this filtered trend with non-energy revenue to construct a measure of PREV that is theoretically grounded in the concept of a "neutral revenue trend" (Mansfield 1980) and empirically measurable using established statistical filters and standard reporting practices in energy-dependent economies. Building on this foundation, we apply cointegration tests to examine the long-run relationship between PEXP and revenue, thereby assessing fiscal equilibrium in the case of Trinidad and Tobago (T&T). We select T&T as our case study because it exemplifies a small, open economy with deep energy dependence (Mahadeo 2020) and a history of underperformance despite its resource endowment (Auty 2017). Studying such economies is particularly valuable, as energy price shocks tend to have more significant macroeconomic effects on smaller economies relative to larger counterparts (Abeysinghe 2001). Our framework and methodology are designed to be applicable to other small, open, energy-dependent economies, such as Norway, Bahrain, Kuwait, and Oman, providing a replicable approach to calculating PREV and assessing fiscal equilibrium.

We also recognize that fiscal equilibrium may be a dynamic process rather than a static state, given the real-world challenges faced by energy-exporting economies; achieving true fiscal equilibrium may be challenging. As such, we use the work of Hamilton and Flavin (1986) and Quintos (1995) to describe "strong form" and "weak form" fiscal equilibrium, respectively. "Strong form" fiscal equilibrium occurs when PREV and PEXP are well-aligned over the long term, with any deviations being fully corrected, and "weak form" fiscal equilibrium happens when PREV and PEXP are linked in the long-run, but the adjustment is partial and gradual. The concept of "weak form" fiscal equilibrium is particularly meaningful in practice, as it reflects the reality that, in energy-dependent economies like T&T, the adjustment process may be slow, inefficient, and influenced by political, institutional, and economic factors. By adopting this more flexible approach, we provide a more practical understanding of fiscal equilibrium in energy-dependent economies.

Our second main contribution is an investigation into the presence and magnitude of asymmetries in the relationship between PEXP and PREV. Asymmetries capture the differing effects of increasing versus decreasing revenue on government spending. This distinction is crucial, as expenditure tends to be downwardly sticky when revenue declines but more flexible and elastic when revenue increases. Existing studies on the expenditure-revenue nexus often overlook this asymmetry by treating revenue and expenditure as aggregates rather than distinguishing between their permanent and transitory components. We introduce a novel approach that focuses exclusively on permanent components, allowing for a more precise assessment of the true relationship without distortions from temporary fluctuations. To achieve this, we employ the non-linear autoregressive distributed lag (NARDL) framework to assess both the short-run and potential long-run asymmetries in the expenditure-revenue relationship.

Understanding the extent of fiscal equilibrium and potential asymmetries is crucial for energy-dependent economies, as revenue volatility and expenditure elasticity pose ongoing challenges. By focusing on permanent budgetary components and uncovering asymmetries in expenditure responses, our study provides a fresh perspective and a necessary step toward developing more resilient economic policies for fiscal equilibrium. In doing so, we offer insights that extend beyond T&T, providing a framework for computing PREVs and testing for fiscal equilibrium in other resource-rich nations navigating the complexities of energy-driven fiscal cycles.

The remainder of this paper is as follows: in Section 2, we present a review of the theoretical and empirical literature related to the expenditure-revenue nexus; we present the data in Section 3. The cointegration and fiscal equilibrium frameworks are discussed in Section 4, and we examine the budget dynamics in Section 5. We present some policy implications and conclude in Section 6.

2 | Literature Review

2.1 | Theoretical Literature

We begin with the theoretical literature which falls within two distinct categories that capture the unidirectional relationship and the bidirectional relationship between government expenditure (EXP) and revenue (REV). The unidirectional relationship comprises two hypotheses, namely the tax-and-spend hypothesis and the spend-and-tax hypothesis. Friedman (1979) proposes that there is a positive causal relationship between taxation and EXP as the government spends all revenue raised from taxation, thus giving rise to the tax-and-spend hypothesis. Peacock and Wiseman (1961, 1979) hold an opposing view and propose that there is a unidirectional causal relationship from EXP to tax policies and REV, and this is referred to as the spend-and-tax hypothesis. Furthermore, governments increase expenditure to deal with crises and shocks, and this is funded by temporary tax policies. When this expenditure becomes permanent, so do the tax policies (Narayan 2005). The bidirectional category features the fiscal synchronization hypothesis with the key idea of a simultaneous relationship between EXP and REV. In essence, it incorporates both hypotheses from the unidirectional category. One of the first to highlight such a relationship is Musgrave (1966) while identifying key functions of a budget policy including income redistribution.

2.2 | Empirical Literature—Non-Energy Economies

To continue, we explore the empirical literature for non-energy economies on the relationship between EXP and REV, which is quite extensive as public economics is a significant area of interest for both developed economies (see, e.g., Saunoris and Payne 2010) and developing economies (see, e.g., Narayan and Narayan 2006), and much of the empirical literature on the EXP–REV nexus focuses on testing these three hypotheses. One of the more popular studies comes from Afonso and Rault (2010) as they investigate the nexus across a panel of EU15 and EU25 countries between 1960 and 2006 using the simple but effective Wald test for Granger causality with bootstrapped critical values. The authors find evidence of spend-and-tax causality for Austria, Italy, France, Spain, Greece, and Sweden, but tax-and-spend causality for Belgium, Germany, Luxembourg, and the UK.

Perhaps even more importantly, understanding the EXP-REV nexus is imperative for developing economies and small states, and two of the more common studies emanate from Narayan (2005) and Narayan and Narayan (2006). Narayan (2005) begins with an investigation of the nexus in nine Asian economies using the conventional F-test for Granger causality, and the results reveal mixed causation. Like Baghestani and McNown (1994), Narayan and Narayan (2006) investigate the relationship between EXP and REV with GDP as a control variable using a sample of 12 developing economies from the Caribbean, South America, and Africa, and the authors find a diverse range of results from the Granger causality tests.

One glaring consensus in the empirical literature prior to 2010 revolves around the estimation techniques, primarily centred on the Engle-Granger and Johansen tests for cointegration, as well as the Granger causality test. However, the results are quite varied. Overall, for non-energy exporting economies, the literature demonstrates support for all three hypotheses across a diverse range of developed and developing economies. Further to this, it highlights that some economies transition from spend-and-tax to tax-and-spend, and the converse holds true.

2.3 | Empirical Literature—Energy-Dependent Economies

Now, we turn our attention to energy-dependent economies where oil and other hydrocarbon revenue plays a crucial role in the political economy and the budgetary process (see, e.g., Farzanegan 2011). However, empirical studies investigating the link between energy revenue and expenditure are infrequent relative to its total counterpart (Hassan 2021). Given the dynamic relationship between EXP and REV in energy-exporting countries, understanding the EXP-REV nexus is vital, especially if fiscal policy is procyclical. Fasano and Wang (2002) investigate the relationship between the variables within the budgetary process across the Gulf Cooperation Council (GCC) countries. Not surprisingly, the results support the tax-and-spend hypothesis across the six Arab countries, especially as the largest share of revenue comes from oil. Given the magnitude and frequency of oil price shocks and the volatility of oil revenue, the authors propose a fiscal policy adjustment so that expenditure is less driven by current revenue availability, and in essence, transitions fiscal policy to a countercyclical stance. They also propose fiscal rules to direct excess revenue away from the budget to a stabilisation fund. In another oil-dependent nation—Iran—Dizaji (2014) finds a strong tax-and-spend channel but a weak spend-and-tax channel. Hamdi and Sbia (2013) are agreeable as they confirm the tax-and-spend hypothesis in Bahrain.

For energy-dependent economies, it is also important to understand and investigate the presence of asymmetry in the EXP-REV nexus. Hassan (2021) undertakes such an investigation across a panel of 34 oil-exporting countries between 1980 and 2018 using an autoregressive distributed lag (ARDL) and its non-linear complement (NARDL) to investigate symmetry and asymmetry respectively. The results from the ARDL estimation support the tax-and-spend hypothesis in both the short and long-run. Using the Wald test to detect the presence of asymmetry, the author finds that the relationship between oil revenue and EXP is asymmetric and that the impact of a positive shock to oil revenue is greater than a negative shock. A deeper analysis using a component of government expenditure—health expenditure—shows that in the long-run, negative changes in oil revenue can dampen health expenditure while the converse holds true but to varying degrees. Military expenditure is another component of total expenditure that is often assessed in the literature. Using a sample of seven OPEC nations, Bakirtas and Akpolat (2020) find that military expenditure is heavily influenced by oil revenue, and for some countries that are even more dependent on oil revenue such as Saudi Arabia, it can destabilize the economy.

Despite extensive studies on the EXP-REV nexus, no research has specifically investigated the relationship between permanent EXP and permanent REV, particularly in energy-dependent economies that face the volatility of energy price shocks. The theoretical literature provides the foundation for understanding fiscal interactions, offering key hypotheses that guide our analysis, while empirical studies highlight variations across different economies. However, while studies have explored both aggregate and disaggregate relationships between EXP and REV (see, e.g., Bakirtas and Akpolat 2020; Hassan 2021), none have explicitly examined how their permanent components interact. This gap is particularly important for energy-dependent economies (especially small, open economies), where fiscal decisions are heavily influenced by fluctuating energy revenues, yet the long-term sustainability of EXP and REV remains unexamined. Additionally, the aforementioned findings on asymmetry suggest that REV changes impact EXP differently in various contexts, reinforcing the need to explore how permanent fiscal components evolve over time. Tanzi (1982) emphasizes that understanding permanent REV and EXP is as relevant for governments as for individuals, and this perspective shapes the focus of our study.

3 | Data Description

T&T has monetized oil more than 100 years ago, starting in 1918, and has subsequently discovered gas in 1968. Since then, the economy has produced and exported natural gas and its associated hydrocarbon products. Given its reliance on not just oil but gas and other hydrocarbon products, key statistics such as REV, export earnings, and GDP are classified and recorded as energy and non-energy related. According to the Central Bank of Trinidad and Tobago (CBTT), the term energy includes petroleum and its related products such as crude oil as well as other hydrocarbon products including liquefied natural gas, natural gas liquids, fertilizers, methanol, and other extractive companies and service contractors within the sector. Between January 1991 and August 2023, energy revenue (ER) as a percent of REV averaged 31.8% and peaked at 76.0% in July 2022. In a similar vein, the three decades from 1991 to 2023 showed earnings from energy exports averaged 39% and 81.8% of GDP and total exports respectively (see Figure A1). This reinforces the continued importance of the energy sector to T&T, as there have been few meaningful efforts to diversify the economy thus far, which reinforces the importance and relevance of our study.

We explore the Tanzi (1982) concept of fiscal equilibrium from myriad angles. To begin our analysis, we adopt what Mansfield (1980) describes as a "neutral revenue trend," representing the level of revenue the government earns if they follow steady patterns, and not affected by pronounced fluctuations. We use this to reflect PREV. It is fundamentally incorrect to completely ignore or remove ER and refer to only non-energy revenue as PREV given that the energy sector has formed the bedrock of the T&T economy for decades. Instead, we define PREV as the sum of non-energy revenue and the trend energy revenue. We describe trend ER as the long-term, smooth, and persistent revenue earned by the government from the energy sector which ignores temporary or high-frequency fluctuations due to transient positive and negative shocks. To derive trend ER, we use the Hodrick and Prescott (1997) (HP) filter, one of the most widely used techniques for decomposing an economic series into its trend and cyclical components (Jönsson 2020).

The HP filter is easy to apply, does not impose a fixed structural form on the smoothed data, and penalizes excessive variations in the trend component (see, e.g., Weron and Zator 2015). Consequently, it is extensively used in macroeconomics and by policymakers (Alfaro and Drehmann 2023). For instance, He et al. (2013) apply the HP filter with a smoothing parameter (λ) of 14,400 to decompose monthly energy prices into trend and cyclical components, while Nan et al. (2022) also adopt it to measure global oil price fluctuations. However, despite its widespread use, the HP filter has notable limitations. Hamilton (2018) argues that it introduces spurious dynamics unrelated to the data generation process and suffers from end-of-sample bias, which can distort trend estimates. To address these shortcomings, the Hamilton filter is proposed as an alternative designed to achieve the same objectives while mitigating these weaknesses, and is gaining traction in the empirical energy economics literature (see, e.g., Heinlein and Mahadeo 2023, 2025). Nevertheless, the HP filter remains one of the most routinely utilized methods for decomposing economic variables into trend and cyclical components and continues to be an appealing option (Phillips and Jin 2021).

As such, we use the HP filter as our baseline method since it is more commonly employed in the analysis of energy-commodity prices (see, e.g., He et al. 2013; Nan et al. 2022). Additionally, Figure 1 (Panel B) displays a time series plot of PREV derived using both filters, where the HP filter maintains a larger sample size since the Hamilton filter omits 36 data points in its computation. The HP filter also excels in smoothing out short-term volatility, providing a clearer representation of the long-term revenue trend (see Table for descriptive statistics, including standard deviation highlighting the lower volatility of PREV using the HP filter). We then use PREV calculated with the Hamilton filter as a robustness check, with an 86% correlation to the HP filter.

To define PEXP, we draw on a combination of data-driven rationale and the work of Ahmed (1986), who described PEXP as that part of government expenditure that can reasonably be expected to continue indefinitely. In other words, it represents the portion of government spending that remains stable over time. Common examples of PEXP include spending on public pensions and salaries for civil servants, both of which are ongoing commitments that typically do not fluctuate significantly year to year. In the case of T&T, we define PEXP as the sum of obligatory expenditures, including wages and salaries, transfers and subsidies, and interest payments. These are all recurring costs that governments are legally or contractually bound to pay. Wages and salaries reflect the ongoing commitments to public sector employees; transfers and subsidies are regular payments to individuals or organizations (such as welfare programs), and interest payments are fixed obligations resulting from national debt. These expenditures are typically stable and predictable, thus forming the core of permanent government spending, which accounts for an average of 73.5% of EXP between 1991 and 2023.

For completeness and robustness, we use current expenditure (PEXP-C) to represent PEXP, as it accounts for over 91.0% of EXP over the same period. Current expenditure includes stable, ongoing costs that are central to government operations, which typically do not fluctuate significantly. It also captures costs that may have been missed by PEXP alone. Specifically, PEXP accounts for an average of 81% of PEXP-C, allowing us to capture the remaining 19% of expenditure not fully reflected in PEXP. With a 99% correlation between PEXP and PEXP-C, this high correlation not only validates the use of current expenditure as a reliable proxy for PEXP but also ensures that our analysis is comprehensive, capturing key aspects of PEXP.

Our total sample consists of monthly data spanning from January 1991 to August 2023 (1991m01 to 2023m08) which we select based on data availability. The sample covers just over three decades of economic history, and the high frequency allows us to examine granular nuances in the budgetary process. We describe the main variables in Table 1, and we present the descriptive statistics of the main variables as well as their total components in Table A1.

In Figure 1 panel A, we show the movements between REV and ER. ER closely mirrors REV, highlighting its dominant role in national earnings. REV surges during energy booms (e.g., 2003–2008, 2010–2014, post-2020) and declines during downturns, showing the economy's reliance on the energy sector. Similarly, panel B shows that the behavior of PREV (as measured by the HP filter) and PREV-H (as measured by the Hamilton filter) aligns with REV but exhibits significantly lower volatility as it smooths out short-term fluctuations. While REV experiences sharp spikes and crashes during energy booms and downturns, PREV presents a more stable trend. However, PREV-H shows slightly greater variability than PREV, suggesting that it captures some short-term fluctuations—though still far less than REV. In fact, the standard deviation of REV and PREV is TT$2,161 million and TT$1,636 million, respectively (see Table A1).

Panel C shows that PEXP and PEXP-C track EXP closely but remain at lower levels, reflecting their role as core components. The alignment of the series indicates that changes in EXP are largely reflected in its permanent components, with some variation in magnitude likely due to temporary or discretionary spending. Finally, we highlight the proportion of PREV to REV in panel D. A ratio greater than one indicates a downturn in T&T's energy market, as actual ER falls short of trend ER, whereas a ratio below one suggests the opposite. On average, the ratio is 0.69 during booms and 1.26 during recessions, confirming a long-term structural weakening of the energy sector, with more frequent and severe downturns post-2000. This ratio can also serve as a leading or concurrent indicator of economic conditions in energy-dependent nations and aid in budgetary forecasting and fiscal planning (discussed further in the policy implications section of the paper).

Next, we propose that a bivariate cointegration test is sufficient to test for fiscal equilibrium, with the cointegrating vector determining the strength of fiscal equilibrium if it exists. With the cointegrating vector $(1, \beta)$, β captures the strength and direction of the cointegrating relationship. As mentioned in the introduction, we draw on the work of Hamilton and Flavin (1986) and Quintos (1995) to introduce the concepts of "strong form" and "weak form" fiscal equilibrium, capturing the complexities of real-world dynamics. Once a cointegrating relationship is established, fiscal equilibrium exists. Specifically, "strong form" fiscal equilibrium is characterized by a cointegration vector of $(1, -1)$, which implies that PEXP and PREV are well-aligned, with any adjustments in PREV being met by corresponding adjustments in PEXP. In contrast, "weak form" fiscal equilibrium occurs when the parameter β lies between zero and one, suggesting a relationship between PEXP and PREV, but one that is not completely aligned. In this case, convergence between PEXP and PREV is not guaranteed; instead, there is a tendency for convergence driven by adjustments and uncertainty. Furthermore, we propose that the absence of cointegration may signal fiscal disequilibrium.

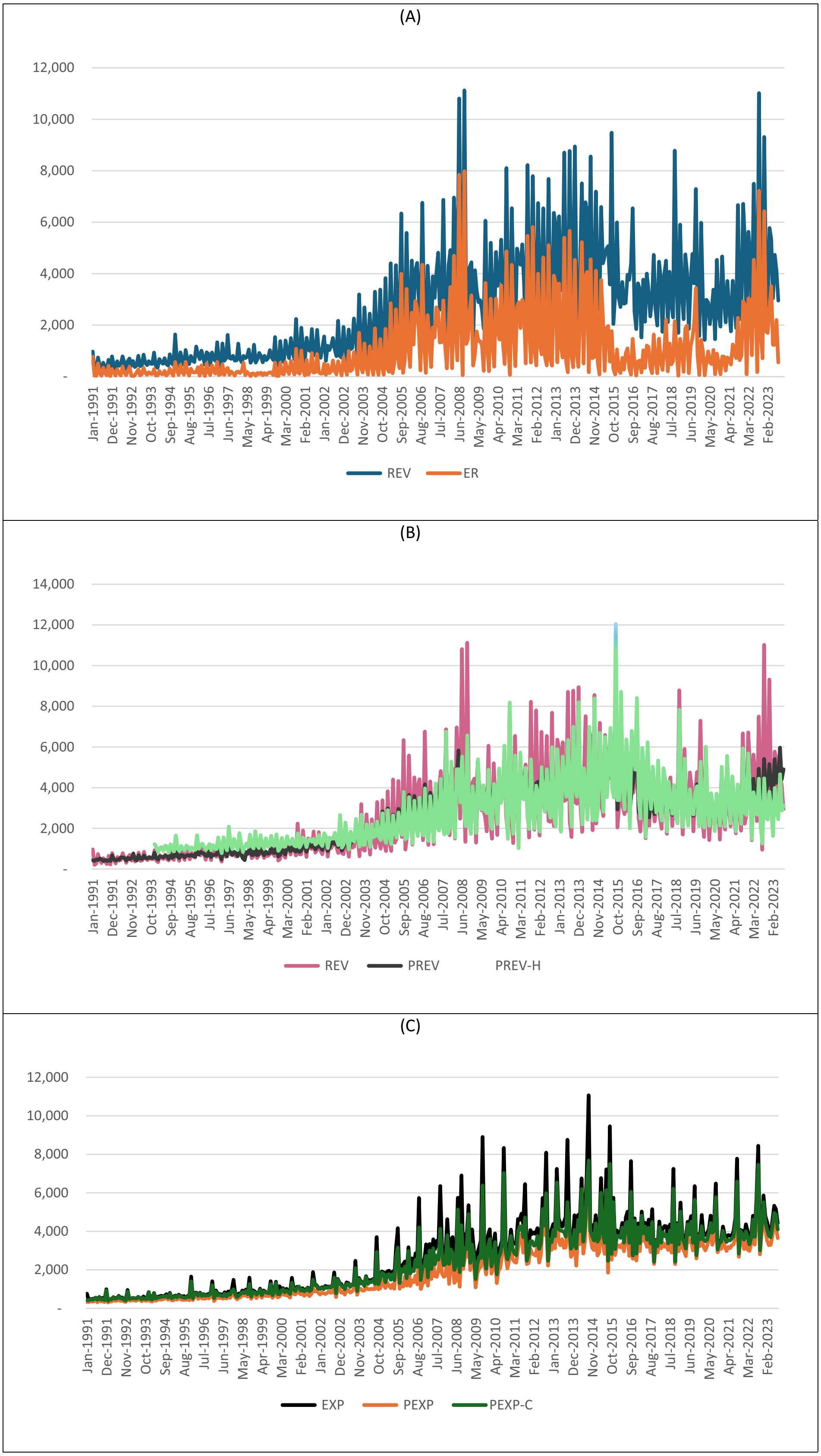

FIGURE 1 | Revenue and expenditure (TT$ million—current value). *Note:* Panel (A) illustrates the time series plot of total revenue (REV) and energy revenue (ER); panel (B) plots REV, permanent revenue as measured by the HP filter (PREV) and the Hamilton filter (PREV-H); panel (C) plots total expenditure (EXP), permanent expenditure (PEXP) and recurrent expenditure (PEXP-C) and panel (D) plots the ratio of PREV to REV. *Source:* Central Bank of Trinidad and Tobago and authors' calculations. [Colour figure can be viewed at wileyonlinelibrary.com]

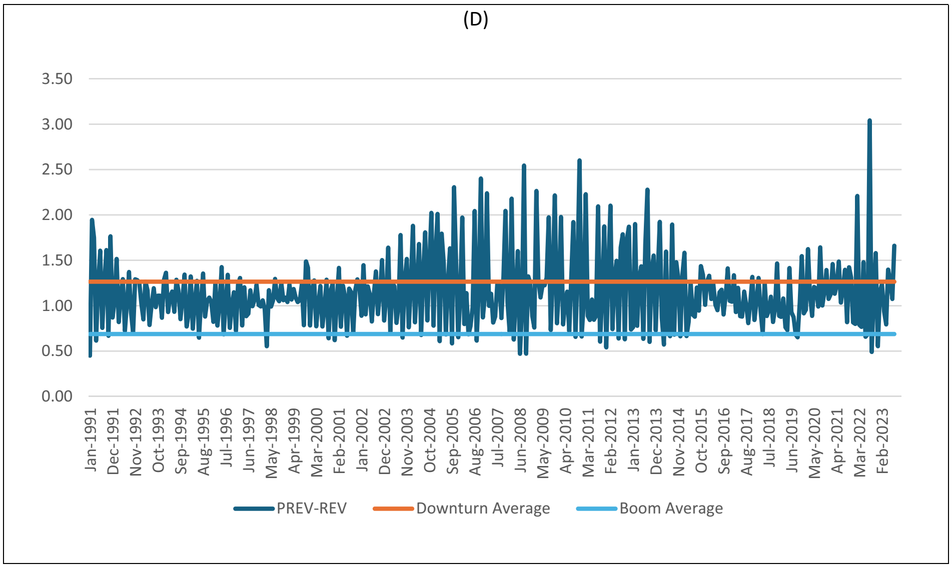

FIGURE 1 | (Continued)

TABLE 1 | Variable description.

Variable	Description	Source
PREV	Permanent revenue is the sum of non-energy revenue and trend energy revenue measured in current value. Trend energy revenue is computed using the HP filter with a smoothing parameter of 14,400 for monthly data.	Central Bank of Trinidad and Tobago (CBTT) and authors' calculations.
PEXP	Permanent expenditure is expenditure that are ongoing or mandatory and is computed as the sum of wages and salaries, transfers and subsidies and interest payments, measured in current value.	CBTT and authors' calculations.
PEXP-C	Permanent expenditure as measured by current expenditure. Current expenditure is the governments recurring expenditure for routine operations, measured in current value.	CBTT and authors' calculations.

TABLE 2 | Stationarity tests.

	ADF test (levels)			ADF test (first difference)		
	Trend	No constant	Drift	Trend	No constant	Drift
Permanent expenditure (PEXP)	−0.185	4.712	−1.562	−10.156**	−10.003**	−8.502**
Permanent revenue (PREV)	−0.752	3.284	−1.836**	−6.582**	−6.437**	−5.669**
Permanent expenditure (PEXP-C)	0.122	4.947	−1.901**	10.200**	−8.411**	−9.955**

Note: We use the Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC) to select 12 lags for the ADF test. The null hypothesis is the presence of unit roots or non-stationarity, and ** denotes the rejection of the null hypothesis at 5% level of significance.

4 | Cointegration and Fiscal Equilibrium

To ensure the robustness of our cointegration and causality tests, it is essential to first examine the underlying assumptions, particularly regarding stationarity and the presence of structural breaks. These assumptions are crucial because the validity of the Johansen approach depends on the stationarity of the time series data, and any potential structural breaks must be accounted for. Given these conditions, we conduct a series of pretests to verify the stationarity of our variables and account for any potential structural shifts. Using the natural logarithms of our measures of PEXP and PREV, we apply the Augmented Dickey-Fuller (ADF)[3] test for stationarity and display the results in Table 2. Based on the results, we conclude that each variable has a unit root in levels but becomes stationary in the first difference. Additionally, it is pertinent to mention that from the time series plot of both PEXP and PREV in Figure 1, we observe that there may be a structural shift or break in both series between 2005 and 2010. To ensure the robustness of our results, we continue with the Zivot-Andrews unit root test, which accounts for

TABLE 3 | Stationarity tests with structural breaks.

	Zivot-Andrews test (levels)			Zivot-Andrews test (first difference)		
	Trend (T)	**Intercept (I)**	**T & I**	**Trend (T)**	**Intercept (I)**	**T & I**
Permanent expenditure (PEXP)	−3.248	−3.149	−3.439	−15.454**	−15.824**	−15.878**
Permanent revenue (PREV)	−2.862	−3.544	−4.041	−6.993**	−7.714**	−7.836**
Permanent expenditure (PEXP-C)	−3.318	−3.416	−3.779	−17.054**	−17.274**	−17-470**

Note: See notes from Table 2.

TABLE 4 | Johansen test for cointegration—Trace statistics.

	Maximum rank	Trend	Restricted trend	Constant	Restricted constant	No trend
Specification 1	0	35.383	41.012	26.504	60.136	55.002
	1	3.289**	4.112**	3.168**	3.927**	0.895***
Specification 2	0	39.194	45.263	27.015	60.366	50.624
	1	2.022**	3.267**	3.022**	4.529**	2.768**

Note: PREV is permanent revenue, PEXP is permanent expenditure, and PEXP-C is permanent expenditure as captured by current expenditure. PREV and PEXP are examined in specification 1, and PREV and PEXP-C are examined in specification 2. We use the SIC and AIC to select 12 lags for the Johansen test. The null hypothesis is that no cointegration exists, and ** denotes the rejection of the null hypothesis at the 5% level of significance. The maximum eigenvalue statistics support this conclusion.

TABLE 5 | Gregory-Hansen test for cointegration.

	Level (constant)	Regime (constant and trend)	Regime trend (constant, trend and slope)
Specification 1			
Z-statistic	−19.40**	−21.09**	−22.74**
Breakpoint	2010m07	2010m07	2010m07
Specification 2			
Z-statistic	−20.58**	−22.83**	−24.05**
Breakpoint	2010m07	2010m07	2010m07

Note: The null hypothesis is that there is no cointegration after accounting for a structural break; the alternative hypothesis is the presence of cointegration with a structural break at a specified breakpoint. ** denotes the rejection of the null hypothesis at the 5% level of significance. See all other notes from Table 4.

structural breaks. The results affirm that each variable has a unit root in levels in the presence of structural breaks. We illustrate the results in Table 3.

We follow with the Engle-Granger (EG) test for cointegration on two bivariate specifications. The first specification (specification 1), serving as our baseline, examines the relationship between PEXP and PREV, while the second specification (specification 2) considers PEXP-C and PREV. The EG test suggests that fiscal equilibrium exists in T&T by confirming the presence of cointegration in both specification 1 and 2, with test statistics of −13.18 and −15.60, respectively, rejecting the null hypothesis of no cointegration at all conventional levels of significance. However, the EG test only confirms the presence of fiscal equilibrium, not its strength.

Therefore, we proceed with the Johansen test for cointegration. The Trace statistics from Table 4, based on the five available trend options ((i) trend, (ii) restricted trend, (iii) constant, (iv) restricted constant, and (v) no trend or constant), indicate the presence of cointegration, with one cointegrating vector in each specification. Following an inspection of the time series plots in Figure 1, we proceed with the restricted trend and restricted constant options since the undifferenced data exhibits no clear deterministic trends. In a similar vein to the structural break from the unit root test, we employ the Gregory–Hansen test for cointegration, which accounts for the possibility of structural breaks and is more robust than the Johansen test in the presence of structural breaks. The results in Table 5 further support a cointegrated relationship and reinforce our conclusion regarding fiscal equilibrium.

Following Fasano and Wang (2002), AbuAl-Foul and Baghestani (2004), and Farzanegan (2011), we then estimate a vector error correction model (VECM) and we specify the bivariate VECM as:

$$\Delta y_t = \alpha \beta' y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \nu + \epsilon_t \quad (1)$$

where y is the vector of variables from specifications 1 and 2, respectively, with the measure of PEXP as the dependent variable,

TABLE 6 | Extracts from the VECM estimations.

		Restricted trend	Restricted constant
Specification 1	ECT	−0.517*** (0.094)	−0.204*** (0.030)
	β	−0.601*** (0.052)	−0.919*** (0.059)
Specification 2	ECT	−0.793*** (0.125)	−0.260*** (0.036)
	β	−0.663*** (0.032)	−0.897*** (0.044)

Note: Standard errors are in parentheses; *** denotes statistical significance at the 1% level of significance, and ECT is the error correction term. See notes on Table 4 for the specification description.

α is the vector of adjustment coefficients, β is the parameter in the cointegrating equations, Γ is the matrix of short-run coefficients, Δ is first difference operator, v is the vector of parameters, and ϵ_t is the white noise error term.

Conforming to our a priori expectations, we find that for both specifications, the coefficient β is negative which implies that there is a positive relationship between PEXP and PREV. That is, a decrease in PREV leads to a decrease in PEXP in the long-run. The converse holds true. For specification 1, the β lies between 0.60 and 0.92 and for specification 2, it lies between 0.66 and 0.90. It is also noteworthy to mention that for both specifications 1 and 2, the coefficient of β is conspicuously close to −1 when we include the trend specification with a restricted constant, and we illustrate this in Table 6. This suggests that "weak form" fiscal equilibrium exists in T&T, which is intuitively accurate and reflects the patterns of budgetary behavior. For instance, the wages and salaries component of PEXP is difficult to adjust, but transfers and subsidies are often altered to reflect the changes in PREV. Additionally, fiscal adjustments are typically gradual, with changes in policy occurring as a response to shifting revenue levels, often influenced by both economic factors and the government's fiscal priorities at the time.

Furthermore, the error correction term (ECT) is negative and statistically significant, which suggests that short-run deviations will adjust and converge to long-run equilibrium between PREV and PEXP. For specifications 1 and 2, the corrective force varies between 0.20 and 0.79, but they all indicate disequilibrium correction occurs relatively quickly, and we illustrate this in Table 6.

To reinforce the validity of the results in Table 6 and further highlight the novelty of the fiscal equilibrium test, we examine the relationship between the total components of the budgetary process—EXP and REV. Similar to the findings from specifications 1 and 2, the Johansen test (with a trend, restricted trend, and constant) confirms the presence of cointegration with one cointegrating vector. However, when we include a restricted constant or omit the trend and constant, no cointegration is found (see Table A2). This divergence underscores the value of our study, as fiscal equilibrium holds across all trend specifications. By inspecting the time series plots in Figure 1 and the results from the cointegration tests, we proceed with the VECM under a restricted trend, with results presented in Table A3. The ECT of −0.64 is below the upper bound of 0.79 from Table 6, suggesting a slower correction of disequilibrium when considering EXP and REV. However, the estimated β of 0.90 aligns with the upper bound observed in specifications 1 and 2, reinforcing the presence of weak equilibrium in the budgetary process. Notably, these results are largely consistent with specification 2 (restricted trend), where PEXP is proxied by current expenditure—which consistently accounts for over 90% of EXP.

As mentioned earlier, we calculate trend ER using the Hamilton filter (PREV-H) as a measure of robustness. However, the results were not statistically significant with both alternatives for PEXP. We also use the suggested breakpoint from the Gregory-Hansen test from Table 5 to split the full sample into two subsamples: 1991 to 2010 m06 and 2010 m7 to 2023; we repeat our analysis. The results from the first subsample were similar to the full sample but with varying magnitudes, while the cointegration results were inconclusive for the second subsample; this could be due to the short subsample size after accounting for 12 lags. We parsimoniously exclude these results, but they are available upon request.

Overall, our baseline estimates from specification 1 supports fiscal equilibrium and the size of β supports "weak form" fiscal equilibrium, and these findings are consistent with specification 2 as well as estimates including structural breaks. It is important to note that the categorization of the relationship between PREV and PEXP as "weak form" equilibrium, with a coefficient $\beta < 1$, reflects the practical realities of fiscal adjustments in energy-dependent economies, such as T&T. This slower adjustment process is influenced by structural and institutional factors (see, e.g., Durand-Lasserve and Karanfil 2023; Moshiri 2015) that hinder the efficient alignment of PREV and PEXP. Thus, while $\beta \neq 1$ suggests the presence of fiscal equilibrium, it also underscores the fact that fiscal policy in such economies tends to correct imbalances over a more extended period. The gradual nature of these adjustments does not signal a failure of fiscal equilibrium but rather aligns with the observed fiscal dynamics in energy-dependent economies.

5 | Understanding Budget Dynamics

We further employ the pairwise Granger causality test to examine the direction of the budgetary relationship and find that the tax-and-spend hypothesis exists for T&T. That is, the causal relationship flows from PREV to PEXP, as indicated in Table 7. This causal relationship is particularly crucial for energy-dependent economies like T&T, where fiscal policy tends to be procyclical (Rahaman and Mahadeo 2024). This results in significant vulnerabilities, as energy revenues can fluctuate dramatically due to external shocks, amplifying both economic booms and recessions. Historical data from 1970 to 2021 supports this, highlighting the impact of such fluctuations (see, e.g., Rahaman 2024). Therefore, fiscal policy should shift toward a countercyclical approach, reducing reliance on energy revenues and focusing on developing a more diversified and stable fiscal base toward the non-energy sector, driven by policy reform and structural transformation (see, e.g., Agboola et al. 2024).

TABLE 7 | Granger causality tests.

Causal relationship	F-statistic
PREV → PEXP	3.68044***
PEXP → PREV	1.10640
PEXP-C → PREV	1.27700
PREV → PEXP-C	3.91962***
PEXP-C → PEXP	3.24887***
PEXP → PEXP-C	2.31304***

Note: Where the null hypothesis is that no Granger causality exists. *** denotes the rejection of the null hypothesis at the 1% level of significance and PREV is permanent revenue, PEXP is permanent expenditure, and PEXP-C is permanent expenditure as captured by current expenditure. We apply the Granger causality test on the level variables given the presence of cointegration from Tables 4 and 5 using 12 lags based on the AIC and SIC.

Achieving this also requires strong fiscal discipline, ensuring that surplus revenues during periods of growth are invested and properly managed, as demonstrated by T&T's stabilization fund, which can provide a buffer during economic downturns and help stabilize the economy. This finding is also consistent with other energy-exporting nations such as Iran (Dizaji 2014) and Bahrain (Hamdi and Sbia 2013). Additionally, the bidirectional relationship between PEXP and PEXP-C indicates a rigid fiscal structure with limited budget flexibility for CAP. This is further reinforced by the bidirectional relationship between CAP and both PEXP and PEXP-C (see Table A4), suggesting that CAP is, at times, driven by PEXP and PEXP-C rather than being purely discretionary. As a result, this increases the risk of a crowding-out effect, where rising current expenditure constrains the ability to allocate funds toward capital projects.

Similar to the empirical work of da Costa António and Rodriguez-Gil (2020) on oil-exporting developing economy—Angola, we continue by using our computations of PREV and PEXP to investigate the presence of an asymmetric relationship since we hypothesize that, at times, PEXP can exhibit downward stickiness or be inelastic in its response to declining PREV, while PEXP may exhibit upward responsiveness or flexibility and be elastic in its response to rising PREV. Several approaches, including momentum threshold autoregression (MTAR) (Paleologou 2013) and quantile cointegration (Chen 2016), have been used to investigate asymmetry. However, as summarized in Khan et al. (2022), one of the more popular methods is the NARDL model proposed by Shin et al. (2014). In contrast to the Johansen cointegration approach, which typically requires all variables to be stationary or integrated of the same order, the NARDL model can accommodate both stationary and non-stationary variables, providing greater flexibility in analyzing diverse time series data. Additionally, it mitigates endogeneity issues in the short and long-run, and provides super-consistent estimates even with small samples (Murthy and Okunade 2016). As such, we adopt this approach and compute the partial sums to capture asymmetry as follows:

Let the positive deviations in PREV be

$$PREV^{+} = \sum_{n=1}^{t} \Delta PREV_t^{+} = \sum_{n=1}^{t} \max(\Delta PREV, 0) \tag{2}$$

Let the negative deviations in PREV be

$$PREV^{-} = \sum_{n=1}^{t} \Delta PREV_t^{-} = \sum_{n=1}^{t} \min(\Delta PREV, 0) \tag{3}$$

Then, we specify the NARDL as:

$$\Delta PEXP_t = \delta_0 + \sum_{i=1}^{p} \alpha_1 \Delta PEXP_{t-i} + \sum_{i=1}^{n} \alpha_2^{+} \Delta PREV_{t-i}^{+} + \sum_{i=1}^{n} \alpha_2^{-} \Delta PREV_{t-i}^{-} + \rho PEXP_{t-1} + \delta_1^{+} PREV_{t-1}^{+} + \delta_1^{-} PREV_{t-1}^{-} + \epsilon_t \tag{4}$$

where δ^{+} and δ^{-} are the respective asymmetric long-run parameters for changes in positive and negative shocks to PREV, and where α^{+} and α^{-} are its short-run counterparts. In error correction form, it is represented as:

$$\Delta PEXP_t = \sum_{i=1}^{p} \alpha_1 \Delta PEXP_{t-i} + \sum_{i=1}^{n} \alpha_2^{+} \Delta PREV_{t-i}^{+} + \sum_{i=1}^{n} \alpha_3^{-} \Delta PREV_{t-i}^{-} + \rho EC_{t-1} + \epsilon_t \tag{5}$$

where $EC_{t-1} = PEXP_{t-1} - \phi_0 - \phi_1^{+} PREV_{t-1}^{+} - \phi_1^{-} PREV_{t-1}^{-}$, ρ is the non-linear error correction speed of adjustment, $\phi_0 = -\frac{\delta_0}{\rho}$, $\phi_1^{+} = -\frac{\delta_1^{+}}{\rho}$, and $\phi_1^{-} = -\frac{\delta_{+}^{-}}{\rho}$.

We use the Akaike Information Criterion (AIC) to parsimoniously select a restricted constant trend specification in both specifications, with lags of 12, 9, 12, as it minimizes the AIC. The results are presented in Table 8, beginning with our baseline specification (specification 1), which confirms the presence of cointegration under asymmetry. The Bounds test yields an F-statistic of 9.94, exceeding the critical value of 4.13 at the 1% significance level (see Table 8). Furthermore, the Wald test suggests the presence of both long-run and short-run asymmetry. The lagged first difference of PEXP is negative and statistically significant through 11 months, and this is consistent with our a priori expectations of PEXP exhibiting inertia, where an increase in PEXP in the previous period leads to a decrease in the current period as a correction mechanism for short-run deviations.

The long-run components suggest a positive relationship between PREV and PEXP following positive and negative shocks to PREV. In particular, a 1% increase in PREV leads to a 0.48% increase in PEXP, and a 1% decrease in PREV leads to a 0.46% decrease in PEXP. In the short-run, there is a positive relationship following a positive shock to PREV in the current period. Thereafter, for each impact period up to 8 months, expenditure decreases following a positive shock to PREV. The cumulative impact over this period is −3.04[4], suggesting that a 1% increase in PREV results in a cumulative 3.04% decline in PEXP over 8 months. This signals that the government is following a pre-defined budgetary allocation (up to 11 months from the NARDL results) and is not influenced by current revenue or immediately influenced by PREV shocks. It also suggests some level of fiscal prudence by the government, and this is especially important since T&T operates a pegged exchange rate (El Anshasy and Bradley 2012). Additionally, higher energy prices and revenue require a mandatory contribution to

TABLE 8 | NARDL estimation results.

Dependent variable	Specification 1 *PEXP*	Specification 2 *PEXP-C*
Long-run		
$PREV^{+}_{t-1}$	0.476*** (0.089)	0.585*** (0.104)
$PREV^{-}_{t-1}$	0.462*** (0.089)	0.572*** (0.103)
Short-run		
$\Delta PEXP_{t-1}$	−0.360*** (0.127)	−0.269** (0.135)
$\Delta PEXP_{t-2}$	−0.317** (0.126)	−0.242* (0.132)
$\Delta PEXP_{t-3}$	−0.361*** (0.124)	−0.322** (0.127)
$\Delta PEXP_{t-4}$	−0.393*** (0.119)	−0.343*** (0.121)
$\Delta PEXP_{t-5}$	−0.484*** (0.115)	−0.426*** (0.114)
$\Delta PEXP_{t-6}$	−0.466*** (0.11)	−0.443*** (0.108)
$\Delta PEXP_{t-7}$	−0.440*** (0.103)	−0.438*** (0.101)
$\Delta PEXP_{t-8}$	−0.438*** (0.096)	−0.466*** (0.094)
$\Delta PEXP_{t-9}$	−0.386*** (0.087)	−0.429*** (0.084)
$\Delta PEXP_{t-10}$	−0.344*** (0.073)	−0.384*** (0.07)
$\Delta PEXP_{t-11}$	−0.321*** (0.049)	−0.381*** (0.047)
$\Delta PREV^{+}_{t}$	0.329*** (0.084)	0.362*** (0.075)
$\Delta PREV^{+}_{t-1}$	−0.488*** (0.136)	−0.530*** (0.133)
$\Delta PREV^{+}_{t-2}$	−0.463*** (0.142)	−0.462*** (0.135)
$\Delta PREV^{+}_{t-3}$	−0.576*** (0.141)	−0.543*** (0.132)
$\Delta PREV^{+}_{t-4}$	−0.484*** (0.142)	−0.402*** (0.132)
$\Delta PREV^{+}_{t-5}$	−0.259*** (0.138)	−0.166 (0.127)
$\Delta PREV^{+}_{t-6}$	−0.443*** (0.132)	−0.404*** (0.12)
$\Delta PREV^{+}_{t-7}$	−0.457*** (0.122)	−0.349*** (0.111)
$\Delta PREV^{+}_{t-8}$	−0.233** (0.115)	−0.203** (0.103)
$\Delta PREV^{-}_{t}$	0.043 (0.101)	0.089 (0.091)
$\Delta PREV^{-}_{t-1}$	−0.361*** (0.134)	−0.389*** (0.133)
$\Delta PREV^{-}_{t-2}$	−0.445*** (0.136)	−0.423*** (0.132)
$\Delta PREV^{-}_{t-3}$	−0.513*** (0.14)	−0.420*** (0.133)
$\Delta PREV^{-}_{t-4}$	−0.365*** (0.137)	−0.288** (0.128)
$\Delta PREV^{-}_{t-5}$	−0.443*** (0.129)	−0.399*** (0.119)
$\Delta PREV^{-}_{t-6}$	−0.462*** (0.123)	−0.370*** (0.114)
$\Delta PREV^{-}_{t-7}$	−0.208* (0.116)	−0.189* (0.105)
$\Delta PREV^{-}_{t-8}$	−0.116 (0.082)	−0.084 (0.076)
$\Delta PREV^{-}_{t-9}$	−0.112 (0.082)	−0.065 (0.076)
$\Delta PREV^{-}_{t-10}$	0.089 (0.077)	0.067 (0.071)
$\Delta PREV^{-}_{t-11}$	−0.170** (0.076)	−0.185*** (0.07)
Break2010	0.231*** (0.061)	0.157*** (0.047)

(Continues)

Dependent variable	Specification 1	Specification 2
	PEXP	*PEXP-C*
Break2015	−0.070 (0.056)	−0.07 (0.05)
C	4.605*** (0.778)	5.428*** (0.872)
EC_{t-1}	−0.777*** (0.133)	−0.881*** (0.143)
Bounds F − test	9.941***	11.109***
Breusch-Godfrey LM	1.649	1.179
Jarque-Bera	38.208	30.721
Long-run asymmetry (Wald *F*-statistic)	49.014***	49.725***
Short-run asymmetry (Wald *F*-statistic)	9.051***	7.874***

Note: Specification 1 estimates the relationship between PREV and permanent expenditure measured by the sum of transfers and subsidies, wages and salaries, and interest payments (PEXP), and specification 2 uses current expenditure as the measure of permanent expenditure (PEXP-C). We use the Akaike Information Criteria (AIC) to select a restricted constant trend specification in both specifications with lags 12, 9, 12 and robust (Huber-White-Hinkley heteroskedasticity-consistent) standard errors are in parentheses. The null hypothesis for the Bounds *F*-test is that no cointegration exists with a 1% critical value of 4.13, and the null hypothesis for the Wald T-test is that there is no asymmetry present. We include two dummy variables for structural breaks in 2010m07 and 2015m09 based on the Gregory-Hansen test from Table 5. Visual inspection of the cumulative sum (CUSUM) and cumulative sum of squares (CUSUM of squares) plots satisfies the stability criteria, the Breusch-Godfrey LM test for serial correlation does not reject the null hypothesis of no serial correlation, and *, **, and *** denote statistical significance at 10%, 5%, and 1% levels of significance, respectively.

T&T's national stabilization fund rather than being allocated to EXP.

Furthermore, the budgetary process is usually hierarchical and procedural (Alesina and Perotti 1996), resulting in bureaucracies and stickiness, with lengthy time lags between a shock, government decisions and actions, and its impact. Moreover, because REV is collected in a periodic manner—for example, end of the month or quarter—a delay between REV driving EXP decisions is common. Now, while our results cannot be directly compared to other studies given the novelty of the study and the variables, which include the permanent components of the budget, much like in our earlier analysis where we compared the results of the tests for fiscal equilibrium to the total components (in Tables A2 and A3), we find that these results are consistent with the findings of Athanasenas et al. (2014) as they adopt the same NARDL methodology to investigate REV and EXP in the Greek economy. Even more relevant to T&T, El Anshasy and Bradley (2012) find that in a sample of 16 oil-exporting economies, there is not a proportionate relationship between oil revenue shocks and EXP.

A negative shock to PREV has no immediate impact on PEXP. However, each impact period up to 11 months has a negative impact on PEXP. That is, a fall in PREV leads to a rise in PEXP. The cumulative impact over this period is −3.11, suggesting that a 1% decrease in PREV results in a cumulative 3.11% increase in PEXP over 11 months. This signals the countercyclical nature of the budgetary components as revenue decreases due to unfavorable energy markets, which ultimately leads to economic contractions. As a result, EXP increases in areas such as transfers and subsidies and other automatic stabilizers. The overall relationship is consistent with Durand-Lasserve and Karanfil (2023) as they find that in low revenue rent regimes with a relatively weak oil and gas revenue position that has been improving or deteriorating, both positive and negative shocks to REV can lead to a decrease in EXP. The ECT is negative and statistically significant, and this implies that when there is higher PEXP above the long-run equilibrium, the ECT will exercise a negative force, and the converse holds true. The size of the coefficient is −0.78, indicating that the correction is relatively quick given its closeness to −1 and it is approaching full correction. The results are also consistent with our conclusion of fiscal equilibrium from our earlier results. We capture the robustness and reliability of our results with similar findings from specification 2.

We conduct tests for parameter instability and present the CUSUM (cumulative sum) and CUSUM of squares (cumulative sum of squares) plots in Figure 2. These plots consistently fall within the 5% significance bands, indicating that the estimated coefficients are valid and stable across the entire sample for both specification 1 (panels A and B) and specification 2 (panels C and D). As a further measure of robustness, we also investigate iterations with macroeconomic control variables such as the retail price index to capture inflation, the treasury bill rate to capture interest rate, and a combination of both variables. The results are consistent with the baseline specification, but the control variables were statistically insignificant. Hence, we parsimoniously exclude these from our analysis, but they are available upon request.

Next, we explore the dynamic non-linear multipliers (m) from the NARDL model, which are useful to identify the adjustment behavior of PEXP following a shock to PREV. Specifically, we analyze the impact of PREV expansions and contractions on PEXP. The positive and negative dynamic multipliers are given by:

$m_h^+ = \sum_{j=0}^{h} \frac{\partial PEXP_{t+j}}{\partial PREV_t^+}, m_h^- = \sum_{j=0}^{h} \frac{\partial PEXP_{t+j}}{\partial PREV_t^-}, h = 0, 1, 2, \ldots, \infty$. As h tends to infinity, the cumulative effects of the revenue shocks will converge towards the positive and negative coefficients respectively. From Equation (5), that is:

$$h \to \infty, m_h^+ \to \phi_1^+, m_h^- \to \phi_1^-$$

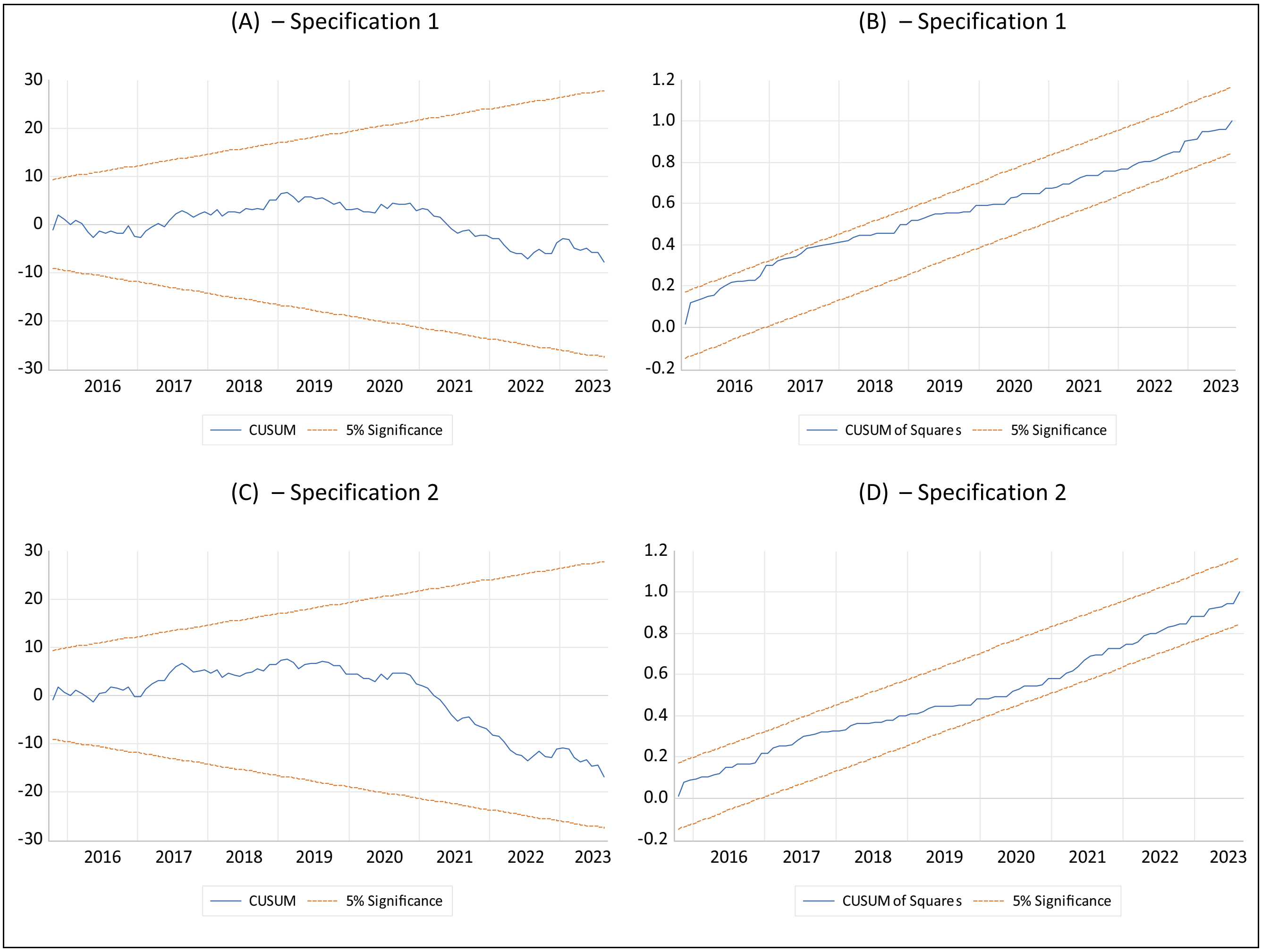

FIGURE 2 | Parameter stability plots. *Note:* Panels (A and B) display CUSUM (cumulative sum) and CUSUM of squares (cumulative sum of squares) plots respectively for specification 1 (PREV and PEXP) and Panels (C and D) show the same for specification 2 (PREV and PEXP-C). The 5% significance bands are displayed. [Colour figure can be viewed at wileyonlinelibrary.com]

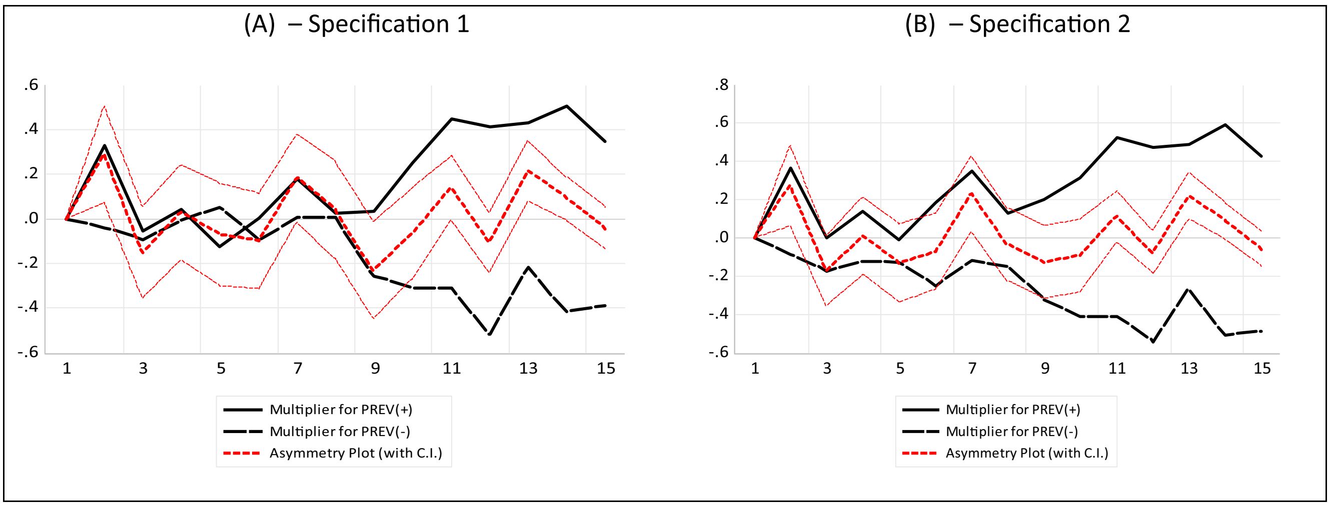

FIGURE 3 | Dynamic multipliers. *Note:* Panel (A) displays the dynamic multiplier plot for specification 1 (PREV and PEXP) and Panel (B) shows the same for specification 2 (PREV and PEXP). The asymmetry plots are displayed as the solid broken red line; the multipliers for positive and negative shocks to PREV are displayed by the solid and broken black lines, respectively. The 5% significance bands are displayed for the asymmetry plot, and the horizontal axis captures the time horizon in months. [Colour figure can be viewed at wileyonlinelibrary.com]

In Figure 3, the solid black line shows how PEXP (panel A) and PEXP-C (panel B) respond to a positive shock in PREV; the dashed black line shows the response from a negative shock to PREV, and the dashed red line represents the asymmetrical plot with a confidence band. For specification 1 (panel A), a positive shock to PREV transmits more forcefully than a negative shock at time period 2 ($t=2$), $t=7$, and $t=13$, whereas the opposite holds for $t=3$ and $t=9$. Although asymmetry exists at other points along the shock horizon, these differences are not statistically significant. As with the NARDL estimation, this could be attributed to lags in the budgetary process. Interestingly, the Wald test for specification 1 (Table 8) indicates asymmetry in both the short and long-run. However, the dynamic multiplier plot highlights periods where asymmetry is insignificant. This divergence arises because the dynamic multiplier reflects cumulative adjustments over time, while the Wald test assesses whether the sum of positive and negative coefficients differs. Specification 2 (panel B) follows a similar pattern; except that $t=9$ is insignificant.

6 | Conclusion and Policy Implications

In this paper, we refocus attention on the concept of fiscal equilibrium as introduced by Tanzi (1982) and propose the novel idea of measuring PREV as the sum of non-energy revenue and the trend component isolated from the energy revenue (ER). For PEXP, we use the sum of spending on transfers and subsidies, wages and salaries, and interest payments. Subsequently, we propose a novel approach to assess fiscal equilibrium using established cointegration tests. We find that PREV and PEXP are cointegrated, which supports fiscal equilibrium. However, given that the coefficient of β in the cointegrating equation is less than one, we classify it as "weak form" fiscal equilibrium.

We continue by using Granger causality tests to analyze the relationship between PREV and PEXP, and find that the unidirectional tax-and-spend relationship characterizes the fiscal operations of the T&T government. The Granger causality tests also support a bidirectional relationship between CAP and current expenditure, potentially indicating the crowding out effect. We then examine the asymmetric relationship between PEXP and PREV, and the Wald test confirms the presence of asymmetry in both the short-run and the long-run. The results remain robust across specifications with the inclusion of routine control variables such as inflation and the interest rate (see, e.g., Payne et al. 2008; Ssebulime and Edward 2019) as they can impact expenditure, the cost of borrowing, and even tax revenue collection.

In light of the results, we draw several policy implications. Figure 1 (panel D) shows that PREV has been gradually declining relative to REV, highlighting T&T's vulnerability due to its dependence on energy sector earnings. Given that the economy follows the tax-and-spend hypothesis, PEXP should be less reliant on PREV, as it is predominantly derived from ER and remains highly susceptible to external shocks (Dizaji 2014). To mitigate this risk and enhance fiscal equilibrium, gradually delinking PEXP from PREV, particularly its energy-based component, is both necessary and feasible (Mehrara and Oskoui 2007). Our results confirm a weak form fiscal equilibrium, with PEXP adjusting only partially to PREV in the long-run.

The NARDL model further shows that PEXP contracts after positive PREV shocks, indicating scope for controlled tightening. These patterns suggest that fiscal realignment, while gradual, is achievable within T&T's existing institutional framework (see, e.g., Koh 2017). A crucial step in this process is accelerating economic diversification to reduce dependence on the shrinking energy sector and build resilience against external shocks. Empirical evidence shows that a diversified economy recovers more swiftly from adverse oil revenue shocks compared to an undiversified one (Stocker et al. 2018), particularly when diversification is underpinned by structural reform, as demonstrated in Indonesia's experience (Mehrara and Oskoui 2007).

With CAP consistently averaging less than 9% of EXP, T&T faces a structural imbalance in budgetary allocations, limiting long-term economic progress. This issue is particularly concerning for energy-dependent nations, where heavy reliance on current expenditure restricts opportunities for sustainable revenue generation. Our empirical results, particularly the bidirectional causality between CAP and both permanent and current expenditure (Table A4), suggest that current spending patterns actively constrain CAP allocations. This interdependence highlights the feasibility of reallocation through fiscal restructuring. Furthermore, the crowding-out dynamic observed in our analysis underscores the urgency of rebalancing the budget toward investment-driven components.

To address this, the government can reallocate resources from current to CAP, fostering more stable PREV in the long-run. Specifically, investment should be redirected towards non-energy sector initiatives and capacity building, supporting non-energy revenue growth and broader economic development (Hasanov et al. 2022). Additionally, transitioning from general subsidies to targeted subsidies or lump-sum transfers of equal value can enhance efficiency (Plante 2014), as seen in Kuwait (Mehrara and Oskoui 2007). Further, energy and fiscal reforms, such as the establishment of a Centre for Spending Efficiency—similar to Saudi Arabia's model—can improve expenditure effectiveness (Hasanov et al. 2022). This contributed to the non-energy sector accounting for a larger share of real GDP, reaching almost 50% in 2024.

The volatility in PREV presents a significant fiscal challenge, as fluctuations in ER impact government planning and economic stability. Historically, the ratio of PREV to REV has averaged 0.69 during booms and 1.26 during recessions, highlighting the need for a structured approach to managing these fluctuations. To address the volatility in fiscal conditions tied to energy revenues, we propose an energy revenue deviation rule as a practical fiscal guide. This rule is empirically grounded in our historical analysis of T&T's fiscal performance (Figure 1, panel D). Accordingly, we adopt 0.60 and 1.00 as indicative thresholds, not arbitrarily, but based on observed turning points in the commodity price cycle and corresponding budgetary pressures. Specifically, when the PREV to REV ratio exceeds 1.00, it signals a likely downturn; governments should proactively implement fiscal adjustments to cushion against anticipated declines in energy revenue.

Conversely, when the ratio falls below 0.60, it indicates an unsustainable boom; in such cases, windfall revenues should not drive expenditure but rather be allocated to the stabilization fund to enhance long-term fiscal resilience. Within the 0.60–1.00 range, governments should exercise fiscal discipline, avoiding over-reliance on temporary surpluses and ensuring a cautious, rules-based budgetary approach. To enhance the usefulness of this framework, we recommend that the PREV to REV ratio be continuously monitored as a concurrent indicator of fiscal vulnerability, providing early warning signals and supporting timely fiscal responses. While the specific thresholds may vary across countries, the approach offers a replicable template for managing energy revenue volatility and aligning expenditure with structurally stable income streams.

The asymmetry observed in the relationship between PREV and PEXP has important implications for fiscal policy calibration. The differing responses of PEXP to increases and decreases in PREV, along with the presence of adjustment lags, indicate that standardized fiscal rules and policies may not be sufficient. Instead, fiscal programs should be designed to account for this imbalance. During periods of rising PREV, expenditure growth should be constrained through structured saving mechanisms or pre-committed transfers to T&T's stabilization fund. Conversely, when PREV declines, some countercyclical flexibility in PEXP may be appropriate to support economic stability, provided it remains temporary, targeted, and fiscally responsible. The lag in expenditure response also highlights the importance of forward-looking fiscal planning, where reliable revenue forecasts inform expenditure decisions in advance. Enhancing institutional frameworks through multi-year budgeting (see, e.g., Hou 2006) and expenditure benchmarks (see, e.g., Marinheiro 2021) can improve the adaptability and resilience of policy in energy-dependent economies.

However, these recommendations are not without their limitations. For instance, delinking PEXP from ER may be challenging in practice as spending commitments often have rigidities that make rapid adjustments difficult. Furthermore, while the proposed ER deviation rule provides a useful fiscal guideline, it assumes that policymakers will consistently adhere to it; but this may be unrealistic given political, institutional, and economic constraints that often lead to procyclical fiscal behavior, especially in small, open, energy-dependent nations.

These concerns are valid and highlight the political and institutional constraints often faced by energy-dependent economies. However, comparative experience suggests that such constraints can be overcome with well-designed institutional frameworks. The cases of Chile and Norway illustrate how targeted strategies can support fiscal equilibrium through diversification and spending efficiency. Chile reduced its reliance on copper by expanding into sectors such as salmon, fruit, and forestry, enabled by public agencies that coordinated investment, training, and innovation to address market failures and build productive capacity through capital investment, which helped to stabilize export earnings and reduce fiscal risk (Lebdioui 2019). In Norway, a fiscal rule limits withdrawals from the government fund to the expected real return, supporting stable and countercyclical fiscal policy. This rule is embedded within a framework of political consensus, ethical governance, and independent oversight by the central bank and parliament (Holden 2013). These cases demonstrate that, even in economies subject to external shocks and internal rigidities, fiscal rules, diversification, and expenditure reallocation strategies can be both feasible and effective when supported by strong institutions and long-term policy commitment.

While we present a novel computation for PREV in energy-exporting nations, along with a robust test for fiscal equilibrium and the asymmetries in the budgetary process, there remains ample scope for further research. In this study, we utilized monthly, nominal data. Although monthly data may introduce noise, it aligns with the collection of energy earnings, justifying our approach. Future research could extend this analysis by employing quarterly or annual data, as well as inflation-adjusted variables, to reduce potential noise and examine real impacts (see, e.g., da Costa António and Rodriguez-Gil 2020). Additionally, our focus was primarily on PREV, with only limited attention to PEXP. A valuable avenue for further research would be to analyze EXP similarly, decomposing it into trend and cyclical components while also incorporating CAP alongside current expenditure. Finally, future research can also focus on identifying fiscal rules or guidelines that allow the PREV to REV ratio to fluctuate in a stable or reasonable manner across the entire economic cycle, especially within the calculated range (in the case of T&T—0.60 to 1.00). This could include studying how different fiscal rules respond dynamically to cyclical changes, thus building fiscal discipline over time. By refining these approaches, future research can provide deeper insights into the fiscal equilibrium of energy-exporting nations, contributing to more effective policy formulation.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Endnotes

[1] We use the terms 'energy-dependent' or 'energy-exporting' economies to refer to countries that rely heavily on oil, gas, and other hydrocarbon products for export earnings and economic activity.

[2] Permanent revenue is the sum of non-energy revenue and trend energy revenue. Trend energy revenue is computed using statistical filters discussed in later sections. Permanent expenditure is expenditure that are ongoing or mandatory such as wages and salaries, transfers and subsidies and interest payments. We elaborate and justify these descriptions in Section 3.

[3] Lag length selection is also important, as it can affect the results of unit root tests. To ensure the reliability of our findings, we use the commonly accepted Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC) to determine the appropriate lag length (see, e.g., Mahadeo et al. 2022). Based on these criteria, we select 12

lags for the ADF test. Moreover, this lag length is consistent with the monthly data used in this study.

[4] Following Greenwood-Nimmo and Shin (2013), we derive the cumulative impact by summing the individual short-run coefficients.

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Appendix A

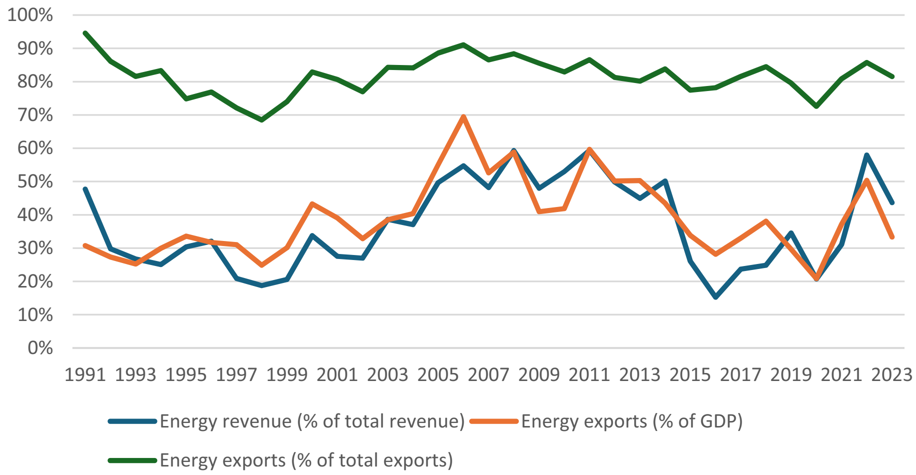

FIGURE A1 | Energy dependence trends (1991–2023). *Source:* Central Bank of Trinidad and Tobago and authors' calculations. [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE A1 | Descriptive statistics.

Variable	Sample size	Mean	Std. dev.	Min	Max
Total revenue (REV)	392	2567	2161	206	11,120
Energy revenue (ER)	392	1054	1383	0	7982
Non-energy revenue	392	1501	1072	167	7714
Permanent revenue (with HP filter) (PREV)	392	2555	1636	398	8960
Permanent revenue (with Hamilton Filter) (PREV-H)	357	2756	1761	786	12,042
Total expenditure (EXP)	392	2711	1939	391	11,061
Permanent expenditure (PEXP)	392	1998	1442	305	6265
Permanent expenditure (as measured by current expenditure) (PEXP-C)	392	2412	1648	389	7679

Note: Descriptive statistics reported in TT$ million (current value).

TABLE A2 | Johansen test for cointegration.

	Maximum rank	Trend	Restricted trend	Constant	Restricted constant	No trend
Trace statistics	0	39.674	43.935	37.609	63.411	58.973
	1	0.472**	3.090**	3.089**	10.388	6.180

Note: We use the SIC and AIC to select 12 lags for the Johansen test. The null hypothesis is that no cointegration exists and ** denotes the rejection of the null hypothesis at the 5% level of significance. The maximum eigenvalue statistics support this conclusion, and REV is total revenue and EXP is total expenditure.

TABLE A3 | Extracts from the VECM estimations.

	Restricted trend
ECT	−0.643*** (0.109)
β	−0.895*** (0.048)

Note: Standard errors are in parentheses; *** denotes statistical significance at the 1% level of significance, and ECT is the error correction term.

TABLE A4 | Granger causality tests.

Causal relationship	*F*-statistic
CAP → PEXP	2.38953***
PEXP → CAP	2.04496***
CAP → PEXP-C	2.24851***
PEXP-C → CAP	2.31845***

Note: Where the null hypothesis is that no Granger causality exists. *** denotes the rejection of the null hypothesis at the 1% level of significance and PEXP is permanent expenditure, PEXP-C is permanent expenditure as captured by current expenditure, and CAP is capital expenditure.