Louvain School of Management

To what extent do supply- and demand driven oil price shocks explain cross-country differences in bond market returns and volatilities?

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Abstract

The aim of this study is to identify the structural drivers of oil price shocks—whether supply or demand-driven—and assess the extent to which these factors abnormally impact sovereign bond market returns and volatilities. By using a structural vector autoregressive (SVAR) model alongside a conditional variance (GARCH) specification on a panel dataset of 71 countries between 2001 and 2024, the research findings show that global demand shocks, country energy status (exporter vs. importer), and maturity horizons are factors that abnormally influence sovereign financing costs. On the other hand, this study fails to prove that physical supply shocks significantly alter the long-term yield curve. Overall, this paper confirms the past results drawn from peers through the lenses of new regression models. Therefore, this study contributes to the existing literature by providing a different perspective and reinforcing the findings of prior research.

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Table of contents

1. Introduction

For many years, the relationship between financial markets and oil shocks has been a major focus of research in international economics. Although the impact of oil on stock markets, inflation and real economic activity is now widely understood, we know little about how these shocks affect bond markets. However, it is essential that investors and policymakers understand how oil price fluctuations affect sovereign financing costs with the ongoing inflationary pressures, the energy transition and geopolitical risks. Countries' exposure to these shocks differs depending on their status as net energy importers or exporters, which requires in-depth analysis. This thesis aims to fill this gap by analysing how financial markets reassess a country's risk depending on whether it is a buyer or seller of oil. Our original approach goes beyond simply observing rates; it also examines market anxiety, thus offering a comprehensive view of global financial stability in the face of energy crises.

This research focuses on a central question: '***To what extent do supply- and demand driven oil price shocks explain cross-country differences in bond market returns and volatilities?'*** Data on bond markets are taken from the IMF's International Financial Statistics (IFS) database, via the 'Financial, Interest Rates, Government Securities, Government Bonds' indicator (code IMF_IFS_FIGB), which measures sovereign bond yields as a percentage per year.

The objective is twofold. On the one hand, it involves tracing the real channel by studying the impact of these shocks on countries' external positions through Commodities Terms of Trade (CTOT). On the other hand, it involves analysing their financial transmission by assessing changes in sovereign financing conditions. The research establishes a causal chain: oil shocks first alter a nation's physical wealth through the CTOT, and this real-world impact subsequently migrates into the financial sphere. This study allows us to verify whether what matters most for the reaction of economies is not the size of the movement in oil prices, but the type of shock causing this movement.

This issue is part of a growing body of literature. Kilian (2009) profoundly renewed the analysis of oil price variations by proposing a structural identification that clearly distinguishes between supply shocks and demand shocks. Ready (2018) extends this approach by relying on financial factors derived from stock markets, while Kang and Ratti (2014) highlight the role of inflation expectations in the response of US sovereign rates. More recently, Chen et al. (2022) and Ziadat et al. (2023) emphasise that the effects of oil shocks depend heavily on the energy structure of economies. However, few studies combine structural identification of shocks, a truly international perspective, and a joint analysis of the real and financial channels. It is precisely in this space that this study makes its contribution.

Beyond the strictly econometric aspect, this research is closely linked to the current global macroeconomic situation. It is marked by increased geopolitical instability and the essential needs of the energy transition. In a world where oil remains a key indicator of geopolitical tensions—from OPEC+ production decisions to the supply disruptions caused by the 2022 invasion of Ukraine—crude oil serves as a main channel for international financial shocks. For energy exporters, oil price swings are no longer just a budget issue; they are a sign of long-term financial health. Markets worry that structures relying on fossil fuels may face bankruptcy in a world moving toward decarbonization.

Methodologically, the analysis follows a two-step approach. First, we estimate a monthly SVAR model using global oil production, which is broken down into monthly data using the Denton-Cholette method, and the oil price based on the WTI benchmark. We use structural decomposition based on a Cholesky scheme to extract supply and demand shocks in line with existing literature. Next, we aggregate these shocks annually and combine them with a large international panel. This panel includes the IMF's annual Commodity Terms of Trade indices and sovereign bond yields from the International Financial Statistics database. It covers up to 71 countries from 2001 to 2024. We conduct panel regressions on country-year data, incorporating interaction terms between oil shocks and a variable that indicates whether a country is an oil exporter. This approach enables a clear comparison of how exporting and importing countries respond differently to these shocks.

A major contribution of this thesis is the focus on the term structure of interest rates. By explicitly comparing 1-year money market rates and 10-year bond yields, the study isolates two competing forces: the immediate liquidity effect, driven by petrodollar inflows, and the long-term sovereign risk premium, driven by structural dependency and transition risks. Crucially, our framework extends beyond first-moment interactions; by transitioning from linear level regressions to a conditional variance specification, we capture the asymmetric clustering of market risk. Preliminary results indicate that supply shocks have a limited effect, while global demand shocks significantly improve CTOTs and reduce the financing costs of exporting countries in the short term, while generating opposite pressures for importers.

Ultimately, this master's thesis provides a significant contribution by bridging the gap between structural oil market dynamics and sovereign debt markets. Instead of viewing oil as a single factor, we use an SVAR-GARCH framework to measure how oil tensions spark changes in financial uncertainty over time. By highlighting the distinct separation between short-term liquidity benefits and long-term risk outlooks, this research shows that for energy exporters, oil wealth can be both beneficial and harmful. These findings give a clearer picture of global financial stability and offer practical insights for policymakers and institutional investors facing the unpredictable landscape of the global energy transition.

2. Literature review

Crude oil is not merely a raw material; it remains the lifeblood of the global economy, a barometer of geopolitics and a fundamental input for many sectors of industry (Hamilton, 1983). In terms of extraction, the oil industry is characterised by extremely rigid physical constraints, facing colossal adjustment costs, significant logistical friction and very long-term planning constraints that make supply inelastic in the very short term (Kilian, 2009; Caldara, Cavallo & Iacoviello, 2019). Extraction methods operate in a wide variety of environments, ranging from conventional onshore drilling to complex offshore operations, but recent technological advances, and more specifically the shale oil (or tight oil) revolution in the United States, have profoundly altered this dynamic by enabling production to adjust more rapidly to price signals (Mohaddes & Raissi, 2018; Kleinberg et al., 2018).

On the global stage, the market is characterised by a sharp geographical and economic division between producer and consumer countries. Among the major players frequently studied in the literature, the major exporting countries include nations such as Russia, Saudi Arabia, Colombia and Ecuador, whilst demand is largely dictated by powerful importers such as China, Turkey, South Africa and India (Chen, Huang & Lin, 2022). This dichotomy creates complex geopolitical dynamics, often regulated by cartels such as OPEC, whose announcements and production quotas structurally influence the balance of global supply (Degasperi, 2023).

Every fluctuation in its price sends shockwaves around the world. Yet, historically, economic analysis has often made the mistake of treating all rises in oil prices in the same way, assuming that a high price per barrel was invariably synonymous with crisis. Modern macroeconomic research, driven by Kilian’s framework (2009), has challenged this conventional belief by demonstrating a fundamental reality: the cause of a change in the price of oil is far more significant than the change itself. A price rise caused by a war or an embargo (a supply shock) acts as a destructive tax on the economy by generating stagflationary pressures (a combination of weak or zero economic growth (stagnation), high unemployment and high inflation (Blinder (1979)), whereas a rise driven by strong global growth (a demand shock) reflects, on the contrary, a fully expanding global economy capable of absorbing these marginal costs.

These shocks are transmitted to bond markets through two main channels: the real channel, via the Commodity Terms Of Trade (CTOT), and the financial channel, via monetary policy and risk premiums. The concept of the CTOT — which measures the ratio between a nation’s export and import prices — is central here because, in theory, a rise in the price of oil alters a nation’s international purchasing power, as shown by Liu, Baek and Noh (2025). For an exporter, an improvement in the CTOT generates a revenue stream (petrodollars) that increases domestic liquidity. This mechanism is analysed by Kassouri and Altıntaş (2020) through the lens of the 'Dutch Disease', where the appreciation of the real exchange rate and inflation in non-tradable prices often force central banks to strike a balance between price stability and external competitiveness. From a financial perspective, the theory of the term structure of interest rates suggests that long-term bonds price in not only inflation expectations but also a sovereign risk premium. An oil shock can therefore have a dual effect: lowering short-term rates via excess liquidity, whilst increasing long-term rates if the market perceives a risky structural dependency, impacting yield spreads as explained by Chen, Huang and Lin (2022). However, this rational mechanism of interest rates is often amplified by investor psychology, transforming economic adjustments into episodes of high volatility.

Contemporary financial literature also points out that market reactions are not linear and must be understood in terms of conditional volatility. The use of GARCH models, formalised by Bollerslev (1986, 2023), makes it possible to model the persistence of uncertainty and the phenomenon of asymmetric reactions. In line with this, Byun and Cho (2013) and Wen et al. (2025) demonstrate, notably through the 'Rocket and Feather Hypothesis', that bond and financial markets tend to react more sharply to sudden rises in energy costs than to equivalent falls. This behaviour is often linked to the 'Flight-to-Safety' theory, whereby, during periods of major oil crises, investors abandon risky assets to seek refuge in sovereign bonds considered safe havens, thereby altering the usual correlations between asset classes—a contagion mechanism studied by Ziadat et al. (2023). This traditional analytical framework is now being challenged by the emergence of sustainable finance, where oil is no longer seen merely as a driver of growth, but as a vector of transition risk.

2.1. Structural identification of shocks

The study of the interactions between energy and financial markets requires a rigorous theoretical framework that goes beyond mere empirical observations of correlations, as a nominal change in the price of oil is never a singular event. On the contrary, the same price rise can have diametrically opposed macroeconomic consequences depending on its origin, making it essential to break down the shocks in order to understand their true transmission channels. Building on the foundations laid by Kilian (2009), modern macroeconomic theory relies on structural vector autoregressive (SVAR) models to isolate fluctuations in the energy market into three distinct categories of underlying shocks.

Firstly, physical supply shocks, caused by unexpected disruptions to production such as geopolitical conflicts or quotas, theoretically act as a tax on global consumption by generating inflationary pressures whilst slowing down real economic activity. Faced with this situation, central banks face a complex dilemma between combating imported inflation and supporting growth. Secondly, shocks to total (or aggregate) demand, driven by the expansion of the global economic cycle, signal an improvement in income prospects and favourable macroeconomic vitality. Thirdly, specific or speculative demand shocks, as defined by Kilian and Murphy (2014), reflect market anxiety regarding the uncertainty of future supplies and manifest themselves as increased financial volatility rather than a lasting change in economic fundamentals. Distinguishing precisely between these causes is of critical importance, as the nature of the shock fundamentally dictates how it propagates through the economy, triggering very different reactions regarding the distortion of the yield curve and risk premiums in bond markets, as has been amply demonstrated by Kang, Ratti and Yoon (2014) and Chen, Huang and Lin (2022).

Cholesky decomposition is usually used to identify these shocks; the normal order is: global production → activity → real oil prices. This ordering is based on Kilian's (2009) view that the physical output of oil cannot adjust to changes in demand within the same month due to the existence of structural frictions in the extraction of oil. Conversely, the oil price is treated as the last variable because it is a forward-looking financial variable. This means the price will quickly reflect any new macroeconomic or geopolitical information.

However, this methodology raises critical issues regarding elasticity assumptions. Caldara, Cavallo and Iacoviello (2019) demonstrate that it is essential to account for elasticity frictions in order to avoid artificially attributing fluctuations to aggregate demand that are in fact due to exogenous supply constraints. In particular, they emphasise that arbitrarily imposing zero supply elasticity mathematically forces the model to generate a disproportionate and unrealistic demand elasticity. To correct this bias, these authors recommend the use of narrative instrumental variables based on historical episodes of exogenous declines in production (such as the Gulf War or natural disasters). The fundamental contribution of this correction is to demonstrate that, contrary to early models which overestimated the role of demand, supply and demand shocks actually play a role of almost equal importance in explaining fluctuations in prices and quantities in the oil market.

To overcome the limitations of traditional SVAR models based on low-frequency monthly macroeconomic data, an alternative and complementary approach has emerged in the financial literature, notably pioneered by Ready (2018). This methodology circumvents macroeconomic publication delays by using high-frequency (daily) financial data to decompose shocks. By using the returns on stock market indices of oil-producing companies and the volatility index (as a proxy for changes in the discount rate and risk aversion), Ready (2018) succeeds in isolating ‘risk shocks’ more clearly from supply and demand shocks.

Ultimately, whether derived from narrative calibration (Caldara et al., 2019) or financial data extraction (Ready, 2018), this rigour in structural identification is not merely an econometric exercise; it is the cornerstone of bond analysis. Incorrect identification of shocks would inevitably lead to a misinterpretation of sovereign risk. Indeed, a bond market will not react in the same way to a rise in oil prices reflecting a thriving global economy (which tends to narrow emerging market sovereign spreads) as it would to a rise driven by speculative panic or a destructive supply shock (which triggers ‘flight to safety’ behaviour and increases required yields).

2.2. Commodity Terms of Trade and Dutch Disease

Once the structural origin of an oil shock has been identified, the key question is to understand the mechanisms through which it spreads to the domestic economy. The fundamental transmission vector is the commodity term of trade (CTOT), defined as the ratio of a country’s export prices to its import prices.

For an exporting country, a surge in oil prices (i.e. a positive CTOT shock) triggers a massive inflow of foreign currency. Kassouri and Altıntaş (2020) explain this mechanism through the well-known theory of the ‘Dutch Disease’. In practical terms, this sudden abundance of ‘petrodollars’ causes the real effective exchange rate of the national currency to appreciate. Whilst this strong currency artificially stimulates demand for domestic services, it severely undermines the international competitiveness of other export sectors (such as agriculture or manufacturing), thereby creating a structural imbalance within the real economy.

Nevertheless, to establish a direct link with the dynamics of bond markets, it is crucial to emphasise that modern finance does not wait for this liquidity to materialise physically in the government’s coffers before reacting. This is where the theory of rational expectations comes into play, via the concept of ‘news shocks’. Liu, Baek and Noh (2025) demonstrate that financial markets incorporate their expectations regarding future price movements almost instantaneously and directly into the assessment of sovereign risk (bond spreads) for emerging economies. Thus, the mere expectation of a fluctuation precedes the real economy and immediately dictates the new financing conditions the government will face.

To model this macro-financial dynamic rigorously, the inclusion of capital accumulation is indispensable. Omotosho (2022) demonstrates that theoretical models that disregard capital are in fact “blind”: they overlook the fact that oil extraction is an extremely capital-intensive industry. Ignoring this component obscures the way in which firms adjust their investment strategies in response to changes in real interest rates caused by the energy shock. Without capital, it also becomes impossible to explain how the economy and households manage to smooth their consumption to cushion the effects of such turbulence.

However, the impact of a positive oil shock on the real economy is not inevitable and depends entirely on the strength and quality of the state’s financial institutions. The institutional capacity to ‘sterilise’ this inflow of capital is fundamental. The concept of sterilisation, a cornerstone of macroeconomic management in rentier states, involves neutralising the effects of increased foreign exchange reserves on the national money supply in order to prevent inflationary overheating and mitigate the volatility experienced by the real economy.

This strategy relies primarily on the establishment of sovereign wealth funds. Rather than immediately injecting petrodollars into the national economy, which would automatically fuel the appreciation of the real effective exchange rate and the notorious Dutch Disease, the state diverts these revenues towards investments in international financial markets. This mechanism, which echoes Hartwick’s rule, transforms a finite natural resource into sustainable financial capital. Recent models, such as that of Omotosho (2022), corroborate this logic: by transferring oil profits to a sovereign wealth fund from which the state derives only returns (transfers) to finance its expenditure, governments manage to smooth domestic consumption across generations in the face of economic fluctuations. Jarrett, Mohaddes and Mohtadi (2019) demonstrate in this regard that a deep and well-developed financial system acts as a genuine macroeconomic ‘shock absorber’. By enabling better risk pooling and diversification, these financial institutions drastically reduce the volatility of growth.

In the bond market, this sterilisation serves as a crucial signal to international investors. A country with a robust stabilisation fund is able to partially decouple its public finances and economic growth from the immediate volatility of oil prices. For bondholders, this translates into reduced fiscal uncertainty and a lower risk of default. Chen, Huang and Lin (2022) demonstrate empirically that the level of official foreign exchange reserves (which include sovereign wealth fund assets) is a key determinant used by investors to assess a country's ability to service its external debt. The government's ability to honour its commitments no longer depends solely on the price of oil at a given point in time, but on the strength of its accumulated savings, the growth of which leads to a significant narrowing of bond spreads. Thus, sterilisation and financial institutions act as a shield that compresses the sovereign risk premium, ultimately protecting the government's creditworthiness in debt markets, even during periods of severe turbulence in energy markets

2.3. The duality of the yield curve

To gain a comprehensive understanding of the financial impact of oil on a country, it is essential to break down the yield curve, that is, to distinguish between the cost of short-term borrowing (i.e. 1-year) and that of long-term borrowing (i.e. 10-year).

Let us imagine an oil-exporting nation facing a surge in oil prices. In the very short term, this country benefits from a massive and immediate influx of foreign liquidity (the 'petrodollars'). Its banking institutions and money market find themselves flooded with fresh money. However, as Abbassi and Linzert (2012) demonstrate in detail, money market rates primarily reflect expectations regarding monetary policy and a 'liquidity premium' closely linked to the reserves available in the interbank system. The abundance of these petrodollars automatically crushes this premium, thereby lowering the government's very short-term financing costs and acting as a genuine 'liquidity cushion'.

However, over the long term (10 years), investor sentiment shifts completely and the logic is reversed. Investors no longer assess immediate short-term liquidity, but rather the country's long-term solvency and structural resilience. Hyper-dependence on oil revenues is then perceived as a major vulnerability: what will happen if prices collapse in five or ten years' time? This is why, as established by Kang, Ratti and Yoon (2014), the transmission of shocks differs fundamentally depending on the maturity of the debt, with a possible rise in long-term rates driven by precautionary savings. Furthermore, Chen, Huang and Lin (2022) demonstrate that, faced with the uncertainty specific to the energy market, investors demand a higher risk premium for holding emerging market sovereign debt in order to compensate for this lack of diversification. Oil therefore has a "double-edged" effect: it provides relief to public finances today through excess liquidity but worsens borrowing conditions for the future by signalling structural risk.

2.4. Monetary policy and term structure of interest rates

From a financial perspective, how does an oil shock manage to distort the sovereign yield curve (i.e. the cost at which a government borrows money over different maturities)? To understand this mechanism, we must first examine the term structure expectations theory. This fundamental theory posits that the yield on a long-term bond (a 10-year bond) is in reality simply the average of the short-term interest rates that investors anticipate for the future, plus a 'term premium', which is a financial compensation demanded for the risk of tying up capital over a long period.

2.4.1. At short-term dynamics: The monetary policy dilemma

In the short term, money market rates (such as the Euribor, the rate at which European banks lend to one another) are the main vehicle through which a central bank steers the economy. As Abbassi and Linzert (2012) explain in detail, these short-term rates are a direct reflection of two components: market expectations regarding the central bank's future decisions, and liquidity risk premiums (the risk that a bank will lack immediate liquidity).

However, when an oil shock hits the economy, the central bank's task becomes drastically more complicated. Bruna and Tran (2020) theorise that, in a regime where the central bank's mandate is to target inflation, the volatility of these short-term interest rates becomes 'endogenous' to macroeconomic shocks, meaning that it is generated internally by the system's very reaction to the turbulence. Indeed, faced with an oil shock that automatically pushes up inflation (imported inflation) whilst risking a slowdown in growth (which widens the output gap), the central bank is confronted with an extremely complex theoretical trade-off: should it raise rates to curb inflation, or lower them to save growth? The presence of a liquidity risk premium that becomes stochastic (random and unpredictable) means that monetary authorities lose perfect control of the yield curve, thus proving that oil shocks generate a financial distortion that is partly beyond the control of central banks.

2.4.2. Long-term dynamics: The vital importance of the nature of the shock

In the longer term, sovereign yields (such as 10-year government bonds) incorporate a structural risk premium. Here, theory teaches us that the transmission of the shock differs fundamentally depending on the maturity of the debt, but above all on the exact nature of this oil shock.

Kang, Ratti and Yoon (2014) demonstrate, using structural vector autoregressive (SVAR) models, that aggregate demand shocks and oil market-specific demand shocks exert asymmetric pressures on bonds. For example, when a rise in the price per barrel is due to a specific demand shock (often linked to uncertainty and fears of a future shortage), this generates significant precautionary saving. Investors, gripped by doubt, adjust their portfolios, which theoretically puts downward pressure on the real yields of 5- and 10-year bond indices.

Conversely, looking at emerging economies, Chen, Huang and Lin (2022) analyse the dynamics of their sovereign spreads (the interest rate differential, or the additional risk premium, that an emerging country must pay to borrow compared to a country deemed risk-free). A shock to aggregate demand logically reduces these spreads, as it signals strong global economic expansion, which is highly favourable to these countries' exports. Regarding the oil-specific demand shock, although one might intuitively think that uncertainty raises rates, research shows that this shock (often driven by heavy speculative activity) actually pushes investors towards a 'search for yield'; attracted by higher returns, they are buying emerging-market debt, which, contrary to expectations, is helping to narrow those very same bond spreads.

2.5. Macroeconomic Absorption Mechanisms

Any assessment of the direct impact of oil shocks on bond markets is epistemologically incomplete if it overlooks the mediating role of fundamental macroeconomic variables such as inflation and real growth (GDP). Theoretically, oil shocks do not determine interest rates directly; they influence them indirectly by altering conditions in the real economy, thereby forcing central banks and investors to readjust their expectations. Bruna and Tran (2020) model this dynamic by demonstrating that, under an inflation-targeting regime, interest rate volatility is fundamentally endogenous to exogenous macroeconomic shocks. When a positive oil shock occurs, it is transmitted to the economy in the form of imported inflation and a change in the output gap. The central bank then reacts to this new inflationary environment by adjusting its policy rate (in accordance with the Taylor rule), which instantly alters the yield curve. Inflation therefore acts as the dominant and overwhelming determinant of sovereign borrowing costs. If an econometric model incorporates inflation as a control variable, it theoretically neutralises the main channel through which oil disrupts bond markets, thereby absorbing almost all of the explanatory power of the crude oil shock.

At the same time, the adjustment of actual output in response to these shocks plays a crucial role as a buffer. The structure of recent dynamic stochastic general equilibrium (DSGE) models, as theorised by Omotosho (2022), must incorporate capital accumulation and investment dynamics in order to understand this absorption. In response to a change in energy prices (which alters the marginal cost of production), firms adjust their investment and demand for labour, whilst households smooth their consumption. GDP growth then becomes the result of this physical adjustment. Consequently, when real growth and inflation are controlled for jointly in the analysis, the apparent effect of the oil shock fades away, giving way to the true structural component of the market: the soundness of the government's balance sheet. It is this mechanism of macroeconomic absorption that explains, in theoretical terms, why the status of oil exporter can suddenly reveal a net financial advantage (lower yields) once inflationary pressures and recessionary cycles have been ruled out. The abundance of resources, stripped of its volatile inflationary impact, once again becomes mere collateral guaranteeing the state's external solvency through the accumulation of solid foreign exchange reserves.

2.6. Volatility Dynamics and Flight-to-Safety

To fully grasp the financial impact of oil price uncertainty, contemporary literature has moved away from traditional linear models, as these incorrectly assume that financial risk remains constant over time. The cornerstone of this new approach is the GARCH (Generalised Autoregressive Conditional Heteroscedasticity) model, formalised by Bollerslev (1986, 2023). This model provides a highly instructive theoretical framework in which the variance (volatility or risk) of a financial series evolves according to the magnitude of past errors. This creates a phenomenon known as volatility clustering: during crises, a period of severe turbulence tends to be immediately followed by further severe turbulence. However, markets do not react in the same way to good and bad news. Byun and Cho (2013) apply asymmetric extensions to these models (such as EGARCH, TGARCH or GJR-GARCH) to demonstrate that market uncertainty (such as in energy or carbon contracts) reacts much more violently to negative shocks than to positive shocks of the same magnitude.

To analyse how this instability spreads from one market to another (known as volatility spillovers), traditional econometric VAR-type models have a major mathematical flaw: they can sometimes generate negative variance forecasts, which is conceptually absurd for a measure of risk cause the squared-standard deviation cannot be negative. To overcome this limitation, modern theory draws on Vector Multiplicative Error Models (vMEM-X). Xu et al. (2024) formalise this rigorous framework to demonstrate that macroeconomic shocks lead to highly directional volatility 'spillovers' between the oil market, equities and bonds.

This asymmetry in the transmission of shocks finds a particularly vivid conceptual embodiment in the 'Rocket and Feather Hypothesis' (RFH). Originally conceived to explain the rigidity of retail petrol prices, Wen et al. (2025) extend this theory to the overall dynamics of financial predictability. According to the RFH, markets adjust in a fundamentally unbalanced manner:

faced with a surge in crude oil costs, financial actors raise their risk premiums at fast speed (they shoot up like a rocket), but take a considerable amount of time to reduce them when prices collapse (they come down as slowly as a feather).

Finally, it is crucial to understand how these shocks alter the very relationship between different asset classes. The dynamics of the correlation between equities and bonds in the face of oil price shocks can be explained by the 'flight-to-safety' theory. Using an asymmetric dynamic conditional correlation model (ADCC-GARCH), Ziadat et al. (2023) postulate that this equity-bond correlation is intimately state-dependent on the macroeconomic. During periods of recession or pessimism activated by an oil supply shock, a wave of panic sets in: investors massively liquidate their risky assets (equities) to seek refuge in assets perceived as safe (government bonds). This sudden shift in capital flows causes the correlation between these two markets to suddenly turn negative.

Polat et al. (2025) confirm this complex network topology using 'Reverse-MIDAS' models. In a highly instructive manner, this econometric model allows high-frequency data (such as daily financial returns) to be combined with low-frequency data (such as monthly oil shocks) without losing the richness of the information. Their results demonstrate that the interconnection (contagion) between financial markets reacts much more strongly to oil-related risk shocks than to mere physical supply shocks.

2.7. Hypothesis

H0: Shocks on aggregate demand have a more significant and lasting impact on sovereign bond yields than oil supply shocks.

H1: A positive oil shock improves the terms of trade of exporting countries, reducing their short-term sovereign risk, while it worsens the external position of importing countries without necessarily increasing their rates proportionally.

H2: For exporting countries, a high price shock reduces short-term interest rates (liquidity effect) but increases the risk premium on long-term bonds (10 years).

H3: The impact of oil shocks on bond yields is mediated by the credibility of monetary policy: a supply shock only raises long-term interest rates if it unlocks inflation expectations.

H4: Shocks in the oil market not only affect interest rates but also significantly increase uncertainty in the bond markets, creating volatility that persists over the long term.

3. Methodology

3.1. Introduction

This study seeks to understand how oil shocks, distinguished between supply shocks and demand shocks, are transmitted to national economies and financial markets. The starting point is that not all countries react in the same way to an oil price shock: an oil-exporting country, which derives a significant portion of its revenue from this resource, does not face the same macroeconomic and financial consequences as a net oil-importing country. With this in mind, the empirical work focuses on two transmission channels. The first is real and involves commodity terms of trade (CTOT). The second is financial and concerns the cost of sovereign financing, measured by government bond yields.

3.2. Research objectives

The main objective of this study is to clarify the complex relationship between fluctuations in oil prices and sovereign debt markets by going beyond an analysis of changes in nominal prices. While traditional literature often treats oil shocks as homogeneous events, this study aims to provide a more nuanced understanding by pursuing three specific sub-objectives:

Firstly, we seek to isolate the underlying factors driving oil price movements using a structural approach. By determining whether a price change originates from a disruption in physical supply, a surge in global demand or anticipatory speculative behaviour, we can better understand the 'narrative' underlying market fluctuations. A key methodological objective here is to maintain a high-frequency (monthly) analysis for shock extraction in order to capture intra-annual volatility, which is often smoothed out in annual macroeconomic data.

Secondly, this research aims to connect 'real' and 'financial' transmission channels. The challenge is to measure how these structural shocks physically change a nation's wealth through CTOT. We also want to see how this wealth effect spreads into the financial sphere. By syncing the monthly shocks with annual panel data, the empirical framework lets us check if improvements in trade balances really lead to lower borrowing costs.

Finally, the central aim of the study is to test the duality of sovereign yields. By focusing on the term structure of interest rates, the objective is to identify a 'decoupling' effect. The aim is to demonstrate that, whilst oil revenues may provide a 'liquidity cushion' that lowers short-term yields (1-year maturity), they simultaneously increase long-term 'sovereign risk premiums' (10-year maturity) due to structural dependence and risks associated with the energy transition. This objective goes beyond simple correlations to offer a nuanced view of how energy shocks are reshaping nations' credit profiles across different time horizons.

3.3. Data

The data used comes from several harmonised sources. The first empirical component concerns oil itself. Global oil production data is available on an annual basis for a long period. In order to use it in a monthly SVAR model with the WTI oil price, it was necessary to use a time disaggregation technique. The method chosen was Denton-Cholette, which allows us to convert from an annual series to a monthly series while ensuring that the sum of the twelve-monthly observations for a given year corresponds to the observed annual total (Denton, 1971). A methodological note regarding the temporal disaggregation of global oil production is necessary. In the literature on energy economics, particularly in the tradition of Kilian (2009), the standard approach relies on monthly physical production data directly compiled from sources such as the International Energy Agency (IEA), the U.S. Energy Information Administration (EIA), or OPEC. However, due to data accessibility constraints and to ensure perfect consistency of the reference base with the available long-term annual framework, this study uses the Denton-Cholette structural disaggregation method. The WTI price is available directly on a daily basis, but we'll use it on a monthly basis to ease the analysis with other variables. This monthly frequency is maintained for the structural shock identification (SVAR) and the volatility analysis (GARCH) to capture high-frequency market dynamics and "uncertainty clustering" that would be lost in annual aggregations.

The second major source of data comes from the IMF's Commodity Terms of Trade. These CTOT indices measure changes in a country's export prices relative to its import prices and are available annually for a large number of countries. They are extracted, restructured and put into a country-year panel format, which allows us to work consistently with oil shocks averaged over the year. The CTOTs are initially used as a dependent variable to validate that the oil shocks captured by the VAR model do indeed have the expected effects on countries' external positioning, particularly those whose export structure is dominated by energy commodities.

To guarantee the econometric integrity of the 71-country panel, a rigorous multi-stage data cleaning procedure was implemented using RStudio. First, since the primary oil production data sourced from Our World in Data natively includes regional and institutional aggregates , a specialized regular expression filter was deployed to systematically exclude multi-country groupings (e.g., OPEC, World, Middle East, and specific income-based country categories).

Second, to address geopolitical fragmentation, a territory-to-country mapping dictionary was constructed to consolidate historical production values from non-sovereign territories into their primary sovereign economic entities (i.e., mapping Puerto Rico to the United States, and Greenland to Denmark).

Finally, rather than arbitrarily assigning country groups, a mathematical threshold was defined to build the interaction variable. A country's historical production profile was established by calculating its mean output across the complete timeframe. Standard sample segmentation was then achieved by selecting the median production of the active dataset as the critical threshold; nations displaying a mean production strictly above this median parameter were designated as net energy exporters (Exporter_Dummy = 1), while the remaining nations served as the net importing baseline (Exporter_Dummy = 0).

To ensure the strength of our analysis, we clearly distinguish between data frequency and instrument maturity. For maturity, we prefer to focus on Government Bond Yields (IMF indicator FIGB). We specifically target two segments of the yield curve: short-term and long-term maturities. For the short end of the curve, we use the Money Market Rate (MMR), which represents the rate at which banks borrow and lend short-term funds in the interbank market. This indicator serves as a proxy for domestic liquidity and immediate monetary conditions. For the long end, we use 10-year Government Bond Yields, which incorporate long-term inflation expectations and sovereign risk premiums. This distinction is essential to test the duality between the liquidity effect and the sovereign risk premium. Regarding frequency, while our SVAR and panel regressions are presented at an annual frequency to maintain consistency with the CTOT and macroeconomic variables, the underlying volatility analysis (GARCH) is conducted using monthly observations. This high-frequency data is essential to capture time-varying uncertainty and volatility clustering, which would be smoothed out and lost in purely annual datasets.

Finally, the third data component concerns sovereign interest rates. These are taken from the IMF's International Financial Statistics (IFS) database. The indicator used is entitled ‘Financial, Interest Rates, Government Securities, Government Bonds’. This is an annual yield expressed as a percentage per year, measuring the cost of financing government bonds. After filtering and cleaning, a series of annual bond yields is obtained for 71 countries over the period 2001–2024. These data are then merged with the CTOT panel and oil shocks, allowing us to study the link between oil shocks, terms of trade and sovereign financing conditions in a consistent framework.

In the interest of empirical transparency, it is important to acknowledge the challenges posed by missing data and the inherent heterogeneity across the 71-country panel. While the dataset was harmonized using IMF and IFS sources, not all countries provided continuous bond yield series for both 1-year and 10-year maturities over the entire 2001–2024 period due to data availability. This 'unbalanced' nature of the panel stems from differences in financial market depth; while advanced economies and major oil exporters (such as Norway or Saudi Arabia) maintain robust reporting, data for certain emerging economies exhibit gaps, particularly during periods of extreme domestic volatility. Furthermore, country heterogeneity remains a significant factor: the transmission of oil shocks is inevitably influenced by varying degrees of institutional quality, exchange rate regimes, and fiscal rules. To mitigate these discrepancies and prevent biased estimations, country-fixed effects were systematically included in all panel regressions. This approach ensures that we control for time-invariant characteristics specific to each nation, allowing the model to isolate the common reaction to energy shocks despite the structural diversity of the sample.

3.4. Econometric model

The empirical strategy is executed in two distinct stages. The first stage involves the identification of structural oil shocks through a Structural Vector Autoregression (SVAR) model, while the second stage employs panel regressions to estimate the transmission of these shocks to real and financial variables.

3.4.1. Structural Shock Identification

One of the major empirical limitations of this study lies in the heterogeneity of the data sampling frequencies. Whilst crude oil prices and financial variables are available on a monthly or daily basis, data on global oil production (sourced from Our World in Data) are only available on an annual basis. To overcome this limitation without sacrificing short-term dynamics, which are absolutely essential for identifying an SVAR model, we apply a time-series disaggregation procedure. Specifically, we use the Denton-Cholette method (Denton, 1971), which allows the annual series to be interpolated into a monthly series using the WTI price as a high-frequency leading indicator. This econometric approach ensures that the generated series strictly adheres to historical annual totals, whilst adopting an intra-annual cyclicality that is temporally consistent with actual market fluctuations.

To disentangle the underlying drivers of oil price movements, a SVAR-model is estimated. The identification of structural shocks relies on a Cholesky decomposition, which establishes a hierarchy of responsiveness among the variables by imposing ‘zero’ restrictions on their simultaneous interactions. Following the seminal framework of Kilian (2009), the variables are ordered as follows: Global Oil Production > Real Economic Activity > Real Oil Prices.

This specific recursive ordering is theoretically justified by the physical constraints and financial realities of the global energy market. Global oil production is placed first, treating it as the most exogenous variable. This assumes that the physical supply of oil is highly inelastic in the very short term; it cannot react instantaneously to within-month changes in global demand or price fluctuations due to the colossal adjustment costs, logistical frictions, and planning constraints inherent in the extractive industry. Conversely, the real price of oil is placed last in the recursive structure because it functions as a forward-looking financial variable. Unlike the rigidities of physical production, price discovery in the crude oil market occurs instantaneously. This allows the WTI benchmark to immediately absorb and reflect all new macroeconomic information, whether it stems from supply disruptions, shifts in aggregate demand, or precautionary motives driven by financial market speculation (Caldara, Cavallo, and Iacoviello, 2019; Kilian, 2009).

3.4.2. Panel Regressions and Transmission Channels

Once the structural shocks are extracted and aggregated at an annual frequency, their impact is estimated using two primary panel models with country-fixed effects:

<u>The Real Channel (Commodity Terms of Trade):</u>

$$CTOT_{i,t} = \alpha_i + \beta_1 Shock\_Supply_t + \beta_2 (ShockSupply_t . Exp_i) + \beta_3 ShockDemand_t + \beta_4 (ShockDemand_t . Exp_i) + \gamma X_{it} + \varepsilon_{i,t}$$

<u>The Financial Channel (Sovereign Yield Duality):</u>

$$Y_{i,t} = \alpha_i + \beta_1 Shock\_Supply_t + \beta_2 (ShockSupply_t . Exp_i) + \beta_3 ShockDemand_t + \beta_4 (ShockDemand_t . Exp_i) + \beta_5 GDP\_Growth_{it} + \beta_6 Inflation_{it} + \varepsilon_{i,t}$$

Where:

- $CTOT_{i,t}$: Commodity Terms of Trade for country in year, measuring international purchasing power for country i in year t.
- $Y_{i,t}$: Represents either the 1-year Money Market Rate (proxy for immediate liquidity) or the 10-year Government Bond Yield (proxy for long-term solvency and risk) for country i in year t.

- $Shock\_Supply_t$: Structural oil supply shock (production disruptions).
- $Shock\_Demand_t$: Structural oil demand shock (global economic activity).
- $GDP\_Growth_{i,t}$ & $Inflation_{i,t}$: Key control variables ensuring that the impact of oil is not confounded by domestic macroeconomic cycles.
- α_i: Country-fixed effects capturing time-invariant institutional characteristics.
- $\varepsilon_{i,t}$: idiosyncratic error terms

3.4.3. GARCH model

In order not to limit the study to an analysis of return levels, we incorporate a dimension relating to market uncertainty by modelling conditional volatility.

GARCH:

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$$

Where:

- σ_t^2: Volatility that your model is trying to predict for today.
- $\alpha_1 \varepsilon_{t-1}^2$: impact of recent shocks or bad news
- $\beta_1 \sigma_{t-1}^2$: persistence or the market's memory
- ω: basic constant

The use of the GARCH(1,1) model is fundamental here to capture the phenomenon of volatility clustering, whereby periods of high volatility tend to follow one another. In the R script, a GARCH specification combined with a Student's t-distribution for the error terms was chosen. This technical choice is crucial, as it allows us to model the 'fat tails' (or heavy tails) characteristic of financial asset returns. In statistics, 'fat tails' mean that extreme and unusual events — such as stock market crashes or massive price surges during an energy crisis — occur much more frequently in the real world than a traditional bell-shaped normal distribution would predict.

To account for this reality, we use a Student's t-distribution instead of a standard Normal distribution. Whilst a Normal distribution treats an extreme event as a virtually impossible anomaly, the Student's t-distribution anticipates and mathematically incorporates these outlier shocks by assigning greater weight to the extremes. This adjustment ensures that our model does not underestimate the actual risk during periods of turbulence.

By extracting the conditional volatility series (σ^2), we transform raw data into a dynamic indicator of uncertainty. This allows us to observe how oil shocks not only affect bond yields and indices, but also destabilise the very structure of risk over the long term

3.5. Methodological approach:

The quantitative analysis is based on two complementary empirical components designed to measure countries' responses to disruptions in the global oil market. First, an SVAR model is estimated to isolate supply and demand shocks individually, thereby distinguishing between fundamentally different sources of price fluctuations. These shocks are then aggregated on an annual basis and incorporated into a database covering a broad group of countries. Secondly, linear panel regressions are conducted to examine the extent to which these differentiated shocks influence, on the one hand, the CTOT and, on the other hand, sovereign bond yields. This financial analysis has a twofold dimension: it assesses the impact on financing costs (yield levels) and, to capture the dynamics of risk, it models the conditional variance of these yields.

All statistical processing and econometric modeling happens in the RStudio development environment using the R programming language. This choice improves data management and helps move from the monthly frequencies of the SVAR model to annual panel data. By using specific libraries like 'rugarch' for volatility modeling and 'plm' for panel data regressions, we ensure that our calculations are robust. This script-based approach guarantees that we can fully reproduce the analysis, making it easier to track data changes and perform significance tests on different macro-financial variables.

This quantitative analysis significantly helps explain how global macro-financial conditions react to changes in the oil market. It also provides a statistical framework for examining differences in transmission between exporting and importing countries. This offers a clearer understanding of the real and financial pathways through which oil shocks spread worldwide.

4. Results

This section constitutes the empirical core of this thesis and marks the transition from theory to empirical validation. After exploring the academic literature and laying the conceptual groundwork for the decomposition of energy shocks in Section 2, and then describing the methodological framework and data structure in Section 3, this section puts our research hypotheses to the test.

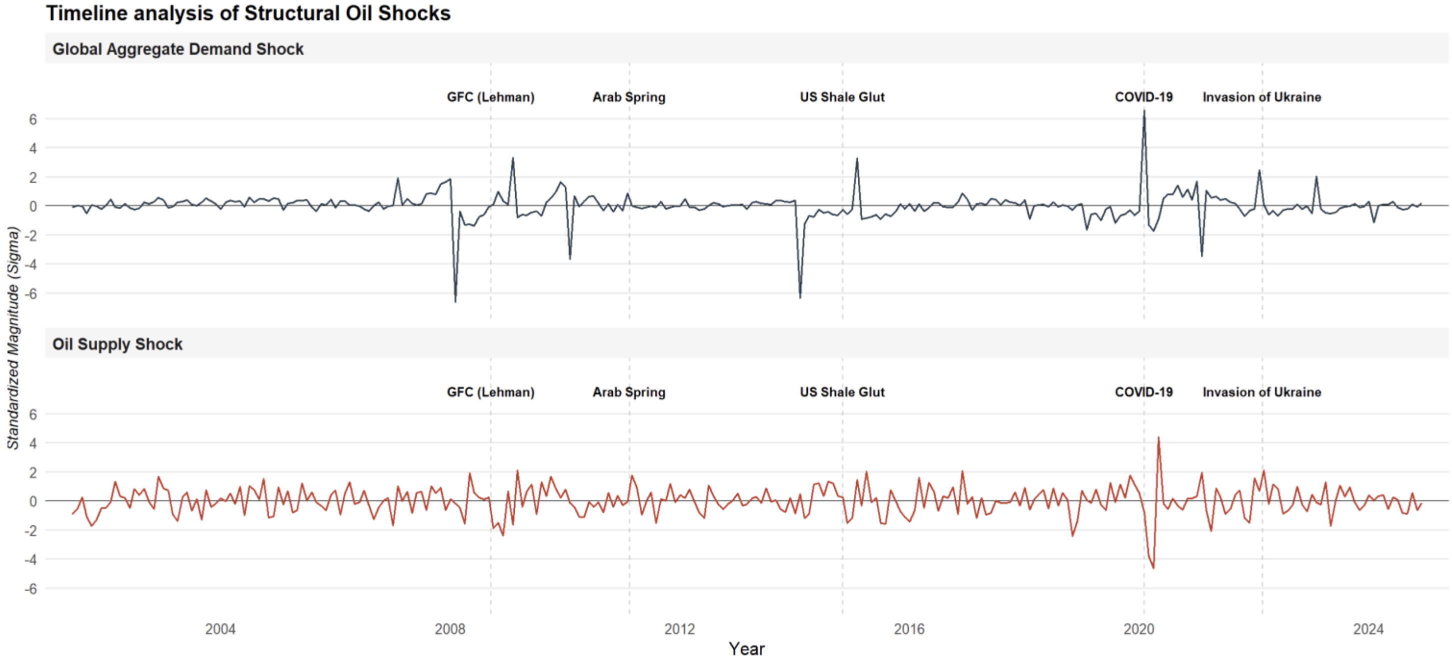
First, by assessing the evolution of supply and demand shocks and correlated events, it then focuses on a twofold comparison: on the one hand, a comparative analysis of economies based on their status as crude oil exporters or importers, and on the other hand, the fundamental distinction between the real sector—represented by changes in the terms of trade—and the financial sector, captured through bond market dynamics. This chapter seeks to precisely map how the nature of an oil shock alters risk premiums and sovereign financing costs across different time horizons.

4.1. SVAR Shocks and Historical Validation

The first crucial step in our analysis is to identify the exogenous components of crude oil price fluctuations using a SVAR model. This approach has enabled us to distinguish between supply shocks and demand shocks, the relevance of which is confirmed by a close correlation with historical cycles. The series of aggregate demand shocks thus follows global growth cycles, falling during historical recessions, while supply shocks isolate production disruptions linked to geopolitical tensions. This historical consistency proves that our model does not deal with random price fluctuations, but captures concrete and significant events in the global economy.

The credibility of any SVAR-model rests not on its mathematical complexity, but on its ability to mirror the actual history of the global economy. By applying a Cholesky decomposition, we have disentangled raw oil price fluctuations into distinct supply and demand components. The pedagogical value of this approach is best demonstrated by mapping these statistical residuals against documented geopolitical and economic milestones. When the model "identifies" a major crisis without being explicitly told it occurred, it provides a powerful validation of its structural integrity.

Figure 1: Timeline Analysis of Structural Oil Shocks



Starting with the Aggregate Demand Channel, the model captures the pulse of global industrial activity with remarkable precision. The most striking example is the 2008 Global Financial Crisis. Following the collapse of Lehman Brothers, the model extracts a massive negative demand shock, confirming that the oil price crash of that era was a symptom of a systemic worldwide recession rather than a surplus of barrels. Similarly, the COVID-19 Pandemic appears as an unprecedented vertical drop in demand, reflecting the synchronized shutdown of global transportation and manufacturing, represented by a sharp reverse "V-shaped" recovery as economies reopened. These episodes prove that the model successfully distinguishes between price drops caused by economic weakness and those caused by other factors.

On the Oil Supply Channel, the intuition shifted from demand-driven cycles to physical and geopolitical disruptions. In 2011, the model identifies supply tensions corresponding to the Arab Spring, particularly the sudden production halts in Libya which exerted upward pressure on prices. A pivotal moment occurs in 2014, where the model isolates a sustained positive supply shock. This aligns perfectly with the US Shale Revolution, a "supply glut" that fundamentally lowered global prices despite a relatively stable global economy. This distinction is vital: it proves the model understands that the 2014 price crash was driven by abundance, whereas the 2008 crash was driven by scarcity of buyers.

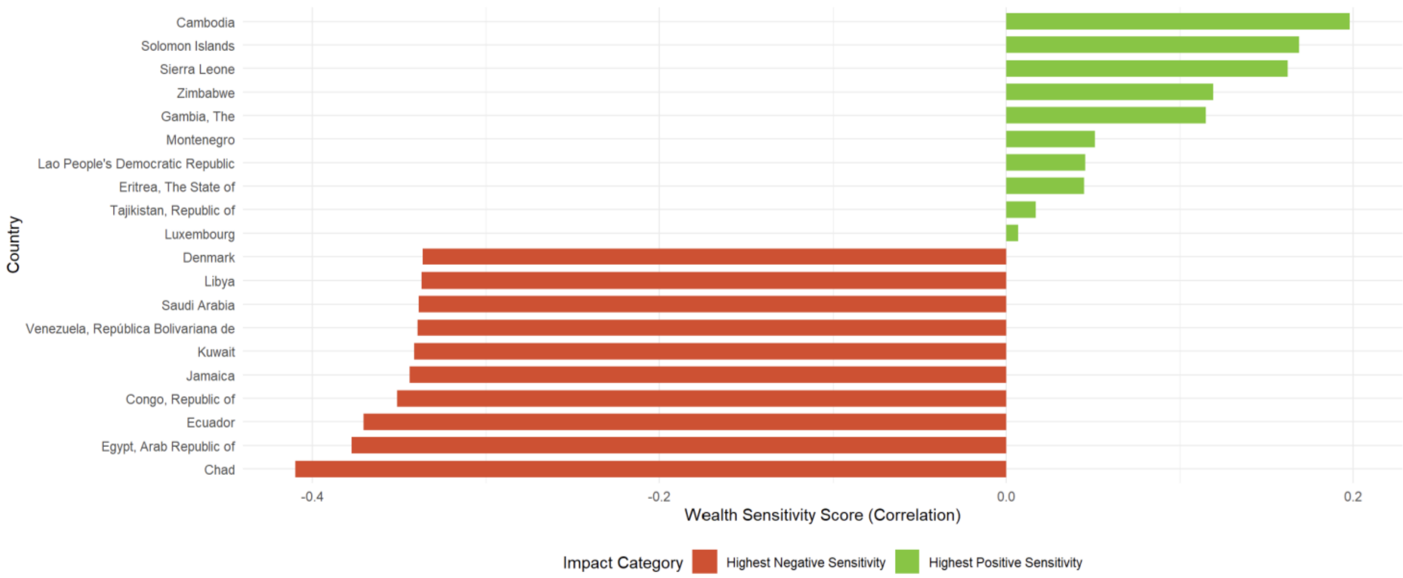
Finally, the 2022 Invasion of Ukraine is captured as a supply shock and a long-period of uncertainty. This reflects the immediate market anxiety regarding Russian export sanctions and the heightened geopolitical risk premium. By successfully isolating these three distinct drivers—demand collapse (2008), supply abundance (2014), and geopolitical scarcity (2022)—the SVAR model demonstrates that it is capturing the true "narrative" of the energy market. This structural accuracy provides a robust and undisputed foundation for our subsequent analysis of market volatility (GARCH) and the duality of sovereign interest rates.

In short, the accuracy of this model confirms that oil shocks—whether caused by supply constraints or a collapse in demand—are not merely statistical anomalies, but are, on the contrary, deeply influenced by major shifts in global economic and geopolitical developments.

4.2. Real Channel: Commodity Terms of Trade

To demonstrate that oil supply and demand shocks affect a country's wealth, this research draws on the concept of terms of trade, which measures a nation's international purchasing power. The central idea is that 'physical wealth' is not static: it fluctuates depending on whether the price of a country's exports rises faster or slower than that of its imports. By using the IMF's Commodity Terms of Trade (CTOT) index as the dependent variable, we statistically isolate the portion of the variation in national wealth directly attributable to the structural shocks identified by the SVAR model. This approach captures the international transfer of wealth: a positive demand shock will act as a redistribution mechanism, increasing the import capacity of nations whose export basket is correlated with energy prices, whilst imposing a levy on the real income of net importing economies.

Figure 2: Top 10 vs Bottom 10 countries by CTOT Response to Oil Shocks



The results of the sensitivity analysis reveal a clear hierarchy in the transmission of these shocks to real wealth. As illustrated in Figure 2, the most extreme correlation scores are concentrated almost exclusively in nations with energy-centred economic structures, such as Chad (-0.41), Egypt (-0.37) and Saudi Arabia (-0.33). This high magnitude confirms that, for these countries, oil shocks are not market noise, but structural determinants of their national wealth. Conversely, for more diversified or import-dependent economies such as Cambodia or Zimbabwe, sensitivity scores are significantly lower (below 0.20), suggesting that the oil shock is either diluted by other trade flows or absorbed by productive diversification.

Our H1 is thus fully confirmed by both sensitivity analysis and panel regressions. An examination of the Commodity Terms of Trade (Figure 2) validates the mechanism of international wealth transfer, revealing extreme and concentrated sensitivity among countries with energy-based economies.

4.3. Financial Channel: Impact on Bond Yields

The main aim of this section is to understand how structural disruptions in the oil market influence the cost of capital for governments, drawing a necessary distinction between short-term money market rates and long-term bond yields. This comparative approach aims to verify the existence of financial duality: the idea that a single shock could simultaneously ease short-term rates by injecting immediate liquidity, whilst tightening long-term rates if investors perceive an increase in credit risk or inflationary pressures in the future. For exporting countries, this analysis helps determine whether oil revenues act as a lever for sustainable wealth or merely as a temporary source of liquidity masking structural vulnerabilities.

4.3.1. Baseline Linear Regressions

Table 1: Descriptive Statistics of the Global Panel (2001-2024)

Statistic	N	Mean	St. Dev.	Min	Median	Max
10Y Bond Yield	1,001	5.354	3.818	-0.525	4.487	29.850
1-Year Short Rate	1,715	6.009	6.316	-0.654	4.759	88.140
Demand Shock (avg)	4,368	-0.002	0.369	-0.994	0.005	0.706
Supply Shock (avg)	4,368	-0.014	0.298	-0.829	0.004	0.491
Inflation	2,368	594.343	13,994.940	2.601	100.127	437,083.700
GDP Growth	4,323	3.559	5.369	-50.339	3.674	86.828

The analysis of descriptive statistics is a crucial step in understanding the economic environment in which our study is set. This table reveals the structural imbalances and vulnerabilities of nations in the face of oil price shocks. Looking at these figures, it quickly becomes clear that international finance does not follow a linear and smooth trajectory, but is marked by extreme events that justify the use of a robust econometric methodology.

The first striking observation concerns the structure of the debt market, where there is a clear dichotomy between short-term (1-year) and long-term (10-year) rates. The disparity in data availability—with far more data available for the short term—highlights a major challenge facing emerging economies: the difficulty, or even impossibility, of reassuring investors over the long term. For many of these countries, issuing 10-year debt is impossible or too costly, due to a lack of robust institutions. Even more telling is the fact that the average short-term rate (6.01%) is higher than the long-term rate (5.35%). In economics, this 'inversion' is often a sign of an immediate liquidity crisis: countries are forced to pay a very high price to obtain money straight away. Record spikes in rates exceeding 88% bear witness to moments of monetary panic where central banks had no choice but to sharply increase the cost of borrowing to protect their economies.

The financial instability observed within our large international sample is closely linked to the volatility of national macroeconomic variables. Indeed, whilst GDP growth may appear stable on average, it actually masks profound disparities: extreme fluctuations, ranging from a halving of national wealth (-50%) to episodes of spectacular growth (+86%), serve as a reminder of the extent to which countries dependent on natural resources are subject to highly volatile cycles. At the same time, inflation figures are sometimes staggering, marked by episodes of historic hyperinflation in certain nations. Although the majority of countries experience more moderate inflation, the presence of these extreme values demonstrates that price-related risk remains unpredictable and has the capacity to completely destabilise an economy. Given such structural heterogeneity, it is therefore essential in our models to assess the impact of oil by controlling for these variations in growth and inflation, which account for a large part of the uncertainty. It is precisely to isolate the pure impact of global energy fluctuations from these internal disturbances that we have rigorously opted for a panel model incorporating fixed effects by country. This advanced econometric approach makes it possible to systematically capture and control for all the institutional, historical and economic characteristics specific to each country. By controlling for these time-invariant characteristics, we ensure that the coefficients measuring the transmission of oil shocks accurately and exclusively reflect the reaction of bond markets, without our estimates being artificially biased by these extreme local dynamics.

Finally, the study of oil shocks themselves allows us to distinguish between two different forces: supply and demand. Our results confirm that it is cycles in global demand (consumption) that cause the most violent fluctuations in the price per barrel. With a broader scope than supply shocks, demand shocks reflect major shifts in the global economy. Conversely, the supply of oil is structurally rigid and inelastic in the short term. Due to the immense technical and financial constraints associated with the extractive industry, producers cannot instantly adjust their production volumes to market conditions. Consequently, this physical rigidity means that sudden and extreme fluctuations in the price per barrel are rarely due solely to changes in production, but are rather driven by fluctuations in global demand. In summary, these statistics confirm the premise of our research: to understand how oil influences nations' debt costs, we must accept that we are dealing with often volatile markets, where liquidity risk and global demand shocks dictate the rules of the financial markets.

Table 2: Results of panel regressions on bond yields and money market rates (2001–2024)

	Dependent variable:			
	Short Term Rate (1)	Bond Yield (2)	Short Term Rate (3)	Bond Yield (4)
Supply Shocks	-0.644	-0.178		
	(0.450)	(0.235)		
Demand Shocks			-0.163	0.087
			(0.351)	(0.183)
Inflation	0.002	-0.015**	0.002	-0.015**
	(0.010)	(0.006)	(0.010)	(0.006)
GDP Growth	-0.135***	-0.137***	-0.137***	-0.136***
	(0.036)	(0.023)	(0.036)	(0.023)
Observations	1,067	766	1,067	766
R2	0.016	0.057	0.014	0.057
Adjusted R2	-0.037	0.002	-0.038	0.002
F Statistic	5.485*** (df = 3; 1012)	14.628*** (df = 3; 723)	4.864*** (df = 3; 1012)	14.505*** (df = 3; 723)
Note:				*p<0.1; **p<0.05; ***p<0.01

The results of our estimates, summarised in the Table 2, confirm the complexity of these mechanisms and the importance of distinguishing the origin of the shocks. We observe that supply shocks exert downward pressure on the entire yield curve, with a particularly significant impact on the short end (-0.644), strikingly validating the hypothesis of a "liquidity cushion" generated by the physical abundance of oil. The coefficient of -0.178 associated with the supply shock on the bond market confirms that the abundance of oil resources acts as a signal of positive solvency for long-term investors. Conversely, demand shocks reveal divergent dynamics and a genuine duality of signs: whilst they still favour short-term liquidity (-0.163), they cause long-term rates to rise (+0.087). This reversal suggests that bond investors interpret a rise in global demand as a signal of potential risk or overheating, requiring a higher return.

The validity of these conclusions is reinforced by the robustness of our statistical analyses. Despite the heterogeneity inherent in a global panel, Fisher's tests (F-statistic) are consistently significant at the 1% level, proving that our variables do indeed explain the dynamics of interest rates. The stability of the GDP growth coefficient, -0.136 in all models, shows that the strength of the domestic economy is the most consistent factor affecting the cost of debt. Interestingly, the direct coefficient of inflation seems small and counter-intuitive in the baseline linear regressions. This emphasizes the significant macroeconomic absorption happening. It suggests that the nominal oil price shock does not directly influence interest rates. Instead, its volatility is managed through central banks' policy rules and long-term expectations, reducing its straightforward explanatory power in level regressions. The higher values seen in the long-term models indicate that our fundamental variables better reflect the structural trends in bond yields rather than the more erratic shifts in the money market. These results urge careful interpretation: while oil may offer immediate monetary relief, it does not resolve the long-term issues in financial markets, which remain focused on the real sustainability of economies that depend on natural resources.

Although our results show clear trends, we should interpret them carefully. Economic reality is often more complicated than what mathematical models can capture. Instead of undermining the analysis, these complexities help clarify the challenges faced by exporting countries.

Hypothesis H2, which deals with the dual nature of sovereign yields, is only partially confirmed. Our results reveal a noticeable difference between time horizons. When there is an aggregate demand shock, short-term rates drop by 0.163 due to increased interbank liquidity. At the same time, 10-year yields rise by 0.087. While the long-term coefficients do not reach a statistically significant level, this change in direction shows two opposing forces at work. Immediate monetary relief exists alongside a cautious reassessment of structural and inflationary risks by long-term investors.

One limitation lies in the diversity of national policies. Not all exporting countries react in the same way to the influx of fresh capital. Some countries practise what is known as 'sterilisation': they capture oil revenues and invest them in sovereign wealth funds abroad rather than allowing them to circulate within their domestic economy. In such cases, the liquidity effect we have measured may be much weaker.

Another limitation concerns the accuracy of the data. In a global panel comprising very different economies, the quality of statistical information is not always consistent. For some emerging economies, data on long-term rates are sometimes patchy or less transparent than in developed economies. This means that our results reflect a global average that may mask specific situations where political or local risk takes precedence over the logic of the oil market.

Finally, it is important to bear in mind that exporting countries do not exist without anything. Their interest rates are also heavily influenced by major external forces, such as decisions by national institutions. If global rates rise sharply due to US policy, an exporting country could see its own rates rise, even if the price per barrel is favourable.

In short, whilst our model shows that oil is a key driver of these countries' financial systems, it is not the only factor at play; financial stability remains a delicate balance between natural resources, domestic political management and the headwinds of the global financial system.

Hypothesis H3 regarding the mediating role of monetary policy and macroeconomic variables is indirectly confirmed by the phenomenon of econometric absorption. When inflation and GDP growth are jointly included as control variables in the panel, the direct effect of oil shocks disappears. Inflation captures and neutralizes the variance in long-term rates, proving that the bond market reacts to the direct macroeconomic consequences of energy (price stability and real growth) rather than to the nominal oil price shock itself, which underscores the importance of central bank credibility in anchoring expectations.

4.3.2. Non-linearity and asymmetry of shocks

In order to fully grasp the subtleties of macro-financial transmission channels, it is essential to move beyond a strictly symmetrical view of shocks. Indeed, an increase or decrease in aggregate demand does not necessarily trigger reactions of equivalent magnitude in the markets. The introduction of a non-linear specification (presented in Table 3) makes it possible to isolate the direction of these aggregate demand shocks and reveal their asymmetric impact on ten-year sovereign bond yields.

The econometric analysis based on Table 3 reveals a striking divergence in behaviour between periods of contraction and phases of economic expansion. Looking first at net energy-importing economies, a negative aggregate demand shock — reflecting a synchronised slowdown in the global economy and a decline in activity — leads to marked upward pressure on their sovereign financing costs (of the order of +0.642). Conversely, when global demand is expanding, these same bond yields tend to fall, but with structurally less intensity (-0.292). This contrast illustrates a profound mechanism of asymmetric risk aversion: international bond investors are substantially more nervous and reactive to signs of global recession than they are reassured by periods of economic prosperity.

Table 3 : Asymmetric Impact of Aggregate Demand Shocks on 10Y Sovereign Yields

	Dependent variable:
	Bond yield
Positive Demand Shock	-0.292
	(0.683)
Negative Demand Shock	0.642
	(0.455)
Inflation	-0.010
	(0.006)
GDP Growth	-0.154***
	(0.024)
Positive Demand Shock * Exporter	-1.075
	(0.830)
Negative Demand Shock * Exporter	0.067
	(0.563)
Observations	735
R2	0.070
Adjusted R2	0.012
F Statistic	8.642*** (df = 6; 691)
Note:	*p<0.05; **p<0.01; ***p<0.001

This asymmetry takes on a particularly interesting dimension when we examine the specific case of energy-exporting nations. During a positive demand shock—that is, during a global economic boom—these countries experience a unique dynamic. The inclusion of an interaction term specific to these producer countries reveals a very pronounced compression effect on their bond yields (with a substantial coefficient of -1.075). Although this estimate lies on the fringes of traditional thresholds of statistical significance, its magnitude provides strong empirical support for the 'liquidity cushion' hypothesis. This change in the aggregate demand shock coefficient between the basic linear model and the asymmetric model shows a structural shift in market behavior. A global demand surge initially indicates inflationary pressures across the entire sample. However, a closer look at the shocks shows that during economic booms, the large influx of petrodollars and the resulting liquidity cushion effectively reduce long-term risk perceptions for energy-exporting countries. In practical terms, strong global demand generates a massive influx of petrodollars that structurally floods the domestic interbank systems of these countries. This excess liquidity then exerts downward pressure on their long-term yield curve, reducing the cost of their debt. This liquidity mechanism acts as a powerful underlying force, which operates even when the effect of each nation's specific economic cycles is isolated.

However, a country's financial stability does not depend solely on capital inflows linked to the oil market. The analysis confirms that real domestic GDP growth remains the model's dominant institutional anchor. A robust local economy significantly reduces interest rates (-0.154), acting as the most robust fundamental shield to protect sovereign solvency against global energy uncertainties and fluctuations.

4.4. The Volatility and Uncertainty Component

Beyond their impact on nominal interest rates, oil shocks have a profound influence on the stability of sovereign bond markets by acting as major catalysts of financial uncertainty. Our empirical analysis suggests that, even when energy shocks do not cause permanent shifts in average interest rates, they significantly increase investor anxiety and market volatility. To quantify the evolution of this uncertainty, we estimated a GARCH(1,1) model on the interest rate series.

The results (Table 4) show a significant volatility structure. The ARCH ($\alpha_1 = 0.128$) and GARCH ($\beta_1 = 0.871$) coefficients are statistically meaningful at the 1% level ($p < 0.01$). The sum of these coefficients is 0.999, indicating very high persistence in the volatility process. This means that when an oil shock causes financial instability, the resulting nervousness in the bond market fades slowly over time.

Additionally, the significance of the ARCH term shows that sovereign risk is highly sensitive to breaking news and sudden price changes. Using a Student's t-distribution for the residuals, validated by a significant shape parameter of 2.18, confirms the presence of fat tails. This suggests that oil shocks are likely to cause extreme movements in interest rates more often than a normal distribution would suggest.

Backed by strong diagnostic tests, especially the Weighted ARCH-LM test (which confirms no residual heteroscedasticity) and the Sign Bias Test (showing a significant asymmetric effect of 2.70), this model illustrates that oil shocks are not just temporary price changes, but lasting triggers of financial instability. This effect is especially strong in resource-dependent economies, where volatility clustering is most evident, making the management of sovereign debt more complex.

In conclusion, our analysis shows that the impact of oil price shocks on sovereign bond yields goes beyond mere changes in interest rates to manifest itself in a structural destabilisation of market volatility. Supply and demand shocks act as triggers for uncertainty, but in distinct ways:

whilst supply shocks tend to reduce interest rates through a liquidity effect, they nonetheless remain vectors of immediate nervousness (significant ARCH coefficient). For their part, demand shocks introduce deeper instability, as they are perceived by investors as signals of inflationary risk or economic overheating, putting pressure on yields and increasing financial unpredictability.

The extremely high volatility identified (0.999) reveals that the bond market in exporting countries retains a traumatic memory of energy shocks. Once instability has been triggered, investor "nervousness" subsides only very gradually, creating a financial environment where risk is ever-present. This dynamic is accentuated by the presence of "fat tails" (shape parameter of 2.18), confirming that oil crises are not marginal events, but catalysts for extreme and frequent movements in interest rates. For oil-dependent economies, oil price volatility therefore translates not only into fluctuating revenues, but also into an intrinsic fragility of their financial standing on the international stage, creating lasting complications for the management of their sovereign debt.

Our hypothesis H4, which posited that global energy shocks lead to a sustained increase in uncertainty in bond markets, is therefore fully confirmed by the estimates from our GARCH(1,1) model. Although our previous panel analyses (Section 5.3) indicate that oil shocks have a neutral effect on the average level of long-term yields, the analysis of conditional variance reveals a profound impact on the risk structure. Indeed, the sum of the ARCH and GARCH coefficients reaches a critical level of 0.999, indicating near-unit persistence of volatility (volatility clustering). This empirical result demonstrates that whilst oil shocks do not alter the direction of 10-year rates, they leave a particularly persistent 'stress imprint', keeping financial markets in a state of prolonged anxiety long after the initial shock has been resolved.

Table 4: Garch & Arch Results

```
*---------------------------------*
*          GARCH Model Fit        *
*---------------------------------*

Conditional Variance Dynamics
-----------------------------------
GARCH Model     : sGARCH(1,1)
Mean Model      : ARFIMA(1,0,0)
Distribution    : std

Optimal Parameters
------------------------------------
        Estimate  Std. Error  t value Pr(>|t|)
mu       0.54290    1.056823   0.5137 0.607459
ar1      0.96711    0.007625 126.8366 0.000000
omega    0.32786    0.135979   2.4111 0.015903
alpha1   0.12758    0.043732   2.9173 0.003531
beta1    0.87142    0.037555  23.2038 0.000000
shape    2.17935    0.061342  35.5278 0.000000

Robust Standard Errors:
        Estimate  Std. Error   t value Pr(>|t|)
mu       0.54290    1.209457   0.44888 0.653522
ar1      0.96711    0.008781 110.13810 0.000000
omega    0.32786    0.125076   2.62130 0.008759
alpha1   0.12758    0.040383   3.15927 0.001582
beta1    0.87142    0.052980  16.44819 0.000000
shape    2.17935    0.045775  47.61011 0.000000
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5. Discussion

The quantitative analysis of the interactions between the global energy market and sovereign bond markets highlights complex dynamics that go beyond simple empirical observations of linear correlations. The joint assessment of the real channel, as captured by the CTOT, and the financial channel, measured through yield curve distortion and the structure of conditional variance, validates a key conceptual insight: the impact of an international energy crisis is never a unified phenomenon. Its intensity and direction depend fundamentally on the original nature of the fluctuations and the energy status of each nation.

In real terms, an asymmetric transmission channel is emerging between economies. For the majority of crude oil-importing countries, structural changes have no long-term impact on their overall terms of trade. This apparent neutrality reflects either a robust diversification of their trade balance or a dilution of their dependence on crude oil within broader import structures. Conversely, for exporting countries, a rise in global prices – particularly when driven by strong global demand – leads to an immediate and substantial improvement in their terms of trade. The hydrocarbon market thus facilitates a gross and directional international transfer of wealth, converting energy dynamics into an influx of liquidity for producing countries.

However, transforming this physical wealth into a stable financial advantage on the government bond markets is far from straightforward. The term structure of interest rates reveals a striking duality, making energy resources a double-edged sword. At the short end of the curve (one-year maturity), a positive supply shock exerts pronounced downward pressure. This phenomenon reflects the existence of a liquidity channel, where the recycling of petrodollars saturates the domestic interbank system and creates a monetary buffer that eases the government's immediate financing costs. Conversely, on the long end (ten-year maturity), aggregate demand shocks trigger an opposite adjustment: they increase short-term liquidity but push up long-term bond yields. This decoupling indicates that long-term investors perceive the expansion of global demand not as a source of enrichment for the sovereign issuer, but as an early warning sign of macroeconomic overheating and future inflationary pressures, thus demanding a higher risk premium to tie up their capital for a decade.

This structural shift highlights the central role played by real and nominal fundamentals in absorbing macroeconomic shocks. The explicit inclusion of GDP growth and inflation within the empirical framework significantly boosts the model's overall explanatory power, whilst absorbing almost the entire direct and gross impact of nominal oil price fluctuations on interest rate levels. The price of oil therefore does not act as a direct determinant of long-term solvency, but rather as an initial catalyst: the true driver of yield curve distortion lies in imported inflation and the endogenous response of central banks to curb it. Once these monetary pressures and recessionary cycles have been neutralised, the risk premium specific to oil-exporting countries becomes negative and significant. This demonstrates that if an oil-producing country manages to anchor inflation expectations and sterilise its capital flows to avoid the distortions associated with the Dutch disease, its abundance of resources becomes a purely collateral financial advantage, structurally reducing its risk of default relative to importing nations.

Nevertheless, the fact that macroeconomic variables help to explain the average level of interest rates should not obscure the markets' perception of risk. An examination of conditional variance reveals that energy shocks bring about a lasting change in the structure of financial uncertainty. The modelling highlights volatility that persists at a level close to unity, meaning that the bond market retains a prolonged and almost traumatic memory of past crises: when a disruption occurs, investor nervousness subsides only very slowly. Furthermore, the validation of a heavy-tailed distribution confirms that, under the influence of oil price movements, extreme fluctuations in interest rates — often amplified by panic or flight-to-safety behaviour — occur with a much higher frequency than predicted by the normal laws of classical finance.

Nonetheless, a methodological point is worth raising regarding the construction of these shock indicators. Unlike traditional approaches in the literature, which rely on monthly physical extraction data to isolate aggregate supply, data availability constraints here necessitate the use of a time-series disaggregation via the Denton-Cholette method, using the WTI price as a high-frequency indicator. Although this technique preserves the accuracy of historical annual aggregates, the use of a financial price index as a proxy for physical volumes introduces a potential bias, by assuming a mechanical short-term alignment between extraction strategies and contemporary price signals. A future comparison of these structural innovations with direct physical extraction time series would be a natural next step in testing the robustness of the identified shocks.

This long-term financial risk is made worse by the new trend of global decarbonization, which presents the serious danger of stranded assets. In the context of the global energy transition, stranded assets are fossil fuel reserves and extraction infrastructure that will lose their economic value or usefulness too soon due to climate regulations, changing investor preferences, and the fast growth of renewable energy. For countries that depend on resources, this shift means that once-abundant resources could become a major liability. Unusable reserves may not be enough to ensure long-term financial stability. To reduce this risk, several forward-thinking exporting countries have set up intergenerational sovereign wealth funds (SWFs) as financial buffers. By channeling oil revenue into diverse portfolios of financial assets, these funds separate public finances from direct physical extraction. This approach turns a limited, temporary geological resource into lasting financial capital. As a result, a well-managed sovereign wealth fund sends an important message to bond markets. It reassures long-term investors that a country can keep up with its debt obligations and handle structural changes, even as global demand for fossil fuels steadily declines.

Ultimately, oil revenues are a paradoxical form of wealth. They offer immediate financial benefit through trade. However, they also expose public finances to strict examination by long-term investors. These investors are very aware of the risks tied to inflation and unpredictable market changes. As the world shifts away from fossil fuels, the risk of losing value in these assets grows. States must work on diversifying their economies and strengthening their economic institutions. This will be essential in guarding against this vulnerability.

To kick things off, the empirical validity and predictive power of the structural framework developed in this thesis would benefit from being tested against contemporary geopolitical dynamics, and more specifically against the current conflict in Iran. This major crisis serves as a prime example of the inherent limitations of ex-post macroeconomic models when faced with energy shocks of unprecedented severity. In terms of markets, the escalation of hostilities and the repeated blockades of the Strait of Hormuz act as powerful catalysts for volatility, propelling the price per barrel well above its historical averages due to physical supply disruptions and a very high war risk premium. However, rigorously incorporating this episode into our econometric analysis framework faces a significant methodological obstacle: the critical lack of hindsight and the short-term unavailability of harmonized statistical data. Indeed, robust estimation of shocks via an SVAR model absolutely requires long, stabilized, and disaggregated time series. At the same time, panel regression analysis—which is essential for assessing the impact on commodity terms of trade (CTOT)—relies on macroeconomic data releases that are inherently subject to long lags. Attempting to incorporate this war in real time would therefore introduce significant censoring bias as well as transitory volatility, risking obscuring the essential distinction between the very high-frequency behavior of financial variables and the slower adjustment of the real economy.

Nevertheless, a qualitative observation of this crisis strikingly corroborates the underlying hypothesis of our thesis, while highlighting a fundamental market mechanism. While this oil shock may initially appear to be driven by a geopolitical shortage of physical supply, structural modeling shows that the surge in prices during such conflicts is in fact massively amplified by a powerful precautionary demand shock, closely linked to market participants' anxiety over potential future shortages. This combination revives the spectre of a global stagflationary dynamic that rapidly spreads to the financial sphere via the inflation channel and interest rate adjustments. The result is a widespread sell-off in global bond markets and a surge in sovereign yields. Ultimately, this situation empirically validates the central importance of rigorous management of inflation expectations and demonstrates, once again, just how vulnerable the sovereign risk premium remains to nervousness in the oil market.

Oil wealth is a true double-edged sword for oil-producing countries. When global demand rises, these nations receive a large amount of money, often referred to as "petrodollars." This influx boosts their financial systems and significantly lowers short-term borrowing costs. However, this immediate flow of cash hides a more cautious reality in the long run. Investors worry about inflation risks and the ongoing instability of these economies. As a result, they ask for higher interest rates on long-term loans, like 10-year loans. The price per barrel is just a trigger. What really protects a country from global shocks is the strength of its fundamentals, such as real growth, and its ability to manage inflation. This caution is even more important today as the green transition picks up speed. It could render these once-valuable oil fields obsolete and worthless. To secure their future and financial stability, these countries must diversify their economies and invest their unpredictable revenues in sustainable savings funds for future generations.

6. Conclusion

This research has shed light on the complex relationship between oil market shocks and the stability of sovereign debt around the world. By going beyond a simple analysis of nominal price changes, the study demonstrated that to understand the impact of oil on a country's economy, one must not only look at whether prices are rising or falling, but above all identify the root cause of these movements. By using an SVAR model identified via a Cholesky decomposition, in accordance with the standards set by Kilian (2009), we were able to separate supply shocks (production disruptions) from demand shocks (global economic activity). The first major finding is that aggregate demand shocks are the true drivers of financial markets: unlike supply shocks, they generate far more powerful and lasting shockwaves on the redistribution of global wealth and the adjustment of interest rates. This innovative dual-frequency methodology has made it possible to capture the historical narrative of energy crises, from the 2008 collapse to the 2022 invasion of Ukraine, while synchronizing these events with annual macroeconomic data from 71 countries.

This transmission of shocks to bond markets occurs through a dual-channel system that this study has measured. For exporting countries, a high oil price driven by global demand creates an immediate wealth effect, which shows up as an improvement in their commodity terms of trade (CTOT). This substantial influx of petrodollars fills their financial system and creates a liquidity channel that lowers short-term interest rates (1-year). However, a more complex situation develops over the long term (10 years). By using a GARCH(1,1) model to study volatility, we found that oil-related uncertainty increases investor anxiety. So, even if a country becomes wealthier, the volatility of its oil revenues leads to a risk premium that raises the cost of its long-term debt. This difference between immediate liquidity and future solvency is central to the challenge faced by nations dependent on natural resources.

The analysis also shows that countries are not passive bystanders in the face of these shocks. The inclusion of control variables such as GDP growth and inflation revealed that macroeconomic stability acts as a genuine shield. A nation with strong institutions and under control inflation manages to absorb some of the energy volatility, while more fragile countries see their sovereign rates skyrocket unpredictably. This observation justifies our rigorous fixed-effects approach, which has allowed us to isolate the pure impact of oil from country-specific characteristics.

In conclusion, this study clearly answers its main research question. Shocks to oil prices, whether supply- or demand-driven, explain the differences between countries in sovereign bond markets. They lead to a structural shift from a short-term real wealth effect to a reassessment of long-term financial risks. Through our structural identification, aggregate demand shocks emerge as the main economic drivers. They generate powerful and systemic cross-country divergences, which far outweigh the localised effects of physical supply disruptions. In the real economy, these shocks trigger an immediate international transfer of wealth. This significantly widens the terms of trade for commodities and injects large waves of capital into net energy-exporting countries. This inflow creates a powerful liquidity buffer in the interbank systems of producer countries. This mechanically compresses short-term money market rates and reduces immediate financing costs. However, as the structural maturity of the yield curve extends to a 10-year horizon, long-term bond yields become decoupled from immediate liquidity. They are heavily influenced by a persistent sovereign risk premium. International investors view demand-driven price surges as early warning signs of global inflation and economic overheating. This triggers a wave of massive sell-offs in long-term bonds. Furthermore, our conditional variance analysis confirms that this financial instability is not temporary. The persistence close to unity (0.999) identified using the SVAR-GARCH framework shows that energy crises leave a mark of prolonged and structural tension on sovereign debt markets. Ultimately, whilst the abundance of natural resources currently provides temporary fiscal relief, it also exposes public finances to sustained scrutiny of structural macroeconomic heterogeneity. This demonstrates that long-term fiscal protection against global energy uncertainty requires robust institutional sterilisation and aggressive structural economic diversification.

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