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The Case of Ecuador

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Emerging Markets Bond Index Performance and Sovereign Default: The Case of Ecuador*

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Abstract

This paper delves into the dynamic impact of Ecuador's 2008 sovereign debt default on the subsequent performance of the country's bonds, specifically as measured by the Emerging Markets Bond Index (EMBI). Through a blend of qualitative and quantitative analyses, the paper develops a framework for understanding the interplay between macroeconomic and political fundamentals, global liquidity dynamics, and investor behaviors. Employing a synthetic control method, the study assesses the default's impact on Ecuador's EMBI performance, revealing a dynamically heterogeneous influence that fluctuates with evolving macroeconomic and political landscapes. The findings highlight the importance of considering a broad spectrum of economic variables in sovereign risk assessment, especially for economies with significant exposure to volatile commodity markets. The study offers insights into the complex dynamics governing sovereign bond markets post default, emphasizing the roles of fiscal discipline, investor communication, and political stability in mitigating sovereign risk.

Keywords: Sovereign Debt Default; EMBI; Fiscal Distress Analysis; Investor Behavior Dynamics; Ecuadorian Economic Policy.
JEL Codes: F34, G15, H63, F65, E44

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1 Introduction

In this paper, we aim to explore the impact of a sovereign debt default by an emerging country on the subsequent performance of that country's bonds in the global market. This inquiry delves into understanding how such a default influences the interaction between macroeconomic and political performance, and interacts with the dynamics of bond yields, investor confidence, and overall market perception in the aftermath of the default event.

Answering this question is relevant for several reasons. Firstly, from a policy-making perspective, understanding the aftermath of a sovereign debt default is essential for guiding fiscal policy in emerging markets. Such insights are crucial for governments seeking to devise preventive measures against future defaults and to stabilize their economies postdefault. This understanding will also aid policy makers in balancing economic growth with fiscal responsibility. Moreover, the implications of sovereign debt defaults extend beyond national borders, because such defaults impact global financial stability. By exploring these effects, this research contributes to a broader understanding of international economic dynamics, which is essential for both domestic and international policy formulation.

Secondly, this research adds value for investors and financial markets. It enhances the understanding of the risks associated with investments in countries that have experienced or are at risk of a debt default. Such insights can significantly influence investor confidence and behavior, possibly shaping investment flows into emerging markets. Furthermore, the findings of this research could guide credit rating agencies in their assessment of countries' creditworthiness postdefault. This, in turn, could affect the interest rates and borrowing costs for these countries, influencing both their economic recovery and long-term financial health. In essence, the study not only enriches academic discourse, it also has practical implications for a range of stakeholders, including policy makers, investors, and international financial institutions.

To address the research question, our study focuses on Ecuador's 2008 sovereign debt default, employing a blend of qualitative and quantitative methods to analyze its effects on country risk perceptions. We began by developing a conceptual framework based on in-depth interviews with investors who specialize in sovereign debt in emerging markets. These

interviews, complemented by a literature review, provided critical insights into the factors influencing investment decisions in emerging markets debt, including those that affected Ecuador's Emerging Markets Bond Index (EMBI) performance following the default. This framework, which considers various economic, political, and social factors at the local and global levels, helps us understand sovereign risk through a broader lens, including the impact of sovereign defaults on a country's risk dynamics.

For the quantitative aspect, we employed a synthetic control methodology to create a counterfactual scenario simulating Ecuador's EMBI performance had the 2008 default not occurred. This approach enables us to isolate and quantify the specific impact of the default on Ecuador's subsequent risk dynamics, offering insights closer to a causal interpretation of the relationship between the default and the subsequent dynamics of the EMBI. This combination of qualitative insights from investor interviews and quantitative analysis through synthetic control methodology provides an examination of the dynamic effects of sovereign debt default on risk perception, particularly in emerging markets like Ecuador.

The academic literature widely acknowledges that the macroeconomic and political instability in emerging countries significantly influences investors' perceptions of the ability of those countries' governments to meet their external debt obligations. This instability is often associated with a higher probability of sovereign debt default. Such default risks are extensively analyzed as consequences of these factors, which encapsulate the effects of adverse economic shocks and local political dynamics on country risk indexes like the EMBI. Additionally, although it is less explored, the role of investor sentiment and global financial market trends—particularly in terms of profitability and liquidity—plays a crucial part in shaping narratives and perceptions about the risks of sovereign debt default in emerging markets.

Moreover, while it is reasonable to assume that sovereign debt defaults should have lasting effects on perceptions of future default risks, we lack systematic evidence on how this process unfolds. In this paper, we present the case study of Ecuador to illustrate the dynamic impacts of sovereign debt defaults on a country's subsequent risk dynamics.

The study of Ecuador's sovereign debt default has significance as a general case and also due

to its unique nature compared to other default episodes in emerging markets. Ecuador's default in 2008 was marked by distinctive characteristics, including the assertion of the illegitimacy of certain bonds and a subsequent debt repurchase and market reentry strategy. The analysis of this unique case provides scholars and policymakers with an exceptional opportunity to explore how unconventional factors, such as debt legitimacy debates and political motivations, intersect with traditional economic and financial aspects in shaping default outcomes. The study of Ecuador's default from this perspective both enriches our understanding of sovereign debt dynamics and offers valuable lessons for managing and resolving financial crises in emerging markets that differ from more conventional default scenarios.

Our findings reveal that Ecuador's EMBI performance displays a distinct behavior compared to that of its regional counterparts, a behavior that is characterized by both higher levels and more volatility over time than its peers. As depicted in Figure 1, Ecuador's EMBI performance not only registers higher levels but also exhibits greater volatility compared to other oil-exporting Latin American countries. Specifically, the coefficient of variation for Ecuador's EMBI performance is 33 percent higher than the average for Latin American oil-exporting economies. This observation raises a pertinent question: to what extent do the unique dynamics of Ecuador's EMBI performance reflect the country's history of sovereign debt defaults? This remains an unresolved issue, warranting further investigation into the relationship between sovereign debt defaults and the subsequent bond market performance in emerging economies like that of Ecuador.

Our study also revealed that the impact of Ecuador's 2008 default on its sovereign debt default risk is characterized by dynamic heterogeneity. On average, the default event led to the assessment that Ecuador presented a higher risk, despite all emerging markets' exposure to the global financial crisis of 2008. Ecuador's EMBI performance exhibited a distinctive pattern, surging to several times that of the synthetic control group in the year of the default, followed by a gradual convergence that indicated a fade-out effect. This convergence persisted for several years until Ecuador experienced a substantial increase in its EMBI performance relative to the counterfactual outcome, notably in 2015, which was attributed to the sharp decline in oil prices. These patterns hold across various specifications used

to generate the donor panel and weights for the synthetic control, with our fully specified model's incorporation of controls for macroeconomic stability highlighting the consistency of these dynamics.

Our research offers an in-depth analysis of the dynamics of Ecuador's EMBI performance in the wake of its 2008 sovereign debt default that relies on insights from investor perspectives and empirical data. Contrary to our initial hypothesis, we found that sovereign debt defaults do not have a lasting, uniform impact on a country's risk profile as reflected by EMBI performance. Instead, the effects vary dynamically. The assessment of country risk's having become greater following a default is particularly evident in cases where the defaulting nation subsequently exhibits fiscal distress. This study posits that investor perceptions of country risk are significantly influenced by their interpretations of past sovereign debt crises.

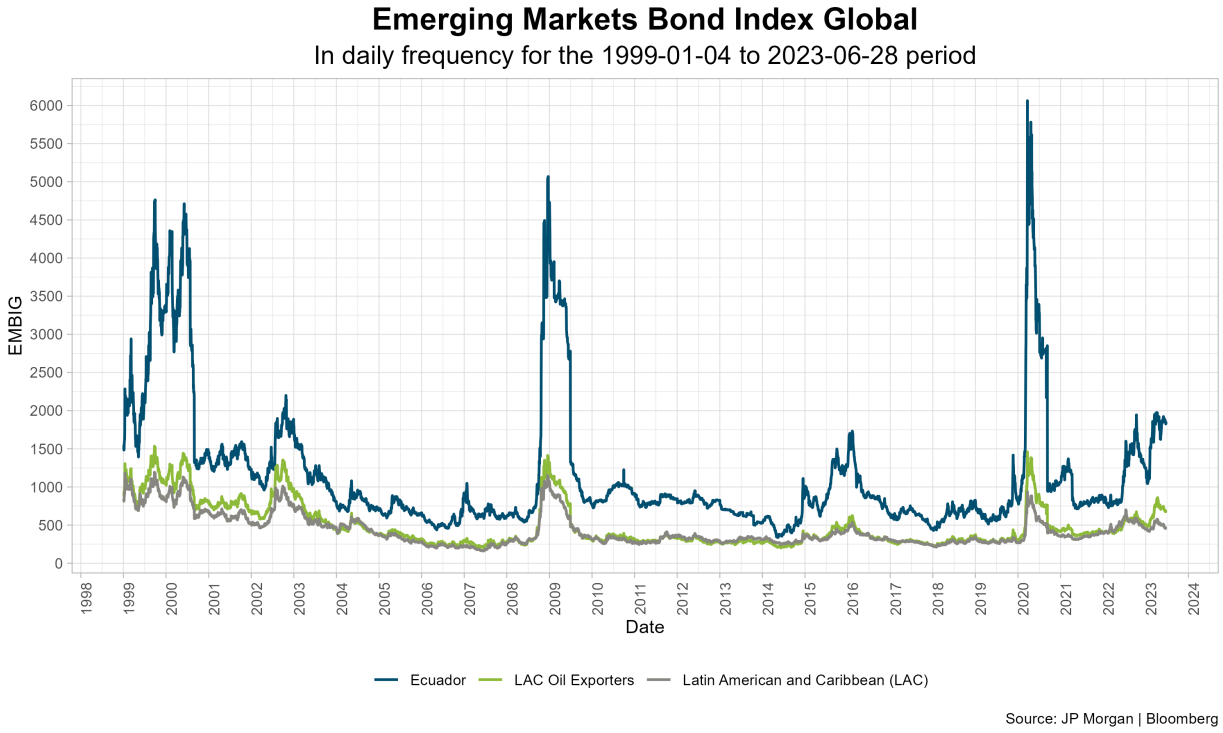
Among other literature, our research shares interest with the analysis of sovereign debt and default risks pioneered by Arellano (2008). Both are interested in understanding better the dynamics of the EMBI, in particular, the role of political and macroeconomic factors, investor sentiment and market perceptions in its dynamics. Yet, while Arellano (2008) builds a model predicting defaults and their effects on macroeconomic variables such as interest rates and consumption volatility (with reference to the 2001 Argentine crisis), we provide empirical estimates of the impact of sovereign defaults on the dynamics of the EMBI, and a narrative to explain how market reactions and investor perceptions post-default affected the dynamics of the EMBI. We are also related to subsequent literature by Cuadra and Sapriza (2008) that assesses the impact of political uncertainty on the likelihood of sovereign default and the resulting interest rate spreads in emerging markets, highlighting the importance of political stability for the economic health and creditworthiness of emerging markets. Our paper also provides empirical insights into how sovereign debt crises, such as Ecuador's 2008 default, influence market perceptions and EMBI performance. We further relate to analysis in the Yue (2010) paper by offering a detailed empirical examination of market reactions and investor perceptions in the wake of sovereign defaults, focusing on specific case studies such as Ecuador, to illustrate the dynamic impacts of sovereign debt crises on emerging economies' market access and EMBI performance. We also relate to literature on

the role of risk aversion of investors in emergent markets, as modeled by Lizarazo (2013), who shows that the dynamics of bonds in emergent markets can be affected by the level of financial wealth and risk aversion of the international investors.

With this research, we aim to contribute to the ongoing dialogue regarding the implications of sovereign debt defaults in emerging markets. Our findings are particularly relevant for investors, policymakers, and academic researchers, providing new insights into the nuanced relationship between sovereign debt events and market perceptions. Additionally, our study introduces a novel approach that integrates qualitative analysis with data-driven research, offering a comprehensive method for understanding the dynamics of sovereign debt and its impact on emerging economies. This approach contributes to a better understanding of how fiscal policies and market reactions are intertwined in the aftermath of a sovereign debt default.

The organization of the paper is as follows: Section 2 sets the foundation by establishing a conceptual framework for understanding the dynamics influencing Ecuador's EMBI performance. This framework, developed through semistructured interviews with sovereign debt investment managers and an extensive literature review, is crucial for identifying the multifaceted factors impacting sovereign debt defaults in emerging economies, with a particular focus on Ecuador. Section 3 explores the complex history of Ecuador's 2008 sovereign debt default, examining its unique political motivations and the subsequent effects on investor perceptions and market dynamics. Section 4 presents the methodology used to estimate the effects of the 2008 default on Ecuador's EMBI performance, employing a synthetic control method supported by a robust set of economic indicators. This section includes a detailed analysis of the data sources, manipulation processes, and model specifications. In Section 5, the results of the analysis are discussed, showcasing the donor panel's weight structure and synthetic control estimates in order to elucidate the dynamic impact of the default on Ecuador's EMBI performance. This section also places these results within the broader context of global economic trends and investor behavior. The paper concludes with a synthesis of the findings, emphasizing the critical roles of fiscal discipline, investor communication, and political and economic institutions in shaping sovereign risk and debt management strategies in emerging markets.

Figure 1: EMBI Performance Daily Evolution



Notes: The countries for the Average in Latin America and Caribbean are: Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Jamaica, Mexico, Panama, Peru, Paraguay, El Salvador and Uruguay. For the Oil Exporters in the LAC region we used: Brazil, Mexico, Colombia, Ecuador, Bolivia, and Peru. We have excluded Argentina and Venezuela due to their volatile EMBIG measures.

2 A Conceptual Framework for Understanding Ecuador's EMBI Determinants

In this section, we present a comprehensive literature review to construct our conceptual framework. This conceptual framework helps to understand the interplay of macroeconomic and political fundamentals, the influence of global liquidity dynamics, the significance of investor types and their strategies, the impact of portfolio structure and yields, the behavior of the EMBI during market distress, and the dynamic nature of a sovereign default's influence on a nation's overall risk profile. The case of Ecuador, with its unique blend of political, economic, and financial characteristics, sheds light on the intricate dynamics that underlie the assessment of sovereign risk in emerging markets, particularly given historical

sovereign debt defaults and the ever-evolving global financial landscape.

2.1 Political and Macroeconomic Fundamentals

Political factors are fundamentals that exert a significant influence on sovereign risk perception. In a stable political environment, where policies are predictable and governance is strong, investors are more confident about the country's ability to manage its debt. Conversely, political instability or uncertainty can lead to heightened sovereign risk: there is the potential for policy shifts that could unfavorably affect debt management (Azzimonti and Mitra, 2023). In Ecuador, the history of political volatility has implications for investor confidence and the political environment has been a critical determinant of the country's sovereign risk profile.

The macroeconomic fundamentals are the bedrock upon which sovereign risk assessments are built and determine the ability of a country to adjust to negative shocks (Aizenman, Jinjarak and Park, 2016). Robust economic growth, low inflation rates, debt-to-GDP ratio reduction, and a sustainable fiscal sector and policies together form a picture of an economy's strength, its government's capacity to service debt, and the performance of sovereign spreads (Nogués and Grandes, 2001; del Cristo and Gómez-Puig, 2017; Edwards, 1986). For example, Baldacci, Gupta and Mati (2011) find that the composition of fiscal policy matters, as higher public investment can lower sovereign spreads, as long as the government's financial situation is sustainable and does not show a deficit. It is worth mentioning that the correlation between macroeconomic fundamentals and sovereign risk is a two-way dynamic relationship, whereby sovereign default might affect the performance of macroeconomic indicators. Along these lines, the literature shows that after a default episode, indicators related to the external sector (for example, terms of trade and exports) suffer deterioration in the short term due to a reduction in the relative external demand for goods of the defaulting country (Gu, 2021). For Ecuador, despite possessing substantial natural resources and having periods of strong growth, macroeconomic vulnerabilities, particularly its dependency on oil revenues and susceptibility to external shocks given that it is a dollarized economy,[1] have historically undermined its economic stability and thus

[1]However, some studies, such as del Cristo and Gómez-Puig (2017), find the opposite, concluding that

exacerbated its sovereign risk.

The interplay between macroeconomic stability and political dynamics plays a pivotal role in the assessment of country risk, particularly in the context of sovereign debt valuation. Political risk emerges as a decisive factor when it has the potential to undermine macroeconomic fundamentals, leading to a deterioration of a country's economic trajectory and in turn its ability to repay debt. Previous studies have shown a correlation between the behavior of country risk and, more precisely, the presence of structural breaks in the EMBI series and the occurrence of relevant political and economic events (Caporale, Carcel and Gil-Alana, 2018). Furthermore, studies have found the roots of EMBI indicators' behavior in political noise, indicating that lower political risk is linked to tighter sovereign spreads (Nogués and Grandes, 2001; Baldacci, Gupta and Mati, 2011). This interrelation highlights that, when capacity to pay is compromised, instability in political processes can undercut payment willingness eroding confidence in a sovereign's commitment to meeting its financial obligations. The strength of a country's institutions often serves as a bulwark against such risks; robust institutional frameworks tend to put in place safeguards against the adverse impacts of political volatility on economic health. Consequently, countries with more resilient institutions are generally perceived as less likely to experience macroeconomic instability as a result of political fluctuations (Azzimonti and Mitra, 2023).

The present work focuses in understanding sovereign debt default with the existing literature. Constructing a model to explain the dynamics observed during Ecuador's 2008 default, aiming to predict and analyze default probabilities and their implications on interest rates and consumption volatility. Furthermore, it contributes to the need to better understand the critical role of political and macroeconomic fundamentals and their complex interaction with market forces expressed in investor sentiment and market perceptions in determining sovereign debt outcomes. This effort builds upon previous research by Arellano (2008) and subsequent literature on the causes and dynamics of sovereign debt defaults on macroeconomic variables.

dollarization reduces vulnerabilities to external shocks that could affect EMBI performance evolution, resulting in a much more stable indicator.

2.2 The Role of Global Liquidity

Global liquidity conditions direct investment flows toward or away from risky assets (such as emerging markets debt); they determine the flow of capital across borders and influence the risk premium demanded by investors. During periods of high global liquidity, emerging markets like Ecuador may benefit from increased capital inflows and lower borrowing costs. Conversely, when global liquidity tightens, these markets may face higher risk premiums and reduced access to credit. Accordingly, González-Rozada and Yeyati (2008) find that external factors, such as global liquidity and investors' risk appetite, explain the variability of EMBI spread, even when accounting for country-specific factors. This dynamic is crucial in understanding Ecuador's sovereign risk, particularly given its integration into the global financial system and its reliance on external financing as a dollarized economy.

A sovereign default acts as a significant inflection point in investor perception, as was the case concerning Ecuador's 2008 default. Such an event often triggers an immediate reassessment of risk, placing the defaulting country under intense scrutiny. The dynamics of such scrutiny are not homogeneous because investors and credit rating agencies alike become more rigorous in their assessments when fundamentals (political or macroeconomic) deteriorate, Comelli (2012). While after defaults, investors assign a higher risk premium to a country's debt, reflecting the increased uncertainty about the country's willingness and ability to meet its future obligations, the influence of such a premium on investment decisions is inversely proportional to global liquidity.

In this sense, this paper is related to the concept of debt intolerance (Reinhart, Rogoff and Savastano, 2003), where the history of default impacts access to international debt markets, and one of its symptoms is investors' perception of risk. There is also a threshold level of debt holdings at which defaulter countries are unable to acquire more debt. In this sense, Matsuoka (2022) finds that there are non-linear relationships between interest rate, thresholds, and debt composition, where the cost of borrowing grows exponentially after a given level of debt. Additionally, Cato and Kapur (2006) found that the heightened volatility of macroeconomic indicators plays a crucial role in the sovereign risk of numerous developing nations. The authors argue that this increased volatility is linked to a heightened

probability of default, leading these countries to face borrowing constraints at lower levels of indebtedness.

Global financial markets are intricately interconnected, with global monetary and financial dynamics playing a crucial role in shaping the risk appetite of institutional investors and influencing capital flows to and from risk markets. Understanding these dynamics, as well as identifying the key players in capital markets, is essential to grasp the factors that drive variations in a country's EMBI performance (Presbitero et al., 2016; Comelli, 2012; Carrillo-Maldonado, Díaz-Cassou and Flores, 2021).

Comprehending the prevailing market regime is vital for interpreting how the EMBI spread changes through time. For instance, a period of global risk appetite can depress the EMBI spread of a country with weak macroeconomic fundamentals, as was observed in 2017, when global liquidity was high and low-risk instruments yielded low returns. Conversely, a global risk aversion phase can overshadow significant improvements in a country's macroeconomic fundamentals, potentially leading to an increase in the EMBI spread, as seen in 2022, when global liquidity was low due to monetary measures undertaken by central banks globally to contain inflation.

3 Ecuador's EMBI Dynamics: the investors' perspective

To conduct the analysis in this section, we employed semistructured interviews to acquire a qualitative understanding of how investors interpret default events in emerging markets, with a particular focus on Ecuador's 2008 default. We engaged with several sovereign debt investment managers who specialize in emerging markets and are influential in the international sovereign bond market. These interviews, supplemented by the thorough literature review previously presented, offered critical insights into the factors that impact EMBI performance, especially within the Ecuadorian context. The information and perspectives gathered from these interviews served as the foundational input for the conceptual framework we present next, a framework that offers a vision of the dynamics surrounding

sovereign debt defaults in emerging economies. Investors' views capture unobserved factors that macroeconomic dynamics data cannot, factors that are especially relevant because they shape dominant narratives that influence investor behavior and, ultimately, market trends. In this section, we have compiled the key insights obtained during the interviews.

3.1 Investor Types Matter

A key factor in understanding the movements of the EMBI is the universe of investors for a specific credit. Different types of investors have unique strategies and sensitivities. A significant portion of the market is dominated by 'real money' investors, who are long-term players. This group includes entities like insurance companies, pension funds, and sovereign wealth funds. These funds constantly deal with inflows and redemptions and typically follow benchmark indices, aiming to achieve returns that outperform these indices. Given the volume of assets these funds manage, they are considered by market experts to be the most influential group in determining the pricing of a country's sovereign bonds.

On the other end of the spectrum is the 'fast money,' primarily coming from hedge funds. These investors aim to maximize returns and are not tied to a benchmark index. They tend to be more opportunistic when it comes to buying or selling a country's bonds, especially during periods of distress. Their strategies often involve rapid movement in and out of positions, reflecting their shorter investment horizons.

Additionally, in recent years there has been a significant rise in passive investors such as Exchange-Traded Funds (ETFs) that replicate the performance of benchmark indices through algorithmic trading. This type of investment has introduced a new dynamic in the market, influencing the behavior of bond prices and further diversifying the investor base in the sovereign debt market. These passive investors, while not actively managing their portfolios, contribute to market liquidity and price discovery, making them an important part of the overall investment landscape.

Market experts agree that the most influential global factor in determining the appetite for risk assets is the interplay between the 'risk-free' interest rate and global growth. The 'risk-free' rate is typically represented by the yield curve of U.S. Treasury bonds. Generally,

lower global (risk-free) interest rates are associated with an increased appetite for riskier assets. However, the macroeconomic determinants behind movements in the global interest rate are crucial. For instance, if the interest rate is rising in the context of robust growth, the global environment may be favorable for risk assets. Conversely, if the interest rate is falling due to developed markets entering a recession, the global context could negatively impact the appetite for risk assets.

Following the default, investors have monitored Ecuador's economic and political decisions with heightened diligence. Each policy change, economic indicator, and political development has been carefully weighed to evaluate its impact on the country's creditworthiness. In the wake of the default, Ecuador has had to navigate this increased scrutiny, with its sovereign bonds being more sensitive to both domestic and international developments that could signal changes in its ability to service debt.

3.2 Portfolio Structure and Yields

Investment decisions and the price at which an investor is willing to buy or sell an asset are not solely dependent on the attributes of that asset alone. Every investment decision involves an opportunity cost—the loss of potential gain from other assets that were not invested in. Thus, investment decisions are relative and it is crucial to identify a 'comparable universe' for each specific asset. Interestingly, this comparable universe is not static; it evolves, shaped by the changing conditions of the sovereign issuer. For Ecuador, for instance, the comparable universe under normal circumstances typically includes other oil-exporting countries or those with similar credit ratings. However, during periods of volatility when the EMBI index rises sharply, the comparable universe shifts toward a basket of countries experiencing distress. Different country groups attract different investor bases and the investment strategies linked to credits under normal conditions versus those in distress can vary markedly.

Investment strategies or approaches inherently account for the expectation of default as investors navigate the decision to invest in riskier assets. This anticipation of potential nonpayment is interwoven with the returns garnered from these instruments in the interim.

Essentially, the probability of default is internalized within the investment strategy: as investors assess the risk of a sovereign default, they simultaneously evaluate the prospective returns that could be realized before any such event might occur. This dual consideration shapes the investment landscape, with the risk of external shocks, for instance, factoring into the calculus of both potential returns and default likelihood.

The concept of 'current yield' plays a crucial role in investment decision-making, particularly in the context of sovereign debt bonds. Current yield is calculated as the ratio of a bond's coupon to its price. The higher the coupon or the lower the price of the bond, the greater the current yield it offers. This metric is fundamental because it reflects the immediate income that an investor can expect relative to the price of the bond. However, a very low coupon structure can lead to distortions in the bond-pricing process. Low or infrequent coupon payments diminish the cushioning effect in terms of investment returns because they raise the break-even bond price of the investment. Particularly in emerging markets and distressed credits, bonds with very low coupon structures might deter investors due to the minimal cash flows they provide. From the standpoint of market psychology, where a credit event is considered a short-term possibility, this technical aspect can lead to a demand for low-bond prices, justifying the perceived risk of the investment. The EMBI consequently moves higher, reflecting the increased risk premium demanded by the market.

From an investment decision perspective, in distressed markets when comparing two bonds with the same spread over U.S. debt, the bond with a lower price could be perceived to offer more value. A lower-priced bond presents a greater opportunity for appreciation and minimizes the potential for loss compared to another bond with the same yield but a higher price. This valuation principle becomes particularly pertinent in the sovereign debt market, where bonds of similar yields can vary significantly in price. In scenarios when the market is navigating uncertainties or potential credit events, investors involved in distressed markets may prefer lower-priced bonds as they offer a more attractive risk-reward balance. This approach underlines the importance of bond pricing and yield structures in shaping investment strategies in the sovereign debt sector.

Because of this dynamic, an often-overlooked factor affecting how investors perceive sovereign

risk is the composition of a country's debt portfolio. For a given context of global liquidity, when the debt instruments are structured to offer short-term yields that are perceived as high, investors may prioritize macroeconomic fundamentals over political risks, because their focus is on the immediate performance of their investment. Conversely, if the portfolio is composed of long-term debt instruments lacking short-term coupons, investors' attention shifts toward the longer-term performance of these instruments, which becomes more sensitive to political risk factors. This shift in focus is especially pertinent in cases where the legitimacy of debt obligations is questioned, as was seen in Ecuador's 2008 default, where political decisions directly influenced the market's perception and treatment of sovereign debt.

3.3 EMBI Values and Market Distress

The EMBI value enters distress when debt investment closely approximates the 'recovery values' estimated by investors—the amount they expect to receive per unit of bond value in the event of a restructuring. During these times, bond price volatility increases, rendering traditional calculations of price elasticities in response to macroeconomic, political, or expectation-driven events less effective. When a country's EMBI value enters a state of distress, there is a noticeable shift in market psychology. Macroeconomic fundamentals begin to lose their previous significance due to the implicit expectation of nonpayment or short-term restructuring of these assets. The trading behavior of the bonds changes as well, with prices across various sovereign bonds, regardless of their terms to maturity, converging toward very low levels.

The investor behavior in response to low-priced bonds differs significantly from that toward bonds under normal conditions. As prices converge toward estimated recovery values, the expected downside risk—the potential for further price falls—tends to be lower than the possible gains from price increases. However, during these episodes of distress, there seems to be a ceiling, influenced by market expectations about potential short-term restructuring. This mindset creates a natural offering of bonds at a certain price, above which the distressed regime of these bonds implies greater risks than profit opportunities. This dynamic illustrates the complex interplay between investor psychology, market expectations, and

the pricing mechanisms in sovereign debt markets in distress.

3.4 The Dynamic Nature of the Default's Impact on Country Risk

Ecuador's sovereign debt history is characterized by a complex dichotomy between the historical record of default and the collective memory of investors. On the one hand, there is an implicit penalty embedded in the pricing of Ecuadorian bonds, a shadow cast by its history of default. On the other hand, institutional investors are inclined to overlook this historical blemish if the perceived risk is deemed to be adequately compensated for by the potential returns, particularly under global liquidity conditions that render these bonds attractive compared to other low-risk financial instruments, such as U.S. Treasury bonds. For instance, given Ecuador's dependence on oil revenues and how oil price shocks almost immediately affect fiscal deficits in this dollarized economy, a negative oil price shock could bring about that shadow affecting the short-term perception of sovereign risk. This investment behavior underscores a complex environment where past defaults do not necessarily preclude future investments; instead, they are factored into a broader calculus of risk and reward, influenced by the prevailing conditions of the global financial markets.

The perception of sovereign risk is a construct influenced by a combination of objective factors. For Ecuador, these factors—alongside the long shadow cast by the 2008 default—have forged an intricate sovereign risk profile that requires careful navigation. Political, macroeconomic, and global liquidity dynamics continue to be the pillars upon which sovereign risk is assessed, but the specter of default has imbued these assessments with an added layer of complexity, making the task of predicting and understanding Ecuador's sovereign risk all the more challenging.

4 Ecuador's Sovereign Debt Default in 2008

The history of Ecuador's 2008 sovereign default intertwines internal policy decisions with the broader dynamics of international markets. Contrary to typical instances of sovereign default, which are often precipitated by acute financial crises or unsustainable debt levels,

Ecuador's situation was unique. The country's debt, while high, was deemed relatively sustainable. However, the decision to default was driven not solely by financial necessity but also by a political agenda aimed at repudiating what was considered illegitimate and oppressive debt terms inherited from previous administrations. This stance was substantiated by the findings of a public debt audit commission, which declared certain bonds illegitimate, culminating in the default on two bond issues in late 2008. The move elicited mixed reactions from the international community, with some investors viewing it as a strategic rejection of unjust debt, while others perceived it as a gamble that risked Ecuador's future access to global capital markets (Feibelman, 2017).

The immediate aftermath of the default saw a significant downturn in bond prices, reflecting the heightened perceived risk of Ecuadorian debt. This scenario underscored the IMF's stance on the importance of fulfilling debt obligations to maintain access to international capital markets. Despite the initial turmoil, Ecuador's strategic maneuvering, including the repurchase of most of its defaulted debt at a discount, allowed it to re-enter the bond market in 2014. This development highlighted the interplay between sovereign decision-making, investor perceptions, and market dynamics.

The events leading to the default were marked by Ecuador's growing dissatisfaction with its sovereign debt, which was increasingly seen as a barrier to economic and social progress. The government's critical view of certain debts as "odious" and the subsequent establishment of a debt audit commission set the stage for a dramatic shift in how Ecuador managed its external debt obligations. The crisis escalated in November 2008 with the decision to delay a $30 million interest payment, a move that reflected a broader strategy to renegotiate the debt terms. The situation reached a climax in December 2008 when Ecuador declared a default on over $3 billion of its global bonds, citing the audit's findings as justification. This bold step was framed as essential for relieving financial pressure and reallocating resources towards critical social and development projects.

In navigating the fallout of the default, Ecuador embarked on a resolution path that involved a strategic buyback of the defaulted bonds in 2009 at approximately 35 cents on the dollar. This approach, though controversial, was defended as vital for reclaiming economic

sovereignty and ensuring fiscal sustainability. However, it also sparked criticism and raised concerns about Ecuador's ability to access international capital markets in the future. Despite these hurdles, Ecuador's successful return to the bond market in 2014, marked by a $2 billion issuance, signaled a regained confidence among international investors in the country's economic management and fiscal policies.

Ecuador's 2008 sovereign default and its aftermath stand as a pivotal episode in the history of international finance, illustrating the intricate balance between meeting sovereign debt obligations and addressing national economic priorities. The country's ability to reduce its debt burden through strategic default and repurchase, followed by a return to the international capital markets, offers valuable insights into the complexities of sovereign debt dynamics, the role of political considerations in financial decisions, and the potential for recovery and re-engagement with global financial systems.

5 Estimating the Effects of the 2008 Default on Ecuador's EMBI Performance

5.1 Data and Methods

In this section, we detail the data sources and imputation processes employed to explore the impact of Ecuador's sovereign default in 2008 on the subsequent performance of the EMBI indicator using synthetic control methods. Our analysis relies on ten key variables: the EMBI, inflation (year-over-year [YoY] variation from the Consumer Price Index [CPI]), unemployment rate, gross domestic product (GDP) in logs of USD (real on base year 2010), GDP growth (YoY variation from GDP), exports in USD (real on base year 2010), population, debt, global balance, and primary balance (the latter three as proportions of GDP). Drawn from a diverse pool of 24 countries[2] and including Ecuador as the treatment

[2]The donor panel, critical to our synthetic control methodology, comprises the following countries: Argentina, Chile, Colombia, Dominican Republic, Ecuador, Egypt, Hungary, Indonesia, Iraq, Lebanon, Mexico, Malaysia, Pakistan, Panama, Peru, Philippines, Poland, El Salvador, Serbia, Turkey, Ukraine, Uruguay, Vietnam, and South Africa. We have excluded Brazil, China, and the Russian Federation because the sizes of their economies were not comparable with that of Ecuador. Finally, these economies (with the

unit, our data ensure robustness, as they originate from authoritative sources. Finally, recall that this panel is composed for the 2005Q1–2019Q4 time span to compute inflation and growth from 2006 to 2019 on a quarterly frequency.

5.2 Data Manipulation

In our data compilation process, we utilize distinct data sets for various economic indicators. Unfortunately, the availability of macroeconomic time series is not always consistent, particularly for emerging markets, specific countries, or specific date ranges. To address this challenge in completing the panel of macroeconomic variables for our donors panel, we draw on data from multiple sources and employ interpolation methods. This enable us to transform the data from a yearly frequency to a quarterly frequency, ensuring a more comprehensive and temporally detailed data set for our analysis.

The Consumer Price Indexes come from the International Financial Statistics (IFS) data set from the International Monetary Fund, with detailed procedures for handling missing data outlined in Table (4). Similarly, the unemployment rate relies on the Global Economic Monitor (GEM) data set from the World Bank (WB), with corresponding procedures detailed in Table (6). GDP data are primarily sourced from the GEM data set; the completion of missing data is explained in Table (5). The Exports data utilize the IFS data set, with a nuanced approach involving both Seasonally Adjusted (SA) and Not Seasonally Adjusted (NSA) series; the procedures for addressing missing data are outlined in Table (7). We should note that for tables (4) to (7) the interpolation method used was the piecewise cubic Hermite interpolation method.[3]

For population, debt, and global and primary fiscal balances (the latter three expressed as a share of GDP), our data were available only in a yearly frequency. To bridge the gaps, we employed the piecewise cubic Hermite interpolation method for all countries.[4]

Brazil, China and the Russian federation) were the only ones that had no-missing values for the 2005 Q1 - 2019 Q4 timespan

[3]We only interpolate within pretreatment periods utilizing data from the pretreatment period, and likewise within post-treatment periods, when interpolating we use data exclusively from the post-treatment period.

[4]For El Salvador and Iraq in the pretreatment period the interpolation method used was the inverse

Population data are exclusively sourced from the World Development Index (WDI) data set. Conversely, debt data are derived from the Global Debt Database of the IMF, specifically the Central Government Debt series.[5] Finally, the global and primary balances are sourced from the World Economic Outlook database provided by the IMF.

5.3 Estimates of the Effects of the 2008 Default

For this paper, we computed estimates based on 10 specifications utilizing the synthetic control method for the EMBI series (see 9.1 for more details). The model specifications are as follows: Specification 1 exclusively utilizes either the raw EMBI series or the residuals, incorporating a constant term across features. Specifications 2 to 7 progressively build upon the previous model. Specification 2 introduces inflation, with a constant term specifically for this feature. Specification 3 incorporates the unemployment rate, including both a constant term and time trends. Moving forward, Specification 4 encompasses exports, integrating a constant term and time trends. Specification 5 introduces population, again with a constant term and time trends. Specification 6 involves debt (as a share of GDP), alongside a constant term and time trends. Specification 7 includes the logarithm of GDP, accompanied by a constant term and time trends.

Specification 8 replaces the logarithm of GDP with the GDP growth rate, retaining only a constant term. Specification 9 extends Specification 8 by incorporating the global balance (as a share of GDP), introducing both a constant term and time trends. Finally, Specification 10 builds upon Specification 9, replacing the global balance with the primary balance (as a share of GDP), and again integrating a constant term and time trends. These specifications offer a nuanced progression, systematically expanding the model's complexity and comprehensiveness. A list of these specifications can be found in the appendix in section 9.1.2.

6 Results

6.1 Donor Panel

Table 1 provides the outlines of the weight structure for the donor pool used to construct the counterfactual scenario for Ecuador's EMBI in the absence of the 2008 default. As we progress from specification S1 to S10 and incorporate additional covariates, there is a noticeable shift in the weight distribution among the donor countries. Initially, countries like Iraq and Ukraine show significant weights in the first specification, which may reflect that Ecuador's EMBI behavior was similar to the EMBI behaviors of these countries for the time period under study. However, the determinants that shape the EMBI movements in each country may have behaved differently. In this way, as more covariates are added, the weights allocated to these countries adjust, suggesting a fine-tuning of the counterfactual to account for the increasingly complex economic environment.

By S10, where the covariates include inflation, unemployment rate, exports, population, debt, GDP growth, and primary balance, a diverse set of countries receives weight, indicating that the counterfactual is accounting for a broad array of economic conditions. Notably, countries like Lebanon, Poland, and Mexico maintain positive weights (more than 10 percent) throughout the specifications, suggesting that their economic situations during the period were perceived by the model as structurally similar to what Ecuador's might have been in the absence of a default.

The use of countries like Lebanon and Iraq in the weighted average for S10 may be reflective of similar challenges (for example, political instability, economic vulnerabilities, and debt concerns). Mexico's presence in the donor pool might be indicative of its Latin American emerging market status and exposure to commodity price fluctuations, which is a characteristic shared with Ecuador. The inclusion of these countries in the donor pool suggests that the counterfactual for Ecuador is drawing from a range of economies with relevant similarities, such as exposure to external shocks, reliance on specific sectors, and experiences with financial volatility.

distance weighted interpolation with power 2.

[5]The detailed procedures for handling missing data are outlined in Table (8).

This diversity in the donor pool contributes to a robust counterfactual that arguably encapsulates the economic landscape that Ecuador would have faced in the absence of default. It suggests that, without the default, Ecuador's EMBI behavior might have followed a trajectory influenced by global economic trends, commodity cycles, and internal economic policies, similar to the experiences of the countries in the donor pool. Therefore, the counterfactual constructed in S10, with its covariate structure and weight distribution, provides a plausible baseline for understanding the potential path of Ecuador's EMBI dynamics had the default not occurred.

6.2 Synthetic Control Estimates

The synthetic control estimates illustrated in Figure 2 profile the impact of Ecuador's 2008 default on its EMBI performance. The 10 model specifications, ranging from "S1", which includes only the country's EMBI behavior, to "S10", which encompasses a broad set of economic indicators, consistently display an initial spike in the country's EMBI behavior following the default. The consistency across these specifications suggests that the default had a significant and robust impact on Ecuador's risk premium, as measured by the country's EMBI behavior, irrespective of the inclusion of various macroeconomic variables.

Further examination of specifications S2 through S10, which sequentially add covariates such as year-over-year inflation, unemployment rate, exports, population, debt, logarithm of GDP, growth, global balance, and primary balance, indicates that the addition of these variables does not alter the fundamental outcome of the analysis. Despite the inclusion of these macroeconomic factors, the trajectory of the country's EMBI behavior after the default event remains relatively unchanged. This persistent effect reflects the depth of the default's impact on Ecuador's perceived creditworthiness and suggests that the event's influence on investor sentiment was not significantly mediated by the performance of other economic indicators during the period analyzed.

The graphs in 2 demonstrate a remarkable degree of homogeneity in Ecuador's postdefault EMBI response, despite the increasing complexity of the models. Even as the number of

covariates grows with the incorporation of a wider array of economic measures, the shape and magnitude of the default's impact retain their distinct features. The initial sharp rise and subsequent decline in the EMBI in good times suggests that default dominates not only the short-term risk assessment of Ecuadorian debt, but also episodes where external factors such as commodity price shocks influence investors' perception of sovereign risk (such as the 2014 oil price collapse), when external factors such as commodity price shocks continued to influence investors' perception of sovereign risk (such as the 2014 oil price collapse). These findings underscore the persistent nature of default-related shocks in sovereign bond markets and affirm the utility of the synthetic control method in isolating such effects from a multitude of economic variables.

This synthetic control analysis thus reveals a dynamically heterogeneous impact of Ecuador's 2008 default on its EMBI performance. Initially, the default triggered a substantial increase in the country's EMBI spread, indicative of a risk premium spike. This immediate reaction is consistent with the theoretical postulation that a sovereign default significantly undermines investor confidence and augments the country's perceived credit risk. The wider EMBI spread reflects the market's rapid reassessment of Ecuador's creditworthiness in light of its failure to meet debt obligations.

Subsequently, the empirical evidence indicates a gradual attenuation of the default's impact on Ecuador's EMBI spread. This diminishing effect suggests a market correction as investors reassess the long-term implications of the default. The attenuation can be attributed to several factors, including Ecuador's strategic responses to the default (notably its renegotiation of debt terms and efforts to restore fiscal balance) and the global economic recovery following the 2008 financial crisis, which may have made investors view emerging markets more favorably in general.

A noteworthy resurgence in the country's EMBI spread was observed around 2015, coinciding with a significant downturn in global oil prices. Given the heavy reliance of Ecuador's economic well-being on oil revenues, this suggests that the sovereign bond market remains sensitive to external economic shocks. The results point toward a reinstated risk aversion behavior among investors, possibly driven by renewed concerns over fiscal sustainability

and external financing capacities amid declining oil revenues.

The re-elevation of Ecuador's EMBI spread is a case that illustrates the interplay between sovereign default history and external economic shocks. While the initial shock of the default was absorbed over time, the vulnerability of the country's fiscal structure to commodity price fluctuations posed recurrent risks to its debt sustainability. This observation aligns with the literature on the susceptibility of commodity-dependent economies to external shocks and those shocks' pronounced impact on sovereign debt valuations.

Overall, the findings of this study show a complex dynamic governing sovereign bond markets in the aftermath of a default, dynamics that are shaped by both internal recovery efforts and external market forces. Ecuador's experience highlights the critical role of fiscal and economic resilience in mitigating the long-term impacts of a sovereign default. It also accentuates the importance of considering a broader spectrum of economic variables when evaluating sovereign risk, particularly for economies with significant exposure to volatile commodity markets.

As a final remark, while we emphasized the narrative on a selected group of countries that enter the donor panel, and a subset of variables that are included to compute the counterfactuals, we played with alternative specifications (more countries and adding institutional stability variables) as presented in the tables and graphs in Appendix 9.1.2. The results here are robust to those alternative specifications of the model.

7 Discussion

In this section, we explain some of the relationships highlighted in the conceptual framework encompassing global liquidity, risk-free assets, and the impact on emerging market bonds, with a particular focus on Ecuador. We analyze the period from 2009 to 2019, which was marked by significant monetary policy shifts by U.S. authorities and economic events that reshaped the global financial landscape.

7.1 Global Liquidity and Risk-Free Assets

Between 2009 and 2019, global liquidity dynamics and the appeal of U.S. Treasury bonds as risk-free assets evolved markedly, a trend underscored by significant statistical changes. Following the 2008 financial crisis, the U.S. Federal Reserve spearheaded extensive quantitative easing (QE) initiatives, resulting in its balance sheet's ballooning from about USD 900 billion in 2008 to nearly USD 4.5 trillion in 2015. This substantial growth in asset purchases was reflected globally. Consequently, U.S. interest rates plummeted to near-zero levels (0–0.25 percent) and remained depressed for an extended period, fostering an environment replete with liquidity.

During this era, U.S. Treasury bonds solidified their status within the global financial ecosystem. Despite the fall in yields on 10-year Treasury bonds from over 3.5 percent in early 2009 to around 1.5 percent by mid-2016, demand for these bonds soared. This demand was fueled not just by their safe-haven appeal, which became particularly significant during crises such as the European debt crisis, but also by post-2008 regulatory changes that underscored the necessity for high-quality liquid assets. The Basel III regulations, for instance, reinforced the importance of such assets for financial institutions. A notable shift in policy occurred in the latter half of the decade, with the Federal Reserve initiating interest rate hikes in December 2015. This resulted in the 10-year Treasury yield's briefly climbing to 3.2 percent by the end of 2018, signaling a gradual return to more-conventional monetary policies and altering the landscape of global liquidity and risk-free investments.

7.2 Global Liquidity and Ecuadorian Bonds

The global liquidity trends and the behavior of U.S. Treasury bonds between 2009 and 2019 significantly impacted emerging market (EM) bonds, including those issued by the government of Ecuador. The prolonged phase of low interest rates and abundant liquidity in developed economies, notably the United States, propelled investors toward higher yields, leading to increased investments in emerging markets bonds. This pursuit of higher returns, characteristic of the post-financial crisis era, resulted in heightened foreign investment in EM bond markets, including Ecuador's.

Specifically for Ecuador, this global financial climate presented a prime opportunity to reaccess international capital markets. Despite its history of economic volatility and a debt default in 2008, Ecuador re-entered the international bond market in 2014, capitalizing on the widespread search for higher yields. For example, the yield on Ecuador's 2014 bond issuance, its first since the default, was approximately 7.95 percent, markedly higher than those of U.S. Treasury bonds at that time.

However, the allure of Ecuadorian bonds came with increased risks, stemming primarily from the nation's economic and political uncertainties. The rising demand for EM bonds, while beneficial for capital inflow, also exposed the nations issuing these bonds to the fluctuations of global financial conditions. The Federal Reserve's decision to start increasing interest rates in late 2015, leading to a stronger U.S. dollar, posed additional challenges for emerging markets, including capital outflows and escalated debt servicing costs. For dollarized economies like Ecuador, the external debt burden became a significant concern, particularly as global financial conditions tightened. Hence, while Ecuador reaped benefits from the surge in global liquidity and the quest for higher yields, it also confronted amplified vulnerabilities due to global financial sentiment and policy shifts in major economies like that of the United States.

7.3 Impact of Oil Price Dynamics

The impact of oil price dynamics in 2015 on Ecuador's country risk, as indicated by the country's EMBI performance, needs to be contextualized within the broader scope of global liquidity and U.S. Treasury bond dynamics during that period.

Ecuador's economy, heavily reliant on oil exports, is significantly influenced by oil price fluctuations. From mid-2014 to early 2016, oil prices experienced a drastic downturn, plummeting from above USD 100 per barrel to below USD 30. This steep decline had profound repercussions on Ecuador's fiscal income and external balances, given the large contribution of oil extraction to its government revenues and export earnings.

This downturn coincided with the period of enhanced global liquidity prompted by low-interest rates in developed economies, especially the United States. Initially, this low-

interest-rate milieu in the United States and elsewhere fostered a growing investor appetite for higher-yield assets, including EM bonds. Ecuador, along with other emerging markets, benefited from this inclination as investors sought returns surpassing those offered by U.S. Treasuries and other developed market bonds.

At the same time, the 2015 collapse in oil prices profoundly altered the economic landscape for oil-dependent countries like Ecuador. Reduced oil revenues excerbated economic vulnerabilities, increasing the perceived risk among investors. Consequently, Ecuador's country risk premium, as reflected in the EMBI spread, likely resulted escalated. The EMBI, which gauges the yield spread of emerging market bonds over U.S. Treasuries, responds to both global financial shifts and specific country risks. In Ecuador's case, the diminished oil prices likely resulted in a broader spread, signaling a perception of heightened risk and potentially greater borrowing costs.

Furthermore, the tightening of global financial conditions toward the latter part of the decade, particularly with the Federal Reserve's interest rate hikes beginning in December 2015, compounded the challenges faced by emerging markets. For Ecuador, this not only involved dealing with reduced oil revenue but also navigating an increasingly less accommodating global investment environment for riskier assets like EM bonds. This confluence of factors likely contributed to an elevated country risk for Ecuador during this period, as evidenced by its EMBI spreads.

8 Conclusion

In this study, we have studied the intricate dynamics that govern sovereign bond markets in the wake of a sovereign default, with a specific focus on Ecuador's 2008 default and its subsequent impact on the country's EMBI spread. The synthetic control analysis employed in our study has shed light on the dynamically heterogeneous effects of this default on Ecuador's EMBI performance.

The initial aftermath of the default witnessed a significant surge in the country's EMBI spread, indicating a substantial spike in risk premiums. This immediate market reaction aligns with theoretical expectations, illustrating how a sovereign default can swiftly erode

investor confidence and heighten perceptions of a nation's credit risk. It underscores the rapid reassessment of Ecuador's creditworthiness following the country's failure to meet its debt obligations.

We then present empirical evidence that reveals a gradual attenuation of the default's impact on Ecuador's EMBI spread. This suggests a market correction as investors reassessed the default's long-term implications. Several factors contributed to this attenuation, including Ecuador's strategic responses to the default (for example, debt renegotiation and fiscal balance restoration). Moreover, the global economic recovery following the 2008 financial crisis likely bolstered investor confidence with regard to emerging markets, given the notable increase in global liquidity, a trend we have discussed in detail.

A significant resurgence in Ecuador's EMBI spread was observed around 2015, coinciding with a marked decline in global oil prices. Ecuador's heavy reliance on oil revenues renders its sovereign bond market sensitive to external economic shocks. This resurgence indicated a renewed aversion to risk among investors, driven by concerns over Ecuador's fiscal sustainability and external financing capacities amidst declining oil revenues.

This cyclical pattern in Ecuador's EMBI spread underscores the intricate interplay between a nation's sovereign default history and external economic shocks. While the initial shock of the default subsided over time, the vulnerability of Ecuador's fiscal structure to fluctuations in commodity prices posed recurring threats to its debt sustainability. This observation aligns with the existing literature on the susceptibility of commodity-dependent economies to external shocks, which can have a pronounced influence on sovereign debt valuations.

Our findings emphasize the complex interplay of macroeconomic, political, and other factors in shaping sovereign risk dynamics, especially in emerging markets. Ecuador's 2008 default serves as a vivid illustration of this intricate interaction, underscoring how the consequences of a default evolve alongside changes in the macroeconomic and political landscape.

In conclusion, our study advocates for a multifaceted approach to sovereign debt management, highlighting the significance of robust fiscal and political institutions, strategic communication with investors, and the support of international financial organizations. Such an approach not only mitigates perceived risks, it can also reshape a nation's position

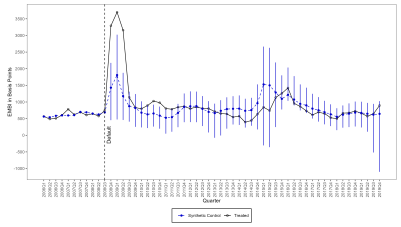
in the global debt market. In summary, our in-depth analysis of Ecuador's EMBI spread in the aftermath of the 2008 default provides valuable insights into the multifaceted nature of sovereign debt management in emerging markets.

Our findings lead us to underscore the importance of a robust communication strategy with both domestic and international investors, supported by strong fiscal institutions, including fiscal rules and medium-term fiscal frameworks. Such measures are critical for stabilizing the EMBI's volatility during adverse times. Moreover, the establishment of fiscal institutions that effectively manage public finances enhances a country's public debt credibility and sustainability (Andrian, 2023), acting as a safeguard against expectations of default (Gomez-Gonzalez, Valencia and Sánchez, 2022).

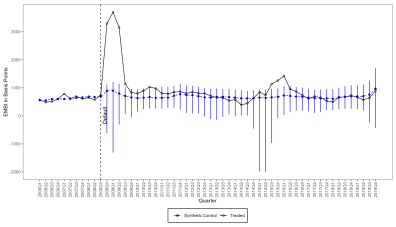
Furthermore, the role of political institutions in promoting transparency, reducing corruption, and enhancing democratic participation is paramount. These factors collectively reduce default probabilities (Azzimonti and Mitra, 2023) and consequently sovereign risk. Additionally, maintaining open channels of communication with the investment community, especially during positive macroeconomic shifts, is vital and can be achieved through investor relations programs and improved market communication.

The support of international organizations like the IMF also plays a significant role in shaping market expectations, extending beyond financial assistance to encompass policies that strengthen a country's long-term macroeconomic stability.

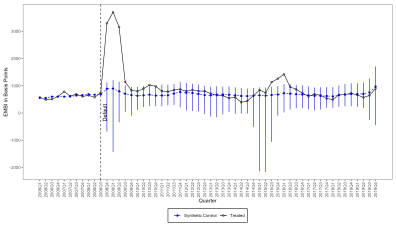
Figure 2: Synthetic Control Results: EMBI at Levels



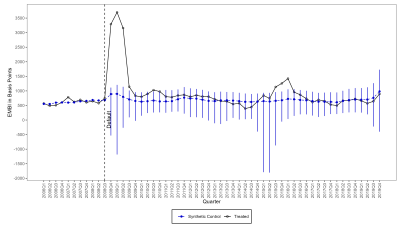
S1: EMBI



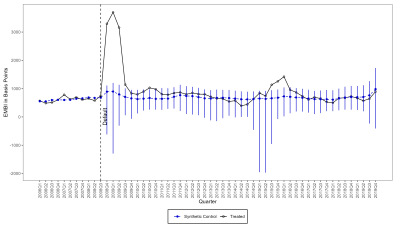
S2: EMBI + Inflation



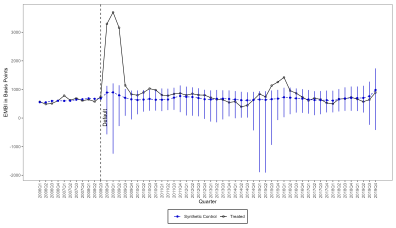
S3: EMBI + Inflation + Unemployment Rate



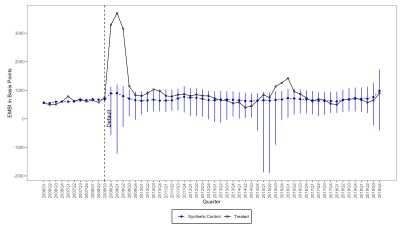
S4: EMBI + Inflation + Unemployment Rate + Exports



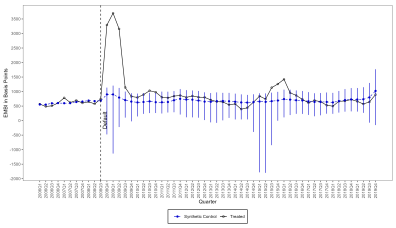
S5: EMBI + Inflation + Unemployment Rate + Exports + Population



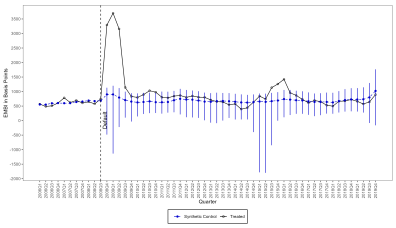
S6: EMBI + Inflation + Unemployment Rate + Exports + Population + Debt



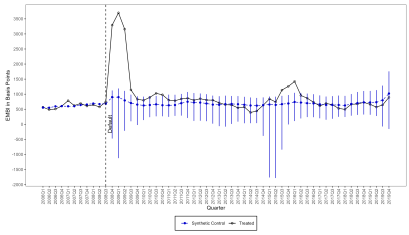
S7: EMBI + Inflation + Unemployment Rate + Exports + Population + Debt + GDP



S8: EMBI + Inflation + Unemployment Rate + Exports + Population + Debt + Growth



S9: EMBIG + Inflation + Unemployment Rate + Exports + Population + Debt + Growth + Global Balance



S10: EMBI + Inflation + Unemployment Rate + Exports + Population + Debt + Growth + Primary Balance

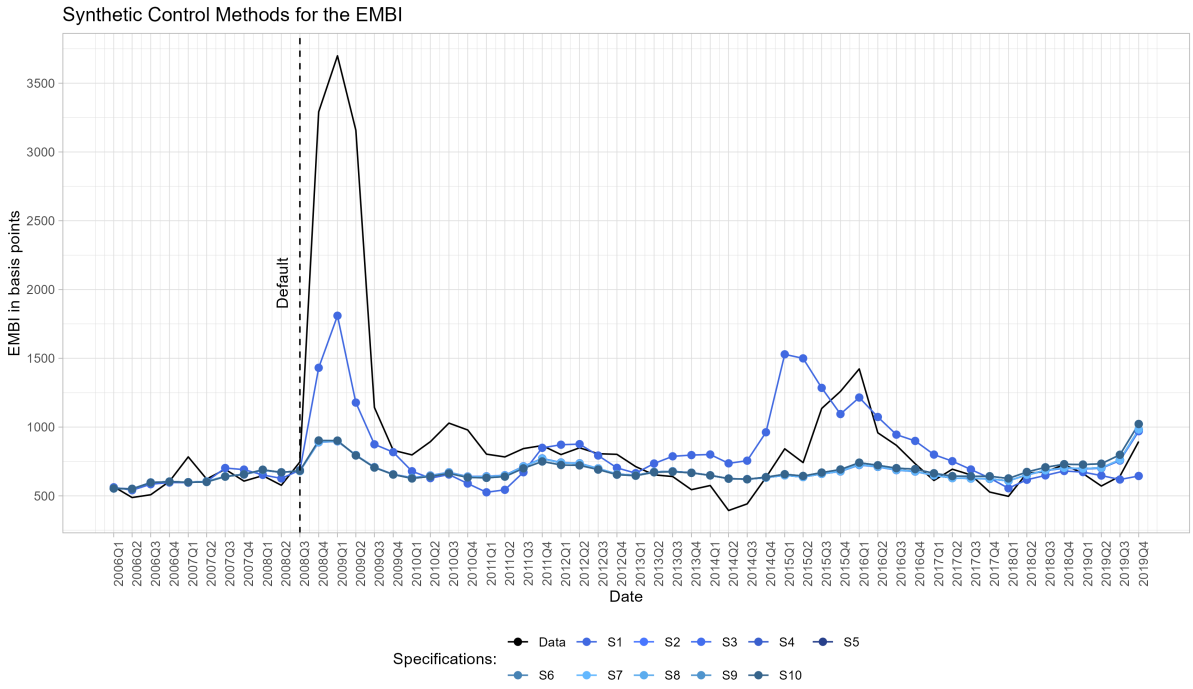


Figure 3: Synthetic Control main models

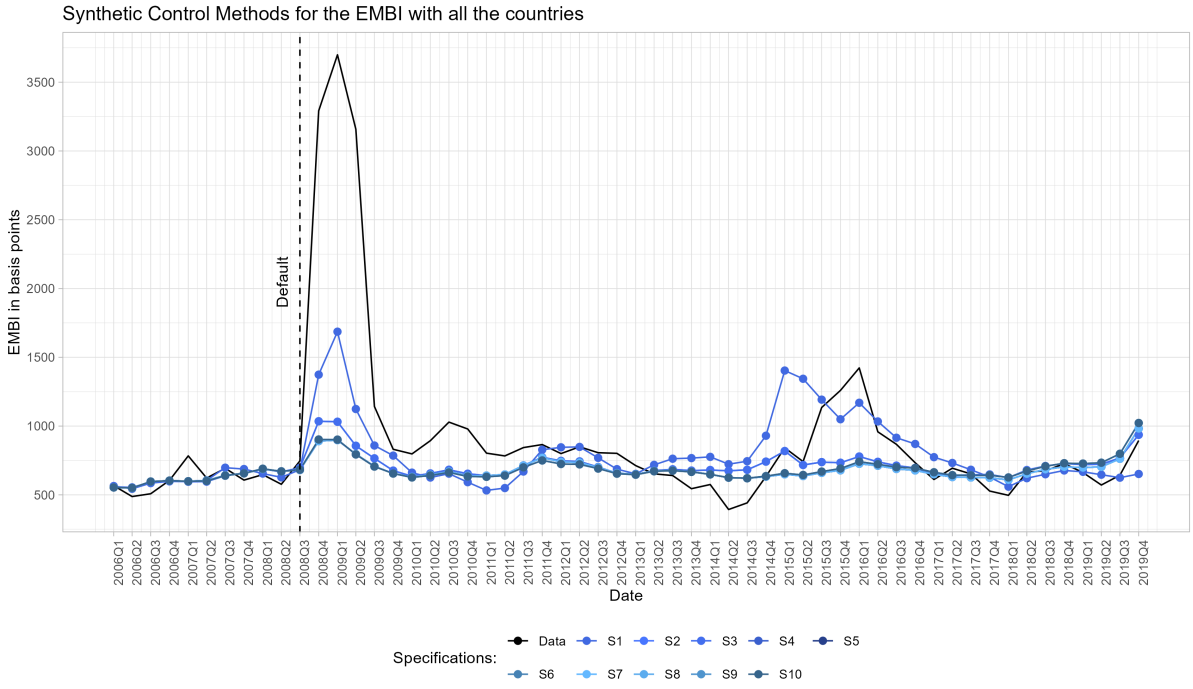


Figure 4: Synthetic Control with Big Countries

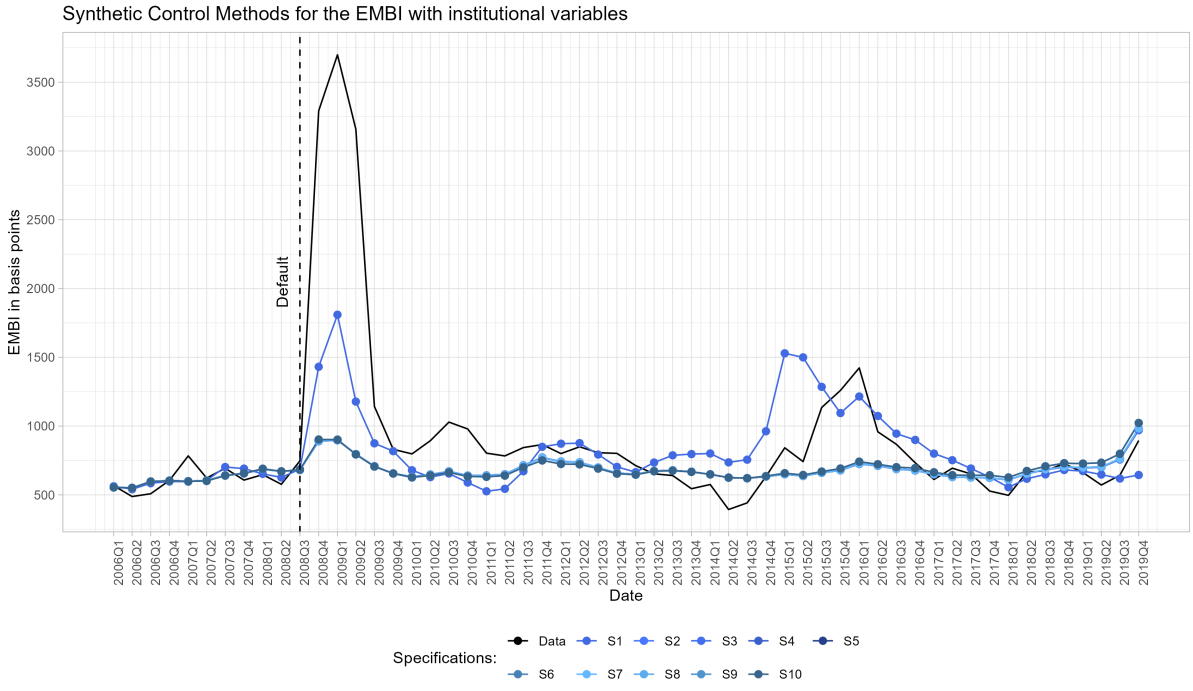


Figure 5: Synthetic Control with Institutional Variable since S1

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9 Appendix

9.1 Synthetic Control Method

Following the explication given by Pinotti (2015) we can model the EMBI spread conditional on the presence of a default. Specifically, the realization in Ecuador during year t is equal to Y_t^1 if Ecuador experiences a default and Y_t^0 otherwise, with

$$\mathbf{Y_t} = D_t \mathbf{Y_t^1} + (1 - D_t)\mathbf{Y_t^0}, \tag{1}$$

where D_t is an indicator for the presence of default in Ecuador. The identification problem is that the treatment of sovereign default,

$$\beta_t = \mathbf{Y_t^1} - \mathbf{Y_t^0}, \tag{2}$$

depends on the potential outcome in both states ($D_t = 0$ and $D_t = 1$), while only one state is observed in any given year. We cannot see $\mathbf{Y_t^0}$, but we can construct an approximation using synthetic control methods to build that counterfactual. The counterfactual is a weighted combination of other countries (our donors panel) chosen to resemble the characteristics of Ecuador before the default. We call the weighted average of other countries the synthetic Ecuador (which did not experience a default). Therefore, according to Pinotti (2015) the treatment effect estimator is

$$\hat{\beta}_t = \beta_t + \left(\mathbf{Y_t^{ECU,0}} - \mathbf{Y_t^{DP,0}} \mathbf{W}^* \right), \ \forall \ t > T^0, \tag{3}$$

where $\mathbf{Y_t^{DP,0}}$ is a $(T \times J)$ matrix containing the EMBI series for each country of the donors panel. Note that T^0 is the period in which the default occurred. Finally, $\mathbf{W}^*$ is the $(J \times 1)$ vector of non-negative weights that sum to 1. It is easy to see that the accuracy of $\hat{\beta}$ relies on minimizing the difference on the second term of the right-hand side of equation (3) before the treatment. Therefore, following Abadie and Gardeazabal (2003), $\mathbf{W}^*$ satisfies (conditional on $\mathbf{V}$)

$$W^*(V) = \min_{w \ \in \ \mathcal{W}} (\mathbf{X_1} - \mathbf{X_0}\mathbf{W})^T \mathbf{V} (\mathbf{X_1} - \mathbf{X_0}\mathbf{W}), \tag{4}$$

where $\mathbf{X_1}$ is a $(K \times 1)$ vector containing the pretreatment predictors of Ecuador, $\mathbf{X_0}$, is a $(K \times J)$ matrix containing the pretreatment predictors for the countries of the donors

panel, and $\mathbf{V}$ is a $(K \times K)$ diagonal matrix with non-negative entries measuring the relative importance of each predictor. Finally, the optimal V^* is chosen to minimize the mean squared error of pre-treatment outcomes.

$$\frac{1}{T} \sum_{t \leq T} \left(\mathbf{Y_t^{ECU}} - \mathbf{Y_t^{DP}} \mathbf{W}^* \right)^2. \tag{5}$$

Up to this point, our discussion has centered on the primary dynamics of synthetic control methods, primarily focusing on the outcome. However, Cattaneo, Feng and Titiunik (2021) demonstrate that the synthetic control framework can be extended to cases where researchers seek to ensure a closer approximation of the synthetic control to the treated unit by incorporating additional characteristics. This involves including supplementary equations for these additional characteristics and minimizing the combined loss. For further reference, see Cattaneo, Feng and Titiunik (2021). The estimated weights and intercepts within the multiequation synthetic control framework can be expressed as

$$(\hat{\mathbf{w}}', \hat{\mathbf{r}}') \in \underset{\mathbf{w} \in \mathcal{W},\ \mathbf{r} \in \mathcal{R}}{\arg\min} \sum_{\ell=1}^{M} \sum_{t=1}^{T^0} v_{t,\ell} (Y_{1t,\ell} - Y_{2t,\ell} w_2 - \cdots - Y_{(N+1)t,\ell} w_{N+1} - r_\ell)^2. \tag{6}$$

In a more general way, Cattaneo, Feng and Titiunik (2021) consider M features of the treated unit, denoted by $\mathbf{A}_\ell = (a_{1,\ell}, \cdots, a_{T^0,\ell})' \in \mathbb{R}^{T^0}\ \forall\ \ell = [1, \cdots, M]$. Furthermore, for each ℓ there exists $J + K$ variables that can be used to predict the T^0-dimensional vector $\mathbf{A}_\ell$. These $J + K$ variables separate into $\mathbf{B}_\ell = (\mathbf{B}_{1,\ell}, \mathbf{B}_{2,\ell}, \cdots, \mathbf{B}_{J,\ell}) \in \mathbb{R}^{T^0 \times J}$, and $\mathbf{C}_\ell = (\mathbf{C}_{1,\ell}, \cdots, \mathbf{C}_{K,\ell}) \in \mathbb{R}^{T^0 \times K}$, more precisely for each j, $\mathbf{B}_{j,\ell} = (b_{j1,\ell}, \cdots, b_{jT^0,\ell})'$, and for each k, $\mathbf{C}_{k,\ell} = (c_{k1,\ell}, \cdots, c_{kT^0,\ell})'$. Both vectors of control variables could also be used to predict $\mathbf{A}_\ell$ over the pretreatment time span. Therefore, the main aim of the synthetic control method is to search for a vector of common weights $\mathbf{w} \in \mathcal{W} \subseteq \mathbb{R}^J$ across the M features and a vector of coefficients $\mathbf{r} \in \mathcal{R} \subseteq \mathbb{R}^{KM}$, such that the linear combination of $\mathbf{B}_\ell$ and $\mathbf{C}_\ell$ "matches" $\mathbf{A}_\ell$ as closely as possible, for $\ell \in [1, M]$. This goal is achieved through the following optimization problem:

$$\hat{\boldsymbol{\beta}} := (\hat{\mathbf{w}}', \hat{\mathbf{r}}')' \in \underset{\mathbf{w} \in \mathcal{W},\ \mathbf{r} \in \mathcal{R}}{\arg\min} (\mathbf{A} - \mathbf{B}\mathbf{w} - \mathbf{C}\mathbf{r})'(\mathbf{A} - \mathbf{B}\mathbf{w} - \mathbf{C}\mathbf{r}), \tag{7}$$

where

$$\mathbf{A} = \begin{bmatrix} \mathbf{A}_1 \\ \mathbf{A}_2 \\ \vdots \\ \mathbf{A}_M \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} \mathbf{B}_1 \\ \mathbf{B}_2 \\ \vdots \\ \mathbf{B}_M \end{bmatrix}, \quad \mathbf{C} = \begin{bmatrix} \mathbf{C}_1 & \mathbf{0} & \cdots & \mathbf{0} \\ \mathbf{0} & \mathbf{C}_2 & \cdots & \mathbf{0} \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{0} & \mathbf{0} & \cdots & \mathbf{C}_M \end{bmatrix}.$$

9.1.1 Prediction Intervals

In their work, Cattaneo, Feng and Titiunik (2021) advance the synthetic control framework by introducing conditional prediction intervals, addressing the inherent statistical uncertainty in synthetic control predictions. This uncertainty emanates from two primary sources: first, the potential mis-specification during the construction of weights in the pretreatment period, and second, the unobservable stochastic error in the post-treatment period when analyzing treatment effects. Recognizing the complexity of this issue, the authors propose prediction intervals designed to account for both sources of randomness. For the first source, they present a simulation-based approach grounded in nonasymptotic probability concentration, offering a robust methodology. To address the second source, they employ a combination of nonparametric and parametric probability approximations, providing a principled framework for sensitivity analysis.

It is noteworthy that estimating prediction intervals in the synthetic control method, particularly when dealing with multiple features, involves intricate calculations that are beyond the scope of this paper. Interested readers are encouraged to see Cattaneo, Feng and Titiunik (2021) and Cattaneo et al. (2022) for comprehensive insights into the computation of these advanced methods. Finally, for computing the prediction intervals we use the simplex option where it constrains the weights to be

$$||\mathbf{w}||_1 = 1, \quad w_j \geq 0, \ \forall \ j \ \in \ [1, J],$$

meaning that the sum of all weights have to be equal to 1 and each weight has to be nonnegative.

9.1.2 Synthetic Control Specifications

This process can be clearly seen in the following list, where Y represents either the EMBI raw series or the residuals:

- S1: Y
- S2: Y + YoY Inflation
- S3: Y + YoY Inflation + Unemployment Rate
- S4: Y + YoY Inflation + Unemployment Rate + Exports
- S5: Y + YoY Inflation + Unemployment Rate + Exports + Population
- S6: Y + YoY Inflation + Unemployment Rate + Exports + Population + Debt
- S7: Y + YoY Inflation + Unemployment Rate + Exports + Population + Debt + log(GDP)
- S8: Y + YoY Inflation + Unemployment Rate + Exports + Population + Debt + Growth
- S9: Y YoY Inflation + Unemployment Rate + Exports + Population + Debt + Growth + Global Balance
- S10: Y + YoY Inflation + Unemployment Rate + Exports + Population + Debt + Growth + Primary Balance

9.2 Synthetic Control Weights

Table 1: Donors Panel Composition across Several Specifications

	Series									
Country	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
Argentina	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Colombia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dominican Republic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Egypt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
El Salvador	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hungary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indonesia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iraq	68.53	7.34	7.34	7.60	7.60	7.62	7.62	6.68	6.68	6.68
Lebanon	0.00	25.55	25.56	26.33	26.33	26.32	26.32	27.11	27.11	27.11
Malaysia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mexico	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.46	13.44	13.44
Pakistan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Panama	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Phillipines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poland	4.15	67.10	67.10	66.08	66.08	66.06	66.06	52.75	52.77	52.78
Serbia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ukraine	27.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uruguay	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2: Donors Panel Composition across Several Specifications **(All Countries)**

	Series									
Country	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
Argentina	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brazil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
China	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Colombia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dominican Republic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Egypt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
El Salvador	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hungary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indonesia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iraq	63.16	8.15	8.15	7.60	7.60	7.62	7.62	6.68	6.68	6.68
Lebanon	0.77	21.41	21.41	26.33	26.33	26.32	26.32	27.11	27.11	27.11
Malaysia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mexico	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.46	13.44	13.44
Pakistan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Panama	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Phillipines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poland	0.00	28.84	28.86	66.08	66.08	66.06	66.06	52.75	52.77	52.78
Russian Federation	14.83	41.59	41.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Serbia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ukraine	21.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uruguay	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3: Donors Panel Composition across Several Specifications **(With Political Stability since S1)**

	Series									
Country	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
Argentina	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Colombia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dominican Republic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Egypt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
El Salvador	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hungary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indonesia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iraq	68.53	7.34	7.34	7.60	7.60	7.62	7.62	6.68	6.68	6.68
Lebanon	0.00	25.56	25.56	26.33	26.33	26.32	26.32	27.11	27.11	27.11
Malaysia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mexico	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.46	13.44	13.44
Pakistan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Panama	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Phillipines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poland	4.15	67.10	67.10	66.08	66.08	66.06	66.06	52.75	52.77	52.78
Serbia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ukraine	27.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uruguay	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

9.3 Missing Data

Table 4: Missing data for CPI.

CPI			
Country	**Period**	**Procedure**	**Source**
Argentina	2005 Q1 - 2019 Q4	None	LMW
Iraq	2005 Q1 - 2006 Q4	Interpolation	IFS (yearly)
Iraq	2007Q1 - 2019 Q4	None	IFS (quarterly)
Lebanon	2005 Q1 - 2006 Q4	Interpolation	CAS (yearly)
Lebanon	2007 Q1 - 2007 Q4	Interpolation	IFS (monthly)
Lebanon	2008 Q1 - 2019 Q4	None	IFS (monthly)

Table 5: Missing data for GDP

GDP			
Country	**Period**	**Procedure**	**Source**
Iraq	2005Q1 - 2019Q4	Interpolation	WDI (yearly)
Lebanon	2005 Q1 - 2011 Q4	Interpolation	WDI (yearly)
Lebanon	2012 Q1 - 2019 Q4	None	CAS (quarterly)
Pakistan	2005 Q1 - 2019Q4	Interpolation	WDI (yearly)
Panama	2005 Q1 - 2006 Q4	Interpolation	LMW
Panama	2007 Q1 - 2019 Q4	None	LMW
Serbia	2005 Q1 - 2019 Q4	None	IFS (Quarterly)

Table 6: Missing data for Unemployment rate.

Unemployment			
Country	**Period**	**Procedure**	**Source**
Indonesia	2005 Q1 - 2019 Q4	Interpolation	IFS (Quarterly and Yearly)
Iraq	2005 Q1 - 2019 Q4	Interpolation	WDI (Yearly)
Lebanon	2005 Q1 - 2019 Q4	Interpolation	WDI (Yearly)
Malaysia	2005 Q1 - 2005 Q4	Interpolation	IFS (Yearly)
Malaysia	2014 Q1 - 2016 Q1	Interpolation	IFS (Quarterly)
Pakistan	2016 Q1 - 2017 Q4	Interpolation	GEM (Monthly)
Panama	2005 Q1 - 2019 Q4	Interpolation	WDI (Yearly)
El Salvador	2005 Q1 - 2019 Q4	Interpolation	WDI (Yearly)
Serbia	2005 Q1 - 2007 Q4	Interpolation	IFS (Yearly)
Serbia	2008 Q1 - 2013 Q3	Interpolation	IFS (Quarterly)
Ukraine	2005 Q1 - 2019 Q4	None	IFS (Quarterly)

Table 7: Missing data for Exports

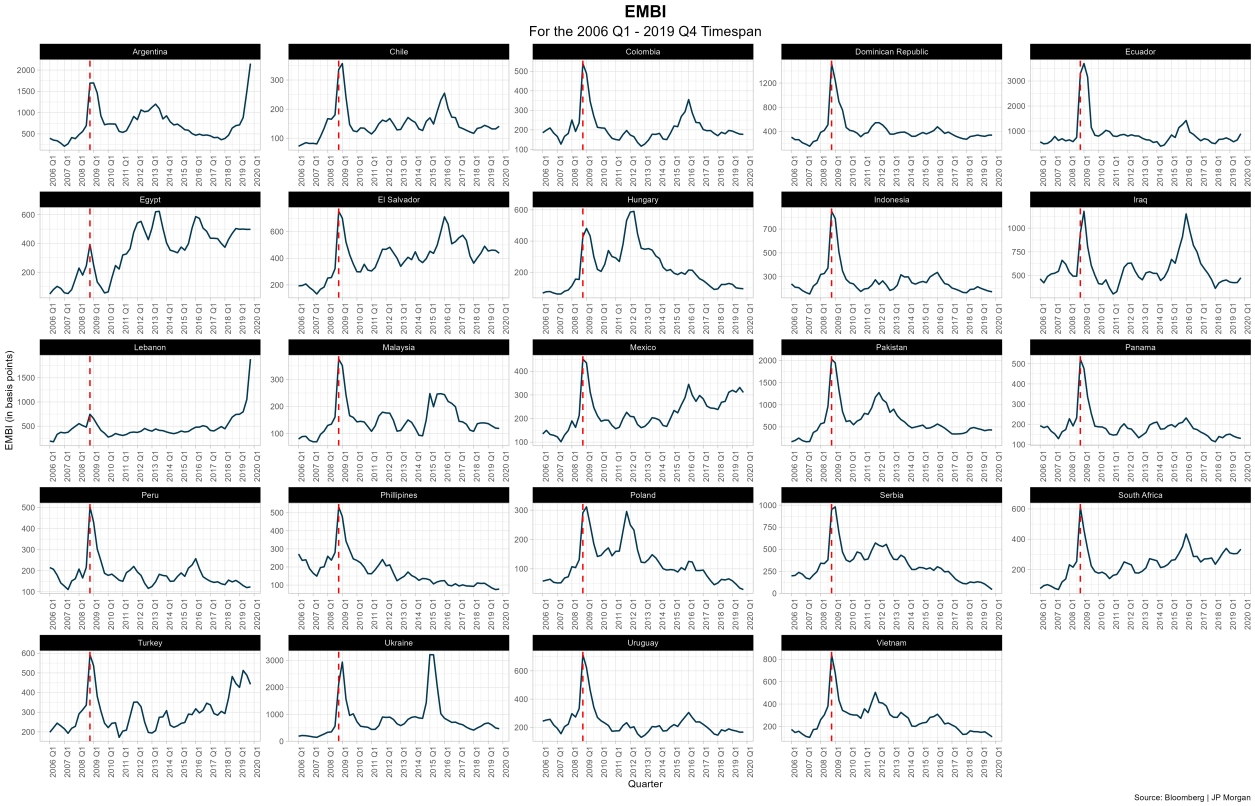
Exports			
Country	**Period**	**Procedure**	**Source**
China	2005 Q1 - 2019 Q4	Interpolation	WDI (Yearly)
Egypt	2005 Q1 - 2019 Q4	Interpolation	IFS (Yearly)
Iraq	2005 Q1 - 2019 Q4	Interpolation	IFS (Yearly)
Lebannon	2005 Q1 - 2019 Q4	Interpolation	IFS (Yearly)
Malaysia	2005 Q1 - 2014 Q4	Interpolation	WDI (Yearly)
Malaysia	2015 Q1 - 2019 Q4	None	IFS (Quarterly)
Pakistan	2005 Q1 - 2019 Q4	Interpolation	WDI (Yearly)
Panama	2005 Q1 - 2017 Q4	Interpolation	WDI (Yearly)
Panama	2018 Q1 - 2019 Q4	Interpolation	IFS (Yearly)
Peru	2005 Q1 - 2006 Q4	Interpolation	IFS (Yearly)
Peru	2007 Q1 - 2019 Q4	None	IFS (Quarterly)
Uruguay	2005 Q1 - 2015 Q4	Interpolation	WDI (Yearly)
Uruguay	2016 Q1 - 2019 Q4	None	IFS (Quarterly)
Vietnam	2015 Q1 - 2019 Q4	Interpolation	IFS (Yearly)

Table 8: Missing data for Central Government Debt.

Central Government Debt *			
Country	**Period**	**Procedure**	**Source**
China	2005 Q1 - 2019 Q4	Interpolation	GDD General Gov. (yearly)
Ecuador	2019 Q1 - 2019 Q4	Interpolation	WEO (yearly)
Egypt	2005 Q1 - 2019 Q4	Interpolation	GDD General Gov. (yearly)
Panama	2005 Q1 - 2019 Q4	Interpolation	GDD General Gov. (yearly)
Philippines	2005 Q1 - 2019 Q4	Interpolation	GDD General Gov. (yearly)
Vietnam	2009 Q1 - 2009 Q4	Interpolation	WEO (yearly)

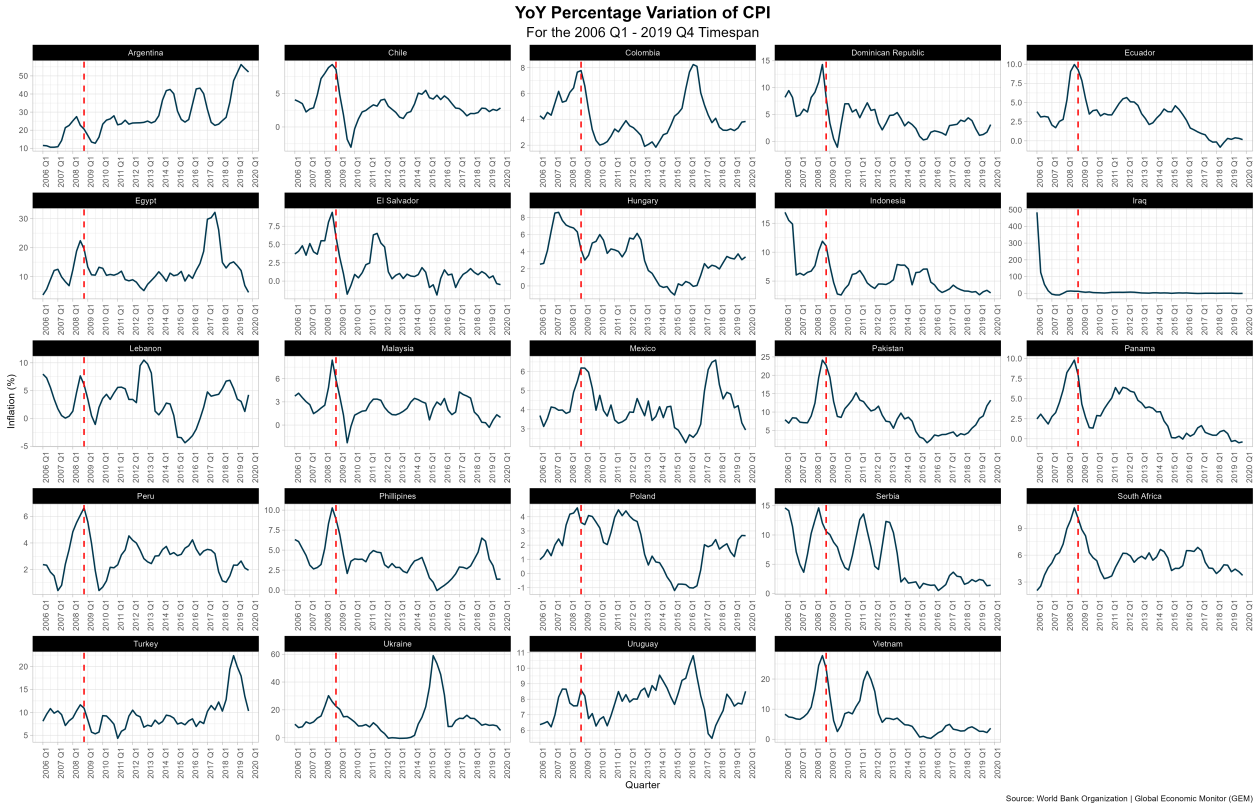
9.4 Donors Panel: Variables Used by Country

Figure 6: EMBI Donors Panel



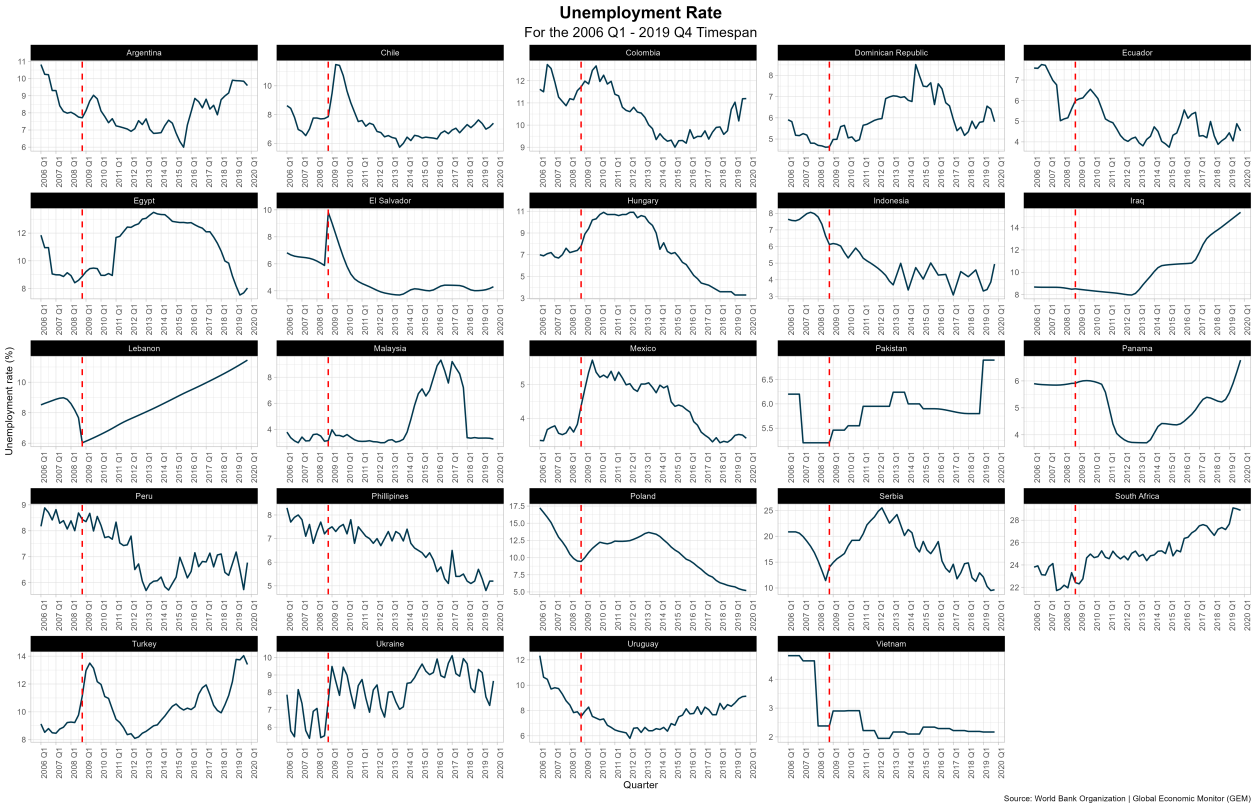
Note: Red line shows the event (when default was declared).

Figure 7: Inflation Donors Panel



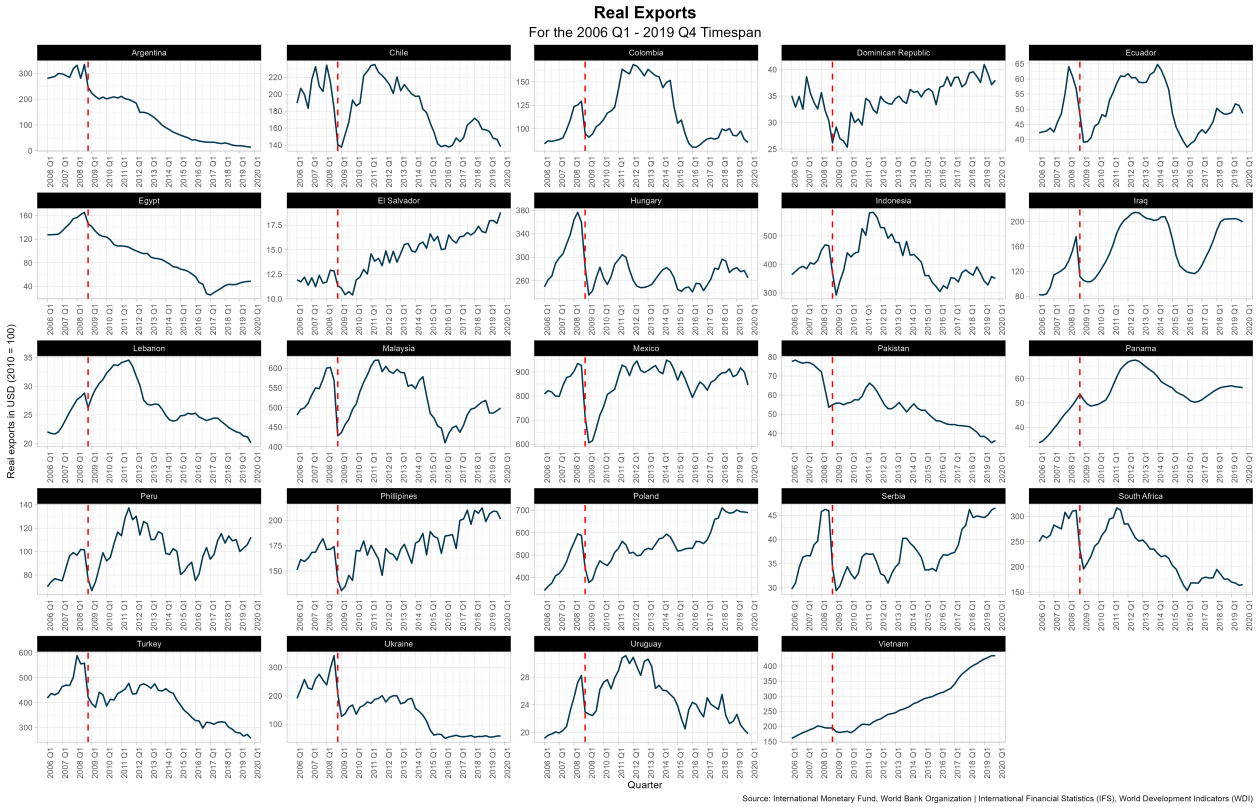
Note: Red line shows the event (when default was declared).

Figure 8: Unemployment Rate Donors Panel: Complete Time Span



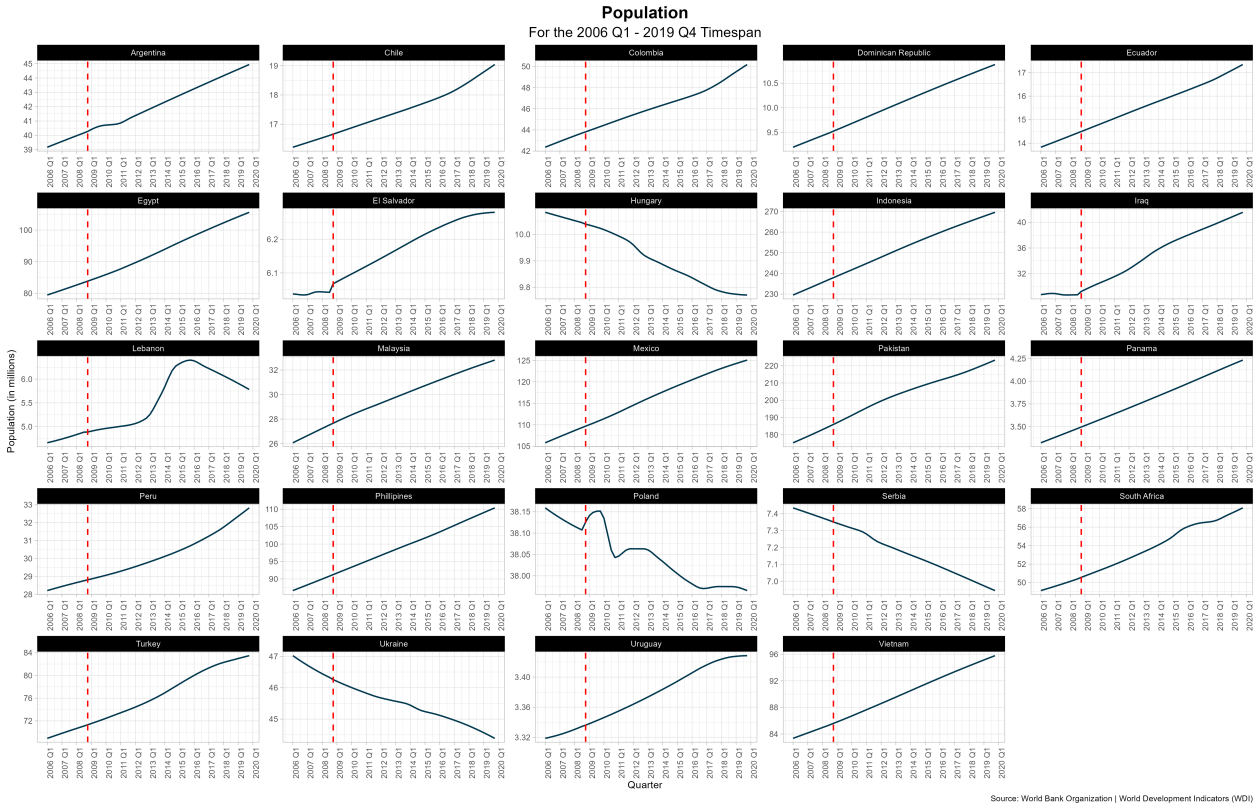
Note: Red line shows the event (when default was declared).

Figure 9: Exports Donors Panel: Complete Time Span



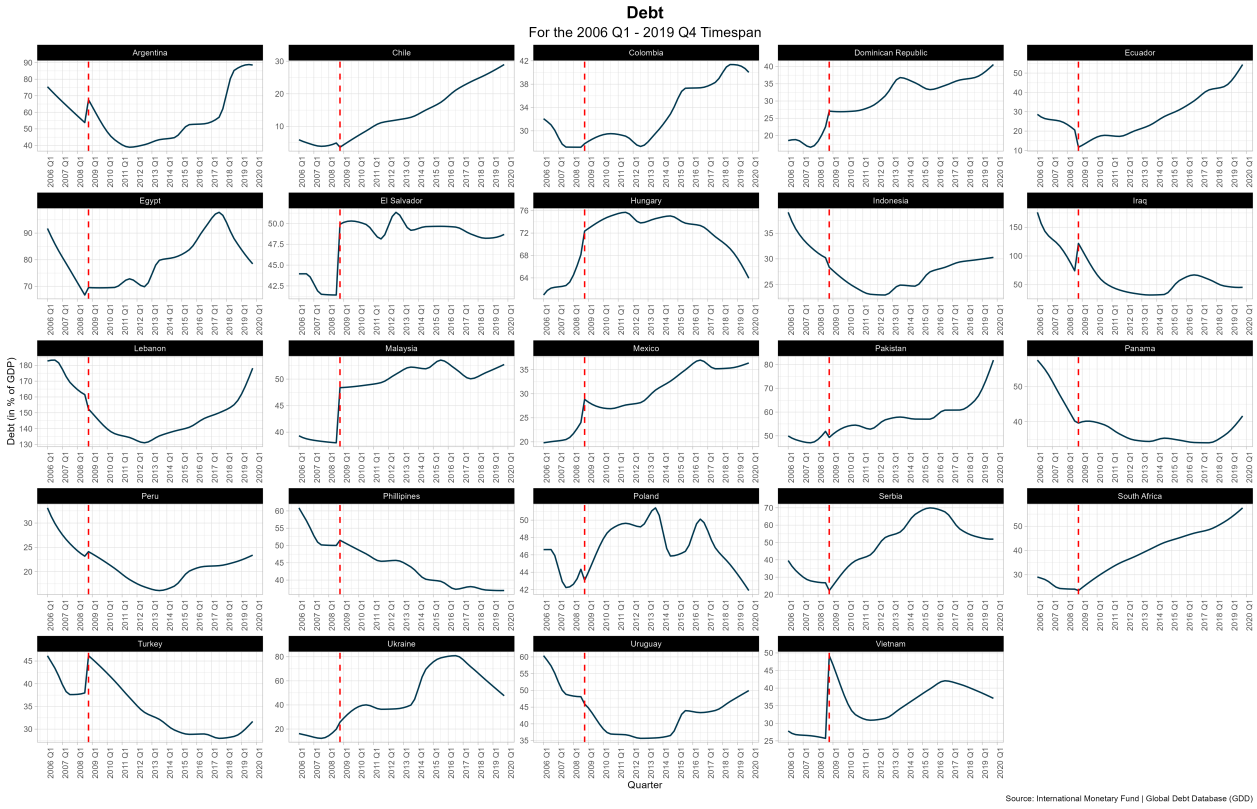
Note: Red line shows the event (when default was declared).

Figure 10: Population Donors Panel: Complete Time Span



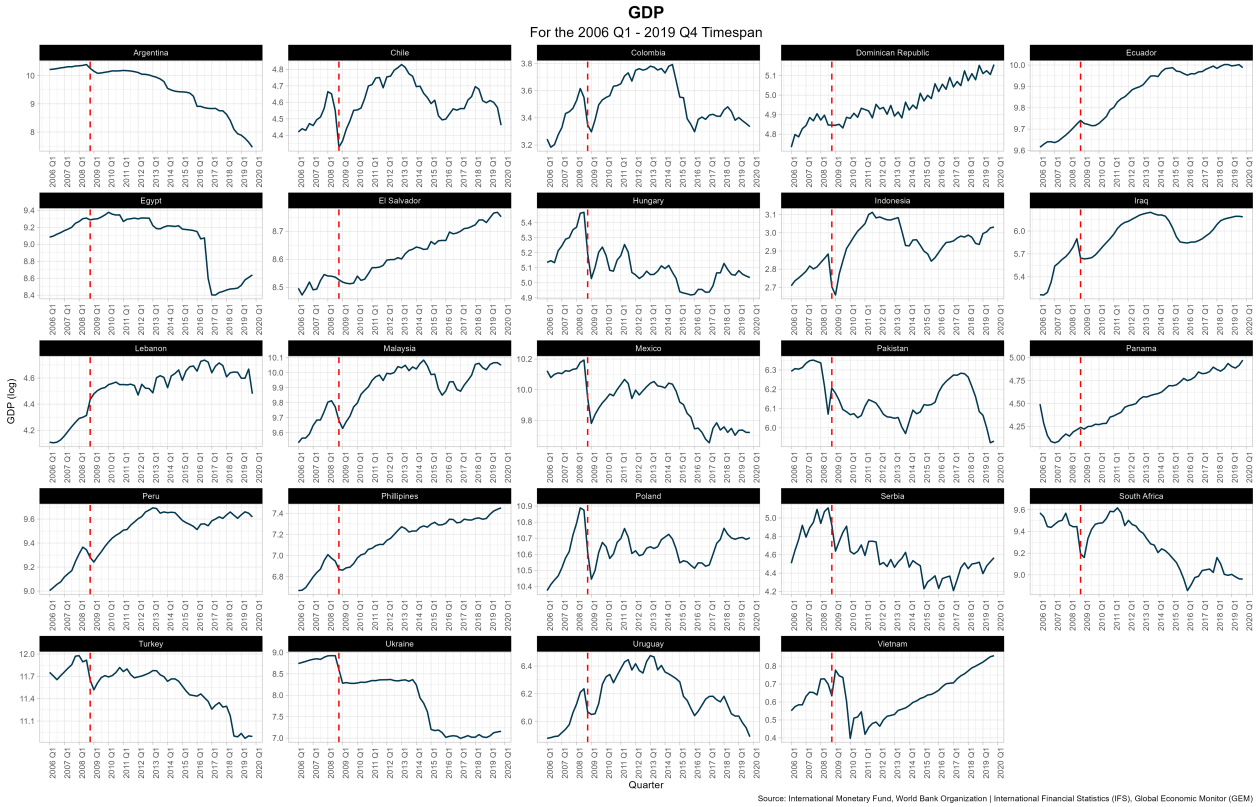
Note: Red line shows the event (when default was declared).

Figure 11: Debt Donors Panel: Complete Time Span



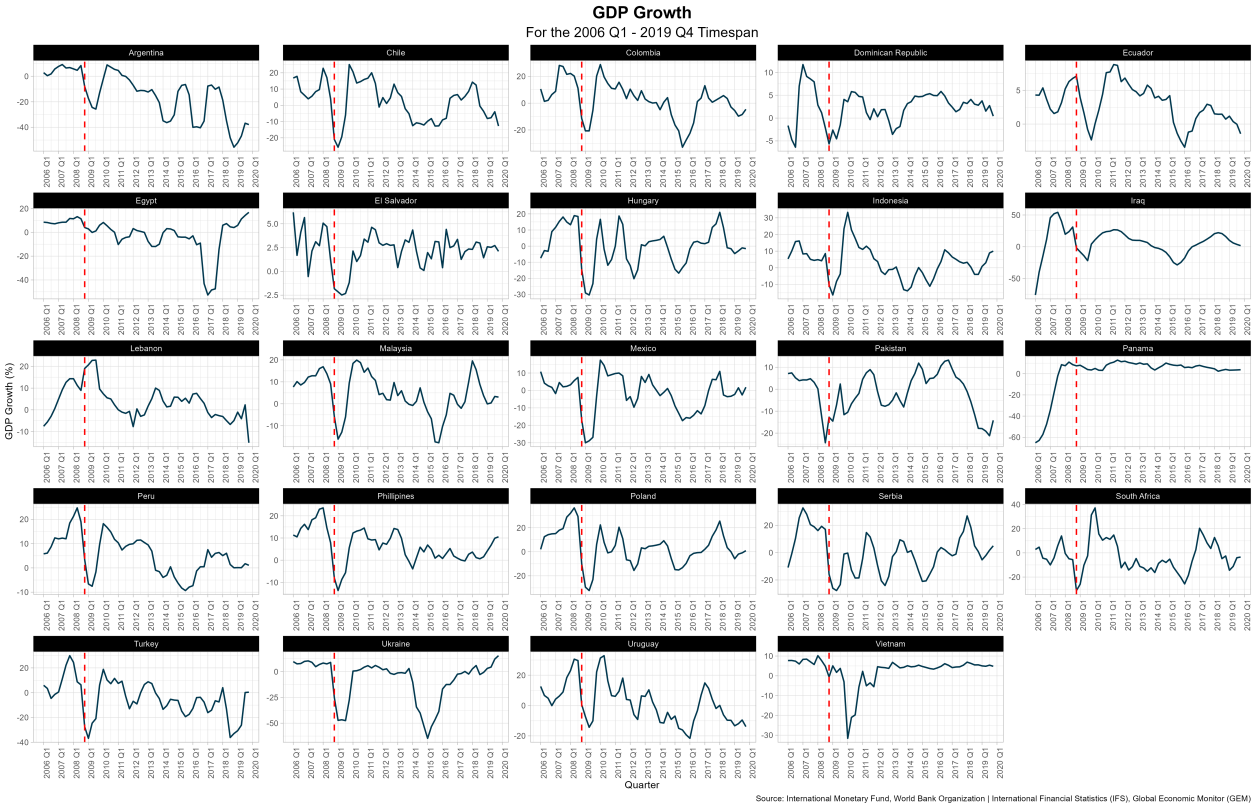
Note: Red line shows the event (when default was declared).

Figure 12: GDP Donors Panel: Complete Time Span



Note: Red line shows the event (when default was declared).

Figure 13: GDP Growth Donors Panel: Complete Time Span



Note: Red line shows the event (when default was declared).

Figure 14: Global Balance Donors Panel: Complete Time Span

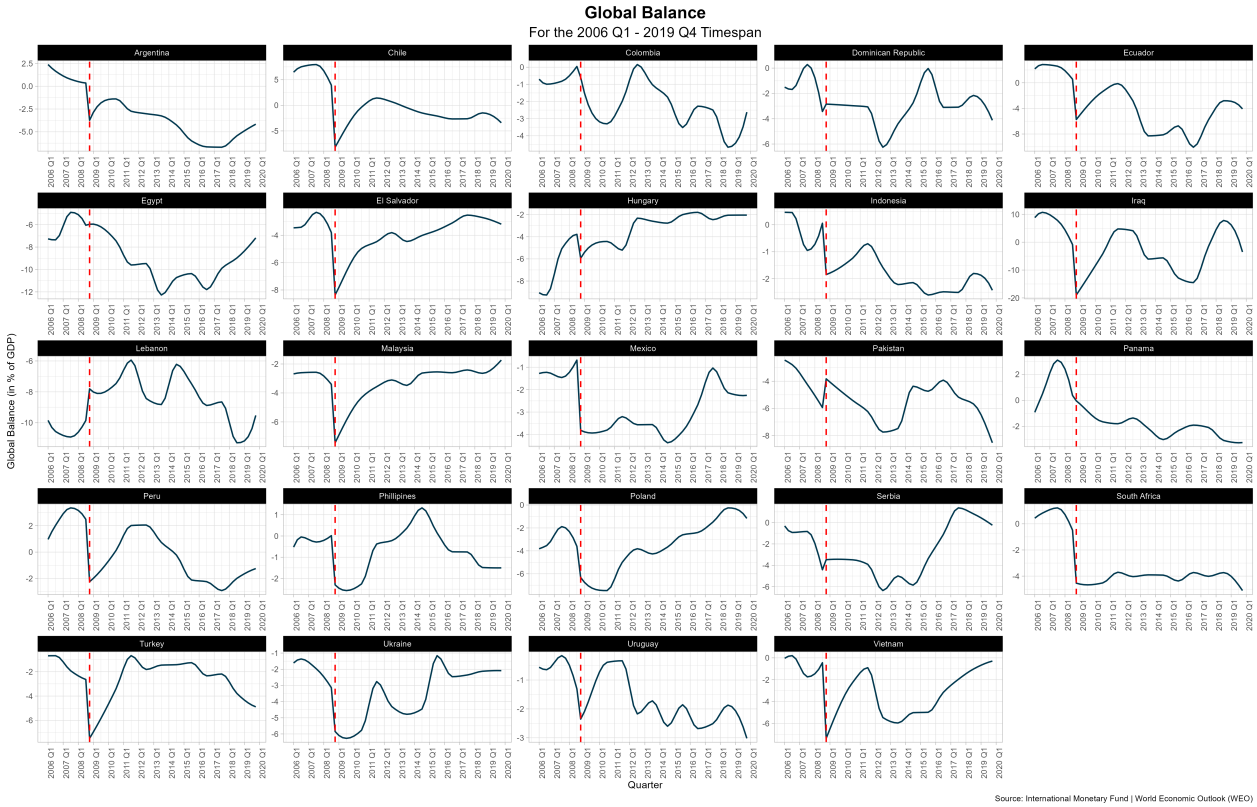


Figure 15: Primary Balance Donors Panel: Complete Time Span