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Dynamic Linkages Between Economic Policy Uncertainty and External Variables in Latin America: Wavelet Analysis

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Abstract: Wavelet coherence analysis (WCA) examines the dynamic interactions between economic policy uncertainty (EPU) in Brazil, Chile, Colombia, and Mexico and key external variables, using monthly data from 2010 to 2022. The findings reveal the following: (i) medium-term co-movements (4–16 months) between EPU and global financial indicators, including the Chicago Board Options Exchange (CBOE) Market Volatility Index (RVIX), Merrill Lynch Option Volatility Estimate Index (RMOVE), and Global EPU Index (RGEPU), emphasizing the sustained influence of financial volatility on domestic policy environments, particularly during global turbulence; (ii) significant interactions between EPU and the Climate Policy Uncertainty Index (RCPU) in resource-dependent economies like Brazil and Colombia, with pronounced effects in medium- and long-term horizons; (iii) bidirectional relationships between Brent crude oil prices (RBRENT) and EPU in Brazil, Colombia, and Mexico, where oil price fluctuations shape policy uncertainty, especially during global market disruptions; and (iv) notable co-movements between EPU and the Dow Jones Sustainability World Index (RW1SGI) in Brazil, Chile, and Mexico, highlighting sensitivity to shifts in sustainability-driven markets. These results underscore the need for economic diversification, strengthened financial safeguards, and integrated climate risk management to mitigate external shocks. By exploring the time–frequency dynamics of global uncertainties and domestic policy environments, this study provides actionable insights for fostering resilience and stability in Latin America's interconnected economies while addressing vulnerabilities to global market volatility and sustainability transitions.

Keywords: economic policy uncertainty; wavelet coherence analysis; financial volatility; global sustainability; climate policy uncertainty; Latin America

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1. Introduction

Economic policy uncertainty (EPU) has emerged as a critical concept for understanding the impact of policy-related ambiguities on macroeconomic performance, financial stability, and investment decisions. Initially developed by Baker et al. (2016), EPU quantifies policy-related ambiguities through a composite index. This index includes three components: the frequency of newspaper articles discussing policy uncertainty, data on expiring federal tax code provisions, and the dispersion in economic forecasts about key macroeconomic variables. These elements provide a comprehensive measure of economic

uncertainty driven by policy factors. Baker et al.'s groundbreaking work highlighted how EPU spikes during major geopolitical and economic events—such as tight presidential elections, financial crises, and fiscal policy disputes—are associated with greater stock price volatility and reduced investment in policy-sensitive sectors. While much of the existing literature focuses on advanced economies, the unique dynamics of EPU in developing regions, particularly Latin America, remain insufficiently explored (Chen et al., 2024; Fujitani et al., 2023; Tutuncu et al., 2024; Bossman et al., 2023; Kirikkaleli & Alola, 2022). This gap is critical given Latin America's reliance on commodity exports, exposure to global market volatilities, and frequent political instability, which amplify its susceptibility to external shocks (Tan et al., 2024; Rúa & Marín-Rodríguez, 2024).

Existing research underscores the role of advanced economies as the net transmitters of EPU risks, while emerging markets, such as those in Latin America, predominantly act as receivers (Tan et al., 2024). This transmission often exacerbates economic vulnerabilities, particularly in commodity-driven economies with limited financial buffers. Additionally, studies have shown that global EPU can significantly amplify the volatility of key asset classes, including precious metals (Raza et al., 2023), creating ripple effects that resonate strongly in Latin America due to its heavy reliance on commodity markets. These findings highlight the importance of analyzing how global and regional EPU dynamics interact to influence economic outcomes in Latin America.

At the same time, the interplay between EPU and environmental sustainability is gaining attention. Research examining the relationship between EPU and green investments (Su et al., 2023) suggests that policy uncertainty can shape the behavior of environmentally focused assets, with potential implications for regions like Latin America that are navigating energy transitions and climate challenges. Additionally, findings from Syed and Bouri (2022) indicate a complex trade-off between short-term environmental degradation and long-term improvements under high-EPU scenarios. These insights underscore the necessity of exploring how EPU intersects with climate policy, especially in Latin America, where economic and environmental policies are deeply intertwined.

Methodologically, recent advances in econometric tools, such as wavelet analysis, offer robust frameworks for disentangling the temporal and frequency-dependent relationships between EPU and economic variables. Studies employing wavelet approaches, such as Shahzad et al. (2018), have demonstrated their effectiveness in capturing short-, medium-, and long-term interactions, making them particularly suitable for understanding the multifaceted impacts of EPU. Additionally, Rúa and Marín-Rodríguez (2024) provide a novel perspective on the relationship between the Economic Policy Uncertainty (EPU) Index and exchange rates in Latin American countries (Brazil, Chile, Colombia, and Mexico). Utilizing wavelet power spectrum (WPS) and wavelet coherence analysis (WCA) on monthly data from January 2010 to May 2022, Rúa and Marín-Rodríguez (2024) indicate a consistent positive correlation between EPU and exchange rates across short-, medium-, and long-term horizons. These findings underscore the strong connection between economic uncertainty and exchange rate dynamics, highlighting the need for careful economic policy management and the consideration of political events to promote stability and economic growth in these Latin American nations. This study builds on these methods to examine the nuanced dynamics of EPU in Latin America, focusing on its interactions with financial markets, oil prices, and climate variables.

The primary objective of this study is to explore the dynamic linkages between economic policy uncertainty (EPU) and external global variables in Latin American economies using wavelet coherence analysis. Specifically, this study addresses two key questions: (1) Which external variables most significantly influence EPU in the Latin American context? (2) How have EPU dynamics evolved over time, particularly in response to global

economic turbulence and regional policy shifts? By focusing on Brazil, Chile, Colombia, and Mexico—countries that represent a significant portion of Latin America's economic activity—this research leverages wavelet analysis to explore the short-, medium-, and long-term interactions between EPU and variables such as oil prices and global uncertainty measures, including the Global EPU (GEPU), Chicago Board Options Exchange (CBOE) Market Volatility Index (VIX), Merrill Lynch Option Volatility Estimate Index (MOVE), Climate Policy Uncertainty (CPU) Index, and Dow Jones Sustainability World Index (W1SGI). The wavelet methodology enables a comprehensive understanding of the complex dynamics influencing uncertainty in the region.

This study contributes to the literature by offering a comprehensive, region-specific analysis of EPU in Latin America, providing valuable insights for policymakers and investors. The findings aim to inform strategies for enhancing economic resilience and mitigating the adverse impacts of EPU in the region by identifying the drivers of uncertainty and their effects on financial, commodity, and climate variables.

This study is structured as follows: Section 2 reviews the literature, summarizing key themes such as the economic and financial impacts of policy uncertainty, global interconnections, methodological approaches, and its relationship with sustainability and corporate strategies. Section 3 describes the data and wavelet coherence methodology. Section 4 presents country-specific empirical findings, while Section 5 discusses their broader implications. Finally, Section 6 concludes with key insights and final remarks.

2. Literature Review

Figure 1 illustrates the interconnectedness of key concepts surrounding economic policy uncertainty (EPU) and its implications, serving as a conceptual framework for analyzing its interactions. At the core, EPU connects with themes like political uncertainty, investment, markets, and growth, revealing critical pathways for its influence on economic systems. Other clusters link EPU with institutional quality, volatility, geopolitical risk, environmental sustainability, and global events such as COVID-19 and oil price volatility, emphasizing the need to address its multifaceted effects in emerging markets.

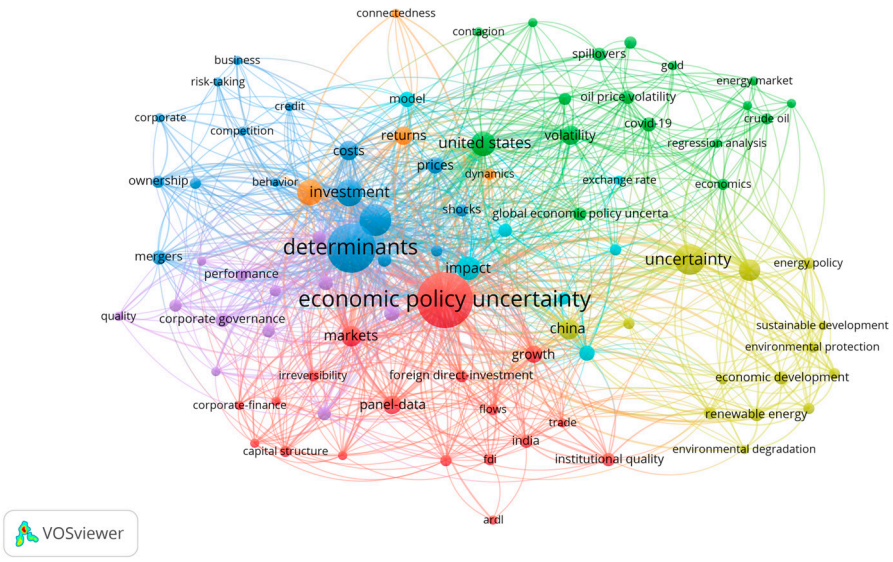


Figure 1. Co-occurrence network of keywords from search terms EPU OR GEPU AND determinants. Source: authors' analysis using VOSviewer with Scopus and Web of Science data.

The following sections will describe each cluster according to its color, highlighting the emerging trends and their implications within the study context.

2.1. Red Cluster: Economic and Financial Dimensions of Policy Uncertainty

This cluster examines how EPU interacts with financial systems, trade flows, and institutional factors. Key themes include financial development, foreign direct investment (FDI), and growth. The literature highlights how strong institutions and diversification mitigate EPU's adverse impacts, while irreversibility underscores the long-term costs of delayed reforms. Advanced methods, such as Autoregressive Distributed Lag (ARDL) models, capture the temporal and spatial dimensions of EPU, revealing its role in shaping FDI and market stability (T. Li et al., 2020; Maquieira et al., 2023; Deng & Li, 2024). However, the specific mechanisms by which EPU influences structural resilience and long-term economic growth, particularly in the Latin American context, remain underexplored. Addressing this gap will contribute to understanding how policy adjustments and structural reforms can strengthen economic stability under uncertainty.

2.2. Green Cluster: Global Interconnections and Methodological Approaches to EPU

This cluster focuses on the interplay between EPU, commodities (for example, crude oil, gold, and bitcoin), and global economic shocks. Key findings reveal how fluctuations in commodity prices influence Latin American economies, while digital currencies reflect adaptive investor behavior in uncertain environments (Demir & Ersan, 2017; Benlagha & Hemrit, 2023; T. Le et al., 2023). Advanced methods like Autoregressive Conditional Variance Model With Mixed Data Sampling (GARCH-MIDAS) and wavelet analysis capture EPU's volatility and spillover effects (Raza et al., 2023; Xiong et al., 2024; Rúa & Marín-Rodríguez, 2024). Nonetheless, there is an insufficient exploration of regional strategies to mitigate the contagion and spillover effects of global EPU on Latin American economies. Investigating these strategies can provide actionable recommendations for reducing external vulnerabilities.

2.3. Blue Cluster: Micro- and Macro-Dynamics of EPU

This cluster explores the behavioral responses to EPU, emphasizing risk-taking, investment delays, and credit constraints. Political uncertainty exacerbates financial market instability, discouraging investment and slowing growth (Karanasos & Yfanti, 2021; Agyemang et al., 2023). Key terms such as investment, risk-taking, credit, and political uncertainty underline how businesses and financial systems react to uncertain policy environments (Soni et al., 2023; Shahzad et al., 2018; Yun & Chun, 2021; Abdoh & Maghyereh, 2024). Despite these insights, targeted policy recommendations to reduce EPU's effects on entrepreneurial and investment activities in Latin America are scarce. Developing such policies can enhance the capacity of businesses to adapt and thrive amidst uncertainty.

2.4. Yellow Cluster: Growth and Environmental Sustainability Under EPU

This cluster highlights the interaction between EPU and climate policy, emphasizing how uncertainty in energy and environmental regulations delays renewable energy adoption and hinders sustainable development (Qamruzzaman et al., 2022; Rehman et al., 2023; Athari, 2024). For resource-rich economies, stable energy policies are critical for fostering growth and meeting climate goals. However, there are limited analyses of policy frameworks that effectively integrate environmental sustainability into economic resilience strategies under EPU. Addressing this gap can inform more holistic approaches to balancing growth and sustainability in volatile contexts.

2.5. Purple Cluster: Corporate Financial Strategies and Governance in Times of Economic Policy Uncertainty

This cluster examines how firms manage liquidity and governance under EPU. Strategies like increasing cash reserves protect firms but slow investment, while robust gover-

nance frameworks enhance decision-making and financial performance (Feng et al., 2022; Zhao & Niu, 2023; Kang & Kim, 2024; Vuong et al., 2023). In Latin America, where governance challenges persist, there is insufficient focus on how governance practices can address structural challenges to mitigate EPU's effects. Bridging this gap will clarify how firms can optimize governance to maintain financial stability and economic performance during periods of uncertainty.

The reviewed literature identifies the dynamic effects of EPU on economic systems, financial markets, and environmental policies. However, gaps remain in understanding the specific mechanisms driving resilience, regional strategies to mitigate global spillovers, targeted measures for business adaptation, and integrated approaches to sustainability. This study seeks to address these gaps by analyzing EPU's multifaceted interactions with external variables in Latin America.

3. Empirical Data and Methodological Approach

3.1. The Dataset

This study's dataset focuses on four Latin American countries—Brazil, Chile, Colombia, and Mexico—which share similar macroeconomic structures, including floating or free-floating exchange rate regimes and inflation-targeting monetary policies. These commonalities make them well suited for comparative analysis, as they are likely to respond similarly to global economic shocks.

The dataset includes monthly series data from January 2010 to May 2022, providing 148 observations based on Colombia's EPU index availability. The variables included in the dataset cover a broad spectrum of economic, uncertainty, and environmental indicators, such as the Climate Policy Uncertainty Index, the Sustainability World Index, and the Brent oil price. Financial and uncertainty indicators include volatility indices (VIX, MOVE). This comprehensive integration of variables ensures robust temporal and sectoral coverage, providing a detailed framework for analyzing macroeconomic interactions in Latin America.

Table 1 provides a detailed list of indices and variables for exploring the intricate relationships between economic policy uncertainty (EPU) and other economic dimensions. This table highlights the diverse sources and methodological approaches underlying each index, emphasizing their relevance to this study's Latin American and global focus.

The economic policy uncertainty (EPU) indices for Brazil, Chile, Colombia, and Mexico were constructed using newspaper-based methodologies pioneered by Baker et al. (2016), with adaptations for regional contexts by researchers such as Cerda et al. (2016) and Gil León and Silva Pinzón (2019). These indices capture localized policy uncertainty trends within specific countries, providing a granular view of how national policy developments influence economic dynamics. Complementing these is the Global EPU Index (GEPU), which aggregates data from 21 countries to present a macroeconomic perspective on global policy uncertainty, normalized for GDP weights and missing data.

Table 1 also includes indices measuring financial market volatility and risk sentiment, such as the VIX (equity market volatility) and MOVE Index (Treasury bond market volatility), widely regarded as proxies for investor confidence and market uncertainty. The inclusion of the Climate Policy Uncertainty (CPU) Index, constructed by Gavriilidis (2021), underscores the role of environmental and climate-related policies in economic uncertainty, while the Sustainability World Index (W1SGI) highlights the integration of corporate governance and climate strategies in global economic assessments. Finally, the Brent crude oil price (CO1 Comdty) adds a vital commodity dimension, reflecting the significant impact of resource price fluctuations on Latin American economies, which depend heavily on natural resource exports.

Table 1. List of variables analyzed.

Variable	Label	Description
EPU Index for Brazil	EPU_BRA Index	Created by Baker et al. (2016) using articles from Folha de São Paulo.
EPU Index for Chile	EPU_CHI Index	Constructed by Cerda et al. (2016) based on articles from El Mercurio and La Segunda, following Baker et al. (2016).
EPU Index for Colombia	EPU_COL Index	Created by Gil León and Silva Pinzón (2019) using El Tiempo data, based on Baker et al. (2016).
EPU Index for Mexico	EPU_MEX Index	Developed by Baker et al. (2016) using El Norte and Reforma journals.
Global EPU Index	GEPU Index	Baker et al. (2016) aggregated GDP-weighted policy uncertainty from 21 countries, normalizing national indices and imputing missing data, covering 71% of global output.
Volatility Index	VIX Index	Calculated by the CBOE, this "fear index" measures market expectations of S&P 500 volatility over 30 days.
Volatility Estimate Index	MOVE Index	The ICE BofA MOVE Index estimates U.S. Treasury bond market volatility, reflecting sentiment and risk in interest rates.
Climate Policy Uncertainty Index	CPU Index	Gavriilidis (2021) follows Baker et al. (2016) to construct a climate-related uncertainty index from eight U.S. newspapers (1987–2022), normalized to a mean of 100.
Sustainability World Index	W1SGI Index	The Dow Jones index ranks the top 10% sustainability-focused companies among the largest 2500 globally, considering climate strategies and corporate governance.
Oil Brent price	CO1 Comdty (Rbrent)	Tracks the generic first crude oil, Brent price.

Source: compiled by the authors using data from Bloomberg, Baker et al. (2016), Cerda et al. (2016), Gil León and Silva Pinzón (2019), and Gavriilidis (2021).

This comprehensive array of variables forms the basis for the wavelet analysis conducted in this study, enabling the examination of complex, time-varying interactions between EPU and financial, commodity, climate, and risk variables. The indices provide a rich dataset that captures both regional specificities and broader global trends, making Table 1 an essential reference point for understanding the methodological framework and scope of the analysis.

3.2. Wavelet Coherence Analysis (WCA)

Wavelet analysis is presented as an essential methodological approach for studying the intricate relationships between macroeconomic variables in the Latin American context. While traditional economic studies often rely on time domain analysis to track variable evolution or frequency domain analysis to focus on cyclic behavior, wavelet analysis bridges these perspectives. Magazzino and Mutascu (2019) highlight that this dual approach offers a dynamic framework to explore how economic policy uncertainty (EPU) interacts with financial, commodity, and climate variables over time and across different frequencies.

Introduced to applied economics by Ramsey and Lampart (1998), wavelet analysis is particularly effective for examining non-stationary data, which characterizes the economic dynamics of Latin American countries. It distinguishes between short-term fluctuations, medium-term cycles, and long-term trends, providing a granular view of how variables evolve across different time horizons (Marín-Rodríguez et al., 2023a, 2023b, 2024). This establishes it as a critical tool for analyzing economic policy uncertainty and its interactions with Latin America's financial, commodity, climate, and risk variables.

3.2.1. Morlet Mother Wavelet

In this study, the Morlet wavelet is employed to analyze the temporal and frequency relationships between EPU indices and other macroeconomic variables such as financial, commodity, climate, and risk variables in Latin America. By using a mother wavelet, small waves are generated, which depend on both time (t) and scale (s). The mathematical representation of the mother wavelet is given by the following:

$$\psi_{\tau,s}(t) = \frac{1}{\sqrt{s}}\psi\left(\frac{t-\tau}{s}\right) \tag{1}$$

Here, τ serves as a translation parameter, and the normalization factor $\frac{1}{\sqrt{s}}$ ensures consistency and comparability across various scales over the time domain.

Various wavelets have been proposed for time series decomposition in the literature, with the choice depending on the research focus. This study adopts the Morlet wavelet, which is well suited for capturing both the amplitude and phase information of cyclical patterns, as demonstrated in similar analyses (Marín-Rodríguez et al., 2023a, 2023b, 2024). The Morlet wavelet is notably recognized for its ability to balance temporal and frequency localization (Addison, 2017), and its Fourier period is closely aligned with the employed scale (Grinsted et al., 2004). The Morlet wavelet function is defined as follows:

$$\psi^M(t) = \frac{1}{\pi^{1/4}}e^{i\omega_0 t}e^{-t^2/2} \tag{2}$$

where ω_0 denotes the wavelet's central frequency. Following the methodologies established in previous studies (Bouri et al., 2020; Marín-Rodríguez et al., 2023a, 2023b, 2024), this study uses $\omega_0 = 6$. This specific choice optimizes information localization in both the time and frequency domains, ensuring an accurate and detailed analysis of EPU dynamics.

3.2.2. Wavelet Power Spectrum and Wavelet Coherence

The continuous wavelet transform (CWT) is utilized to explore the evolution of relationships between EPU and other variables at both the national and regional levels. The CWT of a time series $x(t)$ with a wavelet ψ is expressed as follows:

$$W_{x;\psi}(\tau,s) = \int_{-\infty}^{\infty} x(t)\frac{1}{\sqrt{|s|}}\psi^*\left(\frac{t-\tau}{s}\right)dt \tag{3}$$

where ψ^* represents the complex conjugate of the wavelet, s is a scaling factor, and τ is a translation parameter. This transform provides simultaneous insights into both the time and frequency domains. The wavelet power spectrum (WPS), which measures the localized energy of the time series, is defined as follows:

$$\mathrm{WPS}_x(\tau,s) = |W_x(\tau,s)|^2 \tag{4}$$

Wavelet coherence is applied to analyze the relationship between two variables in both the time and frequency domains. The cross-wavelet transform of two time series $x(t)$ and $y(t)$ is defined as follows:

$$W_{xy}(\tau,s) = W_x(\tau,s)W_y^*(\tau,s) \tag{5}$$

Wavelet coherence, which quantifies the similarity between the two time series, is calculated as follows:

$$R^2_{xy}(\tau, s) = \frac{\left|S\left(W_{xy}(\tau, s)\right)\right|^2}{S\left(\left|W_{xx}(\tau, s)\right|^2\right) S\left(\left|W_{yy}(\tau, s)\right|^2\right)} \quad (6)$$

Phase differences between the variables, which provide insights into lead–lag relationships, are given by the following:

$$\phi_{xy}(\tau, s) = arctan \frac{\Im\left\{W_{xy}(\tau, s)\right\}}{\Re\left\{W_{xy}(\tau, s)\right\}}, \phi_{x,y} \in [-\pi, \pi] \quad (7)$$

The phase difference helps determine whether the variables are synchronized or whether one leads or lags the other. For example, rightward arrows in coherence plots indicate in-phase synchronization with no lag, while leftward arrows signify out-of-phase relationships. Upward and downward arrows reveal the direction of causality between the variables.

3.2.3. Advantages of Wavelet Analysis for EPU in Latin America

Wavelet analysis is particularly suited to studying economic policy uncertainty in Latin America due to its ability to handle non-stationarity, structural breaks, and cyclical patterns simultaneously. Unlike traditional methods, wavelet analysis does not impose assumptions about time horizons, allowing for a flexible exploration of both short-term disruptions and long-term trends. This makes it ideal for examining how EPU interacts with financial variables like exchange rates and stock indices, commodity prices such as oil, and climate-related risks.

By applying wavelet analysis, this study not only captures the time-varying dynamics of EPU in Latin America but also integrates these findings into broader global patterns, linking local uncertainties with international financial and climate trends. The results contribute significantly to understanding the complex and evolving nature of economic policy uncertainty, particularly in economies with high exposure to political and economic volatility.

4. Empirical Results

4.1. Descriptive Statistics and Correlation Analysis

This subsection provides a comprehensive statistical overview of the economic policy uncertainty (EPU) indices for Brazil, Chile, Colombia, and Mexico, alongside selected global financial and economic indicators. Key metrics such as mean, variance, skewness, and kurtosis reveal the diverse characteristics of EPU indices across Latin America, highlighting their behavior and variability (Table 2). Brazil's EPU index (REPU_BRA) stands out with the highest mean (0.124) and variance (0.361), reflecting persistently high and volatile policy uncertainty. In contrast, Chile (REPU_CHI) exhibits the lowest mean (0.052) and variance (0.095), indicating a more stable policy environment. Colombia (REPU_COL) and Mexico (REPU_MEX) display intermediate levels of uncertainty, with moderate means (0.057 and 0.095, respectively) and variances (0.14 and 0.242). Kendall correlation analysis (Table 3) complements this understanding by highlighting significant associations between domestic and global variables, underscoring their interconnectedness.

The descriptive statistics in Table 2 lay a crucial foundation for the subsequent wavelet analysis, which will explore the time–frequency interactions between EPU indices and external factors. By identifying key volatility, asymmetry, and persistence patterns, this study provides actionable insights for policymakers to mitigate uncertainty and enhance economic stability in an increasingly interconnected global economy. Skewness and kurtosis

metrics highlight the irregular nature of EPU dynamics. Brazil (skewness: 2.095; kurtosis: 6.97) and Colombia (skewness: 1.51; kurtosis: 3.35) exhibit frequent and extreme upward spikes in uncertainty, while Mexico (skewness: 1.01; kurtosis: 1.17) shows moderate deviations. Global variables, such as Brent crude oil prices (RBRENT), display significant negative skewness (−2.476) and extreme kurtosis (16.96), reflecting sharp declines and high volatility that influence domestic uncertainties.

Table 2. Descriptive statistics of economic and financial variables selected.

	REPU_BRA	REPU_CHI	REPU_COL	REPU_MEX	RGEPU	RVIX	RMOVE	RCPU	RW1SGI	RBRENT
Mean	0.124 **	0.052 **	0.057 *	0.095 **	0.024	0.032	0.016	0.005	0.005	0.004
Variance	0.361	0.095	0.14	0.242	0.04	0.076	0.032	0.142	0.002	0.012
Skew.	2.095	0.899	1.512	1.010	1.271	1.456	0.994	0.116	−0.395	−2.476
Ex. Kurt.	6.973	1.505	3.352	1.167	3.070	3.959	1.544	0.255	0.530	16.955
JB	408.093 ***	33.894 ***	125.642 ***	33.554 ***	97.967 ***	148.916 ***	39.087 ***	0.732	5.586 *	1924.104 ***
ERS	−5.872	−1.469	−3.570	−1.563	−5.569	−2.831	−3.712	−1.601	−5.831	−3.627
	(0.000)	(0.144)	(0.000)	(0.120)	(0.000)	(0.005)	(0.000)	(0.112)	(0.000)	(0.000)
Q(20)	14.940	26.555 ***	26.529 ***	29.874 ***	18.166 **	15.762 *	20.282 **	36.869 ***	6.377	14.652
	(0.124)	(0.001)	(0.001)	(0.000)	(0.037)	(0.093)	(0.015)	(0.000)	(0.875)	(0.137)
Q2(20)	18.669 **	4.569	10.249	12.757	17.690 **	3.177	15.016	11.969	15.762 *	4.767
	(0.030)	(0.971)	(0.478)	(0.249)	(0.045)	(0.996)	(0.121)	(0.312)	(0.093)	(0.965)

Source: authors' own research using data compiled from multiple sources. Notes: * significant at the 10% level, ** significant at the 5% level, and *** significant at the 1% level. The Elliott, Rothenberg, and Stock (ERS) unit root test confirms stationarity for most variables, except REPU_CHI, REPU_MEX, and RCPU. Q(20) and Q2(20) denote the Ljung–Box statistics for serial correlation and heteroscedasticity, respectively, computed with 20 lags.

Table 3. Kendall correlations of economic and financial variables selected.

Kendall	REPU_BRA	REPU_CHI	REPU_COL	REPU_MEX	RGEPU	RVIX	RMOVE	RCPU	RW1SGI	RBRENT
REPU_BRA	1.000	0.099	0.119	0.029	0.254	0.002	0.115	0.124	−0.142	−0.075
REPU_CHI	0.099	1.000	0.130	0.096	0.202	−0.059	0.060	0.131	−0.002	−0.028
REPU_COL	0.119	0.130	1.000	0.222	0.266	0.121	0.074	0.165	−0.122	−0.095
REPU_MEX	0.029	0.096	0.222	1.000	0.170	0.093	0.117	0.166	−0.081	−0.085
RGEPU	0.254	0.202	0.266	0.170	1.000	−0.011	0.065	0.171	−0.121	−0.177
RVIX	0.002	−0.059	0.121	0.093	−0.011	1.000	0.316	0.059	−0.527	−0.236
RMOVE	0.115	0.060	0.074	0.117	0.065	0.316	1.000	0.001	−0.308	−0.105
RCPU	0.124	0.131	0.165	0.166	0.171	0.059	0.001	1.000	−0.062	−0.061
RW1SGI	−0.142	−0.002	−0.122	−0.081	−0.121	−0.527	−0.308	−0.062	1.000	0.331
RBRENT	−0.075	−0.028	−0.095	−0.085	−0.177	−0.236	−0.105	−0.061	0.331	1.000

Source: authors' own research using data compiled from multiple sources.

The persistence of uncertainty is confirmed by significant Q(20) statistics for most indices, such as REPU_CHI (26.5) and REPU_COL (26.53), indicating strong autocorrelation. Volatility clustering, evident from the Q2(20) results for Brazil (18.67) and the Global EPU Index (17.690), underscores the sustained impact of external shocks.

These findings justify the application of wavelet coherence analysis as an advanced methodological approach to investigate the time–frequency dynamics between EPU indices and global variables. This technique allows for the simultaneous examination of temporal and spectral relationships, providing a nuanced understanding of how these variables interact over different time horizons. By capturing both short-term fluctuations and long-term trends, wavelet coherence analysis can uncover critical insights into the temporal dependencies and phase relationships that drive economic policy uncertainty across Latin America.

Table 3 reveals that there are no strong correlations (below 0.8) between domestic economic policy uncertainty (EPU) indices and global variables. The Global EPU Index

(RGEPU) shows moderate positive correlations with the EPU indices for Brazil (0.254), Chile (0.202), Colombia (0.266), and Mexico (0.170), indicating that global economic policy uncertainty has a measurable influence on domestic uncertainty across Latin America, with Colombia exhibiting the strongest relationship.

Volatility indices (RVIX and RMOVE) demonstrate limited impacts on domestic EPU indices. For instance, RVIX has a weak correlation with Colombia (0.121), and RMOVE shows a similarly modest relationship with Brazil (0.115) and Mexico (0.117). This suggests that while global financial volatility is a factor, its influence on domestic policy uncertainty is not dominant.

Climate policy uncertainty (RCPU) exhibits weak to moderate correlations with domestic EPU indices, particularly for Colombia (0.165) and Mexico (0.166), reflecting the increasing significance of climate-related risks in shaping economic policy environments, especially in resource-dependent economies.

Brent crude oil prices (RBRENT) and the Sustainability World Index (RW1SGI) show weak negative correlations with domestic EPU indices. RW1SGI's negative correlations with Brazil (-0.142) and Colombia (-0.122) suggest that positive global sustainability trends may help stabilize policy uncertainty. Similarly, RBRENT's weak negative correlations imply that higher oil prices have a stabilizing effect, particularly in commodity-exporting economies.

In summary, no strong correlations are present, highlighting the moderate and multifaceted nature of the interactions between domestic and global variables. Global economic policy uncertainty exerts the strongest influence, while climate risks, financial volatility, and commodity prices play secondary roles. These findings provide a basis for exploring the temporal dynamics of these relationships through wavelet coherence analysis.

4.2. Wavelet Coherence Results by Country

Figures 2–5 present the causal interactions between EPU and the selected external variables for the analyzed countries across various time horizons. These visualizations highlight how fluctuations in one variable impact the other, specifying whether the relationship is positive or negative and identifying its occurrence within short-term (ST), medium-term (MT), or long-term (LT) dynamics. To enhance the clarity and depth of the findings, analyses of Figures 2–5 are conducted separately for each country, providing a more comprehensive interpretation of the results within the study context.

4.2.1. Brazil

This section examines the dynamic relationships between Brazil's Economic Policy Uncertainty Index (REPU_BRA) and key external variables. Figure 2a highlights a bidirectional relationship between REPU_BRA and global market volatility (RVIX). During 2010–2012, downward-left (↙) arrows indicate that RVIX negatively influenced REPU_BRA, underscoring Brazil's vulnerability to external financial turbulence, particularly at medium-term scales (8–16 months). Conversely, in 2014–2016 and 2018–2020, upward-right (↗) arrows reveal that REPU_BRA positively impacted RVIX, also at medium-term scales, demonstrating Brazil's role as a transmitter of uncertainty to global markets. This dual causality underscores Brazil's interconnectedness with global financial systems, highlighting the importance of policies to mitigate the global spillover effects of domestic uncertainty while enhancing resilience to external shocks. Effective risk management strategies and alignment with global economic trends are essential for stabilizing Brazil's economic environment.

Additionally, Figure 2b indicates a significant coherence between global bond market volatility (RMOVE) and REPU_BRA during 2012–2013, 2015–2016, and 2019–2020, particularly at short-term scales (1–4 months and 4–8 months). The arrows predominantly

point rightward (→), indicating an in-phase relationship where fluctuations in RMOVE are closely aligned with changes in REPU_BRA. This highlights the influence of global bond market volatility on Brazil's policy uncertainty, likely reflecting Brazil's reliance on external debt and financial flows. Policymakers should monitor global bond market trends to anticipate and mitigate their impact on domestic economic uncertainty.

Figure 2c presents the interaction between global economic policy uncertainty (RGEPU) and Brazil's Economic Policy Uncertainty Index (REPU_BRA), highlighting a bidirectional relationship during 2010–2013. In this period, downward-left (↙) arrows indicate that RGEPU negatively influenced REPU_BRA, emphasizing Brazil's vulnerability to external financial turbulence, particularly at medium-term scales (8–16 months). Conversely, upward-right (↗) arrows during the same period reveal that REPU_BRA positively impacted RGEPU, demonstrating Brazil's role as a transmitter of uncertainty to global markets. This dual causality reflects Brazil's deep interconnectedness with global economic systems, reflecting the dynamics observed with other global volatility indices, such as RVIX. This underscores how Brazil's domestic uncertainty can amplify global economic instability while simultaneously being influenced by external policy shifts. Nevertheless, while peaks in this relationship were observed in 2016–2017 and 2019–2020, the coherence has weakened more recently, suggesting a potential shift in the dynamics or reduced sensitivity in the relationship.

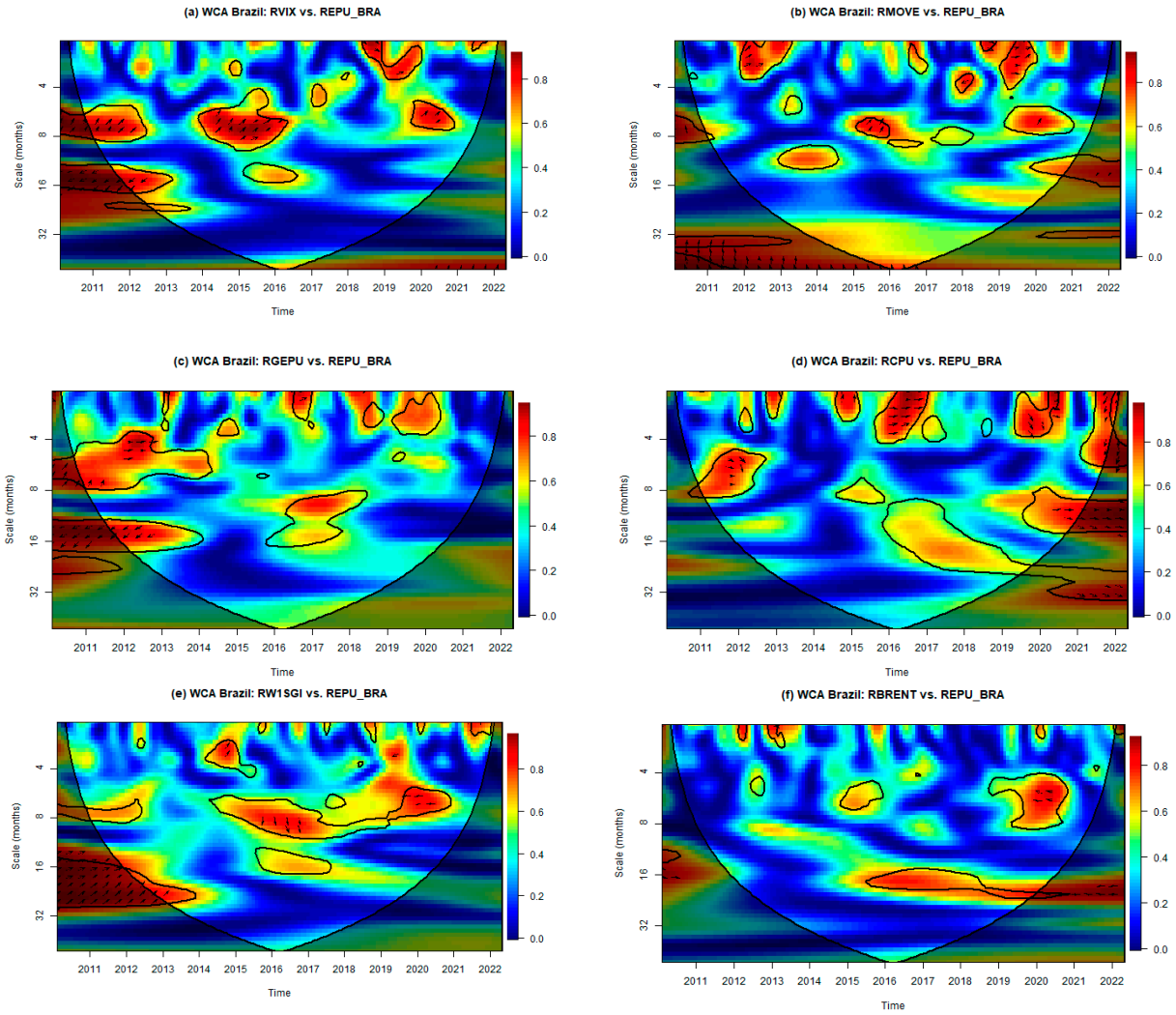


Figure 2. Wavelet coherence analysis of EPU in Brazil and its interactions with global financial, commodity, and climate variables. Source: authors' own research using data compiled from multiple sources.

Furthermore, Figure 2d highlights significant coherence between climate policy uncertainty (RCPU) and Brazil's Economic Policy Uncertainty Index (REPU_BRA) during 2011–2012, 2015–2017, and 2020–2022, predominantly at short-term scales (1–4 and 4–18 months). The arrows, pointing rightward and occasionally downward-right (→ and ↘), indicate both in-phase and negative causal relationships. Notably, in all time frames and across all scales, RCPU consistently causes changes in REPU_BRA. This suggests that global climate-related policy uncertainty directly and consistently influences Brazil's economic policy environment, likely due to the country's reliance on climate-sensitive industries, such as agriculture and energy. In more recent periods, particularly 2020–2022, this relationship has extended to longer-term scales, maintaining the same directional trends (→ and ↘) and causality. These findings reinforce the critical importance of incorporating climate risk management into Brazil's economic strategies to mitigate policy uncertainty arising from global climate challenges and enhance resilience against environmental shocks.

Figure 2e illustrates the relationship between the Sustainability World Index (RW1SGI) and Brazil's Economic Policy Uncertainty Index (REPU_BRA), revealing significant coherence during 2010–2014, 2016–2017, and 2019–2020. During 2011–2014, a negative causal relationship was observed from REPU_BRA to RW1SGI at long-term scales (16–32 months), with arrows pointing upward-right (↗), indicating that REPU_BRA positively influenced RW1SGI. Conversely, in the periods 2016–2017 and 2019–2020, the arrows pointing downward and left (↓ and ←) indicate that RW1SGI negatively influenced REPU_BRA, particularly at medium-term scales (8–16 months). These findings underscore Brazil's vulnerability to global sustainability trends and external market dynamics, reflecting its economic reliance on natural resources and commodity exports. The 2011–2014 period highlights how domestic economic policy uncertainty can disrupt global sustainability indices, possibly due to Brazil's significant presence in resource-based markets. Meanwhile, the 2016–2017 and 2019–2020 periods demonstrate the reverse: global shifts in sustainability-related indices, likely driven by environmental or market policies, exacerbate economic uncertainty in Brazil. These findings highlight the critical need for Brazil to align domestic policies with global sustainability trends. Integrating environmental considerations and sustainability risk assessments into economic strategies is essential to mitigate external market shocks. Additionally, reducing reliance on volatile commodity exports and diversifying the economic base are key steps toward enhancing resilience and stabilizing Brazil's policy environment.

Finally, Figure 2f illustrates the relationship between oil price dynamics (RBRENT) and Brazil's Economic Policy Uncertainty Index (REPU_BRA), revealing significant coherence during 2011 and 2015–2022 at medium-term scales (8–16 months). The arrows, pointing leftward and left-up (← and ↖), indicate predominantly negative relationships, where changes in RBRENT lead to shifts in REPU_BRA. Moreover, this negative causality persists at long-term scales (16–32 months) from 2020 to 2022. These findings underscore the critical role of oil prices in shaping Brazil's economic policy uncertainty, reflecting the sector's substantial contribution to the country's economy.

This analysis highlights the pressing need for strategies to stabilize Brazil's oil sector and buffer against the impacts of global oil price volatility. Proactive measures to diversify the economy, reduce dependency on oil exports, and align domestic policies with global energy trends are essential to managing economic policy uncertainty effectively and fostering long-term economic resilience.

The analysis of Brazil's Economic Policy Uncertainty Index (REPU_BRA) reveals a complex and multidimensional interplay with global factors, underscoring the country's economic interconnectedness. The bidirectional relationships between REPU_BRA and global volatility indices, such as RVIX and RGEPU, highlight Brazil's dual role as both a re-

cipient of external shocks and a transmitter of domestic uncertainty to global markets. This duality emphasizes the need for comprehensive risk management strategies that address external vulnerabilities and domestic policy instability's global implications. The persistent influence of climate policy uncertainty (RCPU) and sustainability indices (RW1SGI) further illustrates the sensitivity of Brazil's economic environment to global sustainability trends and environmental risks, requiring the integration of climate resilience and sustainability into national economic strategies. Additionally, the negative causal relationship between oil price dynamics (RBRENT) and REPU_BRA underscores the critical importance of stabilizing the oil sector and reducing dependency on commodity exports. Collectively, these findings stress the urgency of diversifying Brazil's economic base, aligning domestic policies with global trends, and fostering resilience against both external shocks and internal vulnerabilities to ensure long-term economic stability and policy coherence.

4.2.2. Chile

This section examines the dynamic interactions between Chile's Economic Policy Uncertainty Index (REPU_CHI) and selected external variables. Figure 3a highlights the relationship between global market volatility (RVIX) and REPU_CHI, showing significant coherence during 2010–2013 and 2019–2022 at long-term scales (16–32 months). The arrows, predominantly pointing downward-right and downward (↘ and ↓), indicate a negative causal relationship where RVIX influences REPU_CHI. This suggests that heightened global market volatility intensifies uncertainty within Chile's economic policy framework, likely reflecting the transmission of external financial instability into domestic conditions. These findings emphasize Chile's deep integration with global financial markets and the susceptibility of its policy environment to international volatility. Addressing this interconnectedness will require strategies that enhance resilience to external shocks, potentially through stronger financial safeguards and the diversification of the economic base.

Additionally, significant coherence was observed between global bond market volatility (RMOVE) and Chile's Economic Policy Uncertainty Index (REPU_CHI) during 2013–2016, as shown in Figure 3b, particularly at medium-term scales (8–16 months). The arrows pointing downward-right and downward (↘ and ↓) indicate both in-phase and negative causal relationships, suggesting that fluctuations in RMOVE coincide with or negatively impact REPU_CHI. Furthermore, during 2011 and 2017–2022, a positive relationship emerged at long-term scales (32–64 months), indicating that prolonged global bond market volatility trends positively influenced Chile's policy uncertainty. These findings imply that Chile's economic policy environment is deeply tied to global bond market dynamics. Medium-term volatility exerts immediate pressures, while long-term trends reflect structural sensitivities to external financial conditions. Policymakers should prioritize strategies to mitigate the impact of bond market volatility, such as diversifying financial instruments and reducing reliance on external debt markets. Strengthening domestic financial resilience will be critical in buffering against the ripple effects of global bond market fluctuations.

Figure 3c presents the interaction between global economic policy uncertainty (RGEPU) and Chile's Economic Policy Uncertainty Index (REPU_CHI). The results highlight a pronounced connection between 2010–2012, 2014–2018, and 2020–2022 on short-, medium-, and long-term scales (4–8, 8–16, and 16–32 months). The arrows, predominantly pointing downward-right (↘), indicate that RGEPU amplifies domestic policy uncertainty in Chile. This underscores Chile's sensitivity to international macroeconomic trends, which have the potential to impact domestic investment and fiscal policies. To mitigate these effects, policymakers should focus on aligning domestic policy frameworks with global economic developments to enhance stability and resilience.

Figure 3d illustrates the relationship between climate policy uncertainty (RCPU) and Chile's Economic Policy Uncertainty Index (REPU_CHI), revealing significant coherence during 2012 and 2017, particularly at medium-term scales (0–4 months) and 2020–2022 in the short, medium, and long term (0–4, 4–8, and 32 months). The arrows pointing rightward (→) and downward-right (↘) indicate a combination of in-phase and negative relationships. These findings suggest that global climate policy uncertainty influences Chile's economic policy environment, likely due to the country's reliance on climate-sensitive sectors such as mining and agriculture. This underscores the need to integrate climate resilience into Chile's economic policies to mitigate the impact of global environmental uncertainties and ensure long-term economic stability.

The results presented in Figure 3e reveal a critical connection between global sustainability trends, as represented by the Sustainability World Index (RW1SGI), and Chile's Economic Policy Uncertainty Index (REPU_CHI). Significant coherence observed during 2010–2014 and 2020–2022 at medium- to long-term scales (16–64 months) indicates that shifts in sustainability-related market dynamics are closely linked to variations in Chile's economic policy uncertainty. Notably, the relationship during 2011–2014 is led by RW1SGI influencing REPU_CHI, as indicated by left-up (↖) arrows. Additionally, in 2020–2022, REPU_CHI positively influenced RW1SGI, demonstrated by upward-right (↗) arrows. The shift in causality highlights the growing influence of global sustainability trends on Chile's economic policy uncertainty. While domestic policy uncertainty initially impacted sustainability indices, external environmental policies and market expectations increasingly shaped Chile's policy environment. To address this, Chile should align domestic policies with global sustainability standards, reduce reliance on resource-driven markets, and integrate sustainability risk assessments. These measures will strengthen Chile's resilience to global shocks and enhance its competitiveness in sustainable markets.

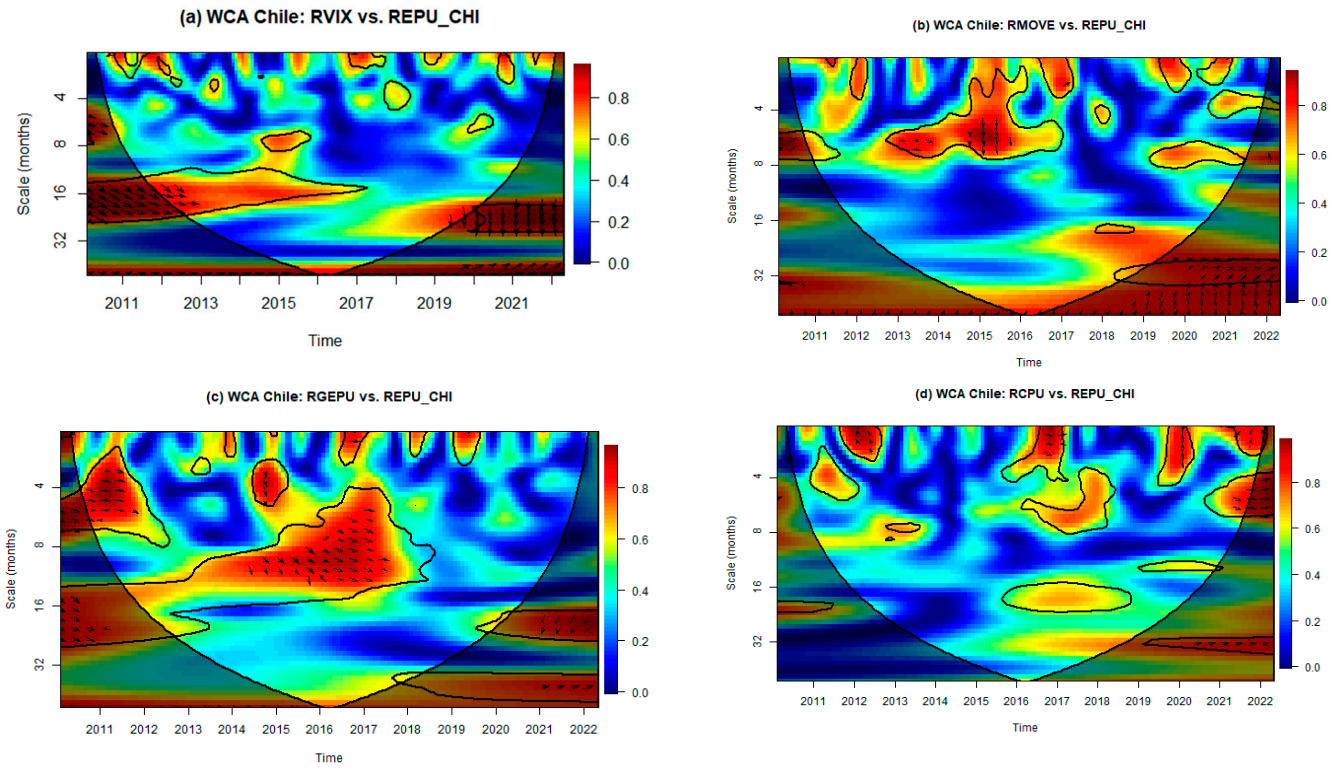


Figure 3. *Cont.*

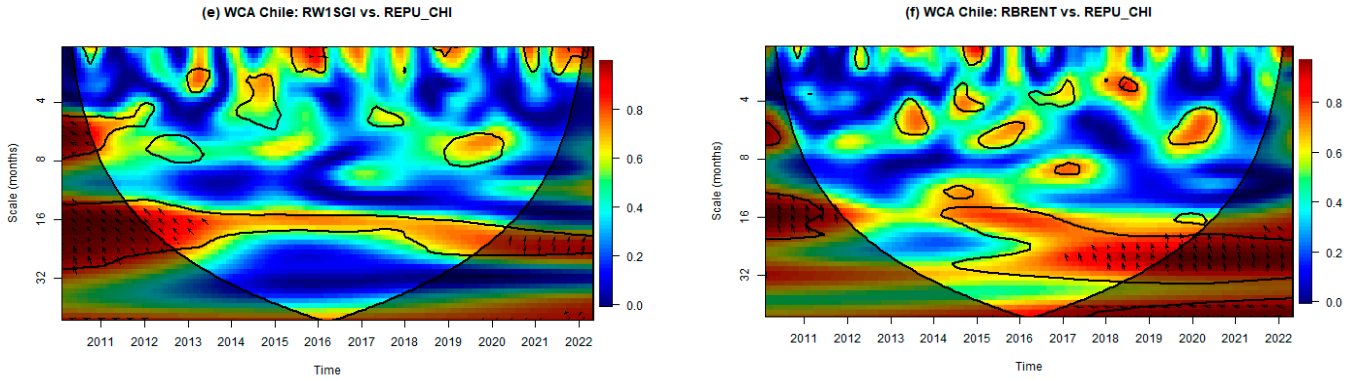


Figure 3. Wavelet coherence analysis of EPU in Chile and its interactions with global financial, commodity, and climate variables. Source: authors' own research using data compiled from multiple sources.

Finally, Figure 3f examines the interaction between oil prices (RBRENT) and REPU_CHI, revealing significant coherence during 2010–2013 and 2017–2022 at medium- and long-term scales (16–32 and 32–64 months). The arrows, pointing left-up (↖), indicate that oil prices lead to changes in REPU_CHI. This underscores the influence of global oil price dynamics on Chile's economic policy uncertainty, reflecting the country's reliance on oil imports. To mitigate these effects, policymakers should focus on stabilizing energy policies and reducing dependency on oil imports to buffer the economy against global oil price fluctuations. The findings emphasize Chile's vulnerability to external shocks due to its reliance on natural resource exports and integration into global sustainability markets. To mitigate risks, policymakers should prioritize economic diversification and reduce dependence on sustainability-driven commodities.

Chile's economic policy uncertainty is deeply influenced by global financial, environmental, and commodity markets, underscoring its vulnerability to external shocks. The country's sensitivity to global volatility indices, bond market trends, and economic policy uncertainty highlights the need for robust financial safeguards and reduced reliance on external debt and resource-based markets.

Moreover, the increasing influence of global sustainability indices and climate policy uncertainty on Chile's domestic policy environment emphasizes the necessity of aligning with international environmental standards and incorporating sustainability risk assessments into national policies. Diversifying its economic base and stabilizing energy policies, particularly reducing dependency on oil imports, will enhance Chile's resilience to global shocks and position it competitively in sustainable markets. These strategies are critical for fostering long-term economic stability and growth in a rapidly interconnected global economy.

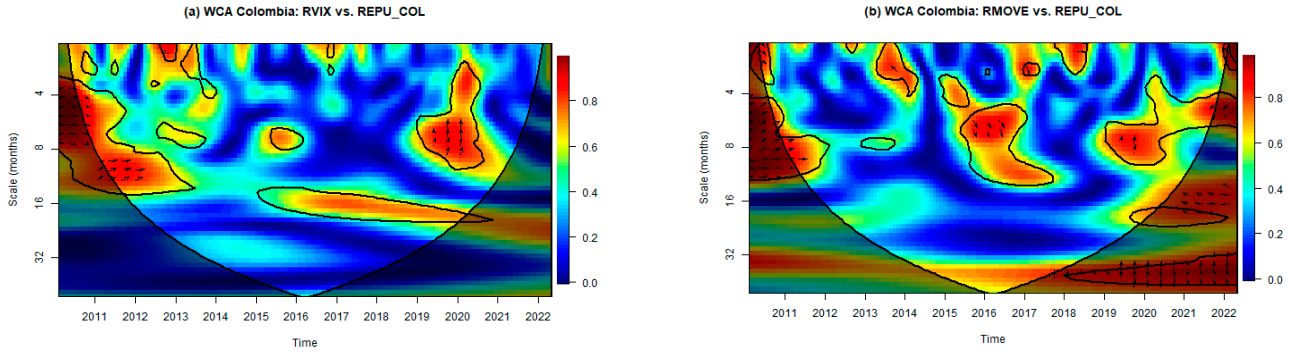
4.2.3. Colombia

This section examines the dynamic relationships between Colombia's Economic Policy Uncertainty Index (REPU_COL) and various external factors. Figure 4a highlights the interaction between RVIX (global market volatility) and REPU_COL, revealing significant coherence during 2011–2013 and 2019–2021, particularly at medium-term scales (4–8 and 8–16 months). The arrows predominantly point rightward (→) and upward-right (↗), indicating a positive causal relationship where increases in REPU_COL contribute to heightened RVIX. This finding underscores Colombia's dual role as both a recipient and transmitter of global financial uncertainty. The observed dynamics suggest that domestic economic policy instability notably influences global market volatility, likely reflecting Colombia's integration into international financial systems. These results emphasize the

critical need for Colombian policymakers to implement measures that reduce domestic uncertainty and its spillover effects on global markets. Enhanced risk management, the diversification of financial instruments, and alignment with international stability frameworks are essential strategies to safeguard the country's economic environment while mitigating its global impact.

Figure 4b examines the relationship between RMOVE (global bond market volatility) and Colombia's Economic Policy Uncertainty Index (REPU_COL), revealing significant coherence during 2010–2012 and 2015–2017 at short- and medium-term scales (0–4, 4–8, and 8–16 months) and extending to medium- and long-term scales (8–16, 16–32, and 32–64 months) in 2019–2022. The arrows, pointing downward-right (↘) and left-up (↖), indicate that RMOVE negatively leads REPU_COL, demonstrating how fluctuations in global bond markets closely align with and influence Colombia's economic policy uncertainty. These findings highlight Colombia's vulnerability to global bond market volatility, where heightened fluctuations exacerbate domestic policy uncertainty through increased borrowing costs or reduced capital inflows. To address this, policymakers should focus on managing external debt, diversifying funding sources, and strengthening domestic financial markets. Such strategies are crucial to enhance economic resilience and mitigate the impact of international market instability on Colombia's policy environment.

Similarly, Figure 4c highlights the interaction between RGEPU (global economic policy uncertainty) and REPU_COL (Colombia's Economic Policy Uncertainty Index), showing significant coherence during 2010–2012 and 2015–2017 at short- and medium-term scales (0–4, 4–8, and 8–16 months) and extending into medium- and long-term scales (8–16, 16–32, and 32–64 months) in 2019–2022. The results closely represent the patterns observed between REPU_COL and RMOVE. The arrows, pointing downward-right (↘) and left-up (↖), suggest that RGEPU negatively influences REPU_COL, underscoring how global economic policy uncertainty directly impacts Colombia's domestic policy stability by aligning with and amplifying local uncertainty dynamics. These findings emphasize Colombia's vulnerability to global economic policy shifts, with external fluctuations cascading into its domestic policy environment. Policymakers must enhance resilience by adopting strategies that reduce dependency on volatile external economic conditions. This includes aligning domestic policies with global economic trends, strengthening institutional frameworks, and diversifying economic structures to mitigate the transmission of global uncertainty into the national context.



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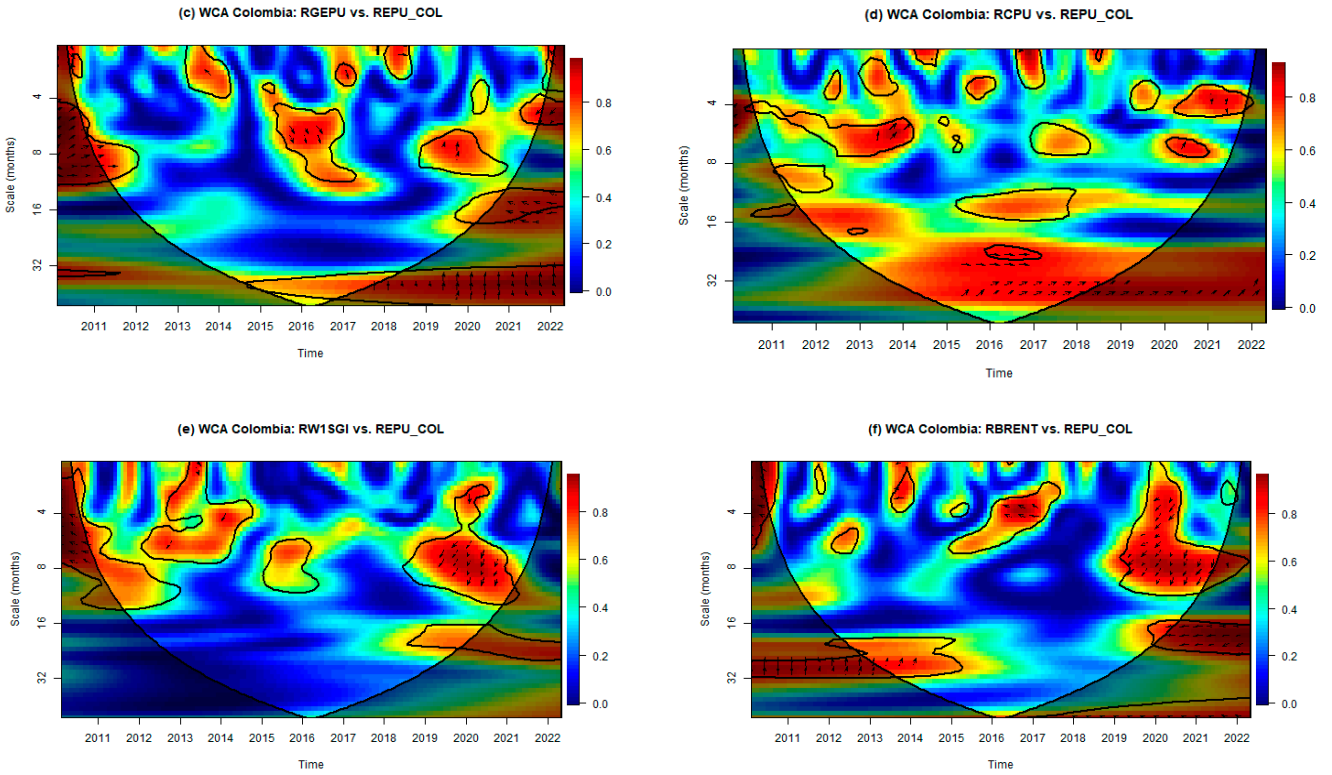

Figure 4. Wavelet coherence analysis of EPU in Colombia and its interactions with global financial, commodity, and climate variables. Source: authors' own research using data compiled from multiple sources.

Furthermore, Figure 4d illustrates the coherence between RCPU (climate policy uncertainty) and REPU_COL (Colombia's Economic Policy Uncertainty Index), showing significant relationships during 2013–2014 and 2021–2022 at short-term scales (4–8 months). Additionally, from 2015 to 2022, the coherence extends to medium- and long-term scales (16–32 and 32–64 months). The arrows predominantly point rightward (→) and upward-right (↗), indicating a positive causal relationship in which increases in REPU_COL amplify RCPU. These findings highlight the nuanced relationship between domestic economic policy uncertainty (REPU_COL) and global climate policy uncertainty (RCPU), suggesting that Colombia's internal economic dynamics may still influence broader climate-related uncertainty despite its relatively small role in the global economy. While Colombia is not a major global player in commodity exports, its reliance on climate-sensitive sectors such as agriculture, mining, and hydrocarbons means that domestic economic uncertainty can raise questions about its ability to implement effective climate strategies. This could subtly shift international perceptions, particularly within regional markets or among trading partners, thereby contributing to heightened global climate policy uncertainty. Additionally, fluctuations in Colombia's economic policy environment might affect the stability of smaller-scale trade flows in carbon-sensitive commodities, creating localized flows that cumulatively add to global uncertainties, especially in interconnected markets.

Figure 4e depicts the relationship between the Sustainability World Index (RW1SGI) and Colombia's Economic Policy Uncertainty Index (REPU_COL), revealing significant coherence during 2010–2012 and 2019–2021, particularly at medium-term scales (8–16 months). The arrows pointing downward-left (↙) indicate a negative causal relationship, where changes in RW1SGI drive fluctuations in REPU_COL. This suggests that Colombia's economic policy uncertainty is influenced by global sustainability trends, reflecting the country's reliance on resource-based exports and its sensitivity to international market dynamics. These findings emphasize the need for Colombia to align domestic

policies with global sustainability trends to mitigate external shocks. Prioritizing economic diversification and embedding sustainability into policy frameworks would enhance resilience to market volatility and position the country to seize opportunities in the global shift toward sustainable development. This approach would strengthen Colombia's economic stability while bolstering its role in sustainability-focused international markets.

Finally, Figure 4f examines the relationship between global oil prices (RBRENT) and Colombia's Economic Policy Uncertainty Index (REPU_COL), revealing significant coherence across multiple periods. During 2010–2014, the upward-pointing arrows (↑) suggest that REPU_COL leads oil prices at long-term scales (16–32 months), indicating that domestic policy uncertainty may influence oil market perceptions. In contrast, during 2016 and 2019–2020, the left-upward arrows (↖) reveal a negative causal relationship, with oil prices exerting a leading influence on REPU_COL. Finally, from 2020 to 2022, at medium-term scales (16–32 months), leftward arrows (←) indicate negative in-phase relationships, with some instances of REPU_COL leading changes in RBRENT. These findings underscore the pivotal role of oil prices in shaping Colombia's economic policy uncertainty, reflecting the sector's importance within the country's economic framework. They also highlight the bidirectional nature of this relationship, where domestic policy uncertainty can influence global oil market dynamics while simultaneously being affected by external price volatility. Addressing these challenges requires implementing robust energy policies, the diversification of the energy sector, and reducing dependency on volatile oil markets. Such measures would help mitigate domestic economic uncertainty, enhance resilience to global oil price fluctuations, and promote long-term economic stability.

Colombia's Economic Policy Uncertainty Index (REPU_COL) is intricately linked to global economic and financial dynamics, as evidenced by its interactions with variables such as market volatility (RVIX), bond market fluctuations (RMOVE), global economic policy uncertainty (RGEPU), climate policy uncertainty (RCPU), the Sustainability World Index (RW1SGI), and oil prices (RBRENT). These relationships, often characterized by medium-term cycles (8–16 months), highlight Colombia's vulnerability to external shocks and its dual role as both a recipient and transmitter of global uncertainties. Despite its relatively small scale in global markets, Colombia's reliance on resource-based exports and climate-sensitive sectors amplifies its susceptibility to global trends.

The findings emphasize the need for strategic policymaking to mitigate these vulnerabilities. Economic diversification is crucial to reduce dependency on oil and commodity exports, while strengthening domestic financial systems can buffer against external market instability. Policymakers should also integrate climate risk management into national strategies to address the challenges posed by global sustainability and environmental trends. These measures will enhance Colombia's economic resilience, stabilize its policy environment, and position the country to capitalize on emerging opportunities in a globally interconnected and sustainability-focused economy.

4.2.4. Mexico

This section analyzes the dynamic interactions between Mexico's Economic Policy Uncertainty Index (REPU_MEX) and a range of external variables. Figure 5a illustrates significant coherence during 2010–2012 and 2019–2020, predominantly at short- and medium-term scales (0–4, 4–8, and 8–16 months). In 2010–2012, the downward-right arrows (↘) reveal a negative causal relationship, where heightened global financial market volatility intensified domestic economic policy uncertainty in Mexico. This suggests that external shocks in global markets significantly drove domestic policy instability during this period, underscoring Mexico's sensitivity to international financial turbulence.

Conversely, in 2019–2020, the upward-right arrows (↗) indicate a shift to a positive causal relationship, where increases in REPU_MEX contributed to intensified RVIX. This reversal highlights Mexico's evolving role as a recipient and a transmitter of global financial uncertainty. Such dynamics may reflect the growing integration of Mexico's economy into international financial systems or heightened global sensitivity to its economic policy fluctuations during domestic instability periods. These findings underline Mexico's dual vulnerability to and influence on global market volatility. The negative causal relationship in 2010–2012 emphasizes the need for mechanisms to shield the domestic economy from external shocks, such as diversifying financial instruments and enhancing regulatory frameworks. The positive causality in 2019–2020 further stresses the importance of stabilizing domestic economic policy to mitigate its spillover effects on global markets. Strengthening financial safeguards, aligning with international stability frameworks, and fostering economic resilience are essential to ensuring Mexico's stability and minimizing its contributions to global financial uncertainty.

Figure 5b reveals a significant interaction between Mexico's Economic Policy Uncertainty Index (REPU_MEX) and global bond market volatility (RMOVE), with notable coherence during 2013–2014 and 2020–2022, particularly at medium-term scales (8–16 months). The predominance of downward-right arrows (↘) indicates a positive causal relationship, highlighting how fluctuations in global bond markets align closely with increases in Mexico's economic policy uncertainty. These findings emphasize Mexico's reliance on international bond markets, underscoring its vulnerability to external financial shocks. Elevated global bond market volatility can increase borrowing costs, reduce capital inflows, and destabilize domestic financial conditions. To mitigate these risks, Mexico must prioritize managing external debt exposure by diversifying funding sources and strengthening its domestic bond markets. Additionally, implementing robust fiscal policies and enhancing financial resilience will reduce the country's sensitivity to global bond market dynamics and ensure greater economic stability.

Figure 5c explores the relationship between global economic policy uncertainty (RGEPU) and REPU_MEX, revealing significant coherence during 2010–2013, 2016–2017, and 2020 at short- and medium-term scales (0–4, 4–8, and 8–16 months). The downward-right arrows (↘) indicate that RGEPU negatively influences REPU_MEX, showing that global macroeconomic policy shifts exacerbate domestic policy uncertainty. These results highlight the interconnectedness of Mexico's economy with international macroeconomic trends and underscore the need for adaptable domestic policies to mitigate risks associated with external economic shifts.

Figure 5d highlights the significant coherence between global climate policy uncertainty (RCPU) and Mexico's Economic Policy Uncertainty Index (REPU_MEX) over the entire period analyzed (2010–2022). This relationship is most pronounced at medium- and long-term scales (8–16 and 16–32 months) from 2010 to 2018, with coherence persisting only at long-term scales (16–32 months) from 2019 to 2022. The predominance of downward-right arrows (↘) indicates a negative causal relationship, where global climate policy uncertainties significantly influence Mexico's economic policy environment. These results underscore the substantial impact of global climate uncertainties on Mexico's economic policy stability, largely due to the country's reliance on climate-sensitive sectors such as energy and agriculture. Global shifts in climate policy likely disrupt domestic markets and amplify policy uncertainty, creating economic vulnerabilities.

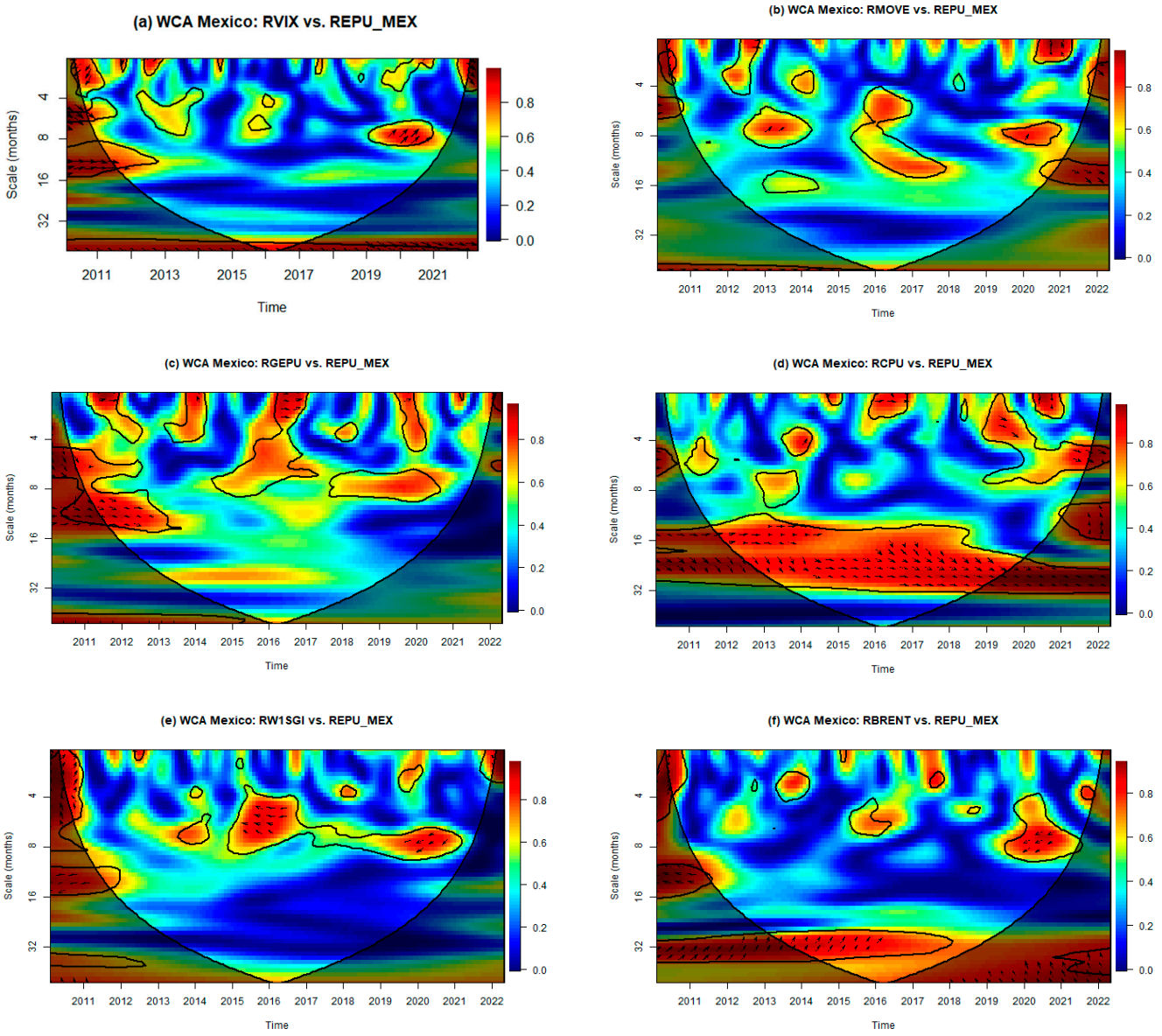

Figure 5. Wavelet coherence analysis of EPU in Mexico and its interactions with global financial, commodity, and climate variables. Source: authors' own research using data compiled from multiple sources.

To address these challenges, Mexico must prioritize integrating climate risk considerations into its national policy frameworks. This includes fostering resilience within climate-sensitive industries through sustainable practices, diversifying the economic base to reduce sectoral dependency, and aligning domestic climate policies with global standards. These measures will help mitigate the effects of global climate policy uncertainty and position Mexico as a proactive participant in the transition toward a more sustainable global economy.

Figure 5e analyzes the relationship between the Sustainability World Index (RW1SGI) and Mexico's Economic Policy Uncertainty Index (REPU_MEX), showing significant coherence during 2010–2011, 2016–2017, and 2019–2020 at short-term scales (4–8 months). The predominance of downward-left (↙) arrows indicates a negative causal relationship, where changes in REPU_MEX influence the Sustainability World Index. These results suggest that fluctuations in Mexico's economic policy uncertainty can influence global sustainability indices, reflecting the country's role in resource-dependent industries and supply chains.

This may disrupt market stability in sectors sensitive to sustainability trends. Mexico should reduce domestic policy uncertainty through stable regulatory frameworks and align economic policies with global sustainability goals to mitigate these effects. Such measures would enhance both Mexico's economic resilience and its contribution to international sustainability efforts.

Finally, Figure 5f analyzes the interaction between oil prices (RBRENT) and Mexico's Economic Policy Uncertainty Index (REPU_MEX), revealing a bidirectional relationship with significant coherence, similar to the patterns observed in Colombia's relationship with oil prices. During 2010–2017, at long-term scales (32–64 months), the upward-right arrows (↗) indicate positive relationships where REPU_MEX leads to a change in RBRENT, suggesting that domestic economic policy uncertainty in Mexico influenced global oil price dynamics during this period. In 2019–2021, at medium-term scales (8–16 months), REPU_MEX also led to changes in RBRENT, but this time in a negative direction, highlighting a shift in the nature of the interaction. Finally, between 2018 and 2022, at long-term scales (32–64 months), the left-upward arrows (↖) indicate a negative causal relationship, with oil prices exerting a leading influence on REPU_MEX, demonstrating how fluctuations in global oil markets increasingly impacted Mexico's economic policy environment.

These findings underscore the complex and evolving nature of the relationship between oil prices and economic policy uncertainty in Mexico. The positive causality observed in earlier years suggests that Mexico's domestic policy dynamics had a measurable influence on global oil price trends, possibly through its role as an oil exporter. However, the later periods reveal a reversal, with global oil price volatility increasingly shaping Mexico's policy uncertainty, reflecting the country's sensitivity to external energy market fluctuations.

Mexico's economic policy uncertainty demonstrates a complex interplay with global financial, climate, and commodity markets, revealing its dual role as both a recipient and transmitter of global uncertainty. The coherence between REPU_MEX and variables such as RVIX, RMOVE, and RBRENT highlights Mexico's vulnerability to external shocks and its growing integration into international markets. The relationships with sustainability indices (RW1SGI) and climate policy uncertainty (RCPU) underscore Mexico's reliance on resource-driven industries and its exposure to global environmental shifts. Fluctuations in REPU_MEX disrupt global sustainability and climate indices, emphasizing the need for stable regulatory frameworks aligned with global sustainability goals.

The bidirectional relationship with oil prices (RBRENT) reflects Mexico's sensitivity to global energy markets, where domestic policy uncertainty has influenced global oil dynamics in earlier periods, while more recent trends show external oil market volatility shaping Mexico's economic policy environment. To enhance resilience, Mexico should prioritize economic diversification, reduce dependency on resource sectors, and align domestic policies with global sustainability and financial frameworks. These measures will mitigate external shocks, stabilize the economy, and position Mexico as a proactive player in global markets.

5. Discussion

5.1. Global Indicators: VIX, MOVE, and GEPU

This study expands upon the existing body of knowledge regarding economic policy uncertainty (EPU) and its diverse, horizon-dependent effects on financial and macroeconomic variables in Latin America. By aligning with global patterns while offering region-specific insights, the analysis underscores how EPU influences market volatility and economic dynamics across varying time frames in conjunction with indices like VIX, MOVE, and GEPU. These findings confirm those of Chen et al. (2024), who emphasize the dynamic role of EPU and VIX in shaping market connectedness, where short- and

medium-term positive effects transition to negative impacts over the long term. This study's evidence of similar transitions within Latin American economies reinforces the relevance of their framework.

Additionally, the pronounced sensitivity of emerging markets, such as Brazil, to global volatility indices like RVIX, as highlighted by Chen (2023), aligns with the observed medium-term coherence between RVIX and Brazil's EPU. These observations are supported by Bouri et al. (2024), who demonstrate the influence of global risk factors, such as EPU and MOVE, on bond market variance across quantiles, particularly during periods of heightened uncertainty. The temporal and horizon-specific dependencies identified by Bouri et al. (2024) closely parallel this study's findings, particularly in Chile and Colombia. In these countries, in-phase relationships (→) reveal a shared vulnerability to global bond market fluctuations (RMOVE), reflecting the alignment of domestic uncertainties with international financial trends. Conversely, Brazil and Mexico exhibit distinct medium-term negative relationships (↘) with RVIX, highlighting their heightened exposure to global financial volatility and their differing economic sensitivities.

Moreover, Balcilar et al. (2021) emphasize the predictive power of global EPU measures for emerging market bond spreads and volatility, particularly under conditions of heightened uncertainty. This study corroborates these findings by revealing the susceptibility of Latin American bond markets to advanced market dynamics. It demonstrates how elevated EPU attracts capital inflows to high-yield bonds, while periods of reduced uncertainty often trigger capital outflows due to the perceptions of increased risk.

Collectively, the results affirm the central role of EPU and the associated global indices as the key drivers of economic and financial volatility. They emphasize the need for tailored, region-specific strategies in Latin America to mitigate risks and enhance resilience, particularly in the context of global interdependencies. By offering granular insights into the interactions between uncertainty indices and regional economies, this study contributes meaningfully to the broader discourse on global economic stability. This study provides actionable guidance for policymakers and investors to navigate uncertainty effectively, balance external dependencies, and enhance domestic financial systems' robustness.

5.2. Climate Uncertainties and Sustainability Trends: CPU and Sustainability Index

This study advances the understanding of economic policy uncertainty (EPU) and climate policy uncertainty (CPU) by highlighting their multifaceted impacts on financial markets, commodity dynamics, and environmental sustainability in Latin America. The findings parallel those of Ghani et al. (2024), who underscore CPU's influence on renewable energy and transportation indices, emphasizing the need to integrate CPU considerations into economic strategies to stabilize climate-sensitive sectors. Similarly, Liu et al. (2024) reveal the temporal complexities of EPU and CPU in oil markets, resonating with this study's identification of short-term depressive effects and medium- to long-term stimulation in commodity-dependent economies in Latin America.

These patterns align with those identified by Dong et al. (2024), who analyze the negative effects of CPU and EPU on green financial assets, reinforcing this study's findings on the nuanced interactions between uncertainty indices and green bonds in the region. Wang et al. (2024) further illustrate strong predictive relationships between CPU, EPU, and green finance in China, mirroring the importance of hedging strategies and portfolio diversification using green assets observed in this study. These insights emphasize the role of green finance in buffering against uncertainty and enhancing economic stability.

The exacerbation of environmental degradation under high-EPU conditions, as shown by Owusu et al. (2024), complements this study's emphasis on the critical role of consistent policies in mitigating ecological instability. Similarly, H. Li et al. (2024) identify EPU

as a driver of increased non-renewable energy use and its associated ecological impacts in BRICS nations, aligning with this study's findings on Latin America's environmental vulnerability. This reinforces the need for targeted strategies to transition away from non-renewable energy sources in the region.

Further, Qureshi et al. (2024) highlight how firms adapt to high EPU by enhancing social engagement to reduce uncertainty, a behavior also observed among Latin American firms in this study. Guo et al. (2020) emphasize the moderating effects of renewable energy policies on environmental degradation, underscoring this study's call for stronger regional renewable energy initiatives. Meanwhile, Liao et al. (2019) demonstrate the importance of internal controls in enhancing corporate resilience under high EPU, paralleling this study's emphasis on robust governance and stakeholder engagement in uncertain environments.

In conclusion, this study underscores the pivotal roles of EPU and CPU in shaping financial markets, commodity dynamics, environmental sustainability, and corporate strategies. For Latin America, the findings emphasize the urgency of integrating economic and climate policies to bolster resilience, promote sustainable development, and address environmental vulnerabilities. Balancing global interdependencies with local priorities allows the region to navigate uncertainty while fostering long-term stability and growth.

5.3. Oil Prices: Brent

The dynamic relationship between oil prices and economic policy uncertainty (EPU) reveals significant asymmetries and time-dependent interactions, underscoring the critical role of global energy markets in shaping economic policy stability. Y. Le et al. (2024) emphasize that fluctuations in crude oil prices act as a key driver of EPU, with volatility in global oil markets exacerbating economic policy instability, particularly in oil-dependent economies. This aligns with Dash and Maitra (2021), who observe that oil prices and EPU often exhibit co-movement during periods of economic turmoil, such as financial crises, highlighting the heightened sensitivity of EPU to disruptions in energy markets.

Mishra et al. (2024) further explore this interplay, demonstrating that oil price shocks contribute to investor pessimism, reduce corporate investments, and amplify policy uncertainty. This effect is particularly pronounced in resource-dependent economies, where fiscal frameworks and economic stability are closely tied to oil revenue. Similarly, Liu et al. (2024) investigate the frequency-dependent effects of oil prices on EPU, noting that while high oil prices may dampen short-term market confidence, they can stabilize medium-term EPU under favorable conditions. This duality reflects the complex and often contradictory nature of oil price volatility's impact on economic policy responses.

Advanced methodological approaches, such as those employed by Isah et al. (2024), provide further evidence of the temporal and structural dependencies in the oil price–EPU relationship. Positive oil price shocks are shown to alleviate EPU in net-exporting countries, as increased revenue bolsters fiscal stability. Conversely, net-importing nations experience heightened uncertainty due to rising import costs and inflationary pressures, with these effects being particularly acute in developing and emerging economies. These findings highlight the divergent outcomes of oil price volatility based on a country's economic structure and reliance on energy imports or exports.

The asymmetric nature of the oil price–EPU relationship is further highlighted by Aimer and Lusta (2022), who demonstrate that negative oil price shocks tend to increase EPU more significantly than positive shocks. This asymmetry is observed across both short- and long-term horizons, underscoring the vulnerability of economic policy stability to downturns in energy markets. Such asymmetries highlight the need for robust and adaptive energy policies to buffer against adverse effects while leveraging favorable oil price conditions.

In summary, the findings reinforce the intricate and bidirectional relationship between oil prices and EPU, with profound implications for policymakers navigating the volatility of global energy markets. For resource-dependent economies in Latin America, this relationship underscores the importance of diversifying economic structures, stabilizing energy policies, and implementing fiscal measures that reduce reliance on oil revenues. By addressing these vulnerabilities, policymakers can mitigate the cascading effects of oil price fluctuations on economic policy uncertainty and enhance long-term stability.

6. Conclusions

This study underscores the intricate interplay between economic policy uncertainty (EPU) in key Latin American economies—Brazil, Chile, Colombia, and Mexico—and external global forces, including financial market volatility, global policy shifts, climate uncertainties, sustainability trends, and commodity price dynamics. Through wavelet coherence analysis, the findings illuminate how these relationships vary across short-term (ST), medium-term (MT), and long-term (LT) horizons, providing a granular perspective on the drivers of domestic policy uncertainty in the region.

As demonstrated by RVIX and RMOVE, global financial instability significantly influences EPU in all four countries, particularly during periods of heightened global turbulence, such as 2014–2016 and 2018–2020. The results highlight that short- and medium-term cycles (4–16 months) dominate these interactions, emphasizing the persistent effects of external shocks on domestic policy environments. The findings align with those of Y. Le et al. (2024) and Isah et al. (2024), who emphasize the time-dependent impact of financial volatility on emerging markets. Similarly, global economic policy shifts (RGEPU) exacerbate domestic policy uncertainty, underscoring the interconnectedness of Latin American economies with international macroeconomic trends. This underlines domestic policies' need to align with global developments, enhancing resilience and stability.

Climate-related risks (RCPU) emerge as a critical factor, particularly for countries like Brazil and Colombia, where climate-sensitive sectors such as agriculture, mining, and energy form a significant part of the economy. This finding was confirmed by Owusu et al. (2024) and H. Li et al. (2024), who highlight the vulnerability of such sectors to environmental uncertainties. Integrating climate risk management into national policy frameworks is vital to safeguard critical industries and promote long-term economic stability. Similarly, the heavy reliance on commodity and oil markets, exemplified by RBRENT, further exacerbates policy uncertainty across the region, necessitating the stabilization of energy policies and economic diversification.

Global sustainability trends, represented by RW1SGI, align closely with EPU in Brazil, Chile, and Mexico, illustrating the sensitivity of these economies to shifts in sustainability-driven markets. This presents both challenges and opportunities, as these countries can leverage global transitions toward sustainability by integrating environmental considerations into economic strategies, reducing uncertainty, and positioning themselves as key players in emerging green markets.

6.1. Policy Implications

Economic diversification is paramount across all countries to reduce reliance on volatile global commodity and energy markets, mitigating the transmission of external shocks into domestic policy environments. Such diversification is necessary to mitigate the transmission of external shocks into domestic policy environments. Strengthening fiscal and monetary frameworks is equally essential, enabling policymakers to absorb the impacts of financial volatility and economic policy shifts. Proactively monitoring global

trends, such as financial turbulence and sustainability transitions, will enhance the region's capacity to adapt to external risks.

Integrating climate risk management into national economic policies is critical for addressing uncertainties arising from climate-related risks. Additionally, integrating climate risk management into national policies is critical for addressing uncertainties stemming from climate-related risks. This approach will safeguard vital sectors, bolster long-term resilience, and align domestic policies with global sustainability standards, allowing countries to capitalize on opportunities in the transition toward sustainable development.

6.2. Limitations and Future Research

While this study offers comprehensive insights into the interactions between EPU and global variables, it has limitations. The analysis focuses on selected external factors and does not account for country-specific domestic policies or structural characteristics that may moderate these relationships. Moreover, historical data may not fully capture the rapidly evolving nature of global finance, policy, and climate uncertainties.

Future research should expand the scope by incorporating domestic variables, such as institutional quality, fiscal and social policies, and economic diversification strategies, to provide a more holistic view of EPU dynamics. Additionally, exploring the influence of emerging trends—such as digital transformation, geopolitical realignments, and energy transitions—could offer valuable insights into the region's vulnerabilities and opportunities. Employing alternative methodologies, such as time-varying parameter models, would further refine the analysis, capturing the temporal evolution of these complex relationships with greater precision.

In conclusion, this study sheds light on the multifaceted drivers of economic policy uncertainty in Latin America, offering actionable insights for policymakers. These findings highlight the need to enhance resilience, foster sustainable development, and navigate the complexities of an interconnected global economy. By aligning domestic strategies with global trends, Latin American economies can better withstand external shocks while capitalizing on emerging opportunities for long-term stability and growth.

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