External shocks in the world economy: a SVAR approach

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This research quantifies and compares the effects of shocks to U.S. GDP growth, Chinese GDP and commodity prices on the economic growth rates of four regions: i) Latin America and the Caribbean (LAC), ii) the European Union (EU), iii) ASEAN-5 and iv) Middle East and Central Asia (MECA), during the period 1983-2023. To this end, a SVAR (Structural Autoregressive Model) model with long-run restrictions is estimated for each region. The results indicate that external shocks significantly impact the economies of LAC, EU, ASEAN-5 and MECA, with regional variations in direction and magnitude. One limitation is the exclusion of economies such as India, Russia and Japan. This paper is the first study to address the impact of these shocks at the regional level within the global context.

JEL Classification: C32, E31, E32, E44, F41, G21, Q43
Keywords: External shocks, economic growth, commodities, SVAR, global.

Choques externos en la economía mundial: un enfoque SVAR

Esta investigación cuantifica y compara los efectos de los choques en el crecimiento del PBI de Estados Unidos, PBI de China y los precios de los commodities sobre las tasas de crecimiento económico de cuatro regiones: i) América Latina y el Caribe (LAC), ii) la Unión Europea (EU), iii) ASEAN-5 y iv) Medio Oriente y Asia Central (MECA), durante el periodo 1983-2023. Con este fin, se estima un modelo SVAR (Modelo Autorregresivo Estructural) con restricciones de largo plazo para cada región. Los resultados indican que los choques externos impactan significativamente las economías de LAC, EU, ASEAN-5 y MECA, con variaciones regionales en dirección y magnitud. Una limitación es la exclusión de economías como India, Rusia y Japón. Este trabajo constituye el primer estudio que aborda el impacto de estos choques a nivel regional dentro del contexto mundial.

Clasificación JEL: C32, E31, E32, E44, F41, G21, Q43
Palabras clave: Choques externos, crecimiento económico, commodities, SVAR, mundial.

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1. Introduction

The economies of the different regions of the world are increasingly interrelated, which has driven an increase in the flow of economic transactions, with fluctuations in monetary value and volume according to each country. In recent decades, two major economic blocs have emerged, representing a significant percentage of the world's Gross Domestic Product (GDP): China and the United States (US). Given their weight in the world economy, the economic cycles of both countries generate far-reaching effects in other regions (Cashin et al.,2021; Hallam, 2022). One of the main transmission channels for these effects is the commodity market, which plays a key role in global production. Because of this nexus, changes in commodity prices have a direct or indirect impact on the economic performance of different countries.

In this context, Latin America and the Caribbean (LAC), the European Union (EU), ASEAN-5, and the Middle East and Central Asia (MECA) have multiple economic structures, with both developed and emerging economies. These regions depend to varying degrees on economic growth in China and the US, as well as on swings in commodity prices. The effect of these shocks can represent both growth opportunities and major challenges (Sato et al., 2011). However, magnitude, direction and significance of these effects on regional economic growth are not yet clearly understood. Given the increasing global interdependence, it is crucial to evaluate these shocks in order to understand the level of dependence of each region on these external variables. Therefore, this study seeks to answer the following question to fill a gap in the literature: How do external shocks, such as U.S. and Chinese GDP growth and commodity price changes, impact economic growth in Latin America and the Caribbean, the European Union, ASEAN-5, and the Middle East and Central Asia regions?

Previous studies have approached this relationship from different perspectives. Miles (2017) analyzed nine Latin American economies and concluded that the U.S. business cycle has shown increasing synchronization with the region. However, Santiago et al. (2020) find that this link has not had a significant impact in the social sphere. Likewise, Soleimani et al. (2016) highlight the key role of the US and China in the economy of other regions, highlighting the influence at the global level. On the other hand, Sen et al. (2024) analyzed a sample of 168 countries and found that international prices of many commodities have a negative impact on GDP per capita. However, the effect of these shocks varies by region. Teng et al. (2016) showed that China's growth has not had a significant impact on the economies of the ASIAN-5 bloc countries, while Crowley (2010) identified that inflation in Middle Eastern and Central Asian countries between 1996 and 2009 is not directly related to changes in crude oil prices. These studies show that, although external shocks have effects on national economies, there is still a significant gap in the literature in their impact at the macroeconomic level.

To address this issue, this study will employ the SVAR (Structural Vector Autoregressive) model, an econometric tool that allows capturing the dynamic structure of the effects of a set of exogenous variables on endogenous variables. This approach facilitates the precise identification of external shocks and their impact on the economic growth of the regions under analysis. The use of SVAR has proven to be effective in previous studies. For example, Calvo et al. (1993) applied this model to show that the variability of the real exchange rate in Latin America is influenced by external

shocks from the U.S. Similarly, Maćkowiak (2007) highlights that the SVAR allows us to isolate more precisely the effects of different shocks, taking advantage over other econometric methodologies. In this study, annual data series covering the period 1983 to 2023 will be used to estimate the effects of external shocks in the four selected regions. From this analysis, we expect to find that external shocks to U.S. and Chinese GDP growth rates, as well as changes in commodity prices, have a differentiated effect on economic growth in Latin America and the Caribbean, the European Union, ASEAN-5 and the Middle East and Central Asia, both in terms of significance, direction and magnitude. The rest of the study is structured as follows. Section 2 presents the literature review. Section 3 describes the methodology used. Section 4 presents the analysis of the results and discussion. Finally, the main conclusions of the article are presented.

2. Literature review

Miles (2017), Gutiérrez (2007), Fajnzylber et al. (2004) and Araujo et al. (2014) analyze how the U.S. business cycle impacts Latin American and Caribbean economies. Miles (2017) finds that the synchronization of U.S. economic growth with the region has increased significantly in recent decades. In line with this, Gutiérrez (2007), in an ECLAC study, using Granger causality analysis and Hodrick-Prescott filters, found that the economic acceleration and deceleration cycles of Latin America and the Caribbean between 1980 and 2005 depend on the behavior of the U.S. economy Complementarily, Fajnzylber et al. (2004) used multiple regressions for the period 1960-2000 and found a high dependence of Latin America and the Caribbean on global business cycles, especially those of the U.S. and commodity price variations. These findings were particularly evident during the debt crisis of the 1980s and the structural reforms of the 1990s. In this context, Araujo et al. (2014), through a panel data analysis since 2000, conclude that fluctuations in commodity prices have played a fundamental role in the region's economic growth. Furthermore, according ECLAC (2023), in the last decade, Latin America and the Caribbean has experienced weak economic growth and high volatility, while the U.S. remains a strategic trading partner.

Within this framework of economic interdependence, the growing trade relationship between China and Latin America and the Caribbean has attracted increasing interest in the literature. Angulo & Lis (2023), Zhou (2023), Berg (2022), Ray et al. (2020) and Menezes & Bragatti (2020) agree that the economic relationship between the two sides has grown significantly in the last two decades. Angulo & Liz (2023), using panel data from 2004 to 2021, find that, although trade with China has increased notably, has had a negative impact on inclusive growth (GDP per capita). Similarly, Zhou (2023), using a general computable model with data from 2000-2020, finds that China's foreign direct investment has been significant, although reliance on extractive sectors increases economic risks.

On the other hand, Berg (2022) notes that China's investments in sectors such as energy, mining and infrastructure have diversified its presence in Latin America and the Caribbean, although risks persist due to dependence on commodity prices. In line with this, Ray et al. (2020) note that in 2019 exports to China reached a record $141 billion, while imports were $161 billion, increasing economic vulnerability to China's cycles. Menezes & Bragatti (2020) highlight that this asymmetric relationship intensified after the 2008 financial crisis. In a broader context, Karuvalappil &

Balakrishnan (2022), Breuss (2017), Uppenberg (2011) and Gong et al. (2001) compare the economic influence of the US and the European Union. In particular, Karuvalappil & Balakrishnan (2022) find, through causality analysis, that both economies have a bidirectional relationship in the short run. However, Breuss (2017) evidences that US GDP did not significantly impact the Eurozone between 2006 and 2010. Complementarily, Uppenberg (2011) highlights that, since 1990, the U.S. has shown higher productivity in services and manufacturing, while Gong et al. (2001) point out that EU labor markets are more rigid, which hinders their competitiveness.

In the same vein, China's influence has also manifested itself in the European Union. Gill & Small (2014), Clegg & Voss (2011), Soleimani et al. (2016) and Sertić et al. (2023) examine the influence of Chinese demand on economic growth in the European Union. Gill & Small (2014) highlight that economic interdependence between the two regions has increased since the 1990s.

However, Clegg & Voss (2011) find that, despite this growth, the impact of Chinese investment in the European Union has been limited. In contrast, Soleimani et al. (2016), through a regression analysis for the period 1995-2014, find that Chinese foreign direct investment has had a significant effect on the region. For their part, Sertić et al. (2023), in an exploratory study, conclude that the European Union remains exposed to Chinese economic growth in various sectors, suggesting a growing dependence.

The impact of the Chinese and U.S. economy has also been studied in other regions. Teng et al. (2016), Lau & Po Lee (2008) and Shabri Abd. Majid et al. (2008) analyze the economic linkages between China, the US and ASEAN-5. Teng et al. (2016) conclude that between 1995 and 2015 China's economic growth did not significantly affect ASEAN-5 financial markets. In contrast, Lau & Po Lee (2008), employing cointegration analysis, identified that since 1960 China's growth has been closely linked to that of ASEAN-5. In turn, Shabri Abd. Majid et al. (2008) show that US growth has had a marginal impact on ASEAN-5 between 1988 and 2006.

In addition to the role of China and the US, several studies have analyzed how these shocks affect countries in the Middle East and Central Asia. Crowley (2010) notes that global fluctuations have influenced price variability in the region. Complementarily, Allegret et al. (2012), using structural vector autoregressive (SVAR) models for the period 1992-2012, determine that the US GDP has had a significant and symmetric impact on these economies. Likewise, Ugazio & Xin (2024) find that, between 1994 and 2021, monetary policy and sudden news from the US market have generated notable effects on economic stability in the region.

Beyond the impact of economic growth in major economies, another key source with direct and indirect effects is the evolution of commodity prices. At the global level, Ge & Tang (2020) concludes that commodity prices are key predictors of economic growth in different countries. In Latin America and the Caribbean, Köse & Ünal (2024), using an SVAR model, find that oil price fluctuations have a significant impact on inflation. Similarly, Sodeyfi & Katircioglu (2016), using a VECM model for the period 1973-2010, conclude that the effects of commodities on economic growth vary by country, reflecting the heterogeneity of the economies analyzed.

In the European Union, Żyra & Shevchuk (2018), through a panel data analysis, find that volatility in commodity prices negatively impacts economic growth in several countries. Complementarily, Garcia et al. (2016), through a VECM model, find that fluctuations in commodity prices affect long-term inflation, suggesting an indirect but persistent relationship with

macroeconomic performance in the region. In the case of ASEAN-5, the impact of oil prices on the economy has been studied in the literature. Setiawan et al. (2020) conclude that changes in crude oil prices between 2000 and 2018 did not have a significant effect on the region. In contrast, Hidthiir et al. (2024) find that the volatility of major commodities between 1980 and 2020 had a negative impact on these countries. On the other hand, Kisswani (2021), through a NARDL model applied to the period 1970-2015, determines that an increase in oil prices has favored economic growth in ASEAN-5, evidencing the heterogeneity in the effects of commodities. For countries in the Middle East and Central Asia, the impact of energy prices is also divergent.

The IMF (2022) highlights that oil exporting countries benefit from high prices, while importers face fiscal difficulties. In this sense, the relationship between the economic structure of each country and the volatility of global markets becomes a determining factor for their macroeconomic performance. In line with the above, there are studies with highly heterogeneous results reflecting the complexity of the impact of external shocks. However, most of these studies have focused specifically on country-level analysis, limiting the understanding of these phenomena from a comparative perspective. To date, there has not been a study that examines these effects in a comprehensive manner across regions. In this context, the present study takes on relevance in macroeconomic literature.

3. Methodology and Data

We have the following traditional VAR (Vector Autoregression): $P_t = \beta + W_1 P_{t-1} + \cdots + W_p P_{t-p} + \mu_t$ where P_t is a vector of internal variables, β is a vector of intercepts, W_1, ..., W_p are coefficient matrices, and μ_t is a vector containing the errors of the system of equations. All variables that enter the VAR model are stationary. In order for the results to be robust, the VAR residuals must be uncorrelated, present normal behavior in their distribution and be homo-elastic. Likewise, the main information criteria are used to identify the optimal lags of the model.

In this sense, we work with the following variables, which are annual growth rates from 1983 to 2023: Gross Domestic Product of the United States (GDP US), Gross Domestic Product of China (GDP China), Commodity Price Index of the World Bank (CPI), Gross Domestic Product of Latin America and the Caribbean (GDP LAC), Gross Domestic Product of the European Union (GDP EU), Gross Domestic Product of ASEAN-5 (GDP ASEAN-5) and Gross Domestic Product of the Middle East and Central Asia (GDP MECA).

The Latin America and Caribbean region consist of 33 countries, the European Union consists of 27 countries, ASEAN-5 consists of Indonesia, Malaysia, the Philippines, Singapore and Thailand, and Middle East and Central Asia consist of 32 countries. The real growth rates of the regions have been obtained from the International Monetary Fund website. Moreover, to quantify the long-run effects of shocks to GDP US, GDP China and CPI on the regions (GDP LAC, GDP EU, GDP ASEAN-5 and GDP MECA), the errors of the traditional VAR are modified to include economic theory SVAR (Structural Vector Autoregression) allows the incorporation of restrictions, which identify causal relationships according to economic theory. We include the matrices A and B to relate pure shocks u_t with structural shocks ϵ_t through: $Au_t = B \in_t$.

The matrix A represents how endogenous variables are affected contemporaneously. The matrix B describes how the structural shocks translate into the observed errors in the endogenous

variables. Likewise, to describe how endogenous variables respond to structural shocks in the long run, we consider the matrix F, which allows us to include economic theory. For this, endogenous variables are only affected by the shocks to themselves and the shocks to the variables that precede them in the ordering. Therefore, the matrix structure F is such that: $P_t = G + F_1 P_{t-1} + \cdots + F_p P_{t-p} + \in_t$ where F_1, ...,F_p are in line with . F In light of the literature review section, shocks to US GDP, China GDP and CPI would have an effect on the Gross Domestic Product of the world regions, therefore this order will be maintained in the econometric estimates. Given this, the matrix F is:

$$F = \begin{pmatrix} F11 & 0 & 0 & 0 \\ F21 & F22 & 0 & 0 \\ F31 & F32 & F33 & 0 \\ F41 & F42 & F43 & F44 \end{pmatrix}$$

where the elements $F41$ $F42$ $F43$ and $F44$ are the coefficients representing the long-run cumulative effect on GDP growth of the regions in the face of a structural shock to US GDP, China GDP, CPI and itself, respectively.

However, it is important to consider some inherent limitations of the SVAR model. Thus, one of the main restrictions lies in the sensitivity of the results to the specification of the identification matrix, which can generate biases in the estimates if the restrictions are not correctly grounded (Uhlig, 2005). In this study, the identification of structural shocks has been carried out following previous literature and applying sound economic criteria to minimize this potential source of error.

4. Results and discussion

4.1 Stylized facts on GDP and commodity growth rates

Table 1 shows that China and ASEAN-5 have had higher average economic growth than their peers, with half of the observations above these figures. This is due to the strong economic expansion during the last decades that these economies have shown. In addition, China, MECA and ASEAN-5 have achieved higher growth rates at times. On the other hand, ASEAN-5 and LAC have experienced deep contractions. ASEAN-5 has the highest volatility, which would be associated with its rapid economic growth. The US has the lowest volatility, indicating its strong economic stability.
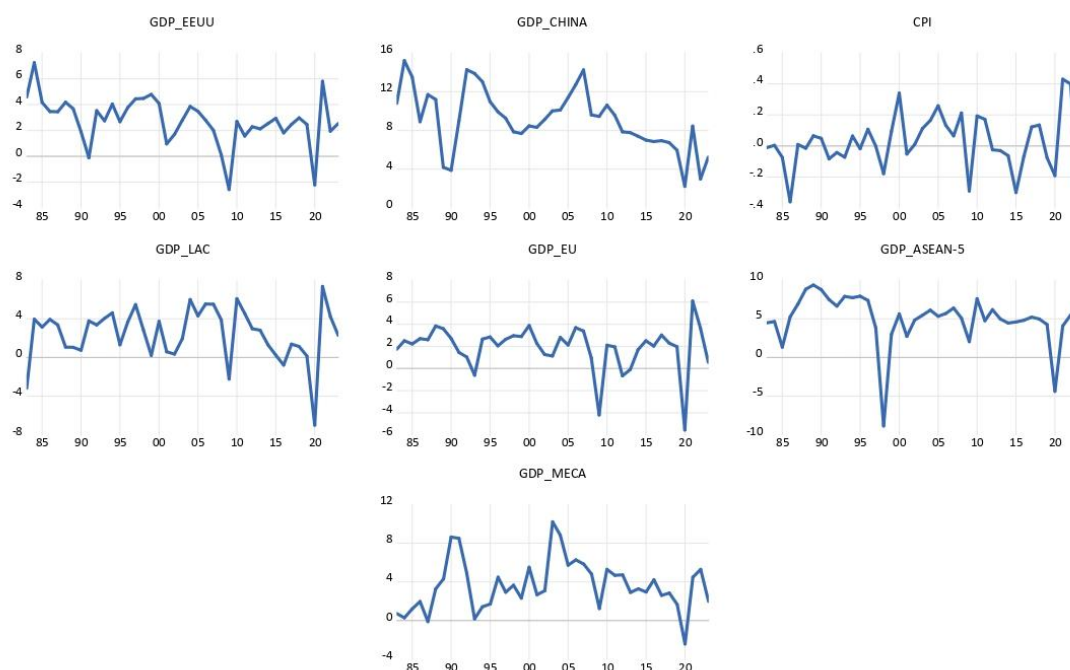
Table 1. Individual descriptive statistics of the series in annual growth rates (1983-2023).

	GDP US	GDP China	CPI	GDP LAC	GDP EU	GDP ASEAN-5	GDP MECA
Mean	2.78	9.13	0.02	2.43	1.92	4.95	3.63
Median	2.79	9.12	0.00	2.97	2.28	5.20	3.27
Maximum	7.24	15.20	0.43	7.34	6.10	9.35	10.20
Minimum	-2.58	2.24	-0.36	-6.98	-5.55	-8.55	-2.41
Std. Dev.	1.82	3.08	0.17	2.73	2.00	3.23	2.59

Source: Own elaboration with estimates from official sources IMF and World Bank, Eviews 13.

Graph 1 shows the economic growth rates of the regions analyzed, together with the variations of the World Bank's Commodity Price Index (CPI), during the period 1983-2023. It shows that the U.S. GDP shows a more stable behavior, with notable drops during global crises, while China's GDP stands out for its accelerated growth.

Regions such as Latin America and the Caribbean and ASEAN-5 show significant variations, highlighting their greater sensitivity to external shocks. On the other hand, the GDP of the European Union and the Middle East and Central Asia show more moderate growth patterns but are also affected by global circumstances such as financial crises. Commodity prices show high volatility, specifically in periods of economic shocks, such as the 2008 financial crisis and fluctuations in the supply and demand of natural resources. This graph allows us to clearly visualize the differences in growth dynamics between economies and how they respond to different factors, highlighting the relevance of the global economic context.

Graph1 . Behavior of the growth rates of endogenous variables from 1983 to 2023.
Source: Own elaboration with estimates from *official sources* IMF *and World Bank, Eviews 13.*

Table 2 shows that economic growth in Latin America and the Caribbean is moderately dependent on external factors, while the European Union economy is highly correlated with U.S. economic growth and commodity price variations. On the other hand, the economic growth of the ASEAN-5 countries is less dependent, while the economy of the Middle East and Central Asia is moderately correlated with commodity prices, which is consistent with the importance of oil and gas for the region's economy.

Table2. Correlations of the series in annual growth rates (1983-2023).

	GDP US	GDP China	CPI	GDP LAC	GDP EU	GDP ASEAN-5	GDP MECA
U.S. GDP	1.00						
Prob.	-						
GDP China	0.38	1.00					
Prob.	0.02	-					
CPI	0.28	0.05	1.00				
Prob.	0.07	0.78	-				
GDP LAC	0.46	0.47	0.49	1.00			
Prob.	0.00	0.00	0.00	-			
EU GDP	0.71	0.16	0.51	0.58	1.00		
Prob.	0.00	0.32	0.00	0.00	-		
GDP ASEAN-5	0.15	0.24	0.31	0.35	0.32	1.00	
Prob.	0.36	0.12	0.05	0.03	0.04	-	
GDP MECA	0.00	-0.03	0.45	0.45	0.36	0.33	1.00
Prob.	0.99	0.86	0.00	0.00	0.02	0.03	-

Source: Own elaboration with estimates from official sources IMF and World Bank, *Eviews* 13.

4.2 SVAR Model Estimates

For the series to enter a VAR (Vector Autoregression) model, it is essential that they are stationary, that is, that their means and variances remain constant over time. This guarantees the validity of the estimates and avoids problems of spurious interpretations in the econometric results. In this context, three stationarity tests were carried out: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS), the results of which are presented in Table 3.

The ADF and PP tests, which evaluate the presence of unit roots, indicate that the annual growth rates of all the series are stationary in levels, since their t-statistics are more negative than the critical values at 5% and the associated p-values are, in general, less than 0.05. Complementarily, the KPSS test, which tests the null hypothesis of stationarity, complements the results of the ADF and PP tests. In most of the series, the values obtained for the LM-Stat statistics are lower than the critical value of 0.46 at 5%, which confirms stationarity.

Taken together, these results suggest that the variables analyzed meet the requirement of stationarity in levels, which allows their direct inclusion in the econometric models without the need to differentiate them. This guarantees the stability of the subsequent econometric results and reinforces the robustness of the conclusions obtained.

Table 3. Results of the Stationarity Tests (ADF, PP and KPSS)

	Test (Levels)	Test critical Values (5%)	t-Statistic	LM-Stat.	Prob.
GDP US	ADF	-2.94	-4.96	-	0.00
	PP	-2.94	-4.96	-	0.00
	KPSS	0.46	-	0.48	-
GDP China	ADF	-2.94	-2.94	-	0.04
	PP	-2.94	-2.89	-	0.05
	KPSS	0.46	-	0.48	-
CPI	ADF	-2.94	-5.54	-	0.00
	PP	-2.94	-5.58	-	0.00
	KPSS	0.46	-	0.21	-
GDP LAC	ADF	-2.94	-6.26	-	0.00
	PP	-2.94	-6.26	-	0.00
	KPSS	0.46	-	0.14	-
GDP EU	ADF	-2.94	-6.21	-	0.00
	PP	-2.94	-6.22	-	0.00
	KPSS	0.46	-	0.26	
GDPASEAN-5	ADF	-2.94	-4.47	-	0.00
	PP	-2.94	-4.48	-	0.00
	KPSS	0.46	-	0.21	-
GDP MECA	ADF	-2.94	-3.80	-	0.00
	PP	-2.94	-3.72	-	0.00
	KPSS	0.46	-	0.14	-

Source: Own elaboration with estimates from official sources IMF and World Bank, Eviews 13.

Given that the economies of the regions (GDP LAC, GDP EU, GDP ASEAN-5 and GDP MECA) would be affected by the structural shocks in the growth of GDP US, GDP China and by the variations of CPI, then, as there are 4 regions, we estimate 4 SVAR models. This allows us to quantify the cumulative effects of each region in the face of structural shocks.

In this exercise, VAR1 will have the following order: GDP US, GDP China, CPI and GDP LAC; while VAR2 will follow the order: GDP US, GDP China, CPI and GDP EU. On the other hand, VAR3 will be formed with the order: GDP US, GDP China, CPI and GDP ASEAN-5, while VAR4 will be set with the order: GDP US, GDP China, CPI and GDP MECA. The VAR1 series are entered into the system with a lag, and have as exogenous variables the 2009, 2020 and 2021 dummies. As for VAR2, the series are entered with two lags, together with the 2009 and 2020 dummies. VAR3 has three lags and the 1998, 2009 and 2020 dummies. Meanwhile, VAR4 is structured with two lags and the 2003, 2009 and 2020 dummies.

Table 4 presents the statistical tests to determine the behavior of the residuals in each model. The probability of the Rao F-Stat statistic shows high values, which would indicate that there is not enough evidence to reject the null hypothesis of no autocorrelation. On the other hand, the Jarque-Bera statistic shows high values. This indicates that the behavior of the residuals would be normal with respect to kurtosis, skewness and in combination. On the other hand, the p-value of the Chi-sq statistic also shows high values, which would indicate that there is not enough evidence to reject the null hypothesis of homoscedasticity.

These results are key, as they allow models to adequately capture the dynamics of the data, strengthen the validity of statistical tests, and improve the efficiency of standard estimators to obtain better conclusions from the estimates.

Table 4. Tests of the Residuals of the VARs

Residue Testing	Statistician	VAR 1	VAR 2	VAR 3	VAR 4
Serial Correlation LM Tests	Rao F-Stat Prob.	0.99	0.91	0.92	0.13
Normality Tests	Jarque-Bera Prob.	0.86	0.81	0.68	0.99
Heteroskedasticity Test	Chi - sq Prob.	0.64	0.51	0.77	0.54

Source: Own elaboration with estimates from official sources IMF and World Bank, Eviews 13.

Since the series are stationary and the residuals of the VAR models are stable, structural factorization is performed to estimate the SVAR with long-run recursive impulse response constraint. Table 5 shows the results obtained from the F matrix of the SVAR1. A shock in the GDP US series (e.g., a 1% increase in the GDP rate) generates a cumulative multiplier effect of -1.10 in the GDP LAC series, however, this number does not turn out to be significant.

This result aligns with the graph in Appendix 1, where it is observed that the confidence band includes zero over the entire time horizon. It appears that shocks to GDP US during the sample period would not influence the LAC economy. This result could be in line with the findings of Santiago et al. (2020) and ECLAC (2023). LAC countries, during the last decades, have not diversified their economic structure; therefore, the benefits of international trade with the United States would not have a multiplier effect on their various sectors. Although Gutiérrez (2007) finds a relationship between the cycles, the methodology would not be the most appropriate, since Granger causality analysis does not show true causality, but rather acts as a predictor of events.

Table 5. SVAR1 F matrix estimation.

	Prob.		Prob.		Prob.		Prob.
F11= 2.32	0.00						
F21= 0.70	0.51	F22=6.72	0.00				
F31=-0.11	0.00	F32=0.04	0.14	F33=0.19	0.00		
F41=-1.10	0.06	F42=3.05	0.00	F43=1.03	0.00	F44=1.58	0.00

Source: Own elaboration with estimates from official sources IMF and World Bank, Eviews 13.

On the other hand, the shocks to China's GDP have had a significant effect, cumulatively increasing the GDP LAC series by 3.05 units, which coincides with the graph in Appendix 1. In this graph, the confidence interval does not include zero, confirming the statistical significance of the positive impact. This result is consistent with research by Zhou (2023), Berg (2022), Ray et al. (2020) and Menezes & Bragatti (2020), it is clear that China's strong growth in recent decades has driven economic growth in the region. However, this dependence implies risks, as a slowdown in the Chinese economy would be capable of having a negative impact. The results differ from Angulo-Bustinza & Liz-Gutiérrez (2023), even though these authors used a very short period of analysis

As for the impact of the CPI, the shocks are significant in LAC, with a cumulative increase of 1.03 units. This is evident in the graph in Appendix1, where the confidence interval is above zero in the early years. This finding is consistent with Sodeyfi & Katircioglu (2016), who indicate that the region is highly dependent on commodity prices

Finally, internal shocks in LAC have a significant positive effect of 1.58 units in the long run. The graph in Appendix 1 supports this finding, showing a positive cumulative response with a confidence interval that does not include zero. This reflects favorable, albeit moderate, domestic growth dynamics.

The results in Table 6 show that shocks to GDP US have a positive and significant cumulative impact of 0.78 in the European Union. This finding aligns with the graph in appendix 2, where we observe a steady growth of the cumulative response, with confidence bands that do not include zero from the third year onwards. This implies the important link between the two regions. Furthermore, these results contradict the findings of Breuss (2017) and Karuvalappil & Balakrishman (2022), who use a rather short period and a methodology with little economic interpretability, respectively.

On the other hand, shocks to China's GDP have a significant negative effect of 0.33 on the EU economy. However, in the graph in Appendix 2, the cumulative response shows a constant non-significant drop. The explanation would be that China, with strong economic growth, has displaced European products and services in several markets, reducing the competitiveness of the European bloc. This finding is in agreement with Sertić et al. (2023), Soleimani et al. (2016) and Gill & Small (2014).

As for commodity price shocks, the results are not statistically significant for the European Union. However, the graph in Appendix 2 shows significance only for the first two years. This result complements the studies of Żyra & Shevchuk (2018) , who indicate that less developed countries are the most affected by these shocks.

Shocks to internal growth in the European Union generate a positive and significant cumulative impact of 0.63. The graph in Appendix 2 shows sustained growth with confidence bands above zero, confirming the moderate resilience of the European bloc to adverse scenarios.

Table 6. SVAR2 F matrix estimation.

	Prob.		**Prob.**		**Prob.**		**Prob.**
F11= 1.84	0.00	0		0		0	
F21= 0.15	0.84	F22= 4.55	0.00	0		0	
F31= -0.10	0.00	F32= 0.00	0.78	F33= 0.16	0.00	0	
F41= 0.78	0.00	F42= -0.33	0.00	F43= 0.16	0.12	F44= 0.63	0.00

Source: Own elaboration with estimates from official sources IMF and World Bank, Eviews 13.

Table 7 shows that a shock to U.S. economic growth generates a significant cumulative effect of 2.10 units in the long run on the aggregate growth of the ASEAN-5 countries. However, the graph in appendix 3 reflects that the confidence bands include zero. While this result is in line with Shabri Abd. Majid et al. (2008) in terms of influence, it contrasts in magnitude. A likely explanation is the incorporation of a strong and globally projected economy, such as Japan.

On the other hand, shocks to China's economic growth show a positive impact of 0.28, but do not conclude significance. The graph in appendix 3 confirms this result, as the confidence bands include zero over the entire time horizon. This result suggests that, although China is a trade ally, the

economies of the ASEAN-5 countries have been quite diversified in growth over the past decades, which suggests that the region is not significantly dependent on China. This result complements that of Teng et al. (2016) regarding the extension of financial markets to the real sector, in contrast to Lau & Po Lee (2008), who use a predictive rather than causal methodology.

As for shocks to annual changes in commodity prices, they have a significant cumulative negative effect of 1.99 on the ASEAN-5 economy, indicating that commodity volatility is strongly related to the region's fruitful performance, given that it encompasses both importing and exporting countries. The graph in Appendix 3 supports this finding, with confidence intervals below zero. This result aligns with the timely study of Hidthiir et al. (2024), who highlights the relevance of policies that hedge against volatility in this region. Although Setiawan et al. (2020) contradict this result, their analysis is based on a very short period, which limits its scope.

Internal shocks in ASEAN-5 have a significant positive cumulative impact of 1.90 units, indicating a resilient economy with a strong financial base and economic diversification. The graph in Appendix 3 confirms this finding by showing a steady and significant growth, with confidence bands that do not include zero. This shows ASEAN-5's ability to respond favorably to internal dynamics and sustain its economic growth in the long term.

Table7. SVAR3 F matrix estimation.

	Prob.		Prob.		Prob		Prob.
F11= 1.80	0.00	0		0		0	
F21= -1.24	0.17	F22= 5.48	0.00	0		0	
F31= -0.32	0.00	F32= 0.20	0.00	F33= 0.17	0.00	0	
F41= 2.10	0.00	F42= 0.28	0.54	F43= -1.99	0.00	F44= 1.89	0.00

Source: Own elaboration with estimates from official sources IMF and World Bank, Eviews 13.

Table 8 shows that shocks to U.S. growth have a negative and significant long-term impact on the combined GDP of the MECA countries. This result is confirmed in the graph in Appendix 4, which shows a sustained fall in the cumulative response, with confidence bands below zero. This supports the hypothesis that robust growth in the U.S. economy can divert investment flows from emerging MECA countries to developed economies. This is evidence of the power of the U.S. economy and its prowess in attracting capital. This result complements the findings of Ugazio & Xin (2024) and Allegret et al. (2012), who also highlight the vulnerability of MECA economies to external shocks.

On the other hand, shocks to growth in the Chinese economy have a significant positive long-run impact of 0.95 on MECA GDP. In the graph in Appendix 4, we observe a steady increase in the cumulative response, with confidence bands above zero only for the first two years. In recent decades, China has increased its global presence, not only through the purchase of raw materials, but also through its aggressive foray into sectors such as energy, technology and tourism.

Commodity price shocks (CPI) have a positive and significant impact of 1.16 in MECA region. However, the graph in Appendix 4 only supports significance in the early years. Many MECA countries are large exporters of raw materials, particularly oil and gas, which increases fiscal revenues and promotes strong investments, positively impacting their GDP. This result is in line with studies by IMF (2022) and Sen et al. (2024), which highlight the relevance of economic diversification in the region.

Internal shocks to the MECA economy have a significant positive cumulative impact of 2.28 units, evidencing solid self-sufficiency and resilience in the face of adverse events. This is clearly reflected in the graph in Appendix 4, which shows a positive cumulative response, with confidence bands above zero.

Table 8. Estimation of the SVAR4 F matrix

	Prob.		Prob.		Prob.		Prob.
F11= 1.95	0.00	0		0		0	
F21= -0.01	0.99	F22= 4.43	0.00	0		0	
F31= -0.12	0.00	F32= -0.00	0.98	F33= 0.16	0.00	0	
F41= -2.10	0.00	F42= 0.95	0.02	F43= 1.16	0.00	F44= 2.28	0.00

Source: Own elaboration with estimates from official sources IMF and World Bank, Eviews 13.

Shocks to the U.S. economy have not been significant in the LAC region, while in the other regions they have been. This could indicate the low diversification of LAC economies, as well as their low growth rates, which do not encourage the long-term development of their different economic sectors. On the contrary, regions such as the European Union and ASIAN-5 translate in the long term the benefits of their economic ties with the United States, this shock being greater in ASIAN-5. As for MECA bloc, although the impact goes in the opposite direction, it does present significant evidence. On the other hand, shocks in China's economy have had a greater impact in the LAC region compared to MECA, while in ASEAN-5 they are not significant.

Chinese demand is very important for exports in many regions of the world, but in LAC, which specializes in exports of raw materials with low value added, it also represents a risk. In the European Union, China has a negative impact, which is evidence of the loss of European markets in recent decades, where its impact was previously significant.

Commodity price shocks are significant in LAC, ASEAN-5 and MECA, although there is no statistical evidence in the case of the US during the period analyzed. With respect to the potential for self-sustaining growth, MECA presents the highest long-run multiplier effect with 2.28, followed by ASEAN-5 with 1.90, LAC with 1.58 and the US with 0.63.

In conclusion, the results of this study present important coincidences and differences with the existing literature. In the case of LAC, a high dependence on China is confirmed, which is in line with Zhou (2023) and Berg (2022), although a higher vulnerability is observed due to its concentration on low value-added exports, in line with Sodeyfi & Katircioglu (2016).

On the other hand, the findings for ASEAN-5 differ from Lau & Po Lee (2008), as China's shocks are not significant, which reinforces the idea of economic diversification in the region, as argued by Hidthiir et al. (2024). As for the European Union, US shocks have a positive impact, which is consistent with Karuvalappil & Balakrishnan (2022), but China shocks show a negative effect, highlighting the loss of competitiveness noted by Sertić et al. (2023). In the MECA bloc, the negative impact of the US aligns with Ugazio & Xin (2024), while commodity price shocks highlight its dependence on commodities, in agreement with IMF (2022).

Additionally, MECA is confirmed to have the highest capacity for economic self-sufficiency (2.28), followed by ASEAN-5, which reinforces the idea of internal resilience to external shocks, in line with Sen et al. (2024).

5. Conclusions

The world's regional economies are exposed to different structural shocks that materialize in the long run. This research quantifies and compares the effects of shocks to U.S. GDP growth, Chinese GDP and *commodity* prices on the economic growth rates of four regions: i) Latin America and the Caribbean (LAC), ii) the European Union (EU), iii) ASEAN-5 and iv) Middle East and Central Asia (MECA). To this end, a SVAR model with long-run restrictions is estimated for each region, which allows us to identify the F matrix of each model. The results suggest, for the most part, that the economies of these regions are dependent on external shocks in the long run.

In particular, the results show that the EU, ASEAN-5 and MECA economies are particularly influenced in the long run by external shocks, associated with the US GDP growth rate. The SVAR F-matrix estimates reveal that the cumulative coefficient of the ASEAN-5 GDP growth rate has been the most positively affected by external shocks, while the EU GDP multiplier shows a smaller magnitude. In contrast, the effect on the MECA region has been negative.

Second, external shocks linked to China's growth rate have a significant cumulative impact on the LAC, EU and MECA regions. The estimates of the F matrix of the SVAR model show that the multiplier effect on the growth rate in LAC has had the largest positive magnitude, while the cumulative effect on the MECA GDP growth rate has been smaller. Conversely, the cumulative effect on the growth rate in the EU has been negative.

Third, the results show that the economies of the LAC, ASEAN-5 and MECA regions are especially influenced in the long run by external shocks associated with the growth rate of *commodity* prices. The SVAR F-matrix estimates show that the cumulative coefficient of the growth rate in the MECA region has had a larger positive magnitude, while the GDP multiplier in LAC has a smaller magnitude. In contrast, the cumulative effect has been negative and of large magnitude on the growth rate in the ASEAN-5 region.

The findings of this study represent a starting point for the implementation of modeling tools at a global level. Based on the SVAR models and the estimates obtained, it is possible to design different counterfactual scenarios or calculate elasticities, serving as a key reference to quantify the influence of global external shocks on economic growth in different regions of the world. Specifically, the endogenous variables used in the estimations are decisive in capturing the dynamics of these shocks, which makes it possible to extend the study to quantify multipliers in other geographical areas.

Finally, we consider the following lines of research to be relevant: i) to incorporate a lower periodicity in the sample used for the estimations; ii) to expand the study towards a GVAR model, to the extent that it allows capturing purely exogenous variables; iii) to expand the study sample to include economies such as India, Russia and Japan; and iv) to quantify the role of monetary and fiscal policies.

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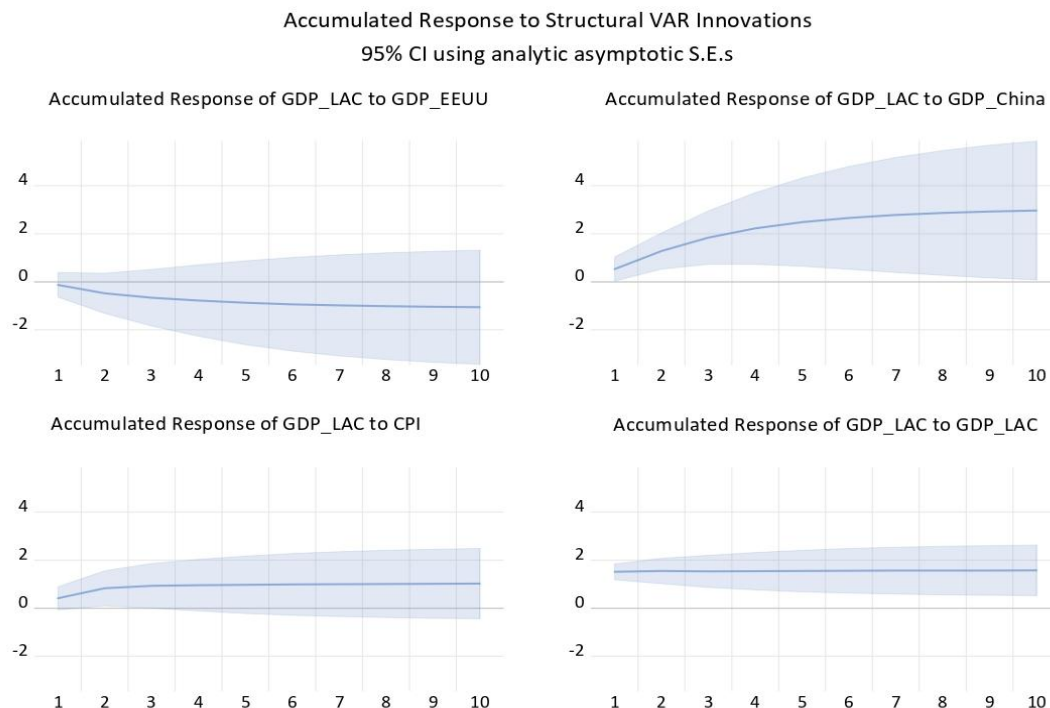[24] Maćkowiak, B. (2007). External shocks, US monetary policy and macroeconomic fluctuations in emerging markets. Journal of monetary economics, 54(8), 2512-2520. https://doi.org/10.1016/j.jmoneco.2007.06.021

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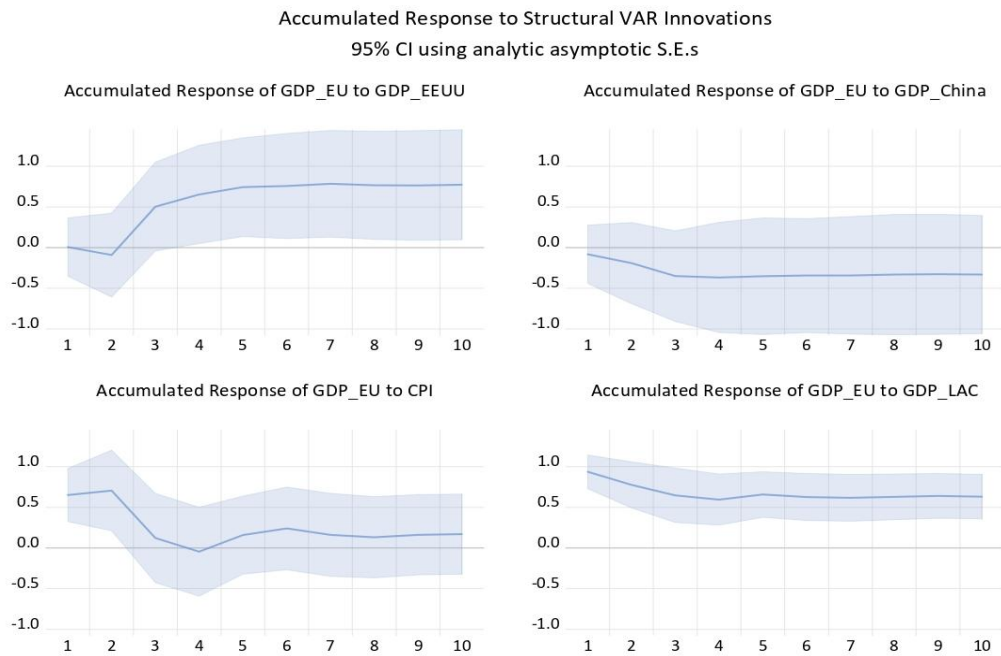
Appendices

Appendix 1.

Cumulative response of the GDP growth rate of Latin America and the Caribbean to external shocks

Accumulated Response to Structural VAR Innovations
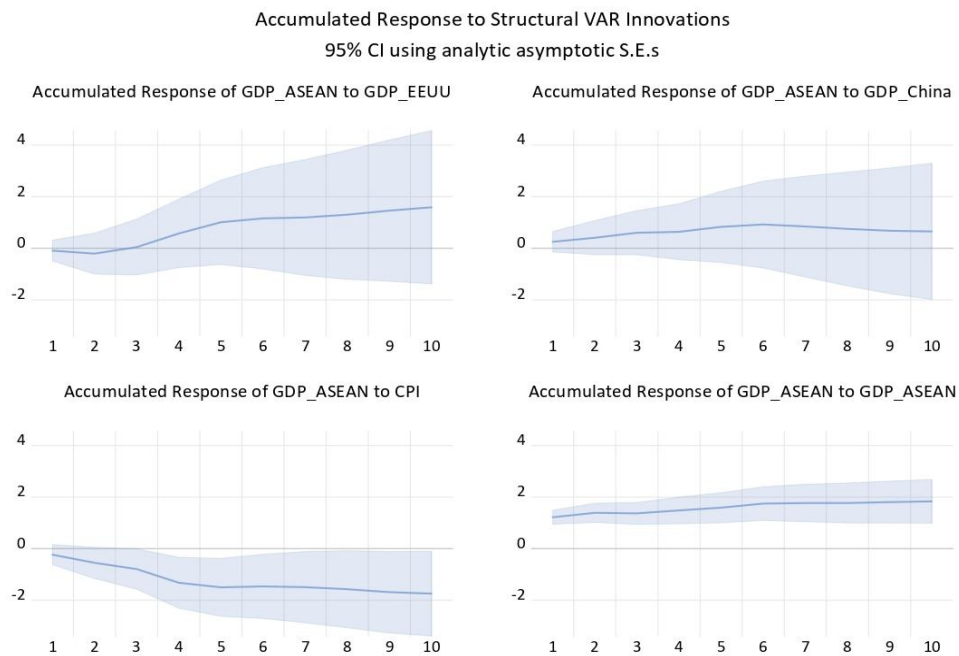95% CI using analytic asymptotic S.E.s

Appendix 2.

Cumulative response of the European Union's GDP growth rate to external shocks.

Appendix 3.

Cumulative response of ASEAN-5 GDP growth rate to external shocks.

Appendix 4.

Cumulative response of the GDP growth rate of the Middle East and Central Asia to external shocks.

Accumulated Response to Structural VAR Innovations
95% CI using analytic asymptotic S.E.s

Accumulated Response of GDP_MECA to GDP_EEUU

Accumulated Response of GDP_MECA to GDP_China

Accumulated Response of GDP_MECA to CPI

Accumulated Response of GDP_MECA to GDP_MECA