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Dynamic Impacts of U.S. Demand Shocks on Mexican and Vietnamese Exports to the United States: A Comparative Analysis Based on a VAR Model

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ABSTRACT

Amid U.S.–China trade tensions and pandemic-era disruptions, we compare how U.S. demand shocks affect Mexico's and Vietnam's exports to the United States. Using matched-frequency quarterly data, we estimate a bivariate VAR for each country with U.S. GDP (external demand proxy) and exports to the U.S., and assess dynamics via Granger tests, impulse responses, and forecast-error variance decompositions. Mexico shows a rapid and statistically significant export response to positive U.S. demand shocks, with effects peaking within a few quarters and non-trivial medium-horizon contributions in the FEVD. Vietnam's responses are small and mostly insignificant, and U.S. demand explains little of its near- to medium-term export variance. These side-by-side results derived under a unified identification and frequency document heterogeneous demand sensitivity consistent with near-/friend-shoring stages: tighter U.S.–Mexico supply chain coupling versus Vietnam's capacity- and organization-driven dynamics. The evidence informs policies to stabilize external-trade growth and calibrate upgrading paths in different integration settings.

KEYWORDS

Exports to the United States; VAR; Impulse response; Granger causality; Nearshoring

1. INTRODUCTION

Since 2018, the imposition of additional U.S. tariffs on Chinese goods and the heightened geopolitical uncertainty have significantly reshaped the geographical distribution of global trade and the organizational forms of global value chains. Existing research shows that U.S. tariff increases and their spillover effects have generated import substitution, trade diversion, and welfare redistribution, confirming the disruptive impact of protectionist resurgence on bilateral and multilateral trade structures [1]. At the same time, in response to policy frictions and cost pressures, firms have engaged in adaptive reconfigurations through supplier diversification, capacity relocation, and regionalized coordination [2], thereby accelerating the trends of nearshoring and friend-shoring. The global shock of the COVID-19 pandemic further triggered transport disruptions and shortages of intermediate inputs, underscoring the vulnerability of global value chains under extreme conditions and the amplification mechanisms of such shocks [3].

Against this backdrop, Mexico and Vietnam have emerged as two key countries in accommodating U.S. market demand and hosting the relocation of value chain functions. Mexico, supported by the institutional framework of North American regional integration and a well-developed automotive and

parts supply base, is better positioned to meet U.S. manufacturing needs. Vietnam, by contrast, has achieved rapid export expansion through foreign-investment-led electronics assembly industries and low-cost labor advantages [4,5]. However, whether the two countries respond symmetrically to changes in U.S. demand, whether the transmission mechanisms behind these responses are homogeneous, and the extent to which external shocks account for their export fluctuations remain underexplored. Building on the trade reconfiguration and global value chain propagation patterns revealed by the trade war and the pandemic, this paper seeks to conduct a comparative study of the two countries within a unified identification framework and provide empirical evidence.

During both the global financial crisis and the COVID-19 pandemic, existing studies have consistently highlighted the crucial role of aggregate demand in international trade fluctuations. Bems [6] find that declines in aggregate demand not only directly affect domestic output but also generate stronger trade shocks through demand spillovers and cross-country production linkages. Bonadio [3] further demonstrate that during the pandemic, the dense interconnections of global value chains amplified the adverse effects of demand and supply shocks, jointly deepening the downturn in trade and output. While these studies underscore the importance of external demand shocks, most focus on extreme episodes or global aggregate effects, with relatively less attention to the heterogeneous impacts across economies.

Although classical research [7] quantified Mexico's high dependence on North American demand under NAFTA using a general equilibrium framework, more recent studies point out that such structural dependence has not been substantially weakened amid institutional evolution and adjustments in market access [8]. According to statistics from the Office of the United States Trade Representative, more than 80% of Mexico's merchandise exports are destined for the U.S., reflecting its pronounced concentration and dependence on the American market. Gereffi [2] further emphasize the interaction between trade policy changes and firms' strategic choices, which has reinforced regionalization and nearshoring processes, thereby deepening Mexico's structural dependence on U.S. demand. Other studies also reveal close linkages between Mexico's manufacturing sector—particularly its automotive and parts industries—and U.S. demand through processing trade and cross-border component networks [9]. However, these studies largely concentrate on long-term structural effects, typically employing computable general equilibrium (CGE) or other structural models to characterize demand shocks, while offering limited insights into the short- to medium-term dynamics and their quantitative contributions.

By contrast, Vietnam's export expansion has been more strongly shaped by inflows of foreign direct investment (FDI), reliance on imported intermediates, and its assembly-based industrial structure. Lakshani [10] show that FDI and exports exhibit significant bidirectional linkages across different countries and regions, lending support to an FDI-driven, export-oriented growth mechanism. Within this context, Amiti [5] find that Vietnam's exchange rate pass-through is relatively weak, due to firm heterogeneity and high import content in production, implying that traditional price and cost shocks are often partially muted under an assembly-based structure. Similarly, further studies note that the transmission of external demand shocks to Vietnam's exports is constrained by supply bottlenecks, product quality stability, and delivery lead times [11], suggesting that Vietnam's short-term responsiveness to changes in U.S. demand is not significant, even though its long-term export growth remains highly dependent on external demand. Most existing literature approaches the issue from industrial-structural or firm-level perspectives, yet there remains a lack of systematic, frequency-aligned, and comparable quantification of how U.S. demand shocks are transmitted to Vietnam's exports in the short to medium term.

At the methodological level, vector autoregression (VAR) and structural VAR (SVAR) models have been widely applied to capture the dynamic interlinkages and shock transmissions among macroeconomic variables [12, 13]. Generalized impulse response functions and forecast error variance decompositions, without relying on strong identification assumptions, can effectively reveal the propagation paths of external shocks and their relative importance [14]. Existing empirical

evidence for Mexico shows that aggregate shocks from the U.S. can be significantly transmitted to its macroeconomic variables [9]. Therefore, this study incorporates U.S. GDP as a proxy for external demand into the VAR framework.

The existing literature generally suggests that external demand shocks, regional structures, and domestic factors are important determinants of export fluctuations. First, under crisis and pandemic conditions, contractions in external demand tend to exert significant negative impacts on international trade [3,6]. Second, within the framework of North American regional integration, Mexico demonstrates a high degree of dependence on U.S. demand [2, 7]. Finally, Vietnam's export expansion is constrained by its foreign-investment-led assembly structure and limited local supply capacity [4,5]. Nevertheless, two gaps remain in the current literature. First, there is a lack of direct comparative analysis between Mexico and Vietnam under a unified identification framework and frequency alignment. Second, existing evidence largely emphasizes long-term structural conclusions or aggregate-level analyses, with limited direct quantitative examinations of the short- to medium-term impacts of U.S. demand shocks on their exports to the U.S.

To fill this gap, this study constructs a parsimonious bivariate VAR system under consistent frequency treatment, using U.S. GDP to proxy external demand shocks. Combined with Granger causality tests, impulse response functions, and forecast error variance decompositions, the model identifies and compares the dynamic response patterns of Mexico's and Vietnam's exports to the U.S.

2. DATA AND METHODOLOGY

This paper adopts a standard vector autoregression (VAR) specification to characterize the dynamic interrelationships among multiple variables [12, 13]. To evaluate the transmission paths and relative contributions of shocks, generalized impulse response functions and forecast error variance decompositions are employed [14]. The direction of causality is identified through the classical Granger causality test [15]. The general form of the VAR model can be expressed as follows:

$$Y_t = c + A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + \varepsilon_t. \quad (1)$$

Here, Y_t denotes the vector of endogenous variables, including export volumes, exchange rate, U.S. demand, and dummy variables; A_i represents the parameter matrices to be estimated; p is the lag order; and ε_t denotes the stochastic disturbance term.

2.1. Econometric Procedures

Stationarity test: The Augmented Dickey–Fuller (ADF) unit root test is employed to ensure that the variables are stationary prior to modeling; differencing is applied where necessary.

Lag order selection: The optimal lag length is determined based on the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), and the Hannan–Quinn (HQ) criterion.

Model estimation: Once stationarity and lag length are established, the VAR model is estimated and Granger causality tests are conducted.

Impulse Response Function (IRF): This traces the dynamic response path of exports to shocks in exchange rates, U.S. demand, and other external disturbances.

Forecast Error Variance Decomposition (FEVD): This measures the relative contribution of each explanatory variable to the fluctuations in exports.

Through the above steps, this paper can systematically reveal the dynamic changes in the export volume of Mexico and Vietnam and its main driving factors.

2.2. Variable Processing and Baseline Model Specification

To focus on the dynamic impact of U.S. demand on the two countries' exports to the United States, this study constructs a bivariate VAR system using quarterly data on U.S. GDP (from the FRED database) and the export volumes of Mexico and Vietnam. The endogenous variables are the first-differenced logarithms of exports and U.S. GDP, $\Delta \ln \text{Exports}$, $\Delta \ln(\text{US GDP})$, with a constant term included. The original series are transformed by taking logarithms and applying first differences. The Augmented Dickey–Fuller (ADF) unit root tests confirm that the differenced series are stationary (Table 1), thereby satisfying the prerequisites for VAR modeling. The lag order is selected based on the Bayesian Information Criterion (BIC/SC): four lags for Mexico and one lag for Vietnam (Table 2). Subsequent identification employs Granger causality tests, impulse response functions (IRFs), and forecast error variance decompositions (FEVDs). For the IRFs, a bootstrap method is used to construct 95% confidence intervals, mitigating potential biases in interval width caused by the relatively small sample size and deviations from normality.

Table 1. ADF Unit Root Test (First-Differenced Logarithms)

Country	Variable	ADF Statistic	P Value	Conclusion
Mexico	$\Delta \ln \text{Exports}$	-3.86	0.03	Stationary
Mexico	$\Delta \ln(\text{US GDP})$	-5.91	0.01	Stationary
Vietnam	$\Delta \ln \text{Exports}$	-4.85	0.01	Stationary
Vietnam	$\Delta \ln(\text{US GDP})$	-5.91	0.01	Stationary

Table 2. Lag Order Selection

Country	Criterion	Optimal Lag Order
Mexico	SC (BIC)	4
Vietnam	SC (BIC)	1

3. EMPIRICAL RESULTS

3.1. VAR Estimation and Granger Causality

As shown in Table 3, the estimation results indicate a bidirectional Granger causal relationship between exports and U.S. GDP in the Mexican sample. In the case of Vietnam, U.S. GDP does not Granger-cause exports ($F = 0.043$, $p = 0.836$), nor is the reverse causality from exports to U.S. GDP significant. For both countries, the presence of instantaneous correlation suggests the influence of high-frequency synchronous shocks or common information sets.

Table 3. Granger Causality Test

Country	Null Hypothesis (H_0)	F	P Value	Conclusion
Mexico	$US\ GDP \nRightarrow Exports$	2.85	0.04	Reject H_0
Mexico	$Exports \nRightarrow US\ GDP$	3.24	0.03	Reject H_0
Vietnam	$US\ GDP \nRightarrow Exports$	0.04	0.84	Do not reject H_0
Vietnam	$Exports \nRightarrow US\ GDP$	2.67	0.11	Do not reject H_0

3.2. Impulse Response Functions

Figures 1 and 2 illustrate the dynamic effects of a positive shock to U.S. GDP on the two countries' exports to the United States, with 95% bootstrap confidence intervals provided to assess statistical significance.

For Mexico, the response is significantly positive and persistent: it peaks within 1–2 quarters following the shock, then gradually declines, converging to zero after approximately 3–4 quarters. The confidence intervals remain above the zero line during the initial half of the response, indicating that the positive effect is statistically robust. This suggests that U.S. demand and inventory cycles can be transmitted relatively quickly to Mexican exports.

In contrast, Vietnam's responses are smaller in magnitude and mostly insignificant: the immediate reaction to shocks is weak, the decline is faster, and the confidence intervals frequently cross the zero line. This pattern is consistent with Vietnam's FDI-led assembly structure, limited local supply capacity, and longer delivery lead times, which together act as supply-side constraints. In such a setting, external demand shocks must pass through capacity and organizational "filters" before translating into deliverable exports, thereby dampening short-term responses.

Further calculations of the cumulative impulse responses (CIRFs) show that Mexico exhibits a significantly positive cumulative effect of U.S. demand shocks, while Vietnam's cumulative effect is statistically insignificant. These results corroborate the Granger causality findings in Section 3.1: Mexico is more sensitive to external demand fluctuations, whereas Vietnam's exports are more strongly shaped by domestic and structural factors.

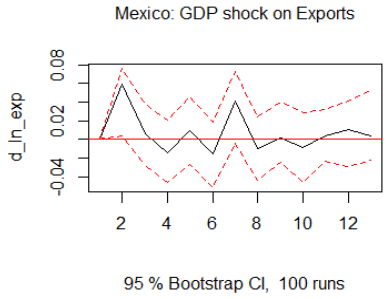

Figure 1. Impulse Response of Mexican Exports to a U.S. GDP Shock (95% Bootstrap CI)

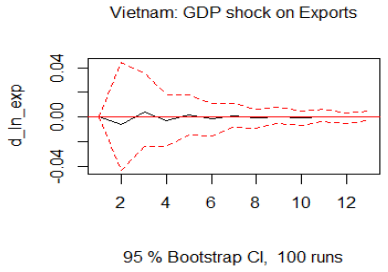

Figure 2. Impulse Response of Vietnamese Exports to a U.S. GDP Shock (95% Bootstrap CI)

3.3. Forecast Error Variance Decomposition (FEVD)

As shown in Figures 3 and 4, the upper panels present the forecast error variance decomposition of export growth, indicating the shares of future export fluctuations explained by own shocks versus U.S. GDP shocks. The lower panels depict the variance decomposition of U.S. GDP growth, serving primarily as a consistency check within the system, which generally shows that U.S. GDP fluctuations are predominantly driven by its own shocks. This study focuses on the upper panels, while the lower panels provide complementary reference information.

For Mexico, the explanatory power of U.S. GDP shocks for export fluctuations rises steadily with the forecast horizon: it is relatively low during the first 1–4 quarters, then gradually increases and stabilizes around 15%–20% in quarters 8–12. This indicates that the transmission of demand signals involves a notable time lag, becoming more prominent over longer horizons. The evidence is

consistent with the IRF results in Section 3.2, where the peak occurs within 1–2 quarters and persists for 3–4 quarters, reflecting high responsiveness and relatively short supply chains under North American integration.

In the case of Vietnam, the share of export forecast error variance explained by U.S. GDP shocks remains below 0.2% for all horizons h=1–12, consistently at an extremely low level. This suggests that fluctuations in Vietnam's exports to the U.S. are almost entirely driven by domestic shocks, with external demand changes contributing minimally to forecast errors in the short to medium term. Combined with the insignificant IRF and Granger causality results, it can be inferred that the short-term transmission of external demand shocks in Vietnam is obstructed and limited in magnitude, making it difficult to generate significant incremental export effects.

The distributional differences in the FEVD provide quantitative evidence of the heterogeneous stages of nearshoring. Mexico can be characterized as demand-dependent, where external demand shocks exert a non-negligible explanatory power in the medium term. Vietnam, by contrast, remains domestically driven, with its export fluctuations more reliant on capacity expansion, order organization, and product quality consistency. For Mexico, it is therefore crucial to monitor demand cycles and optimize product categories and order structures to smooth fluctuations. For Vietnam, the priority lies in shortening delivery lead times, enhancing local component supply and quality stability, so as to improve the accessibility and conversion efficiency of external demand signals.

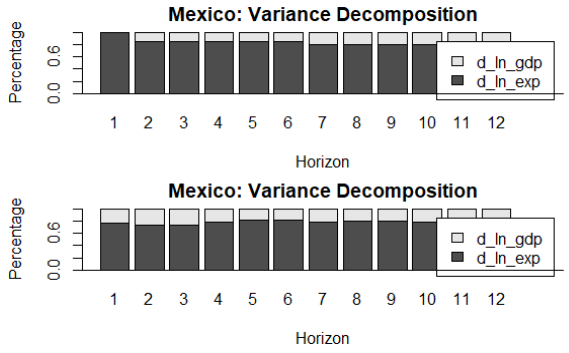

Figure 3. Variance Decomposition of Mexican Exports

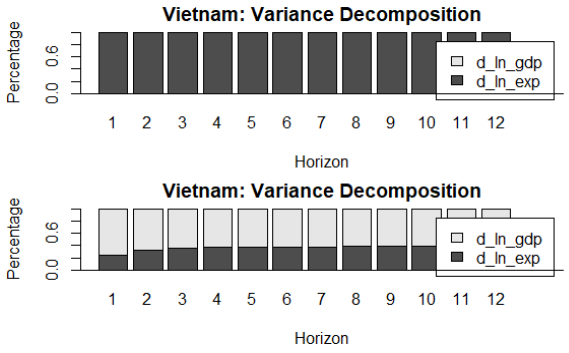

Figure 4. Variance Decomposition of Vietnamese Exports

4. CONCLUSION AND POLICY IMPLICATIONS

Using a bivariate VAR—triangulated with Granger causality tests, generalized impulse responses, and forecast-error variance decompositions (FEVD)—this paper develops a common design that allows side-by-side comparison of the dynamic link between U.S. demand and the exports of Mexico and Vietnam to the United States. The results show a clear divergence: Mexico's exports react faster and more strongly to changes in U.S. demand, whereas Vietnam's export fluctuations are dominated

by domestic supply and organizational factors, with only a modest marginal role for U.S. demand. Over the short to medium horizon, positive U.S. demand shocks elicit statistically significant and persistent responses in Mexico, and demand factors account for a larger share of its export variance. By contrast, Vietnam's immediate responses are generally insignificant, and its volatility is shaped more by internal and structural drivers. These patterns are consistent with different integration stages under near-/friend-shoring: Mexico's supply chains are more tightly coupled with the U.S. market, whereas Vietnam remains earlier in the transition, focused on capacity building and strengthening local linkages.

For Mexico, the central challenge is to manage risks from U.S. demand cycles. Because exports respond quickly and persistently to U.S. demand, the U.S. business cycle transmits strongly to Mexico's exports and employment through external-demand channels. Policy should avoid direct production allocation and instead rely on rule-based, countercyclical trade and financial instruments that buffer negative spillovers and speed up the conversion of positive demand into realized exports. Concretely, external-demand indicators can be embedded in fiscal and policy-bank automatic stabilizers. When external demand weakens, measures include automatic expansions of export credit and insurance, faster processing of export tax rebates and VAT refunds, and temporary reductions in guarantee fees for outward-oriented SMEs—limiting cash-flow strains that would otherwise depress supply. When demand is strong, time-limited expedited customs procedures, port facilitation and priority lanes, and extended operating hours help translate orders into shipments rapidly. Under USMCA, deeper alignment with rules of origin and local-value-added provisions can retain a larger share of cyclical gains domestically. At the exchange-rate level, maintaining flexibility while broadening affordable hedging access reduces firms' financial exposure to external-demand swings. Finally, destination and product diversification should be treated as public policy objectives, with sustained support from the official export-promotion system for non-U.S. market development.

For Vietnam, the IRF and FEVD results indicate that external demand has limited short-term predictability and dynamic impact on exports, with domestic supply and organizational shocks playing the dominant role. Therefore, policy discussions should shift from stimulating demand to enhancing the efficiency of external demand transmission—improving supply-side conditions by reducing transaction costs and internal delays. On the trade system side, priority should be given to trade facilitation reforms to compress institutional clearance times and reduce uncertainty. On the public services side, compliance entry barriers should be lowered to shorten the institutional steps from order acquisition to deliverability. To avoid policies becoming merely declarative, a verifiable evaluation framework should be introduced, with fixed rolling-window VARs re-estimated regularly, clear performance indicators established, and sequential adjustments made to trade facilitation, supplier development, and public service inputs accordingly. Overall, the policy focus should not be on directly expanding external demand, but on reducing institutional frictions, shortening delivery lags, and strengthening local supply capacity, so that external demand signals can be more effectively converted into sustainable export growth.

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