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The Trump tariffs and intraday risk spillovers in the global financial markets

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Abstract

This paper empirically investigates the impact of the Trump tariffs announced on April 2 on intraday risk spillovers across global financial markets. We estimate the intraday volatility spillover index using a TVP-VAR model with five-minute data from major global financial markets. Our results show that Trump tariffs and the ensuing US-China trade conflict impact intraday volatility spillovers across stocks, foreign exchange, commodities, and cryptocurrency markets. Moreover, volatility spillovers peak on days when multiple countries announce tariff-related policies simultaneously. It is also evidenced that net volatility spillovers across the four markets changed after the Trump tariffs announcement, with particularly significant changes in the foreign exchange market. The empirical results suggest that US policies perceived as aggressive toward other nations, along with the retaliatory measures they provoke, heighten market volatility and intensify risk spillovers in global financial markets.

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1. Introduction

Financial markets are highly sensitive to policy changes, particularly those introduced by the United States, the world's largest economic powerhouse. This paper investigates the impact of policy changes enacted by U.S. President Trump on the transmission of intraday risk across global financial markets, specifically focusing on the 'baseline tariff' and 'reciprocal tariffs' announced on April 2, 2025 (Trump tariffs) and the resulting US-China trade conflict.

Recent empirical studies have explored the impact of the Trump tariffs on financial markets. Kaczmarek et al. (2025) finds that stock markets in 67 economies experienced substantial declines following the tariff announcement, primarily driven by a combination of direct trade risks and long-term structural factors, with the latter playing the dominant role. Benguria and Saffie (2025) show that stock price declines in countries with bilateral trade deficits with the United States were largely driven by market expectations. Using the event-study method, Al-Kharusi and Elroukh (2026) also document significant negative abnormal returns in global stock markets following the “Liberation Day” tariff announcement. Other studies further show that the Trump tariffs adversely affected firm-level valuations for trade-exposed firms (Hu et al., 2026; Piserà et al., 2025), firm-level stock liquidity (Fatemi et al., 2025), as well as the Chinese stock market (Wang et al., 2025).

However, the literature examining risk spillovers among financial markets around the time of the Trump tariff announcement remains limited. Bouri et al. (2025) employ higher-order co-moment contagion tests to assess the financial contagion effects of Trump tariffs by comparing pre- and post-tariff periods to evaluate the impact of US trade policy uncertainty on global assets. Kapar et al. (2025) further combine volatility-based analysis with connectedness and network tools to demonstrate that the tariff announcement increased short-term interdependence across major stock markets. These findings suggest that the risk spillover effect among global financial markets increased following the tariff announcement, but it remains unclear which markets exert influence over others. Moreover, because the comparison focuses on a specific period before and after the tariffs, it is also uncertain which days saw intensified spillover effects and what factors contributed to this increase.

This paper employs the intraday volatility spillover index method (IVSI) of Nishimura and Sun (2018), using five-minute data from major global financial markets (stocks, foreign exchange, commodities, and cryptocurrency) to examine how the Trump tariffs and the US-China conflict affected cross-asset intraday volatility spillovers. Furthermore, we extend this method by introducing a time-varying parameter vector autoregression model (TVP-VAR) to capture the dynamic characteristics of volatility spillovers across financial markets during turbulent periods, consistent with recent studies using TVP-VAR (Goel et al., 2025; Fukuda, 2025). This approach is important because average spillover measures may obscure time variation in market connectedness and shifts in transmitter–receiver roles around major policy announcements, while TVP-VAR avoids the sensitivity associated with rolling-window estimation (Antonakakis et al., 2020).

2. Methodology

2.1. Analytical steps

The IVSI method consists of the following three steps. First, intraday periodicity[1] is eliminated from the original data through the application of the flexible Fourier form (FFF) regression method.[2]

Second, the intraday volatility series is estimated using the FIGARCH (Fractionally Integrated GARCH) model developed by Baillie et al. (1996), which accounts for long-memory characteristics.

Third, for each trading day, the five-minute log-volatility series from multiple global financial markets operating within overlapping trading periods are combined to construct the TVP-VAR model, which is then applied to calculate the spillover index for that day. In this way, each daily spillover measure is constructed from intraday volatility observations within that day, preserving the information content of high-frequency volatility dynamics while allowing day-by-day comparison across markets.

2.2. Intraday volatility spillover index

This subsection utilizes the spillover table (Table 1) to intuitively explain the estimation of the intraday volatility spillover index among *N* markets on trading day *t*.[3] The upper-left $N \times N$ matrix contains the *H*-step-ahead generalized forecast error variance decomposition (GFEVD) derived from the TVP-VAR framework, ensuring order invariance in the spillover measures.[4] Specifically, $d_{t,ab}^{H}$ represents the contribution of shocks in Market *b to the H*-step-ahead forecast error variance of Market *a* on trading day *t*, and each (*a*, *b*) entry represents the spillover from Market *b* to Market *a*. A larger value indicates a stronger volatility spillover effect.

Table 1. Intraday Spillover Table Schematic.

	Market 1	Market 2	$\cdots$	Market *N*	FROM others
Market 1	$d_{t,11}^{H}$	$d_{t,12}^{H}$	$\cdots$	$d_{t,1N}^{H}$	$FROM_{t,1\leftarrow\bullet}^{H}$
Market 2	$d_{t,21}^{H}$	$d_{t,22}^{H}$	$\cdots$	$d_{t,2N}^{H}$	$FROM_{t,2\leftarrow\bullet}^{H}$
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$
Market *N*	$d_{t,N1}^{H}$	$d_{t,N2}^{H}$	$\cdots$	$d_{t,NN}^{H}$	$FROM_{t,N\leftarrow\bullet}^{H}$
TO others	$TO_{t,\bullet\leftarrow 1}^{H}$	$TO_{t,\bullet\leftarrow 2}^{H}$	$\cdots$	$TO_{t,\bullet\leftarrow N}^{H}$	Total spillover
NET	$NET_{t,1}^{H}$	$NET_{t,2}^{H}$	$\cdots$	$NET_{t,N}^{H}$	$TOTAL_{t}^{H}$

The figures in the final column, labeled 'FROM others' represent the total directional spillover index from others to Market *a*, and define it as follows:

$$FROM_{t,a\leftarrow\bullet}^{H} = \sum_{\substack{b=1 \\ b\neq a}}^{N} d_{t,ab}^{H} \times 100 \tag{1}$$

[1] Failing to account for intraday periodicity in high-frequency data analysis can lead to bias, thereby undermining the accuracy of statistical inference (Andersen and Bollerslev, 1997; Dominguez, 2006).

[2] For more information on FFF, see Andersen and Bollerslev (1997).

[3] For details on the estimation process of volatility spillover index, see Diebold and Yilmaz (2012, 2014).

[4] Supplementary tests indicate that the log conditional volatility series are stationary and that the TVP-VAR system remains stable throughout the sample; detailed results are available upon request.

Similarly, the figures in the row labeled 'TO others' display the total directional spillover index from Market *b* to others as

$$TO^{H}_{t,\bullet\leftarrow b} = \sum_{\substack{a=1 \\ a\neq b}}^{N} d^{H}_{t,ab} \times 100 \quad (2)$$

And the row labeled 'NET' indicates net total directional spillover index as follows:

$$NET^{H}_{t,a} = S^{H}_{t,\bullet\leftarrow a} - S^{H}_{t,a\leftarrow\bullet} \quad (3)$$

The figures in the bottom-right corner of the table represent the total spillover index, which quantifies the transmission of volatility across all markets on trading day *t*, and it is defined as

$$TOTAL^{H}_{t} = \frac{\sum_{\substack{a,b=1 \\ a\neq b}}^{N} d^{H}_{t,ab}}{\sum_{a,b=1}^{N} d^{H}_{t,ab}} \times 100 = \frac{1}{N}\sum_{\substack{a,b=1 \\ a\neq b}}^{N} d^{H}_{t,ab} \times 100 \quad (4)$$

3. Data

We use the 5-minute returns on the MSCI World Index (STOCK), the US Dollar Future Index (FX), the Bloomberg Commodity Index (COM), and the Bloomberg Bitcoin Index (CRYPTO). The sample period covers November 4, 2024, to April 30, 2025. Table 2 shows detailed information on these markets.[5]

Table 2. Trading Days, Hours and Intraday Observations

	STOCK	FX	COM	CRYPTO
Trading days	127	126	122	121
Trading time	0:00 20:20	0:45 21:25	3:00 19:15	23:15 19:55
Intraday observations	245	249	196	249
Total samples	31115	31374	23912	30129

Table 3 summarizes the descriptive statistics of five-minute returns, adjusted to eliminate intraday periodicity.[6] Notably, the Ljung-Box statistics for squared returns (LB^{2}_{50}) exhibit exceptionally large values, confirming the presence of strong autocorrelation. It is indicated that intraday volatility follows a long-memory process, which is one of the main reasons for us to use the FIGARCH model in this study.

Table 3. Descriptive Statistics

	STOCK	FX	COM	CRYPTO
Mean	0.031	-0.017	0.011	0.133
Std. Dev.	0.049	0.034	0.051	0.183

[5] All high-frequency trading data comes from Bloomberg.

[6] For details on the elimination process of intraday periodicity, see Appendix A.

Skewness	2.672	0.136	0.176	-0.13
Excess Kurtosis	117.88	52.417	28.538	11.449
LB_{50}	1087.71	137.65	206.21	58.04
LB^2_{50}	19661.6	2351.7	10046.5	8933.2

Notes: The Ljung-Box test statistics, denoted as LB_{50} and LB^2_{50}, are employed to assess the presence of serial dependence in the five-minute return series and their squared values over 50 lags, respectively. The mean is multiplied by 100.

4. Empirical Analysis

4.1 Static Analysis

First, we estimate the conditional variance using the ARMA-FIGARCH model and then extract data corresponding to the overlapping trading hours of the four markets. [7] The trading hours in this study extend from 3:00 to 19:15 (GMT), generating 196 five-minute volatility observations per day. These values are subsequently used to compute the volatility spillover index for each day.

Table 4a reports the average estimated IVSI results across the four markets during the full sample period, which are derived from the TVP-VAR model. [8] Based on the FROM and TO indices, their connectedness with other markets is stronger in the stock and FX markets. Meanwhile, the NET index indicates that the stock market acted as a net transmitter of volatility to other markets, while the cryptocurrency markets operated as net receivers of volatility. The table's lower-right corner displays the TOTAL index, which for the sample period is 23.84%.

We also calculate the average spillover index for the subsample period following the Trump tariffs (Table 4b). The TOTAL index is 24.00%, which is nearly identical to the value for the full sample period. However, the idea that significant changes in U.S. trade policy did not influence the volatility spillover across global financial markets is counterintuitive. One possible explanation is that although the Trump tariffs had a significant impact on the market, the resulting shocks dissipated quickly. Another consideration is that the post-announcement subsample is relatively short, which may limit the ability of average volatility spillover measures to capture short-lived but economically important spikes in connectedness. In the next subsection, we present a more detailed analysis and discussion of this phenomenon.

Table 4. Intraday Volatility Spillover Index

(a) *Full sample* ($T = 119$)

	STOCK	FX	COM	CRYPTO	FROM others
STOCK	73.65	11.28	7.63	7.44	26.35
FX	11.79	74.83	6.78	6.60	25.17

[7] See the Appendix B for estimation results of ARMA-FIGARCH model.

[8] All spillover indexes in this study are calculated using a lag order of 5 and a forecasting horizon of 10 periods. The lag order is selected based on the Akaike information criterion (AIC). To assess robustness, we also computed the IVSI under various lag orders (ranging from 1 to 5) and forecasting horizons (10 and 20), consistently obtaining similar results across specifications.

COM	8.08	6.93	78.87	6.12	21.13
CRYPTO	8.73	6.54	7.43	77.30	21.13
TO others	28.59	24.76	21.85	20.15	Total spillover
NET	2.24	-0.41	0.72	-2.55	23.84

(b) *After Trump Tariffs* ($T = 20$)

	STOCK	FX	COM	CRYPTO	FROM others
STOCK	78.85	6.81	7.90	6.45	21.15
FX	8.32	77.38	7.30	7.00	22.62
COM	8.84	7.10	74.88	9.18	25.12
CRYPTO	11.17	6.09	9.87	72.88	27.12
TO others	28.33	19.99	25.06	22.62	Total spillover
NET	7.18	-2.63	-0.06	-4.50	24.00

Notes: The variance decomposition is obtained based on a TVP-VAR model with a 10-step forecast horizon. In the upper-left 4×4 submatrix, the element at position (a, b) captures the pairwise directional spillover transmitted from market b to market a. The final column reports the "FROM others" indicator, aggregating all incoming spillovers to market a, while the penultimate row displays the "TO others" measure, summarizing spillovers originating from market a to all other markets. The overall spillover intensity is summarized in the lower-right cell as the total spillover index. Given that the spillover index is calculated daily using intraday data, we obtain 119 individual spillover tables. The final table summarizes these by taking their average.

4.2. Dynamic analysis

Although Table 4 presents the average spillover effect, it may not fully reflect the essential dynamic characteristics of volatility spillovers across markets. To address this, we illustrate the time-series changes in the spillover index to analyze the dynamic impact of Trump tariffs on volatility spillovers.

Figure 1 illustrates the daily TOTAL index along with its 5-day moving average before and after the Trump tariffs announcement day, covering a one-month period. Overall, the spillover index exhibits numerous spikes, indicating that the intensity of volatility spillovers between markets fluctuates daily. Since April 2, the moving average has exhibited an upward trend, suggesting that the Trump tariffs have heightened risk spillover among global financial markets.[9]

[9] Supplementary pre- and post-announcement comparison tests support this interpretation; detailed results are available upon request.

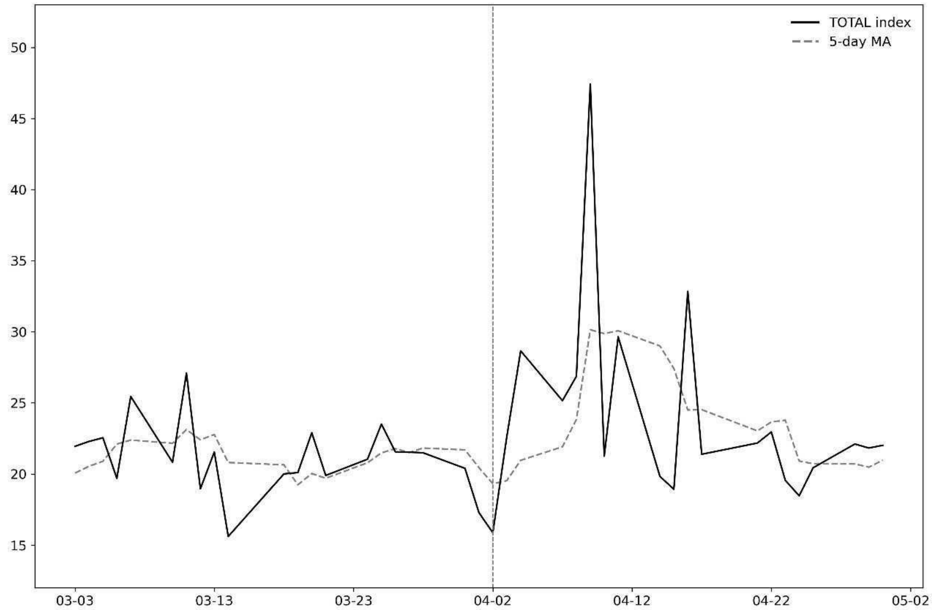

Figure 1. **Total Volatility Spillovers**

Notes: Vertical dashed line marks the Trump tariffs announcement on April 2, 2025.

Below, we analyze the situation on individual days. The spillover index is not high on the day of the Trump tariffs (15.87%). This is because the actual announcement was made at 19:00 GMT, at a time when some markets were already closed and thus fell outside the sample period of our study. The index rose to 22.6% the next day and increased further on April 4 (28.66%), when the Chinese government announced an additional 34% tariff on all imports from the U.S. In response, on April 8, President Trump issued an Executive Order raising the tariff rate on China from 34% to 84% and increasing tariffs on low-value goods. The spillover index on that day was 26.87%.

The highest spillover index (47.43%) across all sample periods was recorded on April 9, the day when 'reciprocal tariffs' officially took effect. On the same day, important information on tariffs was disseminated from several countries. The EU and China announced countermeasures against the Trump tariffs, while President Trump announced a 90-day suspension of 'reciprocal tariffs' for several countries, excluding China. Consequently, the release of multiple significant tariff-related announcements is believed to have triggered a surge in market volatility, thereby intensifying spillovers across global financial markets.

The spillover index peaked on April 9 before entering a downtrend. On April 11, the Chinese government raised tariffs on the U.S. from 84% to 125%, stating that no further action would be taken if the U.S. increased tariffs on China. With the suspension of 'reciprocal tariffs' by the U.S. and the resulting easing of tensions in the US-China conflict, the market gradually stabilized.

4.3. Net volatility spillover

This subsection examines the net spillovers between markets over the one month before and after the Trump tariffs announcement. Figure 2 separately shows each market's daily NET index and their 5-day moving averages. Overall, net spillovers have changed since the Trump tariffs began to affect all markets. Specifically, the stock and commodity markets functioned as net transmitters of volatility to other markets, while the FX and cryptocurrency markets served as net receivers of volatility following the Trump tariffs announcement. A plausible interpretation is that tariff shocks altered exchange-rate expectations and global trade adjustment pressures, causing the FX market to absorb volatility originating in commodity and broader risk-sensitive asset markets. This phenomenon was particularly pronounced during the 10 trading days after the announcement, when the TOTAL index reached a notably high level (see Figure 1).

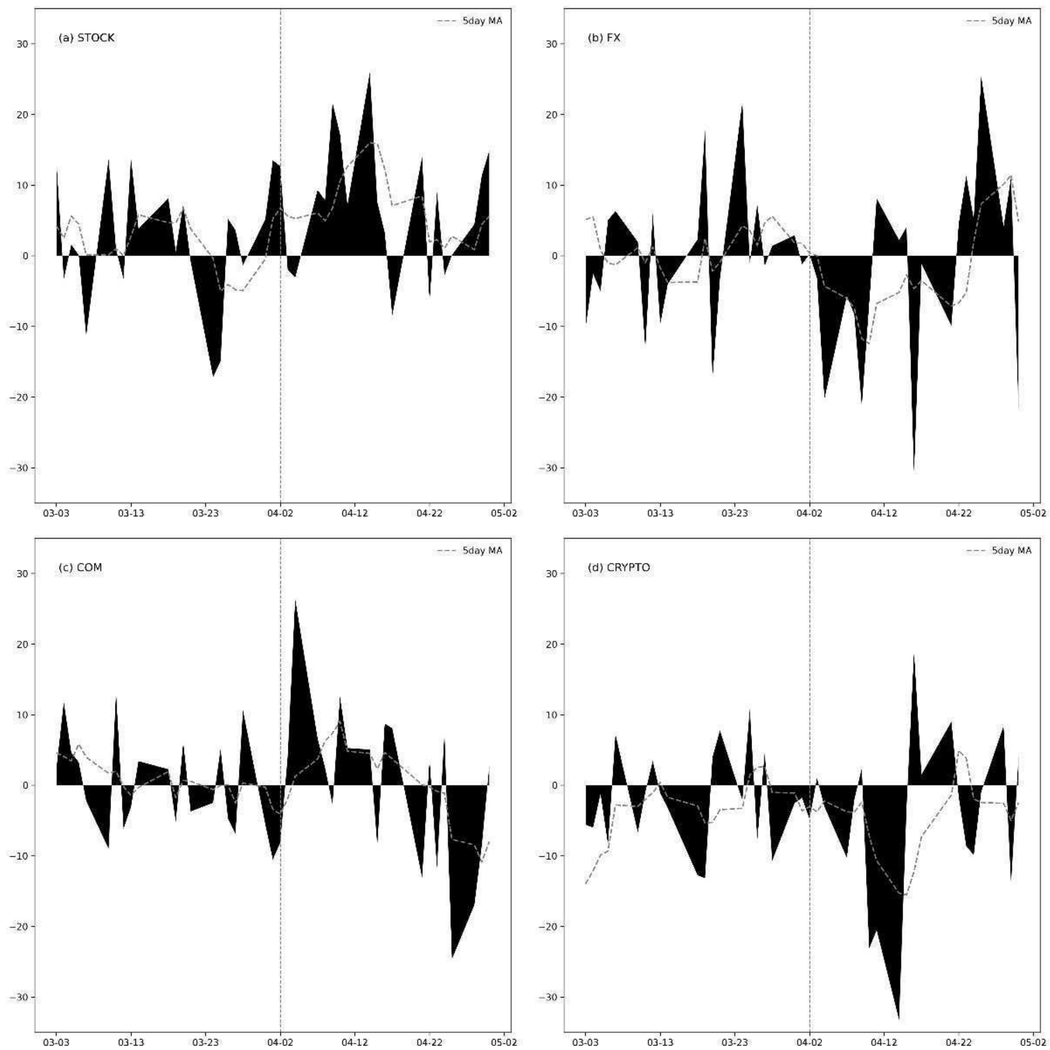

Figure 2. Net Directional Spillovers

Notes: Vertical dashed line marks the Trump tariff announcement on April 2, 2025.

Finally, we compare the net pairwise spillover network across all market pairs in the pre- and post-Trump tariffs periods (Figure 3)[10]. Compared to the pre-period, net pairwise spillover effects across all markets increased during the post-period. The most notable changes are observed in the FX market. While the FX market was a net transmitter of volatility to the

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[10] We compute and compare the average net pairwise spillovers. Note that the post-Trump tariffs period covers a 10-day trading period since April 2, as outlined in the previous analysis. The numerical results are reported in Appendix C.

commodity and cryptocurrency markets in the pre-period, it became a net receiver of volatility shocks from these markets in the post-period. These results suggest that tariff-related policy announcements not only increased overall spillovers but also changed the transmission roles of individual markets.

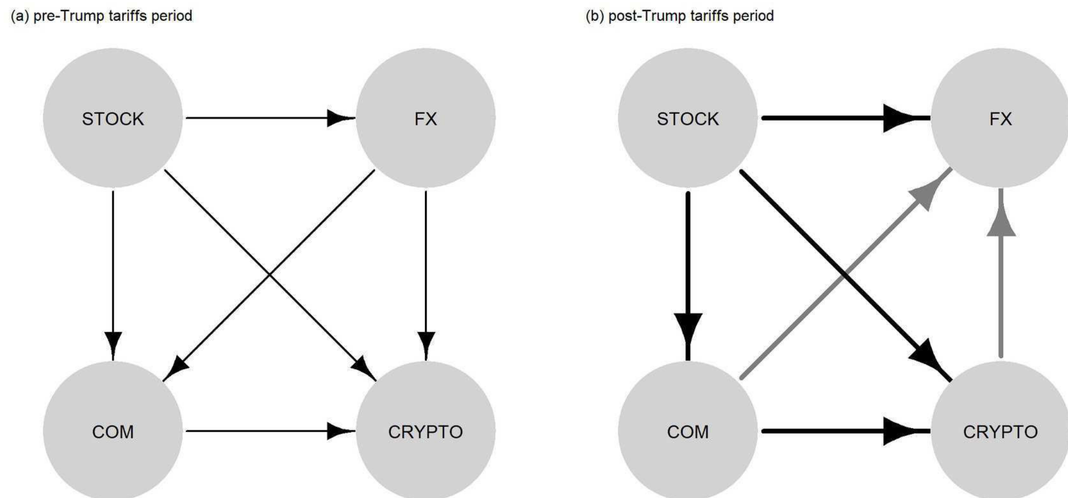

Figure 3. Net Pairwise Directional Volatility Spillover Network

Notes: The direction of the arrow represents the net directional spillover from one market to another. Gray arrows denote a shift in the direction of net directional spillover, while bold lines indicate an increase in spillover effect.

5. Conclusion

We analyze the impact of Trump tariffs on cross-asset risk spillover effects in global financial markets, employing an extended analytical framework based on the IVSI approach.

Our empirical findings contribute to the existing literature in the following ways. First, our results show that the volatility spillover index has risen following the April 2 Trump tariff announcement. This indicates that major trade policy changes enacted by the world's largest economic powerhouse can significantly affect intraday volatility spillovers across global financial markets.

Second, our research finds that the volatility spillover index reaches its highest levels on days when multiple countries simultaneously announce tariff-related policies. In other words, the dissemination of significant policy-related information is believed to increase volatility, thereby strengthening linkages between financial markets.

Third, we discover that the net volatility spillovers from/to each of the four markets have changed after the announcement of the Trump tariffs. The changes in the FX market were particularly significant. Initially, it functioned as a net transmitter of volatility but later became a net recipient, suggesting that exchange rates increasingly absorbed cross-market shocks during the trade conflict. This phenomenon was particularly pronounced during the 10 days following the announcement, as total volatility spillover increased.

Overall, our findings suggest that trade policy shocks not only increase overall interconnectedness but can also change the transmission roles of different asset classes. In this sense, the paper contributes to the spillover literature by providing high-frequency evidence that policy announcements can reshape transmitter–receiver relationships across markets.

Our study is based on the analysis of high-frequency data. This analytical framework can be further expanded to examine other events that may influence capital flows in global financial markets. For instance, outbreaks of infectious diseases and heightened geopolitical risks are also compelling subjects for future research.

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