The Immediate Global Impact of US Monetary Policy

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Abstract

We measure international monetary policy spillovers using US-traded country ETFs, which provide real-time price discovery for foreign equity markets during Federal Reserve announcements. A geographic discontinuity validates our approach: ETF returns predict overnight index gaps only for markets closed during the announcement. A typical contractionary surprise generates immediate, universally negative spillovers, destroying approximately $280 billion in foreign equity value within thirty minutes. This transmission appears in every country examined, regardless of exchange rate regime, development level, or capital account openness. The unanimity and speed of these effects provide high-frequency evidence consistent with a global financial cycle Rey (2015) driven by US monetary policy.

Keywords: International Spillovers, High-Frequency Identification, Exchange-Traded Funds (ETFs), Central Bank Information Shocks, Global Financial Cycle

JEL Classification: E52, F36, F42, G14, G15

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1. Introduction

The transmission of U.S. monetary policy is arguably the most significant driver of global financial conditions. Theoretical frameworks, notably the global financial cycle hypothesis, predict that Federal Reserve actions propagate rapidly across international markets, influencing risk premia and capital flows worldwide (Rey 2015, Miranda-Agrippino and Rey 2020). The economic stakes of this transmission are substantial. Given a non-U.S. equity market capitalization exceeding $65 trillion, a typical one-standard-deviation contractionary surprise by the Fed—which we estimate causes an immediate 0.47 percent decline in foreign equities—implies an aggregate wealth reduction of approximately $300 billion within thirty minutes. Despite this theoretical importance and economic magnitude, empirical measurement of these immediate spillovers faces significant challenges. Studies relying on daily data often report low explanatory power, typically explaining less than 10 percent of the variation in foreign equity returns around Federal Open Market Committee (FOMC) announcements, and sometimes yield conflicting results (Ehrmann and Fratzscher 2009, Ammer, Vega, and Wongswan 2010, Hausman and Wongswan 2011). This gap between theoretical predictions and empirical performance raises a natural question: does US monetary policy genuinely transmit weakly to foreign markets, or does the measurement approach itself obscure stronger underlying effects?

I argue that this disconnect between strong theoretical priors and noisy empirical results stems not from weak transmission, but from a fundamental identification problem: the time-zone mismatch. The FOMC typically announces its decisions at 14:00 Eastern Time. At this moment, European markets have closed hours earlier, and Asian markets will not open for several hours. Consequently, the standard approach relies on daily or two-day returns of foreign indices. This methodology inherently conflates the immediate effect of the U.S. announcement with contaminating information that accumulates during the extensive overnight period

The contamination from these intervening hours is often substantial and systematic. A reliance on closing prices necessarily absorbs the effects of country-specific macroeconomic data releases, political developments, and, critically, other central bank actions. To illustrate the scale of this identification problem and underline the overlap between FOMC announcements and other central bank decisions, we examine the announcement calendars of only ten major central banks (in addition to the Federal Reserve) just for the past five years (2020–2025). We find that 28 of the 46 FOMC announcement dates (61 percent) coincided with a monetary policy decision by at least one other central bank's monetary policy decision on the same calendar day.

On 22 September 2021, for instance, the Federal Reserve, Bank of Japan, People's Bank of China, and Banco Central do Brasil all all made policy announcements. A researcher using daily Japanese equity returns to measure "Fed spillovers" on that date would capture the combined effects of four central bank actions. Similarly, the Bank of England and the Federal Reserve both announced rate decisions on 7 November 2024, rendering UK daily returns an unreliable measure of FOMC transmission alone. These figures likely understate the true contamination because they exclude dozens of smaller central banks whose equity markets also appear in spillover studies. Beyond monetary policy, daily returns absorb idiosyncratic corporate news, scheduled macroeconomic releases, and political developments in each country. The cumulative effect is severe attenuation and inflated standard errors in traditional event-study designs. In other words, this noise attenuates coefficient estimates and obscures the true speed and magnitude of international transmission.

This research proposes a different approach. We use high-frequency data from US-traded country exchange-traded funds (ETFs) to measure foreign equity market responses in real time during FOMC announcements. ETFs are investment funds that hold diversified baskets of securities—typically tracking a country's equity index—but trade on stock exchanges like individual shares. The global ETF market now exceeds $18 trillion in assets under management, with daily trading volume approaching $200 billion. Their liquidity, transparency, and continuous trading during US market hours have made ETFs central to modern portfolio management and price discovery. Crucially for our purposes, a US-listed country ETF continues trading on the New York Stock Exchange or NASDAQ during the FOMC window even when the underlying foreign market is closed. The iShares MSCI Japan ETF (ticker: EWJ), for example, holds Japanese equities but trades in New York; when the Tokyo Stock Exchange is closed at 14:00 ET, informed traders can still transact in EWJ, and its price reflects new information about Japanese equity values in real time.

While no proxy is perfect, this approach provides a demonstrably superior measure of international transmission compared to daily indices. The price discovery literature establishes that when underlying markets are closed, the locus of price formation shifts to the secondary market (Hasbrouck 1995). Market makers incorporate real-time information—including the FOMC surprise—to update the expected fair value of the underlying basket. This institutional feature enables a substantially cleaner identification of spillover effects. By constructing 30-minute returns around FOMC announcements using ETF prices, we can isolate immediate foreign market responses without the overnight contamination that plagues traditional daily measures. The improvement is marked. Baseline event-study regressions using daily foreign index returns achieve explanatory power below 2 percent ($R^2 < 0.02$), consistent with the weak results in prior literature. Moving to 30-minute ETF returns raises explanatory power to approximately 33 percent ($R^2 \approx 0.33$). This tenfold-plus increase suggests that measurement noise, rather than genuinely weak transmission, accounts for much of the imprecision in earlier work.

Three specific questions guide our empirical analysis. First, what is the immediate magnitude of international equity market responses to US monetary policy surprises? The existing literature provides heterogeneous estimates, partly because daily data blend the FOMC shock with unrelated information. High-frequency ETF returns allow us to estimate transmission with greater precision and to characterise whether prior studies have understated or overstated spillover magnitudes. Second, is the transmission universal across countries, or do spillovers vary systematically with country characteristics such as exchange rate regime, capital account openness, or development level? The global financial cycle hypothesis implies that all countries should respond to US monetary policy regardless of domestic policy choices, but this prediction has proven difficult to test cleanly with noisy daily data. Third, do different components of Fed announcements—policy actions versus information revelations about economic conditions—generate distinct international responses? Separating these components requires precise timing that daily data cannot provide.

Our identification strategy rests on the claim that ETF price movements during asynchronous trading hours reflect genuine country-specific information rather than mere noise or US market sentiment. We provide extensive validation of this claim. The central test exploits a geographic discontinuity created by time zones. At the moment of an FOMC announcement, some markets (Asia, Europe, Africa) are closed while others (the Americas) remain open. If ETFs genuinely incorporate country-specific information when underlying markets are closed, then ETF returns during the FOMC window should predict the subsequent overnight gap in the local index—but only for countries whose markets were closed. For countries with markets open during the announcement, both the ETF and the underlying index react simultaneously, and the ETF should have no predictive power for subsequent moves. We find exactly this pattern. All countries in our sample with closed markets, 30-minute ETF returns strongly predict the overnight index gap, with a coefficient of 0.197 and a t-statistic exceeding 5. For the American countries trading during the announcement, the predictive coefficient collapses to 0.010 and is statistically indistinguishable from zero. This twenty-fold difference in predictive power across the geographic boundary isolates the timing mechanism and cannot easily be explained by differential economic exposure or other country characteristics.

We supplement this geographic discontinuity test with cross-asset validation. If ETFs capture fundamental spillovers, they should move in concert with other instruments exposed to the same country risk. We examine three such instruments: equity index futures, currency markets (both spot exchange and currency futures), and American Depositary Receipts (ADRs). Country index futures trade nearly continuously and offer independent real-time price discovery; ADRs are US-listed securities representing claims on individual foreign companies. During FOMC windows, ETF returns correlate at approximately 0.84 with matched index futures, 0.81 with currency movements, and 0.82 with market-capitalisation-weighted ADR portfolios. This coherence across independently traded instruments indicates that our ETF-based measure reflects fundamental country information rather than microstructure artefacts or ETF-specific noise.

With cleaner identification established, we estimate spillover effects using an orthogonalised monetary policy surprise measure constructed from interest rate derivatives (Bauer and Swanson 2023). This approach avoids potential conflation between Fed policy actions and revelation of the

Fed's private economic information. Our estimates indicate that a one-basis-point unexpected tightening is associated with foreign equity returns declining by approximately 8.4 basis points on average, a precisely estimated effect with a t-statistic exceeding 10. Strikingly, the estimated effect is negative for all 37 countries in our sample, with statistical significance at conventional levels in nearly every case. This unanimity contrasts with the mixed signs and marginal significance typical of daily-data studies and provides evidence consistent with a common global factor in equity price responses to US monetary policy.

We also examine whether spillover magnitudes vary with country characteristics. The global financial cycle hypothesis suggests that transmission should be largely invariant to exchange rate regime and capital controls, at least at high frequencies. Our cross-sectional analysis supports this view. While we document some heterogeneity—emerging markets tend to exhibit slightly larger responses than developed markets, and smaller economies respond more than larger ones—the dominant pattern is uniformity. Countries with fixed exchange rates do not differ systematically from floaters, and countries with capital controls do not appear insulated relative to open economies. These patterns suggest that flexible exchange rates and capital controls provide limited short-run insulation from US monetary shocks, though our high-frequency window cannot speak to longer-horizon adjustments.

This paper contributes to several literatures. Most directly, we advance the methodology for measuring international monetary policy transmission by demonstrating that continuously traded proxy assets can address the time-zone identification problem endemic to cross-border event studies. This approach should prove applicable to any event occurring when primary markets are closed. Second, we provide robust high-frequency estimates suggesting that international spillovers are larger and more precisely estimated than prior daily-data studies indicated. Third, we offer new evidence on the speed and homogeneity of global financial cycle transmission (Rey 2015), complementing lower-frequency approaches in the existing literature. Our findings carry implications for debates over monetary policy coordination and the effectiveness of exchange rate flexibility as an insulating mechanism. We further demonstrate in robustness analysis that decomposing shocks reveals distinct channels for pure policy and central bank information (Jarociński and Karadi 2020), confirming theoretical predictions that were obscured in daily data.

The remainder of the paper proceeds as follows. Section 2 develops the theoretical framework for asynchronous price discovery and derives testable predictions. Section 3 describes the data construction. Section 4 presents the empirical validation of the methodology. Section 5 reports the main estimates on international spillovers and cross-country heterogeneity. Section 6 examines robustness to alternative shock measures and temporal stability. Section 7 concludes.

2. Identification Strategy: Asynchronous Price Discovery

The empirical analysis of international monetary policy spillovers confronts a fundamental identification challenge rooted in the structure of global financial markets. Theoretical models predict potent transmission through various channels, including discount rates, portfolio rebalancing, and exchange rates (Rey 2015). Furthermore, empirical evidence suggests that a global factor, highly responsive to U.S. monetary policy, accounts for a significant portion of the variance in risky asset prices worldwide (Miranda-Agrippino and Rey 2020). However, studies measuring these spillovers directly often achieve limited precision, which constrains the literature's ability to characterize the underlying transmission mechanisms precisely.

The primary constraint is temporal asynchronicity. FOMC announcements typically occur at 14:00 Eastern Time (Figure-1). At this moment, the majority of global equity markets are closed. In our sample of 37 countries, 32 (including those in Europe and Asia-Pacific) are inactive during the announcement. This mismatch forces the traditional approach to rely on daily or overnight returns of foreign indices.

This reliance on daily data introduces substantial contamination. Between the FOMC announcement and the subsequent reopening of a foreign market, significant information unrelated to U.S. policy accumulates. This includes other central bank communications, macroeconomic data releases, and idiosyncratic news. As demonstrated previously, this contamination is often systematic, with multiple central banks frequently announcing policy on the same calendar day. The traditional daily return captures all these influences alongside the FOMC signal. The resulting noise inflates standard errors and induces attenuation bias, obscuring the true magnitude of the spillovers.

The domestic US literature has long recognised the value of narrowing the event window. Gurkaynak, Sack, and Swanson (2005) demonstrate that moving from daily S&P 500 returns to 30-minute returns around FOMC announcements triples explanatory power. The logic is straightforward: a narrower window excludes unrelated information and isolates the announcement effect more cleanly. But this high-frequency approach cannot be applied directly to international markets because the underlying foreign indices are simply not trading at the time of the announcement. When the Fed announces policy at 14:00 ET, the Tokyo Stock Exchange has been closed for hours and will not reopen until the following morning. An econometrician cannot observe Japanese equity prices during the FOMC window because there are no prices to observe. Our approach exploits a class of instruments that *do* trade continuously during the FOMC window: US-listed country exchange-traded funds. These ETFs hold diversified baskets of foreign equities—tracking indices such as the MSCI Japan or MSCI Germany—but are listed and traded on US exchanges. When the underlying foreign market is closed, the ETF continues trading in New York. This institutional feature creates a real-time window into foreign equity valuations that would otherwise be unobservable.

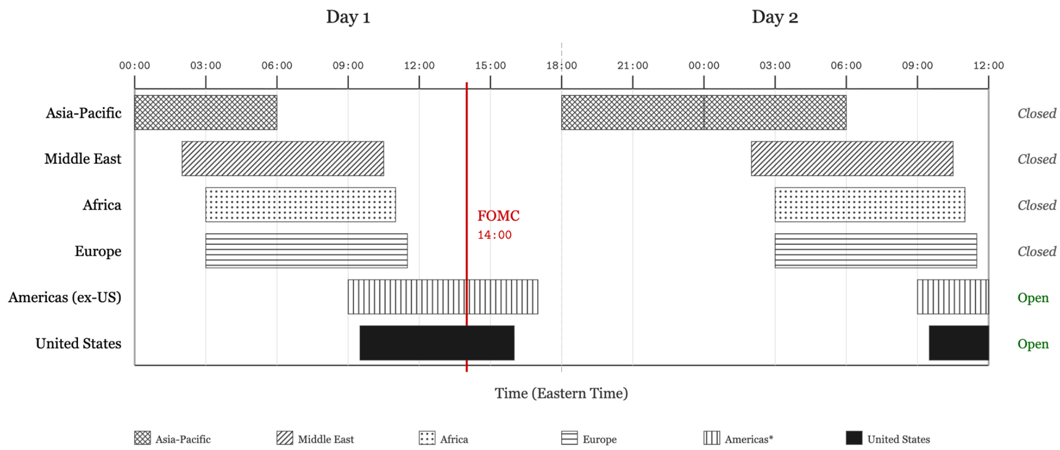

FIGURE 1. Global Equity Market Trading Hours

Notes: 36-Hour Timeline in Eastern Time (ET) — Day 1 through Day 2. Trading hours represent regular market sessions. Americas excludes United States. FOMC monetary policy announcements typically occur at 14:00 ET. At the time of FOMC announcement, only American markets are actively trading. European, MiddleEastern, African, and Asia-Pacific markets react upon their next open

2.1 How ETFs incorporate information when markets are closed

Under normal circumstances, ETF prices remain tightly linked to the value of their underlying holdings through an arbitrage mechanism. Authorised participants—typically large financial institutions—can create or redeem ETF shares by exchanging them for the underlying basket of securities. This process keeps ETF prices close to their Net Asset Value (NAV), which is simply the market value of the underlying portfolio. When both the ETF and the underlying securities trade simultaneously, arbitrage ensures that any meaningful deviation between the ETF price and NAV is quickly eliminated (Petajisto 2017).

When the underlying foreign market closes, this arbitrage mechanism is impaired. The most recent NAV calculation becomes stale because it reflects closing prices from hours earlier. Authorised participants cannot execute the creation-redemption process until the foreign market reopens. Under these conditions, the ETF price can deviate from stale NAV without creating a riskless arbitrage opportunity.

The breakdown of arbitrage does not mean that ETF prices become uninformative. On the contrary, when the underlying market is closed, the ETF becomes the primary venue for price discovery (Hasbrouck 1995). Market makers and informed traders who wish to express views about foreign equity values have no choice but to transact in the ETF (or related instruments such as futures or ADRs). Competition among these participants drives ETF prices toward their best estimate of fair value given all available information. Market makers incorporate signals from correlated assets—currency markets, index futures, ADRs of individual companies, and the ETF's own order flow—to update their quotes. The resulting ETF price reflects a real-time consensus about the expected value of the underlying index when it reopens.

This price discovery process is necessarily imperfect. Market makers face estimation risk: their fair value estimate may differ from the actual opening price hours later. To compensate for this risk, they widen bid-ask spreads and allow the ETF to trade at a premium or discount relative to stale NAV (Engle and Sarkar 2006, Shleifer and Vishny 1997). These premiums and discounts represent compensation for uncertainty rather than a breakdown of information incorporation. The key insight is that despite these frictions, informed traders have strong incentives to act on fundamental information, and competition among market makers drives prices toward fair value.

A natural concern is whether ETF price movements during asynchronous hours genuinely reflect country-specific information or simply mirror US market sentiment. If ETF movements during the FOMC window merely reflect amplified US sentiment rather than fundamental spillovers, our approach would conflate domestic US effects with international transmission. Our identification strategy, detailed below, explicitly addresses this concern by validating the country-specific information content of the ETF returns conditional on U.S. market movements

2.2 A Framework for Comparing Measures

To clarify the conditions under which ETF returns provide a more precise measure of spillovers than daily index returns, we develop a simple framework formalising the two approaches.

Let V_i^* denote the log fundamental value of country i's equity index. A US monetary policy surprise Ω_τ is realised during a narrow intraday window τ when country i's market is closed. Between the announcement and the market's reopening at $t+1$, additional information $\eta_{i,t+1}$ arrives. This contaminating information includes other central bank communications, macroeconomic data releases, political developments, and corporate news from country i and elsewhere. Assuming orthogonality between the FOMC surprise and subsequent news, the total change in fundamental value observed at reopening is:

$$\Delta V_{i,t+1}^* = \beta_i \Omega_\tau + \eta_{i,t+1} \tag{1}$$

where β_i is the true sensitivity of country i to the surprise.

The traditional measure relies on the overnight index return, which is simply the percentage change from the previous close to the next open. This measure equals:

$$R^{Index}_{i,t+1} = \beta_i \Omega_\tau + \eta_{i,t+1} \tag{2}$$

Regressing this overnight return on Ω_τ yields an unbiased estimate of β_i, but the presence of $\eta_{i,t+1}$ inflates the residual variance and attenuates the coefficient estimate toward zero in finite samples. The magnitude of this attenuation depends on the variance of the contaminating information relative to the variance of the shock.

The ETF approach offers an alternative. When the underlying market is closed, ETF market makers set prices to reflect expected NAV conditional on available information:

$$P^{ETF}_{i,\tau} = E_\tau[\text{NAV}_{i,t+1} | \mathcal{F}_\tau] + \delta_{i,\tau} \tag{3}$$

where $\delta_{i,\tau}$ represents the premium or discount reflecting estimation risk, inventory costs, and other market-making frictions. The ETF return during the announcement window is the change in this price:

$$R^{ETF}_{i,\tau} = \beta_i \Omega_\tau + \epsilon^{ETF}_{i,\tau} \tag{4}$$

where $\epsilon^{ETF}_{i,\tau} = \Delta\delta_{i,\tau}$ represents the change in the premium or discount during the window.

Comparing Equations 2 and 4 reveals the trade-off. The traditional approach suffers from contamination ($\eta_{i,t+1}$) accumulated over many hours. The justification for preferring the ETF proxy (Equation 4) over the traditional index measure relies on two critical identification conditions regarding the noise terms.

Condition 1: Relative Efficiency.. The ETF approach provides a superior signal-to-noise ratio if the variance of the microstructure noise is smaller than the variance of the overnight contamination:

$$Var(\epsilon^{ETF}_{i,\tau}) < Var(\eta_{i,t+1}) \tag{5}$$

This condition is plausible on prior grounds. The variance of overnight contamination $Var(\eta_{i,t+1})$ encompasses all global and local news over a 12 to 24 hour period—potentially including other central bank announcements, scheduled data releases, and idiosyncratic events. On the contrary the variance of microstructure noise $Var(\epsilon^{ETF}_{i,\tau})$ is constrained to price discovery frictions within a 30-minute window. Empirically, we assess this condition by comparing the explanatory power achieved with each measure.

Condition 2: Conditional Orthogonality. To address the concern regarding potential overreaction to US sentiment, our identification strategy does not require that ETF microstructure noise is strictly uncorrelated with US policy. This would be implausible since ETFs trade in US markets. Rather, we impose a weaker and more defensible condition: that the *country-specific* component of ETF noise is orthogonal to the shock after conditioning on US market factors:

$$Cov(\epsilon^{ETF}_{i,\tau}, \Omega_\tau | X^{US}_\tau) = 0 \tag{6}$$

where X^{US}_τ represents common US market conditions, such as S&P 500 returns during the same window. This condition implies that after accounting for the general US market response to FOMC announcements, the residual ETF variation reflects country-specific fundamentals rather than sentiment correlated with the shock.

This condition can be validated empirically by adding S&P 500 returns as a control and testing whether country-specific spillover coefficients remain stable. The geographic discontinuity test provides a complementary validation: if ETF movements merely reflected US sentiment, the predictive relationship with overnight gaps would exist regardless of whether the underlying market was open. Section 6.1 confirms that both tests support the conditional orthogonality assumption.

The framework generates four predictions that structure our empirical validation.

Prediction 1: Price Leadership for Closed Markets. For countries whose equity markets are closed during the FOMC window, the ETF incorporates the shock Ω_τ before the underlying index can respond. ETF returns during the announcement window should therefore predict the subsequent overnight gap in the local index:

$$Gap_{i,t+1} = \alpha + \gamma R^{ETF}_{i,\tau} + \nu_{i,t+1}, \quad \gamma > 0 \tag{7}$$

If ETFs capture genuine information about how the underlying market will respond, the coefficient γ should be positive and statistically significant.

Prediction 2: No Price Leadership for Open Markets. For countries whose equity markets trade simultaneously with the FOMC announcement—primarily the Americas—both the ETF and the underlying index incorporate the shock contemporaneously. The ETF has no informational advantage, and its return should not predict subsequent index movements: $\gamma \approx 0$.

The contrast between Predictions 1 and 2 provides the sharpest test of our identification strategy. The geographic boundary between closed and open markets creates a natural discontinuity. If ETF movements during the FOMC window merely reflected US sentiment or noise correlated with the shock Ω_τ, the predictive relationship would exist regardless of whether the underlying market was open. The presence of predictive power for closed markets and its absence for open markets isolates the timing mechanism and validates the conditional orthogonality assumption.

Prediction 3: Cross-Asset Coherence. If ETFs capture genuine country information, their movements should correlate with other instruments exposed to the same fundamental risks. Index futures, currency markets, and ADR portfolios all respond to news about country *i*'s economic prospects. Strong correlations between ETF returns and these alternative measures during the FOMC window would indicate that all instruments respond to a common fundamental signal rather than idiosyncratic noise.

Prediction 4: Improved Explanatory Power. If the noise reduction from using ETFs is substantial, event-study regressions using ETF returns should achieve meaningfully higher R^2 values than regressions using daily index returns:

$$R^2_{ETF} > R^2_{Index} \tag{8}$$

The magnitude of this improvement reflects how much of the imprecision in traditional spillover estimates stems from measurement noise rather than genuinely weak transmission.

We test each of these predictions in Section 4. Before doing so, we describe the construction of our dataset and the measurement of monetary policy surprises.

3. Data and Sample Construction

The empirical analysis requires four types of data: high-frequency prices for US-traded country ETFs, daily returns for underlying foreign equity indices, measures of US monetary policy surprises, and prices for validation instruments including index futures, currencies, and American Depositary Receipts. This section describes the construction and coverage of each dataset.

3.1 Country ETF and Index Data

Our primary data consist of one-minute prices for US-listed single-country ETFs. The sample includes 37 countries—21 classified as developed markets and 16 as emerging markets under the MSCI framework—representing approximately 85 percent of the MSCI World Index (excluding the United States) and 90 percent of the MSCI Emerging Markets Index. We include an ETF if it tracks a broad country equity index rather than a sector or thematic strategy, has intraday data available for at least 20 FOMC announcements, and has corresponding daily index data for validation purposes.

Table 1 reports the coverage for each country. The largest ETFs by trading activity are those tracking major economies: Japan (EWJ), Germany (EWG), the United Kingdom (EWU), Brazil (EWZ), and Mexico (EWW). These instruments have traded since the early 2000s, providing coverage for over 180 FOMC announcements each. Smaller or more recently launched ETFs—such as those for Finland (EFNL), Denmark (EDEN), and Norway (ENOR)—have shorter histories and correspondingly fewer announcement observations. Coverage ranges from 24 FOMC dates for Finland to 213 for Japan, with a median of 139 announcements per country.

Intraday ETF data are sourced from two commercial providers to ensure accuracy and maximise coverage: FirstRateData and PiTrading, the vendor which was employed by Jarociński and Karadi (2020) too. We prioritise consistency with the shock construction by utilising FirstRateData. We carefully merge and clean the data. When both sources provide data for the same ETF-date, we merge observations and retain the record with higher trading volume if timestamps match exactly. This procedure results in a final dataset of 50.4 million unique one-minute records, after removing 37.3 million duplicates from raw observations.

We also collect daily returns for the underlying country equity indices from Wharton Research Data Services. These MSCI country index returns serve two purposes: they provide the overnight gap measure needed to test whether ETF returns predict subsequent index movements (Predictions 1 and 2 from Section 2), and they enable comparison between high-frequency ETF estimates and traditional daily-data estimates (Prediction 4).

TABLE 1. Data Coverage

Country	ETF	Intraday (M)	Daily	FOMC	Source
Panel A: Developed Markets					
Australia	EWA	1.79	6,427	181	FR+PT
Austria	EWO	0.40	6,321	135	FR+PT
Belgium	EWK	0.30	6,511	117	FR+PT
Canada	EWC	1.82	6,741	181	FR+PT
Denmark	EDEN	0.07	6,344	35	FR
Finland	EFNL	0.05	6,399	24	FR
France	EWQ	1.14	6,497	165	FR+PT
Germany	EWG	1.80	6,457	190	FR+PT
Hong Kong	EWH	1.85	6,212	183	FR+PT
Ireland	EIRL	0.09	6,459	36	FR
Israel	EIS	0.17	7,110	61	FR
Italy	EWI	1.12	6,450	161	FR+PT
Japan	EWJ	2.34	6,233	213	FR+PT
Netherlands	EWN	0.55	6,518	157	FR+PT
New Zealand	ENZL	0.16	6,290	70	FR
Norway	ENOR	0.06	6,366	32	FR
Singapore	EWS	1.48	6,381	181	FR+PT
Spain	EWP	1.17	6,480	165	FR+PT
Sweden	EWD	0.86	6,384	166	FR+PT
Switzerland	EWL	1.18	6,378	169	FR+PT
United Kingdom	EWU	1.62	6,435	179	FR+PT
DM Subtotal	21	20.0	135,393	2,801	
Panel B: Emerging Markets					
Brazil	EWZ	2.29	6,256	181	FR+PT
Chile	ECH	0.88	5,749	139	FR+PT
China	MCHI	1.14	6,172	108	FR
India	INDA	1.12	6,315	102	FR
Indonesia	EIDO	1.02	6,181	122	FR
Malaysia	EWM	1.40	6,257	179	FR+PT
Mexico	EWW	1.97	6,337	187	FR+PT
Peru	EPU	0.36	3,527	94	FR
Philippines	EPHE	0.59	6,237	112	FR
Poland	EPOL	0.62	6,377	120	FR
Saudi Arabia	KSA	0.47	6,219	60	FR
South Africa	EZA	1.05	5,750	165	FR+PT
South Korea	EWY	1.99	6,282	180	FR+PT
Taiwan	EWT	1.97	6,258	183	FR+PT
Thailand	THD	0.70	6,215	138	FR
Turkey	TUR	0.86	4,860	136	FR
EM Subtotal	16	18.4	94,992	2,206	
Panel C: Total	37	38.4	230,385	5,007	

Notes: This table reports data coverage for 37 iShares MSCI country ETFs traded on US exchanges. *Intraday* shows millions of 1-minute price observations. *Daily* shows trading days from MSCI country indices via WRDS (2000–2025). *FOMC* shows the number of FOMC announcements with valid ETF intraday returns for each country. *Source*: FR = FirstRateData, PT = PiTrading, FR+PT = merged from both sources. Country classification follows MSCI, with South Korea classified as Emerging Market consistent with the sample period.

3.2 Measuring Returns Around FOMC Announcements

High-frequency price data present measurement challenges that do not arise with daily data. Bid-ask bounce, stale quotes, and transitory price dislocations can distort point-in-time measurements, particularly for less liquid ETFs. A naive approach—taking the price at 13:45 and the price at 14:15—would be sensitive to these microstructure artifacts.

We follow the methodology established in the high-frequency monetary policy literature (Jarociński and Karadi 2020). Rather than using point-in-time prices, we construct median prices over short intervals slightly before and after the announcement window. Specifically, let τ denote the FOMC announcement time (typically 14:00 ET). The pre-announcement price $\tilde{P}_{i,t}^{before}$ is the median of all prices between $\tau - 25$ minutes and $\tau - 15$ minutes. The post-announcement price $\tilde{P}_{i,t}^{after}$ is the median of prices between $\tau + 15$ minutes and $\tau + 25$ minutes. The return is then:

$$r_{i,t} = \ln\left(\frac{\tilde{P}_{i,t}^{after}}{\tilde{P}_{i,t}^{before}}\right) \times 100, \tag{9}$$

This median-based approach reduces the influence of outlier prices while preserving the genuine price response to the announcement. The effective window spans approximately 30 minutes, though the precise endpoints are smoothed.

We express returns in percentage points and winsorise at the 1st and 99th percentiles to limit the influence of extreme observations. Two countries—Japan and New Zealand—exhibit unusually high return volatility around FOMC announcements, possibly reflecting their time-zone position and the resulting longer gap between announcement and local market opening. For these countries, we apply a more stringent winsorisation at the 5th and 95th percentiles, consistent with standard practice in this literature.

3.3 Monetary Policy Surprises

Measuring the unexpected component of FOMC announcements requires a shock measure that isolates the new information revealed by the Fed. We use the orthogonalised monetary policy surprise developed by Bauer and Swanson (2023), denoted $\text{MPS}^{\perp}$. This measure is constructed from Fed funds futures price changes in a narrow window around announcements and is explicitly orthogonalised to pre-announcement macroeconomic releases and equity market movements.

The orthogonalisation addresses an important identification concern. Alternative approaches—including sign-restriction methods that use the comovement of interest rates and stock prices (Jarociński and Karadi 2020)—incorporate equity market responses into the shock construction. While useful for some purposes, this creates mechanical correlation between the shock measure and equity returns, potentially inflating explanatory power and complicating interpretation. The Bauer and Swanson (2023) measure avoids this issue by relying exclusively on interest rate derivatives and explicitly removing any component correlated with pre-announcement information.

The resulting series covers 340 FOMC announcements from January 2000 through July 2025. Positive values indicate contractionary surprises (unexpected tightening); negative values indicate accommodative surprises (unexpected easing). The shock has mean near zero and standard deviation of 5.4 basis points. Most announcements generate modest surprises within a range of ±3 basis points, but the distribution includes substantial outliers during crisis periods, with extremes of −24 and +16 basis points. We exclude announcements occurring outside regular US equity market hours (09:30 to 16:00 ET), as ETF prices are unavailable during these times.

For robustness analysis, we also consider alternative shock measures. The Gurkaynak, Sack, and Swanson (2005) decomposition separates surprises into a Target factor (capturing unexpected changes in the current policy rate) and a Path factor (capturing unexpected changes in the trajectory of future rates). The Jarociński and Karadi (2020) decomposition uses sign restrictions on interest rate and stock price comovement to separate pure monetary policy shocks from central bank information effects—cases where the Fed reveals its private assessment of economic conditions rather than changing policy stance. We report results using these alternatives in Section 6.

3.4 Validation Instruments

Testing whether ETF returns reflect genuine country information (Prediction 3) requires comparison with independent instruments exposed to the same fundamental risks. We assemble high-frequency data on three asset classes.

Equity index futures trade nearly continuously and provide real-time price discovery for the same underlying exposure as ETFs. We collect one-minute data for seven major contracts: four regional aggregates (MSCI EAFE, MSCI Emerging Markets, Euro Stoxx 50, Stoxx Europe 600) and three country-specific indices (DAX for Germany, FTSE 100 for the United Kingdom, Nikkei 225 for Japan). If ETFs and futures both respond to the same fundamental news, their returns during the FOMC window should be strongly correlated.

Currency markets offer an independent check through a distinct transmission channel. US monetary policy affects foreign equities partly through exchange rate movements: an unexpected tightening appreciates the dollar and depresses foreign-currency returns from a US investor's perspective (Bruno and Shin 2015, Rey 2015). We assemble one-minute data on nine currency futures contracts (Australian dollar, British pound, Canadian dollar, euro, Japanese yen, Mexican peso, New Zealand dollar, Swiss franc, and the US dollar index) and 24 spot foreign exchange pairs covering both developed and emerging market currencies. Strong correlation between ETF returns and currency movements would indicate that ETFs incorporate the exchange rate channel of monetary transmission.

American Depositary Receipts provide a structurally different measure of foreign equity exposure. Unlike ETFs, which hold diversified baskets tracking country indices, ADRs are claims on individual foreign companies like Alibaba, ARM etc. A portfolio of ADRs from a given country aggregates firm-level responses to the same fundamental news that affects the country ETF. We identify 157 actively traded ADRs across 25 countries using the JP Morgan depositary receipt database and construct country portfolios using market capitalisation weights. For major economies such as Brazil, the United Kingdom, South Korea, and Japan, ADR portfolios contain 9 to 10 securities and provide well-diversified country exposure.

Finally, we compute S&P 500 returns using the E-mini futures over identical windows. These returns serve as a control for common US market exposure, allowing us to isolate the country-specific component of foreign ETF movements as required by the conditional orthogonality assumption discussed in Section 2. Table 2 summarises the coverage of these validation datasets. In total, the validation data comprise over 530 million one-minute observations across futures, currencies, and ADRs.

TABLE 2. Validation Data Coverage

Asset	Contracts	Intraday (Mil)	FOMC Matched	30-min Valid
Panel A: Index Futures				
Regional Aggregates (well-diversified)				
MSCI EAFE	MFS	1.7	364	129
MSCI EM	MME	3.1	364	127
Euro Stoxx 50	FESX	4.3	364	144
Stoxx Europe 600	FXXP	1.8	364	65
Subtotal	4	10.9	1,456	465
Country-Specific (single-country)				
FTSE 100 (UK)	FTUK	4.1	364	141
DAX (Germany)	FDAX	4.2	364	144
Nikkei 225 (Japan)	NIY	4.4	364	145
Subtotal	3	12.8	1,092	430
US Benchmark				
S&P 500	ES	6.2	364	147
Panel B: Currency Markets				
Currency Futures				
CME/ICE contracts	9	46.6	3,276	1,322
Spot FX				
Major Developed	7	57.9	–	–
Emerging Markets	17	80.6	–	–
Total	24	138.5	–	–
Panel C: American Depositary Receipts (ADRs)				
Individual Securities				
ADRs	157	180.9	57,148	17,129
Country Portfolios: 29 countries				
Well-Diversified	12 countries (≥6 ADRs)	–	–	—
Highly-Diversified	6 countries (≥10 ADRs)	–	–	—
Panel D: Summary		534.4	95,004	35,358

Notes: This table reports data coverage for validation assets used to assess cross-asset consistency of ETF-based spillover measures. *Intraday* shows millions of 1-minute observations from FirstRateData (futures, ADRs) and HistData/FirstRateData merged (spot FX). *FOMC Matched* shows observations successfully matched to 364 FOMC announcement dates (2000–2025). *30-min Valid* shows observations with valid 30-minute returns around FOMC announcements (2:00pm ET ± 15 minutes). Currency futures tickers: A6/AD (AUD), B6 (GBP), DX (USD Index), E1/E6 (EUR), J1 (JPY), MP (MXN), N6 (NZD). ADR individual observations: 157 securities × 364 FOMC dates = 57,148. ADR portfolios constructed using equal-weighted, market-cap-weighted, and volume-weighted schemes for 25 countries with sufficient ADR coverage.

3.5 Sample Characteristics

The estimation sample consists of country-date observations for which we have both valid ETF returns and a monetary policy shock measure. Table 3 reports summary statistics.

The baseline specification uses 30-minute ETF returns and contains 4,400 observations spanning 37 countries and 192 FOMC announcements. The traditional daily index approach yields a slightly larger sample (6,723 observations, 193 FOMC dates) because daily index data have longer historical availability than some ETF series.

The summary statistics in Panel B reveal a pattern consistent with the theoretical framework from Section 2. Daily index returns exhibit substantially higher volatility than 30-minute ETF returns: the standard deviation falls from 1.12 percentage points for daily data to 0.65 percentage points for the 30-minute window. This compression reflects the exclusion of overnight information unrelated to the FOMC announcement. Volatility increases monotonically as the window widens—from 0.65 percent at 30 minutes to 0.99 percent at 120 minutes—consistent with the progressive accumulation of non-FOMC news.

Panel C summarises the monetary policy shock. $MPS^{\perp}$ is approximately mean-zero with a standard deviation of 5.4 basis points. The interquartile range spans −2.1 to +2.7 basis points, with extremes reaching −24 and +16 basis points during crisis periods. The sample spans diverse policy regimes including conventional policy, the zero lower bound, quantitative easing, and the recent tightening cycle which ensures estimates reflect average transmission across varied economic conditions.

TABLE 3. Sample Description and Summary Statistics

	Daily Index	30min	60min	90min	120min
Panel A: Sample Coverage					
Observations	6,723	4,400	4,378	4,418	4,447
Countries	37	37	37	37	37
FOMC dates	193	192	192	191	190
Panel B: Foreign Equity Returns (%)					
Mean	0.19	0.08	0.16	0.20	0.20
Std dev	1.12	0.65	0.79	0.93	0.99
25th percentile	−0.36	−0.23	−0.25	−0.27	−0.30
Median	0.18	0.04	0.11	0.14	0.15
75th percentile	0.75	0.34	0.48	0.61	0.65
Panel C: Monetary Policy Shock ($MPS^{\perp}$, basis points)					
N (FOMC DATES)	Mean	Std. Dev.	Min / Max	25th	75th
340	-0.01	5.39	-24.0 / 16.1	-2.1	2.7
Panel D: Summary by Market Classification (30-min window)					
Market		Obs	Countries	Mean (%)	Std (%)
Developed		2,503	21	0.06	0.62
Emerging		1,897	16	0.10	0.70
Total		4,400	37	0.08	0.65

Notes: This table reports summary statistics for the main estimation sample. Panel A shows sample coverage across different return windows. *Daily INDEX* uses next-day foreign market index returns from MSCI country indices via WRDS, representing the traditional approach in the literature (Hausman and Wongswan 2011, Bowman, Londono, and Sapriza 2015). Intraday windows (30min–120min) use US-traded ETF returns around FOMC announcements at 2:00pm ET. Panel B reports summary statistics for foreign equity returns (in percentage points), winsorised at the 1st and 99th percentiles. Panel C reports summary statistics for the orthogonalised monetary policy shock ($MPS^{\perp}$) from Bauer and Swanson (2023), which purges the raw fed funds futures surprise of correlation with pre-FOMC equity returns and macroeconomic news releases. Panel D shows the 30-minute window sample broken down by market classification, with South Korea classified as Emerging Market. Sample period: February 2000 – July 2025.

4. Empirical Validation

The identification strategy developed in Section 2 rests on two claims: that ETF returns during the FOMC window reflect country-specific fundamental information, and that this measure offers a cleaner signal than daily index returns. This section tests both claims systematically.

The validation proceeds in three steps. We first examine whether ETFs function as genuine country proxies rather than repackaged US exposure—a necessary precondition for the approach. We then present the geographic discontinuity test, which exploits time-zone boundaries to isolate the timing mechanism central to our identification. Finally, we assess cross-asset coherence by comparing ETF movements to index futures, currency markets, and ADR portfolios during FOMC windows. Agreement across these independent instruments would indicate that all respond to the same fundamental information.

4.1 Do ETFs Track Country Fundamentals?

A threshold question is whether US-traded country ETFs genuinely reflect foreign equity values or simply repackage US market exposure. Levy and Lieberman (2013) raise the concern that during asynchronous trading hours, ETFs may track the S&P 500 more closely than their underlying foreign indices. If true, this would undermine the interpretation of ETF movements as country-specific spillovers.

The concern has merit at very short horizons. When foreign markets are closed, market makers cannot observe real-time prices for the underlying securities and must infer fair value from correlated instruments, including the US market. This inference process may generate temporary overreaction to US news. However, Petajisto (2017) and Ben-David, Franzoni, and Moussawi (2018) document that tracking quality is frequency-dependent: high-frequency noise dissipates at longer horizons as arbitrage mechanisms realign ETF prices with underlying values.

Since monetary policy affects equity valuations over months and quarters rather than minutes, the relevant question is whether ETFs provide valid country exposure at these policy-relevant frequencies. Table 4 addresses this question by comparing ETF correlations with country indices versus the S&P 500 across frequencies.

At the daily frequency, the mean ETF-Index correlation (0.630) barely exceeds the ETF-S&P 500 correlation (0.627). This pattern reflects the strong high-frequency global co-movement documented by Miranda-Agrippino and Rey (2020) and is consistent with the overreaction concern. However, tracking quality improves markedly at longer horizons. By the quarterly frequency, the ETF-Index correlation rises to 0.833 while the ETF-S&P 500 correlation remains at 0.640. The gap of nearly 0.20 indicates that country-specific factors increasingly dominate as the horizon lengthens.

Beta regressions reinforce this conclusion. We regress ETF returns on corresponding index returns separately for each country:

$$R_{i,t}^{\text{ETF}} = \alpha_i + \beta_i R_{i,t}^{\text{Index}} + \varepsilon_{i,t}$$

At the daily frequency, mean R^2 is 0.414 and no country exceeds 0.70. By the quarterly frequency, mean R^2 rises to 0.708 and 27 of 37 countries exceed 0.70. Mean betas are close to unity at all horizons, indicating that a one percent move in the underlying index corresponds to approximately a one percent move in the ETF.

This evidence establishes that ETFs provide genuine country exposure at policy-relevant frequencies. The high-frequency overreaction identified by Levy and Lieberman (2013) appears to be transitory, dissipating as arbitrage forces align ETF prices with fundamental values.

TABLE 4. ETF Tracking Performance: Correlations and Beta Regressions

Frequency	Correlations			Beta Regressions		
	ETF–Index	ETF–SPX	Difference	Mean β	Mean R^2	$R^2 > 0.70$
Daily	0.630	0.627	+0.003	0.914	0.414	0/37
Weekly	0.791	0.623	+0.168	1.088	0.635	12/37
Monthly	0.807	0.631	+0.176	1.134	0.662	21/37
Quarterly	0.833	0.640	+0.193	1.151	0.708	27/37

Notes: This table reports mean validation statistics across 37 country ETFs (2000–2025). Correlations compare ETF returns with country index returns (ETF–Index) and S&P 500 returns (ETF–SPX). Beta regressions estimate $r_{i,t}^{\text{ETF}} = \alpha_i + \beta_i r_{i,t}^{\text{Index}} + \varepsilon_{i,t}$ separately for each country at each frequency. Weekly, monthly, and quarterly returns are computed as compound returns. $R^2 > 0.70$ indicates the number of countries achieving R^2 above 0.70. Returns are winsorised at the 1st and 99th percentiles. Sample comprises 183,114 daily observations.

4.2 Geographic Discontinuity: The Central Validation

The geographic discontinuity test provides the most direct evidence for our identification strategy. It exploits the natural boundary created by time zones: at 14:00 Eastern Time, some equity markets are closed (Asia, Europe, Middle East, Africa) while others remain open (the Americas). This boundary generates a sharp prediction. For closed markets, ETF returns during the FOMC window should predict the subsequent overnight gap in the local index (Prediction 1: $\gamma > 0$), because the ETF incorporates the announcement before the index can react. For open markets, no such prediction should hold (Prediction 2: $\gamma \approx 0$), because both instruments respond contemporaneously.

The power of this test lies in what it rules out. If ETF movements during the FOMC window merely reflected US sentiment correlated with the monetary policy shock, the predictive relationship would exist regardless of whether the foreign market was open or closed. Similarly, if the relationship reflected country characteristics such as financial integration or economic linkages to the United States, these characteristics would affect both groups rather than creating a sharp discontinuity at the open/closed boundary. Only the timing mechanism—the fact that closed-market ETFs incorporate news before their underlying indices—can explain a pattern where predictive power appears for closed markets and vanishes for open markets.

We estimate the regression:

$$\text{Gap}_{i,t+1} = \alpha + \gamma \cdot R_{i,t}^{\text{ETF}} + \varepsilon_{i,t+1} \tag{10}$$

where $\text{Gap}_{i,t+1}$ is the overnight percentage change in the local-currency index from close on day t to open on day $t+1$, and $R_{i,t}^{\text{ETF}}$ is the dollar-denominated ETF return during the 30-minute FOMC window.

Table 5 presents the results. For the 31 countries whose markets are closed during typical FOMC announcements, a one percentage point ETF return predicts a 0.197 percentage point overnight gap, with a t-statistic of 5.26. For the 5 countries in the Americas whose markets are open, the coefficient is 0.010 with a t-statistic of 0.65—statistically indistinguishable from zero.

TABLE 5. Geographic Discontinuity Test: ETF Predictive Power for Overnight Gaps

	Markets Closed at FOMC			Markets Open at FOMC		
Window	γ	t-stat	R^2	γ	t-stat	R^2
30-min	0.197***	5.26	0.018	0.010	0.65	0.000
60-min	0.204***	4.51	0.028	0.032	0.98	0.003
90-min	0.217***	4.52	0.044	0.022	0.95	0.002
120-min	0.254***	4.54	0.067	0.016	0.84	0.001
N (Countries)	3,788 (31)			733 (5)		

Notes: Pooled OLS regressions of overnight index gaps on ETF returns during FOMC announcements: $\text{Gap}_{i,t+1} = \alpha + \gamma\, r_{i,t}^{\text{ETF}} + \varepsilon_{i,t}$. The overnight gap is the return from the previous close to the next open of the local country index. Markets "Closed" at 2:00pm ET include Asia-Pacific, Europe, Middle East, and Africa countries. Markets "Open" at 2:00pm ET include the Americas: Brazil, Canada, Chile, Mexico, and Peru. Standard errors clustered by country. Overnight gaps winsorised at the 1st and 99th percentiles. $^{***}\,p < 0.01$.

The contrast is stark: a twenty-fold difference in the point estimate and a shift from high statistical significance to complete insignificance. This pattern is consistent with the timing mechanism and difficult to reconcile with alternative explanations.

The coefficient of 0.197 for closed markets is attenuated relative to full pass-through. This attenuation reflects measurement error in the ETF return, which enters as the independent variable in this validation regression. Standard errors-in-variables logic implies that noise in the regressor biases the coefficient toward zero. However, this attenuation does not affect our main spillover estimates, where ETF returns appear as the dependent variable. Measurement error in the dependent variable inflates residual variance but does not bias coefficient estimates.

The geographic discontinuity test does not require γ to approach unity; rather, it requires a sharp contrast between closed and open markets. The overnight gap incorporates all information arriving between the FOMC announcement and domestic market opening, including subsequent policy responses by local central banks, overnight news, and Asian market movements. If domestic authorities observe the Fed decision and intervene to stabilise financial conditions, the gap will reflect this dampened response rather than the counterfactual full impact. The relevant comparison is therefore between closed markets ($\gamma = 0.197$) and open markets ($\gamma = 0.010$). This twenty-fold difference in predictive power demonstrates that ETF returns during FOMC windows contain genuine country-specific information about how local markets will respond, conditional on the information environment at market opening. US sentiment affects all ETFs symmetrically; only the timing mechanism creates the discontinuity.

Regional and Development Heterogeneity. Table 6 examines whether the discontinuity holds uniformly across regions and development levels. The predictive coefficient is positive and statistically significant for Europe ($\gamma = 0.234$, 15 countries) and Asia-Pacific ($\gamma = 0.205$, 13 countries). The Middle East and Africa group shows a smaller coefficient ($\gamma = 0.068$) that is not statistically significant, but this group contains only three countries (Israel, South Africa, Turkey) with heterogeneous characteristics. For the Americas, the coefficient remains near zero ($\gamma = 0.010$).

The pattern by development level is similar. Both developed closed markets ($\gamma = 0.225$) and emerging closed markets ($\gamma = 0.157$) exhibit significant predictive power, while open markets show none regardless of development status. The consistency of these patterns across different cuts of the data reinforces the conclusion that the operative distinction is whether the market is open or closed, not other country characteristics.

Currency Denomination.. A measurement consideration arises from the currency denomination of returns. ETFs trade in dollars, so their returns combine local-currency equity movements with exchange rate changes:

$$R_{i,t}^{\text{ETF,USD}} \approx R_{i,t}^{\text{Equity,LC}} + R_{i,t}^{\text{FX}}$$

The overnight index gap, by contrast, is measured in local currency. If the currency component of ETF returns were unrelated to equity fundamentals, its presence would attenuate the estimated pass-through.

This framing, however, conflates two distinct phenomena. The currency movement during an FOMC announcement is not mere translation noise; it reflects the same monetary policy shock affecting both asset classes. When the Federal Reserve tightens policy unexpectedly, the dollar appreciates and foreign equity valuations decline. Both responses stem from a common impulse. From the perspective of a dollar-based investor, the ETF return captures the total effect of the shock, including the exchange rate channel documented by Bruno and Shin (2015) and Rey (2015). This is a feature of the measure rather than a source of contamination.

Nevertheless, we assess the quantitative importance of currency effects by constructing a local-currency ETF return that strips out contemporaneous exchange rate movements. For 29 countries with matched high-frequency foreign exchange data, this adjustment increases the predictive coefficient from 0.213 to 0.235 among closed markets with adequate sample sizes (at least 100 observations). The improvement is modest, consistent with the view that currency movements are part of the transmission mechanism rather than noise. The fundamental discontinuity between closed and open markets persists regardless of currency adjustment.

We retain the dollar-denominated specification as baseline for three reasons. First, it represents the return observed by market participants trading these instruments. Second, it captures total spillover effects inclusive of both equity and currency channels. Third, the currency adjustment requires high-frequency foreign exchange data unavailable for seven countries, reducing sample coverage.

TABLE 6. Geographic Discontinuity by Region and Development Level

	γ	t-stat	R^2	N	Countries
Panel A: By Region					
Markets Closed at FOMC					
Asia-Pacific	0.205***	3.09	0.020	1,715	13
Europe	0.234***	5.57	0.031	1,721	15
Middle East & Africa	0.068	1.23	0.001	352	3
Markets Open at FOMC					
Americas	0.010	0.65	0.000	733	5
Panel B: By Development Level					
Markets Closed at FOMC					
Developed	0.225***	5.21	0.024	2,461	20
Emerging	0.157**	2.36	0.011	1,327	11
Markets Open at FOMC					
Developed	0.066	0.41	0.002	179	1
Emerging	−0.005	−0.72	0.001	554	4

Notes: Pooled OLS regressions of overnight index gaps on 30-minute ETF returns during FOMC announcements: $\text{Gap}_{i,t+1} = \alpha + \gamma\, r^{\text{ETF}}_{i,t} + \varepsilon_{i,t}$. Panel A groups countries by geographic region. Panel B groups countries by MSCI development classification and market status at 2:00pm ET. Asia-Pacific includes Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, South Korea, Taiwan, and Thailand. Europe includes Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Poland, Spain, Sweden, Switzerland, and United Kingdom. Americas includes Brazil, Canada, Chile, Mexico, and Peru. Standard errors clustered by country (HC1 robust when only one country in group). $^{***}\,p < 0.01$, $^{**}\,p < 0.05$.

4.3 Cross-Asset Validation

If ETF returns during the FOMC window capture genuine country information, they should move in concert with other instruments exposed to the same fundamental risks. We examine three such instruments: equity index futures, currency markets, and American Depositary Receipts.

4.3.1 Equity Index Futures

Index futures trade nearly continuously and offer independent real-time price discovery. They differ from ETFs in market-making arrangements, investor composition, and pricing mechanisms. Strong correlation between ETF and futures returns during FOMC windows would indicate that both instruments respond to the same underlying information.

We examine seven major futures contracts matched to corresponding ETFs and estimate beta regressions of the form $R_{i,t}^{\text{ETF}} = \alpha + \beta \cdot R_{i,t}^{\text{Futures}} + \varepsilon_{i,t}$. Table 7 reports the results.

The results indicate tight co-movement. The mean correlation is 0.84 and the mean R^2 is 0.72. For the broadest aggregates—MSCI EAFE and MSCI Emerging Markets—the correlation exceeds 0.98 and the beta is indistinguishable from unity. These regional benchmarks provide the most diversified exposure and exhibit nearly perfect correspondence.

The pattern of beta coefficients is informative. European indices show systematically larger betas (ranging from 1.48 to 1.85) than the global aggregates. This amplification has an economic interpretation. ETFs are dollar-denominated while many European futures settle in local currency. When Fed tightening depresses equities and simultaneously appreciates the dollar, the dollar-denominated ETF return mechanically exceeds the local-currency futures return. The elevated betas reflect this currency amplification rather than a breakdown in the relationship.

Japan exhibits a somewhat lower correlation (0.66) and beta below unity (0.85). This pattern may reflect the unique position of the yen as a funding currency, which can generate different dynamics during US monetary policy shocks. Despite this heterogeneity, the overall picture is one of strong coherence between ETF and futures returns.

TABLE 7. Cross-Asset Validation: Index Futures Beta Regressions

Entity	Index vs ETF	β	SE	t-stat	R^2	Corr	N
Panel A: Regional Aggregates							
Emerging Markets	MSCI EM vs EEM	1.065***	(0.013)	83.28	0.982	0.991	127
EAFE	MSCI EAFE vs EFA	1.003***	(0.013)	74.76	0.978	0.989	129
Eurozone	Euro Stoxx 50 vs EZU	1.479***	(0.072)	20.49	0.753	0.868	140
Europe	Stoxx Europe 600 vs IEV	1.852***	(0.194)	9.54	0.591	0.769	65
Panel B: Country-Specific Indices							
United Kingdom	FTSE 100 vs EWU	1.527***	(0.095)	16.13	0.657	0.810	138
Germany	DAX vs EWG	1.584***	(0.106)	14.93	0.618	0.786	140
Japan	Nikkei 225 vs EWJ	0.852***	(0.082)	10.45	0.437	0.661	143
Mean		1.337			0.716	0.839	

Notes: This table reports beta regressions of ETF returns on index futures returns during FOMC announcements (30-minute window): $R_{i,t}^{\text{ETF}} = \alpha + \beta \cdot R_{i,t}^{\text{Future}} + \varepsilon_{i,t}$. Index futures represent the gold standard benchmark for measuring contemporaneous foreign market responses. Standard errors in parentheses. All returns winsorised at 1%/99%. Sample: 364 FOMC announcements, 2000–2025. $^{***}\,p < 0.01$, $^{**}\,p < 0.05$, $^{*}\,p < 0.1$ (test $H_0 : \beta = 0$).

4.3.2 Currency Markets

Currency markets provide validation through a different transmission channel. US monetary policy affects foreign equities partly through exchange rates, and if ETFs capture this channel, their returns should correlate with currency movements during the FOMC window.

Table 8 reports correlations between ETF returns and spot foreign exchange returns for 26 countries with matched high-frequency currency data. The mean absolute correlation at the 30-minute horizon is 0.79. The sign pattern confirms quotation conventions: directly quoted pairs (foreign currency per dollar, such as EUR/USD) show positive correlations with ETF returns, while indirectly quoted pairs (dollars per foreign currency, such as USD/JPY) show negative correlations. When the dollar strengthens, directly quoted exchange rates rise and dollar-denominated ETF returns tend to be positive; the reverse holds for indirect quotation.

TABLE 8. ETF and Currency Market Correlations (Selected Countries)

Country	FX Pair	Correlation by Window				N
		30-min	60-min	90-min	120-min	
Panel A: Direct Quotation (XXX/USD)						
Germany	EUR/USD	0.798***	0.787***	0.768***	0.805***	179
Australia	AUD/USD	0.882***	0.870***	0.878***	0.922***	178
United Kingdom	GBP/USD	0.822***	0.805***	0.832***	0.818***	178
France	EUR/USD	0.855***	0.880***	0.861***	0.836***	162
Spain	EUR/USD	0.836***	0.849***	0.819***	0.808***	162
Italy	EUR/USD	0.793***	0.850***	0.850***	0.822***	158
Netherlands	EUR/USD	0.796***	0.832***	0.847***	0.822***	154
Belgium	EUR/USD	0.693***	0.833***	0.825***	0.820***	115
New Zealand	NZD/USD	0.790***	0.878***	0.903***	0.918***	69
Austria	EUR/USD	0.817***	0.860***	0.811***	0.777***	49
Ireland	EUR/USD	0.600***	0.783***	0.841***	0.816***	36
Finland	EUR/USD	0.668***	0.765***	0.653***	0.769***	24
Panel B: Indirect Quotation (USD/XXX)						
South Africa	USD/ZAR	−0.935***	−0.932***	−0.944***	−0.951***	124
Mexico	USD/MXN	−0.924***	−0.913***	−0.900***	−0.896***	122
Turkey	USD/TRY	−0.919***	−0.925***	−0.916***	−0.902***	122
Brazil	USD/BRL	−0.908***	−0.913***	−0.924***	−0.914***	100
Singapore	USD/SGD	−0.897***	−0.898***	−0.882***	−0.870***	136
Canada	USD/CAD	−0.843***	−0.848***	−0.860***	−0.861***	178
India	USD/INR	−0.840***	−0.898***	−0.900***	−0.887***	94
Poland	USD/PLN	−0.838***	−0.847***	−0.905***	−0.913***	108
Sweden	USD/SEK	−0.829***	−0.804***	−0.872***	−0.869***	136
China	USD/CNH	−0.804***	−0.795***	−0.752***	−0.711***	91
Switzerland	USD/CHF	−0.782***	−0.812***	−0.819***	−0.790***	163
Thailand	USD/THB	−0.600***	−0.588***	−0.631***	−0.667***	119
Denmark	USD/DKK	−0.589***	−0.765***	−0.855***	−0.780***	35
Japan	USD/JPY	−0.538***	−0.577***	−0.548***	−0.491***	190
Panel C: Summary Statistics (Absolute Values)						
All (26)		0.792	0.827	0.831	0.824	122
N ≥ 50 (22)		0.815	0.833	0.838	0.832	138
N ≥ 100 (19)		0.815	0.830	0.836	0.830	147
Mean (ex Japan)		0.802	0.837	0.842	0.838	120
Mean (N ≥ 100, ex Japan)		0.831	0.844	0.852	0.849	144

Notes: Table reports correlations between spot FX returns and country ETF returns calculated over 30-, 60-, 90- and 120-minute windows around FOMC announcements. Returns winsorised at 1% level for all countries except Japan and New Zealand (5% winsorisation). FX pairs employ standard market quotation conventions: direct quotation (foreign currency per USD) for Panel A; indirect quotation (USD per foreign currency) for Panel B. Eurozone countries use EUR/USD. Negative correlations in Panel B are mechanically expected: when USD/CAD rises, the Canadian dollar weakens and Canadian equities decline. Panel C reports mean absolute correlations; Japan excluded in final two rows due to carry trade dynamics that complicate FX-equity relationships. N denotes number of FOMC dates with valid observations. All correlations significant at 1% level (*** $p < 0.01$).

Japan again appears as a partial outlier, with a correlation of −0.54 that is notably lower than other major economies. The yen's role as a safe-haven and funding currency may generate dynamics that partially offset the standard exchange rate channel. Excluding Japan, the mean correlation rises to 0.80. The strong coherence between ETF and currency returns indicates that ETFs incorporate the exchange rate channel of monetary policy transmission. This is consistent with the view that ETF returns capture fundamental spillovers operating through multiple channels rather than reflecting narrow equity-market noise.

4.3.3 American Depositary Receipts

American Depositary Receipts offer a final validation. Unlike ETFs, which hold diversified baskets tracking country indices, ADRs represent claims on individual foreign companies. When underlying markets are closed, ADRs—like ETFs—become venues for price discovery as US-based investors trade on new information (Eun and Sabherwal 2003). We construct market-capitalisation-weighted portfolios of the most liquid ADRs for 25 countries with sufficient coverage. Table 9 reports correlations between these ADR portfolios and corresponding country ETFs during FOMC windows.

The mean correlation using market-capitalisation weights at the 30-minute horizon is 0.82. Correlations are higher for countries with more diversified ADR portfolios, reaching 0.88 for the five countries with at least ten actively traded ADRs. Among individual countries, Brazil (0.95), the United Kingdom (0.93), and South Korea (0.90) exhibit particularly strong correspondence.

The coherence between ADR portfolios and ETFs is notable because the two instruments have different compositions. ADR portfolios reflect the market-capitalisation-weighted performance of individual firms, while ETFs track broad indices. The high correlation indicates that both measures respond to the same country-level news rather than idiosyncratic factors.

TABLE 9. ADR Portfolio and ETF Correlations

Panel A: By Portfolio Type and Time Window				
	30-minute	60-minute	90-minute	120-minute
Equal-Weighted	0.777	0.791	0.805	0.817
Market-Cap Weighted	0.823	0.842	0.859	0.876
Volume-Weighted	0.820	0.838	0.854	0.869
Overall	0.807	0.824	0.839	0.854

Panel B: By ADR Portfolio Diversification		
	N Countries	Mean Correlation
All Countries (≥ 1 ADR)	25	0.850
Well-Diversified (≥ 6 ADRs)	12	0.861
Highly-Diversified (≥ 10 ADRs)	5	0.882

Panel C: Selected Countries (Market-Cap Weighted, 30-minute)		
Brazil	10 ADRs	0.946
United Kingdom	10 ADRs	0.925
South Korea	9 ADRs	0.903
Netherlands	7 ADRs	0.879
Japan	9 ADRs	0.811
Mexico	10 ADRs	0.851
Full Sample (25 countries)		0.823

Notes: ADR data from JP Morgan's ADR database and FirstRateData, covering approximately 400 depositary receipts. We retain the top ten ADRs per country by average daily trading volume, or all available ADRs if fewer than ten exist, yielding 157 ADRs across 25 countries. Equal-weighted portfolios assign weight $1/N$ to each ADR; market-capitalisation-weighted portfolios use market capitalisation from JP Morgan; volume-weighted portfolios use average daily trading volume. Returns calculated using 30-, 60-, 90- and 120-minute windows centred on FOMC announcements following the Jarociński-Karadi median methodology. Panel A reports mean correlations across 25 countries after excluding four countries (Finland, Hong Kong, Ireland, Israel) with average correlations below 0.70. Panel B shows correlations by portfolio diversification threshold using market-cap weighted portfolios averaged across all windows. Panel C presents selected major economies using the preferred specification (market-cap weighted, 30-minute window).

4.4 An Illustration: The Brexit Referendum

As a concrete example of country-specific price discovery, consider the Brexit referendum of 23 June 2016. The unexpected Leave vote represented a large shock specific to the United Kingdom. Figure 2 plots the evolution of the iShares MSCI United Kingdom ETF (EWU) and the S&P 500 during the week of the referendum.

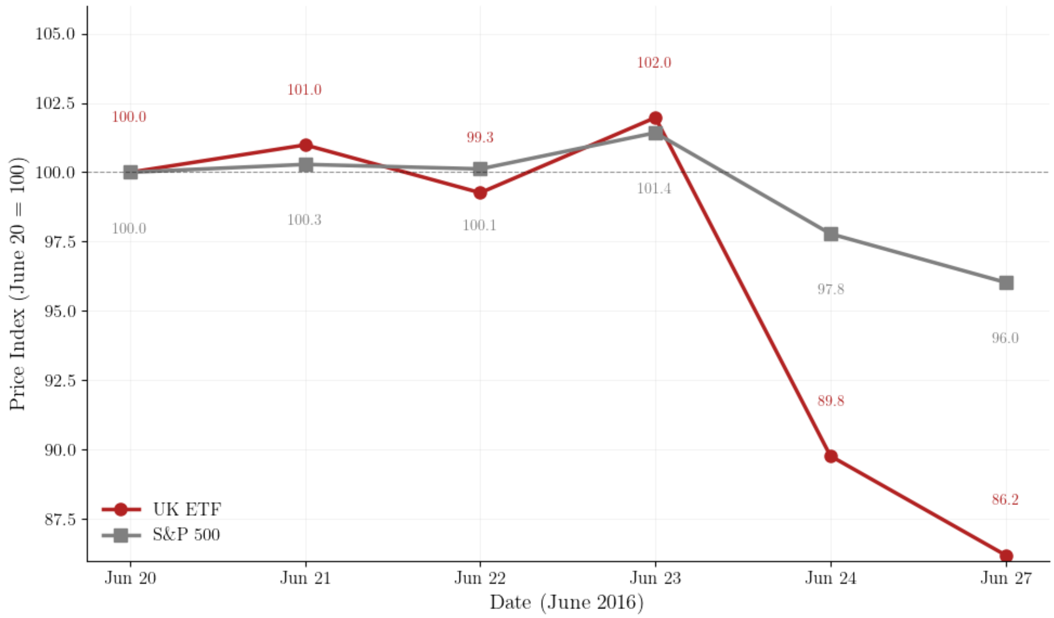

FIGURE 2. Brexit Referendum Week - Average Correlation

Notes: Figure plots daily close prices indexed to 100 on 20 June 2016. The UK referendum on EU membership occurred on 23 June 2016 (voting day), with results announced on 24 June 2016 showing an unexpected Leave vote. EWU is the iShares MSCI United Kingdom ETF. UK ETF captures this large country-specific shock accurately. Data from FirstRate and MSCI.

On 24 June, when results became known, the UK ETF declined sharply while the S&P 500 showed a more modest response. The divergence between the two series isolates the UK-specific component of the shock. This episode illustrates that country ETFs respond to country-specific information even when that information generates movements opposite to or larger than broad US market trends.

Summary of Validation. The cumulative evidence supports the use of ETF returns as measures of international spillovers. The tracking analysis establishes that ETFs provide genuine country exposure at policy-relevant frequencies, with quarterly correlations between ETF and index returns exceeding 0.83 while correlations with the S&P 500 remain at 0.64. The geographic discontinuity test provides sharp evidence for the timing mechanism: ETF returns predict overnight index gaps for closed markets ($\gamma = 0.197$, $t = 5.26$) but not for open markets ($\gamma = 0.010$, $t = 0.36$). This twenty-fold difference in predictive power isolates the informational role of ETFs when underlying markets are closed.

Cross-asset validation demonstrates convergent validity. ETF returns during FOMC windows correlate at 0.84 with index futures, 0.79 with currency markets, and 0.82 with ADR portfolios. This coherence across instruments with independent price formation mechanisms indicates that ETFs capture fundamental country information rather than instrument-specific noise.

With the identification strategy validated, we turn to estimating the magnitude and characteristics of international spillovers.

5. International Spillovers of US Monetary Policy

The preceding validation establishes that high-frequency ETF returns provide a reliable measure of foreign equity market responses during FOMC announcements. We now employ this methodology to address the paper's central empirical questions. How large are the immediate spillovers from US monetary policy to foreign equity markets? How much precision is gained by mitigating the time-zone mismatch that has constrained prior research? And is the transmission universal across countries, or does it vary systematically with country characteristics?

5.1 Baseline Estimates

The starting point is a simple panel regression of foreign equity returns on US monetary policy surprises:

$$R_{i,t} = \alpha + \beta \cdot MPS_t^{\perp} + \varepsilon_{i,t} \tag{11}$$

where $R_{i,t}$ denotes the return for country i in percentage points, $MPS_t^{\perp}$ is the orthogonalised monetary policy surprise from Bauer and Swanson (2023) measured in basis points, and standard errors are clustered by FOMC date. The coefficient β measures how much foreign equity values change, on average, in response to a one-basis-point unexpected tightening of US monetary policy.

The choice of shock measure deserves brief comment. The Bauer and Swanson (2023) measure is constructed exclusively from Fed funds futures and explicitly orthogonalised to pre-announcement equity returns and macroeconomic news. This construction ensures that the shock cannot mechanically correlate with equity market movements, providing a cleaner test of genuine transmission. Alternative approaches that incorporate equity price comovement into the shock identification—such as the sign-restriction methods of Jarociński and Karadi (2020)—can achieve higher explanatory power but risk introducing mechanical correlation between the shock measure and the outcome. We examine these alternatives in Section 6.

Table 10 presents the central comparison between traditional daily-data estimates and our high-frequency approach. The contrast illustrates the severity of the measurement problem we address.

Using daily foreign index returns—the approach standard in the existing literature—the estimated spillover coefficient is −0.027 with a standard error of 0.013. The model explains only 1.5 percent of the variation in daily returns (R^2 = 0.015). This weak result replicates what prior studies have found: statistically marginal effects and low explanatory power that have made it difficult to characterise international transmission with confidence.

The picture changes substantially when we move to 30-minute ETF returns. The coefficient estimate more than triples to −0.084, the t-statistic rises to −10.83, and the R^2 increases to 0.328. This represents a twenty-two-fold improvement in explanatory power. The magnitude of this gain indicates that much of the imprecision in daily-data studies reflects attenuation from overnight contamination rather than genuinely weak transmission. When we measure foreign equity responses during the same narrow window in which the shock is realised, the relationship between US monetary policy and foreign equity values emerges with considerably greater clarity.

The stability of estimates across window lengths provides additional reassurance. As the measurement window expands from 30 to 60, 90, and 120 minutes, the point estimates remain similar (−0.081 to −0.089), though precision declines as the windows incorporate progressively more information unrelated to the FOMC announcement. This pattern is consistent with genuine price discovery occurring rapidly after the announcement, with subsequent price movements reflecting other factors.

TABLE 10. International Spillovers of US Monetary Policy

	Daily	Intraday (ETF)			
	INDEX	30min	60min	90min	120min
Panel A: Baseline Estimates					
$MPS^{\perp}$	-0.027^{**}	-0.084^{***}	-0.081^{***}	-0.087^{***}	-0.089^{***}
	(0.013)	(0.008)	(0.014)	(0.017)	(0.019)
R^2	0.015	0.328	0.211	0.174	0.162
N	6,723	4,400	4,378	4,418	4,447
Panel B: Economic Magnitude					
1 SD impact (%)	−0.15	−0.47	−0.45	−0.49	−0.50
25 bp impact (%)	−0.66	−2.10	−2.02	−2.17	−2.23
R^2 ratio	1.0	22.1	14.2	11.7	10.9
Panel C: Robustness (30min)					
Developed markets		-0.082^{***} (0.008)	[2,503 obs, 21 countries]		
Emerging markets		-0.087^{***} (0.009)	[1,897 obs, 16 countries]		
Winsorisation (2.5%/97.5%)		-0.079^{***} (0.007)	$R^2 = 0.340$		
No winsorisation		-0.134^{**} (0.056)	$R^2 = 0.009$		
Two-way cluster SE		(0.008)	$t = -10.01$		
Bootstrap 95% CI		[−0.099, −0.069], 10,000 iterations			
Panel D: Placebo (10,000 iterations)					
Non-FOMC days		Mean $\hat{\beta} = 0.001$, SD = 0.019, $p < 0.001$			

Notes: Specification: $R_{i,t} = \alpha + \beta \cdot MPS_t^{\perp} + \varepsilon_{i,t}$. Returns in percentage points; shocks in basis points. Standard errors clustered by FOMC date. Sample: 37 countries, 192 FOMC dates. $^{***}p < 0.01$, $^{**}p < 0.05$.

Economic Magnitude. What do these estimates imply in economic terms? A one-basis-point unexpected tightening is associated with an 8.4 basis point decline in foreign equity values—an amplification that reflects the sensitivity of equity valuations to discount rate changes. Scaling to more meaningful shock sizes: a one standard deviation surprise (5.4 basis points) reduces foreign equity values by 0.47 percentage points, while a 25 basis point surprise—uncommon but not unprecedented—implies a 2.10 percent decline.

These percentages translate into substantial dollar amounts. Foreign equity market capitalisation (excluding the United States) exceeds $60 trillion. A typical one standard deviation contractionary surprise therefore corresponds to approximately $280 billion in aggregate value changes within the first thirty minutes of an FOMC announcement. This calculation is necessarily approximate—it assumes uniform percentage responses across markets of different sizes—but it conveys the first-order economic significance of the transmission we document. The Federal Reserve's influence extends far beyond US borders, and does so with remarkable speed.

Robustness. The baseline result survives a battery of specification checks. Developed and emerging markets exhibit similar average responses (−0.082 versus −0.087), a difference that is not statistically significant. This similarity is itself noteworthy: emerging markets, with their greater vulnerability to capital flow reversals and currency mismatch, might have been expected to show substantially larger responses. That they do not suggests that Fed policy operates as a common global factor rather than differentially impacting economies according to their perceived vulnerability.

Alternative approaches to outlier treatment and inference yield consistent conclusions. Tightening the winsorisation threshold from the 1st/99th to the 2.5th/97.5th percentiles produces a nearly identical estimate (−0.079). Removing winsorisation entirely yields a larger point estimate (−0.134) but with a collapsed R^2 of 0.009 as a handful of extreme observations dominate—a reminder of why outlier treatment matters in high-frequency event studies. Two-way clustering by both FOMC date and country yields a t-statistic of −10.01, and a block bootstrap with 10,000 iterations produces a 95 percent confidence interval of $[-0.099, -0.069]$ that comfortably excludes zero.

A placebo exercise confirms that the estimated relationship is specific to FOMC announcement days. We randomly assign the actual monetary policy shocks to non-FOMC trading days and re-estimate the specification. Across 10,000 iterations, the mean placebo coefficient is 0.001 with a standard deviation of 0.019. Not one of the 10,000 placebo draws produces a coefficient as negative as our actual estimate, implying $p < 0.001$. The spillover effect we document is tied to FOMC announcements, not a statistical artefact of return dynamics on arbitrary days.

5.2 Cross-Country Heterogeneity and the Global Financial Cycle

The baseline estimates pool all countries, treating international transmission as homogeneous. This is a useful simplification for establishing average effects, but it obscures potentially important variation. Do all countries respond negatively to US monetary tightening, or do some exhibit zero or even positive responses? Among those that respond negatively, what determines the intensity of transmission?

To address these questions, we estimate the spillover regression separately for each country. Table 11 reports the results for countries with sufficient observations. In the 30-minute window, the coefficient estimates are negative for all countries and statistically significant in each case.

This uniformity in the high-frequency data contrasts markedly with what daily index returns reveal (see in the Table 12). Using traditional daily data, only 35 of 37 countries exhibit negative coefficients, and only 9 achieve statistical significance at the 5 percent level. Two countries—Indonesia and Saudi Arabia—show positive point estimates in daily data, though neither is statistically significant. The transformation when moving to 30-minute ETF returns is striking: all coefficients become negative and significant.

How should we interpret this contrast? One possibility is that the high-frequency measure captures the immediate, common response to US monetary news—a repricing of global discount rates or risk appetite that affects all equity markets within minutes. Daily returns, by contrast, blend this immediate response with subsequent country-specific developments: domestic news, local central bank reactions, and idiosyncratic trading flows that may partially offset or reinforce the initial spillover. The fact that some countries show insignificant or even positive coefficients in daily data may reflect these offsetting forces rather than an absence of immediate transmission.

This interpretation suggests caution about extrapolating our 30-minute estimates to longer horizons. The immediate equity market response to US monetary policy is uniformly negative across countries—this appears to be a robust finding. But over the hours and days that follow, country-specific factors may generate divergent paths. Some countries may experience partial reversals as local conditions reassert themselves; others may see the initial response amplified. Our high-frequency approach isolates the immediate, common component of transmission but cannot speak to these longer-horizon dynamics.

TABLE 11. Cross-Country Spillover Effects (30-Minute Window)

Country	Type	N	$\hat{\beta}^{MPS^{\perp}}$	SE	t-stat	R^2
SOUTH AFRICA	EM	146	−0.142***	0.014	−9.95	0.418
POLAND	EM	99	−0.135***	0.017	−8.13	0.385
BRAZIL	EM	160	−0.113***	0.013	−8.39	0.361
SWEDEN	DM	146	−0.112***	0.010	−11.28	0.478
INDONESIA	EM	101	−0.109***	0.018	−6.11	0.282
AUSTRALIA	DM	161	−0.109***	0.012	−9.09	0.450
TURKEY	EM	117	−0.104***	0.017	−6.04	0.283
FRANCE	DM	144	−0.102***	0.012	−8.18	0.444
SOUTH KOREA	EM	160	−0.099***	0.012	−8.57	0.417
SPAIN	DM	144	−0.097***	0.011	−8.66	0.407
PHILIPPINES	EM	95	−0.094***	0.016	−5.81	0.286
GERMANY	DM	170	−0.092***	0.010	−9.25	0.439
ITALY	DM	140	−0.090***	0.014	−6.34	0.358
CHINA	EM	87	−0.088***	0.013	−6.60	0.346
SWITZERLAND	DM	148	−0.087***	0.010	−8.99	0.433
BELGIUM	DM	114	−0.087***	0.011	−7.81	0.378
INDIA	EM	81	−0.085***	0.015	−5.83	0.273
UNITED KINGDOM	DM	159	−0.084***	0.010	−8.15	0.354
MEXICO	EM	167	−0.082***	0.011	−7.71	0.296
NETHERLANDS	DM	138	−0.080***	0.011	−7.26	0.354
CANADA	DM	161	−0.077***	0.010	−7.81	0.344
TAIWAN	EM	163	−0.075***	0.012	−6.36	0.331
AUSTRIA	DM	127	−0.072***	0.011	−6.62	0.350
IRELAND	DM	35	−0.069***	0.020	−3.47	0.245
HONG KONG	DM	163	−0.069***	0.012	−5.85	0.319
SINGAPORE	DM	161	−0.067***	0.011	−5.97	0.279
JAPAN	DM	193	−0.063***	0.008	−7.81	0.295
NEW ZEALAND	DM	62	−0.061***	0.012	−5.18	0.198
THAILAND	EM	118	−0.059***	0.013	−4.45	0.197
MALAYSIA	EM	159	−0.054***	0.010	−5.22	0.211
CHILE	EM	118	−0.053***	0.009	−5.79	0.233
DENMARK	DM	33	−0.043***	0.015	−2.95	0.266
PERU	EM	87	−0.034***	0.010	−3.42	0.081
ISRAEL	DM	53	−0.027***	0.010	−2.87	0.129
SAUDI ARABIA	EM	39	−0.026***	0.007	−3.76	0.236

Notes: Country-by-country estimates using 30-minute ETF returns (per cent) regressed on $MPS^{\perp}$ (basis points). $MPS^{\perp}$ is the Bauer and Swanson (2023) orthogonalised monetary policy surprise. Standard errors are heteroskedasticity-robust. DM = Developed Market, EM = Emerging Market (MSCI classification). Countries sorted by coefficient magnitude. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

TABLE 12. Cross-Country Spillover Effects (Daily Window)

Country	Type	N	$\hat{\beta}^{MPS^{\perp}}$	SE	t-stat	R^2
BRAZIL	EM	186	-0.058^{***}	0.022	−2.65	0.052
MEXICO	EM	182	-0.052^{***}	0.018	−2.89	0.058
CHINA	EM	175	-0.049^{**}	0.021	−2.31	0.035
TURKEY	EM	135	−0.049	0.033	−1.49	0.025
THAILAND	EM	185	-0.048^{**}	0.020	−2.45	0.056
PERU	EM	87	-0.048^{*}	0.027	−1.76	0.041
CANADA	DM	194	-0.047^{**}	0.019	−2.46	0.050
SOUTH KOREA	EM	184	-0.047^{**}	0.023	−2.07	0.034
HONG KONG	DM	183	-0.042^{*}	0.023	−1.79	0.029
CHILE	EM	167	-0.041^{**}	0.018	−2.37	0.046
JAPAN	DM	177	-0.040^{*}	0.023	−1.78	0.028
SINGAPORE	DM	188	-0.038^{**}	0.016	−2.43	0.042
POLAND	EM	184	−0.034	0.023	−1.47	0.019
TAIWAN	EM	182	−0.031	0.019	−1.60	0.018
PHILIPPINES	EM	189	−0.031	0.019	−1.58	0.021
ISRAEL	DM	191	−0.030	0.019	−1.56	0.027
IRELAND	DM	192	−0.030	0.023	−1.30	0.013
NORWAY	DM	190	−0.027	0.019	−1.41	0.014
NEW ZEALAND	DM	191	-0.026^{**}	0.012	−2.20	0.034
AUSTRALIA	DM	191	-0.024^{*}	0.014	−1.78	0.021
INDIA	EM	183	−0.023	0.023	−1.01	0.011
SPAIN	DM	191	−0.022	0.017	−1.31	0.012
AUSTRIA	DM	188	−0.021	0.017	−1.22	0.012
UNITED KINGDOM	DM	194	−0.018	0.019	−0.98	0.009
SWITZERLAND	DM	188	−0.018	0.015	−1.15	0.011
DENMARK	DM	192	−0.016	0.018	−0.88	0.006
FINLAND	DM	192	−0.015	0.023	−0.68	0.004
NETHERLANDS	DM	191	−0.015	0.018	−0.83	0.005
FRANCE	DM	192	−0.015	0.018	−0.81	0.006
SOUTH AFRICA	EM	160	−0.015	0.020	−0.75	0.004
GERMANY	DM	190	−0.014	0.019	−0.72	0.005
SWEDEN	DM	192	−0.013	0.022	−0.58	0.003
BELGIUM	DM	192	−0.012	0.017	−0.71	0.003
MALAYSIA	EM	184	−0.004	0.013	−0.33	0.001
ITALY	DM	192	−0.003	0.018	−0.17	0.000
INDONESIA	EM	183	+0.002	0.015	+0.16	0.000
SAUDI ARABIA	EM	166	+0.013	0.020	+0.66	0.003

Notes: Country-by-country estimates using daily index returns (per cent) regressed on $MPS^{\perp}$ (basis points). $MPS^{\perp}$ is the Bauer and Swanson (2023) orthogonalised monetary policy surprise. Standard errors are heteroskedasticity-robust. DM = Developed Market, EM = Emerging Market (MSCI classification). Countries sorted by coefficient magnitude. $^{***}\ p < 0.01$, $^{**}\ p < 0.05$, $^{*}\ p < 0.10$.

6. Robustness and Further Analysis

This section evaluates the sensitivity of our baseline findings to potential identification threats and alternative methodological choices. We address three categories of concerns: ETF microstructure effects that could confound the estimated transmission, the choice of monetary policy shock measure, and temporal stability across distinct policy regimes. Throughout, our primary specification employs the Bauer and Swanson (2023) orthogonalised monetary policy surprise ($MPS^{\perp}$), which is constructed exclusively from interest rate derivatives and purged of correlation with equity returns. The goal is to assess whether the baseline estimates reflect genuine international transmission or might instead be artefacts of particular methodological choices.

6.1 Identification Robustness

Two concerns arise with dollar-denominated ETF returns: potential contamination from US market sentiment, and conflation of currency movements with local equity responses. We address both using the Jarociński-Karadi (2020) decomposition.

US Market Co-Movement. The Jarociński-Karadi methodology separates monetary policy (*MP*) from central bank information (*CBI*) shocks via sign restrictions: pure monetary tightening raises interest rates and lowers stock prices, while information shocks move both in the same direction. Because identification incorporates S&P 500 returns, the *MP* shock is orthogonal to US equity sentiment by construction.

Table 13 tests whether adding an explicit S&P 500 control alters our estimates. The S&P 500 coefficient is negligible ($\gamma = -0.002$, $t = -1.62$) and R^2 is unchanged at 0.640. The spillover coefficient β_{MP} increases 13% in magnitude (from −0.096 to −0.109) rather than attenuating, confirming that Jarociński-Karadi identification already absorbs US market co-movement.

Currency versus Equity Channels. Dollar-denominated ETF returns combine currency and local equity movements: $R^{ETF}_{i,t} = R^{LC}_{i,t} + R^{FX}_{i,t}$.

Table 14 decomposes the total spillover by regressing each component on the *MP* shock separately.

TABLE 13. US Market Control Test: Jarociński-Karadi Specification

Specification	β_{MP}	β_{CBI}	γ (S&P 500)	R^2	N	Countries	FOMC dates
Baseline	-0.096^{***}	0.058^{***}		0.640	5,014	37	213
	(0.005)	(0.009)					
+ S&P 500 Control	-0.109^{***}	0.071^{***}	−0.002	0.640	5,014	37	213
	(0.008)	(0.016)	(0.001)				

Notes: Dependent variable is 30-minute ETF return (percentage points). *MP* and *CBI* are Jarociński-Karadi (2020) monetary policy and central bank information shocks (basis points). S&P 500 is the contemporaneous 30-minute return (percentage points). Standard errors clustered by FOMC date in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

TABLE 14. Transmission Channels: Currency versus Equity

Component	β (MP shock)	Share of Total	R^2	N	Countries
Total ($R^{ETF}_{i,t}$)	-0.106^{***}	100%	0.605	3,372	26
	(0.007)				
Currency ($R^{FX}_{i,t}$)	-0.055^{***}	51.7%	0.446	3,372	26
	(0.006)				
Equity ($R^{LC}_{i,t}$)	-0.051^{***}	48.3%	0.351	3,372	26
	(0.004)				

Notes: Dependent variables are 30-minute returns (percentage points). Total is the dollar-denominated ETF return. Currency is the spot FX return, signed so positive indicates foreign currency appreciation against the dollar. Equity is the implied local-currency equity return, computed as $R^{LC}_{i,t} = R^{ETF}_{i,t} - R^{FX}_{i,t}$. *MP* is the Jarociński-Karadi (2020) monetary policy shock (basis points). Sample restricted to 26 countries with matched high-frequency spot FX data. Standard errors clustered by FOMC date in parentheses. $^{***}p < 0.01$.

The currency channel accounts for 52% of the total effect ($\beta^{FX} = -0.055$, $t = -9.20$), reflecting dollar appreciation. The equity channel accounts for 48% ($\beta^{LC} = -0.051$, $t = -12.69$), representing local-currency valuation declines. Additivity holds exactly. A 10 basis point Fed tightening thus destroys 0.51 percentage points of local-currency equity value—real wealth loss independent of exchange rate movements.

These results complement the geographic discontinuity test (Table 5), where ETF returns predict overnight gaps for closed markets ($\gamma = 0.20$) but not open markets ($\gamma = 0.01$). Together, the evidence confirms that our methodology captures genuine international transmission through economically meaningful channels.

6.2 ETF Microstructure

Our identification strategy treats ETF price movements during the FOMC window as reflections of changing expectations about foreign market fundamentals. Two concerns could undermine this interpretation. First, larger monetary policy surprises might coincide with deteriorating trading conditions—wider spreads, reduced liquidity, or increased noise—that could bias the estimated relationship. Second, the results might be driven by liquid ETFs with good price discovery while less liquid instruments contribute noise that happens to align with the pattern.

Trading Conditions and Shock Magnitude. If trading conditions deteriorate systematically when monetary policy surprises are large, our estimates could partly reflect microstructure frictions rather than fundamental repricing. We test this directly by examining whether the high-low trading range during the 30-minute FOMC window—a standard proxy for effective spreads—correlates with shock magnitude:

$$\text{Range}_{i,t} = \alpha + \gamma_1 |\text{MPS}_t^{\perp}| + \varepsilon_{i,t} \tag{12}$$

where $\text{Range}_{i,t}$ is the high-low range expressed as a percentage of the median price for ETF i on date t. We restrict attention to ETFs with at least 100 FOMC observations and exclude dates with extreme shock magnitudes (below the 5th or above the 95th percentile), focusing on normal monetary policy conditions where this test is most informative.

Table 15, Panel A reports the results. The coefficient on shock magnitude is small and statistically insignificant ($\hat{\gamma}_1 = 0.238$, $t = 1.45$). The specification explains less than one percent of trading range variation. Larger surprises do not systematically coincide with wider spreads or more volatile trading conditions. This orthogonality supports the view that microstructure frictions do not confound the estimated spillover effects.

TABLE 15. ETF Microstructure Orthogonality

Panel A: Trading Range–Shock Correlation Test

	Coefficient	SE	t-stat	p-value
$\|MPS^{\perp}\|$ ($\hat{\gamma}_1$)	0.238	0.164	1.45	0.146
R^2		0.005		
Observations		3,302		
Clusters (dates)		169		

Panel B: Spillover Estimates by ETF Liquidity Tercile

Liquidity Tercile	N	$\hat{\beta}^{MPS^{\perp}}$	t-stat	R^2
High	1,986	-0.084^{***}	−10.26	0.343
Medium	1,501	-0.094^{***}	−10.33	0.341
Low	913	-0.067^{***}	−9.04	0.269
Test: $\beta_{High} = \beta_{Low}$		$t = -1.51,\ p = 0.132$		

Notes: Panel A regresses the high-low trading range (as a percentage of the median price) on the absolute value of the Bauer-Swanson orthogonalised monetary policy shock ($MPS^{\perp}$). The sample is restricted to ETFs with at least 100 FOMC observations; dates with shock magnitudes below the 5th or above the 95th percentile are excluded to focus on normal monetary policy conditions. Panel B partitions the sample by average ETF trading volume and estimates the baseline spillover specification for each tercile. High liquidity: Australia, Canada, Germany, Hong Kong, Japan, Singapore, Taiwan, United Kingdom, Mexico, South Korea, Brazil, India, China. Low liquidity: Denmark, Finland, Ireland, Israel, Norway, New Zealand, Philippines, Peru, Belgium, Netherlands, Austria, Thailand. Standard errors clustered by FOMC date. *** $p < 0.01$.

Liquidity and Spillover Estimates. A related concern is that spillover estimates might vary with ETF liquidity. If microstructure noise contaminated the results, we would expect attenuated or erratic coefficients among less liquid ETFs, where price discovery is presumably noisier.

Panel B addresses this concern by partitioning the sample into terciles based on average trading volume and estimating the spillover specification separately for each group. The coefficient estimates are −0.084 for high-liquidity ETFs, −0.094 for medium-liquidity ETFs, and −0.067 for low-liquidity ETFs. All three estimates are highly significant, with t-statistics exceeding 9. The difference between the high and low terciles is not statistically significant ($t = -1.51$, $p = 0.132$).

The R^2 does decline from 0.343 in the high-liquidity tercile to 0.269 in the low-liquidity tercile, consistent with noisier price discovery in thinner markets. But the stability of point estimates indicates that this additional noise does not systematically bias the coefficients. The high-liquidity group includes ETFs for Japan, Germany, the United Kingdom, Brazil, and other major markets; the low-liquidity group includes Austria, Denmark, Finland, and New Zealand. That spillover estimates remain comparable across this range of trading conditions provides reassurance that the methodology captures fundamental transmission.

6.3 Alternative Shock Measures

A methodological concern in the monetary policy surprise literature is that identification strategies incorporating equity responses may conflate policy actions with the revelation of the Fed's private information (Jarociński and Karadi 2020, Bauer and Swanson 2023). We examine whether our results are sensitive to the choice of shock measure by estimating:

$$r_{i,t} = \alpha + \boldsymbol{\beta}'\mathbf{S}_t + \varepsilon_{i,t} \tag{13}$$

where $\mathbf{S}_t$ represents alternative shock constructions: the Bauer and Swanson (2023) $\text{MPS}^{\perp}$ (our baseline), the Jarociński and Karadi (2020) decomposition into pure monetary policy (MP) and central bank information (CBI) components, and the Gurkaynak, Sack, and Swanson (2005)'s Target and Path factors.

Table 16 reports the comparison. The baseline $\text{MPS}^{\perp}$ yields $\hat{\beta} = -0.084$ with $R^2 = 0.328$ (Panel A). The Jarociński-Karadi specification (Panel C) produces $\hat{\beta}^{MP} = -0.098$ for pure monetary policy shocks and $\hat{\beta}^{CBI} = +0.058$ for central bank information shocks. The signs conform precisely to theoretical predictions: contractionary policy depresses foreign equity values, while positive information about US economic conditions raises them. The cross-country correlation of coefficient estimates across the two identification approaches is 0.94, indicating that the ranking of countries by spillover intensity is largely invariant to the choice of shock measure.

The substantially higher R^2 under the Jarociński-Karadi specification (0.632 versus 0.328) reflects a methodological difference rather than superior explanatory content. The J-K identification employs sign restrictions that incorporate S&P 500 responses, creating mechanical correlation between the decomposed shocks and equity returns. The $\text{MPS}^{\perp}$, by construction orthogonal to equity movements, provides an uncontaminated—if lower-powered—test. That coefficient magnitudes and country rankings align closely despite this difference supports the interpretation that our estimates capture genuine transmission rather than statistical artefacts of the identification strategy.

The Gurkaynak, Sack, and Swanson (2005) decomposition (Panel B) separates surprises into a Target factor (unexpected changes in the current policy rate) and a Path factor (unexpected changes in the trajectory of future rates). Using the original factors (1991–2017), the Path coefficient dominates (−0.096, $t = -3.21$) while the Target coefficient is small and insignificant in the joint specification. This pattern suggests that forward guidance has historically been the more potent driver of international spillovers. The recalculated factors extending through 2025 show a stronger Target effect (−0.090), possibly reflecting the return to conventional rate adjustments during the recent tightening cycle.

TABLE 16. Spillover Estimates Across Alternative Shock Measures

	$\hat{\beta}$	SE	t-stat	R^2	N	% Neg
Panel A: Primary Specification						
Bauer-Swanson MPS$^{\perp}$	-0.084^{***}	(0.008)	−10.83	0.328	4,400	100%
Panel B: Gürkaynak-Sack-Swanson Factors						
Original (1991–2017)						
Target (alone)	-0.049^{***}	(0.017)	−2.94	0.093	3,088	
Path (alone)	-0.074^{***}	(0.015)	−5.05	0.151	3,088	
Target + Path (joint)				0.156	3,088	
Target	0.021					
Path	-0.096^{***}					
Recalculated (1991–2025)						
Target (alone)	-0.098^{***}	(0.009)	−11.20	0.314	4,994	
Path (alone)	-0.294^{***}	(0.092)	−3.21	0.099	4,994	
Target + Path (joint)				0.326	4,994	
Target	-0.090^{***}					
Path	-0.107^{**}					
Panel C: Jarociński-Karadi Decomposition						
MP (alone)	-0.106^{***}	(0.007)	−14.47	0.589	4,400	100%
MP + CBI (joint)				0.632	4,400	
MP	-0.098^{***}	(0.006)	−16.51			
CBI	$+0.058^{***}$	(0.010)	+5.88			
Panel D: Coefficient Comparison						
Test $\beta^{BS} = \beta^{JK}$: $\Delta\hat{\beta} = 0.022$, $t = 2.08$, $p = 0.038$						
Cross-country coefficient correlation: $\rho = 0.94$						

Notes: All specifications regress 30-minute ETF returns (percentage points) on monetary policy surprises (basis points). Panel A reports the primary specification using Bauer-Swanson orthogonalised monetary policy surprises constructed exclusively from interest rate derivatives. Panel B reports results using Gürkaynak-Sack-Swanson Target and Path factors decomposing surprises into current rate changes and forward guidance; original factors cover 1991–2017, recalculated factors extend through 2025. Panel C reports results using the Jarociński-Karadi decomposition into pure monetary policy (MP) and central bank information (CBI) shocks. The substantially higher R^2 under J-K (0.63 vs 0.33) partly reflects mechanical correlation, as the sign-restriction identification incorporates S&P 500 responses. Panel D tests coefficient equality across B-S and J-K specifications and reports cross-country correlation of β estimates across 35 countries. Returns winsorised at 1st and 99th percentiles. Standard errors (in parentheses) clustered by FOMC date. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

6.4 Temporal Stability

The sample period spans distinct monetary policy regimes: conventional policy before 2008, the zero lower bound and quantitative easing from 2008 to 2015, gradual normalisation from 2016 to 2019, and the pandemic response followed by aggressive tightening from 2020 onward. We examine whether spillover magnitudes have evolved across these regimes.

Table 17, Panel A reports sub-period estimates. The coefficient is negative and statistically significant in every period, with magnitudes ranging from −0.053 to −0.130. The pre-crisis period (2000–2007) yields $\hat{\beta} = -0.071$. The global financial crisis (2008–2009) shows a larger coefficient of −0.096. The zero lower bound period (2010–2015) exhibits the strongest spillovers ($\hat{\beta} = -0.130$), coinciding with the Federal Reserve's extensive use of quantitative easing and forward guidance. This pattern aligns with evidence that unconventional policies generated stronger international effects than conventional rate adjustments, operating through portfolio balance and signalling channels (Rogers, Scotti, and Wright 2014, Georgiadis 2016).

The normalisation period (2016–2019) maintains elevated spillovers (−0.113), suggesting persistent market sensitivity to Fed actions even after the return to conventional instruments. The most recent period (2020–2025) shows a more modest coefficient (−0.053). This attenuation may reflect improved market capacity to anticipate Fed actions following enhanced communication practices (Blinder et al. 2008), though alternative explanations—including the unusual nature of pandemic-era policy—cannot be ruled out.

Panel B presents formal tests for systematic time variation. We augment the baseline with a linear time index and its interaction with the shock:

$$r_{i,t} = \alpha + \beta_1 \, MPS_t^{\perp} + \beta_2 \, t + \beta_3 \, (MPS_t^{\perp} \times t) + \varepsilon_{i,t} \tag{14}$$

The interaction coefficient is essentially zero ($\hat{\beta}_3 = -0.0001$, $t = -0.05$), providing no evidence of a secular trend in spillover intensity. This null result is somewhat surprising given the deepening financial globalisation documented over this period (Lane and Milesi-Ferretti 2007), though it may reflect offsetting forces: greater integration amplifying transmission while improved communication and market sophistication dampen surprise effects.

TABLE 17. Temporal Stability of Spillover Estimates

	N	FOMC dates	$\hat{\beta}$	SE	t-stat	R^2
Panel A: Sub-Period Estimates						
Pre-GFC (2000–2007)	721	68	−0.071***	0.015	−4.89	0.416
GFC (2008–2009)	393	18	−0.096***	0.022	−4.45	0.377
ZLB (2010–2015)	1,445	48	−0.130***	0.026	−5.01	0.282
Normalisation (2016–2019)	1,065	33	−0.113***	0.015	−7.74	0.458
COVID/Hiking (2020–2025)	776	25	−0.053***	0.013	−4.14	0.319
Full sample	4,400	192	−0.084***	0.008	−10.83	0.328

Panel B: Trend and Crisis Tests	Coefficient	SE	t-stat	p-value	R^2
$\text{MPS}^{\perp} \times$ Year	−0.0001	0.001	−0.05	0.956	0.331
$\text{MPS}^{\perp} \times$ GFC	−0.015	0.023	−0.67	0.502	0.330

Notes: Panel A reports separate regressions for each sub-period. ZLB denotes the zero lower bound period when the Federal Reserve conducted quantitative easing. Panel B reports interaction coefficients from pooled specifications: the trend test includes year (normalised to start at zero), shock, and their interaction; the GFC test includes a crisis dummy (2008–2009), shock, and their interaction. Standard errors clustered by FOMC date. $^{***}\, p < 0.01$.

A separate specification tests for crisis amplification by interacting the shock with a GFC indicator (2008–2009):

$$r_{i,t} = \alpha + \beta_1 MPS_t^{\perp} + \beta_2 GFC_t + \beta_3 (MPS_t^{\perp} \times GFC_t) + \varepsilon_{i,t} \tag{15}$$

The interaction is statistically insignificant ($t = -0.67$). This contrasts with **?**, who document amplified capital flow responses during stress episodes. The discrepancy likely reflects differences in the horizon examined: crisis amplification may operate through slower channels—deleveraging, funding stress, flight to safety—that unfold over days or weeks rather than the thirty minutes our window captures.

The robustness analysis yields three conclusions. First, ETF microstructure does not appear to confound the estimated spillovers: trading conditions are orthogonal to shock magnitude, and coefficient estimates are stable across liquidity terciles. Second, the findings are robust to alternative shock measures, with coefficient magnitudes and cross-country rankings largely preserved across identification strategies. Third, while spillover magnitudes vary across monetary policy regimes—with unconventional policy periods showing larger effects—the core finding of significant negative transmission holds throughout the sample and exhibits no secular trend.

7. Conclusion

This paper addresses a measurement problem that has constrained empirical research on the international transmission of US monetary policy. FOMC announcements occur when most foreign equity markets are closed, forcing researchers to rely on daily returns that blend the Federal Reserve's signal with overnight news from other central banks, macroeconomic releases, and idiosyncratic developments. The resulting attenuation bias and inflated standard errors help explain why the literature has struggled to achieve empirical precision despite strong theoretical priors suggesting substantial transmission.

Our approach exploits US-traded country ETFs, which trade continuously during FOMC announcements while the underlying foreign markets are closed. By measuring foreign equity responses in the same narrow window where the monetary policy shock is realised, we mitigate the contamination that affects daily data. The improvement in precision is substantial: explanatory power increases from $R^2 = 0.015$ using daily index returns to $R^2 = 0.328$ using 30-minute ETF returns. This suggests that much of the imprecision in prior work reflected measurement noise rather than weak underlying transmission.

The identification strategy rests on the theory of asynchronous price discovery, which generates testable predictions. We validate the approach through a geographic discontinuity: for the 31 countries whose markets are closed during FOMC announcements, ETF returns predict the subsequent overnight index gap with coefficient $\gamma = 0.197$ ($t = 5.26$); for the 5 American markets trading simultaneously, the coefficient is $\gamma = 0.010$ ($t = 0.36$). This contrast is difficult to attribute to country characteristics and instead isolates the timing mechanism central to our identification. Cross-asset validation provides additional support: ETF returns correlate with index futures (0.84), currency markets (0.81), and ADR portfolios (0.82) during the FOMC window, suggesting they capture broad market responses rather than instrument-specific noise.

The baseline estimates indicate that a one-basis-point unexpected tightening of US monetary policy is associated with an 8.4 basis point decline in foreign equity values. The coefficient estimates are negative for all countries in the sample and statistically significant in each case. This consistency across countries with diverse exchange rate arrangements, capital account policies, and levels of development suggests that US monetary policy operates through channels affecting equity valuations broadly (shifts in global discount rates or risk appetite, for example) rather than through bilateral linkages specific to individual countries.

The economic magnitudes are substantial. A one standard deviation contractionary surprise corresponds to approximately $280 billion in aggregate foreign equity value changes within thirty minutes. These estimates are robust to alternative shock measures: the Jarociński and Karadi (2020) decomposition yields theoretically consistent signs (negative for pure policy shocks, positive for information shocks), and country-level coefficient rankings are preserved across identification strategies (ρ = 0.94). The core finding holds across sub-periods spanning conventional policy, the zero lower bound, and the recent tightening cycle, though magnitudes vary with the policy regime.

The findings speak to the global financial cycle hypothesis (Rey 2015). The speed and breadth of transmission (significant effects across all countries within thirty minutes) are consistent with US monetary policy driving a common factor in global asset prices. Neither floating exchange rates nor capital controls appear to provide substantial immediate insulation, at least as measured through equity market responses. Hong Kong's currency board and Sweden's floating krona generate spillover coefficients of similar magnitude; China's capital controls do not insulate its equity market from immediate effects.

Several caveats temper these conclusions. Our 30-minute window captures immediate financial market repricing but cannot speak to longer-horizon adjustments. Exchange rate flexibility may provide insulation through subsequent price and output dynamics that unfold over months rather than minutes. The equity market is only one dimension of financial conditions; credit spreads, bank lending, and other channels may exhibit different patterns. And the uniformity of immediate responses in high-frequency data contrasts with the heterogeneity observed in daily data, suggesting that country-specific factors reassert themselves over longer horizons.

These limitations notwithstanding, the findings carry implications for understanding monetary interdependence. The substantial and immediate effects of Federal Reserve actions on foreign equity markets underscore the reach of US monetary policy beyond domestic borders. The results suggest that while countries retain control over short-term policy rates, their broader financial conditions remain linked to Federal Reserve actions in the immediate term. To the extent that insulation is achievable, it may depend more on reducing financial vulnerabilities through macroprudential policy than on the choice of exchange rate regime, though our evidence speaks only to immediate equity market responses, not to the full range of adjustment mechanisms available to policymakers.

Beyond the specific findings on monetary spillovers, this paper demonstrates that continuously traded proxy assets can address the time-zone mismatch problem in cross-border event studies. The methodology applies to any setting where a significant announcement occurs when primary markets are closed but related instruments continue trading. Country ETFs, ADRs, and currency markets all provide windows into foreign market expectations during periods of asynchronous trading. This approach may prove useful for studying the international impact of central bank communications, macroeconomic releases, and other events where timing creates identification challenges.

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