FOMC Announcements and European Index Futures: Monetary Policy vs. Central Bank Information Shocks in the Overnight Session

Özcan Ceylan

Özyeğin University, Turkey

July 19, 2026

Abstract

I examine the overnight transmission of FOMC announcements to three European index futures markets — FTSE 100, DAX 40, and CAC 40 — by decomposing each release into a monetary policy (MP) shock and a central bank information (CBI) shock following Jarociński & Karadi (2020). Using 204 matched events from 2000 to 2025, I document four main findings. First, MP shocks generate a significant negative overnight return in the FTSE and DAX, while CBI shocks produce a larger positive response. Second, Wald tests confirm that these effects are fully absorbed within the overnight session: next-day coefficients are statistically indistinguishable from zero. This session-specific price discovery identifies European index futures as rapid processors of U.S. monetary policy news. Third, the CAC 40 responds only to MP shocks; its CBI coefficient is consistently zero, attributable to its distinct sectoral composition. Fourth, illiquidity amplifies the MP shocks in the DAX, consistent with a microstructural price-impact mechanism. Results survive winsorisation, sub-period splits, alternative outlier thresholds, HAC bandwidth variation, and the Bauer & Swanson (2023) alternative shock series.

Keywords: FOMC; monetary policy shock; central bank information; European index futures; overnight session; speed asymmetry; Jarociński & Karadi decomposition; price-impact moderation.

JEL: E52, E58, G12, G14, G15, F36.

1 Introduction

Federal Reserve policy decisions move asset prices across borders within minutes. A large and growing literature documents this transmission: Fed tightening compresses European financial conditions, raises global risk premia, and propagates to real activity in advanced and emerging economies (Ehrmann & Fratzscher, 2009; Miranda-Agrippino & Rey, 2020; Ca' Zorzi et al., 2023; Degasperi et al., 2026). The channels through which this transmission occurs have been studied extensively (Cesa-Bianchi & Sokol, 2022). Yet two important questions remain incompletely answered. First, how rapidly is FOMC information absorbed in European equity markets, and does the effect persist beyond the immediate session? Second, do the distinct informational components of each FOMC announcement (exogenous policy surprises versus the Fed's implicit signal about economic conditions) transmit differently across European markets and overnight market structures? This paper addresses both questions.

Measuring the effect of FOMC announcements on European equity markets poses a non-trivial identification problem. FOMC decisions are released at 14:15 ET after European equity markets have already closed for the day. The natural benchmark, European opening prices on the following morning, reflects not only the FOMC announcement but also the remainder of the U.S. trading session, overnight global risk movements, Asian market activity, and any news that arrived between the FOMC release and the European open. Isolating the FOMC signal from this bundle of overnight developments is difficult using opening session prices or daily returns.

Overnight European index futures could offer a cleaner setting. The Eurex DAX 40, Euronext CAC 40, and ICE FTSE 100 futures markets all maintain extended overnight sessions that are active at the time of the FOMC release. At that hour, European macro releases have concluded, European equity markets are closed, and the information environment is dominated by the FOMC announcement itself. By measuring returns in a narrow window immediately surrounding the announcement, one can minimize the probability that any other confounding information arrived within the estimation interval (Gürkaynak et al. (2005)). The overnight futures setting is therefore methodologically preferable to opening-price approaches. This identification argument is further supported by the empirical results: the near-zero next-day coefficients indicate that the overnight window successfully absorbs the FOMC information, with no systematic continuation into the next-day opening session.

A naïve approach would treat the FOMC announcement as a single scalar surprise (i.e., the unexpected change in the federal funds rate) as in the early literature following Kuttner (2001) and Bernanke & Kuttner (2005). But Gürkaynak et al. (2005) showed that a single factor is insufficient: FOMC announcements contain at least two distinct dimensions, with the future path of policy factor that is associated with FOMC statements accounting for $75-90\%$ of the variation in Treasury yields. JK2020 formalized this with a sign-restricted decomposition that extracts two orthogonal components: a *monetary policy* (MP) shock, capturing exogenous surprises to the federal funds rate, and a *central bank information* (CBI) shock, capturing the market's inference about the Fed's private assessment of economic conditions. These two shocks have opposite theoretical implications for risky asset prices: unexpected tightening (positive MP shock) depresses equity prices through the discount-rate channel, while a positive CBI shock can support valuations through the cash-flow channel even when accompanied by a rate increase, because it signals that the Fed perceives stronger fundamentals (Nakamura & Steinsson, 2018; Jarociński & Karadi, 2020). The need to disentangle these components is straightforward: high-frequency policy surprises conflate the two, generating the apparent puzzle in which some rate hikes are followed by equity price increases (Romer & Romer, 2000; Miranda-Agrippino & Ricco, 2021). Jarociński (2022) applied the JK2020 decomposition to study transatlantic spillovers in bond and equity markets at daily and monthly frequencies, finding that central bank information effects account for a large share of cross-border co-movement. I extend this analysis to three European equity index futures markets, to the overnight session rather than the trading day, and with a formal test of whether price discovery is complete within the overnight window.

The role of market microstructure in conditioning overnight shock transmission is motivated by a distinct strand of the literature. Kyle (1985) established that informed order flow generates larger price impacts in less liquid markets. Lagos & Zhang (2020) documented empirically that unexpected monetary tightening reduces stock turnover, with price effects systematically larger for less liquid equities, establishing a liquidity channel through which monetary policy operates via market structure. In overnight futures sessions where order books are notably thinner than in daytime trading, spreads are wider, and market-making activity is sparser (Barclay & Hendershott, 2003), this mechanism predicts that the same shock will generate a larger price response when pre-announcement liquidity is lower. Order flow imbalance (OFI), defined as net signed tick volume following Lee & Ready (1991) and consistent with the bid-ask framework of Glosten & Milgrom (1985), provides a complementary microstructure measure: if shocks drive genuine price discovery rather than temporary dislocations, they should generate directionally consistent order flow alongside the return response.

Using 204 matched FOMC events from 2000 to 2025 and one-minute futures data for the FTSE 100, DAX 40, and CAC 40, I document four main results.*First*, both MP and CBI shocks generate significant overnight returns in the FTSE and DAX with signs that are consistent with theory: unexpected tightening reduces returns by 0.106% (FTSE) and 0.081% (DAX), while a positive CBI shock raises them by 0.133% and 0.188%, respectively. These effects are stable across specifications and are corroborated by OFI regressions: MP shocks generate significant net selling pressure in all three markets, while CBI shocks generate net buying in the FTSE and DAX, confirming that price discovery is driven by genuine order flow rather than quote revision alone. *Second*, Wald tests confirm that these overnight effects are fully absorbed within the overnight session: overnight coefficients are statistically distinct from next-day coefficients in the FTSE and DAX, while next-day coefficients are indistinguishable from zero in every case. Extending the next-day window from 30 to 60 minutes leaves the Wald statistics unchanged or larger, ruling out the interpretation that the overnight return reflects a temporary price dislocation rather than genuine price discovery. To my knowledge, this is the first formal test of overnight price discovery for FOMC shocks in European index futures, extending the price-formation framework of Fleming & Remolona (1999) from U.S. Treasury markets to European equity futures. *Third*, the CAC 40 provides an informative contrast: the MP channel is present ($\hat{\beta}^{MP} = -0.074$, $p < 0.10$), but the CBI coefficient is consistently zero across all specifications and in the OFI regressions. I attribute this to the CAC's distinct sectoral composition, discussed in Section 4. *Fourth*, illiquidity amplifies the MP response in the DAX ($\hat{\beta}^{MP\times\lambda} = -0.033$, $p < 0.05$), consistent with the Kyle (1985) and Lagos & Zhang (2020) mechanism: thinner overnight order books amplify the price impact of informed order flow in response to MP shocks.

The remainder of the paper is organised as follows. Section 2 describes the data and summary statistics. Section 3 presents the empirical strategy. Section 4 reports the main results. Section 5 discusses robustness of the results. Section 6 concludes.

2 Data and Summary Statistics

I used one-minute OHLCV bars for three European index futures: the FTSE 100 (FFI contract, ICE Futures Europe), the DAX (FDAX contract, Eurex), and the CAC 40 (FCE contract, Euronext Paris), covering the period from January 2000 to July 2025. Underlying tick data are sourced from TickDataMarket. Continuous one-minute bars are constructed using a volume-based rollover rule: at each minute, the active contract is the one with the highest cumulative trading volume on that calendar day, rolling from the front-month to the back-month contract when the back-month's volume exceeds the front-month's. This ensures series continuity at quarterly expiry boundaries without introducing spurious price jumps at roll dates.

From the tick data, I constructed several pre-event microstructural control variables over the 30-minute pre-announcement window: *Log pre-event volume* is the natural logarithm of mean per-bar contract volume in the window, capturing overall activity level. *Realized variance* is the log-transformed sum of squared log-returns over the pre-event window and measures the pre-announcement price uncertainty. The *Roll spread* (Roll, 1984) is computed as $2\sqrt{-\widehat{\mathrm{Cov}}(\Delta P_t, \Delta P_{t-1})}$ over the trading day to proxy for the effective bid-ask spread in the sense of Glosten & Milgrom (1985). A fourth variable, the *Amihud illiquidity ratio* (Amihud, 2002), computed as $|\text{log-return}|/(P \times V)$, averaged over the pre-event window, log-transformed, and winsorised at p1/p99, is employed as a price-impact moderator (λ_t) to test whether overnight illiquidity amplifies the shock coefficients. The Amihud measure and the Roll spread thus play complementary rather than interchangeable roles: the Roll spread measure captures the cost of immediacy as a liquidity control, while the Amihud ratio captures the permanent price impact of order flow as a moderating variable. *Order flow imbalance* (OFI) is computed by classifying trade volume into buyer- and seller-initiated components using the Lee & Ready (1991) algorithm. This last measure is computed for the post-announcement window to test whether the JK2020 shocks generate directionally consistent order flow.

The primary shock series are obtained from Jarociński & Karadi (2020), who decomposed each FOMC announcement into two orthogonal components using a sign-restricted identification applied to high-frequency changes in federal funds futures and S&P 500 returns in a 30-minute window around each announcement. The *monetary policy* (MP) shock captures exogenous surprises to the policy rate, to which interest rates and equity prices respond in opposite directions. The *central bank information* (CBI) shock captures the market's inference about the Fed's private assessment of economic conditions, to which both respond in the same direction.

I use the median rotation as the baseline identification scheme, in which both shocks may be simultaneously present in each announcement with magnitudes determined by the rotation that best satisfies the sign restrictions at the median. As a robustness check, I also use the poor man's sign restriction, which applies the more restrictive assumption that only one shock dominates each announcement. The raw shock series are publicly available from https://marekjarocinski.github.io. Both series are standardized to unit variance before estimation. The empirical orthogonality condition is satisfied: the Pearson correlation between MP and CBI shocks in the full JK2020 sample is $r = -0.04$ (Table 1, Panel C), confirming independence by construction.

I compiled FOMC announcement dates and precise local release times from Bloomberg. Each announcement time is converted to local European market time. The standard release corresponds to 19:15 GMT for the FTSE and 20:15 CET for the DAX and CAC in winter, with adjustments during the weeks when U.S. and European daylight-saving time (DST) transitions do not coincide. Merging the shock series with futures data yields 204 matched FOMC events from February 2000 to July 2025, but after applying the pre-event data filter (minimum three valid one-minute bars in the pre-announcement window), the effective sample sizes become 136 (FTSE), 195 (DAX), and 163 (CAC) at the event level.

As a further robustness check, I also use the Bauer & Swanson (2023) orthogonalized monetary policy surprise series downloaded from the Federal Reserve Bank of San Francisco open-access data page. This series standardizes high-frequency futures rate changes orthogonally with respect to six publicly available macroeconomic and financial predictors. Results that are obtained using this alternative identification are reported in Section 5.

Table 1 presents descriptive statistics for the sample. Across the 204 matched FOMC events, effective sample sizes differ by market, reflecting differences in overnight session liquidity and data availability. The DAX has the largest usable sample (195 events at the event level, skip rate 4.4%), consistent with the deep liquidity of the Eurex overnight session. The FTSE and CAC have higher skip rates of 33% and 20%, respectively, driven mainly by insufficient pre-event bar availability in the 30-minute window before the announcement. FTSE coverage is effectively limited to the post-GFC period: only five events match before 2009, so the post-2009 subsample ($N = 129$) is the primary FTSE analysis sample.[1]

Overnight returns (Panel B of the Table 1) are small on average. Mean returns range from -0.01% to $+0.03\%$ across markets and windows but exhibit important standard deviations between 0.24% and 0.30% in the primary $W_{[0,\,30]}$ window), pointing to the existence of both informative and non-informative FOMC meetings in the sample. A simple validation of the shock identification emerges from the sign pattern: conditioning on hawkish events (positive $\widehat{S}^{MP}$) yields negative mean overnight returns in all three markets (FTSE: -0.055%; DAX: -0.095%; CAC: -0.049%), while dovish events generate positive returns of comparable magnitude. Next-day returns ($ND_{[0,\,30]}$) are near zero in all markets and show no sign pattern consistent with the shocks, providing preliminary

[1]Full-sample results are identical to post-GFC results; see Table A3, Panel C. The expansion of extended-hours trading on the ICE platform after mid-2009 accounts for the sharp improvement in FTSE overnight coverage.

evidence of overnight price discovery.

As stated before, the JK2020 shock series (Panel C) are orthogonal by construction ($r = -0.044$). The shocks are approximately symmetric throughout the sample: MP shocks are positive in 53% of events, negative in 47%, confirming that the series is not dominated by any particular policy regime.

Pre-event microstructure statistics (Panel D) reveal an important asymmetry across markets. The FTSE Amihud illiquidity measure exhibits severe right skew in the overnight session (max/p75 $= 2.4 \times 10^{10}$), reflecting periods of near-zero trading volume in individual one-minute bars. This numerical instability makes the FTSE Amihud unsuitable as a price-impact moderator, and the FTSE is therefore excluded from the related specification in the empirical analysis. The DAX and CAC Amihud distributions are well-behaved (max/p75 ratios of 5 and 16, respectively) and support reliable estimation of the moderating effect.

Table 2 reports intraday volume ratios on FOMC announcement days relative to the same hour on non-FOMC days. Per-bar volume is elevated across all three markets at the time of the FOMC release: 2.95x for the DAX, 2.25x for the FTSE, and 1.95x for the CAC. These ratios confirm that the overnight sessions are actively traded at the time of the announcement, supporting the identification assumption that price changes in the event window reflect genuine information processing rather than thin-market noise.

3 Empirical Strategy

For each FOMC event, at announcement time t_0, I define two return windows. The *overnight window* $W_{[0,30]}$ is the 30-minute log-return immediately following the release,

$$r_{W,t} = \log\Big(P_{t_0+30}/P_{t_0}\Big) \times 100, \tag{1}$$

capturing the price discovery that takes place within the overnight session itself.

The *next-day window* $ND_{[0,30]}$ is the 30-minute return at the opening of the following European session,

$$r_{ND,t} = \log\Big(P_{\text{open}+30}/P_{\text{open}}\Big) \times 100, \tag{2}$$

If the overnight session fully incorporates the FOMC announcement, the next-day coefficient should be near zero and statistically indistinguishable from zero. A supplementary 90-minute window $W_{[0,90]}$ is reported in Appendix Table A1.

I then estimate three specifications for each market–window combination. The *baseline specification* (M1) regresses the overnight return on the two JK2020 shock components:

$$r_{W,t} = \alpha + \beta_1 \hat{S}_t^{MP} + \beta_2 \hat{S}_t^{CBI} + \varepsilon_t. \tag{3}$$

This parsimonious specification reveals the association between the shocks and overnight returns, without conditioning on pre-announcement market conditions. It serves as the primary reference throughout and tests whether the MP and CBI channels operate in the overnight session.

The *controlled specification* (M2) adds pre-event microstructure controls:

$$r_{W,t} = \alpha + \beta_1 \hat{S}_t^{MP} + \beta_2 \hat{S}_t^{CBI} + \boldsymbol{\gamma}' \mathbf{z}_{pre,t} + \varepsilon_t, \tag{4}$$

where $\mathbf{z}_{pre,t}$ is a vector of pre-announcement conditions: log pre-event volume, log realized variance, and Roll spread, each standardized to unit variance. M2 tests whether the shock coefficients from M1 reflect genuine transmission or are confounded by pre-announcement liquidity and volatility. The stability of $\hat{\beta}_1$ and $\hat{\beta}_2$ across M1 and M2 would itself be informative: large changes would indicate that the shocks correlate with pre-event conditions in a way that contaminates the overnight return.

The *price-impact moderator specification* (M3) augments M2 with an interaction between the MP shock and overnight illiquidity:

$$r_{W,t} = \alpha + \beta_1 \hat{S}_t^{MP} + \beta_2 \hat{S}_t^{CBI} + \beta_3 \hat{\lambda}_t + \beta_4 \hat{S}_t^{MP} \cdot \hat{\lambda}_t + \beta_5 \hat{S}_t^{CBI} \cdot \hat{\lambda}_t + \boldsymbol{\gamma}' \mathbf{z}_{pre,t} + \varepsilon_t, \tag{5}$$

where $\hat{\lambda}_t = \log(1 + \text{Amihud}_t)$, winsorized at p1/p99 and standardized, proxies for the price impact of order flow (Pastor & Stambaugh, 2003). The interaction term β_4 tests whether the same MP shock generates a larger price response in illiquid sessions, consistent with the Kyle (1985) mechanism in which wider bid-ask spreads and thinner order books amplify informed-flow price impact. M3 is estimated for the DAX and CAC only, as the FTSE Amihud measure is numerically unstable in the overnight session.

To test formally whether the FOMC information is absorbed within the overnight session rather than spilling into the following trading day, I compare the overnight and next-day shock coefficients using the Wald statistic:

$$H_0 : \ \hat{\beta}^{shock}_{W_{[0,30]}} = \hat{\beta}^{shock}_{ND_{[0,30]}}. \tag{6}$$

The test is implemented as

$$z = \frac{\hat{\beta}_{on} - \hat{\beta}_{nd}}{\sqrt{\widehat{SE}^2_{on} + \widehat{SE}^2_{nd}}}, \tag{7}$$

treating the overnight and next-day estimates as independent. This is conservative test as the two windows are estimated on overlapping event dates, so positive covariance between the estimates would make the denominator larger and the test harder to reject. Rejection of H_0 indicates that the overnight coefficient differs significantly from the next-day coefficient. That is, FOMC information is processed within the overnight window and does not persist systematically into the following European session. All standard errors are Newey-West HAC (Newey & West, 1987) with bandwidth $\ell = \lfloor N^{1/3} \rfloor$. Events where $|r_{W_{[0,30]}}| > 3\sigma$ of the cross-event distribution are treated as outliers and excluded from the main analysis; their inclusion is explored in Appendix Table A3, Panel A.

4 Results

Table 3 reports the baseline (M1) and controlled (M2) estimates for the primary overnight window $W_{[0,30]}$. The results are compatible across specifications: adding pre-announcement microstructure controls in M2 leaves all coefficients virtually unchanged, confirming that the shock effects are not confounded by pre-event liquidity or volatility conditions. For the *FTSE 100*, both the MP and CBI shocks are highly significant and opposite in sign, consistent with theory. A one-standard-deviation positive MP shock generates an overnight return of -0.106% ($p < 0.001$); a positive CBI shock generates $+0.133\%$ ($p < 0.001$). The adjusted R^2 of 0.35 is high for a parsimonious event-study specification. M2 coefficients are virtually unchanged (-0.109% and $+0.131\%$), and results are statistically indistinguishable between the full sample and the post-2009 subsample (Appendix Table A3, Panel C). The *DAX* pattern mirrors the FTSE with somewhat different magnitudes. The MP coefficient is -0.081% ($p < 0.001$) and the CBI coefficient is $+0.188\%$ ($p < 0.001$), yielding an adjusted R^2 of 0.39 which is the highest in the sample. Notably, the CBI effect is more than twice the absolute MP effect in magnitude, suggesting that the Fed's economic signal dominates the discount-rate channel for DAX investors in the overnight session. This seems to be consistent with the DAX's heavy weighting in export-oriented industrials that are highly sensitive to the U.S. growth outlook conveyed by the CBI shock. For the *CAC 40*, the MP coefficient is negative and marginally significant (-0.074%, $p < 0.10$ in M1; -0.079%, $p < 0.05$ in M2), but the CBI coefficient is consistently zero across all specifications and does not become significant in any sub-period or robustness check. The absence of a CBI channel in the CAC can be attributed to its underlying sectoral composition. The CAC carries a predominant weight in consumer discretionary and luxury goods that are relatively immune to severe macroeconomic shifts. The CBI shock, which primarily conveys the Fed's assessment of U.S. economic conditions, is most directly capitalized through rate-sensitive bank and insurance valuations. While this channel is structurally attenuated in the CAC, the FTSE's large financial sector and the DAX's export-oriented industrials have direct exposure to the Fed's growth signal[2].

Table 6 reports regressions of standardized OFI on the JK2020 shocks, providing a microstructure mechanism for the return evidence. MP shocks generate significantly

[2] The CAC MP response is economically smaller than for the FTSE and DAX, consistent with a lower share of rate-sensitive financial stocks. However, the OFI results below show that MP shocks generate the strongest net selling pressure in the CAC (-0.401%, $p < 0.05$) — indicating that MP news does reach CAC traders and trigger repositioning, even if the resulting price impact is attenuated relative to the other markets.

negative OFI (net selling pressure) in all three markets in the primary window: -0.178% for the FTSE ($p < 0.10$), -0.267% for the DAX ($p < 0.05$), and -0.401% for the CAC ($p < 0.05$). The CAC exhibits the largest order flow response to the MP shock despite a return coefficient (-0.074%) that is statistically weaker than those of the FTSE and DAX, though economically comparable in magnitude. The implied ratio of order flow to return is substantially higher for the CAC than for the other two markets, suggesting that a given amount of selling pressure translates into less permanent price movement in the CAC overnight session. This could be due to a higher proportion of transient, liquidity-driven order flow that is absorbed without lasting price impact. CBI shocks generate positive OFI in the FTSE and DAX ($+0.144\%$ and $+0.271\%$, $p < 0.10$), consistent with informed net buying in response to a positive economic signal. The CAC CBI-OFI coefficient is practically zero ($+0.005\%$, $p = 0.99$), reinforcing the return evidence: CAC traders do not incorporate the Fed's economic outlook signal into overnight positioning.

Table 5 reports the price-impact moderator specification (M3) for the DAX and CAC. For the DAX, the interaction between the MP shock and overnight illiquidity (λ_t) is negative and significant ($\hat{\beta}^{MP\times\lambda} = -0.033$, $p < 0.05$): in more illiquid overnight sessions, the same MP shock generates a larger negative return, consistent with the Kyle (1985) mechanism in which thinner order books amplify the price impact of informed algorithmic repositioning. The CBI interaction for the DAX is insignificant (-0.014, $p = 0.40$) while for the CAC, it is negative and significant ($\hat{\beta}^{CBI\times\lambda} = -0.054$, $p < 0.01$). However, this finding should be interpreted cautiously: the main CBI coefficient for the CAC is zero, so the interaction does not amplify an established channel but rather captures a conditional pattern that cannot be generalized across the full sample[3].

The Wald test results comparing overnight and next-day shock coefficients, which constitutes the paper's central empirical contribution are reported in the Table 4. For the FTSE, the overnight MP coefficient (-0.106) is statistically distinct from the next-day

[3]Replacing the log-Amihud moderator with the Roll (1984) spread (Appendix Table A3, Panel D) leaves the DAX MP interaction sign unchanged but renders it insignificant; the CAC CBI interaction also loses significance. This sensitivity indicates that the moderating role of illiquidity is identified through the Amihud measure's price-impact dimension rather than the bid-ask cost dimension captured by the Roll spread. I therefore characterize the M3 results as suggestive rather than conclusive.

coefficient (+0.022), with Wald $z = -2.74$ ($p < 0.01$); the CBI coefficient diverges even more sharply ($z = +4.91$, $p < 0.001$). For the DAX, both comparisons are similarly large and significant (MP: $z = -3.11$; CBI: $z = +2.88$; both $p < 0.01$). For the CAC, the MP contrast is significant ($z = -2.40$, $p < 0.05$), while the CBI Wald statistic is trivially near zero ($z = -0.006$), consistent with the absence of a CBI channel[4]. Three features of these results deserve emphasis. First, the next-day coefficients are near zero in every case where the overnight coefficient is significant: there is no evidence that the FOMC effect continues into the following European opening session, consistent with complete overnight absorption. Two features of these results deserve emphasis. First, the next-day coefficients are near zero in every case where the overnight coefficient is significant: there is no evidence that the FOMC effect continues into the following European opening session, confirming that both shocks are completely absorbed during the overnight session. Second, the results are robust to extending the next-day window from 30 to 60 minutes (Appendix Table A3, Panel D): Wald statistics are unchanged or larger, ruling out the alternative interpretation that the overnight return reflects a temporary price dislocation caused by thin overnight order books that reverses over a longer horizon rather than representing genuine information-driven price discovery.

5 Robustness

I conduct seven robustness checks given in Tables A2 and A3. The main findings (significant MP and CBI channels in the FTSE and DAX, absence of the CBI channel in the CAC, and complete overnight absorption) are stable across all alternative specifications.

The first set of checks concerns the construction of the dependent variable and inference. Trimming overnight returns at p1/p99 (R1) leaves all coefficients virtually unchanged, confirming that extreme moves do not drive the results. Standard errors are numerically

[4]In the present setting, where overnight coefficients are significant and next-day coefficients are near zero, the Wald test largely confirms what the individual estimates already suggest. But the test would be more valuable in a setting where both windows yield significant coefficients of the same sign, as would arise, for example, if price discovery were spread across both the overnight and daytime sessions, in which case the test provides a formal assessment of whether the magnitude of the effect differs significantly across sessions.

identical across HAC bandwidths of 2, 4, 6, and 8 (R2), as expected in event-study designs with serially uncorrelated residuals. Varying the outlier exclusion threshold between 2.5σ and 3.5σ (R3) produces no qualitative change in the FTSE and DAX results; the CAC MP coefficient strengthens slightly at the tighter threshold $(-0.102, p < 0.001)$ but the CBI null is preserved throughout.

The second set of checks concerns the shock identification. Panel A3 compares three series: the baseline JK2020 median rotation, the JK2020 poor man's sign restriction (in which exactly one shock dominates each announcement), and the Bauer & Swanson (2023) orthogonalized monetary policy shocks. The poor man's series yields smaller but sign-preserving coefficients for both channels in the FTSE and DAX. The BS2023 series which provides a single monetary policy shock without a separate CBI component produces a negative and significant coefficient across all three markets ($-0.098, -0.082, -0.076$; all $p < 0.05$), confirming that the MP channel is not an artefact of the JK2020 decomposition.

Sub-period analysis (R5, Panel C) shows that the DAX results are stable across pre- and post-GFC subsamples, with both MP and CBI channels significant in each period. Excluding the COVID-19 year (2020) and the zero lower bound exit year (2022) leaves results unchanged or slightly stronger. The remaining two checks, the price-impact proxy (R6) and the next-day window extension (R7), have already been discussed in the context of the M3 and overnight price discovery results above.

6 Conclusion

This paper studies how FOMC shocks are transmitted to three European index futures markets during the overnight session, exploiting the clock mismatch that places the FOMC release at approximately 20:15 CET, after European equity markets are closed but during active overnight futures trading. Using the Jarociński & Karadi (2020) decomposition into monetary policy (MP) and central bank information (CBI) shocks, I document four main findings.

The MP and CBI channels both operate significantly in the FTSE 100 and DAX 40 overnight sessions, with signs consistent with theory and magnitudes that are stable across alternative specifications. For the DAX, the CBI effect is more than twice the absolute MP effect, suggesting that the Fed's private assessment of economic conditions, not the discount-rate surprise, is the dominant driver of the overnight price discovery. Order flow regressions confirm that both shocks generate directionally consistent net buying or selling pressure, indicating that the return evidence reflects genuine repositioning rather than quote revision alone.

A formal Wald test establishes that both shock effects are fully absorbed within the overnight window: overnight coefficients are large and significant, while next-day coefficients are statistically not different from zero in every case. Extending the next-day window to 60 minutes leaves the Wald statistics unchanged or larger, ruling out the alternative that the overnight return reflects a temporary price dislocation that reverses at the following open. European overnight index futures are therefore rapid and autonomous processors of U.S. monetary policy news, with no systematic spillover into the following daytime session.

The CAC 40 provides a structurally informative contrast. While the MP channel is present and significant, the CBI channel is consistently absent across all specifications and is confirmed by the OFI regressions. This heterogeneity is consistent with the CAC's structurally lower Financials and Industrials weight relative to the FTSE and DAX, which attenuates the transmission of the Fed's economic outlook signal through rate-sensitive valuations.

Finally, pre-event illiquidity moderates the MP shock effect in the DAX: the same tightening surprise generates a larger overnight return when the order book is thinner, consistent with the Kyle (1985) price-impact mechanism. This finding links overnight monetary policy transmission directly to market microstructure conditions.

References

Amihud, Y. (2002). Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets*, 5(1), 31–56.

Barclay, M.J., & Hendershott, T. (2003). Price discovery and trading after hours. *Review of Financial Studies*, 16(4), 1041–1073.

Bauer, M.D., & Swanson, E.T. (2023). A reassessment of monetary policy surprises and high-frequency identification. *NBER Macroeconomics Annual*, 37, 87–155.

Bernanke, B.S., & Kuttner, K.N. (2005). What explains the stock market's reaction to Federal Reserve policy? *Journal of Finance*, 60(3), 1221–1257.

Bodart, V., & Reding, P. (1999). Exchange rate regime, volatility and international correlations on bond and stock markets. *Journal of International Money and Finance*, 18(1), 133–151.

Ca' Zorzi, M., Dedola, L., Georgiadis, G., Jarociński, M., Stracca, L., & Strasser, G. (2023). Making waves: Monetary policy and its asymmetric transmission in a globalized world. *International Journal of Central Banking*, 19(2), 95–144.

Cesa-Bianchi, A., & Sokol, A. (2022). Financial shocks, credit spreads, and the international credit channel. *Journal of International Economics*, 135, 103543.

Degasperi, R., Hong, S., & Ricco, G. (2026). The global transmission of U.S. monetary policy. *Journal of International Economics*, 161, 104259.

Ehrmann, M., & Fratzscher, M. (2009). Global financial transmission of monetary policy shocks. *Oxford Bulletin of Economics and Statistics*, 71(6), 739–759.

Fleming, M.J., & Remolona, E.M. (1999). Price formation and liquidity in the U.S. Treasury market. *Journal of Finance*, 54(5), 1901–1915.

Glosten, L.R., & Milgrom, P.R. (1985). Bid, ask, and transaction prices in a specialist market with heterogeneously informed traders. *Journal of Financial Economics*, 14(1), 71–100.

Gürkaynak, R.S., Sack, B., & Swanson, E.T. (2005). Do actions speak louder than words? The response of asset prices to monetary policy actions and statements. *International Journal of Central Banking*, 1(1), 55–93.

Jarociński, M. (2022). Central bank information effects and transatlantic spillovers. *Journal of International Economics*, 139, 103683.

Jarociński, M., & Karadi, P. (2020). Deconstructing monetary policy surprises — the role of information shocks. *American Economic Journal: Macroeconomics*, 12(2), 1–43.

Kuttner, K.N. (2001). Monetary policy surprises and interest rates: Evidence from the Fed funds futures market. *Journal of Monetary Economics*, 47(3), 523–544.

Kyle, A.S. (1985). Continuous auctions and insider trading. *Econometrica*, 53(6), 1315–1335.

Lagos, R., & Zhang, S. (2020). Turnover liquidity and the transmission of monetary policy. *American Economic Review*, 110(6), 1635–1672.

Lee, C.M., & Ready, M.J. (1991). Inferring trade direction from intraday data. *Journal of Finance*, 46(2), 733–746.

Miranda-Agrippino, S., & Rey, H. (2020). U.S. monetary policy and the global financial cycle. *Review of Economic Studies*, 87(6), 2754–2776.

Miranda-Agrippino, S., & Ricco, G. (2021). The transmission of monetary policy shocks. *American Economic Journal: Macroeconomics*, 13(3), 74–107.

Nakamura, E., & Steinsson, J. (2018). High-frequency identification of monetary non-neutrality. *Quarterly Journal of Economics*, 133(3), 1283–1330.

Newey, W.K., & West, K.D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica*, 55(3), 703–708.

Pastor, L., & Stambaugh, R.F. (2003). Liquidity risk and expected stock returns. *Journal of Political Economy*, 111(3), 642–685.

Roll, R. (1984). A simple implicit measure of the effective bid-ask spread in an efficient market. *Journal of Finance*, 39(4), 1127–1139.

Romer, C.D., & Romer, D.H. (2000). Federal Reserve information and the behavior of interest rates. *American Economic Review*, 90(3), 429–457.

Table 1: Descriptive Statistics

Panel A: Event coverage

Market	Events	$W_{[0,30]}$ N	$W_{[0,90]}$ N	$ND_{[0,30]}$ N	Pre-GFC	Post-GFC	Skip%
FTSE 100	136	136	136	136	5	131	33.3
DAX	195	153	153	193	67	128	4.4
CAC 40	163	106	107	160	35	128	20.1

Panel B: Overnight returns (%)

Market	Window	N	Mean	Std	Median	P95
FTSE	$W_{[0,30]}$	133	+0.027	0.241	+0.039	0.435
FTSE	$W_{[0,90]}$	133	+0.035	0.488	+0.067	0.641
FTSE	$ND_{[0,30]}$	133	−0.035	0.281	0.000	0.326
DAX	$W_{[0,30]}$	149	−0.011	0.277	+0.021	0.420
DAX	$W_{[0,90]}$	149	+0.026	0.560	+0.052	0.917
DAX	$ND_{[0,30]}$	189	−0.038	0.399	−0.039	0.604
CAC	$W_{[0,30]}$	106	−0.008	0.298	+0.012	0.491
CAC	$W_{[0,90]}$	107	−0.026	0.520	+0.026	0.697
CAC	$ND_{[0,30]}$	160	−0.010	0.325	−0.011	0.512

Panel C: JK2020 shock series (2000–2025)

Variable	Mean	Std	Median	r(MP,CBI)
MP shock	−0.007	0.056	−0.002	−0.04
CBI shock	−0.003	0.023	0.000	

Panel D: Pre-event microstructure (30-min window)

Market	Variable	N	Mean	Median	P95
FTSE	log(volume)	133	3.62	3.54	4.81
FTSE	Roll spread	133	0.68	0.56	1.11
FTSE	Amihud ($\times 10^9$)†	133	—	3.1	10.7
DAX	log(volume)	191	3.60	3.56	4.57
DAX	Roll spread	191	0.62	0.52	1.08
DAX	Amihud ($\times 10^9$)	191	6.6	4.3	20.7
CAC	log(volume)	163	3.16	3.20	4.45
CAC	Roll spread	163	0.37	0.32	0.87
CAC	Amihud ($\times 10^9$)	163	25.6	12.3	85.2

Notes: Panel A: Total merged FOMC events with JK2020 shocks = 204; skip rate measures events with insufficient pre-announcement bars. FTSE pre-GFC coverage is minimal ($N = 5$); the effective FTSE sample is post-2009 ($N = 129$). Panel B: outlier events ($|r_{W_{[0,30]}}| > 3\sigma$) excluded. Panel C: r(MP,CBI) is the Pearson correlation; near-zero value confirms orthogonality of the JK2020 decomposition. Panel D: Amihud = |log-return|$/(P \times V)$ per bar, window mean; FTSE mean suppressed (max/p75 $= 2.4 \times 10^{10}$, highly right-skewed; excluded from M3).

Table 2: Intraday Volume Profile — FOMC vs. Non-FOMC Days

Market	Ann. hour	Ann. hour ratio	Adjacent hour	Adjacent ratio
FTSE 100	h=19 (UTC)	2.25×	h=20 (post)	1.27×
DAX	h=20 (CET)	2.95×	h=19 (pre)	1.35×
CAC 40	h=20 (CET)	1.95×	h=19 (pre)	1.75×

Notes: Ratio = mean per-bar volume on FOMC days divided by mean on non-FOMC days within the same clock hour. FOMC announcements at ≈14:15 ET correspond to ≈19:15 UTC for the FTSE (h=19) and ≈20:15 CET for DAX and CAC (h=20). For FTSE, h=20 is the post-announcement hour; for DAX and CAC, h=19 is the pre-announcement hour.

Table 3: Main Results: FOMC Shock Transmission to European Overnight Futures

	FTSE 100		DAX		CAC 40	
	M1	M2	M1	M2	M1	M2
$\hat{S}^{MP}$	-0.1061	-0.1087	-0.0811	-0.0801	-0.0739	-0.0793
	(0.0229)***	(0.0255)***	(0.0249)***	(0.0239)***	(0.0381)*	(0.0358)**
$\hat{S}^{CBI}$	$+0.1334$	$+0.1310$	$+0.1880$	$+0.1802$	-0.0102	-0.0073
	(0.0286)***	(0.0296)***	(0.0266)***	(0.0313)***	(0.0496)	(0.0532)
log(pre-vol)		$+0.0009$		$+0.0170$		-0.0608
		(0.0293)		(0.0348)		(0.0366)*
log(RV)		-0.0209		-0.0207		$+0.0354$
		(0.0247)		(0.0330)		(0.0383)
Roll spread		$+0.0033$		-0.0074		-0.0544
		(0.0045)		(0.0133)		(0.0327)*
Constant	-0.0021	-0.0024	-0.0423	-0.0409	-0.0110	-0.0199
	(0.0178)	(0.0179)	(0.0163)***	(0.0178)**	(0.0232)	(0.0231)
N	133	133	149	149	106	106
Adj. R^2	0.349	0.341	0.386	0.378	0.046	0.043

Notes: Dependent variable: $r_{W_{[0,30]},t}$ (overnight return, %, window $[t_0, t_0 + 30\text{ min}]$). M1 includes only MP and CBI shocks; M2 adds pre-event microstructure controls. Both shocks standardised to unit variance. HAC standard errors (Newey-West, $\ell = \lfloor N^{1/3} \rfloor$) in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Events with $|r_{W_{[0,30]}}| > 3\sigma$ excluded.

Table 4: Overnight vs. Next-Day Wald Test

Market	Shock	Overnight $W_{[0,30]}$	Next-day $ND_{[0,30]}$	Wald z	p-value
FTSE	MP	-0.1061^{***}	$+0.0216$	-2.740	0.006^{***}
FTSE	CBI	$+0.1334^{***}$	-0.0740^{**}	$+4.907$	$<0.001^{***}$
DAX	MP	-0.0803^{***}	$+0.0377$	-3.115	0.002^{***}
DAX	CBI	$+0.1886^{***}$	$+0.0141$	$+2.876$	0.004^{***}
CAC	MP	-0.0730^{*}	$+0.0671$	-2.402	0.016^{**}
CAC	CBI	-0.0234	-0.0231	-0.006	0.995

Notes: Overnight and next-day coefficients estimated separately from M1 regressions. Wald statistic: $z = (\hat{\beta}_{on} - \hat{\beta}_{nd})/\sqrt{\widehat{SE}^2_{on} + \widehat{SE}^2_{nd}}$ (conservative, treats samples as independent). H_0: overnight coefficient equals next-day coefficient. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 5: Price-Impact Moderator (M3): DAX and CAC

	DAX	CAC 40
$\hat{S}^{MP}$	-0.0751	-0.0808
	$(0.0192)^{***}$	$(0.0250)^{***}$
$\hat{S}^{CBI}$	$+0.1887$	$+0.0641$
	$(0.0249)^{***}$	(0.0549)
$\hat{\lambda}$ (log-Amihud$_z$)	$+0.0117$	-0.0280
	(0.0175)	(0.0258)
$\hat{S}^{MP} \times \hat{\lambda}$	-0.0330	$+0.0296$
	$(0.0149)^{**}$	(0.0244)
$\hat{S}^{CBI} \times \hat{\lambda}$	-0.0142	-0.0543
	(0.0167)	$(0.0196)^{***}$
Constant	-0.0426	-0.0124
	$(0.0161)^{***}$	(0.0244)
N	149	106
Adj. R^2	0.384	0.144

Notes: Dependent variable: $r_{W_{[0,30]},t}$. $\hat{\lambda} = \log(1 + \text{Amihud}_t)$, winsorised p1/p99, z-scored (Pastor & Stambaugh 2003). Controls log(pre-vol) and log(RV) included but not shown. FTSE excluded: Amihud max/p75 $= 2.4 \times 10^{10}$ (see Table 1). HAC standard errors in parentheses. $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 6: Abnormal Order Flow Imbalance

	FTSE 100		DAX		CAC 40	
	$W_{[0,30]}$	$W_{[0,90]}$	$W_{[0,30]}$	$W_{[0,90]}$	$W_{[0,30]}$	$W_{[0,90]}$
$\hat{S}^{MP}$	-0.1775	-0.1553	-0.2671	-0.1704	-0.4011	-0.3085
	$(0.0897)^{*}$	(0.1075)	$(0.1037)^{**}$	$(0.0770)^{**}$	$(0.1757)^{**}$	$(0.1640)^{*}$
$\hat{S}^{CBI}$	$+0.1437$	-0.0185	$+0.2706$	$+0.1863$	$+0.0047$	$+0.0153$
	$(0.0822)^{*}$	(0.1086)	$(0.1542)^{*}$	(0.1377)	(0.1695)	(0.1728)
N	133	133	149	149	106	107

Notes: Dependent variable: standardised order flow imbalance (OFI) in the stated window. OFI = sum of signed tick volume (Lee & Ready 1991), standardised to unit variance within each market-window cell. HAC standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$.

Appendix: Additional Results and Robustness Tables

Table A1: Main Results: Secondary Window $W_{[0,90]}$

	FTSE 100		DAX		CAC 40	
	M1	M2	M1	M2	M1	M2
$\hat{S}^{MP}$	−0.124	−0.114	−0.069	−0.072	+0.003	−0.018
	(0.089)	(0.080)	(0.082)	(0.079)	(0.067)	(0.056)
$\hat{S}^{CBI}$	+0.086	+0.097	+0.120	+0.140	+0.118	+0.127
	(0.155)	(0.150)	(0.129)	(0.114)	(0.079)	(0.074)*
N	133	133	149	149	107	107
Adj. R^2	0.058	0.050	0.032	0.020	0.044	0.050

Notes: Dependent variable: $r_{W_{[0,90]},t}$. Specifications as in Table 3.
$^{*}p < 0.10$.

Table A2: Robustness: R1 Winsorisation and R2 HAC Bandwidth

		FTSE		DAX		CAC	
Check	Specification	MP	CBI	MP	CBI	MP	CBI
Panel A: R1 — Winsorisation of overnight returns (p1/p99)							
R1	Baseline	−0.106***	+0.133***	−0.081***	+0.188***	−0.074*	−0.010
R1	Winsorised	−0.105***	+0.129***	−0.080***	+0.183***	−0.076**	−0.004
Panel B: R2 — HAC bandwidth (coefficients identical across lag 2–8; SE reported for lag=4)							
R2	HAC lag=2	−0.106***	+0.133***	−0.081***	+0.188***	−0.074**	−0.010
R2	HAC lag=4	−0.106***	+0.133***	−0.081***	+0.188***	−0.074*	−0.010
R2	HAC lag=8	−0.106***	+0.133***	−0.081***	+0.188***	−0.074*	−0.010

Notes: M1 specification. Panel B: point estimates are numerically identical across HAC bandwidths, confirming minimal serial correlation in event-study residuals. Default bandwidth: $\lfloor N^{1/3} \rfloor = 5$.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A3: Additional Robustness: R3 Outlier Threshold, R4 Shock Series, R5 Sub-period, R7 Next-day Window

		FTSE		DAX		CAC	
Check	Specification	MP	CBI	MP	CBI	MP	CBI
Panel A: R3 — Outlier threshold sensitivity							
R3	2.5σ	-0.104^{***}	$+0.123^{***}$	-0.081^{***}	$+0.188^{***}$	-0.102^{***}	$+0.050$
R3	3.0σ (baseline)	-0.106^{***}	$+0.133^{***}$	-0.081^{***}	$+0.188^{***}$	-0.074^{*}	-0.010
R3	3.5σ	-0.079^{**}	$+0.140^{***}$	-0.068^{**}	$+0.206^{***}$	-0.074^{*}	-0.010
Panel B: R4 — Shock series comparison							
R4	JK median (baseline)	-0.106^{***}	$+0.133^{***}$	-0.081^{***}	$+0.188^{***}$	-0.074^{*}	-0.010
R4	JK pm series	-0.076^{***}	$+0.079^{***}$	-0.058^{**}	$+0.170^{***}$	-0.067^{*}	-0.022
R4	BS2023 (single)	-0.098^{***}	—	-0.082^{***}	—	-0.076^{**}	—
Panel C: R5 — Sub-period analysis							
R5	Post-GFC ($\geq$2009)	-0.106^{***}	$+0.156^{***}$	-0.071^{*}	$+0.202^{***}$	-0.061	$+0.088^{*}$
R5	Excl. COVID (2020)	-0.118^{***}	$+0.124^{***}$	-0.096^{***}	$+0.177^{***}$	-0.092^{**}	-0.023
R5	Excl. ZLB (2022)	-0.098^{***}	$+0.146^{***}$	-0.071^{***}	$+0.201^{***}$	-0.044	-0.011
R5	Full sample	-0.106^{***}	$+0.133^{***}$	-0.081^{***}	$+0.188^{***}$	-0.074^{*}	-0.010
Panel D: R7 — Speed-asymmetry Wald test, alternative next-day window							
R7	Wald z (MP): $ND_{[0,30]}$	-2.74^{***}		-3.11^{***}		-2.54^{**}	
R7	Wald z (MP): $ND_{[0,60]}$	-3.09^{***}		-3.98^{***}		-2.40^{**}	
R7	Wald z (CBI): $ND_{[0,30]}$	$+4.91^{***}$		$+3.57^{***}$		$+0.34$	
R7	Wald z (CBI): $ND_{[0,60]}$	$+5.71^{***}$		$+3.46^{***}$		$+0.33$	

Notes: Panels A–C: M1 specification; MP and CBI coefficients reported. Panel B: BS2023 uses a single orthogonalised MPS shock (no CBI component). Panel D: Wald statistic as in Table 4; $ND_{[0,60]}$ uses first 60 minutes of next European session. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.