"What moves the market? Individual firms' earnings announcements versus macro releases as drivers of index returns"

Abstract

In this paper, we characterize the relative importance of two sources of fundamental market-wide news—large firms' earnings announcements and macroeconomic releases. Our investigation is motivated by growing concerns in the financial community about the increasing impact of *individual* firms' news on the broad stock market indices and the disconnect between the stock market and the economy at large. We leverage the S&P500 index futures data and use narrow intraday and overnight windows to isolate the market-wide reactions to earnings and macro announcements. We find that earnings announcements represent an economically significant source of index-level market activity—an average earnings announcement experiences around 21% (47%) of abnormal volatility (trading volume) associated with an average macroeconomic release. The returns earned over earnings announcement windows serve as a significant driver of daily index price movement. Importantly, earnings announcements' contribution to index-level volatility has been relatively stable over our sample period from 2004 to 2018, while we observe a drastic decrease in the volatility explained by macro announcements. The latter is consistent with a growing disconnect between the stock market and the broader macroeconomy.

1. Introduction

What moves the price of a stock index? This question is of particular importance to a diversified investor holding a broad portfolio of stocks. The two primary sources of fundamental news relevant for index prices are the releases of macroeconomic indicators and firms' disclosures (e.g., Anilowski, Feng and Skinner 2007; Bonsall, Bozanic and Fischer 2013; Baker, Bloom, Davis, Sammon 2021). Despite a large macro-accounting literature, evidence on the relative importance of these disclosures as a timely source of market-wide news is scarce.[1] Yet, this question has gained more importance recently due to the dual concerns about the increasing impact of *individual* firms' news on the broad stock market indices and the disconnect between the stock market and the economy at large (e.g., Bessembinder 2018; Flynn and Ghent 2020; Schlingemann and Stulz 2020; Byun and Schmidt 2020).[2] To fill this gap, we address two research questions: How do individual large firms' disclosures compare to macro announcements as a driver of stock index price movement? Has the relative importance of these two news sources changed over time?

Our empirical tests use the return and volume information from the S&P 500 e-mini futures market at the intra-hour frequency. The S&P 500 e-mini (ticker ES) is one of the most liquid products traded on the Chicago Mercantile Exchange (CME).[3] The S&P 500 e-mini market is uniquely suitable for evaluating the news sources relevant for equity investors for two reasons. First, the majority of price discovery for the S&P 500 index occurs in the futures market, with futures prices typically leading the spot prices (Hasbrouck 2003).[4] Second, the e-mini futures contracts are traded round the clock, providing an ideal setting for gauging the arrival of the news around earnings and macro announcements, a substantial portion of which falls outside the regular stock exchange trading hours. The ability to isolate an immediate market reaction to the announcements is especially crucial for

[1] In a contemporaneous paper, Kim, Schonberger, Wasely, and Yang (2020) investigate the timeliness of accounting earnings as a source of aggregate news after controlling for the news for a set of macroeconomic indicators. We discuss the complementarity between our paper and Kim et al. in detail in the literature review section.

[2] Similar concerns have also been expressed by the media in recent years with editorial pieces titled "A few big stocks don't tell the whole market story" (Carlson 2017, Bloomberg); "Just three stocks are responsible for most of the market's gain this year" (Sheetz 2018, CNBC); "Rising stock market would be in the red without a handful of familiar names" (Lynch 2020, The Washington Post); "The disconnect between the economy and Wall Street" (Constable 2016; U.S. News); "Don't confuse Dow Jones records for overall economic prosperity" (Jacobs 2017, The Hill); "The disconnect between the markets and economy has grown" (Roberts 2019, Seeking Alpha); "It's NOT the economy. It's buy-backs" (Barone and Great Speculations 2019, Forbes).

[3] Prior research has relied on the S&P 500 e-mini futures to document information release and price discovery around various macroeconomic announcements (Lucca and Moench 2015; Bernile, Hu, and Tang 2016; Cieslak, Morse, Vissing-Jorgensen 2019, Hu, Pan, and Wang 2017 , and Kurov, Sancetta, Strasser and Wolfe 2019).

[4] Since its introduction in September 1997, the S&P 500 e-minis have been the fastest growing product in CME's history (Kurov and Lasser 2004). The size of the e-mini contract is one-fifth of the regular S&P 500 futures contract traded on the floor of CME, which makes them more accessible for traders with limited amount of capital.

measuring the index reaction to *individual* firms' disclosures, because the richness of the information environment at the market-wide level exacerbates the identification issues posed by same-day news (e.g., Li, Ramesh, Shen, and Wu 2015).

Our sample consists of 9,809 earnings-announcement windows for the 100 firms with the largest market capitalization and 9,399 macro-release windows between 2004 and 2018.[5,6] Each announcement window consists of the 15-minute interval that the announcement falls into (time *t*) and the two adjacent 15-minute intervals (*t*-1, *t*+1) to account for the pre- or post-announcement drifts (e.g., Bernile et al. 2016; Kurov et al. 2019).

To tackle our first research question, we compare individual large firms' earnings announcements (EAs) to macro announcements (MAs) as a driver of the index-level market activity within our full sample period. Our empirical strategy follows a two-pronged approach. First, we infer the presence of index-wide information associated with the announcements by measuring the abnormal market activity for the S&P 500 e-mini contracts within the announcement windows.[7] These tests, in the spirit of Beaver (1968), measure new information release. In particular, we estimate the time-series regressions of either the return volatility or the trading volume measured over the 15-minute intervals on the EA and MA window indicators.[8] The time-series regressions include fixed effects that account for the time interval, day of the week, year, and calendar quarter, and control for the announcement timing within the monthly news calendar, as well as microstructure effects (e.g., volume or volatility autocorrelation and futures contract rollover periods).

Our results suggest that individual firms' EA intervals are associated with significant index-level abnormal volatility and trading volume. The absolute returns (volume) around EAs are on average 0.5 basis points (9%) higher than in the non-announcement intervals. The magnitude of abnormal volatility (volume) associated with EAs is also economically significant, representing 21% (47%) of average abnormal volatility (volume) associated with MAs. When compared to macro releases that exclude the major announcements (unemployment, FOMC, inflation, and GDP advance

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5 Although the S&P 500 e-mini contracts have been introduced in 1997, the initial trading hours had an overnight gap. Round-the-clock trading started in 2004 (e.g., Bondarenko and Muravyev 2020). Section 2 provides more details on the futures contract and the institutional features of the futures market.

6 The futures prices and trading volume measured at 15-minute intervals are obtained from Pi Trading Inc. The earnings announcement information, including the date and time of the release, actual earnings and consensus analyst expectations, is from I/B/E/S. We check I/B/E/S timestamps against the news wire times in Ravenpack and use the earlier of the two in our tests (e.g., Bradley, Clarke, Lee, and Ornthanalai 2014). Additional accounting data are from Compustat. The macroeconomic indicator information, including the date and time of the release is from Haver Analytics. Section 3 provides the full list of macroeconomic announcements examined.

7 In this paper, we use index-wide and market-wide interchangeably.

8 The volatility measure is the absolute value of continuously compounded return (e.g., Andersen and Bollerslev 1997).

releases), the magnitude of abnormal volatility (volume) associated with EAs is even more pronounced at 39% (80%) of the respective MA magnitudes.[9] The results are qualitatively similar when we exclude the Great Recession period (December 2007 – June 2009). Overall, our results suggest that the largest firms' EAs exert significant influence on index prices and the effect is of the same order of magnitude as the macroeconomic releases.

Our second approach examines the proportion of the daily index return variation explained by the announcement-window returns, similar to Ball and Shivakumar (2008) R-squared tests. This analysis gauges the overall contribution of earnings and macro announcements to the index's price discovery at the daily frequency, providing a link to prior research that examines stock market reactions to corporate disclosures using daily returns (e.g., Cready and Gurun 2010, Anilowski et al. 2007, Bonsall et al. 2013; Kim et al. 2020). In particular, we regress the daily futures returns on the cumulative returns earned over the EA or MA windows and report the results of the R-squared decomposition (Shapley, 1953).[10]

We find that the returns earned over EA and MA windows together explain around 10% of the daily futures return. The stand-alone EA (MA) window returns account for 4.3% (5.3%) of the daily futures returns. Taking into account that earnings and macro announcements represent only 2.6% and 2.5% of trading intervals in our sample, respectively, both announcement windows account for an abnormally high portion of daily returns. When we exclude the Great Recession period (December 2007 – June 2009), the portion of the daily return variation explained by returns earned around EAs and non-major MAs decreases, suggesting that corporate disclosures may be particularly useful to the investors during economic downturns. Overall, the amount of daily index price variation that is explained by the returns traced to the narrow windows surrounding large firms' EAs is similar to the amount explained by the returns earned around MAs.

[9] The relatively high magnitudes of the abnormal market reactions over the EA intervals suggest that our results are unlikely to be entirely driven by the idiosyncratic returns of the largest S&P 500 index constituents having a mechanical association with index returns. For comparison, Frankel, Johnson, and Skinner (1999) document that firms in their sample experience an average absolute return of 1.77% over the 75-minute window surrounding the earnings announcement, compared to 0.8% average absolute return over the control period, i.e. the earnings announcements are associated with a 0.97% abnormal absolute return. As regular returns do not differ significantly from continuously compounded returns over short intervals, this is equivalent to 0.97% / 5 = 0.19% 15-minutes abnormal absolute return. The average weight (by market capitalization) of the largest 100 firms in the S&P500 index is 0.75%. Thus, when a large firm announces earnings, the mechanical change in the index return should be 19 basis points * 0.75% = 0.14 basis points, which is significantly lower than the average abnormal absolute return of 0.5 basis points that we observe in our sample.

[10] The days are defined as 4:00 pm the previous day to 4:00 pm the present day (i.e., close-to-close) to match the CRSP convention for daily return calculation. We use the residual returns obtained from regressing the raw continuously compounded 15-minute returns on the control variables and fixed effects from the abnormal volatility regressions (except the lags of the dependent variable). However, the results (untabulated) are qualitatively similar if we use raw returns.

We continue with the same two-pronged approach when addressing our second research question on the intertemporal variation in the relative importance of EAs and MAs as the drivers of index-level returns. We first estimate the trends in abnormal volatility associated with EAs and MAs and find that both have been decreasing over our sample period. These results differ from the previously documented increase in the informativeness of EAs for the individual stock returns (Beaver, McNichols, and Wang 2018, 2020; Shao, Stoumbos, Zhang 2021). In addition, we observe a pronounced spike in the abnormal volatility over the EA intervals around the onset of the financial crisis in 2008, which also runs contrary to the firm-level evidence of a lower level of EA informativeness over the 2008-2009 period (Beaver et al. 2020). The elevated aggregate abnormal volatility around EAs during the recessionary periods is, however, consistent with a greater demand for financial information during periods of high aggregate uncertainty (Bonsall, Green, Muller 2020). Using the 90-day trailing-average implied volatility index (VIX) as an uncertainty measure, we confirm that the abnormal volatility over both the EA and MA intervals increases with VIX. Controlling for VIX subsumes a significant coefficient on the recession indicator for the EAs, but it does not fully subsume a downward trend in either the EA or MA abnormal volatility.

The analysis of the changes in the relative contribution of the EA and MA interval returns to the daily index price discovery paints a somewhat different picture. The contribution of EA-interval returns to the daily index return variation decreases only slightly (from 4.29% in the earlier half of the sample to 3.96% in the later half). By contrast, the percentage of daily index return variation explained by the MA-interval returns decreases drastically from 6.95% to 2.06%, a level that is below the fraction of intervals occupied by MAs (2.73%). The drastic drop in the contribution of MA-window returns has made the EA-window returns a primary contributor to the daily index price movement over the last decade of our sample.[11] Collectively, these results are consistent with a growing disconnect between the stock market and the macroeconomy leading to a waning effect of macro releases on the stock index prices (e.g., Schlingemann and Stulz 2020). At the same time, we find little evidence of a

[11] We perform additional tests to reconcile the relatively stable contribution of EA interval returns to the daily index return variation with the pronounced downward trend in the abnormal volatility over the EA intervals. Our results suggest that the discrepancy between these findings can be attributed to the partial reversals of the EA-window returns in the earlier part of the sample. These reversals, driven by the announcements made over the Great Recession period, are indicative of an initial overreaction to EA news in periods of high uncertainty. Thus, the immediate market reactions (measured by abnormal volatility) over the EA windows are likely to be inflated by the overreaction in the early period, resulting in an exaggerated downward-slopping trend in abnormal volatility. The inflated EA-window abnormal volatility does not translate into a high portion of explained daily return variance because these returns partially reverse within the same day. As a result, we do not see the same pronounced downward trend in the EA-window contribution to daily returns. We do not observe the same degree of reversal in the MA-interval returns in the early part of our sample, so the drastic drop in the abnormal volatility around MA windows translates directly into the drop in the MA-driven daily return volatility.

pronounced upward trend in the ability of individual large firms' announcements to influence index prices, which is inconsistent with the argument in recent research and the financial media that extremely large firms are gaining in their market-wide influence due to lack of market diversification (e.g., Byun and Schmidt 2020, Schlingemann and Stulz 2020).

We perform several additional tests to provide a more in-depth investigation of the EAs as a driver of index-wide returns. First, we account for the timing of the announcements. Prior research has identified significant differences in the information content of the overnight and daytime returns both in the stock market (Lou, Polk, and Skouros 2019; Hendershott, Livdan, and Rosch 2020) and in the futures market (Bondarenko and Muravyev 2020; Boyarchenko, Larsen, and Whelan 2020). The comparisons of abnormal market activity over EA and MA intervals in the main analysis do not take into account that a larger share of EAs occurs outside regular stock exchange hours.[12] To provide an "apples-to-apples" comparison between the abnormal market activity around EAs and MAs, we split the events into those that fall within and outside the regular trading hours (we refer to these announcements as daytime and overnight, respectively). We find that only the overnight EAs are associated with a statistically significant amount of abnormal volatility. The contribution of EAs to the overall index volatility is also higher during the overnight periods largely because the overnight EAs are over 8 times more frequent than daytime EAs. Finally, EAs emerge as an especially important driver of index returns outside of the regular trading hours during the non-recessionary periods, where they explain 5.6% of overnight returns, compared to 7.3% explained by the macroeconomic announcements.[13]

Second, we explore the source(s) of the index-wide information conveyed around EAs. Specifically, we investigate the association between the strength of index reaction over the EA intervals and the magnitude of the news in I/B/E/S earnings, bundled guidance, and various additional items that firms release simultaneously with earnings figures. To get around the issue of a potentially state-contingent sign of the aggregate market reactions to earnings news (e.g., Gallo, Li, and Hann 2016), we regress absolute returns (rather than signed returns) on the absolute value of the various surprise measures. Our results suggest that neither I/B/E/S earnings surprises nor bundled management

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[12] Most of the EAs in our sample (89%) occur outside of the regular stock market trading session, compared with 39% of non-major and 83% of major MAs.

[13] Across all partitions, the portion of overall index volatility that's explained by EA-window returns is higher than the underlying EA-window frequency. Specifically, the fraction of overnight returns explained by overnight EA-window returns scaled by event frequency is 1.33 over the full sample and 1.71 excluding recessions, while frequency-scaled fraction of daytime returns attributable to EA windows is 1.43 over the full sample and 1.32 excluding recessions.

guidance can fully explain the abnormal return volatilities over EA intervals. Instead, the index reactions to large firm EAs are driven by the (absolute) surprises in sales and net income (when they are reported by the firm). These results are consistent with the findings in recent firm-level studies on the informativeness of non-street-earnings disclosures (e.g. Bilinski 2020) and underscore the importance of additional financial statement items as a source of market-wide information (e.g, Hann, Li, Ogneva 2021; Abdalla and Carrabias 2021).

Our paper makes several contributions. First, we contribute to the research on the market-wide information content of accounting earnings. Although prior research has documented significant market reactions to firms' earnings and guidance surprises, a statistically significant aggregate earnings response coefficient (ERC) per se does not allow us to gauge the *relative* importance of earnings disclosures as a source of market-wide news when other sources of macroeconomic information are in abundant supply. By benchmarking the abnormal market activity within narrow EA windows against MAs, we provide novel evidence on the economic significance of accounting disclosures as a source of timely market-wide news.

Second, this paper is related to an emerging line of research that examines the effects of *individual* firms on aggregate outcomes. This literature argues that the law of large numbers can be violated when the firms' size distribution is highly skewed, resulting in firm-level shocks being reflected in aggregate output (e.g., Gabaix 2011) or market returns (e.g., Byun and Schmidt 2020) rather than diversified away. Our finding that individual large firms' EAs can generate index-level price movements that are qualitatively similar to those induced by MAs highlights the importance of firm-level disclosures even for well-diversified investors (e.g., Ball and Sadka 2015). However, we do not find evidence supporting an increasing trend in the largest firms' ability to move index returns, contrary to the recent outcry among the financial community that that market returns are increasingly driven by a handful of large firms.

Finally, our paper provides a methodological contribution. By leveraging the round-the-clock intra-hour futures data, we can measure the aggregate-level abnormal market activity surrounding individual firms' disclosures using the event-study research design commonly used in the firm-level research since Beaver (1968), which allows us to compare and contrast the aggregate-level and firm-level findings on the information content of accounting disclosures (e.g., Cready and Gurun 2010; Anilowski et al. 2007; Bonsall et al. 2013). Furthermore, our high-resolution intraday data has the advantage of measuring the immediate reaction to an information event in a liquid market even if the event falls outside regular trading hours. The precision with which we can pinpoint the market reaction over the narrow event window improves identification and allows us to differentiate between the information content of earnings announcements and confounding concurrent events. The intraday frequency thus obviates the need to rely on the magnitude of earnings surprises to infer the market-wide information content; the latter complicates inferences because the sign of the market reactions to aggregate earnings surprises varies over time (Gallo, Li, and Hann 2016) and with the surprise measure specification (Ogneva 2013). Hence our paper adds to the arsenal of research design options available to researchers interested in the market-wide implications of accounting disclosures (e.g., Ball, Gallo, Ghysels 2019; Kim, Schonberger, Wasely and Yang 2020).

2. Prior literature and institutional background

2.1 Prior literature

The stock prices are determined by the market through aggregation of vast quantities of information that arrives almost continuously. Arguably, the two primary sources of fundamental news relevant at the aggregate market level are the macroeconomic releases prepared by government agencies (e.g., GDP growth released by the Bureau of Economic Analysis or unemployment statistics released by the Bureau of Labor Statistics), professional organizations (e.g., PMI index compiled by the Institute for Supply Management) or research institutions (e.g., the Michigan Consumer Survey) and the disclosures made by public companies.

The significance of macroeconomic announcements as a source of market-wide news is well established in prior work (e.g., Flannery and Protopapadakis 2002; Savor and Wilson 2014; Lucca and Moench 2015; Bernile, Hu, and Tang 2016; Cieslak, Morse, Vissing-Jorgensen 2019; Hu, Pan, and Wang 2017; Kurov, Sancetta, Strasser and Wolfe 2019; Baker, Bloom, Davis, Sammon 2021). However, recent research identifies a growing disconnect between the stock market and the economy at large, attributing it in part to the rise of extremely large firms (as measured by market capitalization) whose firm-level shocks are not fully diversified away in aggregate when the distribution of firms' size is fat-tailed. Specifically, firms with extremely high market capitalization may account for a disproportionate amount of aggregate output or the price movement of a broad market portfolio, yet they may not be representative of all U.S. firms as a whole (which includes both private and public firms) in terms of industry composition and may not contribute as much to the economy in terms of the number of workers hired as one would expect based on their sheer size (e.g., Gabaix 2011; Bessembinder 2018; Flynn and Ghent 2020; Schlingemann and Stulz 2020; Byun and Schmidt 2020). These trends raise the possibility of a significant shift in the relative importance of different information sources relevant for a broad stock market index. In particular, the importance of macroeconomic announcements as a source of market-wide news may be waning, while the individual large firms' disclosures may be gaining in economic significance.

Prior research on the market-level information content of accounting disclosures has mostly focused on the long-window co-movements between stock market returns and aggregate earnings (Kothari, Lewellen and Warner 2006. 2006; Sadka and Sadka 2009; Ball, Sadka, and Sadka 2009; Patatoukas 2014; Anilowski et al. 2007). These papers suggest that aggregated firm disclosures contain information that is reflected in aggregate market returns, but they do not provide direct evidence that the stock market extracts market-wide news from accounting disclosures.[14] A handful of studies target short-window reactions to firms' disclosures (e.g., Cready and Gurun 2010; Bonsal et al. 2013). These papers come closer to suggesting that accounting disclosures provide a timely source of market-level news. However, it is difficult to gauge the economic significance of accounting disclosures as a source of market-wide news as these papers do not provide a benchmark against which the market reaction to earnings news can be compared. A contemporaneous study by Kim et al. (2020) goes a step further and uses a GARCH model with daily aggregate stock returns to estimate the market response to aggregate earnings surprises in terms of both the signed reaction and volatility, after controlling for the surprises in macroeconomic indicators. This approach yields parametric estimates for the daily aggregate earnings response coefficients in terms of both the signed and unsigned market reaction. Kim et al. (2020) find that GAAP earnings provide significant timely information to investors that is incremental to other macroeconomic news, although only the volatility response is significantly associated with the magnitude of earnings surprises.[15]

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[14] There is also evidence that, when aggregated across a wide cross-section of public firms, accounting disclosures (e.g. GAAP earnings) contain a significant amount of non-diversifiable information about the broader macroeconomy, such as future GDP growth (Konchitchi and Patatoukas 2014a,b; Abdalla and Carrabias 2021), monetary policy (Gallo et al. 2016), inflation (Shivakumar and Urcan 2017), and unemployment (Hann, Li, and Ogneva 2021). However, the extent to which equity investors rely on firms' earnings disclosures as a source of market-wide news in the presence of a plethora of macroeconomic announcements from regulatory bodies and research institutions has received less attention.

[15] Our paper complements Kim et al. (2020) in several ways. First, our tests capture all information released around earnings announcements rather than focusing on a particular accounting measure, which is particularly important given the documented trends towards bundled disclosures in firms' earnings releases. Second, our event-window design allows us to evaluate economic significance of individual firms' earnings announcements as a source of market-wide information by benchmarking them against macroeconomic announcements releases that are arguably the primary source of market-wide fundamental news. Third, our unique setting with highly liquid round-the-clock trading permits us to have a more granular picture of the immediate market reactions to earnings announcements and macro releases, which frequently occur outside the regular stock exchange trading hours. By incorporating the timing of the announcement in our design, we enable the apples-to-apples comparisons between the market reactions to earnings announcements and macro releases.

Unlike most of prior literature, including Kim et al. (2020), that focuses on aggregate earnings, we are interested in the role that *individual* large firms' disclosures play in the price discovery process at the aggregate level. Most importantly, our objective is to document the trends and the intertemporal variation in the economic significance of individual large firms' earnings disclosures compared to macro indicator announcements. These results could provide a link between the macro accounting literature and the broader research on the growing disconnect between the stock market and the macroeconomy, which has in part been attributed to the rise of large superstar firms (e.g., Bessembinder 2018; Flynn and Ghent 2020; Schlingemann and Stulz 2020).

2.2 Futures market

Our empirical tests rely on the price and volume information from the S&P 500 e-mini futures market. The futures contracts trade on the Globex electronic market of the Chicago Mercantile Exchange (CME) that is open almost round-the-clock.[16] The contracts expire quarterly (March, June, September, and December). At each point in time listed futures include contracts that expire over five consecutive quarters. The contract for the closest quarter is typically the most liquid (except for the rollover period) and it is called a lead (or front) month contract. Our data consists of the lead-month contract prices and trading volume; we control for the rollover between the contracts, as explained below. Over our sample period, the S&P 500 e-mini futures have been the most liquid futures contract on the CME with an average daily trading volume of over $100 billion, far exceeding not only the standard S&P 500 futures but also the volume of trading in the underlying S&P 500 index securities.[17,18]

Generally, a futures contract is an agreement to buy or sell an underlying asset at a pre-determined price at a particular time. For example, an investor buying an S&P 500 e-mini futures is, in theory, committing to purchase the S&P 500 index at that price at the expiration date. In practice, the index-based futures on CME are settled financially. Unlike stock exchanges, where cash payments occur only when securities are bought or sold, the futures market has a daily settlement procedure,

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[16] Section 3 describes in detail the trading hours of the S&P 500 e-mini futures.

[17] CME Group (https://www.cmegroup.com/market-data/volume-open-interest/equity-volume.html) and NYSE (https://www.nyse.com/data-insights/market-volume-and-off-exchange-trading).

[18] E-mini S&P 500 futures are based on the underlying Standard & Poor's 500 stock index. For example, the price of the March 2021 contract at the end of the trading session (17:41 ET) for the S&P 500 e-mini was $3,899.25 on 19 Feb. 2021. The contract unit is $50 x S&P 500 Index, which is one fifth the size of standard S&P futures. So, the notional value that one would need to pay to open an S&P 500 e-mini futures position was $194,962. In May 2019, CME has launched a new product—the S&P 500 micro e-mini futures (ticker MES)—with a lower contract unit equal to 1/10th of the e-mini futures. The micro e-mini contract has since overcome the e-mini S&P 500 as the most-traded futures contract on the CME (in terms of the number of contracts traded).

where funds are added to (subtracted from) an account if the contract has earned a profit (loss) on that day.[19] On the expiration day, the investor ends up with an accumulated cash profit in their account or a paid-out loss and, because at that time a futures price is exactly the same as the underlying spot price, the final settlement involves simply closing an open position.

An important feature of the futures market is contract rollover. Contracts expire on the third Friday of the last month of the calendar quarter and they cease trading on CME Globex eight days prior to the expiration. For example, the expiration date for the March 2021 contract is 3/19/21, it rolls over on 3/11/21 when the June 2021 contract becomes the lead month and the March 2021 contract is no longer available for trading on Globex. Most contracts, however, are not held until expiration and are instead rolled over to the next-month contract. The rollover needs to be initiated by the investor and it is typically associated with a small transaction cost that investors try to minimize by timing the rollover.[20] Most traders switch to the next-month contract a few days prior to the official rollover day (e.g., Huang and Locke 2009). In our empirical tests, we control for the rollover periods defined conservatively as an 11-day period prior to and including the expiration day.

The main purpose of taking a position in the futures market is to get exposure to the underlying index or to hedge market risk. The price of the S&P 500 e-mini is linked to the spot price for the S&P 500 index, but does not equal it exactly.[21] However, within short intraday intervals, the futures price movement approximates the change in the price of the underlying index. Thus, intraday returns of the S&P 500 e-mini futures have been extensively used in prior literature to infer the stock market reactions to various events that tend to occur outside of the normal trading hours. For example, the S&P 500 e-mini futures have been used to measure the stock market reaction and

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[19] In practice, the funds need to be transferred to cover losses only when the daily loss results in net equity falling below the exchange-established maintenance margin levels.

[20] The rollover is accomplished by selling the expiring contract and buying the deferred contracts (i.e., contracts that settle in quarters beyond the current trading quarter). A choice of a time to "buy the roll" (i.e., sell the expiring contract and buy the deferred contracts) depends in part on the difference between the prices of the expiring and deferred contracts that, in turn, is affected by the implicit financing rate and the prevailing short-term rates such as LIBOR.

[21] The difference between the futures and spot prices is called "basis." Basis increases in financing costs and decreases with expected dividends. At a given point in time, the futures price is given by the spot price plus the financing costs minus dividend income. Intuitively, an investor can recreate the return on the future contract by purchasing the underlying index and holding it until the futures expiration date. The return earned in that case would be (a) lower by the amount of financing costs—the interest on the funds an investor would have to borrow to buy an underlying index and hold it until the futures expiration, and (b) higher by the amount of dividends received before the expiration date that a futures holder is not entitled to. Specifically, if we assume that one finances the portfolio at prevailing short-term rates such as LIBOR rates (R) and benefits from the accrual of dividend income measured in index points (Div) over so many days (days) until futures maturity, the futures price is given by [spot price * (1 + R * days/365) – Div]. For example, assume that the spot S&P 500 price is 1,176.80, short-term LIBOR rate is 0.39%, there are 112 days until expiration and we expect 7.90 index points of dividend accrual until futures contract expiration. The fair value of a futures contract is then equal to 1,170.22.

liquidity changes related to information released around the FOMC meetings (Lucca and Moench 2015; Bernile, Hu, and Tang 2016; Cieslak, Morse, Vissing-Jorgensen 2019), Michigan Index of Consumer Sentiment announcements (Hu, Pan, and Wang 2017), and a broad set of macroeconomic releases (Kurovet al. 2019). The jump in the S&P 500 e-mini futures' prices has been used to identify the macroeconomic-level events that affects a significant number of stocks simultaneously (Bradley, Clarke, Lee, and Ornthanalai 2014). To our knowledge, our paper is the first to use the S&P 500 e-mini futures to measure an immediate market reaction to accounting disclosures.

3. Sample and research design

3.1. Sample and data

Futures data

We obtain the futures market data through Pi Trading Inc., which aggregates raw intraday data from the CME for the continuous E-mini S&P 500 contracts.[22] Our sample covers 2004 to 2018, a period over which the futures have been traded round-the-clock on Globex (e.g., Bondarenko and Muravyev 2020).

The futures market is open from Sunday 6:00pm till Friday 5:00pm ET. The trade is halted over the 4:15 – 4:30pm ET interval for the daily settlement, followed by a half-hour trading session, and a non-trading daily maintenance period between 5:00 and 6:00pm ET.[23] We rely on fifteen-minutes intervals to accommodate the fifteen-minutes trading halt between 4:15 and 4:30pm. Each 24-hour calendar day is divided into 96 fifteen-minutes intervals, and after excluding the intervals when the trading in the futures market is closed, each Sunday (weekday) has 20 (91) trading intervals.

We use the minute-by-minute trading data to calculate the return volatility and trading volume for each fifteen-minute interval. Return volatility is the absolute value of the continuously compounded return over each interval (e.g., Anderson and Bollerslev 1997); trading volume is the logarithm of one plus the number of contracts traded during each interval.[24] The return is calculated as a difference between the logarithm of the close price for the last minute in an interval and the logarithm of the open price of the first minute in that interval.

[22] Pi Trading Inc. (https://pitrading.com/) provides data on the active front month contract and switches to the next quarterly contract eight calendar days before the contract expires following the rollover convention of CME to form a continuous time series.
[23] https://www.cmegroup.com/trading/why-futures/welcome-to-e-mini-s-and-p-500-futures.html
[24] At the firm level, a difference in absolute returns between the event and non-event widows has been used to infer the arrival of news during the conference call (Frankel, Johnson, and Skinner 1999).

Earnings announcements

We identify earnings announcements of the 100 largest firms with the highest market capitalization at the end of the previous month. These firms have been frequently used in prior research as "bellwether" firms whose earnings, when aggregated, convey a significant amount of macroeconomic news (e.g., Konchitchki and Patatoukas 2014b; Anilowski et al. 2007). The earnings announcement timestamps are obtained from I/B/E/S and Ravenpack. Ravenpack is a major real-time news analytics service that retrieves firms' press releases directly from Dow Jones Newswire. Although I/B/E/S is our primary source of data pertaining to earnings announcements, the timestamps provided by I/B/E/S can be delayed (e.g., Bradley, Clarke, Lee and Ornthanalai 2014). When we compare firms with timestamps available in both I/B/E/S and RavenPack, I/B/E/S timestamp is delayed for 22.4% observations, with a mean (median) delay of 1.59 (0.30) hours. Accordingly, we use the I/B/E/S timestamp only when it precedes the RavenPack and rely on the RavenPack timestamp otherwise.

Some of our tests require specifying the news items released around earnings announcement times. We rely on I/B/E/S to obtain both the Street earnings surprises and surprises for other concurrently released items. The Street earnings surprise is the realized EPS minus the consensus EPS forecast, which we define as the mean of individual forecasts issued or renewed over the 90 days before the announcement. We collect information on several additional items released concurrently with earnings announcements, including management earnings guidance, sales, gross margin, EBITDA, operating profit, net income, GAAP earnings per share, and cash flow per share. We consider each item to be reported simultaneously with the earnings announcement if the I/B/E/S timestamp for the additional item is within 10 minutes (5 minutes before and 5 minutes after) of the I/B/E/S timestamp for the earnings announcement. We require each additional item to also have a corresponding consensus forecast in I/B/E/S in order to calculate the surprise component of the disclosure.

Macroeconomic announcements

We rely on Haver Analytics to obtain the time stamps for a comprehensive sample of macroeconomic announcements. The announcements include inflation (CPI, PPI), GDP (Advance, Preliminary, and Final), Unemployment, Personal Income, Balance of Payment, Government Deficit, Consumer Credit, Durable Goods, Business Inventories, New Orders, Construction Spending, Capacity Utilization, Industrial Production, Chicago PMI, ISM PMI, Michigan Consumer Sentiment

Index (Preliminary and Final), Housing Starts, New Home Sales, and Retail Sales. In addition, we collect the publication date and time of the FOMC press releases from the FOMC website.[25]

3.2. Research design

Event windows

We denote a 15-minute trading interval as having a macro announcement (*MA*=1) if there is at least one macro announcement released either during that interval or over the preceding (i.e., lag one) or following (i.e., lead one) interval. If there are no macro announcements over the 45 minutes surrounding an interval, *MA* is set to 0. We include the preceding interval to account for any pre-announcement drift and the following interval to accommodate a prolonged market reaction beyond 15 minutes as prior literature documents both the pre- and post-announcement drift around certain macroeconomic releases (e.g., Lucca and Moench 2015; Bernile, Hu and Tang 2016; Hu, Pan and Wang 2017; Kurovet al. 2019).

Similar to macro announcements, we define a 15-minute interval as having an earnings announcement (*EA*=1) if a large firm announces earnings either during that interval or over the preceding (i.e., lag one) or following (i.e., lead one) interval. If there is no large firm announcement over the 45-minutes surrounding an interval, *EA* is set to 0.

Abnormal market reaction

Our first research design relies on a time-series regression using day-interval observations to gauge the abnormal market activity over earnings and macro announcement intervals. Specifically, we estimate the following regression (subscript *t* identifies the day-interval):

$$MKTACT_t = \beta_0 + \beta_1 * EA_t + \beta_2 * MA_t + Controls + \text{FE} + \varepsilon_t, \quad (1)$$

where $MKTACT_t$ is the level of market activity over day-interval *t*. *MKTACT* is either return volatility (*ABSRET*) or log trading volume (*LOG_VOLUME*). EA_t is an indicator equal to 1 if a large firm announced earnings over one of the three 15-minutes intervals surrounding the current interval *t*, and 0 otherwise. $MA_{t,a}$ is an indicator variable that is equal to 1 if there is at least one macro announcements

[25] https://www.federalreserve.gov/newsevents/pressreleases.htm

over one of the three 15-minutes intervals surrounding the current interval *t* and 0 otherwise.[26] The regressions include fixed effects (FE) for the trading interval, weekday, month, and year-quarter. The coefficient β_1 (β_2) measures the average abnormal market activity over the earnings (macro) announcement interval compared to intervals with no large firm (macro) announcements, after controlling for other determinants of market reactions.

We include several control variables (*Controls*) to account for the institutional features and microstructure effects in the futures market. *Rollover* is an indicator variable equal to 1 if a day belongs to the rollover window, which starts 10 days prior to the contract expiration date and ends on the date of contract expiration, and 0 otherwise. *Days* is the logarithm of one plus the number of days since the beginning of the month; it controls for the timing of the announcements within a month, which can significantly affect the market activity (e.g., Ernst, Gilbert and Hrdlicka 2019). We also control for the intraday autocorrelations in volatility and volume by including the lags of dependent variables (e.g., Andersen and Bollerslev 1997; Kurov et al. 2019). Specifically, *LAGn_LOG_VOLUME* (*LAGn_ABSRET*) (where *n* = 1, 2, 3) is *LOG_VOLUME* (*ABSRET*) in the *t-n* interval. We include three lags since after controlling for the institutional features and time fixed effects, the partial autocorrelation for both trading volume and volatility are statistically significant only up to the first three lags.[27]

Contribution to daily volatility

Our second research design aims at gauging the contribution of announcement-window returns into the daily volatility at the index level. Adapting the approach in prior research (e.g., Ball and Shivakumar 2008; Shao, Stoumbos and Zhang 2021), we measure the contribution of announcement-period returns to daily index price variation by regressing the daily S&P 500 futures returns on the

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[26] In certain specifications, we designate two separate indicator variables for major and non-major macro announcements. Specifically, *MA_MAJOR* is an indicator variable that is equal to one if there is at least one major macroeconomic announcement (i.e., CPI, PPI, FOMC, Advance GDP, and Unemployment) during the 45 minutes surrounding the interval, and 0 otherwise. *MA_OTHER* is an indicator variable that is equal to one if there is at least one non-major macroeconomic announcement (i.e., Balance of Payment, Business Inventories, Capacity Utilization, Chicago PMI, Construction Spending, Consumer Credit, Durable Goods, Preliminary GDP, Final GDP, Government Deficit, Housing Starts, Industrial Production, ISM PMI, Preliminary Michigan Consumer Sentiment Index, Final Michigan Consumer Sentiment Index, New Home Sales, New Orders, Personal Income, Retail Sales) during the 45 minutes surrounding the interval, and 0 otherwise.

[27] Specifically, we first regress *LOG_VOLUME* (*ABSRET*) on *ROLLOVER*, *DAYS*, and interval, weekday, month and contract period fixed effects and take the residuals *RES_LOG_VOLUME* (*RES_ABSRET*). We then test the autocorrelation of *RES_LOG_VOLUME* (*RES_ABSRET*) and find positive autocorrelation in these two variables within 3 lags.

returns aggregated over various event intervals. In particular, we estimate the following time-series regression (subscript *t* refers to the trading day):

$rRET_t = \beta_0 + \beta_1 * rRET\_EAONLY_t + \beta_2 * rRET\_MAONLY_t + \beta_3 * rRET\_INTER_t + \Sigma\beta_k INT\_DUMMY_k + \varepsilon_t$, (2)

where $rRET_t$ is the continuously compounded residual futures return over a close-to-close day, i.e., 4:00pm to 4:00pm ET the next trading day. The residual futures returns are obtained by regressing the raw continuously compounded 15-minute window returns on *Days*, *Rollover* and the interval, weekday, month and year-quarter fixed effects. $rRET\_EAONLY_t$ is the sum of continuously compounded residual returns over the intervals with large firm EAs but no macro announcements that fall into the close-to-close day *t*; $rRET\_MAONLY_t$ is the sum of continuously compounded residual returns over the intervals with macro announcements but no large firm EAs that fall into the close-to-close day *t*; $rRET\_INTER_t$ is the sum of continuously compounded residual returns over the intervals with both macro and large firm EAs that fall into the close-to-close day *t*; $\Sigma\beta_k INT\_DUMMY_k$ is a sum of indicator variables equal to 1 if the announcement-interval return for the announcement category *k* is not missing and 0 otherwise, where *k* is either *EAONLY*, *MAONLY*, or *INTER*. The latter dummies take into account that some days contain no events of a certain type.[28] Missing values of any event-window returns are set to 0. We use residual returns in regression (2) to maintain consistency between these tests and the abnormal market reaction regression (1) and to ensure that our results are not driven by the differential timing of the events and the institutional features of the futures market. The results are qualitatively similar throughout the paper when we use raw returns.

The inferences are based on the Shapley (1953) decomposition of the R-squared from regression (2), which allows splitting the overall explained variation in daily futures returns (i.e., the overall R-squared) into portions attributable to the individual explanatory variables. In other words, we can estimate the percentage of daily return volatility that is attributable to the returns earned over the announcement intervals. By further comparing the percent of variation explained by a particular type of announcement returns to the fraction of total intervals occupied by the announcement

[28] In certain specifications, we split the returns earned over all MA windows into those earned over only-major and only non-major macro announcements. In these regressions, *rRET_MAMAJORONLY* and *rRET_MAOTHERONLY* is the sum of the residual interval returns over intervals with major MAs or other MAs but no EAs, respectively. The $\Sigma\beta_k INT\_DUMMY_k$ indicators then include two additional indicators for the days when there are no major or other macro announcements.

windows, we can infer the amount of market return variation that can be tied to the arrival of that type of information.

4. Empirical results

4.1 Descriptive statistics

Figure 1 plots the frequencies of large firm earnings announcements and macroeconomic announcements over the calendar year. Specifically, we group trading intervals by the day since the beginning of the year and calculate the announcement frequency as the percentage of intervals with *EA* (*MA*) equal to 1 for each day. Earnings announcements follow a strong seasonal pattern, with four peaks in January, April, July and October, while macro announcements are distributed more uniformly, with the highest frequencies at the beginning of each month.

Panel A of Table 1 provides more details on the overlap between the intervals that contain the large firm earnings announcements (*EA*) and macroeconomic announcements (*MA*). Of the 9,809 intervals with large firm announcements, 444 (4.5%) intervals overlap with the *MA* intervals. When the *MA* intervals are further split into major macroeconomic announcements (*MA_MAJOR*) and other macroeconomic announcements (*MA_OTHER*), 247 (2.5%) of EA intervals overlap with *MA_MAJOR* intervals; and 197 (2%) overlap with *MA_OTHER* intervals. Overall, our high-resolution data allows us to successfully separate out the announcement intervals that pertain to each event category.

Figure 2 plots the frequencies of large firm earnings announcements and macroeconomic announcements by the intra-hour intervals during the day. Each trading day has a maximum of 91 15-minute intervals from 6pm ET to 5pm ET the next day, excluding the trading halt over the 4:15 – 4:30pm ET interval. The frequencies are measured as the percentage of intervals with *EA* (*MA*) equal to 1 for each interval category. The vast majority (89%) of earnings announcements occur outside the stock exchange trading hours, i.e. outside of the 9:30am - 4:00pm ET period. For macroeconomic announcements the fraction of overnight announcements is much lower — 49%.

Despite the disparity in the intra-day distribution of the two announcements, there is no substantial overlap between the EA and MA intervals in both the overnight and trading-hour periods. As shown in Table 1, of the 8,733 overnight *EA* intervals, 432 (5%) overlap with *MA* intervals; 244 (2.8%) overlap with *MA_MAJOR* intervals; 188 (2.2%) overlap with *MA_OTHER* intervals. The overlap between earnings and macro announcements during the regular stock exchange trading hours is considerably lower. Of the 1,076 trading-hour EA intervals, 12 (1.1%) overlap with MA intervals; 3

(0.3%) overlap with *MA_MAJOR* intervals; 9 (0.8%) overlap with *MA_OTHER* intervals. Thus, we expect to have sufficient statistical power to differentiate between the market reactions to earnings and macro announcements due to the overall low degree of overlap for both overnight and trading-hour announcements.

Table 1, Panel B provides summary statistics on the market activity variables measured over the 15-minutes intervals. The mean (median) signed interval return *RET* is 0.024 (0) basis points with a standard deviation of 13.692, which is comparable with the statistics on hourly S&P e-mini futures returns in Boyarchenko et al. (2020). The mean (median) *ABSRET* is 7.034 (3.698) basis points with a standard deviation of 11.747. *VOLUME* has a mean (median) of 16,778.5 (3,018) contracts with a standard deviation of 30,389.06, and *LOG_VOLUME* has a mean (median) of 7.925 (8.013) with a standard deviation of 2.425.

4.2 Abnormal market reaction around earnings announcements

In this section, we document the index-wide reaction to the earnings announcements of the largest firms by estimating the abnormal return volatility and trading volume in the intervals surrounding the announcements.

We first provide a graphical depiction of the changes in volatility and volume over the intervals surrounding the EA and MA intervals. Specifically, we plot the abnormal volatility and volume over the 21 fifteen-minute intervals surrounding the interval containing the announcement. For this purpose, we estimate the following regression that includes the time fixed effects and microstructure controls:

$$MKTACT_t = \beta_0 + \sum_{k=-10}^{10} \delta_k * EA_t^k + \sum_{k=-10}^{10} \gamma_k * MA_t^k + Controls + \text{FE} + \varepsilon_t, \quad (3)$$

where *MKTACT* is either the absolute value of the continuously compounded return (*ABSRET*) or the log of trading volume (*LOG_VOLUME*); EA_t^0 (MA_t^0) is an indicator variable that is equal to 1 if there is at least one large firm announcing earnings (at least one macroeconomic announcement) in a 15-minute interval *t*, and 0 otherwise; EA_t^k (MA_t^k) (k ~= 0) is an indicator variable that is equal to 1 if an interval is *k* interval(s) before (after) an EA (MA) interval for $k < 0$ ($k > 0$); controls and fixed effects (FE) are the same as in regression (1).

The coefficients on EA_t^k (MA_t^k) dummies represent the average abnormal market activity for the event-time intervals relative to the earnings (macroeconomic) announcements. For example, the coefficient on EA_t^0 represents average abnormal market activity during the earnings announcement window, whereas the coefficient on EA_t^{-5} represents the abnormal activity within the 15-minutes lagged by five intervals relative to the earnings announcement window (i.e., during the [*j*-75 minutes; *j*-60 minutes] relative to the earnings announcement window *j*).

Figure 3 plots the estimated abnormal volatility and volume. The upper two graphs contain the abnormal volatility in event time. For both earnings announcements and macro announcements, the increase in volatility is concentrated over the event window ($k = 0$). The magnitude of the increase is 1.06 basis points for the EA interval and 5.64 basis points for the MA announcement interval. The lower two graphs plot abnormal volume. For earnings announcements, abnormal volume spikes over the -1 and 0 windows. Because we use log-volume, the magnitudes can be interpreted as percentage increases in trading volume over the baseline: the volume increases by 22.4% and 11.8% over the -1 and 0 window, respectively. For macro announcements, the increase in volume of 51.9% is also statistically significant and it is concentrated within the announcement window. After the announcements, market activities (both volume and volatility) revert to their pre-announcement levels. Overall, Figure 3 shows a market-wide reaction associated with the large firms' earnings announcements; the reactions are of comparable magnitude to the reactions generated by the macroeconomic releases.

Next, we formally measure the magnitude of abnormal market reactions over the EA and MA windows by estimating regression (1) and report the results in Table 2. As explained in Section 3, the coefficients on the indicators for the EA and MA intervals measure the abnormal volatility or volume associated with the three 15-minute intervals surrounding each type of the announcement. We measure the abnormal market activity over the entire sample period and excluding the Great Recession period (December 2007 – June 2009).

The left side of Table 2 presents the abnormal volatility results. The slope magnitudes represent basis-point difference in absolute return between the event and non-event intervals. The baseline regression suggests that absolute returns around earnings announcements are 0.46 basis points higher than the non-announcement returns over the full sample (column 1) and 0.36 basis points higher when excluding the recession (column 3). These abnormal return magnitudes amount to around 6.5% (5.1%) of the average absolute return in our sample, which is equal to 7.03 basis points (reported in Table 1).

The right side of Table 2 presents the abnormal volume results. The slope magnitudes represent differences in the log volume between the event and non-event intervals and can be interpreted as percentage increases in volume during the announcement windows. The baseline regression suggests that volume of trading increases by 8.5% around earnings announcements over the full sample (column 5) and by 8.8% when excluding the recessionary period (column 7).

To gauge the economic significance of the abnormal volatility and volume associated with earnings announcement periods, we rely on a benchmark provided by the macroeconomic announcements—arguably, the primary source of macroeconomic information. Both the abnormal volatility and abnormal volume associated with EAs are of the same order of magnitude as those associated with MAs. In particular, the 0.46 basis points (8.5%) increase in volatility (volume) around EAs equals 21% (47%) of the increase in volatility (volume) associated with MAs.[29] When excluding recessionary period, the 0.36 basis points (8.8%) increase in volatility (volume) around EAs represents 16% (48%) of the increase in volatility (volume) around MA intervals. Overall, the immediate market-wide reaction to large firms' earnings announcements is both statistically and economically significant.

The MAs are heterogeneous in terms of their informativeness, which allows us to benchmark the index-moving ability of EAs against MAs with varying importance. Prior research differentiates between the major macroeconomic announcements that are most closely followed by the investors and other macroeconomic releases (e.g., Savor and Wilson 2014). Following this research, we separate out the major macro releases—unemployment, FOMC meetings, CPI and PPI inflation, and GDP advance announcements—and refer to the rest of the MAs as "other" macro releases. The regressions in columns (2), (4), (6), and (8) in Table 2 include two separate dummies for the major (*MA_major*) and other macro announcements (*MA_other*). As expected, the amount of new information impounded into index prices around the major MAs exceeds the "other" MAs—the coefficient magnitudes for *MA_major* are approximately six (five) times of the coefficient magnitudes for *MA_other* in the abnormal volatility (volume) regressions when estimated using either the full sample or excluding recessions. The market-wide news conveyed around earnings announcements is more comparable to the "other" macro releases. In particular, when estimated using the full sample, the abnormal volatility around EA intervals is about 40% (0.398/1.009*100%) of the abnormal volatility associated with the "other" macro releases. Likewise, the abnormal volume around EA intervals is

[29] For example, the 0.463 increase in absolute returns around earnings announcements is about 21% of the 2.231 increase in absolute returns around macro announcements. The 0.085 increase in volume around earnings announcements is about 47% of the 0.182 increase in volume around macro announcements.

about 80% (0.081/0.101*100%) of the abnormal volume associated with the "other" macro releases. When estimated within expansionary periods, the abnormal volatility (volume) around EA intervals is about 28% (85%) of the abnormal volatility (volume) around *MA_other* intervals. Considering that our sample includes 9,809 intervals with earnings announcements and 7,239 intervals with "other" macro releases, the total amount of information conveyed around earnings announcements is on-par with what is conveyed through the "other" macro indicators.

4.3 Earnings announcements and daily index price discovery

To provide further evidence on the relative importance of earnings announcements in the price discovery of the S&P 500 index, we investigate the extent to which EA interval returns can explain the variation in the daily returns of the S&P 500 futures. As discussed earlier in Section 3, we measure the contribution of announcement-period returns to daily index price variation by adapting the R-squared analysis from prior research (e.g., Ball and Shivakumar 2008; Shao, Stoumbos and Zhang 2021). In particular, we regress the daily close-to-close S&P 500 futures returns on the residual returns aggregated over various event intervals that fall into the same close-to-close period, i.e., regression (2). The high frequency intra-hour data of the futures market enables us to isolate intervals with only one type of the event, alleviating the concern that our inferences are contaminated by overlapping announcements.

The estimation results are reported in Table 3. The table contains the coefficients from regression (2) and the results of the R-squared decomposition (Shapley 1953). Shapley values provide the percentage of the overall R-squared that is contributed by each explanatory variable. We multiply these percentages by the overall R-squared to get at the portion of variation explained by the returns earned over each event window (%RSQ). We also compare the explained portion of variation to the fraction of intervals occupied by each event type (%Freq) and report the ratio RSQ / Freq, which is equal to zero under the null hypothesis that returns are distributed iid across all intervals (which assumes no abnormal return earned over the announcement windows). We estimate the regression both for the full sample (Panel A) and for the sample excluding recessions (Panel B).

In Panel A where the regression is estimated using the full sample, the event-interval returns collectively explain 10% of daily variation in the S&P 500 index futures. The contribution from the EA-interval returns implied by the Shapley value is equal to 4.27% of the daily index return variance, which is 1.62 times higher than the average daily frequency of the EA intervals (2.63%). The EA-interval returns' contribution is comparable to the MA intervals: *rRET_MAONLY* contributes 5.32%

of the daily index price variations. When we separate out the major MAs, the contribution of the EA intervals to daily index price movement remains at 4.35%, which is comparable to the contribution of "other" MA interval returns of 4.62% and is higher than the contribution of major MA interval returns of 0.91%.

Similar inferences can be made from Panel B where the regression is estimated using expansionary periods only. The EA-interval returns explain 3.37% of the daily index movement and it is of a comparable magnitude to the portion explained by all MA-interval returns (4.18%) and, when the major and other macro announcements are considered separately, to the portion explained by the "other" MA-interval returns (3.27%). Overall, the evidence in Table 3 suggests that returns earned over narrow intra-hour intervals surrounding large firms' earnings announcements provide a sizable portion of the price discovery for the S&P 500 index that is comparable in magnitude to macroeconomic announcements.

4.4 Intertemporal variation

There is growing concern among both academics and the financial media that the stock market has become increasingly disconnected from the macroeconomy and that the market performance is mainly driven by a handful of high-market-cap firms (e.g., Bessembinder 2018; Flynn and Ghent 2020; Schlingemann and Stulz 2020). To investigate the possibility that the importance of large firms' earnings announcements has shifted over time when compared to the macroeconomic announcements in terms of generating and explaining the index price movement, we document the intertemporal variation in the index-moving ability of the EAs and MAs in the futures market.

We first provide a graphical representation for the trends in abnormal volatility over EA and MA intervals over our sample period (2004 - 2018) in Figure 4. Specifically, we estimate the time-series regression (1) separately for each year in our sample period. The coefficients capture the average abnormal volatility surrounding the EAs and MAs in a particular year after controlling for the institutional features of the futures market and the fixed effects. Figure 4 shows an overall decrease in abnormal volatility associated with EAs and MAs over our sample period. In addition, the abnormal volatility around EAs exhibits a pronounced spike around the onset of the financial crisis in 2008 and remains significantly elevated throughout the Great Recession period ending June 2009. These findings differ from the firm-level evidence of an increasing trend in the abnormal volatility over EA days and a significant drop in EA informativeness around 2008-2009 (Beaver et al. 2020). The elevated aggregate abnormal volatility around EAs during the recessionary periods is, however, consistent with a greater demand for financial information during periods of high aggregate uncertainty (Bonsall, Green, Muller 2020). Figure 5 plots the decile ranks for the 90-day trailing-average CBOE implied volatility index (VIX) over our sample period. The plot confirms that the recessionary periods are associated with higher aggregate uncertainty, but points out a significant variation in aggregate uncertainty beyond the business cycle partitions.

To formally tease out the effects that time trend, business cycle and aggregate uncertainty have on the market reactions to both earnings and macro announcements, we estimate the time-series regression (1) augmented with interaction terms between the EA and MA dummies and the time trend indicator (*EA*Year* and *MA*Year*, respectively), the recession indicator (*EA*Rec* and *MA*Rec*) and the aggregate volatility deciles (*EA*Vixr10* and *MA*Vixr10*, respectively). *Year* is a categorical variable with a value of 0 for the start year of the sample (2004), incremented by 1 for each of the following years. *Rec* is an indicator variable that is equal to 1 if a day falls into the NBER recessionary period (December 2007 – June 2009) and 0 otherwise. *VIXr10* is the decile rankings of the *AVG_VIX* variable defined as the average daily VIX over the past 90 days ending one day before the current day. The regressions include the main effect for *VIXr10*; the main effects for *Year* and *Rec* are subsumed by the year-quarter fixed effects.

The results are reported in Table 4. The time-trend regression estimates in columns (1) and (2) confirm the downward-sloping trend in the market reactions to EAs and MAs. The coefficient on *EA* is statistically significant at the 1% level, indicating significant abnormal volatility over *EA* intervals at the beginning of the sample period (when *Year* equals zero). The coefficient on the interaction term *EA*Year* is significantly negative, suggesting a decreasing trend in the index reaction to large firms' EAs, which is accompanied by a similar downward-sloping trend in the index reaction to MAs (both major and other) over the years. Columns (3) and (4) formally estimate the difference between the abnormal volatility around announcements in the recessionary and expansionary periods. The coefficients on the interaction terms *EA*Rec* and *MA*Rec* are both positive and statistically significant, indicating a higher reaction during the recessionary period, although the significance on the *EA*Rec* interaction becomes marginal once the macro announcements are split into major and other. Columns (5) and (6) present the results for the variation in abnormal volatility over EA and MA intervals associated with aggregate uncertainty. The results suggest that abnormal volatility surrounding the EA intervals increases significantly with aggregate uncertainty, as indicated by the significantly positive coefficient on *EA*VixR10*. A similar positive relationship between abnormal volatility and VIX levels is also observed for the MAs (both major and other). Finally, the regressions in columns (7) and (8) include interaction terms for all three variables. The interaction terms for the time trend and aggregate uncertainty variable remain statistically significant, while the interaction with the recession indicator is no longer statistically significant at the conventional level. Overall, these results suggest that the downward time-series trend in the abnormal market activity associated with both earnings and macro announcements is not entirely driven by the changes in aggregate uncertainty or the presence of the Great Recession in the earlier part of the sample; at the same time, aggregate uncertainty appear to have substantial influence on the abnormal market reactions to both earnings and macro announcements beyond the financial crisis.

In Table 5, we examine the intertemporal variation in the explanatory power of EA- and MA-interval returns for the daily index returns. In Panel A, we split the sample into the early (from 2004 to June 2011) and the late (from July 2011 to 2018) halves and estimate regression (2) and the R-squared decomposition for each subsample separately. The inferences with respect to earnings announcements are somewhat different from the downward-slopping trend in the abnormal volatility tests. In particular, the EA-interval returns' contribution to daily index movement decreases only slightly from 4.29% in the early half of the sample to 3.96% in the later half. By contrast, the contribution of MA-interval returns has dropped from 6.95% in early periods to 2.06% in later periods, which is even lower than the average daily frequency of the MA-intervals (2.55%).

To reconcile the relatively stable contribution of EA interval returns to daily index price variation and the pronounced decreasing trend in abnormal volatility around EA intervals, we examine potential return reversal or drift associated with EAs over the sample period. In particular, we sort the EAs and MAs into quintiles based on the magnitude of the announcement-window residual return (*ERET*), calculated as the average 15-minute residual return over the three consecutive intervals comprising the announcement window (t - 1, t and t +1). We then accumulate returns starting in interval t-10 and ending in period t+30.

Figure 6 contains plots for the cumulative residual returns averaged within each *ERET* quintile, from the highest (eret_r5) to the lowest (eret_r1) for a 41-interval period surrounding a 15-minute interval containing EA or MA. The lines represent residual returns accumulated starting in interval t-10. We report the plots for the full sample, for the early (2004 – June 2011) and late (July 2011 - 2018) sample halves, and for the early sample after excluding the Great Recession period.

Across all plots, we see no evidence of a pronounced pre-announcement drift, but the post-announcement return patters vary significantly. For the full sample, we observe a partial reversal following the EA- and MA-window return—the prices over intervals t+2 onwards move in the opposite direction to the initial price reaction for the extreme quintiles. The reversals are especially pronounced following extreme positive announcement returns and, when compared with the magnitude of the initial reaction, the reversals are stronger for the EAs.

When we split the sample into early (2004 – June 2011) and late (July 2011 - 2018) subperiods, we observe a pronounced return reversal following the EAs in the early period, especially following the extreme positive EA-window returns that fully reverse within 22 fifteen-minute intervals (6 hours). By contrast, there are no reversals associated with EA-window returns in the later period. For the macro releases, the plots identify return reversals that are overall similar across the subperiods, with somewhat larger reversal magnitudes following positive (negative) returns in the earlier (later) period. Zooming in on the early period, the return reversal for the extreme quintiles becomes overall weaker once we exclude the Great Recession, especially for the positive EA-window returns, suggesting that the overreaction to the EAs is mainly driven by the recessionary period.

These findings suggest that the immediate market reactions to the EAs, which are captured by abnormal volatilities around the announcement intervals, are likely to be inflated in the earlier period due to the initial overreaction. Hence the downward-slopping trend in abnormal volatility associated with EAs in Table 4 appears more pronounced than warranted by the permanent price shifts induced by the EAs. Because the initial overreaction subsequently reverses, the higher abnormal volatility around the EA windows in the earlier part of the sample does not result in a higher proportion of daily index return variance explained by the EA-window returns, which explains the relatively stable contribution of EA-window returns to the daily index price discovery in Table 5. For the macro releases, the magnitude of overreaction does not differ significantly across the time periods, so the drastic decrease in abnormal volatility over MA intervals is translated into a similar drop in the contribution of MA-window returns to daily index price movement.

Overall, we find little evidence supporting the argument in recent research and the financial press that index returns have become increasingly influenced by the news of a few extremely large firms (e.g., Byun and Schmidt 2020, Schlingemann and Stulz 2020). At the same time, our results points to a decreasing impact of MAs on index price movement over the last decade of our sample period. This evidence is consistent with the findings in Schlingemann and Stulz (2020) that the stock market has become increasingly disconnected from the aggregate economy in recent years. While there are alternative explanations for the decrease in the index' reactions to MAs, such as a richer information environment rendering macroeconomic releases less timely or informative (e.g., Askitas and Zimmermann 2013; Kapetanios and Papailias 2018; Ferrara and Simoni 2019), these explanations would also need to explain why the index-level contribution of EA-window returns has remained stable.

4.5 Announcement timing effects

Most earnings announcements in our sample (89%) occur outside of the regular stock market trading session, compared with 49% of macroeconomic releases. Prior research suggests that the information content of overnight and daytime returns differs significantly both in the stock market (Lou, Polk, and Skouros 2019; Hendershott, Livdan, and Rosch 2020) and in the futures market (Bondarenko and Muravyev 2020; Boyarchenko, Larsen, and Whelan 2020). Across both markets, the overnight returns account for a disproportionate share of the return premium (e.g., Kelly and Clark 2011; Lou, Polk, and Skouros 2019; Bondarenko and Muravyev 2020; Boyarchenko, Larsen, and Whelan 2020). Our setting allows us to contribute to this research by investigating the role that earnings announcements play in the differences between the overnight and daytime index returns' information content. In particular, we expand the market activity tests discussed in the previous sections to differentiate between the trading-hour and overnight announcement intervals.

Table 6 reports the results of estimating regression (1) with separate dummies for the EAs and MAs that fall into the daytime (*EA*Daytime* and *MA*Daytime*) and overnight (*EA*Overnight* and *MA*Overnight*) periods. Similar to Table 2, the coefficients on these dummies can be interpreted as an abnormal announcement-period absolute return relative to no-event intervals. The results suggest that the market reacts more strongly to the overnight EAs. Specifically, only overnight EAs are associated with significant abnormal volatility while trading-hour EAs elicit little abnormal market reaction. By contrast, the abnormal volatility associated with MAs is significant both during the day and overnight. Considering only the overnight trading intervals, the abnormal volatility associated with EAs amounts, on average, to 19% of the magnitude associated with an average MA (the coefficients on *EA*Overnight* and *MA*Overnight* are 0.549 and 2.88, respectively) when estimated using the full sample. Similar inferences obtain when we exclude the recessionary periods. Taking into account that there are 1.9 times more overnight EA intervals than MA intervals (8,733 intervals versus 4,614 intervals, respectively), EAs are an especially important source of market-wide news outside the regular trading hours.

These observations are further confirmed in the R-squared decomposition tests that compare the relative contributions of EA- and MA-interval returns to the total overnight and daytime index returns. The decomposition is based on a modified version of regression (2), where the dependent variable is either the overnight or the daytime total (continuously compounded) residual index return and the regressors are the event-window residual returns compounded overnight and during daytime (where subscript t indicates the day):

$$rRET\_N_t\ (rRET\_D_t) = \beta_0 + \beta_1 * rRET\_EAONLY\_N\ (rRET\_EAONLY\_D) + \beta_2 * rRET\_MAONLY\_N\ (rRET\_MAONLY\_D) + \beta_3 * rRET\_INTER\_N\ (rRET\_INTER\_D) + \Sigma\beta_k`INT\_DUMMY_k + \varepsilon_t. \quad (4)$$

where $rRET\_N$ ($rRET\_D$) are the overnight (daytime) residual futures returns continuously compounded from 4:00pm day t-1 to 9:30am day t (9:30am day t to 4:00pm day t); and the explanatory variables are the announcement-interval residual returns continuously compounded over the following announcement intervals: $rRET\_EAONLY\_N$ ($rRET\_EAONLY\_D$) - overnight (daytime) intervals with large firm EAs but no macro announcements; $rRET\_MAONLY\_N$ ($rRET\_MAONLY\_D$) - the overnight (daytime) intervals with MAs but no large firm EAs; $rRET\_INTER\_N$ ($rRET\_INTER\_D$) - the overnight (daytime) intervals with both EAs and MAs. All night-time announcement returns are accumulated over 4:00pm day t-1 to 9:30am day t. Table 7 contains the regression (4) estimation results and the corresponding R-squared decomposition. The returns earned over the EA and MA intervals together explain a higher proportion of overnight index returns (14%), compared to 9% daytime index returns explained by these two events. This difference is largely attributed to EAs—EA-interval returns explain 4.4% of overnight index returns and only 1.5% of daytime index returns, while MA-interval returns explain 8.8% of overnight and 7.5% of daytime index returns. The significantly higher contribution of EA-interval returns to the overnight index price movement is mainly attributable to the high proportion of EAs that occur during the overnight period (89%) than daytime period (11%), while the per-interval contribution of EAs remains relatively the same in the overnight and daytime period (1.33 and 1.43, respectively) after accounting for event frequency. Collectively, evidence in Table 6 and Table 7suggest that large firms' EAs are a significant contributor to the index's price movement during the overnight period.

4.6 Information sources

Prior research has identified significant trends in the importance of various disclosures as the sources of timely and relevant information at the firm level. Recent evidence suggests that earnings guidance and other financial statement items released concurrently with earnings have increased their contribution to the overall informativeness of earnings announcements (e.g. Beaver et al. 2020, Bilinski

2020). In this section, we take the initial steps to explain the source(s) of the market-wide news conveyed around the large firms' earnings announcements.

Our main objective is to identify the news that can explain the *abnormal* market-wide return volatility over the announcement windows. Accordingly, our analyses build upon regression (1) and test whether various surprises associated with individual earnings announcements can explain the difference between the event-window and control-sample volatility. In other words, our tests are designed to identify the surprise variables can subsume the explanatory power of the EA indicator. As multiple firms can announce earnings over the same interval but each has a different set of disclosed items, we modify the time-series regression (1) into a panel regression. Specifically, if there are multiple large firms announcing earnings over the same 45-minutes window, we stack observations corresponding to the individual firms, which creates an unbalanced panel. We then regress the absolute returns over the announcement intervals (*ABSRET*) on the *EA* and *MA* dummies, along with the absolute surprises of I/B/E/S street earnings, bundled guidance, and various additional items that firms release simultaneously with earnings figures.[30] By focusing on the unsigned market reaction and absolute surprise measures, we mitigate the confounding effects of the state-contingent sign of the aggregate market reactions to earnings news (e.g., Gallo, Li, and Hann 2016). In the panel regression, the coefficients on the *EA* and *MA* indicators measures the weighted-average abnormal market activity over the EA (MA) interval compared to intervals with no EAs and MAs, after controlling for other determinants of market reactions. The weights depend on the conditional variance of the treatment status and are non-negative as long as there is a non-treated control group within all fixed effect cells (Angrist and Pischke 2008, Section 3.3.1; Borusyak and Jaravel 2017; De Chaisemartin and D'Haultfoeuille 2020).

The estimation results are presented in Table 8. Each column corresponds to a particular absolute surprise measure, as indicated by column headers; *ABSSURP_X_P* is the coefficient estimate for the absolute surprise measure; *HASX* is an indicator equal to one if the measure is disclosed concurrently with the firm's EA. In Column 1, we control for the absolute value of the I/B/E/S earnings surprise (*ABSSURP_P*). The coefficient on *ABSSURP_P* is positive and significant, suggesting that return volatility is positively associated with the magnitude of the earnings surprise, consistent with Kim et al. (2020). However, the coefficient on the *EA* indicator remains significantly

[30] All per-share (total) surprises are scaled by stock prices (market values).

positive, indicating that street earnings news does not fully explain the market-wide information conveyed by EAs.

In column 2, we control for the absolute value of the management guidance surprise. We find no evidence that the market extracts a significant amount of index-level information from earnings guidance—the loading on the absolute guidance surprise is not statistically significant. This finding contrasts the firm-level evidence in Beaver et al. (2020) that earnings announcements bundled with guidance are more informative than stand-alone earnings announcements.

For other financial statement items, the (absolute value of) news in sales (column 3) and net income (column 7) are positively associated with the return volatility. Furthermore, the news about sales and net income can explain the abnormal volatility around earnings announcement windows (these variables subsume the *EA* dummy), suggesting that sales figures and bottom-line net income are the primary sources of market-wide information incorporated by the market over the earnings announcement intervals.

Taken together, the evidence in Table 8 suggests that the index-moving ability of large firms' earnings announcements largely stems from financial statement items other than the street earnings. This evidence is similar to the firm-level evidence in Bilinski (2020) and underscores the importance of additional financial statement items as a source of market-wide information (e.g, Hann, Li, Ogneva 2021; Abdalla and Carrabias 2021).

4.7 Robustness checks

We conduct several tests (untabulated) to ensure the robustness of our results. For the abnormal market activity tests, inferences are qualitative similar if we replace year-quarter fixed effects with rollover-period fixed effects, with each rollover period spanning the days between the rollover dates of the previous and the current contracts. For the R-squared decomposition tests, inferences are qualitatively similar if we use (1) raw futures returns rather than residual returns or (2) value-weighted and equal-weighted CRSP index returns excluding the announcing firms. The latter measures the contribution of the S&P500 index futures returns over the EA-windows to the daily volatility of broader indices. The fact that we continue to find EA-window futures returns being significantly associated with the daily volatility of the broader indices (that exclude the announcing firms returns) suggests that individual large firms' announcements impact index prices beyond the mechanical effect generated through a price jump of an individual constituent firm announcing earnings.

5. Conclusion

This paper aims to characterize the relative importance of two sources of fundamental news—large firms' earnings announcements and macroeconomic releases—as contributors to the index-wide movement in the stock market. This evidence can contribute to developing a better understanding of the role that the largest firms ("superstars") play in the financial markets and help inform the debate about the reasons behind a potential disconnect between the stock market and the economy at large.

Using the intraday round-the-clock trading data from the highly liquid S&P 500 e-mini futures market, we find that earnings announcement of the largest one hundred firms convey a significant amount of index-level information that is of comparable magnitude to the information contained in macroeconomic announcements. Specifically, the abnormal market reactions, as measured by return volatility, over the EA intervals amount to approximately 21% of the abnormal volatility over the macroeconomic announcement intervals. The contribution of earnings announcements to the overall index volatility is relatively stable over time and we find no evidence of an increase in the abnormal market activity around EA windows, which is contrary to the claim in the financial press that individual firms are exerting increasing influence on the market prices in recent years. By contrast, our results points to a decreasing impact of MAs on index price movement over the last decade of our sample period. This evidence is consistent with the findings in Schlingemann and Stulz (2020) that the stock market has become increasingly disconnected from the aggregate economy in recent years. The caveat to this interpretation is that there could be alternative reasons for the decrease in the immediate market reactions to MAs, such as changes in the futures market's microstructure or a richer information environment rendering macroeconomic releases less timely or informative due to the emergence of big-data analytics. However, these explanations would also need to justify the relative stability of the index-level contribution of the EA-window returns.

Our research design allows us to compare and contrast the market-wide reactions to individual firms' earnings announcements to the firm-level results documented in prior research. Some of the documented market-level evidence differs significantly from the firm-level results. In particular, the downward trend in the market-wide reaction to earnings announcements is opposite to the upward trend in the firm-specific information contained in EAs documented over a similar time frame (Beaver et al. 2020). The market-level evidence also points to an increased reaction to individual firms' earnings over the recessionary periods, which is opposite to a decreased reaction to earnings announcements at the firm-level. On the other hand, similar to the firm-level evidence, we find that most of the market-wide information conveyed around EAs relates to the news about items other than street earnings

(Bilinski 2020). However, we acknowledge that the above differences may be driven by our focus on the largest firms or intraday price discovery. Nevertheless, the differential inferences from our market-level findings and prior firm-level research may suggest that some of our understanding of the capital markets consequences of accounting information at the firm level may not pertain to the market level, especially with respect to the largest firms. Given the growing importance of these "superstar" firms in the modern economy, further research into the effects of their information disclosures is perhaps warranted.

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Appendix 1. Variable definitions

Variable	Definition
VOLUME	The number of contracts traded during a 15-minutes interval.
LOG_VOLUME	The logarithm of one plus the number of contracts traded during a 15-minutes interval.
RET	The continuously compounded 15-minutes interval return.
ABSRET	The absolute value of the continuously compounded 15-minutes interval return.
EA	An indicator variable that is equal to 1 if a large firm announced earnings during the preceding (t-1), the present (t), and the following (t+1) interval, and 0 otherwise.
MA	An indicator variable that is equal to 1 if there is a macroeconomic announcement during the preceding (t-1), the present (t), and the following (t+1) interval, and 0 otherwise.
MA_major	An indicator variable that is equal to 1 if there is a major macroeconomic announcement (i.e., CPI, PPI, FOMC, Unemployment, and Advance GDP) during the preceding (t-1), the present (t), and the following (t+1) interval, and 0 otherwise.
MA_other	An indicator variable that is equal to 1 if there are other macroeconomic announcements (i.e., Balance of Payment, Business Inventories, Capacity Utilization, Chicago PMI, Construction Spending, Consumer Credit, Durable Goods, Preliminary GDP, Final GDP, Government Deficit, Housing Starts, Industrial Production, ISM PMI, Preliminary Michigan Consumer Sentiment Index, Final Michigan Consumer Sentiment Index, New Home Sales, New Orders, Personal Income, Retail Sales) during the preceding (t-1), the present (t), and the following (t+1) interval, and 0 otherwise.
Rollover	An indicator variable equal to 1 if a day belongs to the rollover window, which starts 10 days prior to the contract expiration date and ends on the date of contract expiration, and 0 otherwise.
Days	The logarithm of one plus the number of days since the beginning of the month.
rRET (*rRET_N, rRET_D*)	The sum of all 15-minuite residual interval returns over a close-to-close day, i.e., 4:00pm to 4:00pm ET the next trading day. Residual interval returns are the residuals from regressing the raw continuously compounded 15-minute interval returns on *Days*, *Rollover*, and the interval, weekday, month and year-quarter fixed effects. *RET_N* (*RET_D*) are the overnight (daytime) residual futures returns continuously compounded from 4:00pm day *t*-1 to 9:30am day *t* (9:30am day *t* to 4:00pm day *t*).
rRET_EAONLY (*rRET_EAONLY_N*, *rRET_EAONLY_D*)	The sum of residual 15-minute interval returns over the intervals with *EA*=1 but *MA*=0.

	RET_EAONLY_N (*RET_EAONLY_D*) are overnight (daytime) returns accumulated over intervals with large firm EAs but no macro announcements. Missing announcement-interval returns are set to 0.
rRET_MAONLY (*rRET_MAONLY_N*, *rRET_MAONLY_D*)	The sum of residual 15-minute interval returns over the intervals with *MA*=1 but *EA*=0. *RET_MAONLY_N* (*RET_MAONLY_D*) are overnight (daytime) residual returns accumulated over intervals with MAs but no large firm EAs. Missing announcement-interval returns are set to 0.
rRET_MAMAJORONLY	The sum of residual 15-minute interval returns over the intervals with *MA_major*=1 but *EA*=0. Missing announcement-interval returns are set to 0.
rRET_MAOTHERONLY	The sum of residual 15-minute interval returns over the intervals with *MA_other*=1 but *EA*=0. Missing announcement-interval returns are set to 0.
rRET_INTER (*rRET_INTER_N*, *rRET_INTER_D*)	The residual 15-minute interval return compounded over the intervals with *EA*=1 and *MA*=1. *RET_INTER_N* (*RET_INTER_D*) are overnight (daytime) returns accumulated using intervals with both EAs and MAs. Missing announcement-interval returns are set to 0.
INT_DUMMY_k	An indicator variable equal to 1 if the announcement-interval return for the announcement category *k* is not missing and 0 otherwise, where *k* is one of the five announcement categories examined (*EAONLY*, *MAONLY*, *MAMAJORONLY*, *MAOTHERONLY*, *INTER*). When the announcement categories are split by overnight and daytime, the associated *INT_DUMMY* is also split by overnight and daytime.
Year	A categorical variable with a value of 0 for the first year of the sample (2004), incremented by 1 for each of the following years.
VixR10	A decile rank of *AVG_VIX* that takes the value of 0 (9) for days in the lowest (highest) *AVG_VIX* decile. *AVG_VIX* is the average daily VIX over the previous 90 days (not including the current day).
Rec	An indicator variable that is equal to 1 if a day belongs to the NBER recessionary period, and 0 otherwise.
Overnight (*Daytime*)	*Overnight* is an indicator variable that is equal to 1 if the announcement occurs during the overnight period (i.e., 4:00 p.m. to 9:30 a.m. the next day), and 0 otherwise. *Daytime* is equal to 1 – *Overnight*.

Figure 1. The calendar-year distribution of earnings and macro announcements

Figure 1 plots the frequencies of large firm earnings announcements and macroeconomic announcements by day of the year for the 2004-2018 sample period. The frequencies are expressed as the percentage of trading intervals with the *EA* (*MA*) equal to 1 for each day. *EA* (*MA*) is an indicator variable that is equal to 1 if a large firm announced earnings (there is a macroeconomic announcement) during the preceding (t-1), the present (t), and the following (t+1) interval, and 0 otherwise.

Figure 2. The intra-day distribution of announcement times

Figure 2 plots the frequencies of the earnings and macro announcement intervals for the 2004 – 2018 sample period. The frequencies are expressed as the percentage of observations with *EA* (*MA*) equal to 1 within each 15-minute interval. *EA* (*MA*) is an indicator variable that is equal to 1 if a large firm announced earnings (there is a macroeconomic announcement) during the preceding (t-1), the present (t), or the following (t+1) interval, and 0 otherwise. The timeline indicates the 15-minute intervals between the opening of S&P500 futures trading at 6pm ET and the closing at 5pm ET the following day. The vertical lines indicate the opening and closing times of the U.S. stock exchanges (9:30am and 4:00 pm ET, respectively).

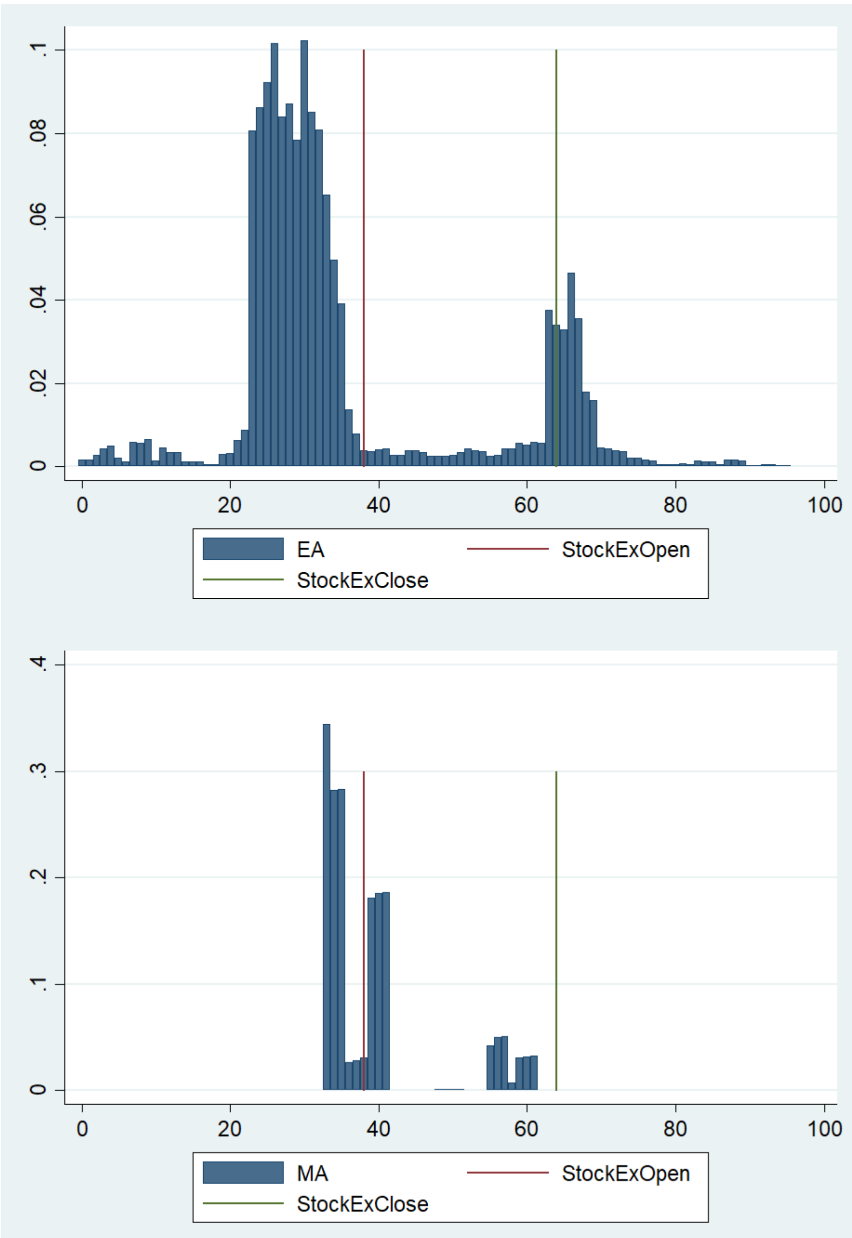


Figure 3. Market activity around announcement intervals

Figure 3 plots the change in log volume and return volatility over a 21-interval period (10 intervals before and 10 intervals after) surrounding a 15-minute interval containing either an earnings or macro announcement. In particular, the plots on the left (right) contain the δ (γ) coefficient estimates from the following regression: $MKTACT_t = \beta_0 + \sum_{k=-10}^{10} \delta_k * EA_t^k + \sum_{k=-10}^{10} \gamma_k * MA_t^k + Controls + \text{FE} + \varepsilon_t$, where *MKTACT* is either the logarithm of one plus the number of contracts traded during an interval (*LOG_VOLUME*) or the absolute value of the continuously compounded interval return expressed in basis points (*ABSRET*); EA_t^k (MA_t^k) is an indicator variable that is equal to 1 if there is at least one large firm announcing earnings (at least one macroeconomic announcement) in a 15-minute interval $t+k$, and 0 otherwise; Controls include three lags of a dependent variable, an indicator for the rollover window, and a log of one plus the number of days since the beginning of the month; fixed effects (FE) include trading interval, weekday, month, and year-quarter. The top two graphs contain regressions for the *ABSRET*. The bottom two graphs contain regressions *LOG_VOLUME*.

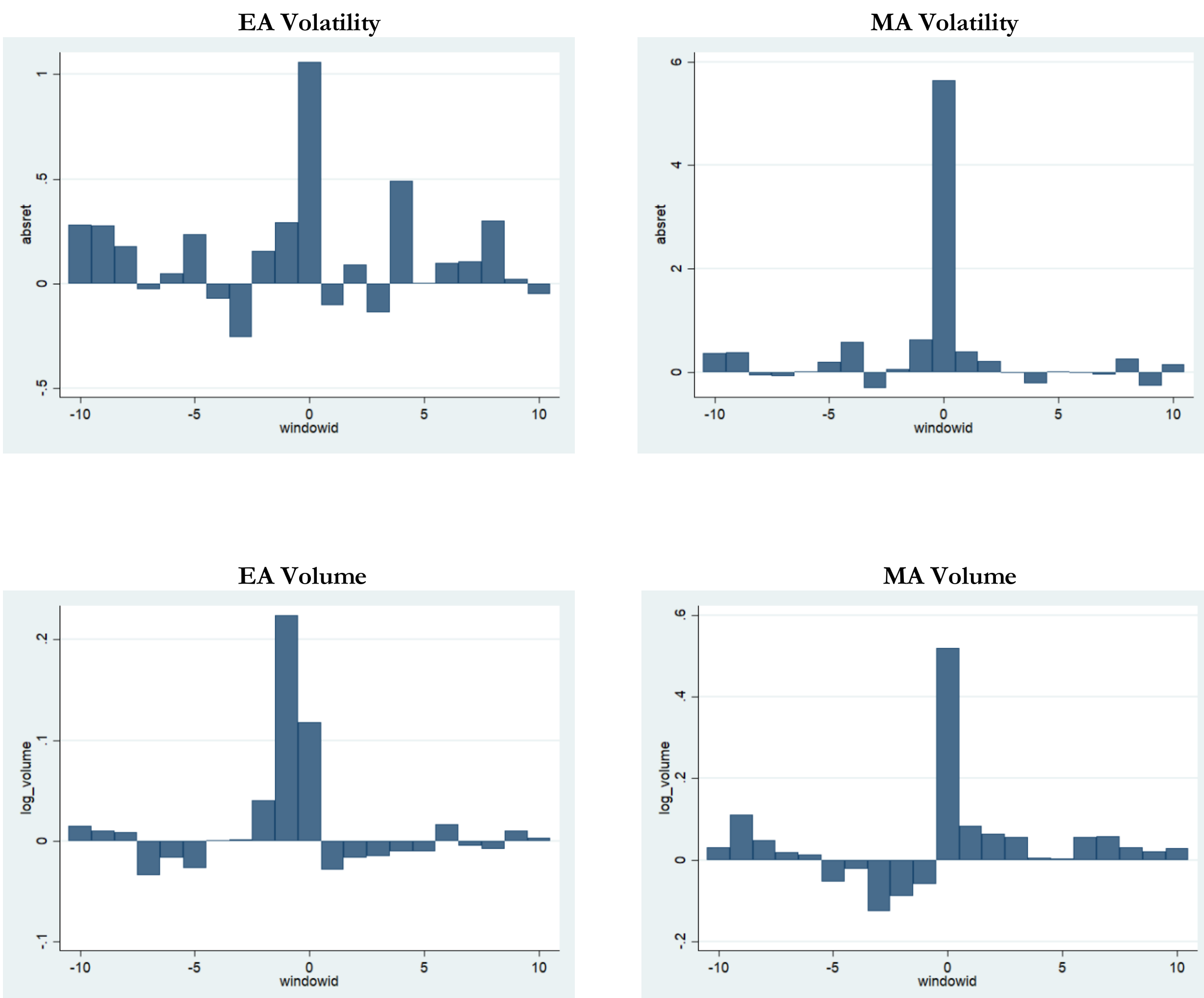
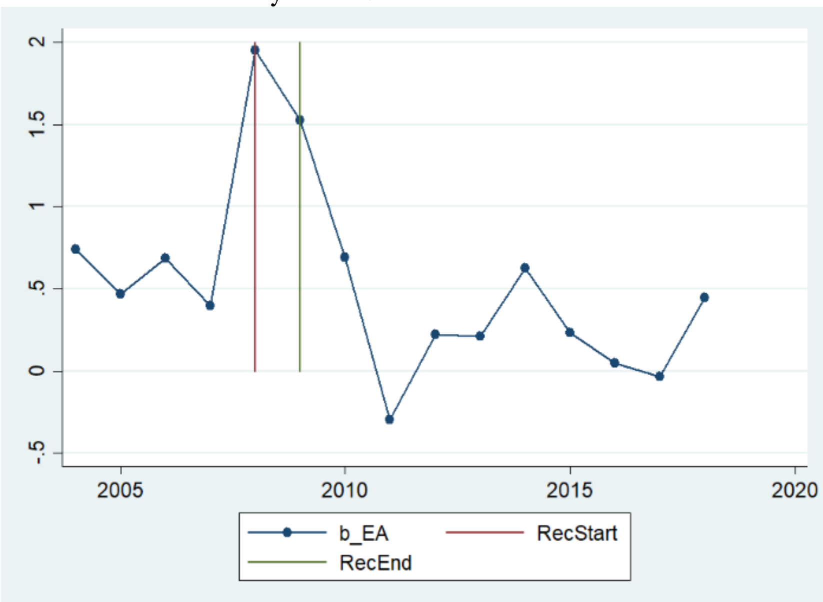


Figure 4. Market activity over announcement intervals by year

Figure 4 describes the trend in the market abnormal volatility (*ABSRET*) over the earnings announcement (EA) and macro announcement intervals (MA). Specifically, we plot the coefficients on the EA and MA dummies in the time-series regression (1) estimated separately for each year in our sample. The coefficients plotted by a blue line with circles (*b_EA* and *b_MA*) capture the average market reactions to large firm earnings announcements and macro announcements within a particular year, after controlling for the institutional features of the futures market and the fixed effects. The red (green) vertical line indicates the start (end) of the Great Recession in December 2007 (June 2009).

Abnormal volatility around EA



Abnormal volatility around MA

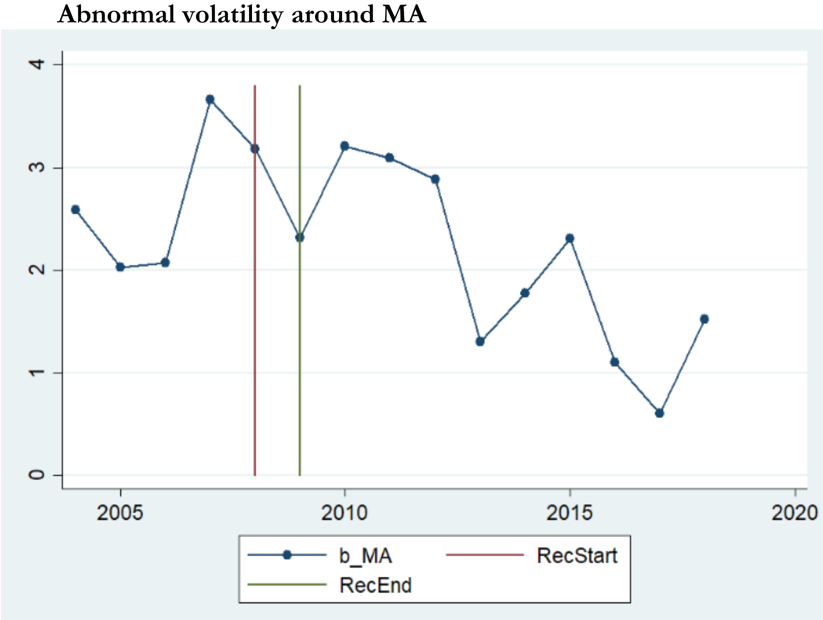


Figure 5. Intertemporal variation in VIX

Figure 5 plots decile rank of the moving-average VIX values, *VIXR10*, over the sample period from 2004 to 2018. The red (green) vertical line indicates the start (end) of the Great Recession in December 2007 (June 2009). Detailed variable description is available in Appendix 1.

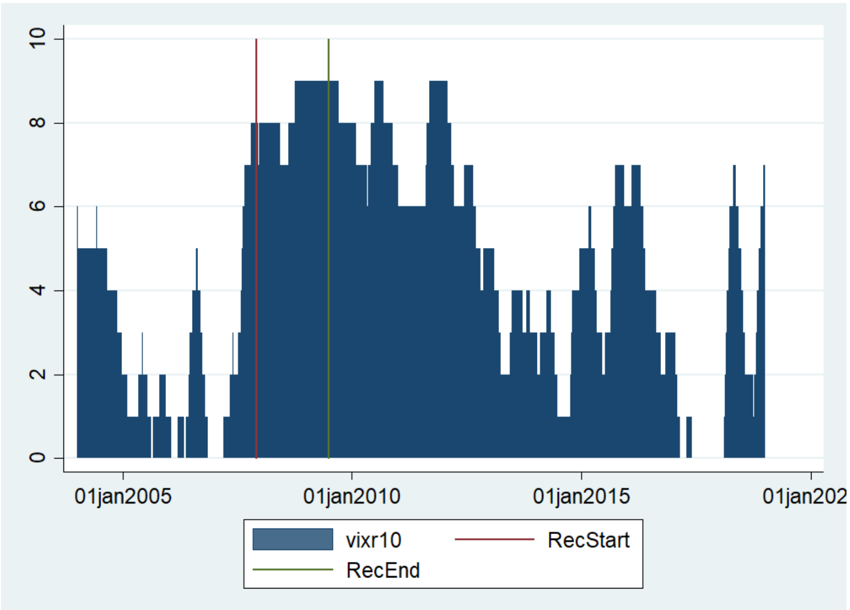
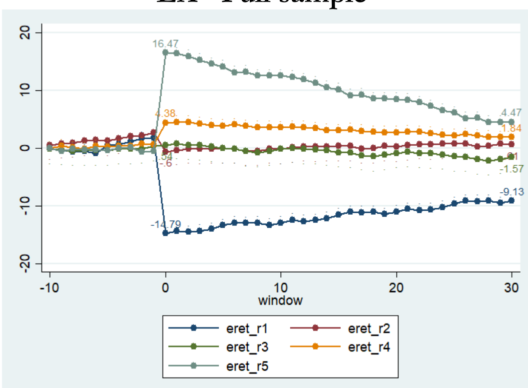


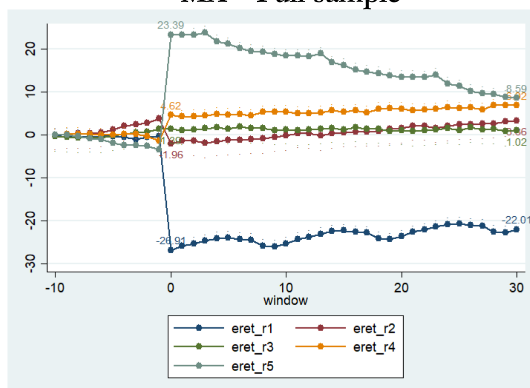
Figure 6. Signed returns around announcement windows

Figure 6 plots the average cumulative residual returns over a 41-interval period surrounding a 15-minute interval containing an earnings announcement (EA) or macroeconomic announcement (MA) (i.e, interval *t*). The EAs or MAs are sorted into quintiles based on the magnitude of the announcement-window residual return, *ERET*. Announcement window includes intervals *t* - 1, *t* and *t* +1. The lines represent residual returns accumulated starting in interval *t*-10, averaged over each *ERET* quintile, from the highest (eret_r5) to the lowest (eret_r1). The early (late) half of the sample is from 2014 - June 2011 (July 2011 – 2018). The returns are in basis points. Detailed variable description is available in Appendix 1.

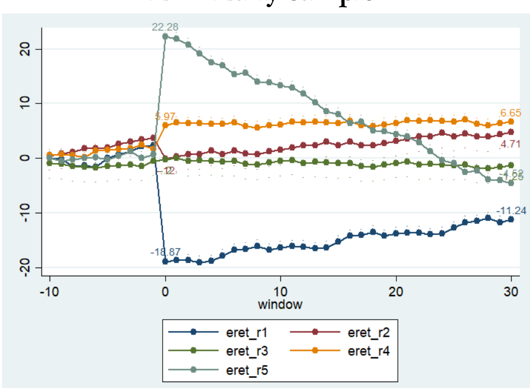
EA - Full sample



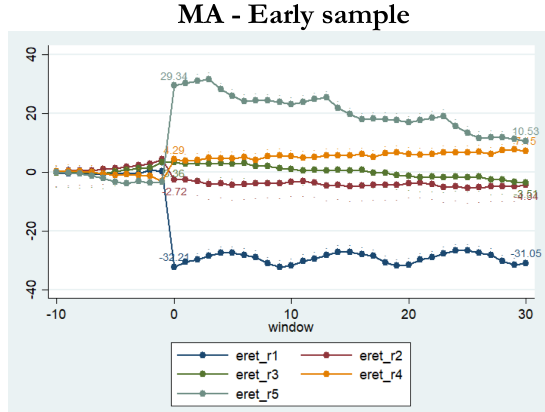
MA – Full sample



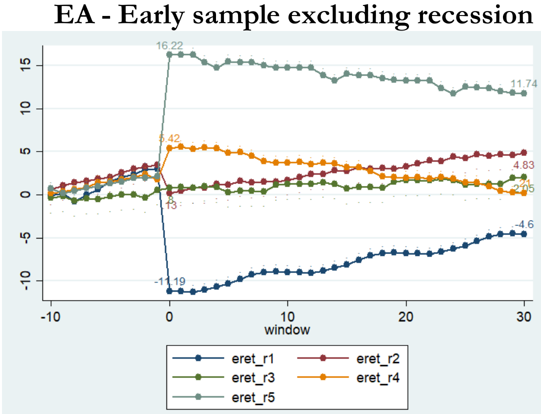
EA - Early sample



MA - Early sample



EA - Early sample excluding recession



MA - Early sample excluding recession

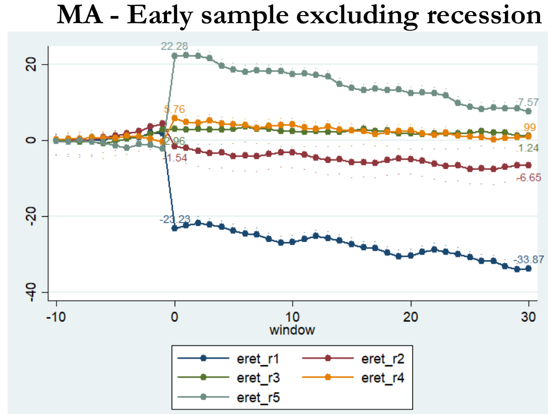
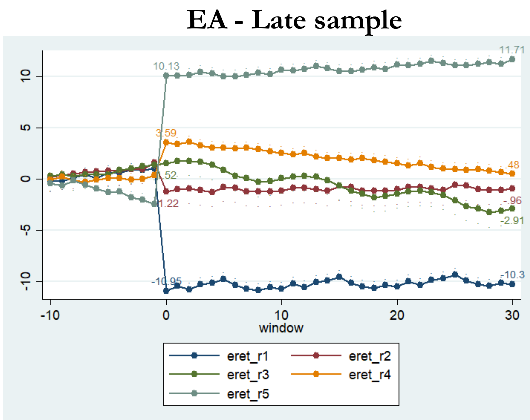


Figure 6. Continued



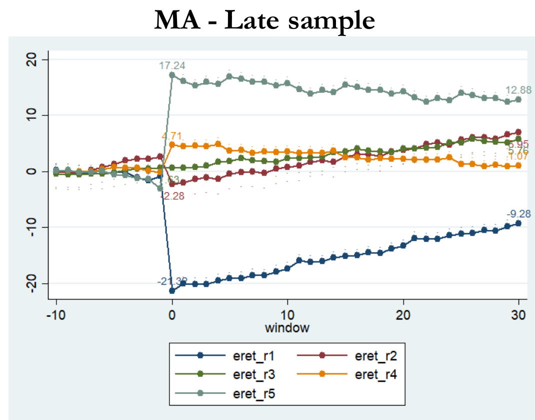


Table 1. Descriptive statistics

Table 1 provides the descriptive statistics of the sample. Panel A reports the number of unique intervals with large firm earnings announcements (EA), macroeconomic announcements (MA), major macroeconomic announcements (MA_MAJOR) and other non-major macroeconomic announcements (MA_OTHER). Major macro announcements include CPI, PPI, FOMC, Unemployment, and Advance GDP. Other macro announcements include Balance of Payment, Business Inventories, Capacity Utilization, Chicago PMI, Construction Spending, Consumer Credit, Durable Goods, Preliminary GDP, Final GDP, Government Deficit, Housing Starts, Industrial Production, ISM PMI, Preliminary Michigan Consumer Sentiment Index, Final Michigan Consumer Sentiment Index, New Home Sales, New Orders, Personal Income, Retail Sales. Panel B reports summary statistics on the return and volume variables. *RET* is the continuously compounded interval return and *ABSRET* is the absolute value of *RET*, all expressed in basis points. *VOLUME* is the number of contracts traded during an interval and *LOG_VOLUME* is the logarithm of one plus *VOLUME*.

Panel A. Frequencies of unique event intervals

		MA		**MA_MAJOR**		**MA_OTHER**		
All events	EA	0	1	0	1	0	1	Total
	0	334,187	8,955	341,229	1,913	336,100	7,042	343,142
	1	9,365	444	9,562	247	9,612	197	9,809
	Total	343,552	9,399	350,791	2,160	345,712	7,239	352,951
Overnight								
	0	238,298	4,182	240,924	1,556	239,854	2,626	242,480
	1	8,301	432	8,489	244	8,545	188	8,733
	Total	246,599	4,614	249,413	1,800	248,399	2,814	251,213
Trading hour								
	0	95,889	4,773	100,305	357	96,246	4,416	100,662
	1	1,064	12	1,073	3	1,067	9	1,076
	Total	96,953	4,785	101,378	360	97,313	4,425	101,738

Panel B. Summary statistics

	Mean	Std. Dev.	P25	P50	P75	N
RET (in bp)	.024	13.692	-3.630	0	3.793	352,951
ABSRET (in bp)	7.034	11.747	1.613	3.698	8.290	352,951
VOLUME	16,778.5	30,389.06	695	3,018	19,091	352,951
LOG_VOLUME	7.925	2.425	6.545	8.013	9.857	352,951

Table 2. Abnormal market activity around announcement windows

Table 2 presents evidence on the abnormal market activity over large firm earnings announcement (EA) and macroeconomic announcement (MA) windows from a time-series regression between 2004 and 2018. Specifically, we regress *ABSRET* (or *LOG_VOLUME*) on *EA*, *MA* (or *MA_major* and *MA_other*), *Rollover*, *Days*, and three lags of the dependent variable, along with interval, weekday, and year-quarter fixed effects. Detailed variable definitions are provided in Appendix 1. Returns are in basis points. The t-statistics in brackets are based on standard errors are clustered by quarter-year. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

DV:	*ABSRET*				*LOG_VOLUME*			
	Full sample		Excl. recession		Full sample		Excl. recession	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EA	0.463***	0.398***	0.359***	0.307***	0.085***	0.081***	0.088***	0.084***
	[4.16]	[3.65]	[4.10]	[3.52]	[10.25]	[9.85]	[9.61]	[9.30]
MA	2.231***		2.220***		0.182***		0.183***	
	[9.76]		[11.10]		[17.65]		[16.18]	
MA_major		6.724***		6.271***		0.480***		0.491***
		[14.33]		[13.40]		[18.55]		[17.63]
MA_other		1.009***		1.116***		0.101***		0.099***
		[4.54]		[6.76]		[13.14]		[11.74]
Rollover	0.268**	0.246*	0.210	0.191	0.011*	0.010	0.013**	0.012*
	[2.08]	[1.92]	[1.65]	[1.51]	[1.77]	[1.54]	[2.04]	[1.81]
Days	0.029	0.032	-0.010	-0.007	0.003	0.004	0.003	0.003
	[0.72]	[0.78]	[-0.25]	[-0.19]	[1.08]	[1.13]	[0.99]	[1.04]
Lag1	0.177***	0.175***	0.175***	0.173***	0.594***	0.592***	0.586***	0.584***
	[19.84]	[19.27]	[14.87]	[14.45]	[61.61]	[61.22]	[61.23]	[60.87]
Lag2	0.171***	0.171***	0.150***	0.151***	0.220***	0.220***	0.223***	0.224***
	[15.70]	[15.77]	[18.79]	[18.88]	[42.49]	[42.60]	[43.97]	[44.14]
Lag3	0.152***	0.152***	0.131***	0.132***	0.136***	0.136***	0.136***	0.137***
	[11.38]	[11.45]	[13.34]	[13.43]	[29.03]	[29.01]	[31.96]	[31.94]
Fixed Effects	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr
N	352,951	352,951	317,682	317,682	352,951	352,951	317,682	317,682
adj. R-sq	0.362	0.363	0.295	0.297	0.910	0.910	0.909	0.909
Clustering	yr-qtr	yr-qtr	yr-qtr	yr-qtr	yr-qtr	yr-qtr	yr-qtr	yr-qtr

Table 3. Earnings announcements and daily returns

Table 3 documents the role that earnings announcements play in the market-wide daily price discovery. The table reports the coefficients from regressions of the daily S&P500 e-mini futures returns on the various event-interval returns $rRET = \beta_0 + \beta_1 * rRET\_EAONLY + \beta_2 * rRET\_MAONLY$ (or $rRET\_MAMAJORONLY$ and $rRET\_MAOTHERONLY$) + $\beta_3 * rRET\_INTER + \Sigma \beta_k INT\_DUMMY_k + \varepsilon_t$, over the full sample (Panel A) or after excluding recessionary periods (Panel B). The coefficients on INT_DUMMY_k are omitted from tabulation. Detailed variable definitions are provided in Appendix 1. %RSQ is the fraction of return variance (in percent) explained by an independent variable, calculated using the Shapley (1953) decomposition. %Freq is the percentage of event intervals over a close-to-close day, estimated for the respective sample. RSQ/Freq is %RSQ divided by %Freq. *t*-statistics (in brackets) are based on standard errors clustered by quarter. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A. Full sample

DV: Daily futures returns	Pooled Macro Announcements				Partitioned Macro Announcements			
(close-to-close day)	Coef.	%RSQ	%Freq	RSQ/Freq	Coef.	%RSQ	%Freq	RSQ/Freq
rRET_EAONLY	1.19***	4.269	2.632	1.622	1.22***	4.345	2.632	1.651
	[6.82]				[6.50]			
rRET_MAONLY	0.91***	5.315	2.535	2.097				
	[6.93]							
rRET_MAMAJORONLY					0.60***	0.914	0.537	1.702
					[2.81]			
rRET_MAOTHERONL					1.06***	4.621	2.00	2.311
					[8.96]			
rRET_INTER	1.13*	0.362	.125	2.896	1.18**	0.375	0.125	3.000
	[1.91]				[2.05]			
R-squared	0.10				0.10			
N	3,914				3,914			

Panel B. Excluding recession

DV: Daily futures returns	Pooled Macro Announcements				Partitioned Macro Announcements			
(close-to-close day)	Coef.	%RSQ	%Freq	RSQ/Freq	Coef.	%RSQ	%Freq	RSQ/Freq
rRET_EAONLY	1.15***	3.367	2.643	1.274	1.15***	3.369	2.643	1.275
	[5.02]				[5.05]			
rRET_MAONLY	0.74***	4.180	2.529	1.653				
	[6.02]							
rRET_MAMAJORONLY					0.59**	1.043	0.541	1.928
					[2.27]			
rRET_MAOTHERONL					0.84***	3.269	1.988	1.644
					[8.02]			
rRET_INTER	1.02**	0.243	0.121	2.008	1.02**	0.244	0.121	2.017
	[2.43]				[2.39]			
R-squared	0.08				0.08			
N	3,523				3,523			

Table 4. Intertemporal variation in abnormal market activity

Table 4 presents evidence on the intertemporal trends in the relative importance of large firm earnings announcement (EA) and macroeconomic announcement (MA) as a source of index-wide news from 2004 to 2018. Specifically, we estimate the time-series regression (1) with *ABSRET* as the dependent variable and add the interactions between *EA*, *MA* (or *MA_major* and *MA_other*) and indicators for various time-series partitions: *Year*, *VixR10* and *Rec*. The coefficients on control variables (*Rollover*, *Days* and three lags of dependent variable) are suppressed. The *t*-statistics in brackets are based on standard errors are clustered by quarter-year. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. Returns are in basis points. Detailed variable definitions are provided in Appendix 1.

DV:	*ABSRET*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EA	0.873***	0.793***	0.237**	0.181	-0.256	-0.286	0.172	0.127
	[3.19]	[2.94]	[2.03]	[1.55]	[-0.96]	[-1.08]	[0.86]	[0.62]
*EA*Year*	-0.061**	-0.059**					-0.032**	-0.031*
	[-2.17]	[-2.12]					[-2.02]	[-1.99]
*EA*Rec*			2.245*	2.102			1.873	1.742
			[1.80]	[1.67]			[1.49]	[1.37]
*EA*Vixr10*					0.161**	0.153**	0.070*	0.067*
					[2.27]	[2.18]	[1.75]	[1.72]
MA	3.978***		1.732***		-0.431		1.272***	
	[7.77]		[5.55]		[-0.89]		[2.68]	
*MA*Year*	-0.251***						-0.185***	
	[-4.51]						[-5.80]	
*MA*Rec*			4.880***				2.462**	
			[5.69]				[2.51]	
*MA*Vixr10*					0.590***		0.442***	
					[6.69]		[5.07]	
MA_major		9.519***		6.004***		2.767***		5.474***
		[10.32]		[12.47]		[4.10]		[6.48]
*MA_major*Year*		-0.399***						-0.295***
		[-3.74]						[-3.55]
*MA_major*Rec*				7.159***				3.477**
				[5.24]				[2.27]
*MA_major*Vixr10*						0.881***		0.660***
						[6.04]		[4.85]
MA_other		2.482***		0.571*		-1.289***		0.152
		[5.52]		[1.82]		[-2.73]		[0.32]
*MA_other*Year*		-0.212***						-0.155***
		[-4.54]						[-5.91]
*MA_other*Rec*				4.284***				2.224**
				[5.89]				[2.53]
*MA_other*Vixr10*						0.509***		0.378***
						[6.25]		[4.28]
Vixr10					0.162**	0.163**	0.169**	0.169**
					[2.33]	[2.33]	[2.43]	[2.43]
Control Variables	Yes							
Fixed Effects	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr
N	352,951	352,951	352,951	352,951	352,951	352,951	352,951	352,951
adj. R-sq	0.362	0.363	0.363	0.364	0.363	0.364	0.363	0.364

Table 5. Intertemporal variation in the announcements' contribution to daily volatility

Table 5 presents evidence on the intertemporal trends in the contributions of large firm earnings announcement (EA) and macroeconomic announcement (MA) interval returns to the price discovery of daily index returns using the Shapley (1953) R-squared decomposition tests. Specifically, it reports the coefficients from regressions of the daily S&P500 e-mini futures returns on the various event-interval returns, $rRET = \beta_0 + \beta_1{*}rRET\_EAONLY + \beta_2{*}rRET\_MAONLY + \beta_3{*}rRET\_INTER + \Sigma\beta_k INT\_DUMMY_k + \varepsilon_t$, over various time-series partitions. In Panels A and B, the regression is estimated separately within the early (2004 – June 2011) and late (July 2011 - 2018) subperiods, respectively. The coefficients on INT_DUMMY_k are omitted from tabulation. %RSQ is the fraction of return variance (in percent) explained by an independent variable, calculated using the Shapley (1953) decomposition. %Freq is the percentage of event intervals over a close-to-close day, estimated for the respective sample. RSQ/Freq is %RSQ divided by %Freq. *t*-statistics (in brackets) are based on standard errors clustered by quarter. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. Detailed variable definitions are provided in Appendix 1.

Panel A. Early period (2004 – June 2011)

DV: Futures return	Early sample (2004 – June 2011)			
(close-to-close day)	Coef.	%RSQ	%Freq	RSQ/Freq
rRET_EAONLY	1.14***	4.289	2.532	1.694
	[5.60]			
rRET_MAONLY	1.04***	6.954	2.521	2.758
	[9.47]			
rRET_INTER	1.08	0.401	0.167	2.401
	[1.65]			
R-squared	0.12			
N	1,956			

Panel B. Late period (July 2011 – 2018)

DV: Futures return	Late sample (July 2011 - 2018)			
(close-to-close day)	Coef.	%RSQ	%Freq	RSQ/Freq
rRET_EAONLY	1.30***	3.963	2.732	1.451
	[3.54]			
rRET_MAONLY	0.58***	2.064	2.548	0.810
	[3.04]			
rRET_INTER	1.52*	0.259	0.083	3.120
	[1.97]			
R-squared	0.06			
N	1,958			

Table 6. Intraday and overnight announcements

Table 6 presents evidence on the abnormal market activity over large firm earnings announcement (EA) and macroeconomic announcement (MA) intervals by announcement time from a time-series regression between 2004 and 2018. Specifically, we regress *ABSRET* on the interactions between *EA*, *MA* (or *MA_major* and *MA_other*) and *Overnight* and *Daytime*, *Rollover*, *Days*, and three lags of the dependent variable, along with interval, weekday, and year-quarter fixed effects. Returns are in basis points. Detailed variable definitions are provided in Appendix 1. The t-statistics in brackets are based on standard errors are clustered by quarter-year. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

DV:	*ABSRET*			
	Full sample		Excl. recession	
	(1)	(2)	(3)	(4)
*EA*Overnight*	0.549***	0.510***	0.424***	0.395***
	[5.30]	[5.02]	[4.84]	[4.52]
*EA*Daytime*	-0.281	-0.310	-0.183	-0.212
	[-0.48]	[-0.53]	[-0.47]	[-0.55]
*MA*Overnight*	2.880***		2.543***	
	[10.98]		[11.95]	
*MA*Daytime*	1.710***		1.960***	
	[4.64]		[7.09]	
*MA_major*Overnight*		5.553***		4.951***
		[12.59]		[12.57]
*MA_major*Daytime*		12.020***		11.918***
		[7.88]		[7.31]
*MA_other*Overnight*		1.285***		1.103***
		[6.20]		[6.31]
*MA_other*Daytime*		0.715**		0.997***
		[2.15]		[4.96]
Rollover	0.267**	0.245*	0.210	0.191
	[2.08]	[1.93]	[1.65]	[1.52]
Days	0.026	0.027	-0.011	-0.010
	[0.64]	[0.68]	[-0.29]	[-0.25]
Lag1	0.176***	0.175***	0.174***	0.172***
	[19.84]	[19.19]	[14.86]	[14.42]
Lag2	0.171***	0.171***	0.150***	0.151***
	[15.70]	[15.81]	[18.81]	[18.89]
Lag3	0.152***	0.153***	0.131***	0.132***
	[11.39]	[11.50]	[13.35]	[13.44]
Fixed Effects	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr
N	352,951	352,951	317,682	317,682
adj. R-sq	0.362	0.363	0.295	0.297

Table 7. Earnings announcements and intraday price discovery

Table 7 documents the importance of event-window returns for the overnight (Panel A) and daytime (Panel B) price discovery for the full sample and after excluding the recessionary period. The table presents coefficients for the regressions of the daytime and overnight S&P500 e-mini futures returns on the event-interval returns, also split by the trading period. $rRET\_N_t$ ($rRET\_D_t$) = β_0 + β_1*$rRET\_EAONLY\_N$ ($rRET\_EAONLY\_D$) + β_2*$rRET\_MAONLY\_N$ ($rRET\_MAONLY\_D$) + β_3*$rRET\_INTER\_N$ ($rRET\_INTER\_D$) + $\Sigma\beta_k$`INT_DUMMY_k + ε_t. Detailed variable definitions are provided in Appendix 1. All night-time announcement returns are accumulated over 4:00pm day *t*-1 to 9:30am day *t*. All day-time announcement returns are accumulated over 9:30am to 4:00pm day *t*. The coefficients on INT_DUMMY_k are omitted from tabulation. %RSQ is the fraction of return variance (in percent) explained by an independent variable, calculated using the Shapley (1953) decomposition. %Freq is the percentage of event intervals over a close-to-close day, estimated for the respective sample. RSQ/Freq is %RSQ divided by %Freq. *t*-statistics (in brackets) are based on standard errors clustered by quarter. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A. Overnight periods

DV: Overnight futures returns	Full sample				Excl. recession			
(4:00pm day *t*-1 - 9:30am day	Coef.	%RSQ	%Freq	RSQ/Freq	Coef.	%RSQ	%Freq	RSQ/Freq
$rRET\_EAONLY\_N_t$	0.86***	4.357	3.269	1.333	0.99***	5.614	3.285	1.709
	[14.07]				[15.53]			
$rRET\_MAONLY\_N_t$	1.07***	8.769	1.656	5.295	0.94***	7.309	1.657	4.411
	[13.72]				[17.55]			
$rRET\_INTER\_N_t$	1.03***	1.112	0.17	6.541	0.86***	0.544	0.164	3.317
	[5.36]				[4.32]			
R-squared	0.14				0.14			
N	3,914				3,523			

Panel B. Daytime periods

DV: Daytime futures returns	Full sample				Excl. recession			
(9:30am day *t* - 4:00pm day *t*)	Coef.	%RSQ	%Freq	RSQ/Freq	Coef.	%RSQ	%Freq	RSQ/Freq
$rRET\_EAONLY\_D_t$	0.86***	1.491	1.046	1.425	1.07***	1.380	1.046	1.319
	[3.40]				[3.68]			
$rRET\_MAONLY\_D_t$	1.08***	7.451	4.691	1.588	0.80***	5.301	4.672	1.135
	[4.37]				[4.89]			
$rRET\_INTER\_D_t$	-0.49	0.002	0.012	0.167	-0.37	0.004	0.013	0.308
	[-0.64]				[-0.48]			
R-squared	0.09				0.07			
N	3,914				3,523			

Table 8. Sources of index-wide information in large firms' earnings announcements

Table 8 reports evidence on the sources of index-wide information in individual large firms' earnings announcements from a panel regression between 2004 and 2018 (with each announcing firm in a day-interval representing one observation). Specifically, we regress *ABSRET* on *EA*, *MA_major*, *MA_other*, various financial statement items reported by the firm, and controls. If there are multiple large firms announcing earnings over the same 45-minutes window, we stack observations corresponding to individual firms, which creates an unbalanced panel. *ABSSURP_X_P* is the absolute value of the large firm's price-deflated surprise measure, with columns (1) through (9) containing surprises for earnings per share, guidance, sales, gross margin, EBITDA, operating profit surprise, net income, GAAP earnings per share, and cash flow per share). For *ABSSURP_EPS_P*, *ABSSURP_GUIDE_P*, *ABSSURP_GRM_P*, *ABSSURP_GPS_P,* and *ABSSURP_CPS_P*, we divide the raw price-deflated surprise by 100 for presentation purposes. If an item is not reported by a firm, the surprise measure is set to 0. *HASX* is an indicator variable that is equal to one if the firm reported a particular item in the earnings announcement, and zero otherwise (the indicator is omitted for EPS that is reported in all announcements). All other variables are as specified in regression (1) and the definitions are provided in Appendix 1. The *t*-statistics in brackets are based on standard errors are clustered by quarter-year. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

X:	***EPS***	***GUIDE***	***SAL***	***GRM***	***EBT***	***OPR***	***NET***	***GPS***	***CPS***
DV: *ABSRET*	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EA	0.336***	0.316**	-0.499	0.542***	0.660***	0.260*	-0.491	0.144	0.748***
	[2.85]	[2.44]	[-1.61]	[3.01]	[3.09]	[1.84]	[-1.36]	[0.44]	[3.01]
MA	1.890***	1.890***	1.888***	1.887***	1.888***	1.890***	1.887***	1.889***	1.891***
	[8.79]	[8.78]	[8.77]	[8.78]	[8.78]	[8.79]	[8.77]	[8.78]	[8.79]
HASX		-0.014	0.601*	-0.293	-0.590*	-0.290	0.593	-0.003	-0.510
		[-0.03]	[1.74]	[-1.24]	[-1.76]	[-0.78]	[1.55]	[-0.01]	[-1.37]
ABSSURP_X_P	0.539*	1.151	75.320**	-0.455	95.421	397.508	195.055**	9.787	-2.459
	[1.90]	[0.95]	[2.48]	[-0.62]	[1.00]	[1.13]	[2.53]	[1.58]	[-1.31]
Rollover	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.206	0.205
	[1.23]	[1.23]	[1.23]	[1.23]	[1.23]	[1.23]	[1.23]	[1.23]	[1.23]
Days	-0.023	-0.023	-0.023	-0.023	-0.023	-0.023	-0.023	-0.023	-0.023
	[-0.30]	[-0.30]	[-0.30]	[-0.30]	[-0.30]	[-0.30]	[-0.30]	[-0.30]	[-0.30]
Lag1	0.178***	0.178***	0.178***	0.178***	0.178***	0.178***	0.178***	0.178***	0.178***
	[18.32]	[18.33]	[18.31]	[18.33]	[18.33]	[18.33]	[18.31]	[18.32]	[18.33]
Lag2	0.184***	0.184***	0.184***	0.184***	0.184***	0.184***	0.184***	0.184***	0.184***
	[6.06]	[6.06]	[6.06]	[6.06]	[6.06]	[6.06]	[6.06]	[6.06]	[6.06]
Lag3	0.105***	0.105***	0.105***	0.105***	0.105***	0.105***	0.105***	0.105***	0.105***
	[3.22]	[3.22]	[3.22]	[3.22]	[3.22]	[3.22]	[3.22]	[3.22]	[3.22]
Fixed Effects	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr	interval, wkday, month, yr-qtr
N	565,189	565,189	565,189	565,189	565,189	565,189	565,189	565,189	565,189
adj. R-sq	0.360	0.360	0.360	0.360	0.360	0.360	0.360	0.360	0.360