Releases of Previously Published Information Move Aggregate Stock Prices*

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Abstract

We document that a recurring release of already publicly available macro economic information, in the form of the U.S. Leading Economic Index (LEI), has a significant impact on aggregate stock returns, volatility and volume. This is despite the fact that a) it is widely known that the index is based on previously published data, and b) the exact procedure used to construct the index is also publicly available and, in fact, relatively easy to follow. This phenomenon of course constitutes a violation of semi-strong market efficiency and suggests that aggregate stock prices are not always able to correctly determine the incremental news content of information releases. However, the findings could stem from costly information acquisition combined with limits to arbitrage. To test that, we investigate the cross-sectional response to the announcement. Contrary

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to the information acquisition cost explanation, we find that stocks that have higher sensitivity to macro economic fluctuations respond *less* to the release of the LEI.

1 Introduction

It is often assumed that publicly available information is immediately impounded in prices, consistent with the notion of semi-strong market efficiency (Fama 1970, 1991). In such a world, investors are able to determine exactly how a particular news event should be mapped into prices. In particular, it is necessary to separate the part of the news event that was expected, and therefore already reflected in prices, from the unexpected part.

But, can the market perfectly separate incremental news from its stale component? A number of studies suggest that this may not always be the case. For instance, there is evidence that *re*-releases of already available public information can have significant price impact on individual stocks: A case where there in fact is *no* incremental news (e.g., Huberman and Regev (2001)).[1] In a related literature, Bernard and Thomas (1990) and Sloan (1996) provide evidence that investors fail to recognize earnings' predictability. The price response of earnings announcements is therefore forecastable based on old information. Again, this is evidence that investors fail to correctly separate the innovation component from the stale component in news announcements.

Such findings are of course not consistent with semi-strong market efficiency in the cross-section of stock returns, but since they concern (singular) company-specific news events, it is not clear what the market level impact of such phenomena are. One may therefore be tempted to regard this evidence largely as minor anomalies or even curiosities that are not of general importance for aggregate prices. In this paper, we challenge this view. In particular, we present strong empirical evidence that a scheduled monthly re-release of previously published macro economic data has significant impact on *aggregate* stock market returns, volatility and volume, as well as systematic cross-sectional impact.

We identify a widely reported release which reports information that is already publicly available and economically relevant in the sense that it is related to future expected aggregate cash flows and/or discount rates: The Conference Board's U.S. Leading Economic Index Index (LEI). It is released monthly on a pre-determined day at a pre-determined time

[1] Huberman and Regev (2001) report an episode where a New York Times article (re-)reporting an article published more than five months earlier in Nature, lead to large price changes in the stock prices of companies related to the story. Similar findings have been reported for other non-news events (e.g., Meschke (2004)).

(10:00am EST beginning January 1997). The index is designed to track business cycle fluctuations and signal turning points in the business cycle. It has a leading relationship relative to macroeconomic aggregates such as output and employment. However, market reaction to announcements should not be expected since 1) the LEI is based on previously released data, and 2) the components and methodology of the LEI are readily available to the public and fairly easily reproducible. Both of these factors lead us to expect that the relevant information in the LEI release should already have been incorporated into stock prices before the day of the release. This is a well-known fact, publicized among other places on the Conference Board's internet page and Bloomberg.[2] Thus, if one so desires, it is possible to calculate the change in the index *before* its release.

Nevertheless, looking at intraday data over 72 announcement days over the period 1997-2005 we find that the released change in the LEI index is positively associated with realized contemporaneous market returns. Further, volatility and volume are higher following the announcement, compared to a matched sample of days that have no macro announcements. The results are both economically and statistically significant. Post-announcement prices seem to revert somewhat, consistent with the existence of investors who try to profit from a market reaction to previously published information. Finally, the magnitude of the effects are sizable relative to previous findings of the aggregate market impact of key macro economic variables (see Andersen et al. (2005)).

While these findings contradict semi-strong market efficiency, they may arise if information gathering is costly and limits to arbitrage exist. Since the LEI is a composite index which takes some (but, not much) effort to reproduce, it may be that a sub-set of investors deem the costs too high. If arbitrage capacity is limited, the announcement can then lead to price changes as less informed investors update their expectations.

We investigate this explanation by looking at the cross-sectional response of stock prices to the announcement. Given that the LEI is a signal of the future state of the economy, uninformed but rational investors, will update the price of stocks that have high, positive sensitivity to such a factor more than stocks that have low (or negative) sensitivity. Since the LEI is pro-cyclical and investors dislike recessions, we would expect high risk premium stocks to be more sensitive to the announcement. On the other hand, if the cause of the price reaction is linked to bounded rationality, the updating is more likely to not be risk-based.

The Fama-French portfolios sorted on size and book-to-market do a good job of capturing

[2]See http://www.conference-board.org/economics/bci/general.cfm) and http://www.bloomberg.com/markets/ecalendar/index.html), respectively.

the cross-sectional spread in excess stock returns. Further, there is evidence that the High Minus Low and Small Minus Big factors predict future GDP growth (see Liew and Vassalou 2000). So, according to the information gathering cost explanation, we should expect large and low B/M firms to have lower LEI announcement response. Examining the size and book-to-market portfolios' return announcement response we find the *opposite* pattern: Large firms, and to a lesser extent high book-to-market firms, are *more* responsive to the announcement. Our results are robust to liquidity issues such as systematic differences in the bid-ask spread across portfolios.

In sum, it appears investors do not perfectly impound public information into prices even at the aggregate level, and that this inefficiency is systematically related to the cross-section of expected stock returns. Market price response to pre-scheduled LEI announcements is forecastable using previously published information. Thus, aggregate prices fail to account for the stale information contained in the announcement. Further, the investors that are responsible for these results do not appear to be "unsophisticated" traders, which have received much attention (see for example Barber and Odean (2000)). Rather, they are likely to be professional traders. We base this claim on three facts: (1) the effect is almost instantaneous, (2) it shows up in S&P500 futures prices, and (3) it shows up in large stocks while individual investors tend to trade small stocks (see Barber, Odean and Zhu (2005)). Bounded rationality of professional traders may therefore be more important than previously considered.

The paper proceeds as follows. In the next section, we relate our findings to existing literature and provide some relevant background information. Section 3 presents the data, including a detailed description of the methodology used for constructing the LEI index. Section 4 presents the empirical results, and section 5 concludes.

2 Background and Related Literature

This paper is related to several strands of literature. First, it is broadly related to the large body of literature on market efficiency and in particular to studies that evaluate the impact of news about fundamentals on asset prices. If markets are semi-strong efficient, public news about fundamentals (future cash flows and/or discount rates) will be immediately incorporated in prices. Thus, cash flow or discount rate relevant news releases ought to be tightly linked to realized returns on stocks and bonds. Early efforts at evaluating the market impact of news releases, both macro and firm-specific, yielded only weak evidence of a link between news and realized returns and volatility of returns (e.g., Schwert (1981), Cutler, Poterba, and Summers (1989), Haugen, Talmor, and Torous (1991)). Mitchell and Mulherin (1994) do find robust evidence of a positive relation between measures of aggregate stock market trading volume, volatility and returns and the number of daily reported news stories by Dow Jones.[3] All of these studies used daily data.

In order to establish a tighter link between macro news announcements and aggregate realized returns, volatility and volume, it has proved necessary to look at intraday data. An early paper using high-frequency data is Fleming and Remolona (1999) who document that scheduled macro news announcements have a very strong and immediate impact on intraday U.S. treasury bond volume, volatility and bid-ask spreads. In addition, they find a prolonged "second stage" price-adjustment period with higher than average (i.e., relative to non-announcement day) volume and volatility. In two recent papers, Andersen et al. (2003, 2005) find strong evidence of macro announcement effects in stocks, bonds, and foreign exchange markets. The key to uncovering this evidence is again to look at intraday data (5 minute returns in their case). The impact of macro news on aggregate stock (and bond and foreign exchange) returns is very short-lived, typically 5-10 minutes. Also, the magnitude of the return effect is rather small, as may be expected since the shocks tend to be small (i.e., most of the information is already impounded in prices). Since this study looks at all available U.S. macro announcements, it serves as a natural benchmark for our results.

In a related literature, several studies have documented that re-reporting of news events can affect individual stock prices. As mentioned, Huberman and Regev (2001) document an instance where a re-release of news had a large instantaneous effect on shares of a number of firms. In May of 1998, *The New York Times* published an article discussing recent developments in cancer research, while mentioning a specific publicly traded firm, EntreMed (ENMD). The article was merely a repetition of news previously covered by *Nature* and in the popular press some six months earlier. ENMD's next day return was 330%. Some of that run-up reverted in the subsequent weeks but a large portion of it appeared to be permanent. Meschke (2004) uses a related data set to show that media attention, absent any new information, may trigger price and volume reactions. The paper studies a set of interviews with CEOs aired on CNBC between 1999 and 2001. Following the coverage, prices of the companies managed by these CEOs experience transitory price increases, confirming the idea that these interviews did not contain new information; trading volume increased as

[3] Huang and Kong (2005) find significant impact at the daily level of scheduled macro announcements on high-yield credit spreads.

well.

The idea that financial markets' reaction to announcement overweight stale information receive support from other studies. Specifically, a number of papers have showed that stock prices do not sufficiently account for the fact that various accounting measures of firm performance are predictable (e.g., earnings). Bernard and Thomas (1990) find that announcement response to future earnings can be forecasted based on *current* earnings. That is, the market fails to account for the degree to which earnings are a mean-reverting process. These market-level findings are consistent with the study of Abarbanell and Bernard (1992) who show that analysts' earning estimates seem to reflect a naive seasonally adjusted random walk model. Building on that, Sloan (1996) shows that stock prices do not fully reflect the fact that forecasts of future earnings can be decomposed into components that have different degrees of persistence. Specifically, future earnings depend differently on current cash flow and accrual components. At the same time, stock returns appear to weight them equally, suggesting that a response that is consistent with a naive model that views earnings as a one-lag autoregressive process. Thus, prices overweight accruals and underweight cash flows. These papers are of particular relevance to our study since they examine the efficiency of stock price response to announcement based on its forecastability.

Our findings are also consistent with a large body of literature on market overreaction. Measuring returns of over short horizons - weeks (see Lehman (1990)), or over very long horizons - years (see for example De Bond and Thaler (1985,1986), Jegadeesh and Titman (1995)), these papers find reversals patterns that can be predicted by various measures (e.g., past returns, scaled performance, etc.). Summarizing this part of the literature, Shleifer (2000) states that "security prices overreact to consistent patterns of news pointing in the same direction". Of course, if markets fail to account for the stale component contained in various announcements, fundamentals and asset prices would diverge. This may result in excess price volatility relative to fundamentals. Such a phenomenon was suggested by Shiller (1981) and Roll (1988), among others.

3 The Leading Economic Index

3.1 Overview

The Composite Index of Leading Economic Indicators (LEI), calculated and published monthly by The Conference Board, (TCB), is designed to predict turning points (peaks and troughs) in the business cycle. TCB took over the responsibility to publish and maintain the LEI and related composite indexes and the Business Cycle Indicators database from the Bureau of Economic Analysis at the U.S. Department of Commerce starting with the December 6, 1995 release (see Business Cycle Indicators Handbook, 2001).

Leading indicators are those series that have an established tendency to decline before recessions and rise before recoveries (for more details on the indicator approach to measuring and analyzing business cycles see Burns and Mitchell (1946), Zarnowitz (1992), and Business Cycle Indicators Handbook (2001)).[4] The indicators used to construct the leading index tend to move ahead of the business cycle as represented by the monthly coincident indicators including industrial production, personal income less transfer payments, manufacturing trade and sales, nonfarm employment, and the quarterly real GDP. For example, businesses adjust hours before changing their employment levels through hiring or firing; new orders for machinery and equipment are placed before completing investment plans; etc. The LEI helps measure and predict cyclical economic movements by summarizing their multi-causal, multi-factor nature as reflected in diverse economic indicators. By design, the composite index of leading indicators (LEI) should help predict changes in real economic activity (see figure 1). Filardo (2004) provides recent evidence based on some nonparametric rules and applications using probability models that the LEI performs well as a variable to forecast cyclical movements in the economy. McGuckin et. al. (2004) also reports evidence on the significant out-of-sample forecasting ability of the LEI using real time data.

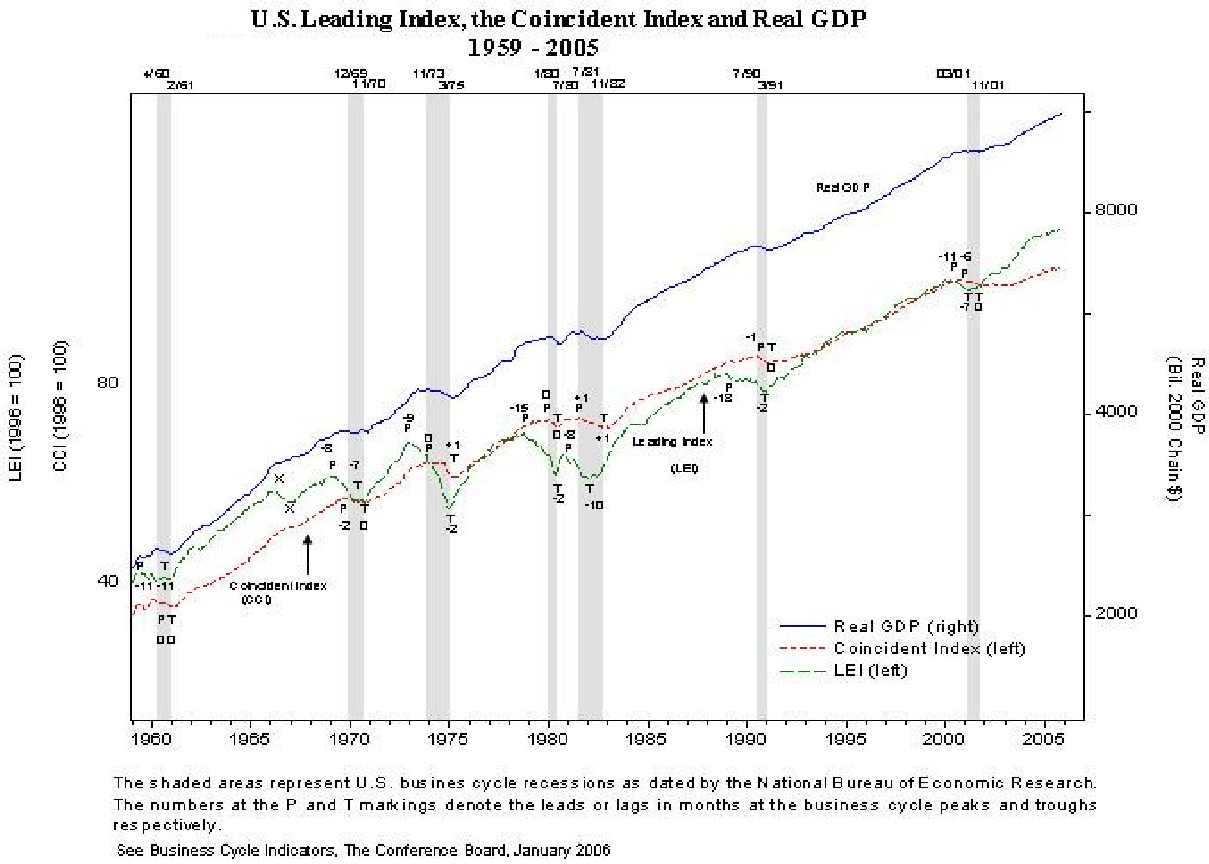
3.2 Methodology

After The Conference Board assumed responsibility for the Business Cycle Indicators program, it reviewed and revised the LEI in 1996 (for additional details see the Business Cycle Indicators Handbook, 2001). Notably, the composition of the LEI was changed: two components were deleted due to their excessive volatility which led to "false signals" of recessions (change in manufacturers' unfilled orders and change in sensitive materials prices) and a new component was added (the interest rate spread). After this major revision (first released December 30, 1996), The Conference Board also started to publish the LEI press release at 10 am to be consistent with its other economic data releases. Previously, the LEI releases were made at 8:30 am following the BEA schedule.

[4]The indicator approach has a long history since mid-1930s and was developed at the National Bureau of Economic Research (NBER), following the influential work of Wesley C. Mitchell and Arthur F. Burns. It has been a major component of the NBER program in economic growth and fluctuations.

FIGURE 1

Figure 1: The Leading Economic Indicator (LEI) and business cycle fluctuations.



In the current indexing methodology, which changed very little since the 1960s when the U.S. Department of Commerce began publishing the composite indexes, the volatility of each component is standardized before the component contributions are averaged together, using equal weights. The volatility adjustment is made using standardization factors which equalize the volatility of the index components so that relatively more volatile series do not exert undue influence on the index (the standardization factors are updated every year in January and are available in the monthly press releases). The average contribution becomes the monthly change in the LEI. Using this monthly change, the index level is calculated recursively starting from a value of 100 in the first month of the sample which begins in January 1959, and then the index is rebased to have an average value of 100 in 1996. More details on index construction are given in the appendix (also see The Conference Board web site and Business Cycle Indicators Handbook, 2001).

According to TCB's press release, data used in the LEI calculation is available the day before a release and three of the ten components of the LEI that are not available on the publication date are based on estimates by TCB. These components (manufacturers' new orders for consumer goods and materials, manufacturers' new orders for nondefense capital goods, and the personal consumption expenditure used to deflate the money supply) are estimated using a time series regression that uses two lags (see McGuckin et. al. (2001) for more on this model and a comparison with other alternative lags structures).[5] The appendix provides more background information and details on why this procedure was selected and how it was implemented by TCB.

Given the transparent methodology and the advance availability of the component data, the cost of estimating the LEI is fairly low. Even without an exact replication of the methodology, using the known components (7 out of 10) and ignoring the unavailable data or using a naïve forecast of the missing components (3 out of 10), it is possible to get good estimates of what the LEI release will contain.[6] The correlation of the monthly changes in the 10 component LEI with the monthly changes in a 7 component LEI is about 0.9.

4 Data

In this study we combine three different data sources: macro news, index prices and individual stock transactions. The LEI release dates and the original index series was provided to us by the Conference Board. For the purposes of this study, it is important to capture the index level at the time of the release since subsequent revisions to macro data resulted in ex-post updates of the index. The index is in our sample always reported at 10:00am.[7] The market returns data is constructed using S&P500 future prices, while the cross-sectional analysis uses individual stock transactions data from the TAQ database. The futures data

[5]When the unavailable data become available in the next month, the index is revised.

[6]According to McGuckin et. al. (2004), since the index averages ten components, measurement errors or forecasts errors in any one component are likely to be offset by those in other components, suggesting a degree of robustness in the estimation of the index value. The other consideration which works to deemphasize the importance of an exact forecast of the latest value of the LEI is the observation that analysts look at short term trends in the LEI and changes in their direction (i.e. the movement of the LEI over the last three to six months is more meaningful than the magnitude of the latest observation).

[7]Before 1997, the index was reported at 8:30am, which coincides with the reporting time for a number of other macro economic releases (e.g., Census Bureau, Bureau of Economic Analysis). The move to the 10:00am announcement time reflected in part a desire to make the announcement during market open hours.

was purchased from Price-Data.com and included five minute interval data on open, high, low and close prices for each of the futures contacts traded in 1997-2005.[8] For each date, we determined which of the multiple contracts available are "on the run" by comparing their daily volume. The intraday return series for each day, from open (9:30 am) to close (4:00 pm) was calculated using prices from that day's "on the run" contract. Since aggregate intraday volume data was not readily available, we constructed it by gathering tick-by-tick data from TAQ for all firms that were in the S&P500 index on a given day. We added transactions across all firms at each 1 minute intervals to arrive at the market volume for that time period. Table 1 provides summary statistics.

TABLE 1
Summary Statistics

Table 1: The table reports descriptive statistics for changes in the LEI index, announcement day returns, and non-announcment day returns during the 09:30am - 10:30 time window.

Statistic	**LEI change**	**Announcements** $(9:30-10:30)$	**Non-Announcements** $(9:30-10:30)$
Mean	.079	−.0010	−.0011
Stand.deviation	.345	.0049	.0049
Skewness	.570	−.561	−.923
Kurtosis	3.61	3.79	5.17

In addition, we used data from the Census Bureau, Bureau of Economic Analysis (BEA), Federal Reserve Board (FRB), National Association of Purchasing Managers (NAPM), and Conference Board, to screen out all dates on which other macro announcements were made between 9:30am and 10:30am. Specifically, we screen out dates on which one of the following announcements were made: New Home Sales, Durable Goods Orders, Factory Orders, Construction Spending, Business Inventories, Consumer Confidence Index, NAPM Index and Target Federal Funds Rate. These announcements were identified by Anderson et al. (2005) as being most important for U.S. equity returns.[9]

[8] Other data fields included trading volume and open interests.

[9] See Table 4 in their paper.

FIGURE 2
Announcement Dates

Figure 2: The figure reports the 72 LEI announcement dates included in our sample, the corresponding non-announcement dates, and the change in the LEI index.

Announcement Dates ((m)mddyy)				Non-Announcement Dates ((m)mddyy)			
81805	121803	62002	110200	82505	121903	62702	110900
72105	112003	52002	83000	72805	112103	52102	90600
62005	102003	41802	70500	62705	102103	42502	71200
51905	91803	32102	40400	52605	91903	32802	41100
42105	82103	22102	122999	42805	82803	22802	123099
31705	72103	12202	80399	32405	72803	12302	81099
21705	61903	121901	50499	22405	62603	122601	51199
12005	51903	112001	40699	12705	52003	112101	41399
122004	42103	102201	123098	122704	42803	102901	10799
111804	32003	92401	110398	111904	32703	92601	111098
102104	22003	82001	80498	102804	22103	82701	81198
92304	12303	71901	50598	93004	13003	72601	51298
81904	121902	62001	123197	82604	122002	62201	10898
52004	112102	51701	120297	52704	112202	51801	120997
41904	102102	32201	110497	42004	102802	32901	111197
31804	92302	22201	80597	32504	93002	22301	81297
21904	81902	12201	60397	22004	82002	12901	61097
12204	71802	122800	50297	12904	71902	122900	50997

The complete list of announcement dates used and the corresponding non-announcement dates is provided in figure 2. We matched each announcement date with one week ahead non-announcement date, unless there was another important macro news release on that date, in which case we picked the date following the LEI release. Out of a total of 104 announcements in our sample (1/1997 - 8/2004), we excluded 30 from our analysis due to the presence of other simultaneous macro announcements and 2 since the intraday future prices were not available for every 5 minutes in the 9:30-10:30 time interval.

It is worth mentioning a number of important features that characterize the data we use. First, it is well known that slow-moving trends in both volume and volatility over weeks and months are present in the data. Second, both volume and volatility exhibit U-shaped intraday patterns, as documented by Wood et al. (1985), Harris (1986), and Admati and Pfleiderer (1988). We deal with both of these issues explicitly in our tests by relying on comparison of announcement day patterns relative to non-announcement day patterns.

5 Empirical Results

This section presents the impact and dynamic effects of the LEI announcements on aggregate stock returns, volatility and volume. Our null hypothesis is that the LEI announcements have no effect. We focus on intraday market activity for two reasons. First, as discussed in Section 2, previous research has shown that the effect of news on aggregate stock market prices are mainly manifested in intraday returns data (see Andersen et al. (2003 and 2005)). Since the LEI actually is a *non*-news announcement, it is even more likely that we need intraday data to be able to uncover any effects. Also, we can now readily compare our findings to evidence from previous research concerning the price impact of "real" macro news announcements. Second, focusing on intraday returns makes our study less sensitive to the presence of other news effects over the same day (including the time from the close the day before) that we may not have captured in our econometric specification. Over the course of any given 24 hour period there is a continuous flow of news. By narrowing the time-window, we minimize the likelihood of the results being contaminated by other, unidentified shocks to investors' information sets.

5.1 General Methodology

A first-order concern when evaluating intraday data is the well-known presence of intraday patterns in volatility and volume (e.g., Admati and Pfleiderer (1988)). Rather than attempt a parametric model to describe such intraday patterns, for which at present there is no agreed upon model, we investigate return, volatility and volume patterns on LEI announcement days vs. non-announcement days (as described in the previous section) by utilizing a matching study. In particular, each announcement day is matched with the day one week after if this is a non-announcement day. If it is not, the closest non-announcement day to the relevant announcement day is chosen. This is usually the day after (Figure 2 shows a list of the days chosen). This way we control for both intra-day and day-of-the-week effects.

The reason we are matching pairs as opposed to just pooling all announcement days and all non-announcement days into two groups, is that there is quite large time-variation in aggregate volatility (GARCH-effects) and in the level of volume over the sample. These slower-moving dynamics are important as they implicitly create different weights for (non-) announcement days in different volatility and volume regimes.[10] To minimize this effect, we

[10]For instance, periods with overall high volume and volatility would have a greater effect on the pooled announcement and non-announcement intraday patterns.

standardize each pair of observations - one announcement and one non-announcement day - by the *non-announcement* day standard deviations of returns and average trading volume, respectively. Specifically, we divide the intraday 5-minute return and volume data for each pair of non-announcement and announcement days by the respective non-announcement day's standard deviation of 5-minute returns and average level of 5-minute volume.[11] We use only the *non*-announcement day's standard deviation and average volume in order to capture any overall higher levels of volatility and volume on announcement days. This normalization does not affect intraday patterns and is valid under the maintained null hypothesis that the volatility and volume over matched announcement and non-announcement days are equal.

We evaluate the return, volatility and volume of announcement days versus non-announcement days over different intraday time-intervals to investigate dynamic effects. The LEI release is at 10:00am throughout the sample. We focus on the 09:30am to 10:30am interval. Using 5-minute futures returns as opposed to, say, tick data has been suggested by other studies as striking the best balance between power and microstructure effects (Andersen et al. (2003)). Further, it allows us to match our results with those obtained in similar studies. For all intervals, we test whether the volatility and volume is different on announcement days vs. non-announcement days. Since we have normalized the returns and volume data based on the matched non-announcement days, we perform pooled test of differences in volatility and volume on announcement days vs. non-announcement days. First, however, we analyze the impact of the LEI index announcements on returns.

5.2 Returns

To investigate the effect of the announcement on returns, we first define the normalized change in the LEI index, L_t, as

$$L_t = \frac{\Delta LEI\_index_t - E_T\left[\Delta LEI\_index_t\right]}{\sigma_T\left(\Delta LEI\_index_t\right)}$$

where $E_T\left[\cdot\right]$ and $\sigma_T\left(\cdot\right)$ denote the sample mean and standard deviation, respectively. We make this normalization for two reasons: 1) it makes the interpretation of regression coefficients more intuitive, and 2) it makes the results easier to compare to related studies where

[11] We calculate standard deviations assuming the 5-minute returns have a mean of zero. This is a reasonable, standard assumption given the short time-interval and yields more robust volatility estimates. Using the residuals of a regression of intraday returns on their lagged value (to capture any bid-ask bounce, which we do not find significant) does not produce qualitatively different results.

such normalizations are standard (e.g., Andersen et al. (2003), Lyons and Evans (2005)). Actually, it is usual to subtract the conditional *expectation* of the release and divide by the standard deviation of the imputed shocks. However, since our index is perfectly forecastable, there are no well-defined "shocks". Therefore, we simply consider deviations from the sample mean.

Anderson et al. (2003) note that looking at 5-minute futures returns strike a good balance between capturing fundamental dynamics operating at high-frequencies and minimizing the noise in returns caused by bid-ask bounce and other micro-structure issues. The futures contracts on the S&P500 are very liquid, so empirically neither stale prices nor the bid-ask bounce are important issues for our purposes. Regardless, we compare all our tests against non-announcement days, where presumably any remaining micro-structure effects are similar. We run the regression

$$R^A_{i,t} = \alpha^A + \beta^A_i L_t + \varepsilon^A_{i,t} \qquad , \; t \in [1, 2, ..., T] \tag{1}$$

where $R^A_{i,t}$ is the intraday interval i's log return on the announcement day t. Thus, if the interval i is before 10am, the regressor is the same-day *future* percentage change in the LEI index, L_t, whereas if the interval i is after 10am, the regressor is the same day's already reported LEI change. For comparison, we also run the regression

$$R^{NA}_{i,t'} = \alpha^{NA} + \beta^{NA}_i L_t + \varepsilon^{NA}_{i,t'}, \; t^{'} \in [1, 2, ..., T] \tag{2}$$

where the superscript ^{NA} refers to the non-announcement day t', which corresponds to the matched announcement day t. It is a little unnatural to insert the actual LEI index change L_t in these regressions, since this release was (usually) one week in advance. However unlikely, the fact that we do not find anything is reassuring with respect to any hitherto unknown intraday patterns in returns that may be present. Table 2 presents the results.

The regression coefficients for the 5-minute intervals before the announcement (from 09:30 - 10:00) are on average positive, but insignificant. The regression coefficients on non-announcement days are also insignificant and on average half as big as the case for the announcement days. At the announcement (interval 10:00 - 10:05), the announcement day regression coefficient is positive and significant, while the non-announcement day regression coefficient is about a quarter in magnitude and insignificant. Thus, the LEI announcement is moving aggregate stock prices in the direction of the change in the LEI index. Over

TABLE 2
Return Regressions

Table 2: The table reports estimates from OLS regression of return data on the same day LEI announcement for announcement days, and matched LEI announcement for non-announcement days. There are 72 observations in each group. Returns are multiplied by 100, standard errors are corrected for heteroskedasticity (White standard errors). The changes in the LEI index have been normalized to have mean zero and unit variance. Bold face denotes significant at the 5 percent level in a two-tailed test. The regression is:

$$R_{i,t_0-t_1} = \alpha_i + \beta_i LEI_t + \varepsilon_{i,t}$$

Time	*Announcement Days*				*Non-Announcement Days*			
$t_0 - t_1$	α (*s.e.*)	β (*s.e.*)	R^2	$p-val$	α (*s.e.*)	β (*s.e.*)	R^2	$p-val$
0930 − 0935	−.0047	.0144	1.34%	0.39	−.0176	.0034	0.07%	0.80
	(.0147)	(.0167)			(.0154)	(.0135)		
0935 − 0940	.0073	.0246	3.88%	0.08	−.0166	.0219	1.99%	0.25
	(.0146)	(.0138)			(.0183)	(.0189)		
0940 − 0945	.0115	−.0103	0.81%	0.43	−.0195	.0238	2.25%	0.20
	(.0136)	(.0131)			(.0187)	(.0183)		
0945 − 0950	.0148	.0134	1.02%	0.43	−.0137	−.0154	1.13%	0.39
	(.0158)	(.0170)			(.0172)	(.0179)		
0950 − 0955	.0125	−.0106	0.75%	0.49	.0086	−.0016	0.01%	0.94
	(.0146)	(.0154)			(.0177)	(.0205)		
0955 − 1000	.0272	.0085	0.46%	0.60	−.0033	.0080	0.40%	0.55
	(.0149)	(.0164)			(.0150)	(.0132)		
1000 − 1005	−.0437	**.0303**	4.01%	0.05	−.0232	.0066	0.23%	0.72
	(.0177)	(.0153)			(.0165)	(.0185)		
1005 − 1010	−.0162	−.0147	1.34%	0.32	.0264	−.0033	0.09%	0.80
	(.0151)	(.0147)			(.0134)	(.0134)		
1010 − 1015	−.0185	−.0064	0.23%	0.73	.0009	.0017	0.01%	0.91
	(.0159)	(.0185)			(.0171)	(.0155)		
1015 − 1020	−.0213	−.0103	0.79%	0.40	−.0291	.0033	0.08%	0.83
	(.0138)	(.0122)			(.0140)	(.0150)		
1020 − 1025	−.0377	−.0002	0.00%	0.99	−.0223	−.0157	1.49%	0.34
	(.0146)	(.0148)			(.0155)	(.0164)		
1025 − 1030	−.0307	−.0035	0.10%	0.76	.0035	−.0043	0.10%	0.73
	(.0136)	(.0112)			(.0161)	(.0122)		

the remaining 25 minutes of the event window, there are no significant effects. However, all the announcement day regression coefficients are negative, indicating that prices revert somewhat after the initial reaction at 10:00am. For the non-announcement days there are no significant effects and the average of the regression coefficients is essentially zero.

Our finding that a positive change in the LEI index is perceived as good news for stock markets is consistent with intuition and empirical findings regarding shocks in *true* news releases of standard variables like Non-Farm Payroll. If we compare the regression coefficient and R^2 with what Andersen et al. (2005) find in their exhaustive study, our results are striking. While the price impact of the change in the LEI index is not as large as what they find for GDP growth, non-farm payroll employment or the consumer price index, it is on par with variables like New Home Sales (included in the LEI index), and Net Exports. Also, consistent with the Andersen et al. (2005) study, the return effect is very short-lived. So, while the aggregate price impact of the change on the LEI index is rather small in absolute terms, it is surprisingly large relative to the price impact of true macro news releases! The regression coefficients for the time-periods immediately after the announcement are insignificant, but negative. This suggests that prices revert somewhat after the announcement "shock".[12]

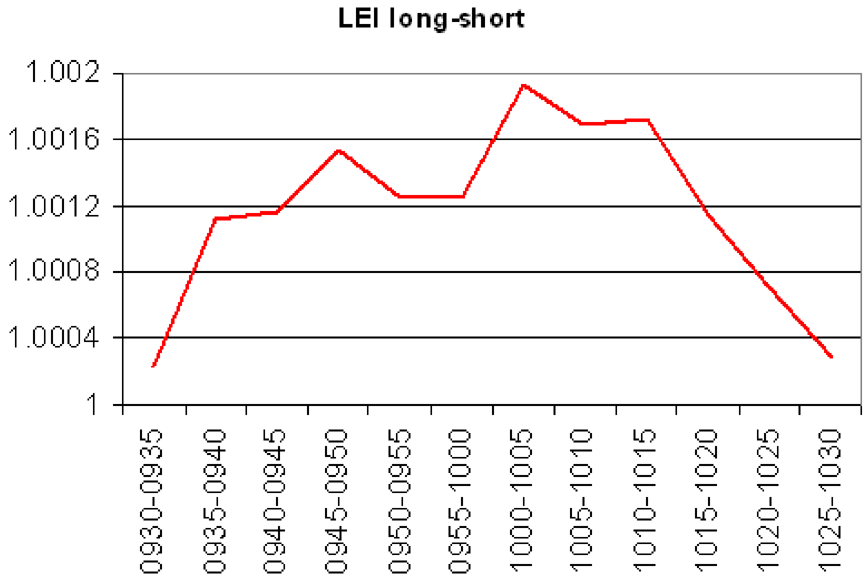
To provide a visual illustration of the price process around LEI announcements, we combine 5 minute returns from all days for which the magnitude of index change was at least one standard deviation. Since the regression results suggest that prices move in the direction of the announcement, we add the returns of positive announcement days to the *negative* of the returns on negative announcement days. The results are presented in figure 3.

The qualitative trends suggest that prices move in the direction of the announcement before 10:00am, spike immediately following the announcement and start reverting after that. The run-up in prices before the announcement as well as reversal afterwards is consistent with idea that trading *at* the announcement is motivated by what some market participants mistakenly interpret as arrival of new information.

[12] Andersen et al. (2005) investigate all macro releases *including the LEI*, but do not find significant evidence that it has a price impact. We offer two explanations for the discrepancy between our results. First, in their table 4, they state that the LEI is released at 8:30am. This is true only for the beginning of their sample. In our sample, from 1997 and onwards, the release time is always at 10:00am. At present we do not know if the authors corrected the change in release time over the sample, but they give no indication in their paper that they do. Second, and more fundamentally, they investigate normalized "surprises" based on market estimates obtain from a survey database (MMS). But, as we discussed in section 3, it is unclear what these "shocks" represent since the index is perfectly forecastable.

FIGURE 3

Figure 3: The red line is the implied average price process for a strategy that goes short 1 dollar in the stock market index if the LEI change is less than one standard deviation below the mean, and long 1 dollar in the market index if the LEI change is more than one standard deviation above the mean. The interval covered is from market open at 9:30am until 10:30am on announcement days. The price pattern shows that prices creep up until the announcement at 10:00am, where they jump up and subsequently decline.



5.2.1 Economic Significance - A Trading Strategy Example

To further assess the economic significance of the return-predictability, we construct a simple trading strategy based the change to the LEI index. The strategy initiates a buy (sell) of S&P 500 index futures at the open prices on the day of the announcement in the direction of change in the index. The amount transacted is proportional to the absolute value of the change, maxed out at .4. Therefore, if the (known) change in the LEI index on date t is .2, the strategy initiates a buy of \$0.5. At 10:05am, the position is reversed.

Notice that this is somewhat of a conservative strategy. An alternative, more aggressive strategy, would initiate the trades immediately before 10:00 and reverse them at 10:05, resulting in lower volatility of profits. Further, volume at the open and right after the announcement is relatively high so there is good reason to believe that these hypothetical trades might have been feasible. At the same time, we do not claim that in practice this strategy would have been profitable as we do not account for trading costs. The purpose of this exercise is simply to obtain a measure of the economic size of the apparent informational inefficiency.

Aggregating the results across the 72 observations, we find that the strategy yields annualized returns of 21.3% with corresponding standard deviation of 7.2%, resulting in a Sharpe ratio of 2.5. We compare that to results obtained from running the same hypothetical trades on the matching non-announcement days, for which we find annualized returns, volatility and Sharpe ratios of 5.8%, 7.7%, and .31, respectively: The difference in Sharpe ratios across announcement and non-announcement days is almost 2.2!

In sum, we conclude that changes in the LEI index have both economically and statistically significant price impact for the aggregate stock market, relative to the measured price impact of true macro news releases. This evidence is surprising given the fact that it is widely known that the index is based on already publicly available information and that the methodology used to compute the index is also publicly available and relatively straightforward.

5.3 Volatility

We obtain estimates of the relevant interval's announcement and non-announcement volatility as follows. Let $\tilde{R}_{i,t}$ be the *normalized* 5-minute log return for the interval i, where we have $j \in \{930:935,\ 935:940,\ ...,\ 1025:1030\}$. Interval i's variance estimate is then

$$\hat{\sigma}_i^2 = \frac{1}{T}\sum_{t=1}^{T}\tilde{R}_{i,t}^2$$

We assume in our analysis that expected 5-minute returns are zero, which is a reasonable approximation relative to their standard deviation and which yields more robust volatility estimates. The subscript t corresponds to the announcement or non-announcement days in our sample, which are indexed 1 to 72. We apply a Levene F-test for each interval i of the two variances being equal.[13] Table 3 shows the results.

The ratio of announcement vs. non-announcement days' volatility exhibits a significant spike for the interval $1000 - 1005$, which corresponds to the time the LEI index is announced. The increase is not only statistically significant (at the 5% level) but also eco-

[13]It is common in empirical work to use modified Levene F-tests (e.g., Brown-Forsythe modified Levene-test), as these are generally more robust to departures from normality of returns. We assume the mean 5-minute returns are zero, which is neither the mean, the median or the 10% trimmed mean, but which empirically turns out to be close to the median.

TABLE 3
Return Volatility Comparison

Table 3: The table reports estimates of standard deviation of normalized returns on announcement and non-announcement days. There are 72 observations in each group. The variance ratio test is a Levene F-test, where zero is assumed to be the median/mean return. Bold face denotes significant at the 5 percent level in a two-tailed test.

$t_0 - t_1$	σ_{ANN}	$\sigma_{NON-ANN}$	$Volatility\ ratio$	$p - val$
0930 – 0935	.899	.758	1.186	.23
0935 – 0940	.728	.927	**.785**	**.02**
0940 – 0945	.818	.876	.934	.72
0945 – 0950	.949	.828	1.146	.41
0950 – 0955	.836	.868	.963	.90
0955 – 1000	.862	.731	1.179	.27
1000 – 1005	1.084	.866	**1.252**	**.05**
1005 – 1010	.829	.732	1.133	.46
1010 – 1015	.882	.851	1.037	.93
1015 – 1020	.971	.732	**1.326**	**.01**
1020 – 1025	.804	.790	1.017	.98
1025 – 1030	.838	.676	1.240	.10

nomically sizable – volatility increases by an average of 25%. Before 10:00am there appears to be no overall pattern in the volatility ratio: volatility is about the same on announcement vs. non-announcement days. There is one significant observation at 9:35-9:40am, for which announcement days seem to have *lower* volatility than non-announcement days. After 10:00am, the volatility ratios are all above 1, indicating that volatility is overall higher on announcement days post the LEI release.

5.4 Volume

We estimate volume over 5-minute intervals from market open at 0930 until 1030, half an hour after the announcement, as

$$\hat{v}_i = \frac{1}{T}\sum_{t=1}^{T} \tilde{v}_{i,t}$$

where $\tilde{v}_{i,t}$ is the normalized volume of the 5-minute interval i on day t, where the t's correspond to announcement days for the announcement day volume estimates, and non-announcement days for the non-announcement day volume estimates. Remember that the matching was already used to obtained normalized 5-minute volume, so the pooled estimates above control for the strong, but slow-moving time-variation in volume (seasonalities, day-of-the-week, and other trends in the sample). To test whether the difference in the volume estimate for interval i is different on announcement days relative to non-announcement days, we simply regress the ratio of announcement day to non-announcement day volume on a constant and test whether the constant is different from 1. Table 4 reports the results.

At market open the volume on non-announcement days is slightly higher, but the difference is insignificant. However, as we get closer to the 10:00am announcement, the volume ratio becomes larger than unity and finally significant at the time of the announcement, as it was for both returns and volatility. The volume effect, however, persists significantly throughout the half hour following the announcement.

The above investigations show that the LEI index announcement have impact on both returns, volatility and volume on the aggregate stock market. The effect is short-lived for returns and volatility, consistent with previous studies of the impact of news announcement on aggregate prices. Volume, however, exhibits a more prolonged reaction. A similar finding was reported in Fleming and Remolona (1999).

TABLE 4
Trading Volume Comparison

Table 4: The table reports estimates of normalized volume on annoncement and non-announcement days. There are 72 observations in each group. A t-test of differences in means is employed and p-values are reported in the right column. The null hypothesis is $\alpha = 1$. The variances are allowed to be different across announcement and non- announcement days. Bold face denotes significant at the 5 percent level in a two-tailed test.

$$Vol_{ANN,t}/Vol_{NON-ANN,t} = a + \varepsilon_t$$

$t_0 - t_1$	α	$SE(robust)$	$p - val$
0930 – 0935	.974	.036	0.46
0935 – 0940	1.016	.035	0.64
0940 – 0945	1.049	.032	0.14
0945 – 0950	1.031	.031	0.31
0950 – 0955	1.048	.029	0.10
0955 – 1000	1.046	.035	0.19
1000 – 1005	**1.068**	.036	**0.04**
1005 – 1010	**1.067**	.030	**0.03**
1010 – 1015	**1.070**	.032	**0.03**
1015 – 1020	**1.071**	.034	**0.04**
1020 – 1025	**1.071**	.030	**0.02**
1025 – 1030	**1.099**	.032	**0.00**

6 Cross-Sectional Analysis

In the previous section, we established the fact that the release of the LEI has a statistically significant impact on aggregate returns, volatility, and volume. While these findings contradict semi-strong market efficiency, they may arise if information gathering is costly and limits to arbitrage exist. Since the LEI is a composite index which takes some (but, not much) effort to reproduce, it may be that a sub-set of investors deem the costs too high. If arbitrage capacity is limited, the announcement can then lead to price changes as less informed investors update their expectations.

We investigate this explanation by looking at the cross- sectional response of stock prices to the announcement. Given that the LEI is a signal of the future state of the economy, uninformed but rational investors, will update the price of stocks that have high, positive sensitivity to such a factor more than stocks that have low sensitivity. Since the LEI is pro-cyclical and investors dislike recessions, we would expect high risk premium stocks to be more sensitive to the announcement. The Fama-French portfolios sorted on size and book-to-market do a good job of capturing the cross-sectional spread in excess stock returns (Fama and French (1992, 1993)), and there is evidence that the High Minus Low and Small Minus Big factors predict future GDP growth (see Liew and Vassalou 2000). Therefore, according to the information gathering cost explanation, we should expect large and low B/M firms to have lower LEI announcement response.

6.1 Data Set Description and Portfolio Construction

Based on the previous section and on the papers by Andersen et al. (2003, 2005), we know that the information contained in macro indicators is integrated into prices within 5 to 10 minutes. Andersen et al. even suggest that it is very likely that the information is actually impounded into prices within less than a minute. We therefore perform our cross-sectional tests on intradaily returns, namely 1- and 5-minute returns. However, intradaily returns to the Fama-French portfolios are not readily available.

In order to test the information gathering cost hypothesis described above on intradaily returns, it is important to have the widest possible cross-section of expected returns. We therefore decided to use the 5x5 Fama-French portfolios sorted on size and B/M. Following the procedure described in Davis, Fama, and French (2000), we obtain the CUSIP codes of all the stocks of all 25 portfolio each month.[14] Using this data, we then extract from the Trade and Quotes (TAQ) database the transactions of every stock in each portfolio from 9:30am until 10:30am on the LEI announcement days.

The calculation of portfolio returns using tick-by-tick data poses a challenge since many stocks do not trade during every return interval. As a result, we designed the following very simple algorithm. For a particular minute, say 10:00 to 10:01, a stock's return is calculated if it traded during that minute and during the preceding minute, in this case 9:59 to 10:00. If a stock trades multiple times during both minutes, we use the latest trades in both minutes in order to calculate the return. All the stocks that do not trade during both or either minute are disregarded. The portfolio return for that minute is then the equally-weighted return of all the stocks' returns that did trade between these two minutes. This is obviously a very crude algorithm but it has the advantage of being simple and therefore not subject to ad-hoc rules that may bias our results in particular ways. For robustness, we designed another algorithm that left our results basically unchanged.

Some summary statistics of all 25 portfolios are shown in Table 5. It is worth pointing out that the average numbers of stocks in our portfolios are consistent with the data provided by Ken French on the daily portfolios. Also, note that none of portfolios have very few stocks trading during the minute when the LEI announcements are made: the minimum is 20 stocks and that is in the large size portfolios, where each stock trades a lot. Hence the actual number of trades between 10:00 and 10:01 is actually very high, which allows us to safely ignore liquidity issues. In the small size portfolios, which might be most subject to liquidity and stale price problems, there are also always enough stocks trading between 10:00 and 10:01, the minimum being 54. Again, the number of trades during that minute is also much higher than this number. Lastly, we would like to highlight the fact that both the average 1-minute and 5-minute returns are statistically indifferent from zero across all portfolios, which gives us confidence that nothing systematic might be at play here besides the effect that we are looking at.

6.2 Hypotheses, Tests, and Results

Having created reliable high-frequency returns for the 25 Fama-French portfolios, we can now turn to the economic question at hand: Do different types of stocks systematically react

[14]The only difference between their procedure and ours is due to the fact that we do not have the hand-collected data from *Moody's Industrial Manuals* that was used in Davis, Fama, and French (2000).

TABLE 5
Descriptive Statistics of the Intradaily Fama-French Portfolios

Table 5: For each of the 25 Fama-French portfolios, we report the average 1-minute and 5-minute returns $\overline{r}$ over the hour from 9:30 to 10:30 along with the respective standard deviations of returns σ. We also report the average number of stocks in each portfolio $\overline{N}_{portfolio}$ and the average number of stocks $\overline{N}_{t,LEI}$ trading from 10:00 to 10:01 in each portfolio. All these summary statistics are for our entire dataset of 72 dates spanning from February 1997 to August 2005. Note that the idiosyncratic nature of the returns and standard deviations of portfolio 10 seem to be due to an error in the TAQ data that we are investigating. Nevertheless, we can confirm that this error does not occur between 10:00 and 10:01.

Portfolio #	$\overline{r}_{1-min}$ (%)	σ_{1-min} (%)	$\overline{r}_{5-min}$ (%)	σ_{5-min} (%)	$\overline{N}_{portfolio}$	$\overline{N}_{t,LEI}$
1	-0.00617	0.19262	-0.03547	0.42423	580	93
2	-0.00409	0.24114	-0.02329	0.5211	433	59
3	-0.00354	0.20421	-0.02019	0.45595	505	54
4	-0.00408	0.22387	-0.01754	0.50988	675	55
5	0.00337	0.20218	0.01652	0.43113	960	69
6	-0.00372	0.10093	-0.01657	0.25863	201	82
7	-0.000737	0.10228	-0.00454	0.24515	156	62
8	0.00282	0.13706	0.00962	0.27527	158	54
9	0.0037	0.15862	0.01946	0.35413	149	49
10	0.01208	0.61251	0.0647	1.42602	91	30
11	-0.00028	0.10274	-0.00272	0.23607	163	91
12	-0.00174	0.07271	-0.00778	0.19377	119	62
13	0.000509	0.07263	0.00378	0.17841	105	53
14	0.00196	0.08177	0.01108	0.17779	82	41
15	0.0015	0.09624	0.01266	0.2125	47	24
16	-0.00227	0.07047	-0.00778	0.20572	138	102
17	0.00108	0.1789	0.000904	0.25688	100	68
18	0.00244	0.12944	0.01501	0.26808	78	50
19	0.000728	0.05695	0.00613	0.14868	54	35
20	0.000566	0.08681	0.00559	0.20817	36	19
21	-0.000876	0.07975	-0.00271	0.19005	158	144
22	0.00164	0.1503	0.00556	0.26003	78	63
23	-0.000564	0.0771	-0.00146	0.16073	50	37
24	0.000232	0.05572	0.00382	0.13478	36	28
25	-0.000134	0.06687	0.00192	0.1554	28	20

more than others to the release of the LEI? The rational and efficient markets null hypothesis obviously states that nothing should happen since the LEI is composed of previously published information. However, we rejected this hypothesis in the previous section by looking at aggregate market data. A weaker hypothesis states that since the LEI is a signal of the future state of the economy, uninformed but rational agents will update the prices of stocks that positively and significantly load on this factor more than stocks that do not. Due to the pro-cyclical nature of the LEI and the fact that agents dislike market downturns, we would expect high risk premium stocks to be more sensitive to the announcement. This hypothesis is in line with the results of Liew and Vassalou (2000) that show that HML and SMB are linked to future good states of the economy. Hence high B/M and small capitalization stocks are positively linked to increasing future changes in GDP. This risk-based hypothesis should lead us to the result that low B/M and large stocks should have smaller responses to the LEI announcements compared to value and small stocks.

In order to shed some light on the above hypothesis, we perform exactly the same return tests as in the previous section, regressing the return of each portfolio from 10:00 to 10:01 on the change in LEI:

$$R_{i,10:00-10:01} = \alpha_i + \beta_i LEI_t + \varepsilon_{i,t} \qquad \text{for all 72 dates } t \text{ in our sample} \tag{3}$$

where $R_{i,10:00-10:01}$ is the return of portfolio i from 10:00 to 10:01.

Table 6 shows the main results from the above regressions. It is comforting to find positive coefficients for almost all portfolios, which is in agreement with the aggregate results from the previous section. Most coefficients are insignificant, but two clear patterns emerge. First, for each B/M quantile, as size increases, the regression coefficient on the LEI becomes larger. For instance for the medium B/M category, the coefficient goes from being insignificant for small size to being equal to 0.02% for the large size.

We further highlight this "size" pattern by constructing aggregate size portfolios by summing the returns across all B/M categories (i.e. summing across the rows). This gives us 5 "super" size portfolios on which we run the same regressions as before. The results are shown in the last column of Table 6 and also in Figure 4. This pattern is very strong. As size increases, the portfolios react more and more to the release of the LEI. This contradicts the information gathering cost hypothesis since large stocks have lower risk premia compared to small stocks.

The second pattern that emerges from Table 6 is the fact that as B/M increases, the

TABLE 6
Cross-Sectional Return Regressions

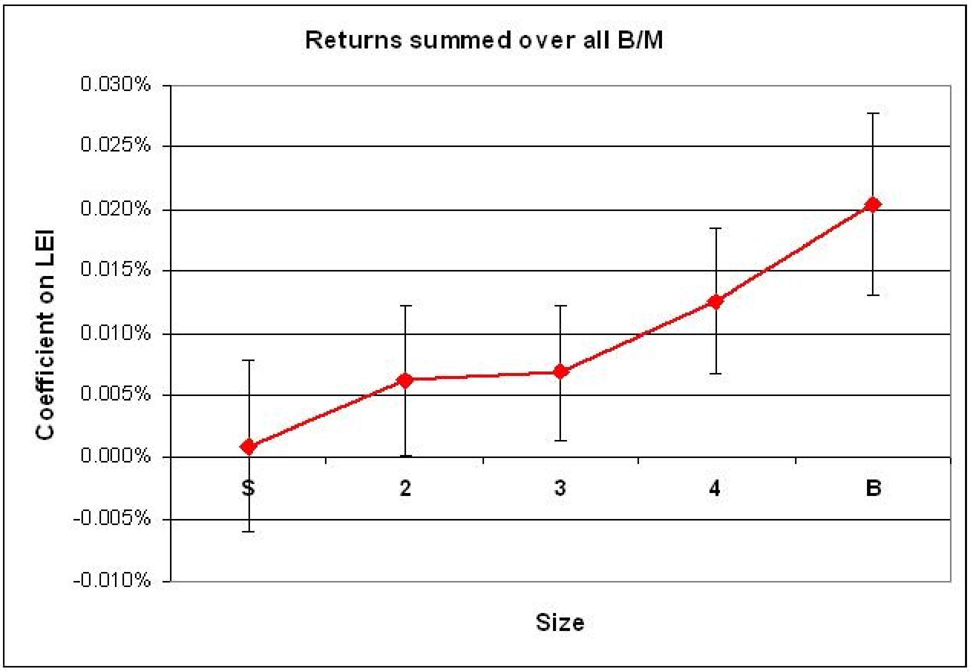
Table 6: The table reports estimates from OLS regressions of return data for each of the 25 Fama-French portfolios from 10:00 to 10:01 on the same minute LEI announcement. There are 72 observations in each group. Returns are multiplied by 100 and standard errors are corrected for heteroskedasticity (White standard errors). The changes in the LEI have been normalized to have mean zero and unit variance. Bold face denotes statistical significance at the 5% level in a two-tailed test. The regression is:

$$R_{i,10:00-10:01} = \alpha_i + \beta_i LEI_t + \varepsilon_{i,t}$$

		Book-to-Market					
		L	2	3	4	**H**	**All B/M**
	S	-0.015	0.008	0.010	**0.026**	-0.015	0.001
		(0.0132)	(0.0129)	(0.0142)	(0.0116)	(0.0195)	(0.0069)
	2	0.013	-0.003	0.007	0.010	0.005	0.006
		(0.0112)	(0.0106)	(0.0076)	(0.0060)	(0.0070)	(0.0060)
Size	3	**0.019**	0.007	0.003	0.002	0.004	0.007
		(0.0090)	(0.0060)	(0.0056)	(0.0056)	(0.0072)	(0.0054)
	4	0.015	0.012	**0.013**	**0.013**	0.011	**0.013**
		(0.0098)	(0.0073)	(0.0065)	(0.0054)	(0.0119)	(0.0059)
	B	**0.026**	**0.022**	**0.020**	**0.017**	0.016	**0.020**
		(0.0113)	(0.0081)	(0.0085)	(0.0059)	(0.0090)	(0.0073)
	All Sizes	0.011	0.009	0.009	**0.014**	0.004	
		(0.0081)	(0.0055)	(0.0063)	(0.0044)	(0.0057)	

FIGURE 4
Size Effect

Figure 4: This Figure shows the coefficients β_i for 5 "super" size portfolios obtained by summing across all B/M categories. The White standard errors are shown as error bars.



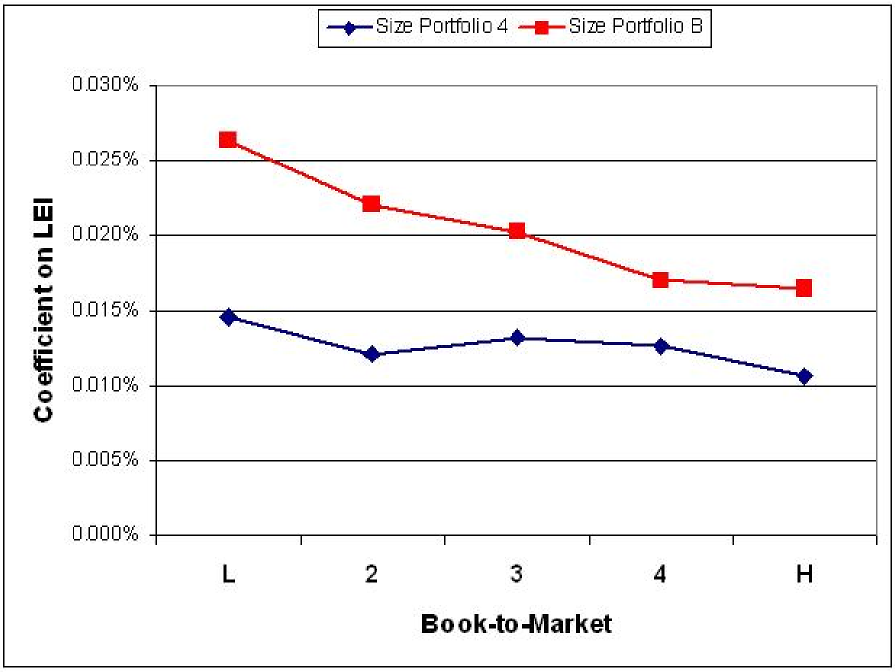
coefficient on the LEI decreases. This "B/M" result is only present for the largest two size quantiles. It is strongest for the largest size quantile, where the coefficient goes from 0.026% to 0.016% as B/M increases. We again highlight this effect by creating five "super" B/M portfolios by summing the returns across size quantiles. This is shown on the last row of Table 6. This effect is indeed weaker than the size effect, but Figure 5 suggests that low B/M, growth stocks, have higher responses than high B/M, value stocks.

This evidence again contradicts the information gathering cost hypothesis since we find that low risk premia stocks have stronger responses to the release of the LEI. Nevertheless, it is important to note that the fact that we find a smaller effect across B/M compared to size is consistent with Liew and Vassalou (2000), where they show the forecasting power of HML for the United States comes out insignificant.

If spreads and bid-ask bounce are in any way systematically related to size and B/M, this could lead us to over-reject the null. It is well established that spreads are higher for small market capitalization stocks. In particular, in the case of, say, a positive LEI announcement we are likely to observe an increase in buy orders executed at the ask price. For small

FIGURE 5
Book-to-Market Effect

Figure 5: This Figure shows the coefficients β_i for the two largest size portfolios across B/M categories.



stocks, this would generate extra returns not necessarily related to the LEI announcement, compared to large stocks that have smaller bid-ask spreads. We would therefore observe a larger β_i coefficient on the small size portfolios even though it is unrelated to the risk-based hypothesis we are testing. As a result, effects related to bid-ask spreads and bounce go against our results, making our rejection of the null even stronger.

To summarize, we find strong evidence that large firms react more to the release of the LEI. Also, we find suggestive evidence that low B/M firms also react more. This is in direct contradiction to the risk-based explanations previously put forward in the literature.

7 Conclusion

This paper tests a very weak restriction on aggregate prices: That they do not respond to announcements of information already available to market participants. We identify a unique stream of announcements, the U.S. Leading Economic Index (LEI), which is released on an ongoing basis at pre-determined times, contains previously published macro data, and is widely followed by the mass media. We show that the announcements have a sizable effect on instantaneous market-level returns (which move in the direction of the announcement), trading volume and price volatility.

This phenomenon of course constitutes a violation of semi-strong market efficiency and suggests that aggregate stock prices are not always able to correctly determine the incremental news content of information release. To test whether the findings stem from costly information acquisition combined with limits to arbitrage, we investigate the cross-sectional response to the announcement. Contrary to the information acquisition cost explanation, we find that stocks that have higher sensitivity to macro economic fluctuations respond *less* to the release of the LEI.

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8 Appendix

8.1 LEI Calculation

More formally, let $\Delta LI_{t,t-1}$ denote the monthly change in the LEI for month (t-1) published in month t. This monthly change is calculated as the sum of component contributions which are derived from a symmetric percent change formula.

$$\Delta LI_{t,t-1} = \left(\sum_{i=1}^{10} \sigma_i * 200 * \frac{X_{i,t} - X_{i,t-1}}{X_{i,t} + X_{i,t-1}} \right) \tag{4}$$

where σ_i is the standardization factor calculated by dividing the inverse standard deviation of component i by the sum of the inverse standard deviations over all components. As the notation makes clear, the index published in month t refers to past data for t-1 which has already been published.

Since January 2001, leading indicator components for month t-1 that are not available at the time of publication, month t, are estimated by The Conference Board using a univariate autoregressive model to forecast each unavailable component. This procedure seeks to address the problem of varying availability in its components (i.e. publication lags). Without it, the index would contain incomplete components or it would not be available promptly under the current schedule.

In the publication schedule prior to January 2001, the index published in month (t) referred to the month (t-2). In the new schedule after January 2001, the index published in month (t) refers to the preceding month (t-1). For example, in the old publication schedule the index would be calculated in the first week of March (t) for January (t-2), and the January value of the LEI would use a complete set of components. According the new schedule, the index is calculated in the third week of March for February (t-1), and the February value of the index uses 70 percent of the components which are already available and remaining 30 percent are forecast. As seen in this example, users of the LEI would have had to wait for two more weeks until April for the February index.

Specifically, the missing components (manufacturers' new orders for consumer goods and materials, manufacturers' new orders for nondefense capital goods, and the personal consumption expenditure used to deflate the money supply are estimated using a time series regression that uses two lags (see McGuckin et. al. (2001) for more on this model and a comparison with other alternative lags structures).[15] When the unavailable data become available in the next month, the index is revised.

The missing components could be forecast through alternative means; however, The Conference Board has focused on simplicity, stability, and low costs of production and argues for concentrating on easily implemented autoregressive model. Note that under the pre-2001 release schedule of the LEI, it would have been possible to perfectly forecast the new value each month if the costs of data collection and application of the index methodology calculation were undertaken. In the post-2001 schedule, this is still possible, but the estimated components require an additional step and introduce some uncertainty, if the exact forecast model is unknown (this information is available from The Conference Board).

The procedure has the advantage of incorporating in the LEI data such as stock prices, interest rate spread, and manufacturing hours that are available sooner than other data on real aspects of the economy such as manufacturers' new orders. McGuckin et. al. (2004) says, "This is a major gain in timeliness in a world where business and government analysts revise and update their predictions nearly every week."

[15]The procedure used to estimate the current month's personal consumption expenditure deflator (used in the calculation of real money supply and commercial and industrial loans outstanding) incorporates the current month's consumer price index when it is available before the release of the U.S. Leading Economic Indicators.