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Local Investor Attention and Stock Returns

Lavesh Kumar

Supervisor: Francisco Santos

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NORWEGIAN SCHOOL OF ECONOMICS

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Abstract

In this thesis, we analyze the effect of local investor attention on stock returns. The study is carried out on a sample of 653 S&P 500 stocks in the period 2004-2016. Specifically, the paper constructs a variable that each month measures abnormal increases in the investor attention a stock receives by local investors, using Google Search Volume Index data filtered by U.S. state and the category "Investing". Furthermore, the paper constructs variables that in each month measure the difference in the attention a stock receives by local investors relative to nonlocal investors. We find that firms that attract an unusual amount of attention by local investors experience significant future price reversals. Similarly, we also find that firms receiving considerably higher attention by local investors than nonlocal investors experience monotonic declines in future returns.

Finally, we propose a new benchmark state to empirically test theories of local bias, namely the Google Top State. The Top State is the state that according to Google Trends exhibits the highest local interest in a particular firm over our designated time series. For the majority of stocks in our sample, we find that the Top State does not equal the headquarter state, which has been traditionally used to explore theories of local bias. We provide strong empirical evidence in favor of the Top State as a unique and superior testing ground for empirical studies on local bias. Moreover, we find that the attention allocation behavior of investors residing in a firm's headquarter state exhibits no predictive power for future returns.

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1. Introduction

Standard asset pricing models are typically based on the assumption that investors immediately process and react to new information and that new information is instantaneously incorporated into asset prices. However, a large body of psychological research reveals that humans have limited central cognitive processing capacity (Pashler, Johnston, & Ruthruff, 2001). Attention requires effort, and in the presence of vast information and limited attentive resources, individuals must be selective in their attention allocation (Kahneman, 1973).

Consequently, recent studies have developed theoretical frameworks in which limited attention can affect asset pricing. Notably, Barber and Odean (2008) rationalize that when buying a stock, individual investors face the challenge of choosing from a large set of stocks. Since there are limits to how much information individual investors can process, they limit their choice set to stocks that recently caught their attention. Individual investors do not buy all stocks that catch their attention, but only tend to buy stocks that do so. In contrast, individual investors do not tend to sell stocks that recently caught their attention, since they rarely engage in short-selling, and hold relatively few stocks. This implies that if a stock is associated with an aggregate increase in attention from individual investors, individual investors become net buyers of these attention-grabbing stocks, which results in temporary positive price pressure and subsequent price reversals.

Furthermore, studies have also developed theories in which the interaction of investor attention and local bias influences stock returns. Nieuwerburgh and Veldkamp (2009) conjecture that, if local investors have an initial local information advantage, they will choose to process more information about local stocks, thereby increasing their local bias. As a result, local investors identify fundamental value-relevant information before non-local investors. After detecting positive value-related information, local investors are likely to further increase their information-processing efforts towards the particular stock. Thus, if the difference between the attention a stock receives from local investors compared to nonlocal investors increases, it suggests that local investors received fundamental private information and that stock prices will increase.

Unlike Nieuwerburgh and Veldkamp, the attention theory of Barber and Odean does not explicitly highlight the interaction between attention and local bias. The model predicts that an aggregate general increase in investor attention leads to inflated prices in the short run and price reversals in the long run. Therefore, a natural implication of Barber and Odean's attention theory is that an aggregate increase in the investor attention a company receives by local investors should also generate net buying from local investors, resulting in positive price pressure and subsequent price reversals for the stock.

In this paper, we empirically test Barber and Odean's behavioral-based attention theory under the above-mentioned implication, by studying the effect of abnormal increases in the attention a company receives from local investors on stock returns.

The Google Search Volume Index (SVI) provides the opportunity to explore the popularity of a search term by location, time period and category. We therefore use Google SVI data for company names to proxy for the investor attention a company receives by local investors in a particular state, over time. Compared to alternative measures of investor attention like advertising expenditure, news coverage and abnormal returns, SVI data is a revealed attention measure: If an investor searches for a stock on Google, he or she is undoubtedly paying attention to the stock. Furthermore, our paper harnesses Google Trends' most recent functions, which allow us to not only filter searches by U.S. state, but also allow us to identify searches made specifically for the purpose of investing, using Google Trends "Investing" category filter. Using Google SVI data, we create the variable *abnormal local attention* and study its asset-pricing implications. Abnormal local attention represents unusual increases in the attention a stock receives by local investors.

Additionally, we test the informational-based attention theory of Nieuwerburgh and Veldkamp. Using Google SVI data, we examine the effects of the variables *relative attention* and *abnormal relative attention* on returns. *Relative attention* measures the difference between the attention a stock receives by local investors and nonlocal investors in a given month. *Abnormal relative attention* measures unusual increases in the attention a stock receives by local investors relative to nonlocal investors.

Underlying each of these empirical research questions, is the fundamental choice of who we define as a local investor, and what we define as local attention. This choice is of vital importance, because in order to successfully detect a significant relation between local attention and asset prices if it exists, we must focus on the local attention of those investors who have more pronounced local bias for a stock. In the context of Nieuwerburgh and

Veldkamp's theory, the greater the local bias of local investors, the more likely they are to notice value-related information before nonlocal investors. Similarly, if investors in a particular state collectively increase their aggregate attention to a particular stock while exhibiting an initial strong local bias for the company, they are more likely to become net buyers of the stock and cause price reversals. In other words, the attention of investors in a state is likely to have incremental value to the extent that it differentiates itself from the attention of investors in other states, in terms of local interest for the particular stock. This raises the important question: Which investors display the highest local bias for a stock?

Coval and Moskowitz (1999) discover that among domestic U.S. stocks, investors have a strong bias in favor of locally headquartered stocks. A series of subsequent research that study local bias therefore focus on the performance, trading patterns and attention of investors living close to the company headquarters, and find varying results (i.e. Coval & Moskowitz, 2001; Ivkovic & Weisbenner, 2005; Pirinsky & Wang, 2006; Seasholes & Zhu, 2010; Mondria and Wu, 2013).

Google Trends denotes the Top State as the U.S. state which exhibits the highest interest in a company over our relevant time series. For the majority of stocks in our sample, the Top State is not the headquarter state, which implies that investors living out-of-state generally display stronger local bias for stocks than investors living close to the company headquarters. This fundamentally challenges the traditional assumption that local bias is most prominent for investors living near the company headquarters. Since investors in the Google Top States exhibit stronger local bias than investors in the headquarter state, the effect of our attention variables on stock returns should be more statistically significant and economically pronounced when they are based on the investor attention in Top States rather than headquarter state.

Our empirical results indeed reveal that this is the case. We perform Fama-Macbeth (1973) cross-sectional regressions of returns on attention variables based on headquarter state and firm characteristics, and find that each attention variable based on headquarter state is statistically and economically insignificant. Moreover, when we include the attention variables based on Top States as control variables, the attention variables based on Top States remain statistically and economically significant, and subsume the predictive power of attention variables based on headquarter state. This empirical evidence demonstrates that the attention allocation behavior of investors living close to the company headquarters – who previous studies assumed to have the strongest local bias - does not affect asset prices, while the local attention of investors in the Top States significantly impacts returns.

Furthermore, our empirical results provide support for Barber and Odean's attention theory, since we document that an increase in abnormal local attention based on Top 3 States, predicts significant price reversals at least up to 6 months after portfolio formation. A portfolio that longs stocks with high abnormal local attention and shorts stocks with low abnormal local attention has a Jensen's alpha of -26 basis points per month assuming a 1-month holding period, which monotonically decreases to -95 basis points per month when the long-short portfolio assumes a 6-month holding period.

Consistent with the attention theory of Nieuwerburgh and Veldkamp, we document a significant relation between relative attention and stock returns, and abnormal relative attention and stock returns. In contrast to the informational-based attention theory, however, we find that an increase in these relative attention variables predict future price reversals instead of a stable increase in returns. To exemplify, an increase in abnormal relative attention based on Top 3 States predicts a monotonic decrease in abnormal returns from -37 basis points 3 months after portfolio formation to -87 basis points 6 months after portfolio formation, which is both statistically and economically significant. Moreover, we find that these results are not driven by Barber and Odean's attention theory, which suggests that relative attention and abnormal relative attention capture a unique effect on returns not explained by existing theories of attention.

Our study provides a number of interesting contributions to the literature on investor attention and asset pricing, and local bias in financial decisions. Firstly, to the best of our knowledge, our empirical study is the first study in financial economics to make use of Google Trends' new category function, which allows us to gauge the popularity of a search term for the right context of the word. This function was not presently available for previous studies that used SVI data to proxy for investor attention. Consequently, if researchers derived SVI data for the word "Apple", the SVI data reflected searches made by both investors, market researcher, customers and others who were simply interested in the fruit. Using Google Trends' new category function, we filter SVI data by the category "Investing", which implies that the SVI data reflects searches for a company made specifically for the purpose of investing. Thus, our SVI data is more likely to unambiguously capture the attention of retail investors, and is therefore more robust compared to the SVI data of previous studies on investor attention (i.e. Da, Engelberg & Gao, 2011; Vlastakis & Markellos, 2012; Ding & Hou, 2015; Dimpfl & Jank, 2016). Our paper documents that Google SVI for searches made specifically for the purpose of investing has predictive power for future stock returns. In comparison, we find that attention variables based on unfiltered general Google SVI data for company names does not explain future returns, which is likely attributed to the added noise in the latter dataset.

Furthermore, to the best of our knowledge, our paper is the first to find support for Barber and Odean's attention theory at the monthly frequency. Moreover, our paper is the first to demonstrate that an aggregate increase in the attention a stock receives by local investors also predicts significant price reversals, which implies that an aggregate increase in investor attention does not predict reversals only in the case when a company receives an increase in attention by the country at large, as documented by Da, Engelberg and Gao (2011). In addition, we find that relative attention and abnormal relative attention capture a unique and significant effect on returns not fully explained by existing theories of attention.

However, most notably, we provide strong empirical support indicating that the Top States derived from Google Trends constitute a unique and superior test-bed for future empirical studies intending to test theories of local bias, as empirical evidence consistently shows that the attention allocation behavior of local investors in the Top States has asset-pricing implications, unlike investors that live close to the company headquarters. This discrepancy in significance and economic magnitude is likely attributed to evidence provided by Google Trends, which shows that investors in Top States are associated with considerably higher local bias than investors in headquarter states.

The rest of the paper is organized as follows: The following section reviews the literature. Section 3 presents the main research questions of our paper. Section 4 describes our sample selection procedure, data sources and the construction of our SVI database. Section 5 presents the construction of our variables of interest. Section 6 briefly explains the empirical methodology applied to examine the research questions. Section 7 presents the results from our empirical analysis. Section 8 discusses the empirical results in the context of behavioral-based and informational-based theories of attention, before the final section concludes.

2. Literature Review

Traditional asset pricing models assume that new information is instantaneously incorporated into prices. This assumption entails that investors allocate sufficient attention to the asset. In reality, however, attention is a scarce cognitive resource (Kahneman, 1973), which implies that investors have limited attention. Subsequently, a series of theoretical frameworks have been formulated in which limited investor attention affects asset pricing.

Firstly, Merton (1987) formulates a model of capital market equilibrium under incomplete information, where investors are not aware of all stocks. As a result, investors only use stocks they are attentive about in constructing their optimal portfolios. Stocks with low investor attention consume the attention of fewer investors. For markets to clear, these investors must assume considerable positions in the low-attention security. Therefore, stocks with lower investor attention offer higher returns to compensate investors for their increased idiosyncratic risk associated with their imperfectly diversified portfolios.

Furthermore, Barber and Odean (2008) present a notable theoretical framework to examine the asset-pricing implications of individual investor attention. First, Barber and Odean test the hypothesis that individual investors are net buyers of attention-grabbing stocks. The authors conjecture that when individual investors intend to buy stocks, they face the daunting search problem of choosing from a large set of alternatives. As a result, attention-grabbing stocks are more likely to enter their choice set. In contrast, individual investors face a comparatively easier search problem when selling, since they only tend to sell stocks that they own and are less engaged in short-selling. Consequently, individual investors will become net buyers of stocks that experience increases in investor attention. By sorting stocks daily based on their level of attention, and then computing the time-series mean of daily buy-sell imbalances for individual investors in each attention quantile, the authors confirm this hypothesis. Within the theoretical framework of Barber and Odean, a stock that experiences increases in investor attention will generate attention-driven buying pressure from individual investors, which results in higher stock prices in the short run and price reversals in the long run.

Empiricists have faced considerable challenges in testing the aforementioned theories of investor attention, due to the difficulty of finding direct measures of investor attention. Hence, a variety of indirect proxies for attention have been applied by empirical papers. For instance, Fang and Peress (2009) use media coverage to proxy for investor attention, and find that stocks not covered by the media earn significantly higher future returns than stocks heavily covered by the media, consistent with Merton (1987). Grullon, Kanatas and Weston (2004) use the similar proxy of a firm's advertising expenses and also find support for Merton's capital market equilibrium model. Studies that deploy advertising expense as proxy for investor attention also provide evidence for the attention theory of Barber and Odean (Chemmanur & Yan, 2009; Lou, 2014). Additionally, Barber and Odean's sorting procedures were based on extreme returns, news and headlines, and abnormal trading volume as attention proxies (Barber & Odean, 2008). Seasholes & Wu (2007) proxy investor attention through the mechanism of upper price limits on the Shanghai Stock Exchange, and also provide confirmation of Barber and Odean's attention-induced price pressure hypothesis.

Nevertheless, even if a stock is more covered in the media, it does not guarantee an increase in investor attention. Similarly, if a stock experiences abnormal trading volumes or returns, the fluctuations could be driven by factors unrelated to investor attention. The critical assumptions underlying the presented proxies therefore diminish their validity. Da, Engelberg and Gao (2011) propose a direct measure of retail investor attention using the Google Search Volume Index (SVI) on Google Trends, and use this measure to explore the implications of individual investor attention on asset pricing. The paper argues that Google search is representative of American search behavior and constitutes a revealed attention measure, because if an investor searches for a stock on Google, he or she is definitely paying attention to it. The paper evinces that Google SVI mainly captures the attention of individual retail investors, and secondly, that an increase in SVI for Russell 3000 stocks predicts higher stock prices in the next 2 weeks and an eventual price reversal within the year – coherent with Barber and Odean's hypothesis. Our thesis also uses Google SVI as a proxy for investor attention, to test the attention theory of Barber and Odean. Unique to our study is that we harness the more recent capabilities of Google Trends to filter searches by location and category. This allows us to specifically study the effect of local retail investor attention on asset pricing, and propose a more precise measure of investor attention, which uses Google SVI data constructed from searches made specifically for the purpose of investing.

Our paper also contributes to another strand of literature that studies the function of geography and local bias in financial decisions. Coval and Moskowitz (1999) initiate this field, by demonstrating that U.S. fund managers exhibit a disproportionate preference or bias for holding stocks by firms headquartered in the state in which they reside. Later, the authors reveal that the local fund managers earn significantly higher abnormal returns associated with their local investments relative to their nonlocal investments (Coval & Moskowitz, The Geography of Investment: Informed Trading and Asset Prices, 2001). Moreover, local stocks avoided by the fund manager underperform those held. This superior performance of fund managers' local stocks is attributed to their ability to exploit local information advantages. To exemplify, local investors can more easily visit the firm and communicate with employees and suppliers, and gain access to private information through established community ties. Interestingly, individual investors reveal an even stronger local bias than fund managers, and their local investments outperform the fund managers' local investments (Ivkovic & Weisbenner, 2005). The ability to process and exploit local information advantages is therefore not exclusive to fund managers.

These empirical studies make the underlying assumption that investors residing in the headquarter state should possess greater local information advantages and local bias for locally headquartered firms than investors residing in other states. Our paper questions this assumption by proposing new benchmarks of investor locality that are later used to explore asset-pricing theories of local information advantage and local bias – namely the Top States according to Google. The Top States represent the states that exhibit the highest interest in the firm over our relevant time series, which by implication suggests that these states are characterized by a high level of local bias.

Nieuwerburgh and Veldkamp (2009) reason that local investors tend to possess a natural information advantage from just residing in a particular location, but also endogenously choose to improve their local information advantage. In their general equilibrium model, home investors first have to decide whether to pay more attention to local or nonlocal stocks, before deciding which assets to hold. The attention choice influences the choice of assets. Before making these decisions, home investors begin with slightly more precise information regarding future local asset payoffs than nonlocal investors. The model demonstrates that the local investor maximizes utility by specializing in what he or she already knows more about than other investors, and is initially less uncertain about.

By doing so, local investors may obtain private information or pay attention to value-relevant information about local firms before the average non-local investor. Home asset prices will therefore not fully reflect this new information which the local investor becomes aware of, due to the higher uncertainty and inattention facing the average investor. Hence, the local investor is able to form positions in local assets that generate expected excess returns.

This theory also has asset-pricing implications. Once local investors obtain positive fundamental private information or other value-relevant information, local investors will seek more information about the relevant local firm. This will cause an increase in the attention a stock receives from local investors relative to nonlocal investors. Increases in relative attention therefore reveal that local investors have received private information, and precede the increased buying pressure by locals and the ensuing increase in market price. Mondria and Wu (2013) document that an increase in relative attention is associated with a future increase in stock prices, providing support for the attention theory of Niewurburgh and Veldkamp. Our paper also intends to test the informational-based theory of Niewurburgh and Veldkamp, by studying the asset-pricing implications of relative investor attention. We distinctively construct measures of retail attention by using category-filtered state-level and nationwide Google SVI data, to facilitate a comparison between the levels of attention a stock receives from local investors to nonlocal investors each month. Moreover, we construct these variables based on traditional and newly proposed modes of investor locality.

3. Research Questions

3.1 Testing Behavioral-based and Informational-based Theories of Investor Attention

Both behavioral-based and informational-based theories of attention conjecture that investor attention has asset-pricing implications, but present widely different mechanisms through which investor attention affects stock returns. Our initial objective is to test the attention theories of Barber and Odean (2008) and Nieuwerburgh and Veldkamp (2009).

Primarily, we test if Barber and Odean's attention theory holds in the context of local investors. Empirical evidence shows that local individual investors display a strong preference for holding local stocks, which is attributed to their local bias (Ivkovic & Weisbenner, 2005). Barber and Odean postulate that individual investors are net buyers of attention-grabbing stocks. Within the framework of Barber and Odean, local stocks should be more likely to grab the attention of local investors since these investors have an initial local bias for these stocks. As a result, when local investors narrow their choice set to attention-grabbing stocks, a considerable proportion of this choice set should contain local stocks. Moreover, after narrowing their choice set, local bias should influence local investors to be more likely to buy the local stocks available in this choice set, over non-local stocks. Consequently, local stocks that experience an aggregate increase in attention by local investors, should generate net buying from local investors, causing inflated prices in the short run and price reversals in the long run.

To test this hypothesis, we produce the variable *abnormal local attention* using local SVI data, which measures the unusual increases in attention a local stock receives from local investors compared to the local investors' normal level of attention for that stock. We then examine the relation between *abnormal local attention* and stock returns using portfolio analysis and Fama-Macbeth (1973) cross-sectional regressions. Thus, our first research question can be summarized as follows:

Does an increase in abnormal local attention predict future price reversals?

On the other hand, Nieuwerburgh and Veldkamp (2009) conjecture that as a result of initial information advantages, local investors choose to process more information about local stocks. Consequently, local investors will receive value-related information before nonlocal investors. If the difference in information-processing efforts between local investors and nonlocals magnifies, it indicates that local investors received positive fundamental information and that stock prices are expected to increase.

In order to test Nieuwerburgh and Veldkamp's attention theory, we produce two new attention measures using local and national SVI data: *relative attention* and *abnormal relative attention. Relative attention* measures the difference in information-processing efforts between local investors and nonlocal investors in a given month. Similarly, *abnormal relative attention* measures abnormal increases in information-processing by local investors relative to abnormal increases in information-processing by nonlocal investors in a given month. We then study the effect of *relative attention* and *abnormal relative attention* on stock returns using portfolio analysis and Fama-Macbeth (1973) cross-sectional regressions. This leads us to our second research question:

Does an increase in relative attention and abnormal relative attention predict an increase in stock prices?

Underlying each of these research question lies the fundamental question of whether Google Search Volume Index data can be used to predict returns.

3.2 New Modes of Investor Locality

In addition to providing state-level SVI data for each stock, Google Trends also provides an overview about the local interest for each stock by state. The Top States enlisted in the Trends dashboard represent those states which exhibit the highest interest in the firm over the relevant time series chosen. We use a new function in Google Trends that filters SVI data to reflect searches made specifically for the purpose of investing. Thus, the Top States are likely to represent the interest by local investors specifically, and not the general population in the state.

Figure 1: Microsoft's Retail Investor Attention by State

The figure above shows that Microsoft receives the highest level of local interest and retail investor attention in Washington. Microsoft is also headquartered in Washington. This discovery is consistent with the empirical research of Coval and Moskowitz (1999, 2001) and Ivkovic and Weisbenner (2005), which documents that local investors display a strong preference for stocks by firms headquartered in the state in which they live.

Figure 2: CenturyLink's Retail Investor Attention by State

CenturyLink's headquarter state is Louisiana. Louisiana ranks as the 25th state in terms of interest for CenturyLink. This implies that investors in 24 U.S. states exhibit a higher level of local interest and attention for the firm than local investors in the headquarter state. It is important to note that SVI measures popularity independent of the population levels in a given state, which implies that Louisiana does not attain a low rank because of its population relative to other states. This evidence diverges from Coval and Moskowitz's underlying assumption that investors display a disproportionate preference and bias for firms headquartered in the state in which they reside.

In fact, CenturyLink receives the highest level of local interest and attention in Colorado, which implies that collectively, retail investors in Colorado demonstrate a greater local bias for CenturyLink – an out-of-state company - than the investors who live close to CenturyLink’s headquarters. Though we must exercise caution in drawing causal connections, the high rank may be partly attributed to that Colorado is the U.S. state with the highest percentage access to CenturyLink (HighSpeedInternet, 2017).

In other words, it is possible that CenturyLink’s unique market position in Colorado has driven attention by retail investors, in such a way that investors in the state perceive the company as local and so develop a local bias for the company, even though it is headquartered in another state.

Only 41.3% of the panel data observations in our sample display that headquarter state equals Top State. This implies that the majority of firms generate the highest local interest from another state than their headquarter location, similar to CenturyLink.

The above-mentioned findings demonstrate a series of important points. Firstly, it is possible for investors in a particular state to demonstrate a stronger local bias for an out-of-state company than a company headquartered in their own state. Secondly, Top States may constitute a new and superior testing ground for theories related to local bias, since investors in these states are shown to exhibit the strongest interest and preference for the company over our relevant time series, according to substantial data evidence based on Google searches made specifically for the purpose of investing.

In comparison, the empirical literature focusing on local bias in the United States has traditionally deployed headquarter state as a benchmark for exploring local bias. Empirical results showing that investors hold a disproportionate amount of local stocks headquartered in the state where they reside has supported the continued use of headquarter state as a benchmark for empirical studies to test theories of local bias. However, the choice of headquarter state as a benchmark for testing local bias associated with a given firm is not based on initial exogenous evidence suggesting that the headquarter state is the state which exhibits the highest level of local bias for the firm in question. To illustrate, an empirical study may reveal that investors in the headquarter state display a strong preference for holding a locally headquartered stock. However, in reality, they may have missed out on an opportunity to explore the investor behavior of investors who are even more locally biased towards the relevant stock.

The attention theories tested are driven by local bias. In the theoretical framework of Barber and Odean, if local investors display an initial local bias for a particular stock, once the stock grabs the investors' recent attention through an attention-grabbing event, locally biased investors should be more likely to become net buyers of these stocks and temporarily inflate prices. Similarly, in the model of Nieuwerburgh and Veldkamp (2009), the greater the local bias, the likelier it is that local investors pay attention to value-related information before the average investor.

We intend to test these attention theories using both the traditional headquarters benchmark of local bias and our proposed benchmark of Top States. We accomplish this by creating three variations of each attention variable introduced above – the first variation is based on headquarter state, the second is based on the Top State and the third variation is a composite measure that takes into consideration the Top 3 States that exhibit the highest interest in the firm.

If the attention variables based on the new benchmarks of local bias display more statistically and economically significant results than the corresponding attention variables based on headquarter state, it provides evidence in favor of Top States as a suitable alternative benchmark for testing theories of local bias and local information advantage.

4. Data

4.1 Sample Selection

This section intends to describe the steps for arriving at our final data sample. To eliminate survival bias and the impact of index addition and deletion, the study examines all stocks every included in the S&P 500 index during the time period for our panel data, which ranges from 2004 to 2016. This initially yields 898 unique firms. The range of our sample is attributed to the fact that Google Trends' Search Volume Index data begins in 2004.

Subsequently, firms not located in the United States are removed. As a result, the sample size is reduced to 732 unique firms. A new function in Google Trends offers Google SVI data for each state located in the United States. This function empowers us to study the impact of local relative to nonlocal investor attention on stock returns, by using state-level Google SVI data for company names as proxy for the local investor attention a stock receives in a particular state. This explains why the paper only concentrates on stocks headquartered in the United States.

Furthermore, we move from filtering at the firm level to security-level filtering. The analysis requires merging accounting data from Compustat with financial data from CRSP. GVKEY is the company identifier in Compustat, while PERMNO is the security identifier in CRSP. There is a 1:M relationship between GVKEY and PERMNO, as one company can offer both primary and secondary issues. We focus on primary issues, and therefore remove all secondary issues.

It is noteworthy to highlight concerns that may arise during a merge of accounting and financial data. The CRSP Link is a data array which contains a history of links using CRSP and Compustat identifiers, and serves to merge CRSP and Compustat data. Each link is marked by a first effective date and a last effective date. Despite removing secondary issues, a 1:1 relation between the company identifier GVKEY and security identifier PERMNO may not be achieved, as some GVKEYS have both expired and updated PERMNO links to security data, in the time range in which we gather data. We remove expired links to ensure that each GVKEY and PERMNO link is updated and valid, and has a 1:1 relation. This feature is desirable to remove secondary issues, and to facilitate a merge between the datasets.

After achieving a 1:1 relation between GVKEY and PERMNO, the relevant accounting input variables are retrieved from Compustat, and the relevant financial input variables are retrieved from CRSP. Accounting and financial data is merged, which finally yields 653 unique firms and securities.

Next we identify the stocks that experience name changes during 2004-2016, which is the time range of our sample. As previously stated, we retrieve national and state-level SVI data for company names to proxy for the national and local investor attention a company receives each month. For each company, each SVI panel data observation is based on a single unique search term, which represents the company name of the firm in that particular month. If the company changes its name and the SVI data continues to be based on the old name, the SVI data may inaccurately reflect the attention the company receives after the name change. To prevent bias in the attention data, it is therefore imperative to first identify stocks that experience name changes.

We identify in total 144 companies that have changed their name during the time period 2004-2016. One simple method to avoid bias in the attention data entails removing all stocks that experience name changes. However, removing all companies that experience name changes for our sample would introduce a look-ahead bias. Moreover, removing all stocks with name changes would also considerably reduce the sample size and the panel data observations.

In order to avoid a significant reduction in observations, we devise a strategy to handle stocks with name changes. Firstly, for each of these stocks we retrieve relevant SVI data based on each search term that represents a name which the company has assumed over our relevant time series. If the new name is a perfect subset of the previous name, SVI data based on the new company name in this case quite accurately captures the popularity of the stock even during the time when the company assumed its old name. In these instances, we only need to retrieve SVI data once based on the new company name. For example, Apple changed its official company name from “Apple Computer Inc” to “Apple Inc” in 2007. Thus, we base our Google SVI data on the search term “Apple Inc”. Since the term “Apple Inc” is a perfect subset of the name “Apple Computer Inc”, the SVI data will in fact accurately capture the search popularity Apple received for “Apple Computer Inc” before 2007 when it was called “Apple Computer Inc”.

However, if the new name is not a perfect subset of the previous name, we separately retrieve SVI data for each name the company has assumed over our relevant time series. If we retrieve SVI data only once based on the most recent company name, the SVI data based on the latest name would not accurately reflect the stock’s popularity during the time it assumed its old name. To exemplify, Hershey changed its official company name from “Hershey Foods Corp” to “Hershey Company” in 2005. In this case, the whole new name is not a subset of the old name. The word “Company” is not a part of the old name “Hershey Foods Corp”. Therefore, SVI data for the search term “Hershey Company” would not accurately reflect the popularity Hershey experienced before 2005, since investors were unaware of this specific name and were unlikely to search for the term.

When we retrieve SVI data for a company more than once, we merge the SVI data for a specific name with the corresponding monthly observations when the company assumed that name.

Since we keep observations for companies that experienced name changes, the sample selection process yields a final database composed of 653 unique companies and primary securities.

4.2 Data Sources

For our final sample of 653 unique securities, we employ monthly stock market data from the Center for Research in Security Prices (CRSP), accounting data from Compustat and state population data from U.S. Census Bureau, for the relevant time series from 2004 to 2016.

4.2.1 Stock Market Data

Specifically, we retrieve daily price, trading volumes and return data from CRSP for the construction of the Amihud illiquidity measure. We also retrieve monthly prices, holding period returns, number of shares outstanding and company name, which serve to produce monthly market capitalization and momentum variables.

4.2.2 Accounting Data

Accounting data is derived from Compustat for the calculation of the book-to-market ratio, where book equity is calculated according to Davis, Fama and French (2000). Thus, the book-to-market ratio is calculated using the book equity from any point in year t-1. Book equity is defined as the stockholder’s equity plus any deferred taxes and investment tax credit, minus the value of any preferred stock. Redemption value is used to determine the value of preferred stock. If redemption value is unavailable, we use liquidating value or carrying value. These mentioned input variables required for the calculation of book equity are retrieved from the monthly updated Fundamentals Annual dataset from Compustat. Additionally, we also retrieve headquarter state data for each firm from Compustat.

4.2.3 Population Data

Each company is associated with Top 3 States that according to Google exhibit the highest interest in the company over the time series 2004-2016. For each company, we collect state population data for each of its Top 3 States, to construct our local attention variables. State population data is derived from U.S. Census Bureau’s 2010 Census Data, which contains population statistics from the most recent decennial census (U.S. Census Bureau, 2017).

4.2.4 Fama-French Factors

The monthly Fama-French three factors are downloaded from Ken French's website (French, 2017).

4.3 Creating the Google SVI Database

4.3.1 Introduction to Google SVI

Google offers the Search Volume Index (SVI) for public use through the product Google Trends. Essentially, the Search Volume Index provides the possibility to explore the popularity of a search term by location, time period and category. Google Trends provides SVI data from 2004 to present.

A search query is defined as the precise search term a user enters into the Google search engine. A search query is executed at a specific time, in a specific location and within a specific context or category. Hence, Google Trends offers the opportunity to explore a search term's popularity along these dimensions, by applying time, location and category filters. Given a specified time (ex. May 2016), location (ex. New York) and category of interest (ex. Investing), the query share of a particular search term is computed as the ratio of the total number of search queries entered for that particular search term during the specified time, location and category, and the total number of queries entered in Google at the specified time, location and in the specified category.

Given a specified time (ex. May 2016), location, category and time series (ex. January 2004 – June 2016), the monthly Google SVI is then computed as the query share for the relevant search term at the specified time (ex. May 2016), location and category, normalized by the highest query share of that search term over the specified time series (ex. January 2004 – June 2016). Therefore, SVI data ranges from 0 to 100. This implies that a decrease in SVI for a search term over time does not necessarily indicate a reduction in the aggregate number of search queries for that particular search term. Rather, a decrease in SVI suggests that the query share of that search term is decreasing, or in other words, that the search term is becoming less popular in the specified location and category over time.

The first aim of the paper is to analyze the effect of local relative to nonlocal investor attention on stock returns. We use SVI data to measure the investor attention a company receives because it is a revealed attention measure. To exemplify, if an investor searches for a stock on Google, he or she is definitely paying attention to the stock. This characteristic makes SVI a direct and unambiguous attention measure. As stated in the literature review, fluctuations in previous measures of attention like abnormal returns and abnormal turnover could be driven by factors unrelated to attention and are therefore indirect. Secondly, previous studies provide evidence that SVI data captures overall investor attention well, and particularly retail investor attention (Da, Engelberg, & Gao, 2011). This feature is useful as the attention theories tested focus on the behavior of individual investors. Moreover, Google is the leading search engine in the United States, generating 64 percent of all search queries and 93 percent of all mobile search queries in the United States (Statista, 2017).

We retrieve monthly SVI data for company names over the time series January 2004 – December 2016, to measure the investor attention a company receives over time. The nonlocal or national investor attention a company receives is measured by SVI data for company names, given United States as location and "Investing" as filter. The second aim of the paper is to explore new definitions of locality beyond company headquarters, a definition which has been consistently used in the literature on local bias. Therefore, in the calculation of local relative to nonlocal investor attention, we apply different definitions of locality for the local attention, such as headquarters, the Top State according to Google or the Top 3 States according to Google. Hence, the local investor attention a company receives is measured by SVI data for company names, given Headquarter state or Google Top States as location and "Investing" as filter. The next sections present a deeper reasoning behind the retrieval of SVI data based on company names, the application of the Investing filter and the different definitions of locality.

4.3.2 Criteria for Google Search Query

The first empirical choice regarding the use of Google SVI to measure investor attention concerns how the search terms which form the basis for the SVI data retrieval should be formulated. Google SVI data is considered an efficient proxy for investor attention only if the data accurately reflects the investor attention a company receives each month, by local investors and national investors. This requires, first and foremost, that the search term applied to retrieve SVI data for each company accurately corresponds with the search term individual investors would normally use to search for information about the company.

Previous papers, like for instance Da, Engelberg and Gao (2011) and Ding and Hou (2015), usually retrieve SVI data for each company using the stock ticker of a company as the relevant search term. The authors argue that the SVI data is likely to reflect searches made specifically by individual investors when the search terms are based on a company's ticker. Alternatively, the SVI data could be based on company name. However, SVI data based on company name may be associated with more noise, as it not only reflects searches made by investors, but is likely to reflect searches by other groups like market researchers or customers. For example, individual investors seeking financial information about Apple are more likely to search using the ticker "AAPL". A rise in SVI based on the search query "Apple", on the other hand, does not necessarily imply that investors are paying more attention to the company, but may rather reflect that more customers are looking to buy Apple products, or simply that more people are interested in the fruit. Considerable noise in the investor attention variable reduces the likelihood of detecting a relationship between investor attention and stock returns.

After the above-mentioned papers were published, Google introduced a new function to refine Google Trends results by category. This implies that if a person is using Google Trends to search for a word like Apple that has multiple meanings, he or she can filter results to a certain category to get SVI data for the right version of the word (Google, 2017). Examples of overarching categories include "Finance", "Arts and Entertainment" and "Autos & Vehicles". Each overarching category has subcategories. The category "Finance" for instance includes more refined filters such as "Investing", "Accounting and Auditing" and "Currencies and Foreign Exchange". If the filter of Investing is applied on a search term, the SVI data will reflect only those searches made for the specific purpose of investing.

However, Google provides little information on how their algorithm is able to detect whether a search is made for the purpose of investing. Searching for the query "Apple" in Google Trends conditional on the filter of "Investing", reveals a dashboard that displays that the top related searches for this search include "apple stock", "apple turnover", "apple dividend", and "apple share price", signifying that the algorithm is indeed able to detect the context of a search.

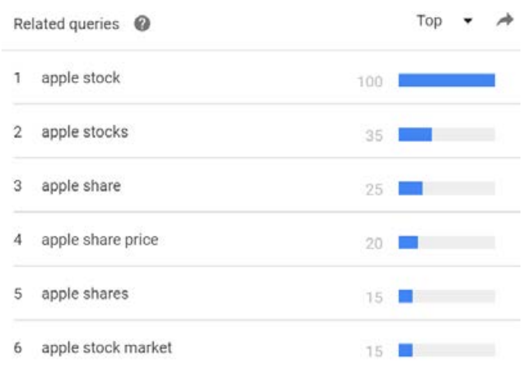

Figure 3: Top Related Searches for Apple

To the best of our knowledge, our paper is the first empirical study to harness Google Trends' new ability to filter SVI data by category. This has implications for how we apply search terms to retrieve SVI data for each company.

We do not retrieve SVI data based on stock tickers. In the absence of filters detecting whether a search was made for the purpose of investing, stock tickers serve as an efficient means to reduce noise in the SVI data. Despite an effort to reduce noisy tickers, tickers are nonetheless abbreviations that are likely to have double-meanings, especially when they are used to retrieve SVI data for local states. Furthermore, an attempt was made to retrieve local SVI data for headquarters using stock tickers in our sample, under the filter "Investing". Similarly, local SVI data for headquarters was retrieved using company names and the same filter. This revealed that SVI-data was more frequently non-valid when stock ticker was used, than when company name was used. Additionally, the top related searches for stock tickers and company names seem to follow a pattern, where the top related search is often the company name, followed by the word "stock", as in "apple stock", which is listed in the dashboard above. These findings suggest that retail investors may in fact be more inclined to search for information about a company by entering its company name than its specific stock ticker.

Therefore, our study retrieves SVI data for each stock based on its company name, under the filter of “Investing”. Consequently, our SVI data reflects searches specifically made for the purpose of investing in each company, which suggests that the SVI data captures retail investor attention.

For each stock in our final sample, we pursue a specific approach to determine the company name which should be used to retrieve the SVI data. For each company, the search term we intend to use to retrieve SVI data is the official company name, listed in the CRSP variable “comnam”. As stated, we retrieve local SVI data for the company headquarter state, and the Top 3 States which exhibit the highest interest in the company over the time series 2004-2016. Sometimes a search term yields national SVI data, but weak or no data at the local level, which is more refined. Therefore, in these cases we systematically modify the name in order to retrieve valid national and local data. This modification entails eliminating business entity abbreviations from the company name, such as “inc”, “ltd”, “co” and “corp”. For instance, the name “Consolidated Edison Inc” is changed to “Consolidated Edison”. Similarly, the name “Wynn Resorts ltd” is changed to “Wynn Resorts”. The problem of non-valid local data tends to be solved when we remove these abbreviations.

4.3.3 Identification of Top 3 States

After determining the company name which should be used to retrieve SVI data, we identify the headquarters for each stock through Compustat. We also manually identify the Top 3 States for each company according to Google. The Top 3 States are defined as the States which according to Google exhibit the highest interest in the stock over the time series 2004-2016.

The Top 3 States are identified by entering the company name in the search field in Google Trends, and applying the relevant time, location and category filters. The time filter specifies the relevant time series from 2004-2016. The category filter specifies interest in searches made for the purpose of investing. Lastly, the location filter specifies interest in searches made in the United States. This yields a dashboard composed of a visual representation of the SVI data and a list ranking the interest by state. Subsequently, the names and state codes of the Top 3 States are noted in the database.

This process is manually performed for every stock in our final sample. Moreover, it is performed twice. We identify the Top 3 States using the filter of “Investing”, and we also identify the Top 3 States using no filter. The intention is to later explore the relation between investor attention and stock returns with and without the filter of "Investing", which was not available for previous empirical studies.

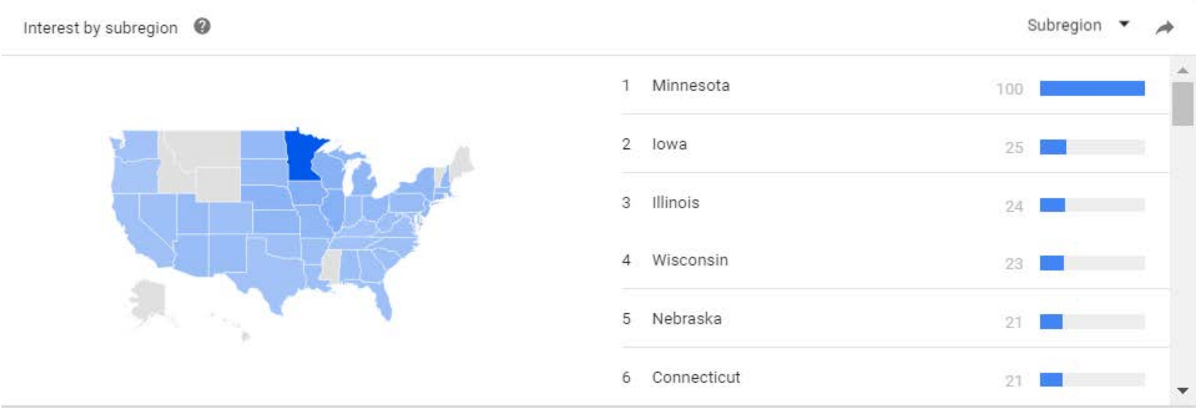

Figure 4: Top States for General Mills, under the «Investing» filter

4.3.4 Retrieving Local and National SVI Data

The assessment of the correct search term to retrieve SVI data and the identification of the Top 3 States for each stock builds the foundation for retrieving the local and national SVI data needed for the analysis. The local and national SVI data are used to create variables representing the local attention and local relative to national attention a company receives each month. Each attention variable is based on a unique definition of locality. For instance, one variable represents the relative attention a company receives in the headquarter state. Similarly, another variable represents the relative attention a company receives in the Top State. The third variation represents the relative attention a company receives in the Top 3 States. Hence, we retrieve national SVI data and local SVI data for each company's headquarter state and each of the Top 3 States according to Google. Data is first retrieved under the filter "Investing" and then under no filter. The data retrieval process is herein described.

For each given company name and state, we collect local and national SVI data simultaneously from Google Trends. To exemplify, let us assume that we want to retrieve local SVI data for Apple's headquarter state, California. In Google Trends, we first enter the search term "apple" and apply "United States" in the location filter. We simultaneously enter an additional search term "apple" and apply "California" in the location filter. For both search terms, we specify interest in the filter “Investing” and the time series from 2004 to 2016. Both local and national SVI time series are then downloaded from Google Trends, as CSV files.

If we only retrieve SVI data for “apple” in United States alone, SVI is computed as the query share for the search term in the U.S. at the current time, normalized by the highest query share of that search term over the specified time series. On the other hand, when we simultaneously retrieve SVI data for United States and California, the query share for both local and national time series are normalized by the same constant, which is the highest query share in any of the time series. Therefore, our search procedure yields comparable local and national SVI data for Apple. A natural implication of this search method is that our SVI data ends up with several national SVI time series, one normalized in relation to each headquarter state and Top State. The search procedure and results are presented in the figure below. The graph illustrates Apple’s local and national SVI time series, or in other words, Apple’s popularity among investors in California relative to its popularity among investors in the United States.

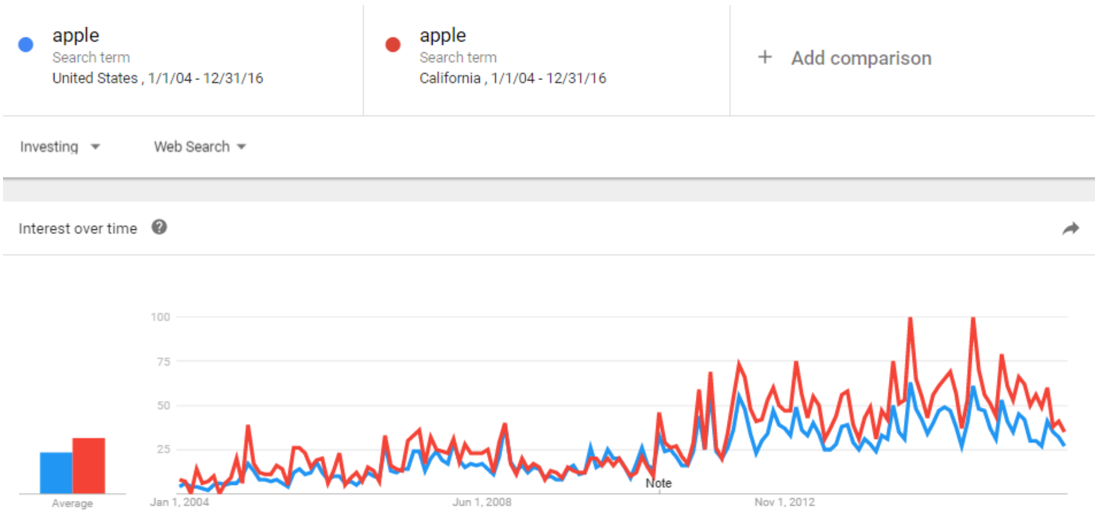

Figure 5: Comparable Local and National SVI Time Series, under the «Investing» filter

4.3.5 Automatization

It would be a very time-consuming process to manually enter the search terms and filters to retrieve local and national SVI data for each combination of company and state location.

Therefore, we use the Ghost Inspector web-crawling software to automate the search input process.

In simple terms, Ghost Inspector inputs the search terms for us and applies the relevant time, location and category filters into Google Trends, for each company-state combination. It then produces a matrix of URLs that generate the right Google Trends web pages from which one can immediately download CSV files with local and national SVI data. The matrix has the dimensions 653 (firms) * 8 (states), which is attributed to our final sample consisting of 653 companies, where each company is associated with four states based on the filter of "Investing", and four states based on no filter. We then manually press each of the URLs and download a total of 5224 associated CSV files with national and local SVI data.

Finally, we write a software to horizontally align the individual CSV files with local and national SVI time series related to the same company, and to vertically align the SVI time series for each company. Accordingly, the software produces our final Google SVI database in long-form.

5. Variable Construction

5.1 Headquarter Variables

Abnormal local attention signifies unusual increases in the attention a stock receives by local investors in the headquarter state:

$$\begin{aligned} &Abnormal\ Local\ Attention\ HQ_{i,t} \\ &\qquad = \ln\left(Local\ SVI\ HQ_{i,t}\right) \\ &\qquad - \ln\left[Med\left(Local\ SVI\ HQ_{i,t-1}, Local\ SVI\ HQ_{i,t-2}, Local\ SVI\ HQ_{i,t-3}\right)\right] \end{aligned} \tag{1}$$

Abnormal national attention represents unusual increases in the attention a stock receives by investors in the country at large. This variable is not a variable of interest, but is a component of the consequent attention measure:

$$\begin{aligned} &Abnormal\ National\ Attention\ HQ_{i,t} \\ &= \ln\left(National\ SVI\ HQ_{i,t}\right) \\ &- \ln\left[Med\left(National\ SVI\ HQ_{i,t-1}, National\ SVI\ HQ_{i,t-2}, National\ SVI\ HQ_{i,t-3}\right)\right] \end{aligned} \tag{2}$$

Below follows the computation of abnormal relative attention, which measures unusual increases in the attention a stock receives by local investors in the headquarter state relative to nonlocal investors in month t:

$$\begin{aligned} &Abnormal\ Relative\ Attention\ HQ_{i,t} \\ &\qquad = Abnormal\ Local\ Attention\ HQ_{i,t} \\ &\qquad - Abnormal\ National\ Attention\ HQ_{i,t} \end{aligned} \tag{3}$$

Relative attention measures the difference between the attention a stock receives by local investors in the headquarter state and nonlocal investors in month *t*, and is computed as follows:

$$Relative\ Attention\ HQ_t = \ln\left(Local\ SVI\ HQ_{i,t}\right) - \ln\left(National\ SVI\ HQ_{i,t}\right) \tag{4}$$

5.2 Top State Variables

Relative attention, abnormal relative attention and abnormal local attention based on Top State are formulated to test if the attention allocation behavior of local investors in the Top State according to Google, has asset-pricing implications. The variables for Top State are computed analogous to the corresponding variables based on headquarter state, but differentiate themselves by using SVI data for local investors in the Top State.

$$\begin{aligned} & Abnormal\ Local\ Attention\ Top\ State_{i,t} \\ & = \ln\left(Local\ SVI\ Top\ State_{i,t}\right) \\ & - \ln\left[Med\left(Local\ SVI\ Top\ State_{i,t-1}, Local\ SVI\ Top\ State_{i,t-2}, Local\ SVI\ Top\ State_{i,t-3}\right)\right] \end{aligned} \tag{5}$$

$$\begin{aligned} & Abnormal\ National\ Attention\ Top\ State_{i,t} \\ & = \ln\left(National\ SVI\ Top\ State_{i,t}\right) \\ & - \ln\left[Med\left(National\ SVI\ Top\ State_{i,t-1}, National\ SVI\ Top\ State_{i,t-2}, National\ SVI\ Top\ State_{i,t-3}\right)\right] \end{aligned}$$

$$\begin{aligned} & Abnormal\ Relative\ Attention\ Top\ State_{i,t} \\ & \qquad = Abnormal\ Local\ Attention\ Top\ State_{i,t} \\ & \qquad - Abnormal\ National\ Attention\ Top\ State_{i,t} \end{aligned} \tag{7}$$

$$\begin{aligned} & Relative\ Attention\ Top\ State_{i,t} \\ & \qquad = \ln\left(Local\ SVI\ Top\ State_{i,t}\right) - \ln\left(National\ SVI\ Top\ State_{i,t}\right) \end{aligned} \tag{8}$$

5.3 Top 3 States Variables

Further, we test composite measures of attention that take into consideration the attention allocation behavior of investors in several different states at single points in time. The Top 3 States exhibit considerably higher local interest for a company than the remaining states. This can be interpreted as local investors in each of the Top 3 States exhibiting varying degrees of local bias. Moreover, investors in each state may have unique information advantages as the same company may operate differently in each state. Consequently, we form the composite attention variables to test if aggregate changes in attention by local investors in several Top States have asset-pricing implications.

Abnormal local attention based on Top 3 States is a population – weighted average of the month *t* abnormal local attention in each of the Top 3 States. Thus, the weighted average of abnormal local attention places more weight on the local attention in states with bigger populations.

$$
\begin{aligned}
&Abnormal\,Local\,Attention\,Top\,3\,States_{i,t} \\
&\quad= \frac{Pop.State\ 1_i}{(Pop.State\ 1_i + Pop.State\ 2_i + Pop.State\ 3_i)} \\
&\quad\times Abnormal\,Local\,Attention\,State\ 1_{i,t} \\
&\quad+ \frac{Pop.State\ 2_i}{(Pop.State\ 1_i + Pop.State\ 2_i + Pop.State\ 3_i)} \\
&\quad\times Abnormal\,Local\,Attention\,State\ 2_{i,t} \\
&\quad+ \frac{Pop.State\ 3_i}{(Pop.State\ 1_i + Pop.State\ 2_i + Pop.State\ 3_i)} \\
&\quad\times Abnormal\,Local\,Attention\,State\ 3_{i,t}
\end{aligned} \tag{9}
$$

Abnormal relative attention based on Top 3 States is a population – weighted average of the month *t* abnormal relative attention in each of the Top 3 States.

$$Abnormal\,Relative\,Attention\,Top\,3\,States_{i,t} = \frac{Pop.State\,1_i}{(Pop.State\,1_i + Pop.State\,2_i + Pop.State\,3_i)} \times Abnormal\,Relative\,Attention\,State\,1_{i,t} + \frac{Pop.State\,2_i}{(Pop.State\,1_i + Pop.State\,2_i + Pop.State\,3_i)} \times Abnormal\,Relative\,Attention\,State\,2_{i,t} + \frac{Pop.State\,3_i}{(Pop.State\,1_i + Pop.State\,2_i + Pop.State\,3_i)} \times Abnormal\,Relative\,Attention\,State\,3_{i,t} \quad (10)$$

Relative attention based on Top 3 States is a population – weighted average of the month *t* relative attention in each of the Top 3 States.

$$Relative\,Attention\,Top\,3\,States_{i,t} = \frac{Pop.State\,1_i}{(Pop.State\,1_i + Pop.State\,2_i + Pop.State\,3_i)} \times Relative\,Attention\,State\,1_{i,t} + \frac{Pop.State\,2_i}{(Pop.State\,1_i + Pop.State\,2_i + Pop.State\,3_i)} \times Relative\,Attention\,State\,2_{i,t} + \frac{Pop.State\,3_i}{(Pop.State\,1_i + Pop.State\,2_i + Pop.State\,3_i)} \times Relative\,Attention\,State\,3_{i,t} \quad (11)$$

6. Empirical Methodology

We examine the relation between our relative attention variables of interest and stock returns with a trading strategy approach and Fama-Macbeth (1973) cross-sectional regressions.

6.1 Portfolio Sorts

To examine the effect of relative attention controlling for risk factors, we form long-short portfolios of stocks sorted by relative attention. Each month, we sort stocks in quintiles based on their level of relative attention in the most recent month. Stocks in the first quintile receive lower attention by local investors than national investors. Contrarily, stocks in the fifth quintile receive higher attention by local investors than national investors. The zero-investment portfolio is formed with a long position in an equal-weighted portfolio of stocks in the fifth quintile, and a short position in an equal-weighted portfolio of stocks in the first quintile. We then compute the return in the following month of this zero-investment portfolio. Repeating this zero-investment strategy every month yields the long-short portfolio time series. The time series of the excess returns of the long-short portfolio is then regressed on the Fama-French 3-factor model, which controls for market, size and value factors (Fama & French, Common Risk Factors in the Returns on Stocks and Bonds, 1993):

$$R_{pt} - r_f = \alpha_p + b_p MKT_t + s_p SMB_t + h_j HML_t + \varepsilon_t, \qquad p = 1, \dots, N, t = 1, \dots, T$$

MKT_t denotes the excess returns on the market portfolio, computed as the return on the NYSE/AMEX/NASDAQ value-weighted index over the one-month T-bill return. SMB_t and HML_t denote the returns to long-short portfolios constructed by sorting stocks on market capitalization and book-to-market ratio, respectively. If the alpha is significantly different from zero, relative attention likely explains a component of expected returns not captured by exposures to the other common risk factors. The estimated alpha is expected to be insignificant if the return difference is fully explained by the known factors.

We estimate Fama-French alphas for long-short portfolios with holding periods of 1 month based on each of our 9 variables of interest. If stocks are sorted by abnormal relative attention variables, stocks in the fifth quintile are characterized by abnormal increases in attention by local investors compared to national investors. Additionally, if stocks are sorted by abnormal local attention variables, stocks in the fifth quintile are characterized by surges in attention by local investors relative to the normal level of local attention a stock receives.

We use the technique of portfolios with overlapping holding periods deployed by Jegadeesh and Titman (1993), to estimate Fama-French alphas for each variable of interest, based on holding periods of 3 months and 6 months for the long-short portfolios. This implies that the time series of excess returns for the long-short portfolios have overlapping monthly returns. Consequently, we compute t-statistics for the Fama-French regressions using Newey-West (1987) standard errors with 3 lags and 6 lags, respectively, to adjust for heteroscedasticity and serial correlation in the time series.

Furthermore, we perform bivariate dependent-sort portfolio analyses, to examine if the effects of relative attention on stock returns are more pronounced for more illiquid stocks and small market capitalization stocks.

Each month, we median-sort stocks based on their Amihud illiquidity measure value in the previous month (Amihud, 2002), and then tercile-sort stocks based on the value of the relevant attention variable in the previous month, within each illiquidity quintile. Within each illiquidity quintile, we then generate the excess returns of a zero-investment strategy that longs an equal-weighted portfolio of stocks in the top attention tercile, and shorts an equal-weighted portfolio of stocks in the bottom attention tercile. Each long-short portfolio assumes a holding period of 1 month. Finally, each time series of long-short portfolio excess returns is regressed on the Fama-French three factor model, to generate the Fama-French adjusted alpha.

The methodology is analogous for double-sorting based on market capitalization, and the double-sorting routine is performed with respect to each of our 9 attention variables of interest.

6.2 Fama-Macbeth (1973) Cross-Sectional Regressions

We also examine the relation between our relevant attention variables and stock returns using Fama-Macbeth (1973) cross-sectional regressions. The Fama-Macbeth regressions provide further robustness of our results by providing standard errors that correct for cross-sectional autocorrelation and allowing for more controls in returns.

We estimate a cross-sectional model for each month in the years 2004-2016, where monthly contemporaneous stock returns are regressed on firm characteristics known to explain cross-sectional returns. Stocks are included in the cross-sectional model if they have returns for that month. The monthly regressions over the period 2004-2016 produce 156 estimates of each coefficient. Subsequently, we compute the mean and standard deviation of the monthly estimates, to perform t-tests for each final coefficient estimate under the null hypothesis of mean equal to zero.

The Fama-Macbeth (1973) regressions control for the firm characteristics size, book-to-market ratio, momentum and liquidity. Below we describe the construction of the control variables used in the Fama-Macbeth regressions:

Firm size is computed as the natural logarithm of market capitalization in the current month. Following Mondria and Wu (2013), the book-to-market ratio is computed as the natural logarithm of the book value of equity, calculated based on Davis, Fama and French (2000), divided by the previous month market capitalization. Momentum is computed as the cumulative return of the stock between month t-12 and t-2. Lastly, to proxy for liquidity, we construct the Amihud illiquidity measure for the current month t, according to Amihud (2002).

Fama-Macbeth regressions are performed for each of our 9 attention variables of interest, with one notable distinction. Each Fama-Macbeth regression for relative attention, abnormal relative attention and abnormal local attention based on headquarter state controls for the above-mentioned firm characteristics. Each Fama-Macbeth regression for the attention variables based on Top State and Top 3 States also include abnormal relative attention based on headquarter state as an additional control variable.

Intuitively, this variable is included to explore if the level of attention a stock receives by local investors in the Top States relative to national investors has an economically and statistically significant impact on stock returns, when we already take into consideration any unusual relative increases in the attention a stock receives from local investors residing in the headquarter state - who most studies in the intersection of geography and finance assume are benchmarks for local bias and information advantages. If the attention variables based on Top State are still significant after controlling for any unusual changes in attention by investors in the headquarters relative to the country at large, it may suggest that it is worth paying attention to the local attention stocks receive by investors living in other states than the headquarter state, as their investor behavior also has asset-pricing implications. Moreover, this significance also suggests that local investors living in other states than the headquarters may indeed possess local bias and local information advantages related to the same company.

7. Empirical Results

In this section, we present and discuss the results from our empirical analysis. We begin by presenting the empirical results for the variables of interest in which local investor attention is defined by the attention a stock receives from investors in the headquarter state. Headquarter state is widely used as a test-bed for exploring local bias and local information advantage in investment decisions. Subsequently, we present the empirical results based on our newly proposed definitions of investor locality, Top State and Top 3 States according to Google. Finally, the empirical results are discussed in the theoretical context of attention allocation theories and investor locality.

7.1 Headquarter State

7.1.1 Portfolio Sorts

Relative Attention – Headquarter State

Panel A in Table 1 reports factor loadings and Jensen’s Alpha for equally-weighted zero investment portfolios formed using quintiles of relative attention, with holding periods of 1 month, 3 months and 6 months, respectively. The monthly alpha of the long-short portfolio with a 1-month holding period is associated with a t-statistic of -1.27, and is thus statistically insignificant. Similarly, the monthly alpha of the 3-month and 6-month long-short portfolios are also statistically insignificant, with t-statistics adjusted for Newey-West standard errors of -1.01 and -1.32. This suggests that the return differential between a portfolio with high relative attention and low relative attention is indistinguishable from zero. However, the alphas are economically significant, as the monthly alpha of the long-short portfolio with a 1-month holding period is -14 basis points. The return differential decreases monotonically with increases in holding periods, evinced by monthly alphas of -30 basis points and -62 basis points for the zero investment portfolios with 3-month and 6-month holding periods. In essence, these results present no empirical evidence supporting a relation between relative attention based on headquarter state and future returns for S&P 500 stocks.

Table 1: Jensen's Alpha for Portfolios Sorted on Attention Variables based on Headquarter States

Portfolios	Alpha	Mkt-Rf	SMB	HML	T
PANEL A: Long - Short Portfolios based on Relative Attention					
EW Returns 1M HOLDING PERIOD	-0.14	4.09	-3.38	10.70**	155
	(0.11)	(3.62)	(5.30)	(5.16)	
EW Returns 3M HOLDING PERIOD	-0.30	15.38	-15.87	27.07*	156
	(0.28)	(10.78)	(9.96)	(13.97)	
EW Returns 6M HOLDING PERIOD	-0.62	36.98**	-36.48*	42.59	155
	(0.47)	(17.18)	(19.62)	(25.93)	
PANEL B: Long - Short Portfolios based on Abnormal Relative Attention					
EW Returns 1M HOLDING PERIOD	-0.30***	2.48	4.47	6.45	154
	(0.08)	(2.51)	(4.61)	(4.89)	
EW Returns 3M HOLDING PERIOD	-0.45**	13.52**	-8.44	8.77	156
	(0.17)	(5.54)	(10.74)	(9.94)	
EW Returns 6M HOLDING PERIOD	-0.97***	34.21***	-36.48**	19.49	155
	(0.29)	(6.56)	(14.10)	(16.86)	
PANEL C: Long - Short Portfolios based on Abnormal Local Attention					
EW Returns 1M HOLDING PERIOD	-0.23***	4.96*	0,2	7,08	154
	(-0.1)	(2.83)	(5.38)	(5.45)	
EW Returns 3M HOLDING PERIOD	-0.42**	11.38**	-13.29	17.13	156
	(0.20)	(5.56)	(9.38)	(11.13)	
EW Returns 6M HOLDING PERIOD	-0.77**	29.93***	-31.87**	33.57	155
	(0.37)	(10.75)	(15.69)	(21.98)	

Note: Jensen's alphas for portfolios sorted by *relative attention*, *abnormal relative attention* and *abnormal local attention* – based on headquarter state. *Relative attention* is the difference between the natural logarithm of local SVI and the natural logarithm of national SVI for the same month. *Abnormal local attention* is the difference between the natural logarithm of local SVI in the current month and the natural logarithm of median local SVI based on the past 3 months. *Abnormal relative attention* is the difference between abnormal local attention and abnormal national attention.

Each month, we sort stocks in quintiles based on their value of the relevant attention variable in the previous month. The zero-investment portfolio longs an equal-weighted portfolio of stocks in the fifth quintile with high attention, and shorts an equal-weighted portfolio of stocks in the first quintile with low attention. We then compute the return in the following month of this zero-investment portfolio. The time series of excess returns of the long-short portfolio is regressed on the Fama-French 3-factor model, which includes the market, size and value factors:

$$R_{pt} - r_f = \alpha_p + b_p MKT_t + s_p SMB_t + h_j HML_t + \varepsilon_t$$

We also use overlapping holding periods to estimate Fama-French alphas based on holding periods of 3 months and 6 months. Panel A presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using quintiles of relative attention, with holding periods of 1 month, 3 months and 6 months, respectively. Panel B presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using quintiles of abnormal relative attention, with holding periods of 1 month, 3 months and 6 months, respectively. Panel C presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using quintiles of abnormal local attention, with holding periods of 1 month, 3 months and 6 months. The sample period is from January 2004 to December 2016. Newey-West (1987) standard errors are in parenthesis. The symbols ***, ** and * denote that the alpha is significant at the 1%, 5% and 10% level, respectively.

Abnormal Relative Attention – Headquarter State

Panel B in Table 1 presents factor loadings and Jensen's Alpha for zero investment portfolios formed using quintiles of abnormal relative attention, with holding periods of 1 month, 3 months and 6 months. The long-short portfolio based on abnormal relative attention with a 1-month holding period shows an economically and statistically significant Jensen's alpha of -30 basis points, at the 1% level. Furthermore, the long-short portfolios based on 3-month and 6-month holding periods exhibit economically and statistically significant alphas of -45 basis points and -97 basis points, respectively. Consistent with the coefficients for relative attention, the negative relation between abnormal relative attention and stock returns continues at least up to 6 months after portfolio formation. The three-factor alphas are monotonically decreasing as holding period increases, which indicates a reversal pattern. A principal result from the three factor model time-series regressions is that abnormal relative attention is a strong predictor of future stock returns and that an increase in abnormal relative attention predicts future price reversals.

Abnormal Local Attention – Headquarter State

Panel C in Table 1 presents factor loadings and Jensen's Alpha for zero investment portfolios formed using quintiles of abnormal local attention, with holding periods of 1 month, 3 months and 6 months. The monthly alpha of the long-short portfolio based on abnormal local attention with a 1-month holding period has an economically significant alpha of -11 basis points, but the null hypothesis of zero in intercept is not rejected. However, long-short portfolios with 3-month and 6-month holding periods display both economically and statistically significant monthly alpha coefficients of -42 and -77 basis points. Consequently, portfolio sorts based on abnormal local attention also seem to exhibit significant reversal over time.

To summarize, the time-series regressions suggest that the discrepancy between the level of local and national attention a stock receives does not predict future returns. Rather, if a stock has recently attracted unusual increases in attention from local investors while national investors have not exhibited such increases in attention, significant declines in future returns are expected. Not only do increases in local attention relative to national investors predict future returns, but unusual increases in abnormal local attention itself also have asset-pricing implications. The alphas are economically significant for each variable, and consistently document monotonic decreases in the return difference over time. In the ensuing discussion section, the results from portfolio sorts are further interpreted in the theoretical context of relevant attention theories.

7.1.2 Fama-Macbeth Cross-sectional Regressions – Headquarter State

In this section we present the results to Fama-Macbeth cross-sectional regressions of monthly stock returns on the attention variables based on headquarter state, and other firm characteristics.

The first column of Table 2 reports the results of Fama-Macbeth regressions of monthly returns on relative attention based on headquarter state and firm characteristics. The relative attention coefficient is negative and statistically significant at the 10% - level, indicating a possible weak negative relationship between relative attention and stock returns, which is consistent with evidence from the one-way sorts.

The second column of Table 2 reports the Fama-Macbeth regressions results with abnormal relative attention as variable of interest. The abnormal relative attention coefficient is statistically insignificant, which contradicts the evidence from the time-series regressions indicating that abnormal relative attention significantly explains stock returns. However, the economic significance is in line with the previous results, since abnormal relative attention in the Fama-Macbeth regressions is negatively associated with average returns.

The third column shows that the abnormal local attention coefficient is positive and statistically insignificant, which implies that we cannot reject the null hypothesis that the coefficient is unrelated to average returns. These results thus conflict with the statistically significant Fama-French alphas and the economic relationship between abnormal local attention and returns evidenced using the portfolio formation approach.

Table 2: Fama-Macbeth (1973) Cross-sectional Regressions based on HQ State

VARIABLES	(1) RelAtt:	(2) AbRel Att:	(3) AbLoc Att:
log(ME)	0.23***	0.23***	0.23***
	(0.08)	(0.08)	(0.08)
log(BE/ME)	0.10	0.10	0.09
	(0.09)	(0.09)	(0.09)
RET[t-12, t-2]	-0.38	-0.38	-0.38
	(0.56)	(0.56)	(0.56)
AMIHUD	0.06*	0.06*	0.06*
	(0.03)	(0.03)	(0.03)
Relative Attention	-0.04*		
	(0.02)		
Abnormal Relative Attention		-0.02	
		(0.03)	
Abnormal Local Attention			0.01
			(0.03)
Constant	-4.46**	-4.45**	-4.45**
	(2.07)	(2.06)	(2.06)
R-squared	0.08	0.08	0.08
Observations	80,675	80,675	80,675
Time Periods	156	156	156

This table reports the results from Fama-Macbeth (1973) cross-sectional regressions from January 2004 to December 2016. The dependent variable is the return on stock i in month t. The regressions control for the following firm characteristics: log(ME) is the natural logarithm of the market capitalization in month t; log(BE/ME) is the natural logarithm of the book-to-market value of equity, where the book value calculated according to Davis, Fama and French (2000), is divided by month t-1 market capitalization; RET[t-12, t-2] is the cumulative return of the stock between month t-12 and t-2; AMIHUD is the Amihud illiquidity measure constructed using daily prices, returns and trading volumes from month t.

The first column reports the results from Fama-Macbeth regressions with relative attention based on headquarter state as variable of interest. The second column reports Fama-Macbeth regressions with abnormal relative attention based on headquarter state as variable of interest. The third column reports Fama-Macbeth regressions with abnormal local attention based on headquarter state as variable of interest.

Relative attention is the difference between the natural logarithm of local SVI and the natural logarithm of national SVI for the same month. Abnormal local attention is the difference between the natural logarithm of local SVI in the current month and the natural logarithm of median local SVI based on the past 3 months. Abnormal relative attention is the difference between abnormal local attention and abnormal national attention. Standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Hence, the effect of abnormal relative attention and abnormal local attention on returns is robust to controlling for risk factors in time-series regressions, but not robust to firm characteristics in cross-sectional regressions. The methodologies present inconsistent results in terms of statistical and economic significance, which reduces the validity of the significant negative relation between the variables and returns initially documented. Consequently, we cannot infer that there is a strong negative and economically significant relation between abnormal relative attention or abnormal local attention, and S&P 500 stock returns.

In other words, if a company receives absolute or relative increases in attention by local investors living in the company's headquarter state, we cannot conclude whether their attention allocation will explain the company's future stock returns.

7.2 Top State

In this section, we investigate if instead the attention allocation behavior of local investors in other states known to exhibit strong interest in the company, has an influence on future returns – using both portfolio sorts and Fama-Macbeth regressions. We also perform additional robustness checks to corroborate the uncertain evidence concerning the cross-sectional relation between increases in attention by local investors in the headquarter state and returns. A series of similar Fama-Macbeth regressions are performed, with abnormal relative attention based on headquarter state as independent variable, and control variables in the form of firm characteristics and alternative attention measures. If attention by local investors in the corporate headquarter state matters more for future returns than the attention of investors in other states, we would expect abnormal relative attention based on headquarter state to subsume the explanatory power of alternative attention measures based on other states and remain statistically and economically significant.

7.2.1 Portfolio Sorts

Relative Attention – Top State

Panel A in Table 3 reports factor loadings and Jensen's Alpha for equally-weighted zero investment portfolios formed using quintiles of relative attention based on Top State, with holding periods of 1 month, 3 months and 6 months, respectively. The long-short portfolio with a 1-month holding period has a monthly alpha of -23 basis points, which is both economically and statistically significant. While examining the abnormal returns 3 to 6 months after portfolio formation, we find that the incremental predictive power of relative attention diminishes when the t-statistic applies Newey-West (1987) standard errors with the appropriate lags, but continues to be significant with heteroscedasticity-robust standard errors. In essence, these results provide evidence that a greater discrepancy in the level of attention between local investors in the Top State and national investors predicts a significant initial price reduction, but we cannot conclude with certainty that this variable also predicts a subsequent reversal as well. However, it is noteworthy that the intercept coefficient monotonically drops to -41 and -88 basis points as holding period increases from 3 to 6 months, indicating a price reversal.

Abnormal Relative Attention – Top State

Panel B in Table 3 presents factor loadings and Jensen's Alpha for equally-weighted zero investment portfolios formed using quintiles of abnormal relative attention based on Top State, with holding periods ranging from 1 month to 6 months. By ascending holding period, the long-short portfolios based on abnormal relative attention show economically significant Jensen's alpha of -17 basis points, -36 basis points and -69 basis points. Thus, the results indicate the familiar reversal pattern seen during all previous Fama-French time series regressions. However, the t-statistics of the coefficients are marginally insignificant relative to the 10% significance level, indicating initially that abnormal relative attention based on Top State does not predict future returns.

Thus, we perform robustness tests to further examine the predictive power of abnormal relative attention. Table 8 in the Appendix reveals that the results from the dependent-sort portfolio analysis based on size yields a significant monthly long-short portfolio alpha of -31 basis points for high market capitalization stocks. Similarly, the dependent-sort portfolio analysis based on the Amihud illiquidity measure yields a strongly significant monthly alpha of -21 basis points for low illiquidity stocks. In the discussion, we intend to reflect upon these double-sorting results from the perspective of informational-based models of attention and findings of related empirical studies. For now, it serves to assert that the effect of abnormal relative attention on returns is indeed statistically significant and more pronounced among a certain group of stocks.

Table 3: Jensen's Alpha for Portfolios Sorted on Attention Variables based on Top State

Portfolios	Alpha	Mkt-Rf	SMB	HML	T
PANEL A: Long - Short Portfolios based on Relative Attention					
EW Returns 1M HOLDING PERIOD	-0.23**	7.44**	-12.34**	9.03*	155
	(0.11)	(3.46)	(5.04)	(4.89)	
EW Returns 3M HOLDING PERIOD	-0.41	14.04	-34.35***	46.91***	156
	(0.31)	(9.98)	(13.00)	(13.01)	
EW Returns 6M HOLDING PERIOD	-0.88	29.38	-71.04***	96.11***	155
	(0.60)	(18.44)	(24.68)	(28.28)	
PANEL B: Long - Short Portfolios based on Abnormal Relative Attention					
EW Returns 1M HOLDING PERIOD	-0.17	4.36	-2.87	2.32	154
	(0.11)	(3.26)	(5.01)	(4.53)	
EW Returns 3M HOLDING PERIOD	-0.36	6.41	-25.22***	21.82*	156
	(0.24)	(7.05)	(9.29)	(12.43)	
EW Returns 6M HOLDING PERIOD	-0.69	16.49	-59.60***	44.95**	155
	(0.44)	(12.47)	(17.41)	(22.33)	
PANEL C: Long - Short Portfolios based on Abnormal Local Attention					
EW Returns 1M HOLDING PERIOD	-0.11	3.30	-4.26	6.36	154
	(0.13)	(3.53)	(5.99)	(6.15)	
EW Returns 3M HOLDING PERIOD	-0.30	2.49	-21.13*	23.78**	156
	(0.23)	(7.05)	(11.35)	(10.07)	
EW Returns 6M HOLDING PERIOD	-0.73	13.67	-51.35**	56.91***	155
	(0.45)	(13.40)	(24.79)	(20.80)	

Note: Jensen's alphas for portfolios sorted by relative attention, abnormal relative attention and abnormal local attention – based on Top State. Relative attention is the difference between the natural logarithm of local SVI and the natural logarithm of national SVI for the same month. Abnormal local attention is the difference between the natural logarithm of local SVI in the current month and the natural logarithm of median local SVI based on the past 3 months. Abnormal relative attention is the difference between abnormal local attention and abnormal national attention.

Each month, we sort stocks in quintiles based on their value of the relevant attention variable in the previous month. The zero-investment portfolio longs an equal-weighted portfolio of stocks in the fifth quintile with high attention, and shorts an equal-weighted portfolio of stocks in the first quintile with low attention. We then compute the return in the following month of this zero-investment portfolio. The time series of excess returns of the long-short portfolio is regressed on the Fama-French 3-factor model, which includes the market, size and value factors. We also use overlapping holding periods to estimate Fama-French alphas based on holding periods of 3 months and 6 months.

$$R_{pt} - r_f = \alpha_p + b_p MKT_t + s_p SMB_t + h_j HML_t + \varepsilon_t$$

Panel A presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using quintiles of relative attention, with holding periods of 1 month, 3 months and 6 months, respectively. Panel B presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using quintiles of abnormal relative attention, with holding periods of 1 month, 3 months and 6 months, respectively. Panel C presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using quintiles of abnormal local attention, with holding periods of 1 month, 3 months and 6 months. The sample period is from January 2004 to December 2016. Newey-West (1987) standard errors are in parenthesis. The symbols ***, ** and * denote that the alpha is significant at the 1%, 5% and 10% level, respectively.

Abnormal Local Attention – Top State

Panel C in Table 3 presents factor loadings and Jensen's Alpha for equally-weighted zero investment portfolios formed using quintiles of abnormal local attention based on Top State, with holding periods ranging from 1 month to 6 months. Similar to the preceding attention variables based on Top State, the monthly alphas based on abnormal local attention also exhibit price reversals, with monthly alpha ranging from -11 basis points, -30 basis points to -73 basis points. However, neither of the alphas are statistically significant. A double-sorting routine by size and abnormal local attention renders the monthly long-short portfolio alpha statistically insignificant for both small market capitalization and big market capitalization stocks. Similarly, the long-short portfolio alphas are statistically insignificant for both illiquid and illiquid stocks. It is thus reasonable to infer that abnormal local attention based on Top State likely does not explain future returns.

In contrast to the zero investment portfolios based on headquarter state, the time series regression results based on Top State suggest that absolute changes in local attention do not predict returns. Rather, the level of local attention relative to nonlocal attention impacts future returns, or unusual increases in attention by locals compared to nonlocals.

7.2.2 Fama-Macbeth Cross-sectional Regressions – Top State

This section presents the results to Fama-Macbeth cross-sectional regressions of monthly contemporaneous returns on variables of interest based on Top State, with firm characteristics and abnormal relative attention based on headquarter state as control variables.

Relative Attention – Top State

The first column of Table 4 reports the results of Fama-Macbeth regressions of monthly returns on relative attention based on Top State and control variables including firm characteristics and abnormal relative attention based on headquarter state. The coefficient of relative attention based on Top State is statistically significant at all conventional levels. Furthermore, relative attention based on Top State is negatively associated with average returns. These results are strongly consistent with the significant negative monthly alphas found in the quintile portfolio sorts based on relative attention – Top State.

Table 4: Fama-Macbeth (1973) Cross-sectional Regressions for Attention Variables based on Top State

VARIABLES	(1) RelAtt:	(2) AbRelAtt:	(3) AbLocAtt:
log(ME)	0.23***	0.22***	0.22***
	(0.08)	(0.08)	(0.08)
log(BE/ME)	0.10	0.10	0.10
	(0.09)	(0.09)	(0.09)
RET[t-12, t-2]	-0.38	-0.37	-0.37
	(0.56)	(0.56)	(0.56)
AMIHUD	0.06*	0.06*	0.06*
	(0.03)	(0.03)	(0.03)
Abnormal Relative Attention - HQ State	-0.00	-0.01	-0.01
	(0.03)	(0.03)	(0.03)
Relative Attention	-0.08***		
	(0.03)		
Abnormal Relative Attention		-0.06**	
		(0.03)	
Abnormal Local Attention			-0.01
			(0.03)
Constant	-4.46**	-4.41**	-4.40**
	(2.05)	(2.05)	(2.05)
R-squared	0,08	0,08	0,08
Observations	80,675	80,675	80,675
Time Periods	156	156	156

This table reports the results from Fama-Macbeth (1973) cross-sectional regressions from January 2004 to December 2016. The dependent variable is the return on stock i in month t. The regressions control for the following firm characteristics: log(ME) is the natural logarithm of the market capitalization in month t; log(BE/ME) is the natural logarithm of the book-to-market value of equity, where the book value calculated according to Davis, Fama and French (2000), is divided by month t-1 market capitalization; RET[t-12, t-2] is the cumulative return of the stock between month t-12 and t-2; AMIHUD is the Amihud illiquidity measure constructed using daily prices, returns and trading volumes from month t; Abnormal Relative Attention – HQ State is the difference between abnormal local attention based on headquarter state and abnormal national attention based on headquarter state in month t.

The first column reports the results from Fama-Macbeth regressions with relative attention based on Top State as variable of interest. The second column reports Fama-Macbeth regressions with abnormal relative attention based on Top State as variable of interest. The third column reports Fama-Macbeth regressions with abnormal local attention based on Top State as variable of interest.

Relative attention is the difference between the natural logarithm of local SVI and the natural logarithm of national SVI for the same month. Abnormal local attention is the difference between the natural logarithm of local SVI in the current month and the natural logarithm of median local SVI based on the past 3 months. Abnormal relative attention is the difference between abnormal local attention and abnormal national attention. Standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

A method to quantify the economic significance of the relative attention coefficient is to obtain the difference between the average relative attention in the fifth and first quintile and multiply it by its regression coefficient. The average relative attention is 2.55 in the fifth quintile, and -0.24 in the first quintile. Following this computation shows that, holding control variables fixed, the predicted monthly return of stocks with high relative attention is about 22 basis points lower than stocks with low relative attention, which is similar in magnitude to the -23 basis points monthly alpha found using portfolio sorts. This signifies that relative attention based on Top State is also economically significant.

Moreover, the Fama-Macbeth regressions reveal that abnormal relative attention based on headquarter state - which the portfolio sorts suggested was the most significant predictor of returns in comparison to the other measures based on headquarter state – is both statistically and economically insignificant. The predictive power of the variable has been subsumed by relative attention based on Top State and other documented predictors of the cross-section of returns. Intuitively, this result implies that the attention allocation behavior of local investors living in the headquarter state is unrelated to average returns, whereas the attention allocation of investors in the Top State according to Google influences stock returns.

Abnormal Relative Attention – Top State

The second column of Table 4 reports the results of Fama-Macbeth regressions of monthly returns on abnormal relative attention based on Top State and the control variables applied in the previous regression. We evidence a statistically and economically significant negative relation between abnormal relative attention based on Top State and average returns. The significance and economic magnitude of abnormal relative attention are in line with the aforementioned results from the time-series regressions for the same variable.

Similar to the preceding Fama-Macbeth regression, abnormal relative attention is both statistically and economically insignificant, providing further evidence that abnormal relative attention based on headquarter state is unrelated to average returns. Abnormal relative attention based on headquarter state and Top State are comparable in the sense that the variables are formulated identically, except for that each variable focuses on a separate set of local investors. The results therefore imply that unusual increases in attention by local investors in the Top State relative to such increases in attention by the country at large, are related to average returns. Contrarily, unusual changes in attention by local investors living in the headquarter state compared to the rest of the country, do not affect returns.

Abnormal Local Attention – Top State

The third column presents the results of Fama-Macbeth regressions of monthly returns on abnormal local attention based on Top State. Consistent with the portfolio sorts based on abnormal local attention, the abnormal local attention coefficient is neither statistically nor economically significant. The abnormal local attention coefficient is negative, which corresponds with the negative relation between attention variables and average returns found in the preceding analyses. Abnormal relative attention based on headquarter state continues to be statistically insignificant.

To summarize, the Fama-Macbeth regressions complement the portfolio sorts with further evidence that relative attention and abnormal relative attention based on Top State are strongly negatively associated with stock returns. The Fama-Macbeth regressions also provide further evidence that the relative level and relative changes in attention by local investors residing in the Top State likely predict future returns, unlike the attention allocation behavior of investors living in the headquarter state.

The slope coefficient of the Amihud illiquidity measure and the book-to-market ratio are positive in each regression, consistent with previous literature (Amihud, 2002; Fama & French, The Cross-Section of Expected Stock Returns, 1992). In our sample, however, the slope coefficient of momentum assumes negative values. As Lewellen (2014) argues, the latter coefficient may be influenced by the time range for our sample and the calculation of the book-to-market ratio. For instance, Lewellen finds in similar Fama-Macbeth regressions, that several months in 2009 were catastrophic for momentum and the inclusion of the year could lead to a notable reduction in the monthly slope. Moreover, in calculating the book-to-market ratio, we compute book equity annually. Lewellen finds that updating book equity more frequently increases the negative correlation of book-to-market ratio with momentum, leading to an increase in the slope of momentum from the base case of annual updates in book equity.

7.3 Top 3 States

7.3.1 Portfolio Sorts

The following section presents the results of long-short portfolios sorted by quintiles of attention variables based on Top 3 States.

Relative Attention – Top 3 States

Panel A in Table 5 reports factor loadings and Jensen's Alpha for equally-weighted zero investment portfolios formed using quintiles of relative attention based on Top 3 States, with holding periods of 1 month, 3 months and 6 months, respectively. The monthly return differential for each of the long-short portfolios based on single-sorts of relative attention are statistically insignificant relative to the three-factor model. However, the double-sorting routine with illiquidity as dependent variable reveals that the long-short portfolio earns a monthly alpha of -28 basis for high market capitalization stocks that is both economically and statistically significant at all conventional levels. The monthly alpha of a strategy that longs in high relative attention stocks and shorts in low relative attention stocks for liquid stocks is similarly -30 basis points and statistically significant at the 1% - level. These results provide strong evidence that the negative effect of relative attention based on Top 3 States on future returns is more pronounced for liquid stocks and high-market capitalization stocks, which coheres with the double-sorting results for relative attention and abnormal relative attention based on Top State.

Abnormal Relative Attention – Top 3 States

Panel B in Table 5 shows that the monthly alpha of the long-short portfolio with a 1-month holding period equals -33 basis points, and is statistically significant at the 1%-level. Abnormal relative attention based on Top 3 States also predicts statistically significant long-run price reversals, with abnormal returns monotonically decreasing to -37 basis points 3 months after portfolio formation and -87 basis points 6 months after portfolio formation. Moreover, the long-short portfolio alpha is statistically and economically significant in each size and illiquidity quintile. However, the alphas for liquid stocks and high-market capitalization stocks are statistically significant at all conventional levels. The dependent-sort portfolio analyses results for relative attention based on Top 3 States also document greater significance related to liquid stocks and high market capitalization stocks.

The time-series regressions for relative attention and abnormal relative attention indicate that it may be of value to simultaneously monitor changes in the attention allocation behavior of investors in several states known to exhibit interest in the stock, since stocks that attract an abnormal amount of aggregate attention from local investors in the Top 3 States compared to nonlocals earn lower future returns.

A portfolio that buys stocks that recently received low relative increases in attention by local investors in the Top 3 States and sells stocks that recently received unusual increases in attention by local investor in the Top 3 states, earns positive risk-adjusted future returns.

Abnormal Local Attention – Top 3 States

By ascending order of holding period, Panel C in Table 5 shows long-short portfolio alphas of -26, -42 and -95 basis points. Each monthly alpha is statistically significant at the 5%-level. Similar to abnormal relative attention based on Top 3 States, unusual aggregate increases in local attention by investors in the Top 3 States are associated with statistically significant long-run return reversals. Additionally, the effect of abnormal local attention is more pronounced and statistically significant at all conventional levels, for liquid stocks and high market capitalization stocks.

In contrast, abnormal local attention based on a single Top State exhibited no predictive power for stock returns in neither of the statistical techniques deployed. Similarly, the monthly alphas for the overlapping long-short portfolios for abnormal relative attention based on Top 3 States exhibit greater statistical significance than the related alphas for the same variable based on a single Top State. Consequently, these findings indicate that the statistical power of attention variables is increased, in terms of the time-series regressions, when the variables take into consideration the attention allocation behavior of local investors in several states known to exhibit interest in the stock.

To summarize, each variable based on Top 3 States exhibits more pronounced effects for liquid stocks and high market cap stocks 1 month after portfolio formation. However, abnormal relative attention and abnormal local attention also predict significant future return reversals.

Table 5: Jensen's Alpha for Portfolios Sorted on Attention Variables based on Top 3 States

Portfolios	Alpha	Mkt-Rf	SMB	HML	T
PANEL A: Long - Short Portfolios based on Relative Attention					
EW Returns 1M HOLDING PERIOD	-0.07	1.56	-0.05	-0.45	155
	(0.11)	(3.03)	(5.27)	(6.07)	
EW Returns 3M HOLDING PERIOD	0.16	-2.80	2.21	6.80	156
	(0.24)	(5.66)	(11.96)	(11.47)	
EW Returns 6M HOLDING PERIOD	0.22	-5.07	-10.09	19.49	155
	(0.50)	(14.81)	(24.26)	(26.90)	
PANEL B: Long - Short Portfolios based on Abnormal Relative Attention					
EW Returns 1M HOLDING PERIOD	-0.33***	0.46	0.92	-3.12	154
	(0.10)	(3.63)	(4.58)	(6.20)	
EW Returns 3M HOLDING PERIOD	-0.37**	3.58	0.13	8.16	156
	(0.17)	(5.70)	(9.77)	(12.51)	
EW Returns 6M HOLDING PERIOD	-0.87***	7.60	-22.20	23.93*	155
	(0.29)	(6.68)	(15.46)	(12.78)	
PANEL C: Long - Short Portfolios based on Abnormal Local Attention					
EW Returns 1M HOLDING PERIOD	-0.26**	5.84	-4.49	4.52	154
	(0.10)	(4.08)	(4.80)	(6.65)	
EW Returns 3M HOLDING PERIOD	-0.42**	12.94*	-15.09	20.58*	156
	(0.20)	(6.72)	(9.42)	(11.18)	
EW Returns 6M HOLDING PERIOD	-0.95**	25.74**	-39.25**	57.93***	155
	(0.39)	(11.94)	(17.59)	(13.93)	

Note: Jensen's alphas for portfolios sorted by relative attention, abnormal relative attention and abnormal local attention – based on Top 3 States. Relative attention is the population-weighted average of relative attention in each of the Top 3 States. Abnormal local attention is the population-weighted average of abnormal local attention in each of the Top 3 States. Abnormal relative attention is the population-weighted average of abnormal relative attention in each of the Top 3 States.

Each month, we sort stocks in quintiles based on their value of the relevant attention variable in the previous month. The zero-investment portfolio longs an equal-weighted portfolio of stocks in the fifth quintile with high attention, and shorts an equal-weighted portfolio of stocks in the first quintile with low attention. We then compute the return in the following month of this zero-investment portfolio. The time series of excess returns of the long-short portfolio is regressed on the Fama-French 3-factor model, which includes the market, size and value factors. We also use overlapping holding periods to estimate Fama-French alphas based on holding periods of 3 months and 6 months.

$$R_{pt} - r_f = \alpha_p + b_p MKT_t + s_p SMB_t + h_j HML_t + \varepsilon_t$$

Panel A presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using quintiles of relative attention, with holding periods of 1 month, 3 months and 6 months, respectively. Panel B presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using quintiles of abnormal relative attention, with holding periods of 1 month, 3 months and 6 months, respectively. Panel C presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using quintiles of abnormal local attention, with holding periods of 1 month, 3 months and 6 months. The sample period is from January 2004 to December 2016. Newey-West (1987) standard errors are in parenthesis. The symbols ***, ** and * denote that the alpha is significant at the 1%, 5% and 10% level, respectively.

7.3.2 Fama-Macbeth Cross-sectional Regressions – Top 3 States

This section presents the results to Fama-Macbeth cross-sectional regressions of monthly contemporaneous returns on variables of interest based on Top 3 States, with firm characteristics and abnormal relative attention based on headquarter state as control variables.

Relative Attention – Top 3 States

The first column of Table 6 presents the results of Fama-Macbeth regressions of monthly returns on relative attention based on Top 3 States and control variables. The coefficient of relative attention is statistically significant at all conventional levels. Multiplying the coefficient with the difference in the mean of relative attention in the first and fifth quantile, suggests that, everything else equal, observations with high relative attention earn monthly returns that are 23 basis points lower than observations with low relative attention. The Fama-Macbeth results correspond with evidence from the double-sorts that relative attention based on Top 3 States is strongly negatively related to stock returns.

Abnormal relative attention based on headquarter state remains statistically insignificant, implying that unusual changes in the attention of investors from the headquarter state relative to the country are unrelated to average returns.

Table 6: Fama-Macbeth (1973) Cross-sectional Regressions based on Top 3 States

	(1)	(2)	(3)
VARIABLES	**RelAtt:**	**AbRelAtt:**	**AbLocAtt:**
log(ME)	0.22***	0.22***	0.22***
	(0.08)	(0.08)	(0.08)
log(BE/ME)	0.09	0.10	0.10
	(0.09)	(0.09)	(0.09)
RET[t-12, t-2]	-0.41	-0.40	-0.40
	(0.55)	(0.55)	(0.55)
AMIHUD	0.06*	0.06*	0.06*
	(0.04)	(0.04)	(0.04)
Abnormal Relative Attention - HQ State	-0.01	-0.01	-0.02
	(0.03)	(0.03)	(0.03)
Relative Attention	-0.09***		
	(0.03)		
Abnormal Relative Attention		-0.05	
		(0.04)	
Abnormal Local Attention			0.05
			(0.05)
Constant	-4.38**	-4.34**	-4.38**
	(2.10)	(2.09)	(2.10)
R-squared	0,08	0,08	0,08
Observations	77,912	77,912	77,912
Time Periods	156	156	156

This table reports the results from Fama-Macbeth (1973) cross-sectional regressions from January 2004 to December 2016. The dependent variable is the return on stock i in month t. The regressions control for the following firm characteristics: log(ME) is the natural logarithm of the market capitalization in month t; log(BE/ME) is the natural logarithm of the book-to-market value of equity, where the book value calculated according to Davis, Fama and French (2000), is divided by month t-1 market capitalization; RET[t-12, t-2] is the cumulative return of the stock between month t-12 and t-2; AMIHUD is the Amihud illiquidity measure constructed using daily prices, returns and trading volumes from month t; Abnormal Relative Attention – HQ State is the difference between abnormal local attention based on headquarter state and abnormal national attention based on headquarter state in month t.

The first column reports the results from Fama-Macbeth regressions with relative attention based on Top 3 States as variable of interest. The second column reports Fama-Macbeth regressions with abnormal relative attention based on Top 3 States as variable of interest. The third column reports Fama-Macbeth regressions with abnormal local attention based on Top 3 States as variable of interest. Relative attention is the difference between the natural logarithm of local SVI and the natural logarithm of national SVI for the same month. Abnormal local attention is the difference between the natural logarithm of local SVI in the current month and the natural logarithm of median local SVI based on the past 3 months. Abnormal relative attention is the difference between abnormal local attention and abnormal national attention. Standard errors are in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Abnormal Relative Attention – Top 3 States

The second column of Table 6 presents the results of Fama-Macbeth regressions of monthly contemporaneous returns on abnormal relative attention based on Top 3 States and control variables. Abnormal relative attention based on Top 3 States is associated with a t-statistic of –1.32, implying that the variable is unrelated to contemporaneous returns. We thus perform a Fama-Macbeth regression of next-month returns on current-month values of the variable of interest and control variables. The results of this regression are presented in Table 10 of the appendix. The robustness check reveals that abnormal relative attention based on Top 3 States is statistically significant at the 1%-level, and is negatively related to next month's average returns. Holding control variables fixed, stocks with high abnormal relative attention earn 15.7 bps lower future returns than stocks with low abnormal relative attention, which exhibits that the variable is economically significant. These results are consistent with the time-series regressions of the long-short portfolio excess returns on the three-factor model, which yields significant negative monthly alphas using both a single-sorting and double-sorting procedure and varying holding periods. In both Fama-Macbeth regressions, abnormal relative attention based on headquarter state remains statistically and economically insignificant.

Abnormal Local Attention – Top 3 States

The third column of Table 6 presents monthly contemporaneous returns on abnormal local attention based on Top 3 States and various controls. The coefficient of abnormal local attention based on Top 3 States is statistically insignificant, analogous to the results of the regressions in the second column. We similarly perform Fama-Macbeth regressions of next-month returns on current-month values of the variable of interest and controls. The results reveal that abnormal local attention has significant predictive power for next-month's average returns, at the 5%-level. Furthermore, abnormal local attention is negatively related to next-month returns and is economically significant, as the coefficient indicates that stocks with abnormal increases in local attention by investors in the Top 3 States earn future returns that are 13 basis points lower than stocks that have not displayed such unusual increases in attention by local investors in the same states.

In essence, for each of the attention variables based on Top 3 States, the time-series regressions and Fama-Macbeth cross-sectional regressions provide statistically and economically significant and consistent evidence that relative attention, abnormal relative attention and abnormal local attention based on Top 3 States are negatively related to S&P 500 returns.

It is, however, worth noting that the strength of the evidence may vary depending on variable and statistical method. To exemplify, the time-series regressions reveal that relative attention is significantly related to returns only in the two double-sorting procedures based on size and illiquidity, but is statistically significant in the Fama-Macbeth regressions of contemporaneous returns on relative attention and controls. Moreover, for abnormal relative attention and abnormal local attention, each monthly alpha in the single-sorting procedures is significant in the time-series regressions, but the variables are only significant in the Fama-Macbeth regressions based on next-month returns. Nonetheless, for each variable, the techniques provide some complementing evidence of a significant and negative relation between the attention variable and returns.

The significance of the Top 3 States – variables infers that the aggregate attention allocation behavior of local investors in several Top States likely has asset-pricing implications. In contrast, The Fama-Macbeth regressions provide additional evidence that the attention allocation behavior of investors in the headquarter state is unrelated to returns.

8. Discussion

8.1 Consistency with Behavioral-based and Information-based Attention Theories

In this section, we intend to evaluate our empirical results in the theoretical context of behavioral-based attention theories and informational-based attention theories.

The informational-based theory of Niewurburgh and Veldkamp (2009) postulates that, as a result of their initial local information advantage, local investors choose to direct their attention and information-processing efforts towards local stocks. As a result, local investors are likely to receive private information or otherwise pay attention to fundamental value-related information before the average investor. The private information is therefore not immediately reflected in the stock price when the local investor discovers it, but is later gradually incorporated into the stock price. When a local investor receives positive private information, the investor is likely to increase his or her information-processing efforts for the particular company, which magnifies the discrepancy in information-processing between local investors and nonlocal investors for the particular stock. Thus, the theory postulates that increases in the relative attention between local and national investors infers that local investors received fundamental private information, and that stock prices will increase.

An empirical study provides support for this theory if it first documents that the discrepancy in information-processing between local and national investors significantly predicts future stock returns, and secondly if increases in relative attention predict a future stock price increase.

Our empirical results provide support for the first implication of the informational-based theory. Relative attention based on Top State documents a statistically significant effect on stock returns in both a portfolio sorting technique and Fama-Macbeth regressions. Similarly, both statistical methods report a significant and consistent relation between relative attention based on Top 3 States and returns. In other words, these results imply that if we observe a large discrepancy in the level of information-processing efforts a stock receives by local investors and the level of information-processing a stock receives by nonlocal investors, it is likely to have an economically and statistically significant impact on future returns.

Portfolio sorts and Fama-Macbeth cross-sectional regressions also provide consistent evidence that abnormal relative attention based on Top State and abnormal relative attention based on Top 3 States significantly explain future returns. These results suggest that abnormal increases in information-processing efforts by local investors compared to nonlocal investors, has predictive power for stock returns. These findings are also coherent with the informational-based theory.

Informational-based theories assume that local investors receive and react to positive fundamental information about the company. Since an increase in relative attention by local investors precedes a future price increase that reflects fundamental information about the firm, no long-run reversals are expected. The empirical tests for both relative attention and abnormal relative attention based on Top State and Top 3 States, however, consistently show that these variables are significantly negatively related to stock returns, and predict future price reversals up until at least 6 months after portfolio formation. This empirical evidence is less consistent with an informational-based story which conjectures a positive relation between relative attention variables and future stock returns and no long-run reversals.

Consequently, we explore whether alternative attention theories serve to explain our empirical results. Barber and Odean (2008) argue that individual investors are net buyers of attention-grabbing stocks. When individual investors intend to buy stocks, they must choose from a large set of alternatives. Therefore, individual investors simplify their search problem by buying stocks that have recently grabbed their attention. Individual investors only tend to sell what they own and are less engaged in short-selling. As a result, stocks that experience increases in aggregate individual investor attention generate net-buying from individual investors, which leads to inflated stock prices in the short run and price reversals in the long run.

Abnormal local attention represents the increase in attention for a local stock by local investors. According to Barber and Odean’s theory, an aggregate increase in the attention a stock receives from local investors should cause local investors to become net buyers of these attention-grabbing stocks, which predicts price reversals in the long run. Our empirical results provide support for Barber and Odean’s attention theory, as we evince that an increase in abnormal local attention based on Top 3 States predicts significant price reversals for these stocks at least up to 6 months after portfolio formation.

Barber and Odean's theory would also serve to explain the empirical result for relative attention and abnormal local attention, if we observe that the attention allocation by local investors alone is driving the significant results for the relative attention variables. This may initially seem plausible, as both abnormal local attention and relative attention variables predict future price reversals. However, consistent evidence from both portfolio sorts and the Fama-Macbeth regressions indicates that abnormal local attention based on Top State is unrelated to stock returns, whereas relative attention based on Top State and abnormal relative attention based on Top State are significantly negatively associated with returns. Based on this empirical evidence, we cannot conclude that abnormal local attention is driving the effects of the relative attention variables, and hence, that the effects of relative attention and abnormal relative attention are the results of attention-induced buying. Thus, it is reasonable to infer that relative attention and abnormal relative attention capture a unique and significant relation to stock returns that is not fully explained by existing attention theories.

In addition, we also deem it noteworthy to pinpoint that we initially conjectured that the effect of our relative attention variables on returns should be more pronounced for smaller stocks and stocks with lower liquidity. The conjecture was based on findings that smaller firms with lower liquidity are associated with lower familiarity nationwide (Loughran & Schultz, 2005). Consequently, if a firm is comparatively less familiar nationwide, the impact of local attention on returns should be more pronounced. For instance, local investors should be more likely to extract value-related information for the firm before national investors when national investors are inattentive, and thereby predict future returns. Interestingly, the double-sorting results contradict the initial conjecture, as most attention variables exhibit more statistically and economically significant results for more liquid stocks and stocks with higher market capitalization.

These unexpected results may be attributed to that S&P 500 stocks are stocks associated with high market capitalization and liquidity, which render size and illiquidity to be less robust proxies to highlight the effects of information frictions between local investors and national investors. Ideally, we would have ensured the time to double-sort by national analyst coverage, which we believe would serve as a better measure to help reveal if the effect of relative attention on returns is more pronounced under greater information frictions.

8.2 New Modes of Investor Locality

The literature in the field of local bias and financial decisions often applies the headquarter state as a benchmark for exploring investors’ local bias and local information advantage and their effect on local fund manager performance and asset pricing (Coval and Moskowitz, 2001; Ivkovic and Weisbenner, 2005; Mondria and Wu, 2013). These studies thus rely on the assumption that investors in the corporate headquarter state are likelier to exhibit a local bias and local information advantage for a particular company than investors who do not reside in the headquarter state.

Under this assumption, informational-based theories suggest that local investors in the headquarter state possess information advantages over investors in other states, and investors in the headquarter state are therefore likely to identify value-related events before investors in other states. A rising discrepancy in the level of attention investors in the headquarter state devote to the local company and the level of attention nonlocal investors devote to it infers that investors in the headquarters state anticipated value-related information and predicts that future stock prices increase. Thus, an increase in relative attention based on the headquarter state should significantly explain future returns. Moreover, the attention variables based on headquarter state should subsume the predictive power of alternative attention measures based on other states. Similarly, under this assumption, the attention theory of Barber and Odean predicts that increases in abnormal local attention by investors in the headquarter state is followed by attention-induced buying by these investors and subsequent price reversals.

Contrary to the theories’ predictions, the empirical results reveal that neither relative attention, abnormal relative attention nor abnormal local attention based on headquarter state predict future returns. Interestingly, it is rather the relative attention, abnormal relative attention and abnormal local attention by investors residing in the Top States according to Google, which significantly predict future returns.

Moreover, Fama-Macbeth cross-sectional regressions with abnormal relative attention based on headquarter state and attention measures based on Top State and Top 3 States as independent variables demonstrate that the latter attention measures and control variables subsume the predictive power of abnormal relative attention based on headquarter state – which consistently remains statistically and economically insignificant in each regression.

Thus, the robust empirical evidence indicates that the attention allocation behavior of investors in Top States have asset pricing implications, whereas the attention allocation behavior of investors in the headquarter state does not. The greater significance of attention variables based on Top States suggests that investors in the Top States exhibit higher local information advantage, local bias and interest in a company than the investors who live in the state where the company is headquartered. Consequently, these results provide support for our initial conjecture that Top States from Google may constitute a unique and superior test-bed for empirical studies on local bias and local information advantage in finance. The significant empirical results for Top States are consistent with Google's definition of the Top 3 States being the states that on average exhibit the highest interest in the company over the relevant time series.

Our findings imply that an investor does not necessarily develop local information advantage or local bias for a company because the person lives near the company headquarters, where the company's most important strategic objectives are performed. The revealed phenomenon of investors in a state other than the headquarter state collectively possessing higher local interest and bias for a company than investors in the headquarter state, may be attributed to the fact that the company has a unique market position in the particular state. Through its unique market position, the company builds exposure and a relationship to the residents of the state in such a way that the residents perceive the company as local, even if it is headquartered somewhere else. For instance, the company may have a near-monopoly position in the product market, emphasize target advertising to customers in the state, or be a significant employer to the state.

Since a company's unique role may differ depending on the state, investors in different states may possess different information advantages for the same company. Furthermore, investors in one state may experience an attention-grabbing event before investors in other states, causing them to increase their attention towards the stock before other investors do so. It is possible that the superior predictive ability of our broad and composite measures of attention based on Top 3 States may be attributed to the variables' ability to detect and consider such variations in information advantages, and the variables' ability to detect early investor attention that later culminates into net-buying.

9. Conclusion

In this paper, we first deployed portfolio analysis and Fama-Macbeth (1973) cross-sectional regressions to investigate if an increase in abnormal local attention for a stock predicts future price reversals. We employed a direct and precise measure of local investor attention for each company in our sample, by using Google Search Volume Index data filtered to reflect searches made specifically for the purpose of investing in the respective companies, in states defined as local. A long-short portfolio with a 1-month holding period sorted by *abnormal local attention based on Top 3 States* exhibits a statistically and economically significant Jensen's alpha of -26 basis points, which monotonically decreases to -42 and -95 basis points in overlapping long-short portfolios with holding periods of 3 months and 6 months, respectively. The Fama-Macbeth regressions validate these results. Thus, our empirical evidence suggests that unusual increases in the attention a stock receives by local investors predicts future price reversals.

Secondly, we examined if an increase in the local relative to national attention level a stock receives predicts an increase in stock prices, and relatedly, if an unusual increase in attention by local investors relative to national investors predicts an increase in stock prices. Using portfolio analysis and Fama-Macbeth regressions, we find that *relative attention* and *abnormal relative attention based on Top State and Top 3 States* as benchmarks of local bias document a statistically significant effect on returns. Nevertheless, the four variables exhibit a statistically and economically significant negative relation with stock returns and predict future price reversals at least up to 6 months after portfolio formation. The negative empirical relation between relative attention and returns documented, is not driven by alternative attention measures and is unexplained by existing attention theories.

Thirdly, we propose and test Top State and Top 3 States as new benchmark states to explore theories of local bias in the United States. Specifically, we examine attention theories that predict that the effect of abnormal local attention and relative attention on returns is more pronounced the stronger the local bias of the investor. Google Trends provides evidence that – for the same stock - investors in the Top State exhibit stronger local bias for the stock than investors living in the headquarter state where the company is located. Ceteris paribus, we should document a more pronounced effect of abnormal local attention and the relative attention variables on returns when these variables are based on the local attention of investors in the Top States according to Google. Our empirical findings support this hypothesis, showing that the abnormal local attention, relative attention and abnormal relative attention of investors living in the Top States predict future returns. However, the attention allocation behavior of local investors in the headquarter state does not influence stock returns. This implies that we are able to detect the effect of the interaction between attention and local bias on returns - only using the newly proposed benchmark of local bias. The strong empirical evidence documented using several attention variables and statistical techniques suggests that Top State and Top 3 States according to Google represent a unique and superior test-bed for exploring theories of local attention.

We hope our empirical findings encourage future research on local bias to employ Top States as a testing ground to empirically test theories related to local bias. For instance, our database reveals that the same way many firms can be headquartered in the same state, many firms can also have the same Top State. Thus, a particular state can be a Top State to many different stocks, which implies that investors in the state demonstrate a strong preference for many out-of-state stocks. Thus, it could prove interesting to examine if fund managers or retail investors in a given state hold a disproportionate amount of stocks that they according to Google Trends should have a strong preference for, or in other words stocks that have their state as Top State. If this is the case, it would also be interesting to explore the performance of local investors' investments in Top State stocks. Furthermore, it could be interesting to examine if firms that have the same Top State exhibit covariation in returns, and if this could be linked to the local bias of residents.

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11. Appendix

Table 7: Jensen's Alpha for Double-sorted Portfolios: Attention Variables based on HQ State

Portfolios	Alpha	Mkt-Rf	SMB	HML	T
PANEL A: Long - Short Portfolios based on Relative Attention					
EW Returns First Size Quintile (Small stocks)	0.01	6.81	6.45	22.33**	155
	(0.16)	(4.72)	(7.96)	(9.60)	
EW Returns Second Size Quintile (Big stocks)	-0.31***	8.94***	-0.37	4.01	155
	(0.09)	(2.79)	(4.41)	(3.67)	
EW Returns First Illiquidity Quintile (Liquid Stocks)	-0.32***	9.48***	-0.02	0.20	155
	(0.10)	(2.88)	(4.72)	(4.25)	
EW Returns Second Illiquidity Quintile (Illiquid Stocks)	0.01	6.15	2.78	30.75***	155
	(0.15)	(4.09)	(7.92)	(10.15)	
PANEL B: Long - Short Portfolios based on Abnormal Relative Attention					
EW Returns First Size Quintile (Small stocks)	-0.08	0.85	9.34	23.52**	154
	(0.15)	(4.62)	(7.74)	(9.81)	
EW Returns Second Size Quintile (Big stocks)	-0.30***	8.30***	5.76	-7.06**	154
	(0.09)	(2.67)	(4.31)	(3.47)	
EW Returns First Illiquidity Quintile (Liquid Stocks)	-0.29***	7.97***	3.68	-7.05*	154
	(0.09)	(2.39)	(4.49)	(3.66)	
EW Returns Second Illiquidity Quintile (Illiquid Stocks)	-0.10	0.67	10.15	25.41***	154
	(0.14)	(4.20)	(7.00)	(9.52)	
PANEL C: Long - Short Portfolios based on Abnormal Local Attention					
EW Returns First Size Quintile (Small stocks)	0.07	2.99	10.06	19.68*	154
	(0.18)	(4.31)	(9.32)	(11.80)	
EW Returns Second Size Quintile (Big stocks)	-0.35***	9.87***	0.27	-0.61	154
	(0.10)	(3.09)	(5.47)	(4.22)	
EW Returns First Illiquidity Quintile (Liquid Stocks)	-0.30***	8.57***	2.54	-2.30	154
	(0.10)	(3.11)	(5.25)	(4.92)	
EW Returns Second Illiquidity Quintile (Illiquid Stocks)	-0.01	5.63	3.94	22.11*	154
	(0.18)	(4.21)	(8.94)	(12.74)	

Note: Jensen's alphas for portfolios double-sorted by size and relative attention, abnormal relative attention and abnormal local attention – based on headquarter state, and Jensen's alphas for portfolios double-sorted by illiquidity and relative attention, abnormal relative attention and abnormal local attention – based on headquarter state. Size is the natural logarithm of the market capitalization in month t. Illiquidity denotes the Amihud illiquidity measure constructed using daily prices, returns and trading volumes from month t. Relative attention is the difference between the natural logarithm of local SVI and the natural logarithm of national SVI for the same month. Abnormal local attention is the difference between the natural logarithm of local SVI in the current month and the natural logarithm of median local SVI based on the past 3 months. Abnormal relative attention is the difference between abnormal local attention and abnormal national attention.

Each month, we median-sort stocks based on their size in the previous month, and then within each size quintile, tercile-sort stocks based on the value of the relevant attention variable in the previous month. Within each size quintile, we then generate a zero-investment portfolio that longs an equal-weighted portfolio of stocks in the top attention tercile, and shorts an equal-weighted portfolio of stocks in the bottom attention tercile. Each long-short portfolio assumes a holding period of 1 month. Finally, the time series of long-short portfolio excess returns from each size quintile is regressed on the Fama-French 3-factor model, which includes the market, size and value factors. The double-sorting procedure is analogous with respect to the Amihud illiquidity measure and the attention variables.

Panel A presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using terciles of relative attention, within each size quintile and illiquidity quintile. Panel B presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using terciles of abnormal relative attention, within each size quintile and illiquidity quintile. Panel C presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using terciles of abnormal local attention, within each size quintile and illiquidity quintile. The sample period is from January 2004 to December 2016. Heteroscedasticity-robust standard errors are in parenthesis. The symbols ***, ** and * denote that the alpha is significant at the 1%, 5% and 10% level, respectively.

Table 8: Jensen's Alpha for Double-sorted Portfolios: Attention Variables based on Top State

Portfolios	Alpha	Mkt-Rf	SMB	HML	T
PANEL A: Long - Short Portfolios based on Relative Attention					
EW Returns First Size Quintile (Small stocks)	-0.07	11.43**	-1.30	20.20***	155
	(0.17)	(5.12)	(8.34)	(7.53)	
EW Returns Second Size Quintile (Big stocks)	-0.30***	10.80***	-9.70*	7.65	155
	(0.11)	(3.49)	(5.00)	(4.78)	
EW Returns First Illiquidity Quintile (Liquid Stocks)	-0.31***	10.21**	-13.22**	5.41	155
	(0.11)	(3.93)	(5.23)	(4.77)	
EW Returns Second Illiquidity Quintile (Illiquid Stocks)	-0.00	10.24**	-1.80	23.61***	155
	(0.16)	(4.66)	(7.96)	(7.57)	
PANEL B: Long - Short Portfolios based on Abnormal Relative Attention					
EW Returns First Size Quintile (Small stocks)	-0.08	6.21	11.82	15.37	154
	(0.19)	(5.94)	(8.92)	(9.91)	
EW Returns Second Size Quintile (Big stocks)	-0.21*	5.64*	-7.52	-3.39	154
	(0.12)	(2.91)	(5.13)	(5.03)	
EW Returns First Illiquidity Quintile (Liquid Stocks)	-0.32***	5.52*	-8.12	-3.16	154
	(0.12)	(3.22)	(5.72)	(4.94)	
EW Returns Second Illiquidity Quintile (Illiquid Stocks)	0.10	5.43	9.41	18.72*	154
	(0.18)	(5.37)	(8.04)	(10.22)	
PANEL C: Long - Short Portfolios based on Abnormal Local Attention					
EW Returns First Size Quintile (Small stocks)	-0.02	1.13	11.61	16.07*	154
	(0.21)	(5.72)	(9.41)	(9.40)	
EW Returns Second Size Quintile (Big stocks)	-0.10	7.99**	-11.11*	1.04	154
	(0.15)	(4.02)	(6.50)	(8.80)	
EW Returns First Illiquidity Quintile (Liquid Stocks)	-0.15	5.73	-11.66	0.01	154
	(0.15)	(3.75)	(7.15)	(7.81)	
EW Returns Second Illiquidity Quintile (Illiquid Stocks)	0.10	4.28	4.35	18.72*	154
	(0.20)	(5.55)	(9.18)	(9.56)	

Note: Jensen's alphas for portfolios double-sorted by size and relative attention, abnormal relative attention and abnormal local attention – based on Top State, and Jensen's alphas for portfolios double-sorted by illiquidity and relative attention, abnormal relative attention and abnormal local attention – based on Top State. Size is the natural logarithm of the market capitalization in month t. Illiquidity denotes the Amihud illiquidity measure constructed using daily prices, returns and trading volumes from month t. Relative attention is the difference between the natural logarithm of local SVI and the natural logarithm of national SVI for the same month. Abnormal local attention is the difference between the natural logarithm of local SVI in the current month and the natural logarithm of median local SVI based on the past 3 months. Abnormal relative attention is the difference between abnormal local attention and abnormal national attention.

Each month, we median-sort stocks based on their size in the previous month, and then within each size quintile, tercile-sort stocks based on the value of the relevant attention variable in the previous month. Within each size quintile, we then generate a zero-investment portfolio that longs an equal-weighted portfolio of stocks in the top attention tercile, and shorts an equal-weighted portfolio of stocks in the bottom attention tercile. Each long-short portfolio assumes a holding period of 1 month. Finally, the time series of long-short portfolio excess returns from each size quintile is regressed on the Fama-French 3-factor model, which includes the market, size and value factors. The double-sorting procedure is analogous with respect to the Amihud illiquidity measure and the attention variables.

Panel A presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using terciles of relative attention, within each size quintile and illiquidity quintile. Panel B presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using terciles of abnormal relative attention, within each size quintile and illiquidity quintile. Panel C presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using terciles of abnormal local attention, within each size quintile and illiquidity quintile. The sample period is from January 2004 to December 2016. Heteroscedasticity-robust standard errors are in parenthesis. The symbols ***, ** and * denote that the alpha is significant at the 1%, 5% and 10% level, respectively.

Table 9: Jensen's Alpha for Double-sorted Portfolios: Attention Variables based on Top 3 States

Portfolios	Alpha	Mkt-Rf	SMB	HML	T
PANEL A: Long - Short Portfolios based on Relative Attention					
EW Returns First Size Quintile (Small stocks)	-0.05	7.17	6.52	5.83	155
	(0.15)	(5.63)	(6.78)	(7.03)	
EW Returns Second Size Quintile (Big stocks)	-0.28***	8.05***	-5.51	6.85**	155
	(0.09)	(2.35)	(4.56)	(3.41)	
EW Returns First Illiquidity Quintile (Liquid Stocks)	-0.30***	8.56***	-6.64	4.76	155
	(0.10)	(2.61)	(4.49)	(3.59)	
EW Returns Second Illiquidity Quintile (Illiquid Stocks)	0.02	5.10	4.03	11.05	155
	(0.14)	(4.55)	(7.09)	(6.77)	
PANEL B: Long - Short Portfolios based on Abnormal Relative Attention					
EW Returns First Size Quintile (Small stocks)	-0.36**	9.82	5.38	9.49	154
	(0.15)	(6.43)	(6.75)	(8.03)	
EW Returns Second Size Quintile (Big stocks)	-0.30***	5.22**	-0.60	1.23	154
	(0.09)	(2.18)	(4.60)	(3.92)	
EW Returns First Illiquidity Quintile (Liquid Stocks)	-0.34***	7.23***	-2.09	2.31	154
	(0.09)	(2.12)	(4.68)	(4.38)	
EW Returns Second Illiquidity Quintile (Illiquid Stocks)	-0.27**	6.85	2.58	11.21**	154
	(0.13)	(5.53)	(6.71)	(5.57)	
PANEL C: Long - Short Portfolios based on Abnormal Local Attention					
EW Returns First Size Quintile (Small stocks)	-0.07	7.10	7.40	6.19	154
	(0.18)	(7.69)	(8.03)	(10.50)	
EW Returns Second Size Quintile (Big stocks)	-0.29***	7.84**	-7.10	5.42	154
	(0.11)	(3.06)	(5.27)	(6.36)	
EW Returns First Illiquidity Quintile (Liquid Stocks)	-0.34***	5.84*	-5.94	2.29	154
	(0.11)	(3.28)	(5.10)	(5.73)	
EW Returns Second Illiquidity Quintile (Illiquid Stocks)	0.02	8.55	0.59	12.18	154
	(0.17)	(6.33)	(8.04)	(11.61)	

Note: Jensen's alphas for portfolios double-sorted by size and relative attention, abnormal relative attention and abnormal local attention – based on Top 3 States, and Jensen's alphas for portfolios double-sorted by illiquidity and relative attention, abnormal relative attention and abnormal local attention – based on Top 3 States. Size is the natural logarithm of the market capitalization in month t. Illiquidity denotes the Amihud illiquidity measure constructed using daily prices, returns and trading volumes from month t. Relative attention is the difference between the natural logarithm of local SVI and the natural logarithm of national SVI for the same month. Abnormal local attention is the difference between the natural logarithm of local SVI in the current month and the natural logarithm of median local SVI based on the past 3 months. Abnormal relative attention is the difference between abnormal local attention and abnormal national attention.

Each month, we median-sort stocks based on their size in the previous month, and then within each size quintile, tercile-sort stocks based on the value of the relevant attention variable in the previous month. Within each size quintile, we then generate a zero-investment portfolio that longs an equal-weighted portfolio of stocks in the top attention tercile, and shorts an equal-weighted portfolio of stocks in the bottom attention tercile. Each long-short portfolio assumes a holding period of 1 month. Finally, the time series of long-short portfolio excess returns from each size quintile is regressed on the Fama-French 3-factor model, which includes the market, size and value factors. The double-sorting procedure is analogous with respect to the Amihud illiquidity measure and the attention variables.

Panel A presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using terciles of relative attention, within each size quintile and illiquidity quintile. Panel B presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using terciles of abnormal relative attention, within each size quintile and illiquidity quintile. Panel C presents factor loadings and Jensen's alpha for equally-weighted zero investment portfolios formed using terciles of abnormal local attention, within each size quintile and illiquidity quintile. The sample period is from January 2004 to December 2016. Heteroscedasticity-robust standard errors are in parenthesis. The symbols ***, ** and * denote that the alpha is significant at the 1%, 5% and 10% level, respectively.

Table 10: Fama-Macbeth (1973) Cross-sectional Regressions for Attention Variables based on Top 3 States

Variables	(1) AbRelAtt:	(2) AbLocAtt:
log(ME)	-0.25***	-0.25***
	(0.08)	(0.08)
log(BE/ME)	-0.05	-0.05
	(0.09)	(0.09)
RET[t-12, t-2]	-0.22	-0.22
	(0.49)	(0.49)
AMIHUD	0.04	0.04
	(0.04)	(0.04)
Abnormal Relative Attention - HQ State	0.02	0.01
	(0.03)	(0.03)
Abnormal Relative Attention	-0.10***	
	(0.04)	
Abnormal Local Attention		-0.10**
		(0.05)
Constant	6.52***	6.53***
	(2.08)	(2.08)
Observations	77,313	77,313
R-squared	0.08	0.08
Time Periods	155	155

This table reports results from Fama-Macbeth (1973) cross-sectional regressions from January 2004 to December 2016. The dependent variable is the return on stock i in month t+1. The regressions control for the following firm characteristics: log(ME) is the natural logarithm of the market capitalization in month t; log(BE/ME) is the natural logarithm of the book-to-market value of equity, where the book value calculated according to Davis, Fama and French (2000), is divided by month t-1 market capitalization; RET[t-12, t-2] is the cumulative return of the stock between month t-12 and t-2; AMIHUD is the Amihud illiquidity measure constructed using daily prices, returns and trading volumes from month t; Abnormal Relative Attention – HQ State is the difference between abnormal local attention based on headquarter state and abnormal national attention based on headquarter state in month t. The first column reports the results from Fama-Macbeth regressions with abnormal relative attention based on Top 3 States as variable of interest. The second column reports Fama-Macbeth regressions with abnormal local attention based on Top 3 States as variable of interest.

Abnormal local attention is the difference between the natural logarithm of local SVI in the current month and the natural logarithm of median local SVI based on the past 3 months. Abnormal relative attention is the difference between abnormal local attention and abnormal national attention. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.