Cash to Spend: IPO Wealth and House Prices*

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Abstract

This study empirically demonstrates the positive impact of initial public offerings (IPOs) on local housing prices in California from 1993 through 2017. In the spirit of the difference-in-difference approach, we test whether hedonic price indexes increase after IPO events more for the areas around IPO firm headquarters. We use the IPO events of public filing, issuing, and lockup expiration to distinguish changes in the shareholders' expected wealth, assessed wealth, and immediately available wealth, respectively. HPIs increase more within 10 miles of IPO headquarters than in the surrounding area by 1.0% after filing and 0.8% after issuing but approximately zero after lock-up expiration. This result suggests that original shareholders change their housing demand when their wealth changes but not when liquidity constraint is relaxed. The impact is larger when the wealth increase by IPO is larger; e.g., higher offer price, larger IPO proceeds, and larger share underpricing at filing. The impact is also larger for younger and smaller firms.

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1 Introduction

An initial public offering (IPO) rewards the founders, angel investors, venture capitalists, and key employees with stock options (henceforth original shareholders). For example, PrivCo reported that twitter's IPO created 1,600 millionaires.[1] As a result, original shareholders may experience significant changes in their wealth and liquidity around an IPO that can lead to changes in their consumption. In particular, demand may increase for housing and services that impacts the local housing market.

In California, where start-up companies cluster (Figure 1), a positive correlation is observed between the number of IPOs and house prices (Figure 2). Although this positive correlation is sometimes interpreted as a causal effect of the wealth created by a cluster of start-up companies, causality is not immediately obvious.[2] Furthermore, if a wealth change is anticipated, the original shareholders would change their consumption and tenure choices well before an IPO (Friedman, 1957). Thus, for an IPO to affect housing demand, there must be either unexpected wealth changes or obstacles to consumption smoothing such as liquidity constraints. Moreover, if IPOs cause the house price appreciation, they may create a negative side-effect on economic agglomeration through an increase in the cost of living and business (Cornaggia et al., 2017).[3]

In this study, we ask two questions. First, do IPOs influence local housing markets? The positive correlation between IPOs and house prices can be a coincidence or can be generated by confounding factors such as high amenities and housing supply constraints. We attempt to isolate the causal effect of IPOs on housing prices. Second, if IPOs influence housing markets, when and how do they influence? Most IPOs have three sequential events: IPO filing, share issuing, and the expiration of a lock-up period. These sequential stages provide a unique setting for decomposing a shock to shareholder wealth into an update of the expected future wealth at the time of an IPO filing, an update of the assessed wealth based on the market share price at the time of issuance, and the relaxed liquidity constraint at the time of lockup expiration event. The liquidity constraint can play an important role in housing tenure choice when mortgage financing requires a significant amount of cash (e.g., Artle and Varaiya, 1978; Schwab, 1982; Slemrod, 1982; Henderson and Ioannides, 1983; Brueckner, 1986).

We combine data for IPOs and residential property transactions in California from 1993 through 2017. To control for the housing heterogeneity, we construct hedonic constant-quality home price indexes (HPIs)

[1] PrivCo does market research of private firms and reported on twitter's IPO: `http://www.privco.com/the-twitter-mafia-and-yesterdays-big-irs-payday`.

[2] New York Times, February 20, 2017, "With Snap's I.P.O., Los Angeles Prepares to Embrace New Tech Millionaires," (`https://www.nytimes.com/2017/02/20/technology/snap-ipo-los-angeles-real-estate.html`); and Zillow Blog, "Millionaire's Row: How Did Facebook's IPO Affect Silicon Valley Real Estate?" (`https://www.zillow.com/blog/millionaires-row-how-did-facebooks-ipo-affect-silicon-valley-real-estate-86027/`)

[3] See also San Francisco Business Times, August 16, 2017, "Why 83 percent of Bay Area renters say they plan to leave (`https://www.bizjournals.com/sanfrancisco/news/2017/08/16/why-83-percent-of-bay-area-renters-say-they-plan.html`) and The Economist, August 30, 2018, "Why startups are leaving Silicon Valley" (`https://www.economist.com/leaders/2018/08/30/why-startups-are-leaving-silicon-valley`)

for areas of different proximities to the headquarters of each IPO firm. A monthly HPI is constructed for each IPO event by using the event date as the base date. Using the event-specific HPIs, we exploit both the spatial difference in proximity to IPO firms and the discontinuity in time around IPO events. In this difference-in-differences strategy, the treatment group is housing transactions occurring near the IPO-firm's headquarters and a treatment is an IPO event.

We utilizes original shareholders' housing preferences for the proximity to the firm's headquarters. Anecdotal evidence suggests that managers and key workers of technology firms tend to prefer to live near their companies.[4] Of course, some of original shareholders prefer other residential areas that are distant from their companies. We do not measure the effect of IPOs on these distant locations because it is difficult to identify the remote areas to which managers and workers moved. We also do not measure the effect on commercial real estate due to data availability. There is certainly a separate impact on commercial real estate because zoning restrictions between residential and commercial uses are relatively strict in California. Our data also do not allow us to distinguish whether home buyers are original shareholders or not. There might be speculating buyers who hope to sell houses in the future at higher prices. Thus, our estimate includes both direct and indirect effects of IPOs on housing markets near headquarters.

We first test the hypothesis that IPOs affect local housing markets. Specifically, we estimate the average change in the HPI before and after IPO events for the area around the IPO-firm's headquarters (the treatment area) by controlling for the HPI of the surrounding area in the same zip code or county (the control area). We use 90- and 180-day windows to define pre- and post-event periods and 1-, 5-, and 10-mile radii to define the area around the IPO-firm's headquarters. To ensure the validity of our test result, we also conduct several placebo tests by falsifying the headquarters location and event dates. We also test whether the characteristics of transacted properties change before and after IPO events. Furthermore, we analyze whether the effect is heterogeneous by firm and IPO characteristics, and the IPO performance.

The three types of IPO events are well-defined with explicit dates. When management decides to take the firm public, they file Form S-1 with the SEC that publicizes their intention of pursuing an IPO.[5] Subsequently, the firm issues a combination of primary and secondary shares on a public exchange and the firm's market value is revealed. Many IPOs have a lockup period, during which restricted shares cannot be sold.[6]

We find the statistically significant effect of IPOs on local house prices with varying sizes by event type,

[4] e.g., Business Insider, "Zuckerberg Buys A $7 Million Home Near Facebook's New Campus," `https://www.businessinsider.com/zuckerberg-buys-a-7-million-home-near-facebooks-new-campus-2011-5`; Marcotte Properties, "Where Do Silicon Valley's Tech Workers Really Live?" `https://www.marcotteproperties.com/silicon-valleys-workers-live/`

[5] Under the Securities Act of 1933, Form S-1 registers the securities being offered in an IPO. Emerging growth companies may have the ability to file registration materials confidentially based on the Jumpstart Our Business Startups (JOBs) Act that was enacted April 5th, 2012.

[6] The lockup period acts as a signal of the firm's quality to remedy information asymmetries and price supports by restricting the supply of shares (Brav and Gompers, 2003; Arthurs et al., 2009).

proximity to the firm, and the characteristics of firms and IPOs. The results for Silicon Valley are not significantly different from those for California. Based on the baseline estimation using the county control group, the effect is largest for share issuing events: 3.3%, 1.7%, and 1.3% for a 1-. 5-, and 10-mile radius, respectively, based on the 90-day pre- and post-event windows. This result is consistent when zip code areas are alternatively used as the control group. The monotonic decay by distance is consistent with original shareholders' preferences for proximity although the standard errors are large for a 1-mile radius.[7] The effect is also large for IPO filing events: 2.2%, 1.3%, and 1.6% for a 1-. 5-, and 10-mile radius, respectively. However, the effect of lock-up expiration events is smaller: 0.1%, 1.4%, and 0.8%. These effects based on HPIs are estimated for the houses with the same observed characteristics, but we also confirm that the average characteristics of transacted properties do not significantly change after IPO events.

However, there is a concern that the location near IPO firms' headquarters may have a higher baseline growth rate of house prices regardless of IPOs due to some unobservable factors. For example, IPO firms may have chosen the high-amenity locations that tend to exhibit large property price appreciation. Although firm fixed effects capture unobserved locational heterogeneity in price levels, there may still be heterogeneity in growth rates. When we estimate the HPI premium for the treatment area each month around an IPO event, we observe both a discontinuity around an IPO event and a trend of widening gaps. Thus, we conduct a placebo test by falsifying event dates while maintaining the correct locations.[8] We find the baseline premium in growth rate for the treatment area defined by a 1- to 2-mile radius. This baseline premium is comparable in magnitude to the estimated treatment effect in our main result. However, the baseline premium is significantly smaller (around 0.6%) for a 10-mile area. When we remove the baseline growth rate premium from our main result for a 10-mile area, the average treatment effect is 1.0% for filing and 0.8% for issuing, but approximately zero for lock-up expiration.

This result suggests that original shareholders change their housing demand when their wealth changes but not when liquidity constraint is relaxed. Because the original shareholders cannot cash out their wealth at the time of share issuance or IPO filing, our result suggests that the original shareholders can finance their home purchases based on their illiquid wealth. It is unlikely that arbitrageurs (flippers) with enough liquidity buy houses to make short-term profits because of large housing brokerage fees. Banks in California may not be very restrictive in originating mortgages to entrepreneurs and workers at start-up firms because of their relatively rich experience with this type of consumers. Thus, the result of no liquidity constraint may not extend to other states. For example, in a related study, Hartman-Glaser et al. (2017) use the

[7] Figure A2 depicts the geographical decay.

[8] A related concern is that the price increase after IPO events may not be specific to the location of IPO firm headquarters. We conduct a placebo test by falsifying the location of an IPO firm's headquarters while maintaining the correct event date but do not find a significant change in house prices for the falsified locations.

IPO and housing data for Denver, Colorado, and find a larger treatment effect for the lockup expiration event than for the filing and issuing events. Although this difference between California and Colorado is not conclusive because of differences in data sources and estimation methods, this contrast is very suggestive of the uniqueness of mortgage origination markets in California.

The effect of IPOs on house prices varies by firm and IPO characteristics. The effect is generally larger for younger and smaller firms than for older and larger firms. For example, when firms are younger than the first quartile, there is a 2.8% increase in house price levels around the issuing event, which is 3.8 times the increase for the firms older than the third quartile. This result is consistent with the observation that managers and workers at start-up firms prefer to live closer to the firms. The treatment effect is also positively related with offer price, IPO proceeds, and the degree of underpricing at filing, all of which represent the size of wealth increase by IPOs. The IPOs with secondary share offering and no lockup restriction suggest that original shareholders can monetize their wealth immediately after share issuance. These characteristics are associated with a unique pattern of house prices. Although they are not associated with the price change after IPO events, they are associated with significantly lower house prices during the six-month period around filing and significantly higher prices during the six-month period around issuing. These results are consistent with a possibility that home purchases are delayed until debt financing is available just before share issuance, but micro-level buyer data are needed for a conclusive analysis.

We also examine the relation between the treatment effect and IPO performance as measured by the stock price return over the offer price and its volatility. Based on a 5-mile radius within a 90-day event window, a one-percentage point increase in returns is associated with a 1.4% larger treatment effect around the IPO issuing event and a 0.7% larger effect around the lockup expiration event. This result supports the wealth hypothesis. In contrast, the stock return volatility does not create a significant difference in the treatment effect. However, greater volatility is associated with larger HPIs around headquarters both before and after a lockup expiration date. This finding is consistent with the hypothesis that original shareholders with volatile wealth diversify their portfolios into housing at either filing or issuing.

In summary, the evidence supports an *expectations hypothesis*, in which the original shareholders without liquidity constraints change their demand for housing consumption at the IPO filing event. The evidence also supports a *wealth hypothesis*, in which the original shareholders change their housing demand when their book value of wealth is determined in the stock exchange. However, the evidence does not support a *liquidity hypothesis*, in which the original shareholders change their housing demand only when they can monetize their book wealth. In general, IPOs partly explain the appreciation of local housing prices.

This paper contributes to the literature in two ways. First, to our knowledge, this is the first study that identifies a causal effect of IPOs on local house prices. We demonstrate that positive correlations between

IPOs and home price appreciation cannot be entirely attributed to the causal effect of IPOs. On average, we find a 1% effect of a filing event and a 0.8% effect of a share issuing event; i.e., a 1.8% increase in local house price around IPO firms' headquarters for each IPO. Second, different IPO events provide a unique setting for comparing the impact of wealth and liquidity constraints. Our findings indicate that original shareholders in California shift their housing demand when a future wealth increase is anticipated and when a wealth increase is confirmed regardless of weather wealth is immediately available. This result suggests that personal financing function well for high-wealth individuals in California, allowing them to smooth consumption.

The paper is structured as follows. Section 2 provides institutional background and sets up the hypotheses. There is a discussion about the data and methods in section 3, which includes summary statistics. The main results are presented in section 4. In section 5 the treatment is decomposed at the property transaction level by market segment and composition. Finally, there is a concluding section.

2 Background and Hypothesis Development

Underwriting standards in mortgage lending and credit constraints in home purchasing are explicit and uniformly applied. For example, the down payment constraint also known as loan-to-value (LTV) thresholds limit the amount of a property's sales price that a borrower can finance and impose additional costs for higher LTV loans.[9] Also, the debt-to-income (DTI) restriction limits the amount of outstanding debt that a borrower can have in proportion to their income.

The LTV and DTI constraints are most likely to affect original shareholders. First, original shareholders are unable to use pre-IPO shares and firm equity for a down payment. Second, stock options that compensate original shareholders with equity substitutes for cash compensation. In the case of cash constrained start-ups, they are more likely to compensate employees with stock options where the larger the proportion of compensation to original shareholders is in the form of stock options increases the likelihood of a binding DTI constraint because it lowers the amount of housing services that original shareholders can purchase as a function of their income. As a result, original shareholders are disproportionately likely to be bound by credit constraints that lead them to forego housing consumption today. In addition, to smooth consumption original shareholders are more likely to use their stock options and equity stake as a mechanism to save for a down payment. Therefore, by saving less of their income original shareholders are able to smooth their consumption.

Under the null hypothesis, there is no association between property values and IPOs.

[9]For example, loans with an LTV in excess of 80% are charged private mortgage insurance (PMI) that is added to the monthly mortgage payment as a percentage of the loan amount.

H_0**:** *(Null Hypothesis)* There is no change in property values associated with IPO events.

In this case, the credit constraints are not binding and there is no unexpected changes to the personal wealth of original shareholders that would lead them to change their demand for housing services. If there is evidence of a post-treatment effect then we reject the null hypothesis in favor of the alternative that either there are binding credit constraints or there is an unexpected wealth shock.

In rejecting the null hypothesis in favor of the alternative that IPOs influence local housing markets, there are three mechanisms that may be driving the treatment effect that are not mutually exclusive. These are the *expectations, wealth,* and *liquidity* hypotheses, which closely follow from the sequential events of a completed IPO.

First, a firm declares their intent to go public. The firm is signaling that their IPO is imminent and removing uncertainty about the timing and exit strategy for original shareholders.[10] Using the date when Form S-1 is submitted as the IPO filing event, we define the *expectations hypothesis* as a change in the demand for housing from this updated expectation.

H_1**:** *(Expectations Hypothesis)* There is a change in local property values following the submission of Form S-1.

A change in expectation increases the demand for housing if credit constraints to acquire financing are not binding. In this case, original shareholders can adjust their consumption of housing services even if wealth cannot be immediately monetized.

Second, at the IPO event the firm issues equity and they are listed on an exchange. At this point, any uncertainty around the firm's market value is removed as well as the uncertainty about whether the firm would successfully IPO.

H_2**:** *(Wealth Hypothesis)* There is a change in local property values after the firm's shares are listed on a public exchange when an unexpected change to original shareholders' book value of wealth leads to a change in their demand for housing.

There are two possible reasons for a change in house prices around the issuing event. First, original shareholders changer their housing demand in response to the realization of a wealth shock from the IPO when their book value of wealth is determined in the stock exchange. An unexpected change impacts the consumption and tenure choice of original shareholders in the post-IPO period (Friedman, 1957). Second, if there were binding constraints in the pre-IPO period that no longer bind. For example, if the firm's

[10]If original shareholders consider the present value of the payoff from the IPO as the discounted sum of the probability that the firm IPOs in each period then filing increases the present value of the payoff by significantly reducing the number of discounted periods.

listing occurs at the same time that they make significant changes to the compensation structure for original shareholders. However, original shareholders' wages are unlikely to change around the IPO event and in the presence of a lockup restriction their pre-IPO shares cannot be liquidated to go towards a down payment. Under the *wealth hypothesis* changes in property values around the IPO event are due to unexpected changes in the book value of wealth for unconstrained original shareholders that lead to changes in the demand for housing.

At this point, wealth-constrained original shareholders respond to changes in their illiquid assets whereas liquidity-constrained original shareholders will not (Tobin, 1972). The presence of a lockup restriction may lead original shareholders to be liquidity constrained because they are unable to liquidate their equity position in the firm until the lockup period expires. During this period, which is usually 180 days between the IPO and the expiration of the lockup, original shareholders are restricted from selling and cashing-out their shares. In some cases, there are IPOs that do not have a lockup period but that is not the norm. The lockup period benefits original shareholders by signaling the firm's quality to investors, aligns incentives, and protects underwriters.

However, firms can offer existing "secondary shares" at the IPO from original shareholders to the public in addition to new "primary shares" that allows original shareholders to liquidate their pre-IPO shares at the issuance when a lockup restriction is present. In this case, the lockup restriction does not apply to this subset of original shareholders. In Chua and Nasser (2016) does find that original shareholders are motivated to offer secondary shares by apparent liquidity needs. For example, smaller cash-pay is associated with larger secondary offerings. However, secondary shares are viewed negatively by investors and Aggarwal et al. (2002) demonstrate that it is optimal for managers to wait for the end of the lockup. Therefore, the majority of firms do not offer secondary shares and when they do it tends to be only a small proportion of original shareholders that have this opportunity (Field and Hanka, 2001).

Third, the lockup event occurs when the limits on original shareholders' trading restricted shares expires.[11] To restricted shareholders, the only difference between immediately before and immediately after the lockup expiration is their ability to liquidate their restricted shares. Under the *liquidity hypothesis* there is a change in the demand for owner-occupied housing following the expiration of the lockup restriction when liquidity constrained original shareholders are no longer subjected to binding credit constraints.

H_3**:** *(Liquidity Hypothesis)* Higher property values follow the expiration of the lockup period.

We assume that the wealth associated with the restricted shares is either not fungible or is costly to access. However, there is a concern that the lockup event is associated with additional potentially confounding

[11] When more than one lockup expiration date appears in the IPO data from SDC the first incidence is considered as the lockup expiration date for that IPO.

treatment effects. For example, Field and Hanka (2001) find an abnormal three-day return of -1.5% from looking at the returns around lockup expiration events. Therefore, changes to original shareholders' wealth consistent with an abnormal negative return around the lockup expiration only biases against finding evidence supporting the *liquidity hypothesis*.

The lockup period acts as a triggering event similarly to the down payment requirement. Artle and Varaiya (1978) show how down payments deter home ownership when the benefits from ownership do not exceed the loss in utility from having to save. Therefore, individuals make tenure choices as soon as they reach the down payment threshold associated with their demand for housing consumption where the down payment acts as a triggering event. Similarly, when original shareholders are liquidity constrained such that credit constraints are binding then they are unable to fulfill their demand for housing services until the lockup expires, which then acts as a trigger event. The question about the magnitude and significance of the impact on local housing markets is an empirical one.

3 Methodology and Data

We follow a hedonic approach for modeling house prices to test for an association between IPOs and local house price changes. Rosen (1974) is credited with developing the hedonic price method that assumes property values can be regarded as the sum of implicit prices of a bundle of attributes in equilibrium. It is a common method applied in housing related research.

However, there is an omitted variable concern when prices and implicit goods are determined in a spatial equilibrium. In this case, if the choice of the firm's location correlates with the timing of the IPO; if the timing of the IPO correlates with local housing market cycles; or they both correlate with an unobserved omitted variable then the estimates for treatment will be biased.

Our main concern is that the timing of an IPO and the location of the firm are choice variables that are endogenous. In Brau and Fawcett (2006) they survey chief financial officers (CFOs) and find that creating shares for acquisitions is the most important motivating factor for going public where the overall stock market and industry performance are the largest determinants of IPO timing. Therefore, IPOs are not timed in coordination with house prices directly but the determinants of IPO timing may still correlate with an omitted variable that correlates with local property values.

To deal with this problem, we exploit spatial-temporal variation of IPOs. The approach is similar to Pope and Pope (2015) that looks at Walmart openings and compares transactions that are closer to a Walmart to those slightly farther away before and after it opens. Other studies with similar designs have looked at the impacts of sex offenders (Pope, 2008), the spillover effects associated with foreclosures (Gerardi et al., 2015;

Lin et al., 2009; Schuetz et al., 2008), and forced sales (Campbell et al., 2011). In our case, we construct IPO specific house price indexes that capture the trend of house prices on the treated population around the firm's headquarters and then control for general house price trends with the complementing county level HPI.

This difference-in-differences approach requires two assumptions for a causal interpretation of the results. First, original shareholders are assumed to value proximity to the firm's headquarters, ceteris paribus. As long as they place some cost on the time they spend commuting and there is an association between distance and commuting time this assumption holds. Second, we attribute changes in house prices levels right before and right after an IPO event to the IPO event itself. By only including transactions that occur around the IPO event date being considered and within 5 miles of the firm's headquarters limits the possibility of confounding events. This approach controls for the trend in house prices and time invariant omitted variables related to the firm's location.

Also, we consider each IPO as three separate event studies corresponding to the sequential events of a completed IPO. In this way, the IPO events being considered do not occur simultaneously with the decision to go public. Instead the time between the decision to go public and the each IPO event varies by event and by firm. For example, the length of time between the filing event and issuance depends on the length of time that managers spend with underwriters on the road show gauging investor interest. Then after the firm is listed, the time between IPO issuance and the expiration of the lockup period is generally 180 days, which is defined by institutional convention and not from any consideration of local house prices. As a result, the length of time between IPO filing and the expiration of the lockup period can span years and there is no indication that IPOs are timed with the local housing cycle over the course of the IPO events. Therefore, it is assumed that IPO events are exogenous shocks to the local housing market.

3.1 Data and Summary Statistics

Transaction Level Data

We use Zillow residential property level data for California. It is the product of merging their transaction and property assessment files. In the raw file there are 12.8 million transactions with 99% falling between 1993 and 2017. The observations are cleaned on missing and unwanted or unreasonable property characteristics. For example, intra-family transactions are excluded. Also, properties are filtered by property type, the number of parcels, and the number of buildings. We restrict the sample to single parcels where there is only one building and include property types: residential general, single family or inferred single family, rural residence, townhouse, row house, planned unit development, and bungalow. The final sample consists

of properties that: have at least one full bathroom and at least one bedroom, non-negative property age and less than or equal to 150 years old, non-missing sales price greater than or equal to $1,000, not more than four units, non-missing latitude and longitude, non-missing land size strictly greater than 500 square feet, and non-missing number of stories less than or equal to three. The final sample has around 6.5 million unique property transactions from 1993 to 2017.

Initial Public Offering (IPO) Data

From SDC, we obtain 1,987 unique IPOs for California from 1970 through 2017.[12] This list of IPOs is filtered for missing address information, when a P.O. Box is listed as the firm's address, and when geocoding returns a less than to the street address level accurate longitude and latitude.[13] Ultimately, the final sample includes 725 IPOs from California with an IPO event between 1993 and 2017.

We summplement the IPO data from SDC with data from CRSP and from data available from Ritter.[14] From CRSP, we obtain the daily open and closing stock prices, returns with and without dividends, the number of shares outstanding, and the volume of shares traded. From Ritter, we obtain the firm's founding year and rollup status.[15] From the 725 unique IPOs: there are 224 firms that offer secondary shares at the IPO; 447 that are identified as being backed by venture capital; 71 where the IPO issue is backed by private equity; and 16 identified as being rollup firms.

Summary Statistics

Table 1 summarizes the distribution of transactions and IPOs by year and by IPO event. It does appear that the IPOs come in waves with the most filings in 1999 at the peak of the dot-com bubble and smaller waves around 2004 and then again around 2014. Therefore, our period of analysis covers multiple cycles and market environments including the financial crisis period.

Descriptive statistics are provided in Table 2 at the property and firm level. Panel A summarizes the transacted properties where the average sales price over this period is $335,145. After adjusting for inflation the average adjusted sales price over this period is $415,363.[16] For the analyses, the adjusted sales prices are used to generate the results althought they are robust to using the raw sales price. In terms of property characteristics, there are large standard deviations but they are inline with similar studies.

Panel B summarizes the sample of IPOs where the average target price is $12.99 per share with a max

[12] See figure A1 of the appendix for a comprehensive summary of the SDC IPO search criteria.
[13] The Google maps geocoding API was used to return longitude and latitude of the firm's listed address.
[14] The Field-Ritter data on IPOs was downloaded (10/21/2017) from: `https://site.warrington.ufl.edu/ritter/ipo-data/`
[15] A rollup is a firm that grows by acquiring other firms.
[16] Sales prices are adjusted by finding the 05/2017 dollar equivalent according to the monthly Consumer Price Index (CPI) for All Urban Consumers: All Items from `https://fred.stlouisfed.org/series/CPIAUCSL` (downloaded 7/19/2017).

of $97.00 and average proceeds from the IPOs of roughly $131 million. There is a lot of variation within IPO and firm level characteristics exhibited by the large ranges and standard deviations. For example, the average for total assets is $224.24 million where the minimum is $0.10 million and the maximum is $7,190 million for the largest firm by total assets. We will exploit the variation in firm and IPO characteristics in robustness tests to further examine the relationship between IPOs and local house prices. Specifically, we focus on the variation in firm age, total assets, offer type, offer price, IPO proceeds, IPO underpricing, and the firm's stock performance post-IPO.

Panels C and D provide additional summary information about the performance of the IPO. The average return at 1 year from the IPO is 25.47% with a minimum return of -227.78% and a maximum of 740.83%. Here the firm's return is calculated as the percentage change from the offer price to the closing price on the date considered (i.e. 1 year following IPO) and the displayed average return is the simple average across the firm's. To quantify the risk associated with the IPO, we calculate the relative volatility for each firm's stock post-IPO as the standard deviation of daily closing prices divided by the average of closing prices for the period.

Event Level Statistics

Table 3 shows mean differences in adjusted sales prices of transactions in a pre or a post-period by event type and across distances of 1, 5, and 10 miles from the IPO firm's headquarters. Specifically, transactions are identified as occurring in a pre or post event window if they are within a specified radius of a firm's headquarters (1, 5, or 10 miles) and the sales date for the property is within 90 days of that firm's IPO event. For example, for Facebook's IPO case, we define a 5-mile radius from Facebook's headquarters and identify property transactions that occurred within 90 days before and after Facebook's IPO filing event (Figure 3). We repeat this procedure for each IPO firm (e.g., Figures 4 and 5). It is possible that a transaction will be included in the pre-period for one IPO and the post or treatment period for another. For this table, we only include those observations that are in one pre-period or one post-period window by event type for a clean interpretation of treatment. For example, a transaction that appears in the pre-lockup expiration period for XYZ and the post-lockup expiration period for another IPO is excluded from this table summary of the lockup event. Instead the main results are based on house price indexes that are generated at the firm event level where overlapping observations are not excluded.

In Table 3 the post-filing prices are consistently higher than the corresponding pre-filing prices or roughly a 3.7% increase in unconditional mean at 1 mile, which falls to 2.8% and 1.3% at 5 miles and 10 miles respectively. The lockup expiration event shows a consistent negative price change in local house prices across the distances with the largest decrease or -6.5% at 1 mile around the firm. The change around the

issue date varies from negative at 1 mile and 10 miles but is positive at 5 miles. The largest magnitude of price change around the issue date is -2.4% within a 1 mile distance boundary from the firm. To control for differences in the composition of properties transacted and trends in house prices in the pre versus post-period by IPO event additional analysis is necessary.

4 Constructing the IPO Event HPIs

We construct by firm (f) by event (e) level house price indexes (HPI_{fetd}). These house price indexes by firm and by IPO event are generated following the time dummy approach and only those observations identified in the firm's pre or post-period by IPO event are included. It is a log-linear specification that includes controls for property characteristics (X_i) and time dummies that are defined in event time:

$$ln(P_{it}) \quad = \quad \beta_0 + uX_i + \sum_{t=1}^{5} \delta_t T_{it} + \varepsilon_{it}. \tag{1}$$

The dependent variable is the natural log of the adjusted sales price (P_i) for property i and the time dummies (T_{it}) specify 30 day buckets from the IPO event. The property level controls (X_i) capture observable differences due to: land sf, total number of rooms, number of bedrooms, number of full bathrooms, number of half bathrooms, age, the number of stories, property type, and county fixed effects. Because IPO events do not coincide with calender dates, we impose an event time and bucket transactions into 30 day intervals from the IPO event date. Therefore, the coefficient estimates over time ($\hat{\delta}_t$) give the variation in house price levels over time relative to the base period, which is -90 to -60 days from the IPO event. This base model is estimated for each firm (f) and IPO event (e) to construct firm event level house price indexes ($HPI_{fetd} = 100 \cdot exp(\hat{\delta}_t)$) by distance ($d$) from the firm.

In addition, we generate the complementing HPI or comparable county level house price indexes by firm by event (HPI^c_{fetd}). The county level HPIs are unique to each firm (f), event (e), and boundary specification (d) so as to be consistent with the firm event level house price indexes (HPI_{fetd}). The county level HPI is defined as the complement of the transactions that are used in the construction of the firm event level HPI (HPI_{fetd}). For example, the county level HPI for IPO XYZ's filing event includes the transactions not included in the sample used to generate XYZ's filing event HPI but that are in the same counties and over the same pre and post-period.

We first present the main result for the average treatment effect on the treated followed by several robustness checks. We then expand on the base model and test for an association between treatment and firm characteristics, IPO characteristics, and IPO performance.

4.1 Main Result

To identify the conditional average treatment effect on the treated, we estimate the following base model by IPO event:

$$HPI_{fetd} = \beta_0 + \beta_1 Post_{fe} + \beta_2 HPI^c_{fetd} + \eta_f + \varepsilon_{fet} \tag{2}$$

The left-hand variable (HPI_{fetd}) gives the time series of house price levels over the performance window. When the performance window is defined at ±90 days and the HPI is defined at 30 day intervals then there are 6 observations or house price levels per firm event. The dummy variable $Post_{fe}$ identifies the post-period by firm (f) and event (e). Including the county level HPI complement (HPI^c_{fetd}) controls for house price trends and the fact that the IPO events across firms do not occur simultaneously reduces the concerns of confounding events. Also, firm fixed effects (η_f) are included to control for firm level variation.

Table 4 displays the base model results by IPO events at 1, 5, and 10 mile boundary specifications. According to the adjusted R-squared, the base model explains a significant amount of the variation in house price levels around a firm's headquarters around IPO events. The variable of interest, in this case, is the post-period indicator that identifies the treated population of transactions occurring in the post-period. Across the IPO events the coefficient estimate for the post-indicator for treatment is positive and tends to be statistically significant at the 1% level. There is a 1.3% increase at 5 miles associated with the post-period compared to the pre-period following the filing event that is statistically significant at the 1% level. The strongest magnitude appears after the issue date within 1 mile where there is a roughly 3.3% increase in the 3 months following the issuing date. Also, the treatment effect is monotonically decreasing with increasing distance or 1.7 and 1.3 at 5 and 10 miles respectively. Around the lockup expiration event, the treatment effect of post-lockup restrictions is 1.4% at 5 miles and 0.8% at 10 miles with the 1% significance level.

Thus, we fail to reject the null hypothesis as the results from the base model specification are consistent with the alternative hypotheses of changing expectations following the filing event, a wealth shock present around the issuing event, and the removal of a liquidity constraint around the expiration of the lockup restriction.

4.1.1 Tests for Changes in Transaction Characteristics

Since our main result is based on quality-controlled house price index, our estimates are not influenced by potential changes in the average transaction characteristics before and after an IPO event. However, potential changes in the average characteristics of house transactions are important when we are concerned about the aggregate impact of IPOs. For example, if the average size of traded properties is larger in the

post-period, there is an additional composition effect of IPOs on housing markets.

Following Pope and Pope (2015), we estimate the following model to test for changes in the composition of transacted properties in the housing market from the pre to the post-period.

$$PropChar_{if} = \beta_0 + \beta_1 Post_{if} + cnty_i + \eta_f + \varepsilon_{if} \quad (3)$$

We examine the treatment effect on the property characteristics ($PropChar_{if}$) including ln(finished sf), stories, total rooms, number of bedrooms, number of full and half bathrooms, and age. Firm and county fixed effects control for the spatial and temporal variation by IPO event and the errors are clustered at the firm level. Table 5 shows the result. We conclude that there is not a significant change in the composition of properties being transacted after an IPO event for all event types. Only age is significant but we do expect the population of post-period properties to be older from the event study design being in time.

4.1.2 Robustness Check by Zip-Code Control Area

As a robustness check, we estimate Equation (2) by defining the control area by zip code. Table 6 displays the result. The result is qualitatively consistent with the main result. The estimated coefficients on Post Event Date are statistically significant for all IPO events and the treatment area size. For example, the HPI for the treatment area defined by 10 mile boundary is 1.7% higher after IPO filing, 1.9% higher after issuing, and 1.3% higher after lockup expiration than the HPI for the control area in the same county.

4.1.3 Robustness Check by Transaction-Level Data

As a robustness check, we estimate the base model at the property transaction level. We use the observations that appear only in a single pre- or post-period window to remove the effect of overlapping multiple events.

$$ln(P_{if}) = \beta_0 + \beta_1 Post_{if} + \beta_2 HPI^c_{fetd} + uX_i + \eta_f + \varepsilon_{if} \quad (4)$$

The dependent variable is the natural log of the adjusted sales price (P_{if}) for property i that falls in the IPO event window for firm f. Equation (4) includes covariates for property characteristics (X_i), firm fixed effects (η_f), and the firm event HPI county complement (HPI^c_{fetd}).[17] The transaction-level result shown in Table A1 is consistent with the main result.

[17]The controls for property characteristics (X_i) include: land sf, total number of rooms, number of bedrooms, number of full bathrooms, number of half bathrooms, age, the number of stories, property types, and county.

4.1.4 Robustness Check by Monthly Estimates

The main result is based on the average HPI during the 90-day post event period compared with the base HPI measured at 90 days before the event. However, there may be gradual or non-monotonic price changes around an event date because of information spillover or other factors affecting the market microstructure. Thus, we estimate the monthly difference in HPIs between the treatment and control areas. Figure 6 depicts the estimation result.

We confirm that the house price premium for the treatment area significant increases at the event date. For filing events, the house price premium is not significantly different from zero before the event date based on two standard deviations. However, the premium becomes statistically significant after the event date. We also find the same result for issuing events and lockup expiration events.

At the same time, we also observe gradual increase in home price premia before and after the event date. Unlike in a liquid and informationally efficient financial market, a gradual drift after an event is not inconsistent with the treatment effect of an event in a housing market. For example, the original shareholders may not be able to purchase a house at an event because it may take several months to find the best suited house in housing markets. Furthermore, arranging a mortgage and making a purchase agreement usually takes additional time. The price may also drift up before an event if the IPO event is highly anticipated. As an anticipated IPO event approach, banks may become more willing to originate mortgages to the original shareholders. Alternatively, there may be housing speculators who purchase houses in anticipation of a future IPO event.

However, it is also possible that there is an unobserved difference in the growth condition of housing markets between the treatment and control areas. For example, headquarters locations may have high urban amenities and attract more wealthy residents regardless of IPO events. Alternatively, an IPO firm is located in the area where housing demand is rapidly growing because of high amenities. To address this possibility, we conduct several placebo tests. We report the result in the next section.

4.1.5 Robustness Check by Placebo Tests

We conduct placebo (falsification) tests to address the following concerns. First, unobserved housing market conditions may generate different baseline growth in house prices around headquarters locations. Second, the management choice may be endogenous as to when they pursue an IPO and where they locate the firm's headquarters.

We run two types of placebo tests. First, we estimate equation (2) for the firm's true headquarters location but at incorrect event dates through time or by pseudo-random date assignment. Then, we compare

the falsified estimation results with our primary results based on the true IPO event dates. Second, we randomly assign the latitude and longitude of the firm's headquarters and estimate equation (2). Then, we similarly compare the falsified estimation results with our primary results based on the true headquarters locations. The detail of the falsification procedure is described in Appendix B.

Figure 7 depicts the result of the first type of placebo tests based on 90-day windows around falsified event dates. Each panel shows the treatment effect with two-standard-error bands for the true event date (at the value of 0 on the horizontal axis) and for falsified event dates (from -730 days before the true event date to 730 days after the date).

For filing, the true treatment effect for a 10 mile boundary is clearly larger than the effects around falsified dates. The average treatment effect for falsified event dates is 0.59% whereas the true effect is 1.59%. The 1.00% difference is sufficiently large relative to the average of standard errors (0.18). Thus, although there seem to be a baseline difference in home price growth rates between the headquarters location and other ares, a large deviation in home price growth occurs only around the true IPO filing date.

Similarly, for share issuing, the treatment effect at the true event date is 0.76 points larger than the baseline premium in home price growth rates. However, the difference is not large for lockup expiration. Table 7 shows the result for other sizes of the treatment area. The true treatment effect is significantly larger than the baseline premium only for 3 miles or more around issue dates and for 10 miles around filed dates. The effect of lockup expiration is also generally larger than the baseline premium, but the additional increase in house price is not large. Thus, we can conclude that IPO filing and issuance affect the surrounding housing market of a 10-mile radius by 1% and 0.8%, respectively. However, IPO lockup expiration does not significantly impact the housing market in California.

Table 8 shows the result of the placebo test by 20 falsified headquarters locations. The average treatment effect for falsified locations is not statistically significant relative to the standard deviation for any IPO event and any boundary distance. For example, based on a 10-mile boundary, the average estimate for 20 locations is 1.43% for filing whereas the standard deviation of estimates is 1.65%.

4.2 Variation By Firm Characteristics

In terms of firm characteristics, firm age is a likely proxy for growth and time at the headquarters while total assets is a proxy of firm size. For example, growth firms can be cash constrained and thus rely more heavily on stock options to compensate original shareholders. Because firm level characteristics may not be linearly related with the treatment effect, we sort the firms into buckets by quartiles of the characteristic of interest and estimate the base model (2) for each bucket. We demonstrate the results for a boundary

specification of 5 miles.[18]

(Firm Age) Table 9 shows the coefficient estimates of treatment by firm age quartile by event where firm age is defined as the difference between the founding year and issue year.[19] The coefficient estimate for treatment is consistently positive across the events and tend to be statistically significant. The youngest quartile of firms exhibits the largest magnitude coefficient estimates of treatment across the IPO events or 1.8% increase following the filing date, 2.8 after issuance, and 2.1 after the lockup expires where these estimates are significant at the 1% level. Therefore, firm age is correlated with the treatment effect and explains additional variation in house price levels.

(Total Assets) Firms are sorted into quartiles by their total assets where the firm's total assets is measured prior to going public. Table 10 gives the estimates of treatment by total asset quartile where the association between firm size and the treatment effect is mixed.[20] Smaller firms appear to exhibit larger magnitude treatment effects. Around the issuing date the lowest quartile exhibits the highest post-period level change of 2.2%. One concern is that firm size is only loosely associated with the size of the firm's headquarters. For example, larger firm's may be more likely to have offices spread across regions.

4.3 Variation By IPO Characteristics

The characteristics of the IPO are associated with the size of wealth shocks to original shareholders and the extent to which original shareholders are liquidity constrained. First, we proxy the magnitude of wealth shocks by using the amount of proceeds, offer price, and the degree of underpricing at issuance. Second, we examine the degree of liquidity constraint by identifying whether an IPO involves secondary share offerings and lockup restrictions. Our sample of 725 unique IPOs includes 152 IPOs without a lockup period and 224 IPOs with secondary shares offerings. Original shareholders are not subjected to liquidity constraint at share issuance if no lockup restriction is imposed or their secondary shares are offered (Chua and Nasser, 2016).

(Proceeds) We predict that larger IPOs by total proceeds will be associated with larger treatment effects similar to the expectation that larger firms by total assets would have a greater impact on the local housing market. We construct subsamples by quartiles of IPO proceeds and estimate the base model (equation (2)) separately for each subsample. Table 11 displays coefficient estimates of the treatment effect when the IPOs are sorted into quartiles by total IPO proceeds.[21] A positive relation between proceeds and the treatment effect is strongest for the filing event. The treatment effect is 1.8% and statistically significant at the 1%

[18] Results at 1 and 10 miles are consistent with those at 5 miles and are available by request.
[19] See Figure A3 in the appendix for a graphical representation.
[20] See Figure A4 in the appendix for a graphical representation.
[21] See Figure A5 in the appendix for a graphical representation.

level for the largest quartile of IPOs by proceeds. However, the relation is not monotonic for the issuing and lockup expiration events.

(Offer Price) Fernando et al. (2004) suggest that the offer price is informative and is associated with institutional investment, underwriter reputation, and the mortality rates of firms. We construct subsamples by quartiles of offer prices and estimate the base model for each subsample. Table 12 shows heterogeneous results in the association between offer price, the treatment effect, and IPO events.[22] For example, the offer price and the treatment effect is positively related and increasing over the quartiles for the filing date. The top quartile exhibits the largest magnitude of 1.8% and is significant at the 1% level. Similarly, for issuing event, the treatment effect tends to be larger for larger offer prices. In contrast, the relation is opposite for the lockup expiration; the treatment effect is larger for smaller offer prices.

(Underpricing) We define underpricing as the ex post percentage increase from the offer price to the closing price on the issue date. Thus, the larger the underpricing, the larger the realized gain from the IPO to original shareholders. Table 13 displays coefficient estimates of the treatment effect when firms are bucketed into quartiles by IPO underpricing.[23] For all three types of events, there is a U-shaped pattern in the relation between the treatment effect and the degree of underpricing. For the filing and issuing events, the treatment effect is largest for the IPOs with a largest degree of underpricing (1.9% and 2.5% for filing and issuing, respectively). For the lockup event, there is insufficient evidence of the relation between underpricing and the treatment effect.

To examine the variation by secondary share offerings and lockup restrictions, we estimate the following variation of the base model that includes indicators for the presence of secondary shares and a lockup restriction. In addition, these indicators are interacted with the indicator of treatment to give the differential treatment effect.

$$\begin{aligned} HPI_{fetd} &= \beta_0 + \beta_1 Post_{fe} \\ &\quad + \beta_2 (Post_{fe} \cdot SecShrs_f) + \beta_3 SecShrs_f \\ &\quad + \beta_4 (Post_{fe} \cdot NoLockup_f) + \beta_5 NoLockup_f \\ &\quad + \beta_6 HPI^c_{fetd} + \eta_f + \varepsilon_{fet} \end{aligned} \tag{5}$$

The HPI complement (HPI^c_{fetd}) and firm fixed effects are included as controls with the displayed standard errors are clustered at the firm level.[24]

(Secondary Shares) Table 14 shows the results from equation (5) where the main effect for secondary shares is consistently significant at the 1% level. The coefficient estimate is negative around the filing date and positive around the issuing and lockup events. This pattern is consistent with original shareholders

[22] See Figure A6 in the appendix for a graphical representation.
[23] See Figure A7 in the appendix for a graphical representation.
[24] Results at 1 and 10 miles are consistent with those at 5 miles and are available by request.

opting out of the market in anticipation of the IPO similar to Ashenfelter's Dip where updated expectations are associated with a pre-treatment treatment effect.[25] However, the coefficient estimates for the interaction term are not significant across the IPO events, indicating that secondary shares make no additional change in house prices after IPO events. These results can be explained if original shareholders with secondary shares delay their home purchases until a few months before the issue date when they can arrange debt financing. More micro-level analysis is called for to test whether this hypothesis is true.

(Lockup Restriction) When there is no lockup restriction, original shareholders are free to liquidate their holdings immediately following the share issuance. Similar to the main coefficient estimates for the secondary share indicator, the main effect of no lockup period is significant at the 1% level and changes from -5.9% at filing to 3.7% at issuance. The interaction term between the indicators for post event date and for no lockup period is 1.4% for filing. This result is also consistent with delayed home purchases with debt finance until several months before issuance.

4.4 By Performance: Returns and Volatility

We measure post-IPO performance by the firm's stock return and volatility. Larger returns increase the original shareholders' wealth whereas larger volatility may increase the early exercise of employee stock options (ESOs) (Huddart, 1994; Kulatilaka and Marcus, 1994; Huddart and Lang, 1996). We estimate the following IPO performance model that incorporates event specific returns and volatility to test whether the treatment effect significantly differs by the firm's post-IPO performance.

$$\begin{aligned} HPI_{fetd} &= \beta_0 + \beta_1 Post_{fe} \\ &\quad + \beta_2(Post_{fe} \cdot Return_{fe}) + \beta_3 Return_{fe} \\ &\quad + \beta_4(Post_{fe} \cdot RelVolatility_{fe}) + \beta_5 RelVolatility_{fe} \\ &\quad + \beta_6 HPI^c_{fetd} + \eta_f + \varepsilon_{fet}. \end{aligned} \tag{6}$$

The return ($Return_{fe}$) is defined as the percentage change from the offer price for firm (f) to the closing price for the issuing and lockup expiration event dates (e). For the issue date the return is synonymous with IPO underpricing. For firm risk, relative volatility ($RelVolatility_{fe}$) is intended to proxy for the risk of holding the firm's stock post-IPO and is defined as the standard deviation, σ_{fe}, of daily closing prices divided by the mean of daily closing prices,μ_{fe}, for firm (f) up to and including the close of the event date (e). A higher ratio indicates larger variability in closing prices and vice versa. Table 15 displays the estimation results for equation (6) for a 5-mile radius.

(Returns) A 1 percentage point increase in the return to the closing price at issuance is associated with

[25] Ashenfelter (1978) identified pre-treatment wage trends in employment and training programs.

a 1.4% larger treatment effect at the 1% level. Similarly, a 1 percentage point increase in the return to the closing price on the lockup expiration date is associated with a 0.7% larger treatment effect at the 5% level. Because returns proxy for the wealth effect from the firm going public, a larger treatment effect supports the *wealth hypothesis*.

(Volatility) The difference by relative volatility is marginal. The difference in the treatment effect (i.e., the estimated coefficients on the interaction terms with Post) is not statistically significant for both the issue and lockup expiration dates. The main effect of volatility is positive during a 6-month period around the lockup expiration date (0.015), which can be consistent with the hypothesis that risk-averse original shareholders diversify their portfolios into housing. However, this is possible only if original shareholders can finance their home purchases a few months before the lockup expiration date.

5 Conclusion

In this paper, we combine IPO and residential property transaction data for California from 1993 through 2017 and: (1) test for an association between IPOs and local house prices; (2) compare and contrast the different IPO events; (3) test for an association between IPOs and changes in the composition of residential properties being transacted by looking at property characteristics and market segment; and (4) test for an association between firm characteristics that includes IPO performance and house prices.

We find evidence consistent with there being a positive and significant association between local house price changes and firms going public. The evidence is consistent with the three non-mutually exclusive hypotheses for how IPOs impact local property values. There is support for the *expectations hypothesis* where original shareholders that are not liquidity constrained respond to changes for their demand for housing consumption from updated expectations around the IPO filing event. Also, for the *wealth hypothesis* or a positive change in property values when the IPO is issued. Finally, there is evidence supporting the *liquidity hypothesis* of a positive change following the expiration of the lockup restriction but there is heterogeneity in the treatment effect depending on firm characteristics and the performance of the IPO. We conclude that IPOs are associated with price changes to local property markets that are in part due to the presence of credit constraints in housing.

This study uses the setting of IPOs as a natural experiment to highlight credit constraints in mortgage lending that are binding for a segment of original shareholders and pre-IPO shareholders. Our results are preliminary and more studies are needed. This paper informs on the role entrepreneurs play in the demand and consumption of housing services and how completed IPOs impact local house prices. In addition, the sequential events of the IPO provides a natural experiment to deconstruct an overall effect, in this case a

wealth shock to original shareholders, into changes in expectation, wealth, and liquidity in the presence of mortgage lending constraints.

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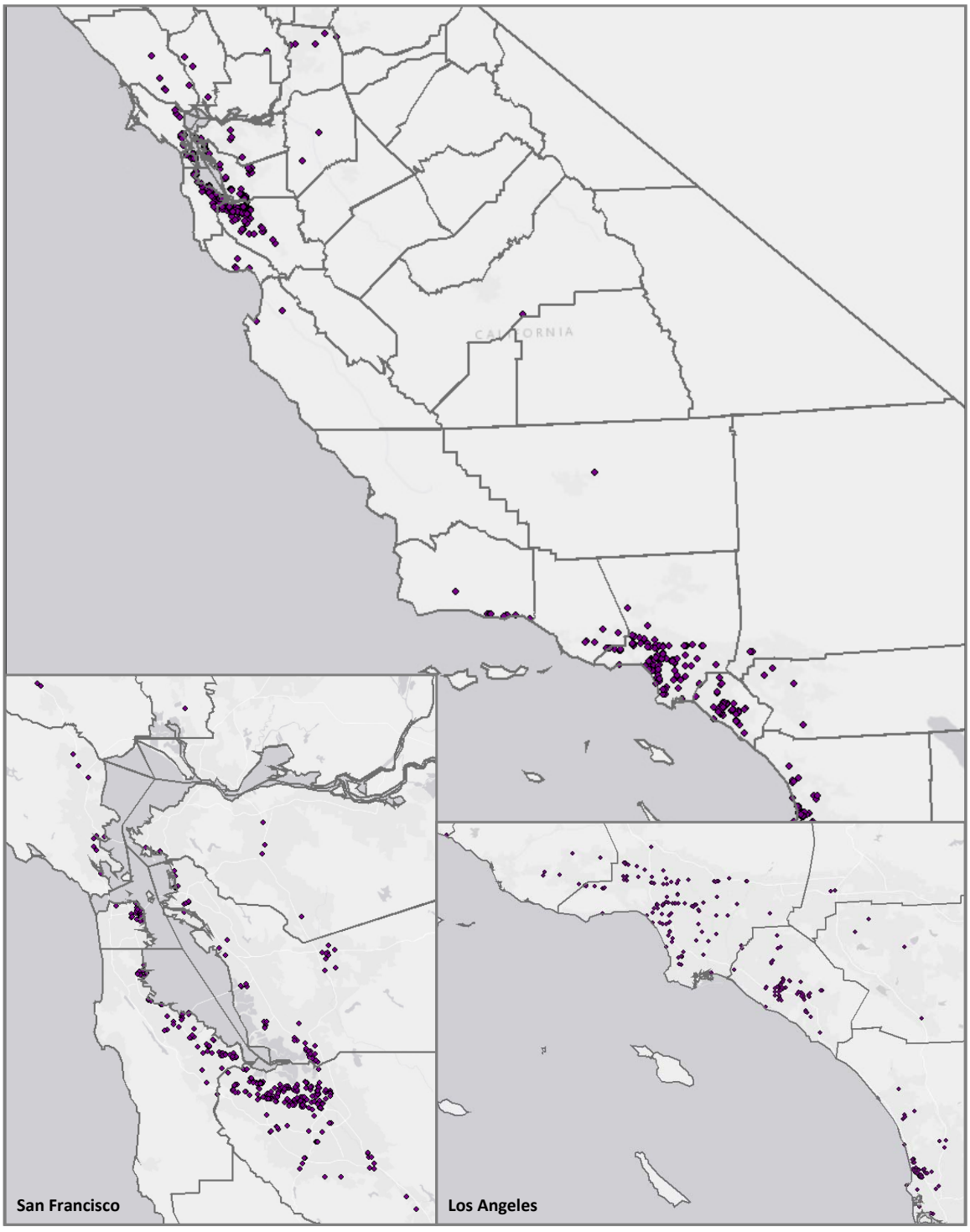
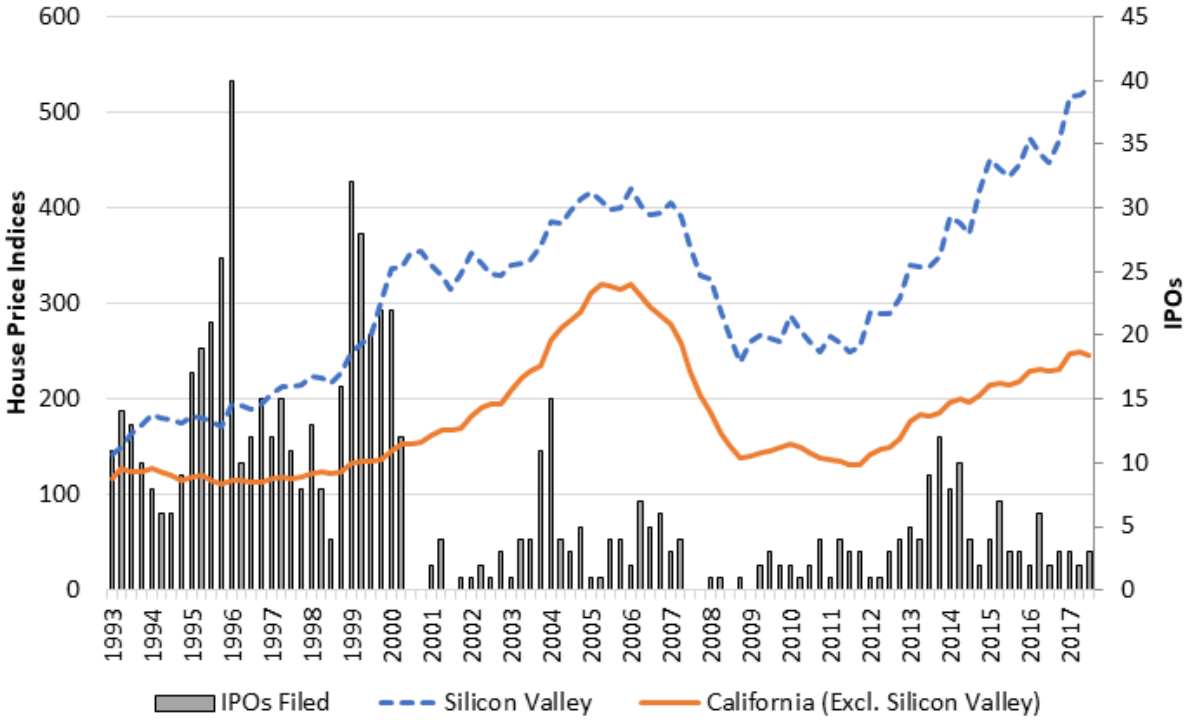
Figure 1. California IPOs from 1993 to 2017



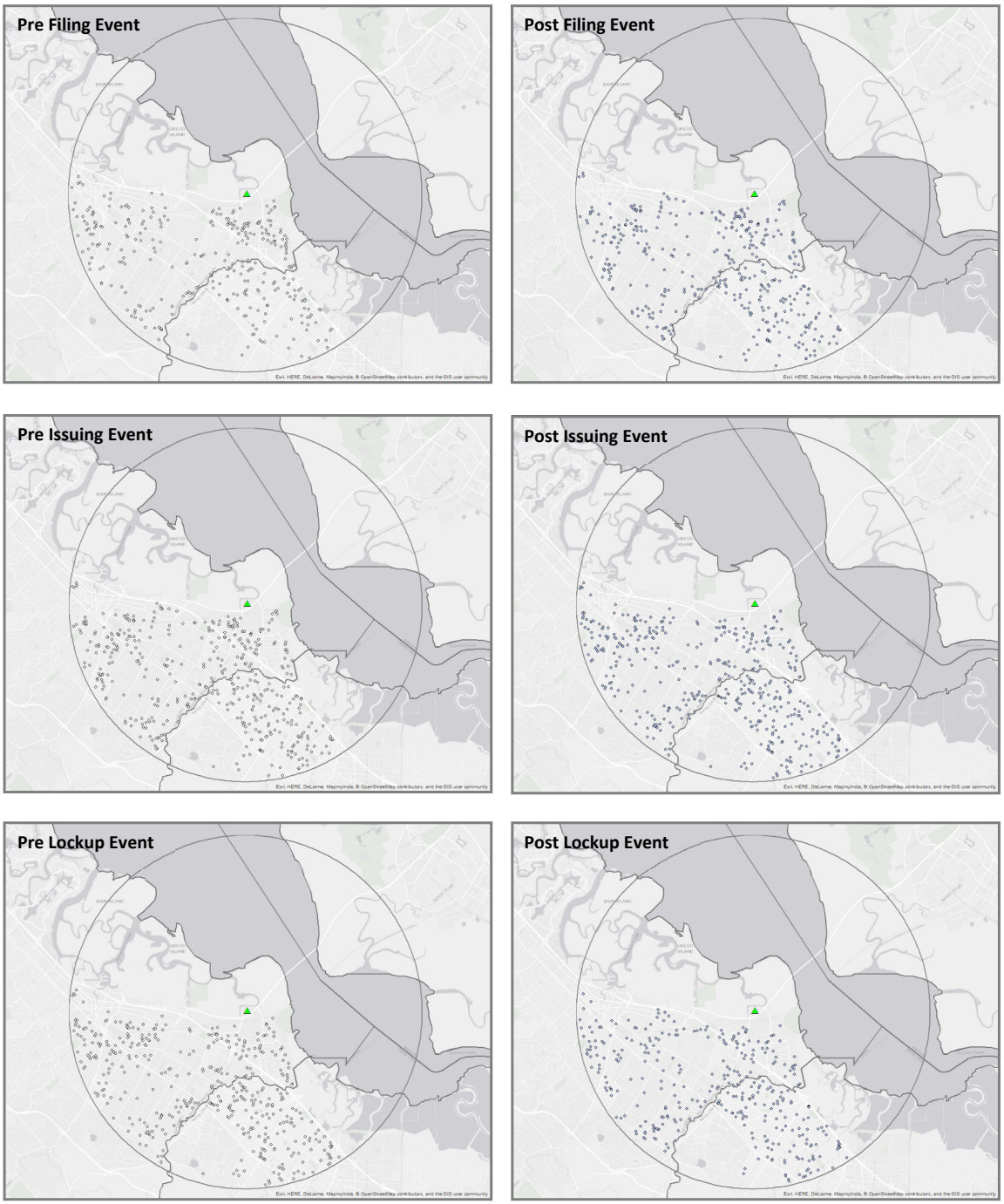
Displayed are the headquarter locations of firms that initiated IPOs between 1993 and 2017.

Figure 2. Number of IPOs and California House Prices from 1993 to 2017



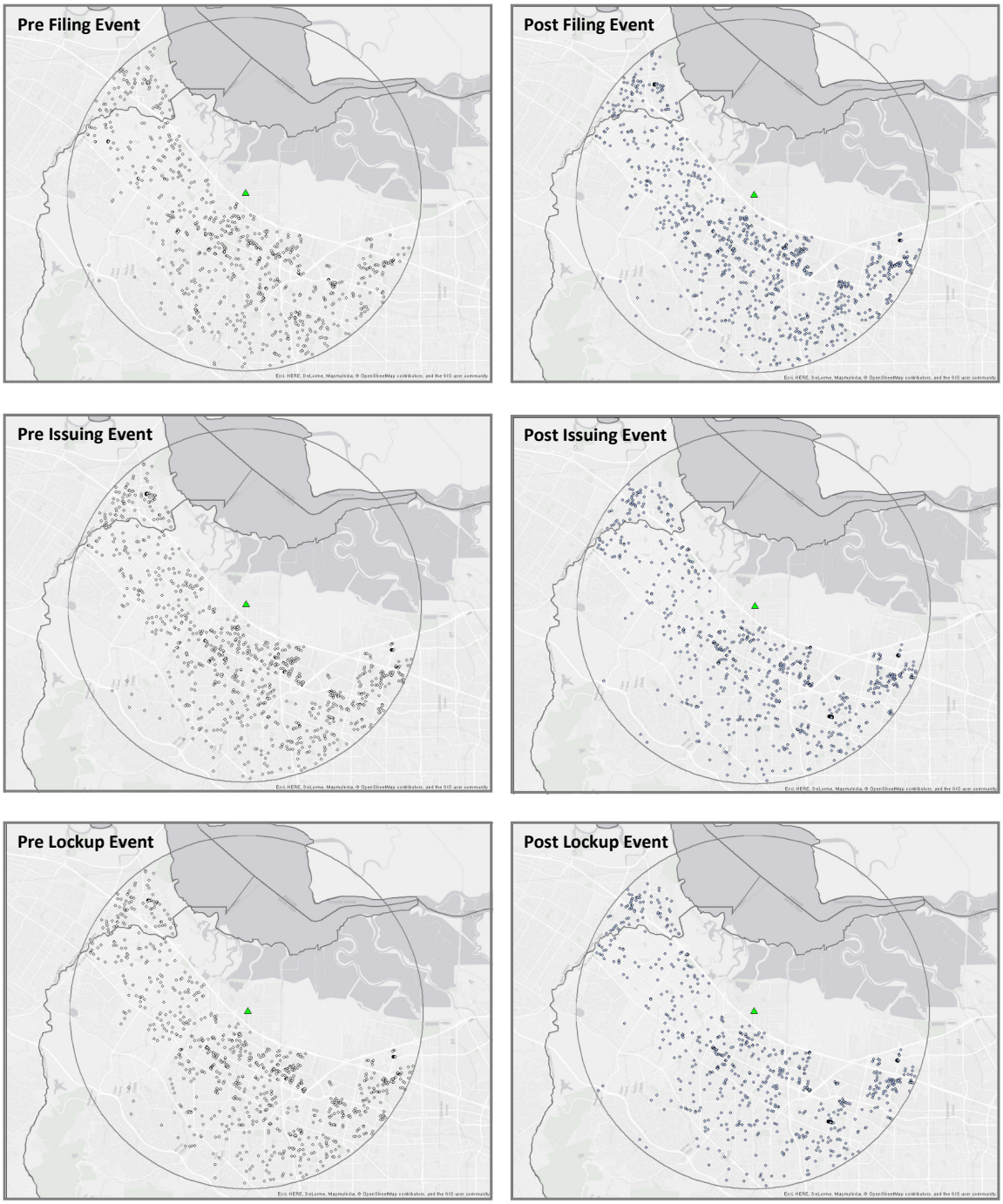
This figure compares the number of IPO filings and house price indices for Silicon Valley and the rest of California between 1993 and 2017.

Figure 3. House Transactions within 5 miles of Facebook's headquarters by IPO Event



Displaying a 5-mile radius around Facebook's headquarters in Silicon Valley and the locations of house transactions around the filing, issuing, and lockup expiration events. The "pre" period is inclusive of 90 days prior to the event and the event. The "post" period is defined as the following 90 days after an event.

Figure 4. House Transactions within 5 miles of Google's headquarters by IPO Event

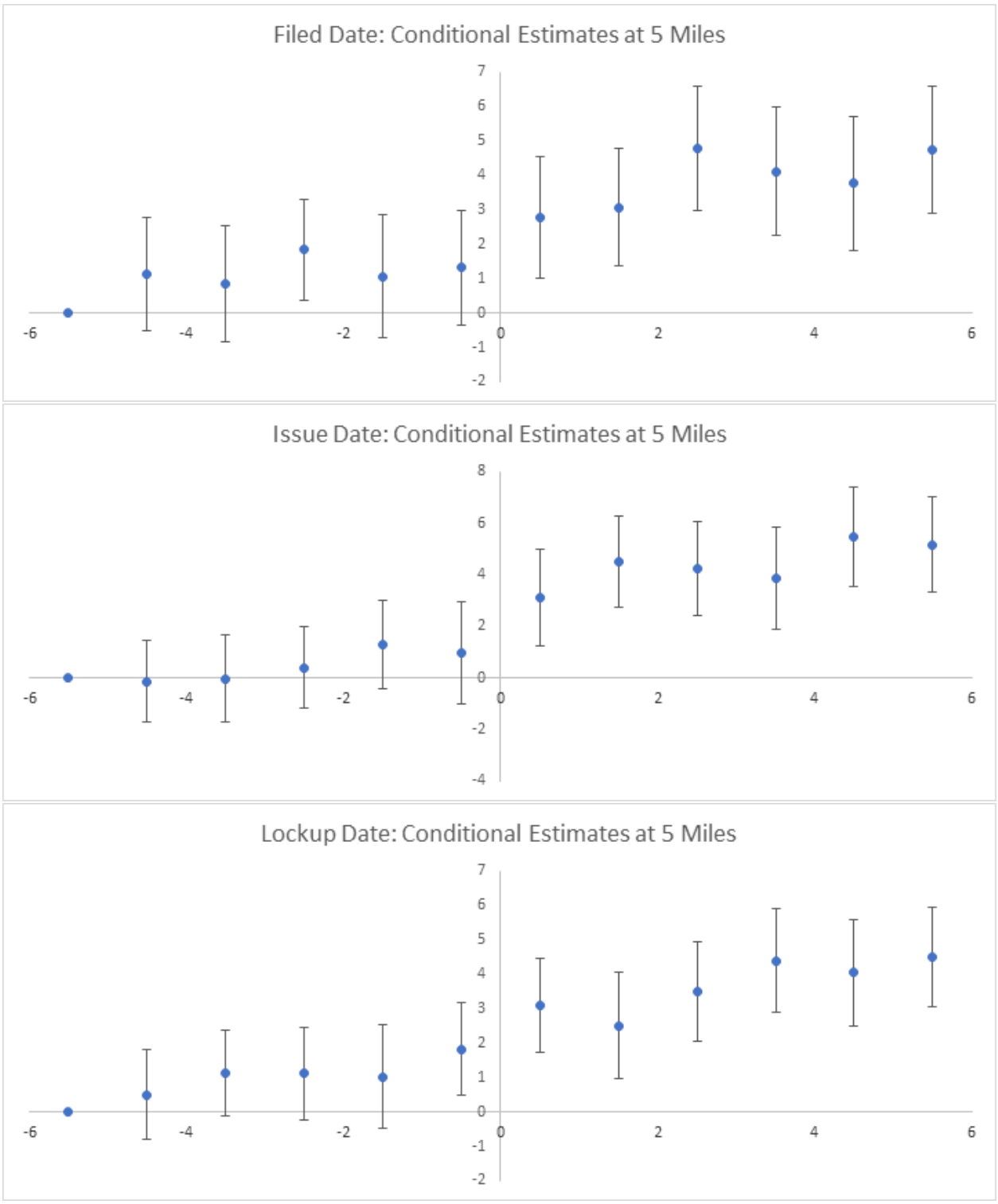


Displaying a 5-mile radius around Google's headquarters in Silicon Valley and the locations of house transactions around the filing, issuing, and lockup expiration events. The "pre" period is inclusive of 90 days prior to the event and the event. The "post" period is defined as the following 90 days after an event.

Figure 5. House Transactions within 5 miles of Twitter's headquarters by IPO Event

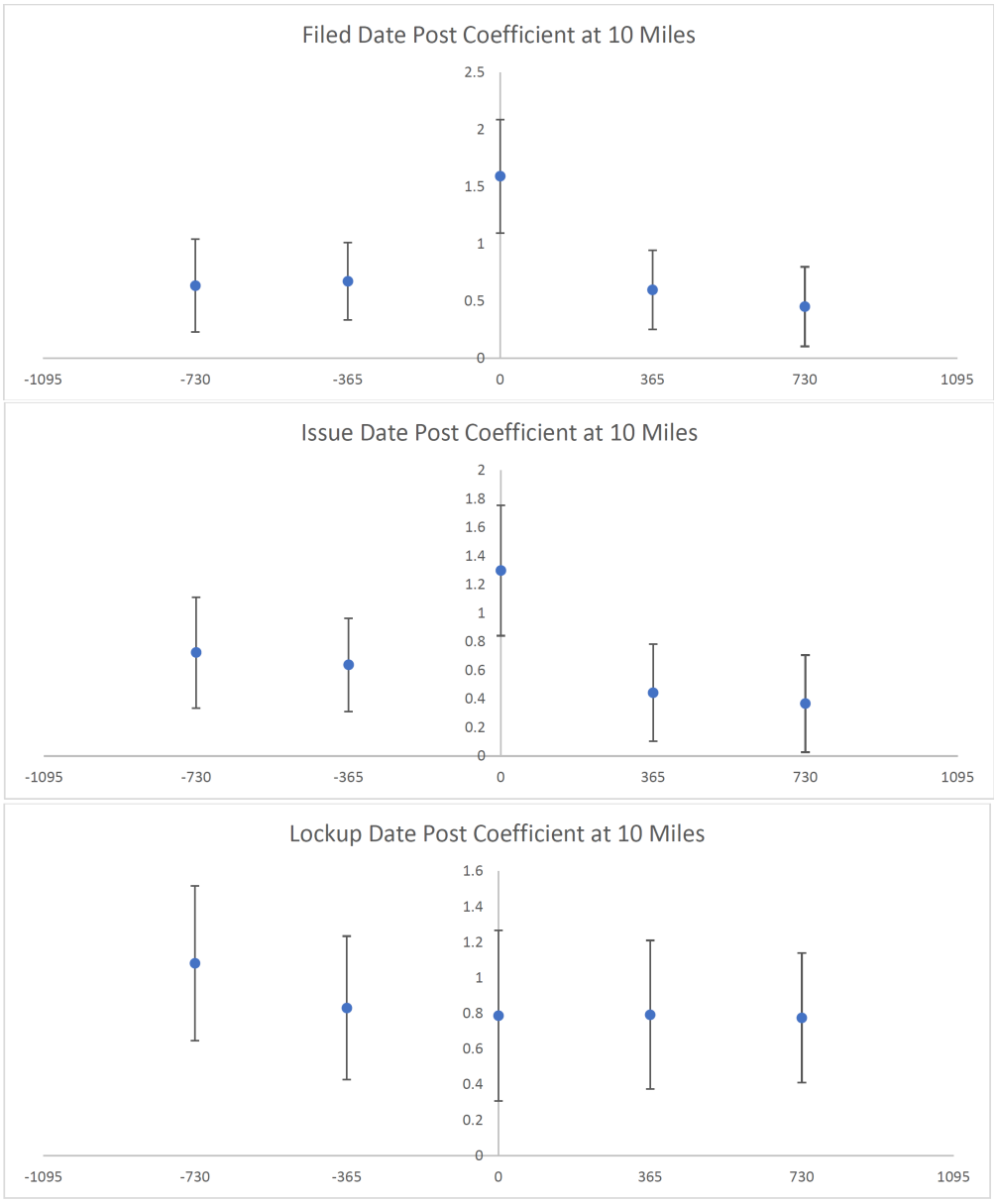
Displaying a 5-mile radius around Twitter's headquarters in Silicon Valley and the locations of house transactions around the filing, issuing, and lockup expiration events. The "pre" period is inclusive of 90 days prior to the event and the event. The "post" period is defined as the following 90 days after an event.

Figure 6. Monthly Estimate of HPI Premium for the Treatment Area (180-day window, 5-mile boundary)



This figure depicts the coefficient on the month indicator during the 180-day pre- and post-event windows. The treatment area is defined by a 5-mile radius around IPO firm headquarters. The "pre" period is inclusive of 180 days prior to the event and the event. The "post" period is defined as the following 180 days after an event. The vertical bar indicates the two-standard error band.

Figure 7. Placebo Tests by Falsified Event Dates



This figure depicts the HPI premium after an falsified event date for the treatment group.

Table 1. Property Transactions and IPO Events by Year

Year	Observations	Filed Date	Issue Date	Lockup Date
1993	65,877	50	53	32
1994	200,200	30	32	32
1995	182,591	66	56	34
1996	212,709	88	92	81
1997	240,619	53	49	55
1998	276,327	33	37	37
1999	288,666	96	83	24
2000	283,809	56	71	35
2001	266,668	6	11	23
2002	294,527	5	8	7
2003	318,125	12	6	3
2004	348,088	33	34	22
2005	346,806	11	12	26
2006	258,758	18	14	11
2007	213,637	13	20	19
2008	335,477	2	3	10
2009	328,327	6	4	1
2010	297,348	7	6	6
2011	287,641	12	10	9
2012	268,893	8	13	10
2013	233,346	22	17	13
2014	214,384	34	30	23
2015	231,224	16	19	21
2016	226,731	13	14	12
2017	161,022	11	17	18
Total	6,381,800	701	711	564

Displaying the counts of California IPO events and property transactions from the cleaned data sample. The firm level data is from SDC and Zillow ZTraxx provides the property transaction level data.

Table 2. Descriptive Statistics

Variables	Mean	S.D.	Minimum	Maximum
Panel A: Property Transaction Level				
Sales Price	335,145	501,165	1,000	400,000,000
Sales Price*	415,363	610,106	1,005	487,142,528
Land (sf)	18,707	741,819	502	433,566,875
Total Rooms	5.06	3.38	0.00	99.00
Bed Rooms	3.24	0.87	1.00	20.00
Full Bathrooms	2.00	0.70	1.00	20.00
Half Bathrooms	0.26	0.44	0.00	11.00
Age	29.20	23.53	0.00	150.00
Stories	1.32	0.48	1.00	3.00
Observations	6,381,800			
Panel B: IPO Level				
Firm Age	11.60	16.86	0.00	158.00
Total Assets ($ mil)	224.95	733.18	0.10	7,190.00
IPO Offer Price	12.99	6.94	0.10	97.00
Proceeds Amount ($ mil)	131.11	640.86	0.04	16,006.88
Shares Outstanding After Offer	41,643,796	112,713,832	900,000	2,138,084,992
Secondary Shares of Shares Offered	3,647,752	17,049,468	3,395	241,233,616
Secondary Shares of Shares Offered (%)	9.40	19.45	0.00	100.00
Primary Shares of Shares Offered (%)	90.60	19.45	0.00	100.00
Secondary Shares Flag	224			
No Lockup	152			
Number of IPOs	725			
Panel C: IPO Returns (%) from Offer Price to Close of				
Issue Date	35.87	60.96	-23.07	525.00
Lockup Date	28.50	101.26	-260.42	1,140.00
IPO at 1 year	25.47	112.97	-227.78	740.83
Panel D: IPO Relative Volatility (%) from IPO to Close of				
Lockup Date	26.83	24.80	0.71	302.33
IPO at 1 year	36.64	27.50	5.12	319.13

Displaying California IPOs and property transactions from the cleaned data sample. (*) are adjusted to current prices using the monthly CPI or Consumer Price Index for All Urban Consumers: All Items (to December 2017 prices). IPO returns (%) are calculated as the percentage change from the IPO offer price to the most recent closing price by event date being considered. IPO relative volatility is the standard deviation of closing prices divided by the average of closing prices over the holding period.

Table 3. Sales Price by IPO Event

	Total		Pre		Post		T-Stat
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Diff.
Panel A: at 1 Mile and 90 Days							
Filed Date	629,279	563,366	617,520	528,570	640,645	594,880	2.71
Issue Date	646,357	740,927	654,034	828,953	638,329	635,938	-1.40
Lockup Date	668,347	912,462	690,948	1,089,577	645,953	693,064	-2.92
Panel B: at 5 Miles and 90 Days							
Filed Date	681,985	807,360	672,437	802,307	691,254	812,131	5.60
Issue Date	694,828	799,696	692,611	824,883	697,135	772,627	1.40
Lockup Date	706,437	814,693	708,142	795,428	704,718	833,664	-1.02
Panel C: at 10 Miles and 90 Days							
Filed Date	631,072	673,299	627,083	612,071	634,981	728,321	3.76
Issue Date	627,098	656,341	629,227	657,589	624,903	655,047	-2.20
Lockup Date	651,237	702,546	653,601	707,191	648,864	697,849	-2.22

Displaying California mean differences of sales price for property transactions in current (December 2017) dollars that are identified as falling in a pre or post-IPO event window. The pre and post-periods include transactions within 90 days of the event date where day 0 is (the event date itself) is included in the pre-period and transactions present in more than one pre-post window per event are excluded.

Table 4. HPI by IPO Event

Dependent Variable: HPI by Firm by Event	1 Mile	5 Miles	10 Miles
Panel A: Filed Date			
Post Event Date	2.196*	1.265***	1.592***
	(1.204)	(0.259)	(0.248)
HPI Complement	0.516***	0.541***	0.428***
	(0.143)	(0.035)	(0.032)
Firm FE	Y	Y	Y
Constant	50.555***	49.212***	49.099***
	(14.916)	(3.578)	(3.817)
Adjusted R-Sqr	0.46	0.56	0.60
Number of Periods	1,206	2,382	2,388
Number of IPOs	201	397	398
Panel B: Issue Date			
Post Event Date	3.307***	1.695***	1.298***
	(1.029)	(0.251)	(0.228)
HPI Complement	0.593***	0.465***	0.410***
	(0.150)	(0.034)	(0.033)
Firm FE	Y	Y	Y
Constant	37.855***	52.021***	51.420***
	(14.517)	(3.301)	(3.909)
Adjusted R-Sqr	0.47	0.53	0.59
Number of Periods	1,296	2,454	2,298
Number of IPOs	216	409	383
Panel C: Lockup Date			
Post Event Date	0.123	1.366***	0.787***
	(1.070)	(0.304)	(0.240)
HPI Complement	0.573***	0.342***	0.414***
	(0.146)	(0.043)	(0.037)
Firm FE	Y	Y	Y
Constant	34.451**	66.149***	57.022***
	(14.583)	(4.237)	(3.415)
Adjusted R-Sqr	0.40	0.49	0.58
Number of Periods	990	1,860	1,662
Number of IPOs	165	310	277

Displaying coefficient estimates based on IPO by event level HPIs with standard errors clustered at the IPO firm level. The HPIs give monthly house price levels consistent in IPO event time from 3 months before and to 3 months after the event. It is conditional on property characteristics and county level fixed effects where only those pre-post transactions by IPO are included. The base HPI period is the first month (-90 to -60 days) and the post-indicator identifies the 3 HPI periods (0 to 30, 30 to 60, and 60 to 90) following the IPO event. The 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 5. OLS Transaction Level by IPO Events and Property Characteristics

Dependent Variable:	Ln(Land SF)	Stories	Total Rooms	Bedrooms	Full Bathrooms	Half Bathrooms	Age
Panel A: Filed Date							
Post Event Date	0.002	-0.008**	-0.015	-0.009	-0.003	-0.004	0.464***
	(0.006)	(0.004)	(0.013)	(0.006)	(0.005)	(0.003)	(0.177)
Firm FE	Y	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y	Y
Constant	8.270***	1.067***	4.901***	2.152***	1.356***	0.258***	34.760***
	(0.095)	(0.080)	(0.267)	(0.119)	(0.103)	(0.041)	(2.786)
Adjusted R-Sqr	0.17	0.05	0.26	0.06	0.09	0.04	0.36
Observations	230,692	230,692	230,692	230,692	230,692	230,692	230,692
Number of Firms	482	482	482	482	482	482	482
Panel B: Issue Date							
Post Event Date	-0.000	-0.003	0.001	-0.001	0.000	0.000	0.409**
	(0.005)	(0.004)	(0.012)	(0.006)	(0.005)	(0.003)	(0.177)
Firm FE	Y	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y	Y
Constant	8.922***	2.003***	7.999***	4.001***	3.000***	-0.000	23.591***
	(0.005)	(0.004)	(0.012)	(0.006)	(0.005)	(0.003)	(0.177)
Adjusted R-Sqr	0.16	0.05	0.27	0.06	0.09	0.04	0.36
Observations	243,991	243,991	243,991	243,991	243,991	243,991	243,991
Number of Firms	494	494	494	494	494	494	494
Panel C: Lockup Date							
Post Event Date	-0.001	-0.001	0.001	0.002	-0.008	0.002	0.515***
	(0.006)	(0.004)	(0.016)	(0.007)	(0.005)	(0.003)	(0.194)
Firm FE	Y	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y	Y
Constant	8.820	1.283	6.286	3.639	2.047	0.294	27.376
	(.)	(.)	(7.420)	(2.625)	(1.852)	(.)	(.)
Adjusted R-Sqr	0.16	0.04	0.23	0.07	0.08	0.04	0.35
Observations	235,456	235,456	235,456	235,456	235,456	235,456	235,456
Number of Firms	418	418	418	418	418	418	418

Displaying transaction level OLS estimates where the dependent variable is one of following property characteristics: ln(land sf), number of stories, total number of rooms, number of bedrooms, number of full bathrooms, number of half bathrooms, and age. The figures in parentheses are standard errors clustered at the firm level and the 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively. Observations that occur in more than one IPO event per event type are excluded as well as transactions beyond 1 mile from the firm's headquarters and outside the performance window.

Table 6. The Effect of IPOs on House Prices (Using Zip Code for Control Area)

Dependent Variable: HPI by Firm by Event	1 Mile	5 Miles	10 Miles
Panel A: Filed Date			
Post Event Date	1.873*	2.121***	1.713***
	(1.033)	(0.255)	(0.188)
HPI Complement	0.113	0.314***	0.371***
	(0.080)	(0.026)	(0.022)
Firm FE	Y	Y	Y
Constant	93.660***	80.692***	64.896***
	(8.185)	(2.302)	(2.363)
Adjusted R-Sqr	0.40	0.53	0.61
Number of Periods	1,230	2,346	2,646
Number of IPOs	205	391	441
Panel B: Issue Date			
Post Event Date	5.075***	1.823***	1.943***
	(1.111)	(0.247)	(0.209)
HPI Complement	0.092	0.251***	0.332***
	(0.078)	(0.027)	(0.029)
Firm FE	Y	Y	Y
Constant	85.371***	76.944***	65.017***
	(7.915)	(2.365)	(2.859)
Adjusted R-Sqr	0.43	0.49	0.59
Number of Periods	1,368	2,472	2,202
Number of IPOs	228	412	367
Panel C: Lockup Date			
Post Event Date	2.900**	1.708***	1.337***
	(1.308)	(0.276)	(0.197)
HPI Complement	0.075	0.192***	0.298***
	(0.084)	(0.029)	(0.030)
Firm FE	Y	Y	Y
Constant	84.119***	81.090***	71.111***
	(7.011)	(2.798)	(2.886)
Adjusted R-Sqr	0.41	0.45	0.55
Number of Periods	996	1,866	2,046
Number of IPOs	166	311	341

Displaying coefficient estimates based on IPO by event level HPIs with standard errors clustered at the IPO firm level. The HPIs give monthly house price levels consistent in IPO event time from 3 months before and to 3 months after the event. It is conditional on property characteristics and zip code level fixed effects where only those pre-post transactions by IPO are included. The base HPI period is the first month (-90 to -60 days) and the post-indicator identifies the 3 HPI periods (0 to 30, 30 to 60, and 60 to 90) following the IPO event. The 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 7. Placebo Test by Falsified Event Dates

Days from the event date	-730 days	-365 days	0 days	365 days	730 days	Average for False Dates	Difference (True-False)
Panel A: Filed Date							
1-mile boundary	-0.28	1.80	2.20	2.70	1.83	1.51	0.68
	(1.17)	(1.21)	(1.20)	(1.09)	(0.94)	(1.10)	
2-mile boundary	1.27	2.14	1.78	1.16	1.58	1.54	0.24
	(0.66)	(0.57)	(0.56)	(0.48)	(0.47)	(0.54)	
3-mile boundary	1.09	1.15	1.11	1.05	1.35	1.16	-0.05
	(0.39)	(0.39)	(0.33)	(0.36)	(0.33)	(0.36)	
4-mile boundary	1.12	1.53	1.04	0.62	0.94	1.05	-0.01
	(0.31)	(0.31)	(0.30)	(0.30)	(0.26)	(0.29)	
5-mile boundary	1.09	1.28	1.27	0.68	0.97	1.00	0.26
	(0.28)	(0.26)	(0.26)	(0.25)	(0.21)	(0.25)	
10-mile boundary	0.64	0.67	1.59	0.60	0.45	0.59	1.00
	(0.20)	(0.17)	(0.25)	(0.17)	(0.17)	(0.18)	
Panel B: Issue Date							
1-mile boundary	2.91	2.62	3.31	2.22	0.87	2.15	1.15
	(1.43)	(1.25)	(1.03)	(0.91)	(1.03)	(1.15)	
2-mile boundary	2.14	0.62	1.63	0.86	0.96	1.15	0.49
	(0.58)	(0.53)	(0.52)	(0.43)	(0.48)	(0.51)	
3-mile boundary	1.71	0.81	1.88	0.27	0.97	0.94	0.94
	(0.38)	(0.33)	(0.36)	(0.32)	(0.33)	(0.34)	
4-mile boundary	1.31	0.63	1.73	0.44	0.74	0.78	0.95
	(0.33)	(0.26)	(0.29)	(0.27)	(0.28)	(0.28)	
5-mile boundary	1.40	0.59	1.70	0.66	0.57	0.81	0.89
	(0.27)	(0.22)	(0.25)	(0.23)	(0.23)	(0.24)	
10-mile boundary	0.72	0.64	1.30	0.44	0.37	0.54	0.76
	(0.19)	(0.16)	(0.23)	(0.17)	(0.17)	(0.17)	
Panel C: Lockup Date							
1-mile boundary	1.35	4.76	0.12	0.96	2.86	2.48	-2.36
	(1.58)	(1.53)	(1.07)	(1.08)	(1.27)	(1.36)	
2-mile boundary	0.15	0.33	1.89	1.42	1.22	0.78	1.11
	(0.72)	(0.64)	(0.58)	(0.55)	(0.57)	(0.62)	
3-mile boundary	0.74	1.27	1.62	1.03	0.46	0.87	0.75
	(0.41)	(0.44)	(0.38)	(0.37)	(0.37)	(0.40)	
4-mile boundary	0.86	0.65	1.53	1.25	1.07	0.96	0.57
	(0.33)	(0.31)	(0.32)	(0.32)	(0.30)	(0.32)	
5-mile boundary	1.14	0.91	1.37	0.83	0.68	0.89	0.48
	(0.31)	(0.26)	(0.30)	(0.27)	(0.25)	(0.27)	
10-mile boundary	1.08	0.83	0.79	0.79	0.78	0.87	-0.08
	(0.22)	(0.20)	(0.24)	(0.21)	(0.18)	(0.20)	

This table shows the estimated price premium over 90-day windows around true and falsified event dates for the 10-mile treatment area. Standard errors are in parentheses. The treatment effect is measured by event level HPIs with standard errors clustered at the IPO firm level. The HPIs give monthly house price levels consistent in IPO event time from 3 months before and to 3 months after the event. It is conditional on property characteristics and county level fixed effects where only those pre-post transactions by IPO are included.

Table 8. Placebo Test by Falsified Headquarters Locations

Dependent Variable: HPI by Firm by Event	1 Mile	5 Miles	10 Miles
Panel A: Filed Date			
Post Event Date (avg)	0.80	1.16	1.43
S.D.	3.06	0.86	1.65
Adjusted R-Sqr (avg)	0.42	0.44	0.45
Panel B: Issue Date			
Post Event Date (avg)	-0.30	0.45	1.65
S.D.	3.66	0.84	1.06
Adjusted R-Sqr (avg)	0.27	0.38	0.42
Panel C: Lockup Date			
Post Event Date (avg)	-0.76	1.55	1.10
S.D.	3.38	0.93	1.16
Adjusted R-Sqr (avg)	0.32	0.36	0.37
Number of Trials	10	10	10

Displaying average coefficient estimates from randomly assigning latitude and longitude of IPOs within the same county.

Table 9. HPI Pre-Post at 5 Miles by Firm Age Quartile

Dependent Variable: HPI by Firm by Event	Youngest Q1	Q2	Q3	Oldest Q4
Panel A: Filed Date				
Post Event Date	1.835***	1.745***	1.111*	1.172**
	(0.609)	(0.554)	(0.602)	(0.545)
HPI Complement	0.459***	0.550***	0.567***	0.636***
	(0.073)	(0.068)	(0.079)	(0.074)
Constant	57.951***	49.588***	36.716***	39.404***
	(8.295)	(6.225)	(8.933)	(7.689)
Adjusted R-Sqr	0.52	0.60	0.53	0.57
Number of Periods	540	492	492	468
Number of IPOs	90	82	82	78
Panel B: Issue Date				
Post Event Date	2.803***	1.701***	1.292**	0.734
	(0.516)	(0.536)	(0.614)	(0.570)
HPI Complement	0.413***	0.421***	0.526***	0.522***
	(0.062)	(0.072)	(0.082)	(0.069)
Constant	52.687***	52.852***	56.183***	46.994***
	(7.077)	(8.648)	(9.228)	(6.572)
Adjusted R-Sqr	0.48	0.50	0.57	0.51
Number of Periods	540	540	540	468
Number of IPOs	90	90	90	78
Panel C: Lockup Date				
Post Event Date	2.064***	1.193**	0.612	1.455**
	(0.768)	(0.578)	(0.594)	(0.595)
HPI Complement	0.288**	0.330***	0.400***	0.309***
	(0.113)	(0.084)	(0.074)	(0.081)
Constant	72.547***	64.488***	65.341***	69.380***
	(10.611)	(7.642)	(8.542)	(7.994)
Adjusted R-Sqr	0.41	0.52	0.46	0.53
Number of Periods	366	456	450	378
Number of IPOs	61	76	75	63
Firm FE	Y	Y	Y	Y

Displaying coefficient estimates based on IPO by event level HPIs with standard errors clustered at the IPO firm level. The HPIs give monthly house price levels consistent in IPO event time from 3 months before and to 3 months after the event. It is conditional on property characteristics and county level fixed effects where only those pre-post transactions by IPO are included. The base HPI period is the first month (-90 to -60 days) and the post-indicator identifies the 3 HPI periods (0 to 30, 30 to 60, and 60 to 90) following the IPO event. The 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 10. HPI Pre-Post at 5 Miles by Total Assets Quartile

Dependent Variable: HPI by Firm by Event	Least Q1	Q2	Q3	Most Q4
Panel A: Filed Date				
Post Event Date	1.085**	2.311***	0.785	0.857
	(0.538)	(0.532)	(0.544)	(0.571)
HPI Complement	0.586***	0.470***	0.612***	0.510***
	(0.093)	(0.067)	(0.074)	(0.061)
Constant	35.903***	55.041***	42.068***	52.657***
	(10.340)	(7.543)	(6.863)	(6.895)
Adjusted R-Sqr	0.55	0.58	0.60	0.49
Number of Periods	468	588	522	492
Number of IPOs	78	98	87	82
Panel B: Issue Date				
Post Event Date	2.210***	2.014***	1.815***	1.018
	(0.451)	(0.506)	(0.576)	(0.626)
HPI Complement	0.446***	0.415***	0.586***	0.480***
	(0.058)	(0.070)	(0.077)	(0.073)
Constant	54.822***	63.510***	40.371***	45.766***
	(5.364)	(6.636)	(8.833)	(8.386)
Adjusted R-Sqr	0.49	0.53	0.61	0.49
Number of Periods	492	630	558	486
Number of IPOs	82	105	93	81
Panel C: Lockup Date				
Post Event Date	1.459*	2.433***	1.558**	1.038
	(0.751)	(0.589)	(0.631)	(0.640)
HPI Complement	0.391***	0.342***	0.308***	0.306***
	(0.097)	(0.068)	(0.093)	(0.105)
Constant	62.559***	67.908***	63.239***	69.894***
	(9.065)	(6.463)	(10.752)	(12.245)
Adjusted R-Sqr	0.44	0.55	0.51	0.47
Number of Periods	426	426	432	300
Number of IPOs	71	71	72	50
Firm FE	Y	Y	Y	Y

Displaying coefficient estimates based on IPO by event level HPIs with standard errors clustered at the IPO firm level. The HPIs give monthly house price levels consistent in IPO event time from 3 months before and to 3 months after the event. It is conditional on property characteristics and county level fixed effects where only those pre-post transactions by IPO are included. The base HPI period is the first month (-90 to -60 days) and the post-indicator identifies the 3 HPI periods (0 to 30, 30 to 60, and 60 to 90) following the IPO event. The 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively. Total assets is adjusted to current price levels (December 2017).

Table 11. HPI Pre-Post at 5 Miles by IPO Proceeds Quartile

Dependent Variable: HPI by Firm by Event	Least Q1	Q2	Q3	Most Q4
Panel A: Filed Date				
Post Event Date	0.359	1.287**	1.476***	1.827***
	(0.494)	(0.502)	(0.548)	(0.492)
HPI Complement	0.453***	0.528***	0.581***	0.555***
	(0.078)	(0.073)	(0.067)	(0.057)
Constant	59.730***	50.570***	46.809***	47.059***
	(8.748)	(7.492)	(6.252)	(6.500)
Adjusted R-Sqr	0.51	0.57	0.57	0.56
Number of Periods	474	696	642	570
Number of IPOs	79	116	107	95
Panel B: Issue Date				
Post Event Date	1.067**	1.975***	2.068***	1.366**
	(0.510)	(0.414)	(0.472)	(0.635)
HPI Complement	0.336***	0.407***	0.509***	0.548***
	(0.061)	(0.060)	(0.064)	(0.071)
Constant	59.032***	57.539***	45.087***	45.844***
	(5.684)	(5.819)	(5.842)	(6.479)
Adjusted R-Sqr	0.44	0.53	0.54	0.57
Number of Periods	504	696	672	582
Number of IPOs	84	116	112	97
Panel C: Lockup Date				
Post Event Date	2.074***	1.275**	0.739	1.317**
	(0.631)	(0.561)	(0.608)	(0.605)
HPI Complement	0.289***	0.376***	0.269***	0.430***
	(0.084)	(0.086)	(0.075)	(0.086)
Constant	78.605***	62.770***	80.278***	63.841***
	(9.801)	(8.492)	(8.615)	(8.114)
Adjusted R-Sqr	0.51	0.46	0.45	0.54
Number of Periods	492	558	444	366
Number of IPOs	82	93	74	61
Firm FE	Y	Y	Y	Y

Displaying coefficient estimates based on IPO by event level HPIs with standard errors clustered at the IPO firm level. The HPIs give monthly house price levels consistent in IPO event time from 3 months before and to 3 months after the event. It is conditional on property characteristics and county level fixed effects where only those pre-post transactions by IPO are included. The base HPI period is the first month (-90 to -60 days) and the post-indicator identifies the 3 HPI periods (0 to 30, 30 to 60, and 60 to 90) following the IPO event. The 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively. IPO Proceeds are adjusted to current price levels (December 2017).

Table 12. HPI Pre-Post at 5 Miles by Offer Price Quartile

Dependent Variable: HPI by Firm by Event	Smallest Q1	Q2	Q3	Largest Q4
Panel A: Filed Date				
Post Event Date	0.499	1.377***	1.261**	1.812***
	(0.491)	(0.470)	(0.510)	(0.605)
HPI Complement	0.426***	0.559***	0.529***	0.599***
	(0.074)	(0.070)	(0.074)	(0.061)
Constant	62.975***	47.249***	50.434***	39.454***
	(6.958)	(7.896)	(7.653)	(5.728)
Adjusted R-Sqr	0.55	0.58	0.51	0.57
Number of Periods	528	672	594	588
Number of IPOs	88	112	99	98
Panel B: Issue Date				
Post Event Date	1.396**	1.163**	2.460***	1.667***
	(0.553)	(0.446)	(0.464)	(0.559)
HPI Complement	0.427***	0.399***	0.482***	0.526***
	(0.074)	(0.057)	(0.063)	(0.072)
Constant	50.378***	57.791***	49.949***	40.128***
	(6.927)	(6.475)	(6.094)	(8.570)
Adjusted R-Sqr	0.42	0.56	0.58	0.50
Number of Periods	516	702	636	600
Number of IPOs	86	117	106	100
Panel C: Lockup Date				
Post Event Date	1.666**	1.400***	1.066*	1.265
	(0.649)	(0.526)	(0.537)	(0.772)
HPI Complement	0.242***	0.355***	0.314***	0.525***
	(0.082)	(0.072)	(0.082)	(0.090)
Constant	82.928***	62.126***	69.017***	60.632***
	(9.400)	(6.501)	(8.080)	(8.448)
Adjusted R-Sqr	0.45	0.52	0.49	0.51
Number of Periods	468	582	474	336
Number of IPOs	78	97	79	56
Firm FE	Y	Y	Y	Y

Displaying coefficient estimates based on IPO by event level HPIs with standard errors clustered at the IPO firm level. The HPIs give monthly house price levels consistent in IPO event time from 3 months before and to 3 months after the event. It is conditional on property characteristics and county level fixed effects where only those pre-post transactions by IPO are included. The base HPI period is the first month (-90 to -60 days) and the post-indicator identifies the 3 HPI periods (0 to 30, 30 to 60, and 60 to 90) following the IPO event. The 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively. Offer price is adjusted to current price levels (December 2017).

Table 13. HPI Pre-Post at 5 Miles by Underpricing Quartile

Dependent Variable: HPI by Firm by Event	Least Q1	Q2	Q3	Most Q4
Panel A: Filed Date				
Post Event Date	1.274***	0.343	1.393**	1.866***
	(0.482)	(0.594)	(0.561)	(0.505)
HPI Complement	0.603***	0.520***	0.497***	0.555***
	(0.072)	(0.079)	(0.077)	(0.062)
Constant	42.703***	46.758***	53.774***	46.253***
	(6.723)	(7.430)	(7.986)	(5.742)
Adjusted R-Sqr	0.59	0.54	0.55	0.56
Number of Periods	504	510	564	678
Number of IPOs	84	85	94	113
Panel B: Issue Date				
Post Event Date	1.198**	1.051*	1.590***	2.541***
	(0.505)	(0.591)	(0.513)	(0.463)
HPI Complement	0.389***	0.446***	0.426***	0.550***
	(0.075)	(0.062)	(0.072)	(0.062)
Constant	63.209***	51.324***	55.850***	45.072***
	(7.181)	(5.611)	(6.937)	(5.689)
Adjusted R-Sqr	0.47	0.53	0.48	0.58
Number of Periods	528	546	594	678
Number of IPOs	88	91	99	113
Panel C: Lockup Date				
Post Event Date	1.566**	0.968*	1.448**	1.422**
	(0.627)	(0.540)	(0.701)	(0.557)
HPI Complement	0.280***	0.298***	0.409***	0.380***
	(0.083)	(0.089)	(0.074)	(0.092)
Constant	79.881***	67.510***	59.429***	71.604***
	(9.657)	(8.070)	(7.285)	(10.593)
Adjusted R-Sqr	0.46	0.50	0.47	0.53
Number of Periods	474	504	450	390
Number of IPOs	79	84	75	65
Firm FE	Y	Y	Y	Y

Displaying coefficient estimates based on IPO and event level HPIs with standard errors clustered at the IPO firm level. The 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 14. IPO Offering Type at 5 Miles

Dependent Variable: HPI by Firm by Event	Filed Date	Issue Date	Lockup Date
Post Event Date	1.166***	1.519***	1.436***
	(0.356)	(0.361)	(0.389)
Post*Secondary Shares Flag	-0.635	0.080	-0.214
	(0.538)	(0.548)	(0.605)
Post*No Lockup Flag	1.401**	0.718	
	(0.604)	(0.591)	
Secondary Shares Offered	-4.670***	8.746***	2.918***
	(0.649)	(0.655)	(0.493)
No Lockup Period	-5.889***	3.678***	
	(0.417)	(0.296)	
HPI Complement	0.528***	0.462***	0.341***
	(0.034)	(0.034)	(0.043)
Firm FE	Y	Y	Y
Constant	55.616***	43.574***	63.374***
	(4.148)	(3.901)	(3.873)
Adjusted R-Sqr	0.56	0.53	0.49
Number of Periods	2,382	2,454	1,860
Number of IPOs	397	409	310

Displaying coefficient estimates based on IPO by event level HPIs with standard errors clustered at the IPO firm level. The HPIs give monthly house price levels consistent in IPO event time from 3 months before and to 3 months after the event. It is conditional on property characteristics and county level fixed effects where only those pre-post transactions by IPO are included. The base HPI period is the first month (-90 to -60 days) and the post-indicator identifies the 3 HPI periods (0 to 30, 30 to 60, and 60 to 90) following the IPO event. The 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 15. IPO Performance at 5 Miles

Dependent Variable: HPI by Firm by Event	Filed Date	Issue Date		Lockup Date	
Post Event Date	1.265***	1.695***	1.141***	1.366***	1.553***
	(0.259)	(0.251)	(0.310)	(0.304)	(0.514)
Post*Price Change			0.014***		0.007**
			(0.004)		(0.003)
Post*Rel. Volatility					-0.012
					(0.015)
Price Change			-0.007***		0.001
			(0.002)		(0.002)
Rel. Volatility					0.015**
					(0.008)
HPI Complement	0.541***	0.465***	0.467***	0.342***	0.335***
	(0.035)	(0.034)	(0.034)	(0.043)	(0.043)
Firm FE	Y	Y	Y	Y	Y
Constant	49.212***	52.021***	52.109***	66.149***	66.644***
	(3.578)	(3.301)	(3.270)	(4.237)	(4.225)
Adjusted R-Sqr	0.56	0.53	0.53	0.49	0.49
Number of Periods	2,382	2,454	2,346	1,860	1,794
Number of IPOs	397	409	391	310	299

Displaying coefficient estimates based on IPO and event level HPIs with standard errors clustered at the IPO firm level. (*) Price change is defined as the stock return from the offer price to the Issue or Lockup date. Relative volatility is defined as the standard deviation of closing prices divided by the average closing price from the IPO to the Lockup date.

Appendix A IPO Events and Sample Period

Initial Public Offering (IPO) Date Events

- **IPO filing event:** when a firm submits the appropriate documents required for the IPO. The filing event date is the date that a firm files Form S-1 with the U.S Securities and Exchange Commission (SEC).
- **IPO issuing event:** when the firm's equity is listed on an exchange. This is the date when the firm goes public. Issuing coincides with a firm's submission of their IPO prospectus Form 424 with the SEC.
- **Lockup event:** when restrictions on some shareholders and insiders are lifted allowing them to sell and liquidate their shares. It is usually 180 days.

Changes in the IPO Landscape Over this Sample Period

The decision to pursue an IPO is taken as exogenous and is assumed to be independent of local house price changes. However, regulatory changes over this period that impact IPOs may fundamentally change the composition of the sample of firms that choose to go public. This is a concern if the change in composition correlates with house prices in proximity to the firm's headquarters and cannot be controlled by specifications that include controls to capture variation at the firm level and over time.

In Gao et al. (2013), they identify a significant drop in the number of IPOs annually spanning 2001 to 2013 than during 1980 to 2000. They attribute this difference to changing market and regulatory conditions that make it more advantageous for small private firms to be acquired than to go public. Iliev (2010) found that the passage of the Sarbanes-Oxley Act (SOX) in 2002 and the requirements, specifically, under Section 404 imposed additional compliance costs reducing the value of small firms. In 2012 congress passed the Jumpstart our Jobs Act intended to increase the frequency of IPOs by lowering the cost of going public. For example, under the JOBS Act firms considering an IPO can test-the-waters and communicate with potential investors prior to submitting the registration Form S-1 publicly. Dambra et al. (2015) find that the changes implemented under the JOBS Act increased IPO activity in the two years following its passage. The issue of IPO composition and regulatory changes is compounded by evidence of hot and cold IPO markets going back to Ibbotson and Jaffe (1975) and Ritter (1984).

Appendix B Details of Placebo Tests

B.1 Pseudo-Random Date Assignment

In the first falsification test where the date is moved but the location is held constant, the procedure is in many ways identical to that associated with the base model specification and result. From the 725 unique firms that are present in the cleaned sample of California IPOs, for each one the base model specification produces coefficient estimates from regressions that are run independently by IPO, event date (filing, issuing, and lockup, and distance band. The only variation is that instead of considering the actual event date as defining the pre and post treatment periods the event date is pseudo-randomly assigned to capture the housing transactions around -730, -365, 365, and 730 days from the actual event under consideration. For example, for the filing event at a 5-mile boundary and -730 days the location of the firm is unchanged but the transactions that are now identified as falling in the pre and post-periods for constructing the house price indices will change.

The included controls for generating the HPI around the pseudo-event dates in the first-stage base model specification remain the same. The geographic area identified as the complementing HPI at the county level is the same area but is re-estimated so as to be consistent in time with the falsified date. Also, the second stage is unchanged where the house price indices across the IPOs for a particular event and distance boundary are then used to estimate an average treatment effect on the treated separately by pseudo-event date. Therefore, when assigning a 2-year ahead pseudo-issuing event, first, the house price indices across IPOs are estimated as if the event is the actual issuance event and then a post-period coefficient can be estimated to give the change in house prices in the post-period for the performance window around an event 2-years from the actual issuing event when controls include house prices in the surrounding counties and firm fixed effects.

In this case, because the number of transacted properties varies by geography over time the sample of IPOs included at each point is limited to those with sufficient observations to generate the house price indices. Also, by estimated the house price indexes separately by IPO and the post-period indicator of treatment separately by pseudo-randomly assigned date the estimates for property characteristics and the firm fixed effects are not held constant.

B.2 Random Assignment of Longitude and Latitude

The approach in the second falsification test where the firm location is randomly assigned is similar to that of the first falsification test with respect to randomly assigning across a geographic area. In the case of

randomly assigning the longitude and latitude of the firm effectively changes the population of transactions that fall around the new location in the same time as the actual event window.

To assign a reasonable location for each of IPO, first a list of the counties that are within 10 miles of each firm is found by assigning all of the transactions that occur within 10 miles through time (irrespective of transaction date according to the entirety of property transactions from the cleaned Zillow sample) to their corresponding counties. These counties become the available set of counties for the purposes of finding a location with similar characteristics as the actual location.

In this case, the large size of counties in California allows for randomly assigning IPOs according to their local region so as to be able to match on geographic and economic considerations whereas smaller counties found in the Northeast, for example, would make such an approach infeasible.

Once the available set of counties for randomly assigning the location of the firm is defined, the population of transactions that fall within those counties (irrespective of time) is used to internally define the minimum and maximum boundaries for the firm's new latitude and longitude. Specifically, uniform random variables are drawn to determine where between the minimum and maximum latitude and longitude the firm's randomly assigned headquarters falls. With the updated headquarters the analysis proceeds as usual where a band is drawn around the firm for defining the treated population and house price indices are constructed by IPO and event with the complementing county HPI updated accordingly. Lastly, to ensure that the overlap of the treated population is limited between the randomly assigned location versus the firm's true headquarters, when the distance between the addresses is less than the specified distance band (1, 5, or 10 miles) then that particular assignment is not included in the regression for estimating post-treatment effects for that distance band. For example, if the firm's randomly assigned location is 4-miles from the original true location then the house price indices for that firm would be included for the analyses at bands of 5 and 10-miles but not 1-mile.

Also, whereas in the first falsification test where different dates are considered through time, for randomly assigning the location the 725 IPOs are each randomly assigned locations 20 times. As a result, the displayed coefficient estimates are averages of that result over the different trials and the standard deviations of the average coefficient estimates.

Appendix C Additional Tables and Figures

Figure A1. SDC IPO Search Criteria

Request	Operator	Description	Hits
Database	Include	Common Stock Convertible Equity Pipeline & Registrations Equity Private Placements	n/a
Issuer/Borrower Nation (Code)	Include	United States of America	83,432
Listing: Primary Exchange Nation of Issuer"s Stock (Code)	Include	United States of America	68,295
SDC Deal Type	Include	US Common Stock US Common Stock Withdrawn from Registration	38,246
Issue Type	Include	IPO	14,696
Original IPO Flag (Y/N)	Equals	Yes	14,696
Closed-end Fund/Trust Flag (Y/N)	Equals	No	13,301
Unit Investment Trust Flag (Y/N)	Equals	No	10,967
Blank Check Company Flag Y/N	Equals	No	10,233
Foreign Issue Flag (eg Yankee) (Y/N)	Equals	No	10,233
Unit Issues: Unit Issue Flag (Y/N)	Equals	No	9,344
REIT Type (Code)	Exclude	Equity Hybrid Mortgage Unknown	9,000
Security Type (Code)	Include	Class A Common Shares Class B Common Shares Series B-1 Common Stock Series 1 Common Stock American Depositary Receipts Ordinary Shares Class A Common Shares of Beneficial Interest Class C Common Stock Class D Common Stock Class A Limited Voting Common Stock Special Common Stock Class B Voting Common Stock Ordinary / Common Shares Class E Common Shares Class C Ordinary Shares Class A Ordinary Shares Class A Voting Common Stock Class B Ordinary Shares Common Stock Equity Shares Class Share	8,739
Standard Common Stock Eligible Flag	Equals	Yes	8,626
favorites		favorites…	8,626

Of the 8,626 IPOs from SDC, there are 1,987 IPOs that have their firm's headquarters in California.

Table A1. Property Transaction Level Pre-Post Event Date at 5 miles

Dependent Variable: ln(Sales Price)	Filed Date	Issue Date	Lockup Date
Post Event Date	0.010*	0.019***	0.009**
	(0.005)	(0.005)	(0.004)
Ln(Land SF)	0.249***	0.239***	0.246***
	(0.009)	(0.008)	(0.009)
Total Rooms	0.040***	0.047***	0.049***
	(0.005)	(0.005)	(0.005)
Bedrooms	-0.017***	-0.022***	-0.018***
	(0.006)	(0.006)	(0.006)
Full Bathrooms	0.165***	0.167***	0.153***
	(0.008)	(0.008)	(0.007)
Half Bathrooms	0.118***	0.126***	0.118***
	(0.007)	(0.006)	(0.006)
Age	-0.013***	-0.013***	-0.013***
	(0.001)	(0.001)	(0.001)
Age Squared	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Age Cubed	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Age $\geq$ 50 Years	0.030**	0.036***	0.051***
	(0.012)	(0.011)	(0.010)
Stories $>$ 1 & $<$ 2	0.086***	0.089***	0.097***
	(0.015)	(0.016)	(0.015)
2 Story	0.058***	0.053***	0.049***
	(0.007)	(0.007)	(0.007)
Stories $>$ 2 & $<$ 3	0.169***	0.146**	0.149***
	(0.057)	(0.073)	(0.056)
3 Story	0.073***	0.080***	0.062***
	(0.017)	(0.018)	(0.017)
2nd Home	0.149***	0.140***	0.101***
	(0.022)	(0.021)	(0.017)
PUD	0.110***	0.100***	0.103***
	(0.010)	(0.009)	(0.009)
Condominium	0.012	0.002	-0.008
	(0.016)	(0.016)	(0.015)
ln(HPI Complement)	0.506***	0.471***	0.461***
	(0.071)	(0.067)	(0.050)
Firm FE	Y	Y	Y
County FE	Y	Y	Y
Constant	7.959***	-7.622***	8.425***
	(0.342)	(1.727)	(0.278)
Adjusted R-Sqr	0.55	0.55	0.55
Observations	191,784	207,520	196,376
Number of IPOs	355	368	294

Displaying transaction level OLS estimates where the dependent variable is the natural log of sales price (December 2017 dollars). Displayed standard errors are clustered at the Firm level and the 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively. Transactions that are present in more than one IPO event per event are excluded.

Figure A2. Distance Profile of the Treatment Effect

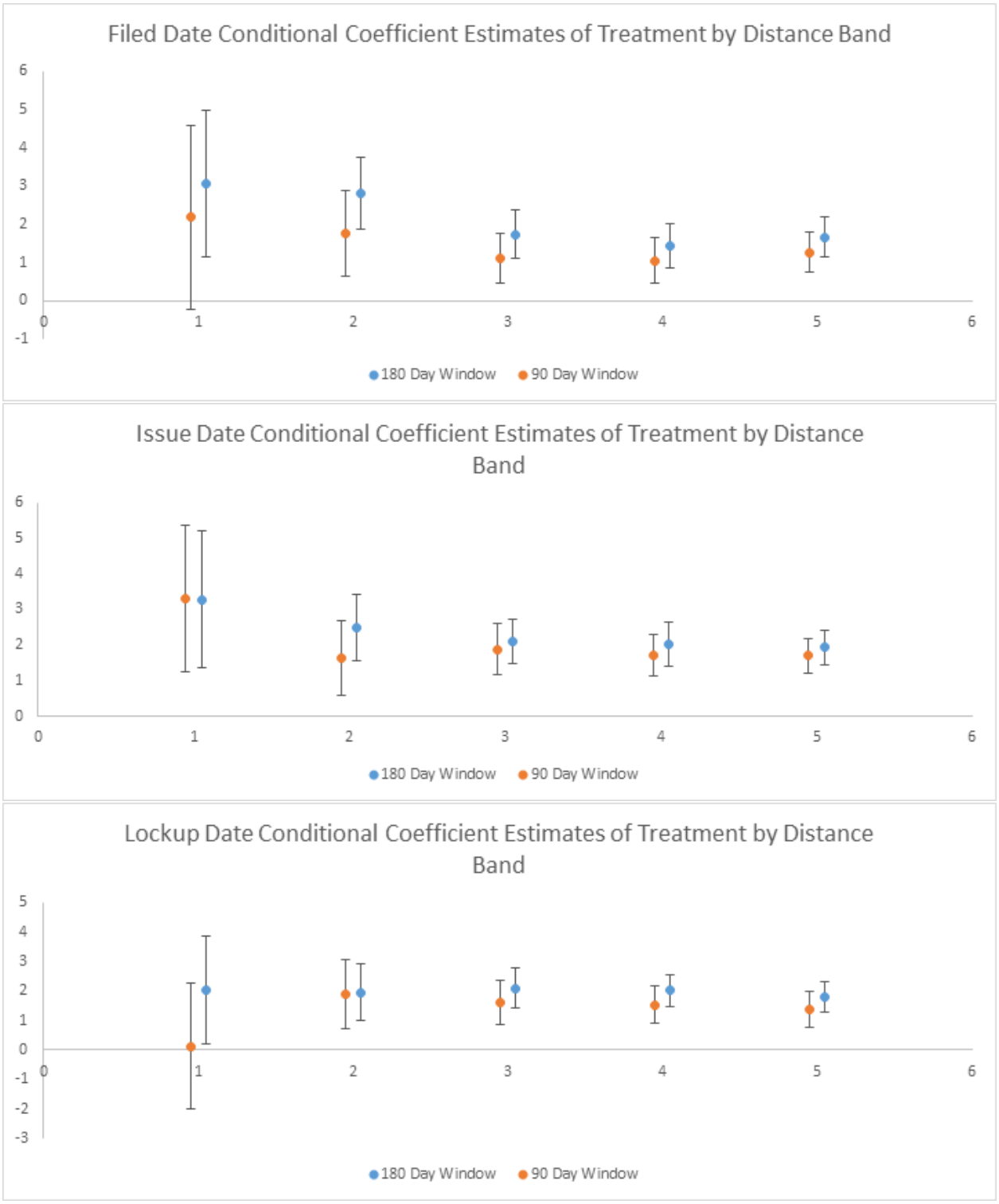


Figure A3. HPI Post Estimates by Firm Age Quartiles at 5 Miles

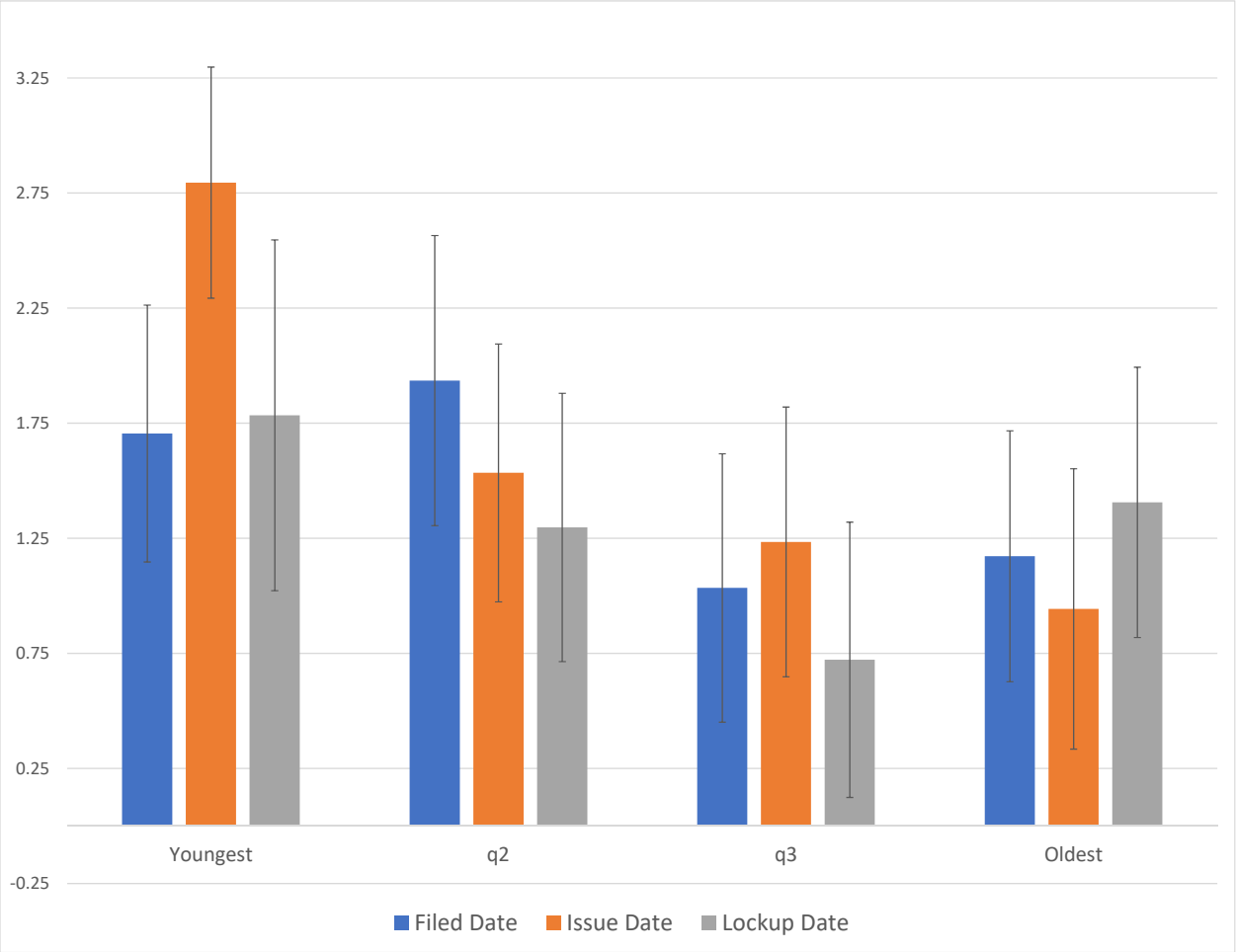


Figure A4. HPI Post Estimates by Total Assets Quartiles at 5 Miles

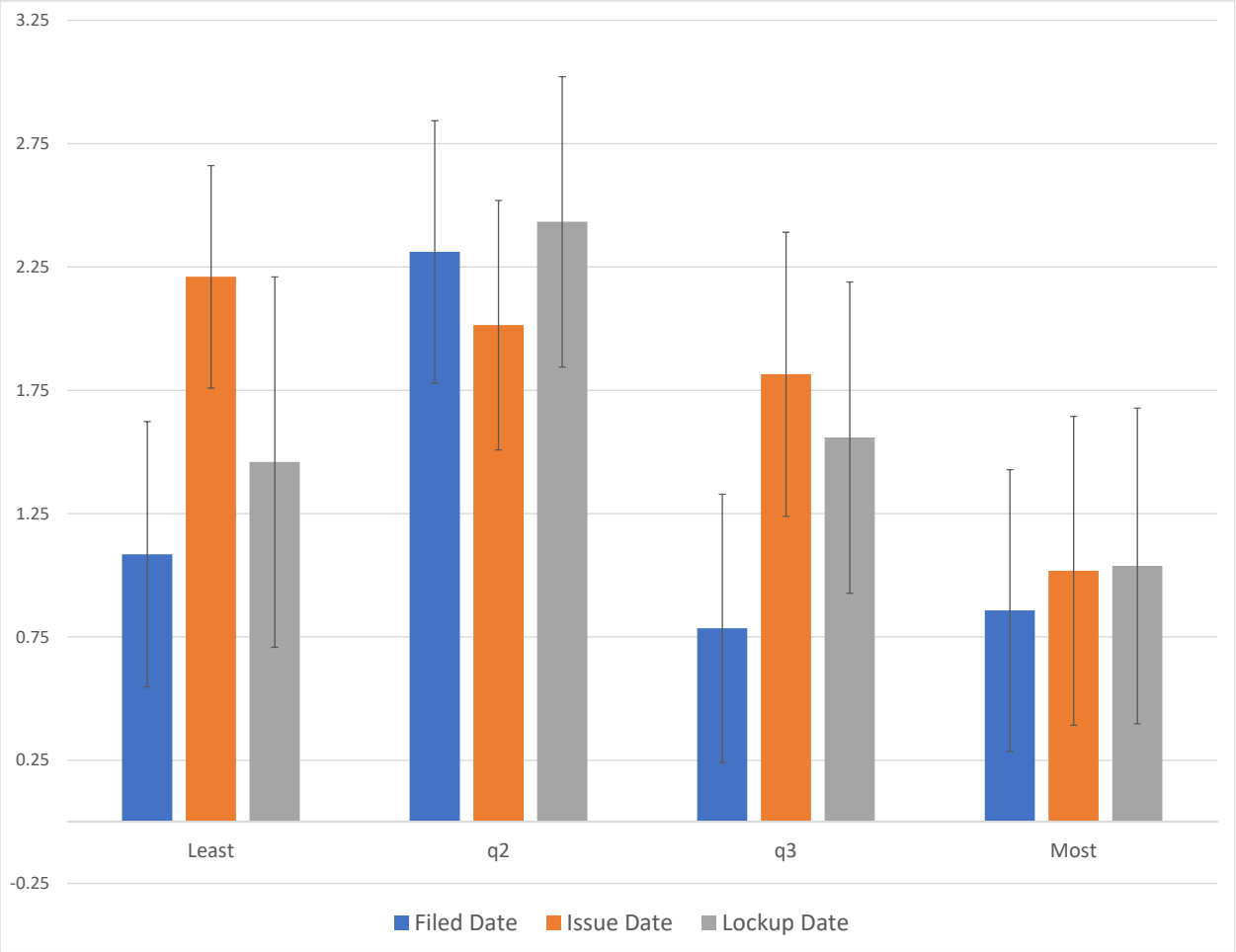


Figure A5. HPI Post Estimates by IPO Proceeds Quartiles at 5 Miles

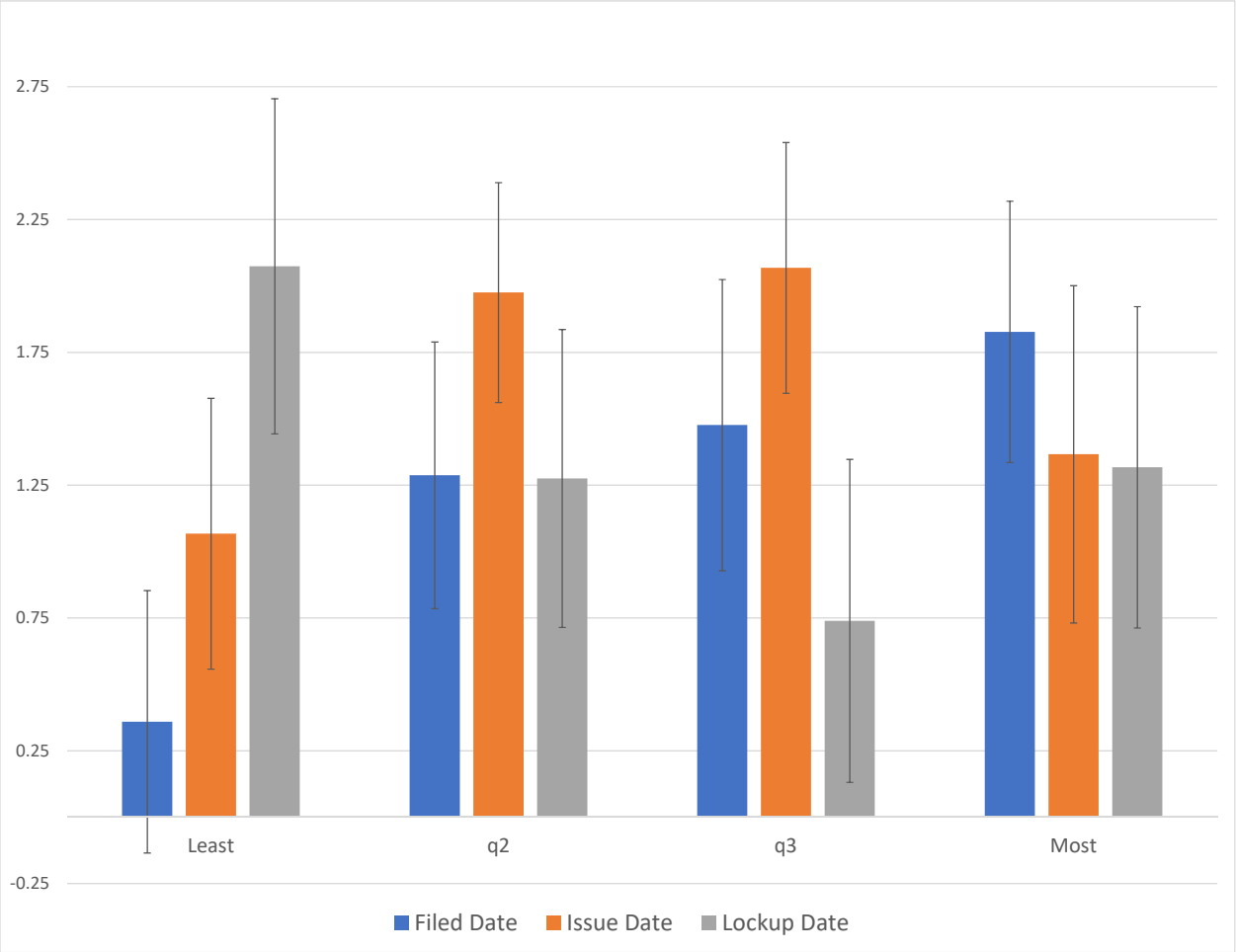


Figure A6. HPI Post Estimates by Offer Price Quartiles at 5 Miles

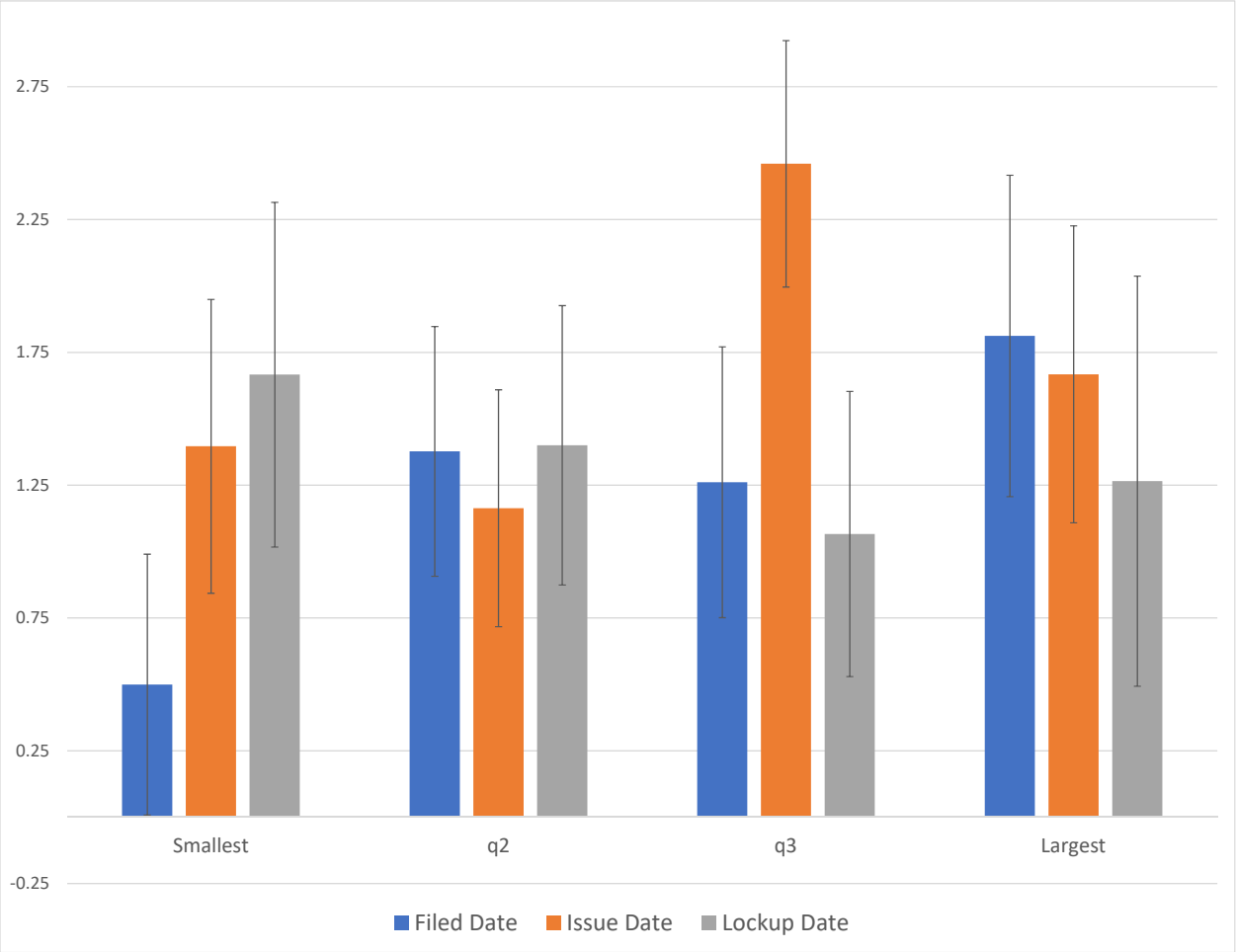


Figure A7. HPI Post Estimates by Underpricing Quartiles at 5 Miles

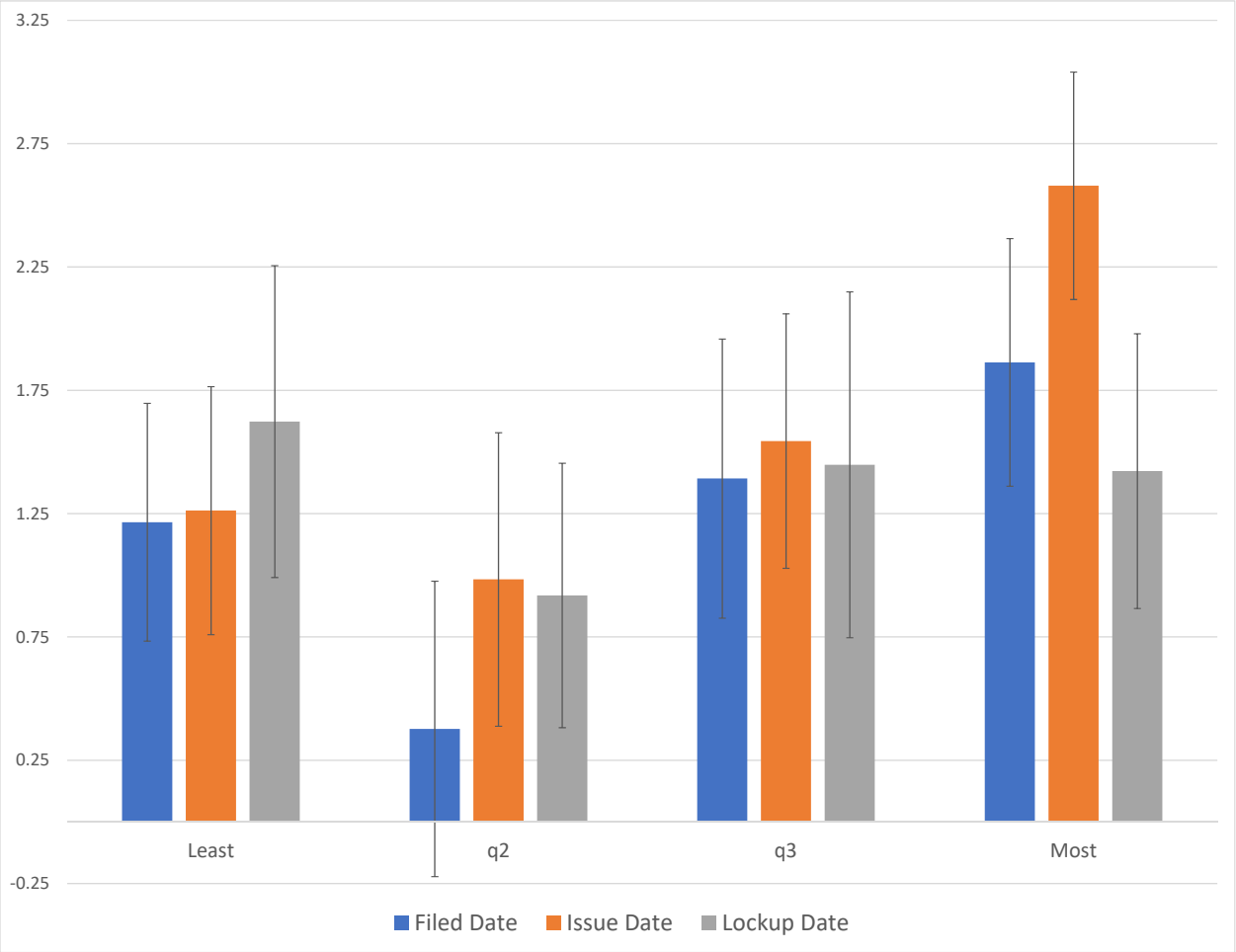


Table A2. Firm Level Summary

Issuer	Facebook Inc	Google Inc	Twitter Inc
Panel A: Firm and IPO Characteristics			
Firm Age	8	6	7
Total Assets ($ mil)	6,859	1,328	993
IPO Offer Price	38	85	26
Proceeds Amount ($ mil)	16,007	1,915	2,093
Shares Outstanding After Offer (mil)	2,138.0	271.2	555.2
Secondary Shares of Shares Offered (%)	57	28	0
Primary Shares of Shares Offered (%)	43	72	100
Panel B: IPO Returns (%) from Offer Price to Close of			
Issue Date	0.61	18.04	72.69
Lockup Date	-47.71	19.42	49.04
IPO at 1 year	-30.92	229.40	57.08
Panel C: IPO Relative Volatility (%) from IPO to Close of			
Lockup Date	15.56	3.18	16.56
IPO at 1 year	15.77	28.51	19.24

IPO returns (%) are calculated as the percentage change from the IPO offer price to the most recent closing price for the lockup date or the date of the IPO at 1 year. IPO relative volatility is the standard deviation of closing prices divided by the average of closing prices over the period.

Table A3. Transaction Level Descriptive Statistics by Firm

Variables	Mean	S.D.	Minimum	Maximum
Panel A: Facebook Inc at 5 miles and 90 days				
Sales Price	1,491,879	1,691,618	2,000	21,750,000
Sales Price*	1,614,614	1,828,451	2,167	23,457,038
Land (sf)	22,115	372,217	512	10,000,069
Total Rooms	7.02	2.20	0.00	19.00
Bed Rooms	3.25	1.05	1.00	8.00
Full Bathrooms	2.20	1.05	1.00	8.00
Half Bathrooms	0.25	0.44	0.00	1.00
Age	51.09	26.19	0.00	109.00
Stories	1.30	0.49	1.00	3.00
Observations	1,441			
Panel B: Google Inc at 5 miles and 90 days				
Sales Price	761,098	505,289	5,000	12,700,000
Sales Price*	999,141	664,160	6,498	16,732,891
Land (sf)	9,131	189,195	512	10,000,069
Total Rooms	6.49	1.86	1.00	15.00
Bed Rooms	2.92	0.95	1.00	9.00
Full Bathrooms	1.95	0.72	1.00	7.00
Half Bathrooms	0.35	0.48	0.00	1.00
Age	35.16	21.45	0.00	101.00
Stories	1.39	0.55	1.00	3.00
Observations	2,794			
Panel C: Twitter Inc at 5 miles and 90 days				
Sales Price	1,189,188	960,534	2,000	11,000,000
Sales Price*	1,253,474	1,011,562	2,094	11,516,995
Land (sf)	4,056	25,987	808	1,137,903
Total Rooms	6.90	2.18	0.00	17.00
Bed Rooms	3.13	1.12	1.00	9.00
Full Bathrooms	2.22	1.07	1.00	8.00
Half Bathrooms	0.00	0.04	0.00	1.00
Age	76.70	26.18	0.00	134.00
Stories	1.53	0.65	1.00	3.00
Observations	2,077			

Displaying California IPOs and property transactions from cleaned data sample. (*) are adjusted or current prices using the monthly CPI or Consumer Price Index for All Urban Consumers: All Items (to December 2017 prices).

Table A4. Sales Price by Firm and IPO Event

	Total		Pre		Post		T-Stat
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Diff.
Panel A: Facebook Inc							
At 5 Miles and 90 Days							
Filed Date	629,279	563,366	617,520	528,570	640,645	594,880	2.71
Issue Date	646,357	740,927	654,034	828,953	638,329	635,938	-1.40
Lockup Date	668,347	912,462	690,948	1,089,577	645,953	693,064	-2.92
At 10 Miles and 90 Days							
Filed Date	962,458	1,046,469	919,071	1,021,422	995,067	1,064,037	1.97
Issue Date	1,107,626	1,302,479	1,039,453	1,120,452	1,177,121	1,461,993	3.19
Lockup Date	1,131,537	1,341,498	1,172,017	1,453,433	1,085,716	1,201,091	-1.89
Panel B: Google Inc							
At 5 Miles and 90 Days							
Filed Date	1,000,426	714,765	993,529	635,877	1,006,327	776,215	0.37
Issue Date	991,647	668,993	989,682	751,588	993,933	558,185	0.13
Lockup Date	987,215	556,426	961,754	522,277	1,017,355	593,262	2.02
At 10 Miles and 90 Days							
Filed Date	937,391	735,448	956,083	791,269	922,717	688,221	-1.77
Issue Date	958,534	721,347	944,388	649,587	974,902	796,164	1.61
Lockup Date	960,202	705,518	940,302	594,198	983,839	817,787	2.31
Panel C: Twitter Inc							
At 5 Miles and 90 Days							
Filed Date	1,201,027	958,956	1,147,601	927,995	1,258,857	989,114	1.82
Issue Date	1,209,390	982,272	1,234,634	1,093,861	1,175,555	809,114	-0.89
Lockup Date	1,314,508	1,064,281	1,300,317	1,004,717	1,327,297	1,116,056	0.40
At 10 Miles and 90 Days							
Filed Date	903,849	735,088	883,321	706,946	926,027	764,061	1.33
Issue Date	907,696	755,126	920,325	823,887	890,522	650,164	-0.85
Lockup Date	990,456	817,441	974,761	789,289	1,004,013	841,118	0.81

Displaying California mean differences of sales price for property transactions in current (December 2017) dollars that are identified as falling in a pre or post IPO event window by firm. The pre and post-periods include transactions within 90 days of the event date where the exact event date is included in the pre-period.

Table A5. Pre-Post at 5 Miles by Firm

Dependent Variable: ln(Sales Price)	Filed Date	Issue Date	Lockup Date
Panel A: Facebook Inc			
Post Event Date	0.134**	0.099**	0.075
	(0.060)	(0.049)	(0.046)
Constant	9.488***	9.890***	10.011***
	(0.666)	(0.882)	(0.891)
Property Characteristics	Y	Y	Y
Adjusted R-Sqr	0.47	0.48	0.50
Observations	638	792	705
Panel B: Google Inc			
Post Event Date	0.020	0.038**	0.030
	(0.020)	(0.018)	(0.019)
Constant	11.019***	11.289***	11.553***
	(0.202)	(0.332)	(0.366)
Property Characteristics	Y	Y	Y
Adjusted R-Sqr	0.47	0.49	0.48
Observations	1,735	1,707	1,640
Panel C: Twitter Inc			
Post Event Date	0.090**	0.023	-0.039
	(0.039)	(0.039)	(0.043)
Constant	11.296***	11.257***	10.513***
	(0.621)	(0.725)	(0.530)
Property Characteristics	Y	Y	Y
Adjusted R-Sqr	0.18	0.18	0.18
Observations	985	894	981

Displaying transaction level OLS estimates where the dependent variable is the natural log of sales price (December 2017 dollars). Displaying robust standard errors and the 1, 2, and 3 stars indicate statistical significance at 10%, 5%, and 1%, respectively.