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Claremont McKenna College

IPO Underpricing and Insider Wealth
Maximization in Internet firms

Submitted to
Professor Lisa K. Meulbroek

by
Bhavika Booragadda

for
Senior Thesis
Fall 2017
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ABSTRACT

This paper empirically tests the theoretical model developed by Aggarwal, Krigman and Womack (2001), which argues that insiders of a firm strategically underprice its initial public offering to maximize personal wealth by selling shares at lockup expiration. First day underpricing generates information momentum for the stock in terms of increased research coverage and recommendations by analysts. Increased research coverage is positively correlated with stock returns and insider selling at the end of the lockup period. Although the value of the stock should be typically based on discounted expected future cash flows, several empirical papers suggest a downward sloping demand curves for new issues (Kaul, Mehrotra and Morck 2000, Field and Hanka 2000), consistent with the assumption of this paper's empirical model. The hypothesis is tested using a sample of 210 internet-based firms such as Social media platforms, online travel agents, online real-estate agents and E-commerce services. The empirical results are significant and consistent with the hypothesis.

SECTION I: INTRODUCTION

An Initial Public Offering (IPO) is the first time the stock of a private company is offered to the public. The proceeds of its sale are used by the company as capital for funding future growth. While interning for a Wealth Management firm over the summer, I observed that clients would often call in and take buy or sell suggestions for newly listed public firms. Since the firm I was interning with was situated in the heart of Silicon Valley, these questions would usually pertain to Technology or Internet-based startup firms, especially firms that were priced low. This led to me to look further into IPO pricing trends and literature, and motivated me to write this thesis.

In an IPO, the issuer typically obtains the assistance of an underwriting firm, which helps determine what type of security to issue, the best offering price, the amount of shares to be issued, timing of the offering and the lockup period. Underpricing refers to the pricing of the initial offering below its market value, and is calculated as the return from offer price to close price on first day of trading. A lockup period is a predetermined amount of time following an IPO where large shareholders, such as company executives are restricted from selling their shares, lasting for six months on an average. In a survey of Chief Financial Officers (CFOs) that took their firms public, Krigman, Shaw and Womack (2001) find that the CFOs of most underpriced firms are highly satisfied with the performance of their lead IPO Underwriter. Issuing owner-managers seem unconcerned about situations of extreme underpricing, even though substantial proceeds are forgone.

So why are IPOs underpriced? Over the last twenty years, a plethora of literature has been published on reasons for underpricing of IPOs. The IPO Underpricing literature can be broken into three main categories. The first category addresses underpricing in relation to greater wealth for the firm's initial owners, which claims that by underpricing the initial offering, firms attract increased research coverage which in turn leads to higher returns for

insiders selling at lockup expiration (See for example, Spiess and Pettway 1997, Rajan and Servaes 1997, Aggarwal, et al. 2001). The second category explores the underpricing signaling hypothesis where in a high-quality firm underprices and IPO with the expectation that the loss can be recouped through a subsequent seasoned equity offering (SEOs) after investors have had the opportunity to recognize the firm's true potential (See for example Welch 1989, Booth and Chua 1996). The third category claims that underpricing generates increased research coverage for the firm, thereby attracting customers and increasing fundamental value of the firm (See for example, Hakenes and Nevries 2000), which is an extension to the underpricing signaling hypothesis.

While there have been recent papers surrounding the underpricing signaling hypothesis, there has not been a recent study discussing the insiders' personal wealth maximization incentives behind underpricing. This paper addresses this gap within the literature by analyzing data from initial public offerings of the last decade, from 2007 through 2016. Hence, this paper tests the implications outlined by Aggarwal et al. (2001) who argue that underpricing creates information momentum, a phenomena of increased interest in the stock, which shifts the demand curve for the firm's stock outwards. This generates higher prices at the lockup expiration, when managers have their first opportunity to sell shares. As a result, managers accept substantial underpricing in order to maximize personal wealth. Although the value of the stock should be typically based on discounted expected future cash flows, several empirical papers suggest a downward sloping demand curves for new issues (Kaul et. al 2000, Field and Hanka 2000), consistent with the assumption of this paper's empirical model.

I argue that it is important to look at data from the recent past since the IPO market is quite dynamic in nature (Figures 1 and 2 show how number of IPOs and underpricing vary over time). Rajan and Servaes (1997) examine the relationship between underpricing, number

of analysts providing earnings estimates and lockup expiration returns for data between 1975 and 1987, and conclude that returns are positively related to research coverage. While Spiess and Pettway (1997) find no evidence that an underpriced IPO leads to greater wealth for the firm's initial owners for data between 1987 – 1991, Aggarwal et al (2001) find contrasting results for a period shortly thereafter (1994 – 1999). Similarly, IPO frenzy has had its ups and downs between 2007 – 2016, especially with the financial crisis of 2008.

The data sample of this paper is restricted to the Internet industry as classified by the Bloomberg Industry Classification Standard (BICS)¹, which includes Internet-based services including Social media platforms, Online travel agents, Online real-estate agents and E-commerce services. Since a part of the data had to be hand-collected, this restriction was vital due to practical considerations. Furthermore, the intuition is that substantial benefit from underpricing can only be derived in a relatively hot IPO industry that is followed by and invested in by a wide range of investors. The last decade saw well-known Internet based firms such Facebook, Twitter, LinkedIn, Etsy, Zillow going public and Alibaba setting the record for the largest US-listed IPO. In the last ten years, Internet firms comprised of 20% and 12% of number of initial offerings and size of initial offerings respectively; no other industry comes as close. Moreover, while the use of stocks and options for executive compensation varies across firms, such compensation seems particularly common in Internet-based companies (Meulbroek 2000).

The model tests the relationship between underpricing, lockup expiration returns and lockup expiration selling through the effects of information momentum. High insider

¹ Bloomberg classifies companies by tracking their primary business activities as measured by their primary source of revenue; it then groups them together according to the end markets these businesses service. These classifications are reviewed annually or after significant event such as an acquisition, merger, or divestiture. The hierarchy comprises of Sector, Industry Group, and Industry, with each company being classified at the Industry level. **SIC classification was not used since SIC codes were developed for traditional industries prior to 1970. As a result, SIC has been slow to recognize new and emerging industries, such as those in the internet and technology sectors, which are relevant to this paper.**

ownership prior to IPO results in higher underpricing, which generates significant information momentum. By underpricing the issue, the large increase in stock price on the first day attracts interest from research analysts and media. The enhanced coverage attracts the attention of more investors, thereby increasing the demand for the stock. Insiders take advantage of this additional demand while selling shares at lockup expiration. Thus, underpricing results in increased insider wealth. The model is tested using a sample of 210 IPOs of Internet based firms, between 2007 and 2016. It is important to note that the insiders' intentional underpricing results in an opportunity cost to the firm in terms of forgone proceeds from the IPO. Ritter (1991) points out that these forgone proceeds lead to long-run underperformance. In this paper, the insider trades off benefits of information momentum against the opportunity cost of the forgone proceeds for the firm.

Agarwal et al (2001) examined IPO data in the years leading up to the dotcom bubble crash, where more than 50% underpricing was quite common. Although 2007 – 2016 was not a period of extreme underpricing, the results of this paper are consistent with Rajan and Servaes (1997) and Agarwal et al (2001). Firms in which insiders hold a high number of shares and options have greater first-day underpricing. Firms with greater first-day underpricing receive substantially more recommendations from research analysts in the months leading up to the lockup expiration. Finally, increased research coverage from analysts leads to higher stock prices and greater insider selling at lockup expiration.

This paper consists of the following sections. Section II describes the data sources, the sample and its characteristics. Section III presents the empirical model and results. Sections IV and V discuss the shortcomings and conclude the paper respectively.

SECTION II: DATA AND DATA SOURCES²

Internet-based IPOs in 2007 through 2016 listed on a United States Exchange were examined, a period during which 53% of the firms had more than 15% first-day underpricing. The Bloomberg Industry Classification Standard (BICS) served as a reference to narrowing down the sample to Internet-based firms, comprising of online travel agents, social media, e-commerce firms and so on. The data comes from several sources. Bloomberg's IPO database is used for data on characteristics of the IPO: Effective Offer Date, Offer Price, Offer Size, Number of Primary and Secondary Shares offered in the IPO, Venture Capital (VC) Backed, Private Equity (PE) Backed, VC Exit, PE Exit, and Lockup Expiry date. The data on insider ownership pre-IPO was hand collected from the S-1 form, a Securities and Exchange Commission (SEC) registration filing used by companies intending to go public. The S-1 form was used to gather data on number of executives and directors with insider ownership, executive stock ownership as a percentage of shares outstanding and executive options ownership as a percentage of shares outstanding. The following positions are included in the definition of an insider: Chairman of Board, President, Chief Executive Officer, Chief Financial Officer, Vice President, General Partner, Officer, Director, Chief Accounting Officer, and Controlling Person. Ang and Brau (2003) study concealment strategies by insiders and state that they underreport the number of personally owned shares in the original S-1, and instead use an obscure amendment to communicate the true higher level; hence, the most recent amendment of the S-1 was used to gather the required data for this paper.

First day underpricing defined as the return from the offer price to close price of first day of trading is calculated using security prices data from the Center for Research in Security Prices (CRSP) database. CRSP database is also used to examine returns between the IPO and lockup expiration. The theoretical model developed by Aggarwal et al (2001)

² A detailed list of variables and descriptions is available in Appendix I.

predicts that underpricing generates information momentum. In this paper, Research Analyst reports are used as a proxy for information momentum. The Institutional Brokers' Estimate System (IBES) database available through the Wharton Research Data Services is used to identify the timing and quantity of research recommendations of firms in the Bloomberg IPO dataset. The data on number of buy, hold and sell recommendations as well as number of analysts tracking the IPO from the effective date of the IPO through one month following the expiration of the lockup provision is collected.

The Thompson Reuters Insider trading database is used to identify insider sales around lockup expiration. This database has the transaction details of all insider filings received by the SEC beginning in 1986. The definition of insiders remains consistent from pre-IPO insider ownership. The transactions are dated and coded by the type of transaction. They also contain the name and position of insider, the number of shares, and the transaction price. Insider selling data two months prior to two months following the lockup expiration date is collected, since selling prior to the expiration of the lockup is permitted with written consent of the lead underwriter. However, most underwriters do not choose to waive lockup periods early since the Financial Industrial Regulatory Authority (FINRA) mandates a public disclosure of the same (Rule 5131). In certain instances, where an early lock-up release permitted insiders to sell into the market, shareholders (public investors) have sought to bring a class action in connection with losses suffered as a result of the drop in the issuer's stock price.

Finally, several control variables are included in the empirical model. An indicator variable for a subsequent equity offering for each firm is included. This data is available on Bloomberg. The name of the lead underwriter, number of co-managers, and executive compensation packages were compiled from the most recent amendment of the S-1 form. The lead underwriter ranking is based on the adjusted Carter-Manaster rankings from Jay Ritter's

IPO data³ (Carter and Manaster 1990). All other returns, market capitalization post-IPO and trading volume data is captured from the CRSP database.

Tables 1 and 2 contain summary statistics of the primary data sample. In the sample, 153 IPOs, or 73% of the sample are between calendar years 2011 – 2014. This can be explained by the occurrence of the 2008 financial crisis, and the subsequent take-off of the market post crisis. IPO markets in 2008 and 2009 were duller compared to the rest of the time periods in the sample, accounting for only 3% of the sample. Hence, the changes in the IPO market through time are controlled for in the empirical analysis. In Table 1, the average offering size of the IPO is \$320 million, with a mean offering price of \$10.22 per share. The distribution for size of offering is quite skewed with a mean of \$320 million and median of \$62.30 million. This can be attributed to the presence of certain high profile and large IPOs in the sample by firms such as Facebook and Alibaba (\$16 billion and \$25 billion offer sizes respectively). The mean underpricing (measured as offer to first day close) is 29.3% and the median is 17.2%. This is significantly lower when Agarwal et. al (2001) findings, which is not surprising considering that their period of study (1994 – 1999) constituted of extreme underpricing. In this sample only 28% of the firms sold secondary shares. 36% of the offerings were backed by Venture Capitalists and 33% were backed by Private Equity firms at some point in time. In 29% and 16% of the firms, the exit, or in this case the initial public offering was carried out under the guidance of a Venture Capitalist and Private Equity firm respectively. Unlike Venture Capital firms which typically invest minority stakes in early stage companies with proprietary technology, Buyout or Private Equity firms invest majority stakes in mature companies. Hence, the difference in preferences are controlled for in the empirical analysis by including VC and PE Indicator variables. The mean rank of the Lead Underwriter was 5.7, measured on a scale of 1.1 to 9.1, with the assistance from an average

³ <https://site.warrington.ufl.edu/ritter/ipo-data/>

of 1.89 co-managers. A majority of the firms (75%) in the sample have a lockup period of 180 days, a standard practice in the IPO market.

Panel A of Table 2 comprises of details of insider ownership prior to the initial public offering. On average, managers hold 58% of stock and 6% of options as a percentage of shares outstanding. Venture capitalists, Angel investors, Buyout firms, Non-management employees and others hold the rest. The high stock ownership is common in Internet-based firms. While the percentage of options ownership is lower for the industry, it is common for startups to have limited options since they are not well-established in the market. Panel B of Table 2 contains the summary statistics on Research coverage. In the sample, 8% of firms have no research coverage from the time of the IPO until one month after the expiration of the lockup period. For firms with research coverage, the mean number of analysts making recommendations is 6.08. This is significantly higher than Agarwal et. al (2001) findings, and can be attributed to the fact that internet firms receive more coverage in general. Each IPO with Research Coverage was mentioned 52.9 times on average. Panel C of Table 2 provides a summary on insider selling around the lockup expiration. In the sample, 91% of the firms have insider selling in the period two months prior to two months following the lockup expiration with an average of 9.58% of shares outstanding sold; 5% of these firms have insider selling prior to lockup expiration with an average of 6.89% of shares outstanding sold.

SECTION III: EMPIRICAL MODEL, RESULTS AND ANALYSIS

The Empirical Model tests four assumptions as outlined by Agarwal et al (2001), which suggest that underpricing affects lockup expiration returns and insider selling through the effects of information momentum. The first implication is that higher insider ownership prior to initial offering leads to greater underpricing. The second claim that is empirically tested is whether high first day underpricing generates information momentum in the form of greater levels of research coverage by analysts. Then, the model estimates if increased research coverage leads to higher returns at the expiration of lockup. The fourth and final implication is if the number of shares sold by insiders around the expiration of lockup is increasing with research coverage.

In order to determine if high insider ownership prior to IPO leads to greater underpricing, the following linear model is estimated:

$$y_{it} = \alpha + \beta x_{it} + \mu_t + \epsilon_{it}$$

where y_{it} is a measure of underpricing, that is, the offer price to close return on the offering's first day. x_{it} is a vector of independent variables that includes insider stock and options ownership measured as a percentage of outstanding stock, secondary shares measured as a percentage of total shares offered in the IPO, Log of Offer Size, Lead IPO underwriter rank, Number of co-managers, and Indicator variables for VC backed firms, PE backed firms, and Subsequent equity offerings. A calendar year indicator μ_t is included to control for any time effects and changes in the IPO and financial markets, especially financial crisis of 2008. ϵ_{it} is the error term with the usual properties. The independent variables of interest are insider stock and options ownership measured as a percentage of outstanding stock, and secondary shares measured as a percentage of total shares offered in the IPO. Since, Secondary Shares in contrast to Primary shares refer to shares of existing shareholders that are sold to investors

in an offering, intuitively, high percentage of Secondary shares in an IPO should result in lower underpricing.

The size of the offering is controlled by including Log of Offer Size and quality of offering is controlled by including the rank of the Lead IPO underwriter and number of co-managers. Higher quality offerings are underwritten by higher quality investment banks, and that higher quality investment banks have greater market share in terms of IPO proceeds raised (Megginson and Weiss 1991). Hence, higher the quality of the underwriter, lower the incentive of underwriter to underprice the IPO. Indicator variables for VC and PE backed firms are also included (VC Backed, VC Exit, PE Backed, PE Exit). Unlike venture firms which typically invest a minority stake in early-stage companies with proprietary technology, buyout or PE firms invest majority stakes in mature companies. This might result in significant differences that arise in underwriting due to the difference in investment strategies and level of involvement of the pre-IPO investor. The underpricing signaling hypotheses (Welch 1989) is controlled for by including an indicator variable for follow-on or subsequent equity offerings. The results are contained in Table 3.

The first regression leads to notable findings. Consistent with the literature (Rajan and Servaes 1997, Aggarwal et al 2001), Underpricing is positively correlated with Insider stock ownership. Intuitively, options ownership should follow the same relation as stock ownership with underpricing. On the other hand, Secondary shares sold in an IPO should have an inverse relationship with underpricing, since secondary shares are shares of the insiders and other existing stockholders sold in the IPO. While Insider options ownership and Secondary shares sold in the offering are positively and negatively correlated with Underpricing respectively in the estimates, their coefficients are insignificant. This could be attributed to the fact that a lower proportion of firms in the sample had insider options ownership (6% of total sample) and secondary shares (28% of total sample) sold in the IPO. Overall, the results

are consistent with the implication that managers with larger holdings are willing to underprice more. While the economic significance of this effect is larger compared to the Agarwal et al (2001) findings, the effect still remains minimal; an increase of 10% in insider stock ownership is associated with a 4.4% increase in underpricing.

The second implication of the model tests whether higher first day underpricing leads to greater levels of research coverage in the form of frequent mentions in the IBES Database. As an initial investigation of the above implication, the sample is partitioned into four groups based on Aggarwal et al (2001) IPO underpricing cutoff levels; Cold IPOs have an underpricing of 0% or below, Cool IPOs are underpriced between 0 – 10%, Hot IPOs are underpriced between 10 – 60% and extra-hot IPOs have an underpricing greater than 60%. In Table 4, consistent with the findings of Rajan and Servaes (1997), the number of times the stock was mentioned in the IBES database is increasing with the level of underpricing.

In order to formally test if first day underpricing leads to greater number of mentions in the IBES Database, a Heckman two-stage model is estimated (Heckman 1979). The first stage is designed to explain why IBES has no research coverage for certain firms. As noted by the Wharton Research Data Services (WRDS) portal, WRDS had recently discontinued the First Call Research Coverage database and merged it with the IBES Estimates. Hence, the lack of research coverage data in the sample is probably due to IBES database missing data in the data merging process, rather than no research coverage occurring. The second stage estimates the impact of underpricing on research coverage, after correcting for potential selection bias.

The first stage is a probit model as outlined below.

$$\text{Stage 1 : } y_{it} = \alpha + \beta x_{it} + \mu_t + \epsilon_{it}$$

where y_{it} is an indicator for a firm's mention in the IBES Database, equaling 1 if the firm was even mentioned from the time of the IPO through one month following the lockup

expiration period, or 0 otherwise. x_{it} is a vector of independent variables that Log of Market Capitalization measured four weeks following the IPO, Lead Underwriter rank, and Indicator variables for VC and PE backed firms. A calendar year indicator μ_t is included to control for any time effects and changes in the IPO and financial markets. ϵ_{it} is the error term with the usual properties.

The second stage is a linear estimation as outlined below:

$$\text{Stage 2: } y_{it} = \alpha + \beta x_{it} + \gamma(\text{Inverse mills ratio}) + \mu_t + \epsilon_{it}$$

where y_{it} is Research Coverage, defined as the total number of mentions in the IBES database from the time of the IPO through one month following the lockup expiration period. x_{it} is a vector of independent variables that includes underpricing, underpricing squared, Log of Market Capitalization measured four weeks following the IPO, Lead Underwriter rank, Number of Co-Managers, Turnover (measured as the average amount of trading volume in the first month as a percentage of shares offered in the IPO), and Indicators for VC and PE backed firms. The inverse mills ratio estimated in the first stage is also included as an independent variable. A calendar year indicator μ_t is included to control for any time effects and changes in the IPO and financial markets. ϵ_{it} is the error term with the usual properties.

The independent variables of interest are Underpricing and Underpricing squared. The Underpricing squared term is included to test for concavity in the relationship between underpricing and information coverage as outlined by the theoretical model in Aggarwal et al (2001). A control of Number of co-Managers is added since IPOs with higher number of Co-Managers might have increased marketing efforts and roadshows, thereby receiving greater coverage. A variable for Turnover is also included, measured as the average amount of trading volume in the first month as a percentage of shares offered in the IPO to control for the possibility that greater volume leads to greater research coverage. The first stage is estimated with the full sample of 210 firms. The second stage only includes 193 firms, which

have some level of research coverage. The results are contained in Table 5 (Panel A and B comprise of Heckman first and second stage results respectively).

Focusing on the second stage estimates of the Heckman analysis (Table 5, Panel B), the number of mentions in the IBES database by research analysts following the stock is significantly related to the level of Underpricing. These results are consistent with those in Rajan and Servaes (1997), who find that the number of analysts providing earnings estimates is positively associated with IPO underpricing. Consistent with the theoretical model outlined by Agarwal et al (2001) which assumes concavity of the information momentum generating function, the relationship between Underpricing and Research Coverage is concave, as suggested by the positive coefficient of Underpricing and negative coefficient of Underpricing Squared in the linear estimation. The economic significance of this estimation is quite substantial; an increase of 1% in underpricing is associated with an additional 3.63 mentions in the IBES Database. This makes sense intuitively since the internet industry garners more attention from analysts, in general.

In order to test if increased research coverage leads to higher returns at lockup expiration, the following linear model is estimated:

$$y_{it} = \alpha + \beta x_{it} + \mu_t + \epsilon_{it}$$

where y_{it} is the Lockup period expiration return. x_{it} is a vector of independent variables that includes Number of mentions in the IBES Database, Log of Market Capitalization measured four weeks following the IPO, Lead Underwriter rank, Number of Co-Managers, Indicator variables for VC and PE backed firms, Research Coverage indicator, Underpricing, and Underpricing Squared. A calendar year indicator μ_t is included to control for any time effects and changes in the IPO and financial markets. ϵ_{it} is the error term with the usual properties.

Table 6 shows that research coverage defined as the number of mentions of the stock by analysts from the time of the IPO to one month following the lockup expiration is positive and significant in explaining returns at lockup period expiration. Furthermore, there is no independent and significant effect of Underpricing on returns. This is consistent with the hypothesis that there is no clear direct relationship between lockup expiration returns and level of Underpricing, except through the effects of information momentum. From Table 5, an increase of 1% in underpricing is associated with an additional 3.63 mentions in the IBES Database, which in turn leads to an incremental return of 1% during lockup expiration.

The fourth and final implication of whether insider selling around lockup expiration is increasing with research coverage is estimated in two ways - a Logit and a Tobit Model.

$$Y_{it} = \alpha + \beta x_{it} + \mu_t + \epsilon_{it}$$

In the Logit specification, y_{it} equals one if there are any stock sales by insiders in the period from two months prior to two months following the lockup expiration. In the Tobit specification, y_{it} is defined as the amount of stock sold by insiders in the period two months prior to two months following the lockup expiration as a percentage of total shares outstanding. x_{it} is a vector of independent variables that includes Returns at lockup expiration, Number of Mentions in the IBES database, Research Coverage indicator, Log of Market Capitalization measured four weeks following the IPO, Lead Underwriter rank, Number of Co-Managers, Indicator variables for VC and PE backed firms, Underpricing, Underpricing Squared and a Percentage of base salary and cash bonus as a percentage of executive compensation package. Base salary and cash bonus as a percentage of executive compensation package is included to control for liquidity needs of insiders. As Meulbroek (2000) points out, many managers in Internet-based firms have undiversified portfolios, holding mainly equity of their firms. Hence, high amount of insider selling can be attributed to lack of diversification in their portfolio and liquidity. A calendar year indicator μ_t is

included to control for any time effects and changes in the IPO and financial markets. ϵ_{it} is the error term with the usual properties.

Consistent with Agarwal et. al (2001), insider selling around lockup expiration is increasing in the number of recommendations made by analysts (Table 7). Although lockup sales as a percentage of total shares outstanding is increasing with level of underpricing in Table 5, Underpricing, Underpricing squared and Lockup expiration returns do not have an independent effect on insider sales around lockup expiration according to results in Table 7. Thus underpricing, returns and sales only operate through the effects of information momentum. Finally, from Table 5, an increase of 1% in underpricing is associated with an additional 3.63 mentions in the IBES Database, which in turn leads to an incremental insider selling of 3.9% around lockup expiration.

SECTION IV: SHORTCOMINGS

The dataset was limited by the availability of pre-IPO insider ownership data. Since the insider stock and options ownership data prior to the initial public offering had to be hand collected, the sample was restricted to a narrower time frame and industry. If more data was accessible, the results could have potentially been more impactful. In the first linear estimation of the effect of pre-IPO ownership on the degree of underpricing, a control (indicator) variable for Subsequent Equity offerings (SEO) is included to control for the effects of underpricing signally hypothesis. However, since a SEO can take place any time period after the initial offering, this variable is dynamic, and is not the best representation of whether a company chooses to make a secondary offering. It is also important to note that certain a small proportion (7%) of IPOs in the sample were not assisted by an underwriter, and thus were assigned a rank of zero; this might have slightly skewed the mean of underwriter ranking. Furthermore, since a comprehensive dataset is not available for recent rankings, this paper uses underwriter rankings as of 2003. Hence, this might have affected the lead underwriter rankings of IPOs post 2003.

Certain companies have a staged lockup expiration process for insiders, in which a proportion of shares remain locked in even after the first lockup expires, and can only be sold at the second or third lockup expiration. In this paper, the model uses the first lockup expiration as a data point while calculating lockup expiration returns and identifying insider sales. Although this is a fair assumption, since only 2% and 1% of the firms in the sample have a second and third lockup period respectively, it still could have potentially impaired the insiders' ability to sell after the first lockup expiration, thus bringing in potential biases in the insider selling data. While adding control variables in the fourth linear estimation that could potentially affect insider sales besides high returns at lockup expiration, the model includes an estimate of base salary and cash bonuses as a percentage of total executive compensation

to control for insiders' liquidity needs. However, the model does not account for the diversification needs of the insiders. As Meulbroek (2000) points out, insiders in Internet-based firms have largely undiversified portfolios, holding mainly the equity of their companies. Hence, managerial selling can also be attributed to the fact that insiders do not want to bear the full volatility of internet firms. An alternative explanation for this paper's findings is insider risk aversion. More risk-averse insiders would want to underprice more in order to ensure that the IPO is successful. However, risk-averse managers would also want to sell secondary shares in the IPO, which is not a predominant feature in this data sample (only 28% of firms sold secondary shares). While there is very weak evidence (in Table 3) that IPOs in which insiders sell secondary shares are underpriced less, this does not seem to be a full explanation since very few insiders sell initially.

SECTION V: CONCLUSION

This paper develops a model in which insiders underprice the initial public offering to maximize personal wealth. Unlike previous literature (See for example, Spiess and Pettway 1997, Rajan and Servaes 1997, Aggarwal, Krigman and Womack 2001) which examined all initial public offerings in a given time period, the data sample in this paper consists solely of Internet-based firms. The data sample consists of 210 IPOs of internet-based firms spanning the time period of 2007 to 2016. Consistent with the hypothesis, underpricing creates information momentum, thereby generating increased returns and high selling at lockup expiration, when insiders have the first opportunity to sell. As a result, managers accept substantial underpricing in order to maximize personal wealth. The economic significance is noteworthy; an increase of 1% in underpricing is associated with an incremental return of 1% and increased insider selling of 3.9% during lockup expiration. The key condition for this model is that the value of information momentum must be sufficiently high so as to significantly shift out the demand curve for a new issue. Intuitively, such a condition is likely to be met in hot IPO markets, such as internet-related firms.

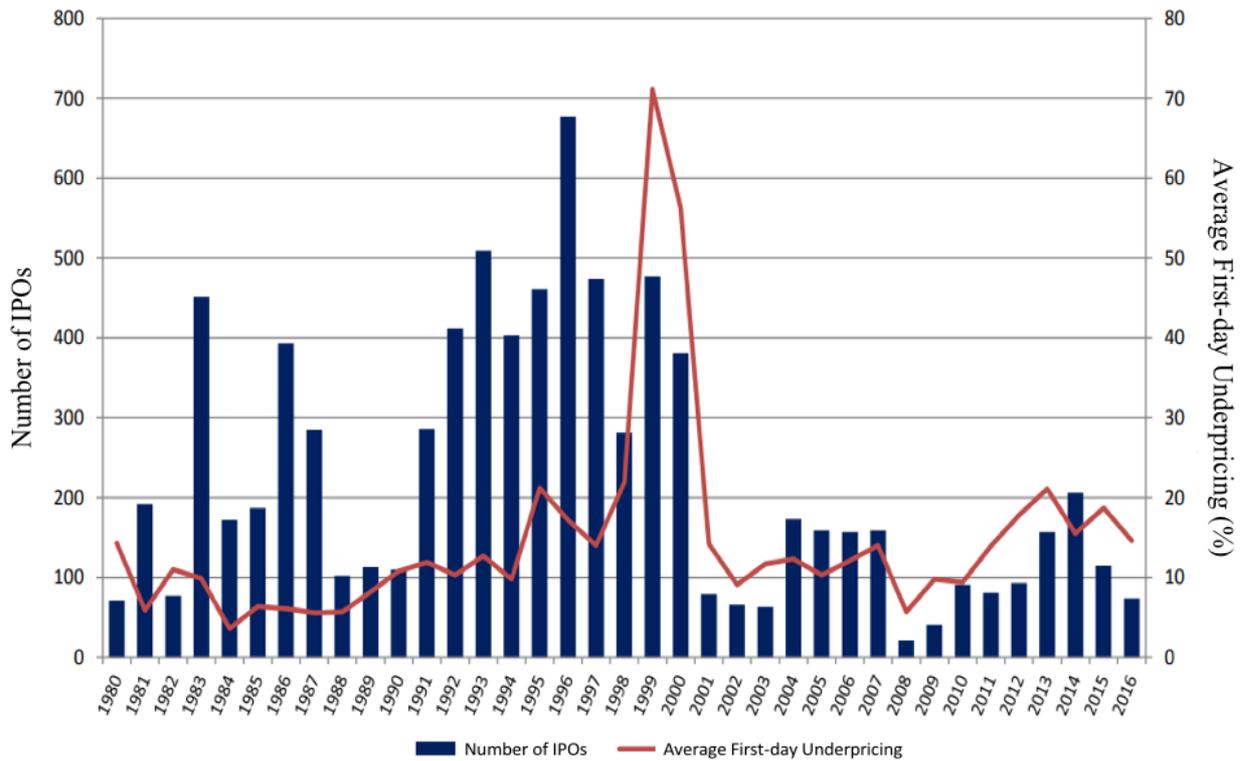
The dataset was limited by the availability of pre-IPO insider ownership data. Since the insider stock and options ownership data prior to the initial public offering had to be hand collected, the sample was restricted to a narrower time frame and industry. If more data was accessible, a comparative study could have been carried out to test the value of information momentum and benefits to substantial underpricing in hot IPO markets (such as internet-related firms) versus cold IPO markets. Intuitively, when the value of information momentum is low, in industries that are not perceived to be hot, there should be little benefit to substantial underpricing.

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Figure 1:

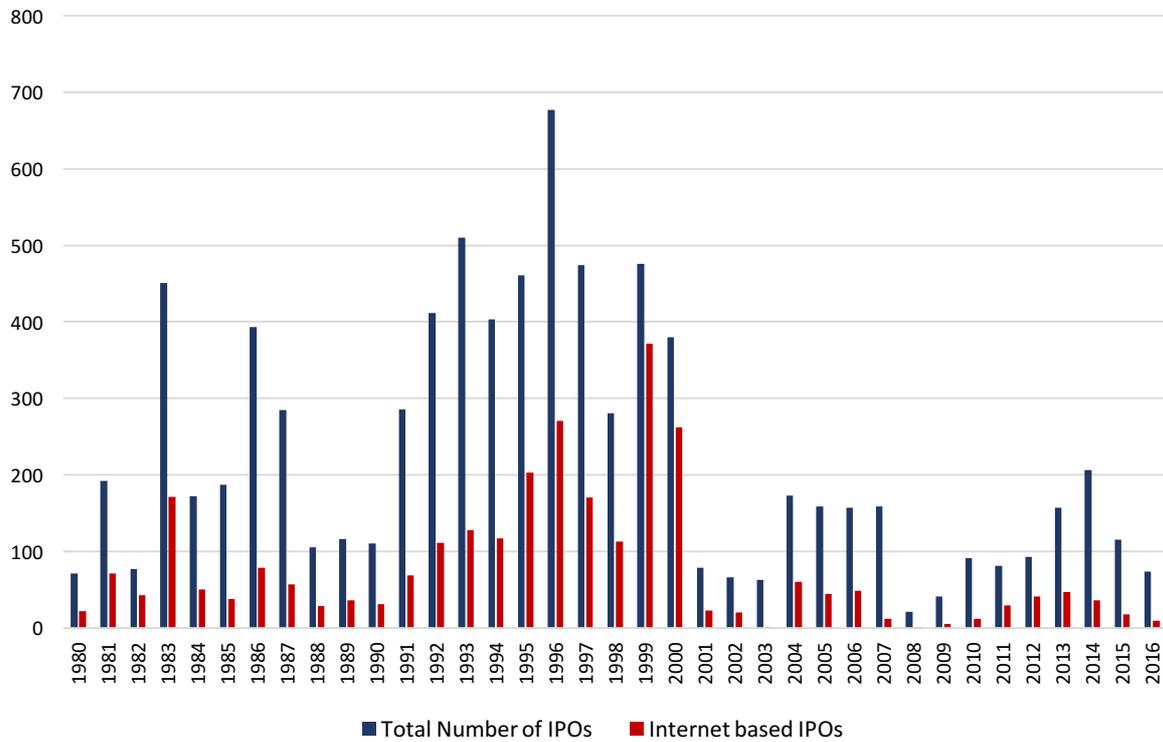
Number of Initial Public Offerings and Average First-day Underpricing 1980 – 2016 (Source: Jay Ritter’s IPO Data)⁴



⁴ <https://site.warrington.ufl.edu/ritter/ipo-data/>

Figure 2

Number of Initial Public Offerings (Total and Internet based firms) 1980 – 2016 (Source: Jay Ritter’s IPO Data⁵ and Bloomberg)



⁵ <https://site.warrington.ufl.edu/ritter/ipo-data/>

Table 1:**Summary Statistics of IPO Data**

The sample consists of 210 firms that completed an initial public offering (IPO) between January 2007 and December 2016. All internet-based firms listed on a Unites States exchange are included. Data presented include mean and median of Offer price (per share), Secondary shares sold in the offering as a percentage of total number of shares offered, Size of Offering, Market value of Equity of firm 4 weeks post-IPO, Percentage of sample that was backed by Venture capitalists prior to IPO, Percentage of sample that was backed by a Private Equity firm prior to IPO, IPO Lead Underwriter rank, Number of Co-Managers in the IPO, Number of days in lockup period, and Lockup period expiration return.

	Mean	Median
Observations		210
Offer Price (per share)	10.22	9.60
Offer Size (\$ Million)	320.00	62.30
% Secondary Shares Offered	27.58%	22.30%
Market Value of Equity (\$ Million)	1730	98.30
Underpricing	29.30%	17.22%
% Venture backed	36.19%	
% Venture exit	13.81%	
% PE backed	32.86%	
% PE exit	16.19%	
Lead Underwriter Rank	5.73	6.1
Number of Co-Managers	1.89	0
Days in lockup expiration	163.92	180
Lockup Expiration return	8.60%	9.86%

Table 2:**Summary statistics of Insider Shareholdings, Research Coverage and Insider selling data**

The sample consists of 210 firms that completed an initial public offering (IPO) between January 2007 and December 2016. All internet-based firms listed on a Unites States exchange are included. Data presented in Panel A includes mean and median of shares and options held by insiders as a percentage of shares outstanding. Panel B presents the summary statistics of firms with and without research coverage in the IBES database. The mean and median of number of mentions, number of buy recommendations and number of analysts covering the stock from the time of the IPO to one month following the lockup expiration are presented for firms with some level of research coverage. Panel C comprises of Insider selling data collected two months prior to two months following lockup expiration.

	Mean	Median
<i>Panel A: Insiders Shareholdings Data</i>		
Percent shares held by insiders	57.92%	66.21%
Percent options held by insiders	5.77%	4.89%
<i>Panel B: Research Coverage</i>		
Firms with no research coverage	8.10%	
Firms with research coverage	91.90%	
Total number of IBES Mentions	52.95	35.00
Total number of Buy Recommendations	49.73	32.00
Number of Analysts	6.08	5.00
<i>Panel C: Insider selling around lockup expiration</i>		
Firms with no insider selling at lockup expiration	8.57%	
Firms with selling at lockup expiration	91.43%	
Shares sold as a percentage of outstanding stock	9.58%	10.83%

Table 3:**Pre-IPO Insider Ownership and IPO Underpricing**

The sample consists of 210 firms that completed an initial public offering (IPO) between January 2007 and December 2016. All internet-based firms listed on a United States exchange are included. The dependent variable is a measure of underpricing, that is, the offer price to close return on the offering's first day. The Independent variables are Insider stock and options ownership measured as a percentage of outstanding stock, secondary shares measured as a percentage of total shares offered in the IPO, Log of Offer Size, Rank of lead IPO underwriter, Number of co-managers, and Indicator variables for VC backed firms, PE backed firms, and Subsequent equity offerings. A calendar year indicator is included to control for any time effects and changes in the IPO and financial markets.

Underpricing	
Intercept	-8.489 [0.828]
Percent management shares held	0.443 [0.001]
Percent management options held	0.219 [0.753]
Secondary shares at IPO	-0.126 [0.225]
Venture Capital backed IPO indicator	-0.029 [0.859]
Venture Capital exit IPO indicator	-0.049 [0.736]
Private Equity backed IPO indicator	-0.002 [0.986]
Private Equity exit IPO indicator	0.102 [0.512]
Log of IPO Offer Size	-0.003 [0.848]
Number of Co-Managers	-0.004 [0.792]
Lead Underwriter Rank	-0.008 [0.532]
Subsequent Equity offering indicator	0.062 [0.477]
Calendar year dummies	0.004 [0.824]

Table 4:**Research Coverage and IPO Underpricing partitioned by level of Underpricing**

The sample consists of 210 firms that completed an initial public offering (IPO) between January 2007 and December 2016. All internet-based firms listed on a Unites States exchange are included. The sample is partitioned into four groups based on Aggarwal et al (2001) IPO underpricing cutoff levels; Cold IPOs have an underpricing of 0% or below, Cool IPOs are underpriced between 0 – 10%, Hot IPOs are underpriced between 10 – 60% and extra-hot IPOs have an underpricing greater than 60%. Data presented include number of observations, mean and median of Number of IBES Mentions and Number of Analysts making recommendations from the time of the IPO through one month following the lockup expiration period, and lockup sales two months prior to two months following lockup period expiration as a percentage of total shares outstanding.

	Cold IPO UP < 0%		Cool IPO 0% < UP < 10%		Hot IPO 10% < UP < 60%		Extra Hot IPO UP > 60%	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Observations	68		19		97		26	
Number of IBES Mentions	5.47	5.00	10.14	9.60	56.04	57.56	162.28	130.22
Number of Analysts making recommendations	2.00	2.00	5.68	7.00	7.67	7.18	8.15	8.00
Lockup Sales at Expiration	3.30%	1.56%	9.70%	10.45%	11.59%	12.78%	11.84%	13.16%

Table 5:**Research Coverage and IPO Underpricing by Heckman 2-stage estimation*****Panel A: First stage estimates***

The first stage model is a Probit model explaining when the dependent variable in the second stage is missing. The sample consists of 210 firms that completed an initial public offering (IPO) between January 2007 and December 2016. All internet-based firms listed on a Unites States exchange are included. The dependent variable is an indicator for a firm's mention in the IBES Database, equaling 1 if the firm was even mentioned from the time of the IPO through one month following the lockup expiration period, or 0 otherwise. The independent variables are Log of Market Capitalization measured four weeks following the IPO, Lead Underwriter rank, and Indicator variables for VC and PE backed firms. A calendar year indicator is included to control for any time effects and changes in the IPO and financial markets.

Research Coverage Indicator Variable	
Intercept	-7.027 [0.742]
Log of Market Value of Equity post-IPO	-0.005 [0.417]
Lead Underwriter Rank	0.005 [0.464]
Venture Capital backed IPO indicator	-0.027 [0.667]
Venture Capital exit IPO indicator	-0.082 [0.304]
Private Equity backed IPO indicator	0.039 [0.553]
Private Equity exit IPO indicator	-0.014 [0.865]
Calendar year dummies	0.004 [0.708]

Panel B: Second stage estimates

The second stage is a linear estimation and only includes 193 firms, which have some level of research coverage. The dependent variable is Research Coverage, defined as the total number of mentions in the IBES database from the time of the IPO through one month following the lockup expiration period. Independent variables include Underpricing (measured as the return from offer to first day close), Underpricing squared, Log of Market Capitalization measured four weeks following the IPO, Lead Underwriter rank, Number of Co-Managers, Turnover (measured as the average amount of trading volume in the first month as a percentage of shares offered in the IPO), and Indicators for VC and PE backed firms. The inverse mills ratio estimated in the first stage is also included as an independent variable. A calendar year indicator is included to control for any time effects and changes in the IPO and financial markets.

Number of IBES Database Mentions	
Intercept	5.973 [0.275]
Underpricing	-3.631 [0.004]
Underpricing Squared	-0.690 [0.021]
Log of Market Value of Equity post-IPO	3.428 [0.260]
Lead Underwriter Rank	-3.196 [0.280]
Number of Co-Managers	0.061 [0.544]
Inverse Mills ratio	-1.799 [0.260]
Venture Capital backed IPO indicator	0.018 [0.302]
Venture Capital exit IPO indicator	-0.057 [0.271]
Private Equity backed IPO indicator	-0.027 [0.274]
Private Equity exit IPO indicator	-0.011 [0.249]
Turnover	-0.264 [0.321]
Calendar year dummies	-2.693 [0.277]

Table 6:**Research Coverage and Lockup Period expiration returns**

The sample consists of 210 firms that completed an initial public offering (IPO) between January 2007 and December 2016. All internet-based firms listed on a United States exchange are included. The dependent variable is Lockup period expiration return. The independent variables are Number of mentions in the IBES Database, Log of Market Capitalization measured four weeks following the IPO, Lead Underwriter rank, Number of Co-Managers, Indicator variables for VC and PE backed firms, Research Coverage indicator, Underpricing (measured as the return from offer to first day close), and Underpricing Squared. A calendar year indicator μ_t is included to control for any time effects and changes in the IPO and financial markets.

Returns at Lockup Expiration	
Intercept	-2.086 [0.513]
Number of mentions in IBES database	0.003 [0.001]
Log of Market Value of Equity post-IPO	-0.005 [0.951]
Lead Underwriter Rank	0.005 [0.599]
Number of Co-Managers	-0.002 [0.139]
Venture Capital backed IPO indicator	0.0194 [0.042]
Venture Capital exit IPO indicator	-0.008 [0.944]
Private Equity backed IPO indicator	-0.002 [0.876]
Private Equity exit IPO indicator	-0.002 [0.878]
Research Coverage indicator	0.066 [0.032]
Underpricing	0.015 [0.268]
Underpricing Squared	-0.001 [0.723]
Calendar year dummies	0.001 [0.513]

Table 7:**Research Coverage and Insider selling at Lockup expiration**

The sample consists of 210 firms that completed an initial public offering (IPO) between January 2007 and December 2016. All internet-based firms listed on a Unites States exchange are included. The model is estimated in two ways: a Logit specification and a Tobit specification. In the Logit specification, the dependent variable equals one if there are any stock sales by insiders in the period from two months prior to two months following the lockup expiration. In the Tobit specification, the dependent variable is defined as the amount of stock sold by insiders in in the period from two months prior to two months following the lockup expiration as a percentage of total shares outstanding Independent variables include Returns at lockup expiration, Number of Mentions in the IBES database, Research Coverage indicator, Log of Market Capitalization measured four weeks following the IPO, Lead Underwriter rank, Number of Co-Managers, Indicator variables for VC and PE backed firms, Underpricing (measured as the return from offer to first day close), Underpricing Squared and a Percentage of base salary and cash bonus as a percentage of executive compensation package.

Insider Selling at Lockup Expiration	Logit	Tobit
Intercept	-0.851 [0.952]	-4.845 [0.153]
Number of mentions in IBES database	0.008 [0.028]	0.011 [0.002]
Returns at Lockup expiration	0.348 [0.0262]	0.241 [0.579]
Log of Market Value of Equity post-IPO	0.181 [0.780]	-0.321 [0.330]
Lead Underwriter Rank	-0.007 [0.131]	-0.001 [0.487]
Number of Co-Managers	0.003 [0.943]	0.002 [0.967]
Venture Capital backed IPO indicator	0.029 [0.509]	0.031 [0.798]
Venture Capital exit IPO indicator	0.026 [0.619]	0.072 [0.953]
Private Equity backed IPO indicator	-0.026 [0.555]	-0.016 [0.878]
Private Equity exit IPO indicator	-0.025 [0.658]	0.013 [0.340]
Research Coverage indicator	0.747 [0.023]	0.614 [0.039]
Underpricing	0.106 [0.170]	0.098 [0.036]
Underpricing Squared	-0.023 [0.197]	-0.014 [0.214]
Measure of Insider liquidity	-0.997 [0.215]	-0.813 [0.804]
Calendar year dummies	0.005 [0.944]	0.002 [0.154]

Appendix I: Variables and Descriptions

Variable	Description
Effective Date of IPO	Refers to the date when shares become available for sale in an initial public offering
Executive Options Ownership	Insider ownership of options as a percentage of shares outstanding, prior to IPO
Executive Stock Ownership	Insider ownership of stock as a percentage of shares outstanding, prior to IPO
IBES Analysts	Number of analysts following the firm from the effective date of the IPO to one month following the IPO (Data from IBES database)
IBES Buy Recommendations	Number of times an analyst posted a buy recommendation for a firm from the effective date of the IPO to one month following the IPO (Data from IBES database)
IBES Mentions	Number of times a firm has been mentioned in the IBES database from the effective date of the IPO to one month following the IPO
IBES Research Coverage indicator	Indicator variable representing if a firm has been mentioned in the IBES database from the time of the IPO to one month following the IPO
Insider Liquidity	Base salary and cash bonus as a percentage of executive compensation package, prior to the IPO
Insider Sales indicator	Indicator variable representing if a firm had insiders sales two months prior to two months after the IPO
Insider Sales	Insider sales as a percentage of shares outstanding two months prior to two months after the IPO
Lead Underwriter Rank	Rank of lead underwriter of the IPO according to the Carter-Manaster rankings
Lockup Period	The amount of time following an IPO where large shareholders, such as company executives are restricted from selling their shares (measured in number of days)
Lockup Period Expiration return	Return between the time of the IPO to the end of the lockup period
Market Value of Equity	Market Value of Equity of the firm four weeks after the Effective date of the IPO
Number of Co-Managers	Number of firms assisting the lead underwriter during the underwriting process of the IPO

Appendix I: Variables and Descriptions (contd.)

Variable	Description
Offer Price	Price of each share offered in the IPO (Size of IPO Offered divided by the total number of shares offered)
Offer Size	Size of the IPO Offering
Private Equity Backed	Indicator variable for firms who received funding from a Private Equity firm prior to IPO
Private Equity Exit	Indicator variable for IPOs that were assisted by Private Equity firms at the time of going public
Secondary Shares	Number of shares of current shareholders being sold in the IPO as a percentage of total number of shares offered in the IPO
Subsequent Equity Offering	Indicator variable representing if a firm decides to have a subsequent equity offering after the initial public offering
Turnover	Average amount of trading volume in first month as a percentage of shares offered in the IPO
Underpricing	Return from offer price to first day close price
Venture Capital Backed	Indicator variable for firms who received funding from a Venture Capital firm prior to IPO
Venture Capital Exit	Indicator variable for IPOs that were assisted by Venture Capital firms at the time of going public