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Three Essays On Private Market Interactions

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THREE ESSAYS ON PRIVATE MARKET INTERACTIONS

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ABSTRACT

In Part 1, I address why insurers, whom traditionally invest in relatively safe assets, choose to invest in private equity (PE). Using insurer financial disclosures, I test theories relating how risk-shifting, managerial discretion, underinvestment, asset-liability matching, regulation, home bias, and reaching-for-yield affect PE investment. Results indicate risk-shifting and managerial discretion by stock insurers does not factor into the PE investment decision. In addition, results confirm home bias positively influences PE investment while underinvestment, asset-liability matching, and regulation deter PE investment. Finally, insurers have not increased their PE allocation due to low-yield interest rate environments. In Part 2, I directly test the economies of scope hypothesis of Gao, Ritter, and Zhu (2013) using the data envelopment analysis (DEA) methodology of Demerjian et al. (2012, 2013). I find private firms with less than $50 million in sales are more likely to be acquired than to offer an IPO when their industry has high economies of scope. I do not find evidence that 3-year buy-and-hold returns for IPOs are associated with economies of scope levels. I also find economies of scope are negatively related to firms adopting a dual tracking strategy, but does not explain sell-out premiums for acquired private firms. Lastly, in Part 3, I examine whether private IPOs (PIPOs) decrease information asymmetry in firms that eventually engage in an IPO. Theoretically, PIPOs can mitigate problems of adverse selection and moral hazard because private investments can signal undervaluation and potentially provide more effective monitoring. Consequently, firms with larger, more recent, and frequent PIPOs should experience less underpricing and post-IPO volatility relative to other IPOs due to increased monitoring, lower signal attenuation, and positive feedback with existing investor buy-ins, respectively. Results indicate the percentage of PIPO investment compared to total equity at IPO is negatively associated with underpricing, thus suggesting PIPOs decrease information asymmetry. However, the longer the amount of time between the last PIPO and the IPO and the total number of PIPOs are positively related to underpricing.

DEDICATION

This dissertation is dedicated to my father, Roy J. Daigle, for paving the way before me and providing endless encouragement.

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PART 1

INTRODUCTION

The trend of private equity (PE) firms entering into the U.S. insurance marketplace has led to controversy. Over the course of 2015, PE backed insurers accounted for 242 of the total of 451 U.S. and Canadian acquisitions within the industry (OPTIS Partners 2016). This activity has captured the attention of the National Association of Insurance Commissioners (NAIC). The NAIC fear the traditionally higher risk tolerance of PE firms may eventually conflict with paying guaranteed liabilities. Undoubtedly, they have substantiated concerns. Historically, PE firms focus on high-risk investments to earn high-yield returns for themselves, the general partners, and their investors, the limited partners. Interestingly, insurers play a vital role as limited partners. Insurers hold approximately $189 billion, or 10%, of the total PE under management (Preqin 2015). This fact is at odds with the traditional view of insurers as acquirers of relatively safe assets. Why do insurers invest in a risk asset such as PE? Our study addresses this question.

Using a sample of 8,321 insurers over the 2006-2013 period, we are able to test investment choice theory and identify the determining factors for PE holdings. Our results indicate a number of important findings. While stock insurers have exhibited greater managerial discretion and risk-shifting than mutual insurers; they are actually 20.6% less likely to invest in PE. Additionally, the underinvestment problem deters highly levered insurers from investing in PE. Insurers with higher leverage are 7.4% less likely to invest in PE relatively to lower leveraged insurers. Among insurers who do choose to invest in PE, leverage is negatively related to the percentage of PE investment. We also find strict levels of regulation deter PE investment. Using New York as our proxy for stringent regulation, we find insurers with higher levels of premiums written within New York are 3.2% less likely to invest relative to other insurers. In terms of asset-liability matching, we find little evidence suggesting insurers factor this into their PE investment decision. Rather we find statistical evidence showing a negative relation between long tail lines and PE investment.

We also identify factors that increase the likelihood of PE investment. We find insurers are susceptible to home bias investment with respect to PE. Insurers located within close proximity to major PE markets are 9.5% more likely to invest in PE. We also note that insurer size is the most important economic determinant for both the decision to invest in PE. Furthermore, our analysis indicates insurers who invest in PE do not follow a finite risk paradigm. According to the finite risk paradigm, insurers who assume more risk in a portfolio area should assume less risk in another area. However, our results indicate historically risk assets (i.e. junk bonds) are positively related to PE investment while cash is negatively related to PE investment.

Lastly, we investigate whether insurers "reach for yield" by either increasing risk within the PE asset class or by substituting less risky assets with PE. Due to the low interest rate environment, insurers have incentives to explore both strategies. Becker and Ivashina (2015) find evidence indicating insurers reach-for-yield in the corporate bond market. Furthermore, insurers who did reach for yield experienced larger equity losses during the latest financial crisis. Therefore, reaching-for-yield can be particularly problematic because an increased concentration of systematic risk in insurers' portfolios can have a negative impact on the broader economy. This study finds mixed results for insurers reaching-for-yield with PE. Risk within PE investments appears constant over the sample period, but both the percentage of insurers who invest and PE portfolio allocations increase. However, the increase in PE is not at the expense of safer assets such as U.S. government bonds. Finally, in a multivariate setting, our results indicate the 2006-2013 period is associated with a 7.7% decrease in the likelihood of PE investment among the top quartile of insurers and is negatively related to the percentage of PE allocation.

The remainder of our study proceeds as follows. Section II provides an overview of PE investments. Section III develops the hypotheses. Section IV outlines the methods used in studying the determinants of PE investment and describes the NAIC dataset. Section V presents the results. Section VI summarizes the findings and concludes.

OVERVIEW OF PRIVATE EQUITY

Private equity (PE) is an alternative asset class consisting of equity investments that are not freely tradable in a public market. Typically, PE provides capital to private companies for expansion, product development, or restructuring. Regardless of the strategy, the investment process generally follows the same cycle. Figure I outlines the relationships among general partners, LPs and portfolio companies for a generalized PE fund. Initially, the general partners, a group of professional managers, solicit capital for a fund. Institutions such as endowments, pensions, insurers, and banks act as the LPs and provide the bulk of capital required for these funds. Once the fundraising is complete, general partners make a series of investments directly into various private companies forming a portfolio for the fund. Afterwards, general partners actively manage this portfolio by providing guidance and, therefore, enhance the value of the portfolio companies. Unlike the general partners, LPs do not have direct involvement with the companies in order to maintain their limited liability status. A fund typically has a life of ten years, but can be extended up to an additional three years in some cases. Towards the end of a fund's life, general partners liquidate their positions, using a variety of exit strategies, and distribute proceeds between themselves and LPs. Furthermore, it is common that well respected general partners will develop new funds every few years with prior LPs usually get first access over new investors. See Figure II for the complete PE cycle.

[Insert Figure I]

[Insert Figure II]

For the purpose of our study, we examine the following types of private equity investments: venture capital, leveraged buyouts, growth capital, mezzanine, distressed debt, and fund of funds[1]. These investment categories are defined as follows. *Venture capital* (VC) consists of investments made in an early-stage company for equity stakes that are commonly sold through either an IPO or trade sale. *Leveraged buyouts (LBO)* consist of investments where either the company itself or its assets are taken private through the use of debt. *Growth capital* refers to situations where minority equity stakes are bought from mature privately ran companies. *Mezzanine* is the use of subordinated debt and/or preferred equity stakes. Typically, companies that offer mezzanine financing have taken on too much debt for creditors to continue extending credit, yet are hesitant to dilute existing equity stakes. *Distressed debt* consists of the use of either equity or debt instruments in companies on the brink restructuring. Lastly, *fund of funds* refers to situations where a PE fund is dedicated solely to investment into other PE funds.

The literature observing the interaction between PE and the insurance industry has recently developed. Braun, Schmeiser, and Siegel (2014) investigate the attractiveness of PE among life insurers from both regulatory capital and performance viewpoints. They provide evidence that PE is over-penalized from a regulatory capital perspective by standard approaches, Solvency II and the Swiss Solvency Test, for a representative life insurer. In the case of Solvency II, the standard formula uses a crude stress factor for "other equities" when calculating PE capital charges. This is problematic because the "other equities" stress factor is used for PE, hedge funds, commodities, and emerging market equities regardless of the fact these classes have a high degree of heterogeneity in return distributions. Braun et al. argue using a specific stress factor for each asset

[1] Although there are self-identified equity investments in real estate, we exclude these since real estate is contested as belonging to the PE asset class.

is more appropriate and consequently would decrease capital charges for PE.

Other studies such as Lerner, Schoar, and Wongsunwai (2007) and Da Rin and Phalippou (2014) investigate the heterogeneity of returns among different LP types, which include insurers. Lerner et al. observe returns differ drastically across LP types with endowments earning annual returns approximately 21% greater than the average LP while insurers underperform 3.5% from the average. They propose the heterogeneity of returns occurs because LP types differ in their sophistication and investment objectives. Da Rin and Phalippou find larger LPs receive more favorable contractual terms, pay less fees, and employ more specialized screening and monitoring of PE contracts than the smaller LPs. This study differs from those previously mentioned because it investigates the factors that influence a specific LP type's decision to invest, not return differences.

HYPOTHESES

The purpose of this study is to identify what factors influence a LP's decision to invest in PE and the extent of their investment. Therefore, we develop the following hypotheses and how they relate to PE investment decisions.

Agency Issues

PE investment can potentially lead to risk shifting by the firm's managers. Due to limited liability, managers, working in the interest of owners, have an incentive to substitute a riskier asset for a less risky asset. In the insurance setting, stock insurer owners can potentially invest in a riskier asset such as PE at the expense of policyholders. Lee, Mayers, and Smith (1997) document this risk shifting behavior in the insurance context. They observe stock insurers participate in risk shifting by increasing their stock holdings while decreasing their bond holdings around the date of guaranty-fund enactments. However, they do not find evidence suggesting mutual insurers engage in this behavior.

Additionally, the mutual insurer organizational format may actually limit PE investment. Mayers and Smith (1981, 1994) argue stock insurers should hold a comparative advantage in activities that involve managerial discretion. The separation of managerial and ownership functions provides stock insurers with liquidity and risk-bearing efficiencies that mutual insurers cannot match due to the higher cost of controlling management. Fama and Jensen (1983) outline that investments requiring greater managerial discretion are characterize as more costly to trade, generate more uncertain cash flows, and are more difficult to value. PE fits all three of these criteria. PE is highly illiquid (due to the long holding periods required), has a wide variance in cash flows to LPs, and difficult to value (lack of market trading). Taken together, a greater amount of managerial discretion may be required to evaluate the relative complexity of PE investment compared to traditional asset classes (i.e. bonds). This is at odds with mutual insurers requiring assets with easily determined values in order to fulfill redemptions of residual claims (Fama and Jensen). Therefore, stock insurers may have a comparative advantage over mutual insurers when investing in PE.

Hypothesis 1a: Stock insurers are more likely to invest in PE than mutual insurers, ceteris paribus.

Hypothesis 1b: Stock insurers invest a higher percentage of their portfolio in PE than mutual insurers, ceteris paribus.

Underinvestment

Underinvestment occurs when shareholders pass up positive net present value projects because the fixed claimants receive higher disproportional benefits relative to shareholders (Myers, 1977). Firms can reduce the variance of their value by reducing investment portfolio risk and therefore strengthen their ability to repay fixed claimants and decrease potential underinvestment costs. Subsequently, investment portfolio risk should be less for firms that are highly levered. Mayers and Smith (1987) and Colquitt and Cox (1999) document an inverse relation between leverage and risky investment behavior among insurers. Consequently, as financial leverage increases, insurers should be less inclined to invest in PE due to the costs of underinvestment.

Hypothesis 2a: Insurers with higher leverage are less likely to invest in PE than insurers with less leverage, ceteris paribus.

Hypothesis 2b: Insurers with higher leverage will invest a lower percentage of their portfolio in PE than insurers with less leverage, ceteris paribus.

Asset Maturity Structure

Mayers and Smith (1981) suggest insurers specializing in selling long-lived fixed liability claims, like life insurance, should be more likely to hold investments such as privately placed loans for two reasons. First, these claims are paid out after long periods and the investment in privately placed loans should match the lower liquidity needs of these policies. Second, since there is no readily available secondary market, the cost of changing the characteristics of the firm's cash flow distribution after the policy's sale is increased. The same reasoning for holding privately placed loans is applicable for PE. PE investments require long durations (the average PE fund has a ten-year duration) and there is not a viable secondary market for PE. Following this reasoning, insurers who write relatively more long-tail policies than short-tail policies are expected to have higher proportions of PE holdings for both asset-liability matching and liquidity reasons[2]. However, there is evidence suggesting life insurers today may not face the same duration needs as compared to prior decades. Doffou (2005) points out that the volatility in U.S. interest rates has shortened the duration of liabilities among U.S. life insurers. Consequently, if true then the decrease in duration should increase liquidity needs, which is not favorable for PE investment.

[2] Long-tail lines include Ocean Marine, Medical Professional Liability, International, Reinsurance, Workers' Compensation, Other Liability, Product Liability, Aircraft, Boiler and Machinery, Farmowners Multiple Peril, Homeowners Multiple Peril, Commercial Multiple Peril, and Automobile Liability. (Phillips, Cummins, and Allen, 1998)

Hypothesis 3a: Insurers with a higher percentage of net premiums written in long-tail lines are more likely to invest in PE than insurers with a lower percentage in long-tail lines, ceteris paribus.

Hypothesis 3b: Insurers with a higher percentage of net premiums written in long-tail lines invest a higher percentage of their portfolio in PE than insurers with a lower percentage in long-tail lines, ceteris paribus.

Regulation

An insurer's regulatory environment could potentially limit risky investments. Demsetz and Lehn (1985) contend regulation provides monitoring and discipline for regulated firm's management (e.g. regulators can apply pressure to replace a bank's management if the balance sheet appears overly risky). Smith (1986) argues regulation limits managerial discretion in investment decisions. Consequently, if PE requires greater managerial discretion then regulation can limit insurer investment. Following both assertions, we believe regulation will have a negative relation to PE. We use the state of New York as our stringent regulation proxy because New York insurance regulation mandates extraterritorial requirements and is considered the strictest state within the U.S. Therefore, we propose:

Hypothesis 4a: Insurers with a higher percentage of net premiums written in New York are less likely to invest in PE than insurers with a lower percentage in New York, ceteris paribus.

Hypothesis 4b: Insurers with a higher percentage of net premiums written in New York invest a lower percentage of their portfolio in PE than insurers with a lower percentage in New York, ceteris paribus.

Home Bias

Home bias occurs when investors favor investment opportunities within close proximity rather than distant ones. Studies have demonstrated this behavioral bias in both individual and institutional investors[3]. Hochberg and Rauh (2012) study this theory specifically for another class of LPs, public pension funds, and find they are more likely to overweigh their investment portfolio in local PE funds. Local investment could indicate local insurers have lower asymmetric information costs than insurers located further away. Consequently, we expect insurers close to major PE markets (e.g., New York and Boston for leveraged buyouts and Palo Alto for venture capital) are more likely to invest in PE due to lower information asymmetry costs.

Hypothesis 5: Insurers located closer to major PE markets are more likely to invest in PE than insurers who are not, ceteris paribus.

Reaching-for-Yield

Reaching-for-yield may be a potential motivator for insurers to invest in PE. The low interest rate environment following the 2008 financial crisis has left insurers seeking higher yields to pay off guaranteed liabilities. Becker and Ivashina (2014) find insurers invest in the corporate bond market because of higher yield spreads. Furthermore, A.M. Best (2014) reports insurers are increasing their overall allocation to Schedule BA - of which PE is a major component. The report reiterates insurers' desire to achieve higher yield in a low yield environment. Therefore, insurers may have increased their PE investments following the 2008 financial crisis in order to achieve higher yields.

[3] See French and Poterba (1991), Ivkovic and Weisbenner (2005), Coval and Moskowitz (2001), Chan, Covrig, and Ng (2005), and Hau and Rey (2008).

Hypothesis 6a: Insurers are more likely to invest in PE during the sample period due to the low interest rate environment, ceteris paribus.

Hypothesis 6b: Insurers invest a higher percentage in PE of their investment portfolio during the sample period due to the low interest rate environment, ceteris paribus.

METHODS AND DATA

Since much of the sample does not invest in PE, there is a large distribution of zero values for the dependent variables. Therefore, the use of ordinary least squares (OLS) as an estimation procedure on the full sample of insurers is likely to result in biased and inconsistent coefficient estimators. Consequently, we use two empirical models to determine the participation and extent of PE investment. The first model is a probit estimation to observe the effect of the independent variables on the likelihood of PE investment and is as follows:

$$DoInvest_i = \alpha + \beta_1 STOCK_i + \beta_2 LEVERAGE_i + \beta_3 LTPCT_i + \beta_4 NYPCT_i + \beta_5 LOCAL_i + \beta_6 TREND_i + \beta_7 SIZE_i + \beta_8 GROUP_i + \beta_9 RBC_i + \beta_{10} JUNK_i + \beta_{11} REAL\ ESTATE_i + \beta_{12} COMMON_i + \beta_{13} CASH_i + \beta_{14} MORTGAGE_i + \varepsilon_i$$

In this model, the dependent variable, $DoInvest_i$, holds a binary of 1 if the insurer has PE investments and 0 otherwise. MUTUAL is a dummy variable equal to 1 if the insurer has a mutual organizational form and 0 if it has a stock organizational form. LEVERAGE is the natural log of total liabilities to the sum of surplus, common stock, and preferred stock as seen in Colquitt and Hoyt (1997). LTPCT is the percentage of net premiums written in long-tail lines to total net premiums written. NYPCT is the percentage of net premiums written in the state of New York relative to total net premiums written in all states. We follow Tian (2011) and define LOCAL as a dummy variable equal to 1 if the insurer is within 100 miles of New York City, Boston, or Palo Alto and 0 otherwise[4]. TREND is the aggregate amount of total PE under management worldwide

[4] We use other distances such as 25, 50, and 150 miles and results remain consistent.

for each year. ϵ_i is the error term. In addition, we identify the following controls to isolate the effects of theoretically motivated variables.

Size

Larger insurers should have two distinct advantages when investing in PE. First, both Pottier (2007) and Da Rin and Phalippou (2014) propose that larger insurers are more apt to hire an internal staff of investment analysts, which would allow specialization in specific asset classes[5]. In addition, both Dyck and Pomorski (2011) and Da Rin and Phalippou (2014) find LP'S size is positively related to larger returns. We expect a positive relation between an insurer's size and PE investment. We follow Pottier (2007) and proxy for insurer size, SIZE, with the natural logarithm of total net admitted assets.

Group Membership

In the insurance industry, some insurers operate as either standalone insurers or members of insurer groups. This distinction could influence risk taking behavior. Standalone insurers should be more averse to taking risks since they have to maintain their own stature. On the other hand, group members are aware if they experience a liquidity shortage they can request help from other group members. Therefore, group members could exhibit more risky taking behavior than standalone insurers. Colquitt, Sommer, and Godwin (1999) document this difference in risk aversion by finding insurers who have group membership hold less cash than standalone insurers. Following this argument, we expect group membership positively relates to PE investment. We use a binary variable, GROUP, equal to one for aggregated groups and zero for a standalone

[5] Da Rin and Phalippou's discussions with industry practitioners reinforce this belief.

insurer.

Financial Quality

The financial quality of the insurer could also affect potential PE investment. In the U.S., insurers are required to maintain risk-based capital (RBC) to support their operations with respect to their size and risk profile. Cummins, Harrington, and Klein (1995) state RBC can provide incentives for insurers to operate safely. Furthermore, based on statements from Preqin (2013), it appears insurers are concerned about higher capital charges for PE investments. Therefore, we predict that insurers who have large amounts of RBC will be more inclined to participate in PE investment while those with lower levels will be less apt because of the higher capital charge. We control for financial quality by using RBC, the ratio of total adjusted capital to the authorized control level risk-based capital.

Riskiness of other Investment Choices

Cummins and Sommer (1996) and Baranoff and Sager (2002 and 2003) provide evidence supporting the finite risk paradigm among property-casualty and life-health insurers respectively. This theory proposes firms with greater risk in one area will compensate by reducing risk in other areas. Following Pottier and Sommer (1998), we also control for the overall riskiness of other portfolio holdings by including other asset classes, which could have an impact on an insurer's PE investment decision. We include both historically risky investments of junk bonds, real estate, and common stock along with historically safe investments of cash and mortgages. Following the finite risk paradigm, we expect junk bonds, real estate, and common stock holdings to have a negative relation with PE investment. Likewise, we expect cash and mortgage holdings will have a positive relation with PE investment. We control for these holdings with the variables JUNK, REAL ESTATE, COMMON, CASH, and MORTGAGE, which are defined as the percentages of junk bonds, real estate, common stock, cash, and mortgages respectively in total invested assets.

Table I presents the hypotheses along with their respected variables of interest, predicted signs relative to PE investment, and definitions.

[Insert Table I]

The second model employs an ordinary least squares model with Heckman's two-step selection correction to analyze the effect of the independent variables on the extent of PE investment. In order to obtain proper estimates at least one variable should be dropped from the selection equation (Puhani 2000). Since location of the investor is likely to only influence the decision to invest and not the magnitude of investment, the dummy variable, LOCAL, is excluded from the equation. The model is as follows:

$$PE_i = \alpha + \beta_1 MUTUAL_i + \beta_2 LEVERAGE_i + \beta_3 LTPCT_i + \beta_4 NYPCT_i + \beta_5 TREND_i + \beta_6 SIZE_i + \beta_7 GROUP_i + \beta_8 RBC_i + \beta_9 JUNK_i + \beta_{10} REAL\ ESTATE_i + \beta_{11} COMMON_i + \beta_{12} CASH_i + \beta_{13} MORTGAGE_i + \sigma\lambda_i + \varepsilon_i \text{ , } where\ DoInvest = 1$$

Where the dependent variable, PE_i, is the insurer's percentage of PE to total invested assets, λ_i is the inverse Mills ratio, and all other variables are as previously defined.

We collect data for all U.S. life and property-casualty insurers from the NAIC database for the years 2006 through 2013. Since PE investment decisions are likely made at the group level, we aggregate affiliated members together as a single observation. In addition, we aggregate insurers who write both life and property-casualty insurance. We exclude insurers with non-positive total admitted net assets, net premiums written, equity, or cash holdings. In addition, we exclude 404 insurers who are neither a mutual or stock insurer to remove other organizational forms that may confound the results. Furthermore, we apply a size screen of $7.5 million to eliminate small insurers that may not have the means to access PE investments[6]. In order to reduce the impact of outliers we winsorize continuous variables annually at the 1st and 99th percentile. After applying these screens, the final sample consists of 8,321 firm-year observations with 1,493 unique insurers of which 232 invest in PE.

Insurers who invest in PE must identify the type and strategy of these investments on Schedule BA. PE investments are marked as '1', '2' or '3' for venture capital, mezzanine financing, or leveraged buyout respectively. Upon inspection, some insurers appear to neglect proper identification of their long-term assets[7]. Consequently, we verify the proper identification of 102,961 long-term asset listings by hand by using each listing's description, vendor, and geographical information. We only use listings if we confirm with one of the following methods: 1) a major newswire such as Bloomberg, 2) SEC filings, or 3) the fund's website. Furthermore, we remove listings that appear to be suspiciously low in value by using a cutoff value of $10,000. Table II reports the accuracy of PE investment reporting by insurers, per year. Approximately 13% of listings are misclassified as the wrong type of PE or as a hedge fund annually. In addition, nearly 22% of listings are not classified at all. Taken together insurers only correctly identify 65% of their PE investments. The verification process results in a final sample of 48,139 PE investments by 232 insurers.

[Insert Table II]

Table III presents summary statistics of PE investments among investors. Panel A shows a steady 30% increase in the number of investments between 2006 (5,023) and 2013 (6,500). Additionally, there is a wide range in investment amounts per fund from the cutoff of $10,000 to

[6] We used the size of the smallest insurer who invested in PE as our cutoff.
[7] This fact was confirmed during discussions with multiple NAIC employees. The NAIC does not verify the validity of type and strategy designations.

$500,000,000. Panel B provides summary statistics at the investor level. The number of investors appears fairly constant at 150 per year. As in Panel A, there appears to be an increase in the amounts held by investors during the sample period. Furthermore, there is a wide dispersion in investment amounts among investors. Panel C reports the allocation of funds investors hold. While the typical investor commits to 16-22 funds on average, there is a wide range in the number of funds owned with some investors holding single fund whereas others hold over 200 funds.

[Insert Table III]

Table IV reports summary statistics of regression analysis variables with Panels A and B presenting the full sample and investors respectively. On the surface, the full and investor samples appear to be similar with respect to stock insurer organization (0.69 vs. 0.65), percentage of net premiums written in long-tail lines (82.33% vs. 84.93%), and percentage of net premiums written in NY (7.07% vs. 6.39%). However, there appears to be marked differences between the samples for the other theoretically motivated variables. Investors and are more likely located within 100 miles of a major PE investment market (0.48 vs. 0.21) compared to the full sample. However, investors are more highly levered (1.31 vs. 0.54) compared to the full sample. Later analysis compares the means and medians of non-investors and investors to determine if they significantly different from each other.

[Insert Table IV]

RESULTS

Univariate Results

Table V compares the differences in the means and medians of variables between investors and non-investors. We define investors as insurers who hold PE investment for a given year, while non-investors are insurers who do not. First, investors are more likely to be a mutual insurer compared to non-investors. Interestingly, underinvestment does not appear to be an issue for investors as they are more levered than non-investors. This difference may indicate investors are actually risk seeking. We also observe a positive relation between asset-liability matching and PE investors. This provides initial support that insurers who write more in long-tail lines may invest in PE to match the payout and liquidity needs of their liabilities. Based on the difference of medians, investors appear to write a greater percentage of net premiums in the state of New York relative to non-investors. This runs counter to the monitoring and managerial discretion theories offered by Demsetz and Lehn (1985) and Smith (1986) respectively. Furthermore, 48% of the investors are located within 100 miles of a major PE market compared to only 17% for non-investors. Investors may have lower asymmetric costs than non-investors, which would provide a competitive advantage with PE investment.

Among the controls, size, group membership, and mortgage holdings are in line with their predicted signs. The results indicate the average investor operates with a lower RBC ratio, is less liquid, and holds higher percentages of junk bond and common stock holdings than the average non-investor. These results suggest investors may not follow a finite risk paradigm and are actually risk seeking.

[Insert Table V]

We now focus on the remaining theory by investigating whether insurers exhibit behavior indicating they are "reaching-for-yield" in the PE asset class. Reaching-for-yield can be problematic because an increased concentration of systematic risk in insurers' portfolios can have a negative impact on the broader economy. Becker and Ivashina (2014) examine if reaching-for-yield was an important determinant for asset dislocations during the most recent financial boom using insurer investment in the corporate bond market. Unlike mutual funds and pension funds, insurers have capital requirements based on NAIC designation codes[8]. Consequently, this could provide an incentive for insurers to invest in riskier assets within the NAIC Designation Codes. Becker and Ivashina (2014) demonstrate insurers, unlike mutual funds and pension funds, are more inclined to invest in new corporate bonds because of higher yield spreads within NAIC Designation Codes. Furthermore, they find insurers who reach for yield prior to the 2008 crisis suffer equity losses greater than predicted by systematic risk during the crisis.

We are interested if their findings also apply to the PE asset class. They point out a financial institution's incentive to search for positive α is not limited to a specific asset class.

[8] The NAIC 1 designation is assigned to obligations exhibiting the highest quality (AAA:A-). The NAIC 2 designation is assigned to obligations of high quality (BBB+:BBB-). The NAIC 3 designation is assigned to obligations of medium quality (BB+:BB-). The NAIC 4 designation is assigned to obligations of low quality (B+:B-). The NAIC 5 designation is assigned to obligations of the lowest credit quality (CCC+:CCC-), which are not in or near default, where credit risk is at its highest and credit profile is highly volatile, but currently the issuer has the capacity to meet its obligations. NAIC 5* is assigned by the Securities Valuations Office (SVO) to certain obligations when an insurer certifies: (1) that documentation necessary to permit a full credit analysis of a security does not exist and (2) the issuer or obligor is current on all contracted interest and principal payments and (3) the insurer has an actual expectation of ultimate repayment of all contracted interest and principal. The NAIC 6 designation is assigned to obligations that are in or near default (CC:D). NAIC 6* is assigned by an insurer to an obligation in lieu of reporting the obligation with appropriate documentation to the SVO for a full credit analysis or filing the certification required for obtaining an NAIC 5* Designation. Standard and Poor's ratings provided in parenthesis.

Rather the incentive is likely greater for illiquid and complex assets because their risk measurements are more problematic. PE displays both of these characteristics. However, unlike corporate bonds, the NAIC does not require insurers to provide designation codes for long-term assets on Schedule BA of their annual statutory filings. Nonetheless, we can still draw inferences based upon the investment patterns of insurers who provide NAIC designation codes.

Table VI presents PE investments by NAIC designation code during the sample period. NAIC 1 and NAIC 2 designation codes are reserved for securities with investment grades while NAIC 5 and NAIC 6 are for highly speculative grades (CCC and below). Upon review, insurers increased both NAIC 1 and NAIC 5* rated securities while simultaneously decreasing NAIC 6 rated securities over the sample period. Furthermore, the increase in NAIC 5* rated securities is offset by the decrease in those rated NAIC 6. Consequently, evidence is inconsistent with insurers reaching for yield *within* the asset class during the sample period.

[Insert Table VI]

While it appears risk has stayed consistent within the asset class, we examine if additional insurers invest in PE or substitute PE for another less risky asset. Table VII presents investor distribution over time. While the number of investors remains relatively stable over the sample period there are new entrants every year. Furthermore, the percentage of PE investors increases over time, but this may be due to consolidation within the insurance industry. In order to determine if insurers are substituting PE for safer assets we conduct an analysis on the relation between U.S. Government bonds and PE. Table VIII presents trends in U.S. Government bonds and PE allocations. While the percentage invested in PE increases by roughly 70%, it does not come at the expense of relatively risk free assets. Instead, investors increase their allocation to U.S. Government bonds following the 2008 financial crisis. These results suggest investors did not engage in risk-shifting with PE.

[Insert Table VII]

[Insert Table VIII]

Heckman Two Stage Results

Table IX reports the results for Heckman's two-step estimation of investor characteristics on PE investment for both the full sample and top size quartile. We investigate the top size quartile because there appears to be a strong relation between insurer size and PE investment. We begin the analysis by reporting and interpreting the results from the first step probit regression, which examines the determinants of the PE investment decision. We measure economic impact for each variable by following Barclay and Smith (1995) and Pottier (2007). We calculate implied changes in the probability of investment and the percentage invested for each independent variable by changing the value of 1) a dummy variable from 0 to 1, 2) a continuous variable from its value at the 25^{th} percentile to its value at the 75^{th} percentile, or 3) the TREND variable from the aggregate amount of PE under management in 2006 to its 2013 value while holding the remaining independent variables at their mean values.

The coefficient of the agency issues variable, STOCK, is negative and significant. This result is inconsistent with the potential benefits of managerial discretion by stock insurers (Mayers and Smith 1981, 1984). Within the full sample, being a stock insurer only decreases the likelihood of PE investment by 1.4%. However, this relation is amplified within the top size quartile. We find stock insurers are 20.6% less likely to invest in PE relative to mutual insurers.

The coefficient of the underinvestment variable, LEVERAGE, is negative and highly significant. This finding supports the underinvestment hypothesis of Myers (1977) in the context of insurers investing in PE. Levered insurers are less likely to invest in PE since the reduction in investment portfolio risk can increase their ability to repay fixed claimants and decrease potential underinvestment costs. This result is consistent with Colquitt and Cox (1999) whom find leverage is negatively related to asset portfolio risk among insurers. Changing leverage from the 25^{th} to the 75^{th} percentile decreases the probability of PE investment by 0.6% and 7.4% for the full sample and top size quartile, respectively.

Surprisingly, the coefficient for the asset-liability matching variable, LTPCT, is negatively related to the decision to invest in PE. This result suggests insurers do not match asset-liability matching needs when deciding to invest in PE. Doffou (2005) offers a possible explanation for this finding. He notes U.S. interest rates have experienced greater volatility over the past three decades, which consequently has shortened the liability durations of U.S. life insurers and increased their need for liquidity. The same explanation could possibly be extended to long-tail lines in general. Consequently, PE may not be well suited since it requires long term investment and is considerably illiquid.

The coefficient of the regulation variable, NYPCT, is negative and highly significant. This finding provides support for the regulation hypothesis that insurers licensed in highly regulatory areas are less likely to invest in PE. The decreased likelihood for PE investment may be attributed to regulators monitoring risk taking by management (Demsetz and Lehn 1985) and/or limiting managerial discretion in investment decisions (Smith 1986). However, the economic impact for operating in a highly regulated area only decreases the probability of PE investment by 0.7% and 3.2% for the full sample and top size quartile, respectively.

The coefficient of the home bias variable, LOCAL, is positive and highly significant, meaning insurers located within 100 miles of major PE markets (e.g. New York, Boston, and Palo

Alto) are more likely to invest in PE. This result supports the home bias hypothesis that asserts investors favor investment opportunities within close proximity due to lower asymmetric information costs than investments located further away. Consequently, local insurers may have a competitive advantage over insurers located further way due to lower asymmetric information costs. This finding is consistent with Hochberg and Rauh (2012) whom find another LP type, public pension plans, overweigh their portfolio to local PE investments. Finally, being located within 100 miles of a major PE market increases the likelihood of PE investment by 1.8% and 9.5% for the full sample and top size quartile, respectively.

Contrary to expectations, the coefficient of the reaching-for-yield variable, TREND, is negatively related to the decision to invest in PE. While insurers reached for yield with new corporate bond issuances (Becker and Ivashina 2014), this result suggests the low interest rate environment following the 2008 financial crisis did not entice insurers to seek higher yields by investing in PE. Over the span of the sample period of 2006-2013, insurers in the top size quartile were 7.7% less likely to invest in PE.

Examining the control results provides additional insights. First, as expected, the coefficient of the size variable, SIZE, is positive and highly significant. This result is aligned with larger insurers being more capable of hiring an internal staff of investment analysts, which can provide investment specialization in different asset types. Additionally, the economic impact for SIZE is substantial. Adjusting SIZE from the 25^{th} to the 75% percentile increases the probability of PE investment by 12.7% and 46.8% for the full sample and top size quartile, respectively.

Second, results for the riskiness of other investment choices further suggest investors do not follow a finite risk paradigm. In contrast to earlier predictions, but aligned with the differences in means/medians results, the coefficients for traditionally risky portfolio variables, (JUNK, COMMON, and REAL ESTATE) are positive and highly significant while CASH is negatively related to PE investment. Consequently, insurers who assume risk in other portfolio assets are more likely to assume additional risk portfolio risk by investing in PE.

[Insert Table IX]

Table X presents the results of the second step regression including the inverse Mill's ratio estimated on the subsample of insurers who choose to invest. Despite being significant in the first step, the coefficient for the agency issue variable, STOCK, is insignificant in the second step. Although PE is relatively complex compared to other asset classes (i.e. bonds), the lack of significance indicates the managerial discretion capabilities of stock insurers is not a factor when evaluating the amount of PE investment.

The coefficient for the underinvestment variable, LEVERAGE, is also negative and highly significant in the second step. This result provides evidence that as investors increase their leverage they will subsequently decrease their allocation to PE. Levered insurers are less likely to invest in PE since the reduction in investment portfolio risk can increase their ability to repay fixed claimants and decrease potential underinvestment costs. Furthermore, leverage has a large economic impact on the amount invested into PE. Since the average investor allocates 0.88% of their portfolio to PE an increase in leverage from the 25^{th} to the 75^{th} percentile would decrease PE allocation by approximately a third.

The coefficient for the asset-liability matching variable, LTPCT, is negatively related to the percentage invested into PE. Therefore, we find no evidence suggesting insurers match asset-liability matching needs when deciding how much of their portfolio they allocate to PE. We also find the coefficient of the regulation variable, NYPCT, is not significantly related to the percentage invested into PE. Consequently, we do not find evidence suggesting insurers take regulatory constraints (e.g. risk monitoring and/or limiting managerial discretion) into account when deciding on the amount of PE investment.

Matching results from the first step, the coefficient of the reaching-for-yield variable, TREND, is negatively related to the percentage invested in PE. Unlike, Becker and Ivashina (2015), this result suggests insurer did not reach for yield within the PE asset class during the low interest rate environment following the 2008 financial crisis.

Once again, examining the control results provide additional insights. The coefficient of the size variable, SIZE, is positive and highly significantly related to the percentage of PE invested. Therefore, we find evidence supporting the assertion that larger investors are more capable of hiring an internal staff for investment specialization. Surprisingly, both the coefficients of the group membership variable, GROUP, and financial quality variable, RBC, are negative and highly significant. Both were assumed to have a positive relation to PE allocation. This finding runs counter to standalone insurers being risk adverse while group members assume additional risk because other group members can aid them during distress. In addition, the model predicts as an insurer increases their RBC ratio they will decrease their PE allocation. Therefore, the model suggests insurers with the largest "cushion" hold less PE than those with lower RBC. Taken together both of these results propose insurers who have the safest financial positions hold less PE than investment decision theory would predict.

Finally, the second step results for the riskiness of other investment choices provide additional evidence that investors do not follow a finite risk paradigm. The coefficients for traditionally risky portfolio variables, JUNK and REAL ESTATE are all positive and highly significantly related to the percentage of PE holdings. Furthermore, we find the coefficient for cash allocation, CASH, to be negative and highly significant. Consequently, these results indicate investors who assume risk in one or more portfolio holdings assume greater risk in their portfolio with PE while those who exhibit safer investment tendencies continue their behavior with less PE allocation.

[Insert Table X]

CONCLUSION

Why do insurers invest in PE? This paper takes advantage of their detailed disclosure by constructing and estimating a model for the determinants of PE modeling. Consequently, we test theories relating how agency issues, underinvestment, asset maturity structure, regulation, home bias, and reaching-for-yield affect the PE investment decision and the percentage of PE investment.

We find mutual insurers are more likely to invest in PE than stock insurers, which implies managerial discretion is not a factor in PE investment among insurers. We also observe leverage is negatively related to both the decision to invest in PE and the percentage of PE investment which supports the underinvestment theory. This finding is consistent with insurers attempting to reduce their portfolio risk to decrease potential underinvestment costs. Interestingly, we do not find support that insurers match asset-liability matching needs when investing in PE. This finding is possibly explained by an increase in U.S. interest rate volatility, which has shortened liability durations. Additionally, insurers in highly regulated areas are less likely to invest in PE, which is consistent with regulators monitoring risk taking and limiting managerial discretion. Furthermore, we find support for the home bias hypothesis; insurers located within 100 miles of major PE markets are more likely to invest in PE. Finally, we find evidence inconsistent with the reaching-for-yield hypothesis, insurers did not increase their PE allocation following the 2008 financial crisis.

We also find that firm size is the most economically significant determinant for both an insurer's decision to invest in PE and their PE allocation. In addition, we find group membership and higher amounts of risk-based capital are associated with lower PE allocation. Furthermore, we find evidence that insurers who do invest do not follow a finite risk paradigm. Rather insurers who assume risk in traditionally risky asset classes (e.g. junk bonds, real estate, and common stock) are more likely to invest in PE and hold a larger percentage of PE in their portfolio than otherwise while traditionally safer asset classes (e.g. cash and mortgages) are linked to lower PE allocation.

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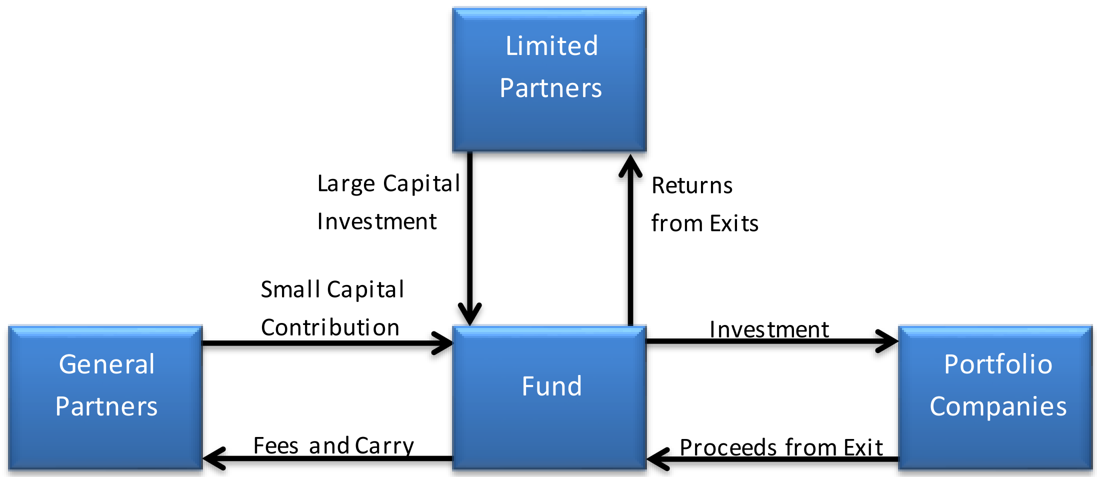
APPENDIX

APPENDIX 1: PRIVATE EQUITY MODEL

Figure I

Private Equity Model

Figure I outlines the relationships between General Partners, Limited Partners, and Portfolio Companies for a generalized private equity fund.

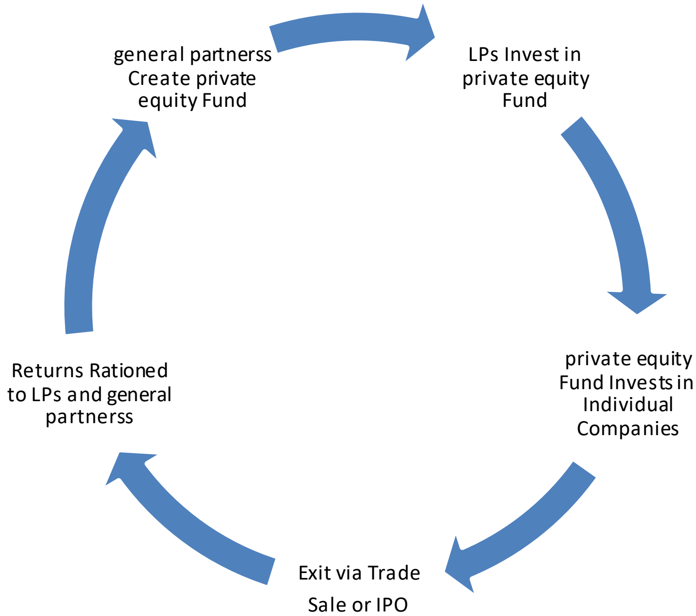


APPENDIX 2: PRIVATE EQUITY FUND CYCLE

Figure II

Private Equity Fund Cycle

Figure II presents a generalized private equity fund cycle.



APPENDIX 3: SUMMARY OF HYPOTHESES

Table I

Summary of Hypotheses

Table I presents the six theoretically motivated variables of interest along with the eight control variables, their predicted signs relative to the proportion of private equity holdings to total invested assets, and their definitions.

Variable	Predicted Impact on PE	Definition
Agency Issues		
STOCK	+	Dummy variable equal to 1 if stock organizational form, 0 if it has a mutual organizational form
Underinvestment		
LEVERAGE	-	Natural log of the ratio of total liabilities to the sum of surplus, common stock, and preferred stock
Asset-Liability Matching		
LTPCT	+	Percentage of net premiums written in long-tail lines to total net premiums written
Excessive Regulation		
NYPCT	-	Percentage of net premiums written in the state of New York relative to total net premiums written in all states
Home Bias		
LOCAL	+	Dummy variable equal to 1 if insurer is within 100 miles of New York, Boston, or Palo Alto, 0 otherwise
Reaching for Yield		
TREND	+	The aggregate amount of private equity under management for each year
Controls		
SIZE	+	Natural log of total net admitted assets
GROUP	+	Dummy variable equal to 1 if observation is at group level
RBC	+	Ratio of total adjusted capital to authorized control level risk-based capital
JUNK	-	Percentage of junk bond holdings to total invested assets
REAL ESTATE	-	Percentage of real estate holdings to total invested assets
COMMON	-	Percentage of common stock holdings to total invested assets
CASH	+	Percentage of cash and short-term investments to total invested assets
MORTGAGE	+	Percentage of mortgage holdings to total invested assets

APPENDIX 4: INSURER CLASSIFICATION OF PRIVATE EQUITY INVESTMENTS

Table II

Insurer Classification of Private Equity Investments

Table II reports the accuracy of private equity investments by insurers per year as reported in Schedule BA of their annual statutory filings. Data is collected from the National Association of Insurance Commissioners (NAIC) for years 2006 through 2013. We identify investments as correctly classified, misclassified, or omitted. The total number of incorrect classifications is the sum of both misclassified and omitted classifications.

	No. of Investments	No. Correctly Classified	% Correct	No. Misclassified	% Misclassified	No. Omitted	% Omitted	Total Incorrect	% Incorrect
2006	5,023	3,168	63.07%	652	12.98%	1,203	23.95%	1,855	36.93%
2007	5,433	3,354	61.73%	738	13.58%	1,341	24.68%	2,079	38.27%
2008	6,055	3,647	60.23%	772	12.75%	1,636	27.02%	2,408	39.77%
2009	5,877	3,766	64.08%	730	12.42%	1,381	23.50%	2,111	35.92%
2010	6,068	3,869	63.76%	785	12.94%	1,414	23.30%	2,199	36.24%
2011	6,237	4,308	69.07%	843	13.52%	1,086	17.41%	1,929	30.93%
2012	6,946	4,774	68.73%	973	14.01%	1,199	17.26%	2,172	31.27%
2013	6,500	4,368	67.20%	831	12.78%	1,301	20.02%	2,132	32.80%
Total	48,139	31,254	64.92%	6,324	13.14%	10,561	21.94%	16,885	35.08%

APPENDIX 5: SUMMARY STATISTICS OF PRIVATE EQUITY INVESTMENTS

Table III

Summary Statistics of Private Equity Investments

Table III presents summary statistics of private equity investments among investors. Data is collected from the National Association of Insurance Commissioners (NAIC) for years 2006 through 2013.

Panel A – Fund Level

Year	No. of Investments	Mean	Median	Minimum	Maximum	Std. Dev.	Total
2006	5,023	$5,410,126	$1,837,087	$10,036	$648,700,261	$16,511,868	$27,175,060,753
2007	5,433	$6,653,324	$2,284,768	$10,006	$712,081,588	$20,251,189	$36,147,508,354
2008	6,055	$6,692,012	$2,537,176	$10,028	$526,538,818	$17,409,362	$40,520,134,721
2009	5,877	$6,896,942	$2,729,665	$10,186	$528,259,862	$18,110,210	$40,533,326,347
2010	6,068	$7,967,133	$3,409,549	$10,161	$487,438,990	$17,410,877	$48,344,564,079
2011	6,237	$8,059,647	$3,299,917	$10,001	$508,075,107	$16,874,781	$50,268,018,837
2012	6,946	$7,959,058	$3,242,018	$10,023	$565,206,331	$16,904,535	$55,283,616,369
2013	6,500	$8,220,826	$3,489,434	$10,298	$446,354,015	$17,080,696	$53,435,366,085

Panel B – Investor Level

Year	No. of Investors	Mean	Median	Minimum	Maximum	Std. Dev.
2006	153	$177,614,776	$7,692,914	$10,653	$3,806,766,207	$518,846,518
2007	150	$240,983,389	$11,187,616	$13,906	$5,498,022,935	$739,383,328
2008	147	$275,647,175	$12,968,558	$27,500	$5,581,381,188	$800,568,435
2009	146	$277,625,523	$12,346,974	$17,286	$5,252,289,756	$803,470,812
2010	152	$318,056,343	$13,230,369	$11,769	$6,231,971,327	$926,145,545
2011	148	$339,648,776	$15,044,889	$25,456	$6,178,453,052	$960,078,650
2012	153	$361,330,826	$21,254,635	$17,092	$6,212,379,297	$987,058,828
2013	158	$338,198,520	$18,625,394	$12,301	$6,209,512,838	$963,490,420

Panel C – Distribution of Funds Across Investors

Year	Mean	Median	Minimum	Maximum	Std. Dev.
2006	16.10	3	1	186	32.14
2007	17.19	3	1	225	34.54
2008	19.60	4	1	251	38.11
2009	19.72	4	1	247	38.53
2010	20.03	4	1	261	38.60
2011	20.93	5	1	244	39.19
2012	22.19	4	1	277	44.68
2013	20.06	4	1	261	44.34

APPENDIX 6: SUMMARY STATISTICS OF VARIABLES

Table IV

Summary Statistics of Variables

Table IV reports summary statistics of regression analysis variables. Data is collected from the National Association of Insurance Commissioners (NAIC) for years 2006 through 2013. PE is the ratio of private equity to total invested assets. STOCK is a dummy variable equal to 1 if the insurer has a stock organizational form and 0 if it has a mutual organizational form. LEVERAGE is the natural log of total liabilities to the sum of surplus, common stock, and preferred stock. LTPCT is the percentage of net premiums written in long-tail lines to total net premiums written. NYPCT is the percentage of net premiums written in the state of New York relative to total net premiums written in all states. LOCAL is a dummy variable equal to 1 if insurer is within 100 miles of New York, Boston, or Palo Alto, 0 otherwise. SIZE represents the natural log of total net admitted assets. GROUP is a dummy variable equal to 1 if the insurer combines into a group observation and 0 if a standalone insurer. RBC is the ratio of total adjusted capital to authorized control level risk-based capital. JUNK is the percentage of junk bonds to total invested assets. REAL ESTATE is the percentage of real estate holdings to total invested assets. COMMON is the percentage of common stock to total invested assets. CASH is the percentage of cash and short-term investments to total invested assets. MORTGAGE is the percentage of mortgage holdings to total invested assets. Independent variables are winsorized at the 1% and 99% levels to remove the presence of outliers.

Panel A – Full Sample

Variable	N	Mean	Median	Minimum	Maximum	Std Dev.
PE	8,321	0.13%	0.00%	0.00%	6.66%	0.52%
STOCK	8,321	0.69	1.00	0.00	1.00	0.46
LEVERAGE	8,321	0.54	0.46	-3.35	3.64	1.14
LTPCT	8,321	82.33%	94.03%	0.00%	100.00%	26.32%
NYPCT	8,321	7.07%	0.00%	0.00%	100.00%	21.33%
LOCAL	8,321	0.21	0.00	0.00	1.00	0.41
SIZE	8,321	19.08	18.66	15.84	26.09	2.32
GROUP	8,321	0.46	0.00	0.00	1.00	0.50
RBC	8,321	12.66	8.28	0.00	246.64	20.01
JUNK	8,321	1.25%	0.05%	0.00%	14.19%	2.27%
REAL ESTATE	8,321	1.26%	0.00%	0.00%	21.32%	2.75%
COMMON	8,321	11.07%	6.96%	0.00%	70.52%	12.88%
CASH	8,321	16.58%	7.94%	0.00%	100.00%	21.71%
MORTGAGE	8,321	1.50%	0.00%	0.00%	30.09%	4.23%

Panel B – Investors

Variable	N	Mean	Median	Minimum	Maximum	Std Dev.
PE	1,195	0.88%	0.41%	0.00%	6.66%	1.10%
STOCK	1,195	0.65	1.00	0.00	1.00	0.48
LEVERAGE	1,195	1.31	1.11	-1.47	3.64	1.07
LTPCT	1,195	84.93%	92.56%	0.00%	100.00%	22.32%
NYPCT	1,195	6.39%	2.57%	0.00%	100.00%	12.15%
LOCAL	1,195	0.48	0.00	0.00	1.00	0.50
SIZE	1,195	22.58	22.53	16.20	26.09	2.09
GROUP	1,195	0.88	1.00	0.00	1.00	0.32
RBC	1,195	8.72	7.94	0.00	119.15	5.72
JUNK	1,195	2.90%	2.39%	0.00%	14.19%	2.60%
REAL ESTATE	1,195	0.84%	0.32%	0.00%	17.97%	1.55%
COMMON	1,195	11.87%	8.71%	0.00%	65.22%	11.81%
CASH	1,195	5.49%	3.35%	0.00%	60.23%	6.94%
MORTGAGE	1,195	4.00%	0.45%	0.00%	25.51%	5.45%

APPENDIX 7: DIFFERENCES OF MEANS AND MEDIANS – UNIVARIATE ANALYSIS

Table V

Differences of Means and Medians - Univariate Analysis

Table V presents differences of means and medians for the insurer specific characteristics. STOCK is a dummy variable equal to 1 if the insurer has a stock organizational form and 0 if it has a mutual organizational form. LEVERAGE is the natural log of total liabilities to the sum of surplus, common stock, and preferred stock. LTPCT is the percentage of net premiums written in long-tail lines to total net premiums written. NYPCT is the percentage of net premiums written in the state of New York relative to total net premiums written in all states. LOCAL is a dummy variable equal to 1 if insurer is within 100 miles of New York, Boston, or Palo Alto, 0 otherwise. SIZE represents the natural log of total net admitted assets. GROUP is a dummy variable equal to 1 if the insurer combines into a group observation and 0 if a standalone insurer. RBC is the ratio of total adjusted capital to authorized control level risk-based capital. JUNK is the percentage of junk bonds to total invested assets. REAL ESTATE is the percentage of real estate holdings to total invested assets. COMMON is the percentage of common stock to total invested assets. CASH is the percentage of cash and short-term investments to total invested assets. MORTGAGE is the percentage of mortgage holdings to total invested assets. Variables are winsorized at the 1% and 99% levels to remove the presence of outliers.

Variable		Non-Investors	Investors	Difference	p-value
Agency Issues					
STOCK	Mean	0.69	0.65	**0.04**	0.003
	Median	1.00	1.00	**0.00**	0.003
Underinvestment					
LEVERAGE	Mean	0.42	1.31	**-0.89**	<.001
	Median	0.37	1.11	**-0.84**	<.001
Asset-Liability Matching					
LTPCT	Mean	81.90%	84.93%	**-3.03%**	<.001
	Median	94.14%	92.56%	1.58%	0.366
Regulation					
NYPCT	Mean	7.18%	6.39%	0.79%	0.234
	Median	0.00%	2.57%	**-2.57%**	<.001
Home Bias					
LOCAL	Mean	0.17	0.48	**-0.31**	<.001
	Median	0.00	0.00	**0.00**	<.001

Table V (continued)

Variable		Non-Investors	Investors	Difference	p-value
Controls					
SIZE	Mean	18.49	22.58	**-4.09**	<.001
	Median	18.22	22.53	**-4.31**	<.001
GROUP	Mean	0.39	0.88	**-0.49**	<.001
	Median	0.00	1.00	**-1.00**	<.001
RBC	Mean	13.32	8.72	**4.60**	<.001
	Median	8.36	7.94	**0.42**	<.001
JUNK	Mean	0.97%	2.90%	**-1.93%**	<.001
	Median	0.00%	2.39%	**-2.39%**	<.001
REAL ESTATE	Mean	1.33%	0.84%	**0.49%**	<.001
	Median	0.00%	0.32%	**-0.32%**	<.001
COMMON	Mean	10.94%	11.87%	**-0.93%**	0.020
	Median	6.66%	8.71%	**-2.05%**	<.001
CASH	Mean	18.44%	5.49%	**12.95%**	<.001
	Median	9.25%	3.35%	**5.90%**	<.001
MORTGAGE	Mean	1.07%	4.00%	**-2.93%**	<.001
	Median	0.00%	0.45%	**-0.45%**	<.001
Observations		7,126	1,195		

APPENDIX 8: PRIVATE EQUITY INVESTMENTS WITH NAIC DESIGNATION CODES

Table VI

Private Equity Investments with NAIC Designation Codes

Table VI presents private equity investments with NAIC designation codes. Data is collected from the National Association of Insurance Commissioners (NAIC) for years 2006 through 2013. The NAIC 1 designation is assigned to obligations exhibiting the highest quality where credit risk is at its lowest and the issuer's credit profile is stable. The NAIC 2 designation is assigned to obligations of high quality where credit risk is low but may increase in the intermediate future and the issuer's credit profile are reasonably stable. The NAIC 3 designation is assigned to obligations of medium quality where credit risk is intermediate and the issuer's credit profile has elements of instability. The NAIC 4 designation is assigned to obligations of low quality where Credit risk is high and the issuer's credit profile is volatile. The NAIC 5 designation is assigned to obligations of the lowest credit quality, which are not in or near default, where credit risk is at its highest and credit profile is highly volatile, but currently the issuer has the capacity to meet its obligations. NAIC 5* is assigned by the Securities Valuations Office (SVO) to certain obligations when an insurer certifies: (1) that documentation necessary to permit a full credit analysis of a security does not exist and (2) the issuer or obligor is current on all contracted interest and principal payments and (3) the insurer has an actual expectation of ultimate repayment of all contracted interest and principal. The NAIC 6 designation is assigned to obligations that are in or near default. NAIC 6* is assigned by an insurer to an obligation in lieu of reporting the obligation with appropriate documentation to the SVO for a full credit analysis or filing the certification required for obtaining an NAIC 5* Designation.

Year	NAIC 1	NAIC 2	NAIC 3	NAIC 4	NAIC 5	NAIC 5*	NAIC 6	NAIC 6*	Total
2006	12	1	6	3	26	39	35	0	122
2007	11	0	0	10	36	41	19	0	117
2008	9	0	0	9	21	47	21	1	108
2009	11	0	2	6	34	47	18	1	119
2010	10	1	2	0	39	51	16	0	119
2011	25	0	0	0	29	64	4	0	122
2012	24	2	0	0	34	76	2	0	138
2013	27	0	0	3	31	84	0	0	145
Totals	129	4	10	31	250	449	115	2	990

APPENDIX 9: INVESTOR DISTRIBUTION OVER TIME

Table VII

Investor Distribution Over Time

Table VII presents the number of Non-Investors, Investors, and new Investors over the sample period. New investors are defined as insurers who do not invest in private equity the prior year, but then choose to invest the next year. Data is collected from the National Association of Insurance Commissioners (NAIC) for years 2006 through 2013.

Year	Non-Investors	Investors	New Investors
2006	1,222	153	-
2007	1,216	150	11
2008	1,182	147	7
2009	1,140	146	9
2010	1,091	152	10
2011	1,062	148	8
2012	1,045	153	13
2013	1,015	158	18

APPENDIX 10: U.S. BOND AND PRIVATE EQUITY INVESTMENTS OVER TIME

Table VIII

U.S. Bond and Private Equity Investments Over Time

Table VIII presents trends in the percentage of U.S. bond and private equity investments of total invested assets by private equity investors. Data is collected from the National Association of Insurance Commissioners (NAIC) for years 2006 through 2013.

Year	Private Equity	U.S. Bonds
2006	0.73%	6.24%
2007	0.94%	4.55%
2008	1.08%	5.32%
2009	1.09%	6.97%
2010	1.20%	6.89%
2011	1.22%	7.23%
2012	1.29%	6.80%
2013	1.25%	6.61%

APPENDIX 11: FIRST STEP HECKMAN CORRECTION RESULTS FOR PRIVATE EQUITY INVESTMENTS

Table IX

First Step Heckman Correction Results for Private Equity Investments

Table IX reports results for the first step of the Heckman's two-stage estimation of investor characteristics on private equity investment. The first step is a probit regression (examining the determinants of the investment decision) estimated on the full sample and is as follows:

$$DoInvest_i = \alpha + \beta_1 STOCK_i + \beta_2 LEVERAGE_i + \beta_3 LTPCT_i + \beta_4 NYPCT_i + \beta_5 LOCAL_i + \beta_6 TREND_i + \beta_7 SIZE_i + \beta_8 GROUP_i + \beta_9 RBC_i + \beta_{10} JUNK_i + \beta_{11} REAL\ ESTATE_i + \beta_{12} COMMON_i + \beta_{13} CASH_i + \beta_{14} MORTGAGE_i + \varepsilon_i$$

DoInvest is a binary variable equal to 1 if the insurer chooses to invest and 0 otherwise. STOCK is a dummy variable equal to 1 if the insurer has a stock organizational form and 0 if it has a mutual organizational form. LEVERAGE is the natural log of total liabilities to the sum of surplus, common stock, and preferred stock. LTPCT is the percentage of net premiums written in long-tail lines to total net premiums written. NYPCT is the percentage of net premiums written in the state of New York relative to total net premiums written in all states. LOCAL is a dummy variable equal to 1 if insurer is within 100 miles of New York, Boston, or Palo Alto, 0 otherwise. TREND is the aggregate amount of private equity under management for each year. SIZE represents the natural log of total net admitted assets. GROUP is a dummy variable equal to 1 if the insurer combines into a group observation and 0 if a standalone insurer. RBC is the ratio of total adjusted capital to authorized control level risk-based capital. JUNK is the percentage of junk bonds to total invested assets. REAL ESTATE is the percentage of real estate holdings to total invested assets. COMMON is the percentage of common stock to total invested assets. CASH is the percentage of cash and short-term investments to total invested assets. MORTGAGE is the percentage of mortgage holdings to total invested assets. Independent variables are winsorized at the 1% and 99% levels to remove the presence of outliers. Implied Change in Probability indicates the likelihood of PE investment where 1) the value of a dummy variable changes from 0 to 1, 2) the value of a continuous variable changes from the 25th to 75th percentile of its distribution, and 3) the value of TREND changes from the aggregate amount of private equity under management from 2006 to 2013 while holding the remaining independent variables at their mean values.

	Full Sample			Top Size Quartile		
	Coefficient	Implied Change in Probability	p-value	Coefficient	Implied Change in Probability	p-value
Agency Issues						
STOCK	**-0.159**	**-0.014**	0.003	**-0.526**	**-0.206**	<.001
Underinvestment						
LEVERAGE	**-0.064**	**-0.006**	0.064	**-0.110**	**-0.074**	0.035
Asset-Liability Matching						
LTPCT	**-0.365**	**-0.007**	0.001	-0.103	-0.009	0.541
Regulation						
NYPCT	**-0.413**	**-0.001**	0.012	**-0.900**	**-0.032**	<.001
Home Bias						
LOCAL	**0.190**	**0.018**	0.001	**0.240**	**0.095**	0.001
Reaching-for-Yield						
TREND	-0.000	-0.007	0.303	**-0.000**	**-0.077**	0.079
Controls						
SIZE	**0.478**	**0.127**	<.001	**0.544**	**0.468**	<.001
GROUP	0.060	0.005	0.321	**0.162**	**0.064**	0.100
RBC	**-0.013**	**-0.009**	<.001	**-0.025**	**-0.046**	<.001
JUNK	**6.982**	**0.008**	<.001	**9.833**	**0.145**	<.001
REAL ESTATE	**2.468**	**0.002**	0.028	-0.636	-0.002	0.838
COMMON	**0.391**	**0.005**	0.088	**0.746**	**0.042**	0.056
CASH	**-0.468**	**-0.006**	0.067	**-1.206**	**-0.023**	0.033
MORTGAGE	**2.945**	**0.000**	<.001	**2.539**	**0.040**	0.002
Observations		8,320			2,080	
Pseudo R^2		0.484			0.307	

APPENDIX 12: SECOND STEP HECKMAN CORRECTION RESULTS FOR PRIVATE EQUITY INVESTMENTS

Table X

Second Step Heckman Correction Results for Private Equity Investments

Table X reports results for the second step of the Heckman's two-stage estimation of investor characteristics on private equity investment. The second step is a regression including the inverse Mill's ratio estimated on the subsample of insurers who choose to invest. It examines the determinants of the percentage invested and is as follows:

$$PE_i = \alpha + \beta_1 STOCK_i + \beta_2 LEVERAGE_i + \beta_3 LIFE_i + \beta_4 NYREG_i + \beta_5 POST2008_i + \beta_6 SIZE_i + \beta_7 GROUP_i + \beta_8 RBC_i + \beta_9 JUNK_i + \beta_{10} REAL\ ESTATE_i + \beta_{11} COMMON_i + \beta_{12} CASH_i + \beta_{13} MORTGAGE_i + \sigma\lambda_i + \varepsilon_i\ , where\ DoInvest = 1$$

PE is the percentage of private equity to total invested assets. STOCK is a dummy variable equal to 1 if the insurer has a stock organizational form and 0 if it has a mutual organizational form. LEVERAGE is the natural log of total liabilities to the sum of surplus, common stock, and preferred stock. LTPCT is the percentage of net premiums written in long-tail lines to total net premiums written. NYPCT is the percentage of net premiums written in the state of New York relative to total net premiums written in all states. TREND is the aggregate amount of private equity under management for each year. SIZE represents the natural log of total net admitted assets. GROUP is a dummy variable equal to 1 if the insurer combines into a group observation and 0 if a standalone insurer. RBC is the ratio of total adjusted capital to authorized control level risk-based capital. JUNK is the percentage of junk bonds to total invested assets. REAL ESTATE is the percentage of real estate holdings to total invested assets. COMMON is the percentage of common stock to total invested assets. CASH is the percentage of cash and short-term investments to total invested assets. MORTGAGE is the percentage of mortgage holdings to total invested assets. LAMBDA is the inverse Mills ratio from the first step of the analysis. Independent variables are winsorized at the 1% and 99% levels to remove the presence of outliers.

	Full Sample		
	Coefficient	Implied Change in Dependent Variable	p-value
Agency Issues			
STOCK	0.0003572	0.0003572	0.635
Underinvestment			
LEVERAGE	**-0.0019797**	**-0.0033625**	<0.001
Asset-Liability Matching			
LTPCT	**-0.0044019**	**-0.0010079**	0.012
Regulation			
NYPCT	0.0001189	0.0000103	0.965
Home Bias			
TREND	**-0.0000013**	**-0.0027716**	0.010
Controls			
SIZE	**0.0028355**	**0.0083252**	<.001
GROUP	**-0.0046827**	**-0.0046827**	<.001
RBC	**-0.0001540**	**-0.0006821**	0.012
JUNK	**0.0437302**	**0.0018077**	0.010
REAL ESTATE	**0.0346693**	**0.0002831**	0.097
COMMON	0.0061301	0.0008390	0.122
CASH	**-0.0211543**	**-0.0009668**	<.001
MORTGAGE	**0.0346826**	**0.0027947**	<.001
LAMBDA	**0.0085245**		<.001
Observations		1,195	
R^2		0.086	

PART 2: DO ECONOMIES OF SCOPE LIMIT IPOS?

PART 2

INTRODUCTION

There has been a substantial decline in the number of U.S. initial public offerings (IPOs) since 2000. The market averaged 310 IPOs per year from 1980 through 2000, but only averaged 111 IPOs per year for the past 15 years (Ritter, 2016). This decline is mysterious considering real GDP has doubled over this timeframe and economic theory suggests the number of IPOs should also double (Smith et al., 2014). Consequently, the deterioration of new offerings has raised concerns. First, commentators argue the decline in IPOs cost the U.S. economy significant employment opportunities (Weild and Kim, 2009; IPO Task Force, 2011; and Levy and Pruitt, 2012). Second, since IPOs are typically growing companies, the decline in employment opportunities also raises concern innovation is deterred (Weild and Kim, 2010; and Weild, Kim, and Newport, 2013). Proponents of deregulation argue the decrease in IPOs signal a weak capital market where infusion is not widely available.

In order to reinvigorate the IPO market, policymakers invited comments for possible solutions. The most prominent concern raised was that regulatory costs deterred small firms from going public. In response policymakers included a provision in the Dodd-Frank Act, which exempts firms with less than $75 million in public equity from Sarbanes-Oxley (SOX) Section 404(b) reporting. The Jumpstart Our Business Start-Up (JOBS) Act further reduced regulatory costs for small firms by extending the 404(b) exemption for a greater proportion of firms by creating the Emerging Growth Companies[1] classification. More recently, the SEC has attempted to rein in other regulatory costs by amending Regulation A[2] to preempt blue-sky registration[3] for issues of greater than $20 million and increase the maximum amount sought to $50 million (SEC, 2015). Others argue the IPO decline is the result of weak secondary market support for small firms (IPO Task Force, 2011 and Weild, Kim, and Newport, 2012). Weild, Kim, and Newport (2012) argue diminished spreads remove compensation for market makers and decreases liquidity for small firms. In response to such claims, the SEC commissioned the Pilot Tick Size Program to examine the effects of increasing the minimum tick size (SEC, 2014). Other solutions that have been proposed include firms providing an annual fee for Designated Market Makers (DMMs) to enhance liquidity (Bessembinder, Hao, and Zheng, Forthcoming) or the creation of venture exchanges similar to those of the London's AIM and Toronto's TSX Venture (SEC, 2015).

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[1] "The term 'emerging growth company' means an issuer that had total annual gross revenues of less than $1,000,000,000 (as such amount is indexed for inflation every 5 years by the Commission to reflect the change in the Consumer Price Index for All Urban Consumers published by the Bureau of Labor Statistics, setting the threshold to the nearest 1,000,000) during its most recently completed fiscal year. An issuer that is an emerging growth company as of the first day of that fiscal year shall continue to be deemed an emerging growth company until the earliest of—''(A) the last day of the fiscal year of the issuer during which it had total annual gross revenues of $1,000,000,000 (as such amount is indexed for inflation every 5 years by the Commission to reflect the change in the Consumer Price Index for All Urban Consumers published by the Bureau of Labor Statistics, setting the threshold to the nearest 1,000,000) or more; ''(B) the last day of the fiscal year of the issuer following the fifth anniversary of the date of the first sale of common equity securities of the issuer pursuant to an effective registration statement under this title; ''(C) the date on which such issuer has, during the previous 3-year period, issued more than $1,000,000,000 in non-convertible debt; or ''(D) the date on which such issuer is deemed to be a 'large accelerated filer', as defined in section 240.12b–2 of title 17, Code of Federal Regulations, or any successor thereto.''. The Jumpstart Our Business Start-Up Act (2012).

[2] Regulation A is an exemption from the Securities Act of 1933, which permits unregistered public offerings by security-holders of a company. Prior Regulation A offerings were subject to state-level registration and qualification requirements. However, the prior form of Regulation A was rarely used and critics suggested the cost and complexity of federal and state law compliance made it less practical than other Securities Act exemptions. On March 25, 2015, the SEC adopted final rules to implement Section 401 of the JOBS Act by expanding Regulation A into two tiers: Tier 1, for securities offerings of up to $20 million in a 12-month period; and Tier 2, for securities offerings of up to $50 million in a 12-month period. The resulting exemption is referred to as "Regulation A+" and enables firms to bypass blue sky laws under certain conditions. SEC (2015)

[3] "In addition to the federal securities laws, every state has its own set of securities laws —commonly referred to as "Blue Sky Laws"—that are designed to protect investors against fraudulent sales practices and activities. While these laws do vary from state to state, most state laws typically require companies making offerings of securities to register their offerings before they can be sold in a particular state, unless a specific state exemption is available. The laws also license brokerage firms, their brokers, and investment adviser representatives." SEC (2015)

However, there is significant disagreement for the underlying reason the U.S. IPO market remains depressed among academics (Davidoff and Rose, 2014). The *regulatory overreach hypothesis* argues the combination of regulatory efforts (SOX, Regulation FD, the 2003 Global Settlement[4], order-handling rules, and diminished spreads) have led to a market ecosystem that is unsuitable for small firms, which account for the majority of IPOs. Since 2008, virtually all policy recommendations have aimed to address these concerns.

On the other hand, the *economies of scope hypothesis* by Gao et al. (2013) posits getting big fast is more important than it used to be due to increases in globalization and technological innovation that has decreased profitability among small firms. Consequently, for small firms, growing organically is an inferior strategy to growing quickly through mergers and acquisitions. Therefore, small firms are more apt to making acquisitions or selling out in a trade sale than conducting an IPO. Their study demonstrates evidence that is inconsistent with the regulatory overreach hypothesis while consistent with their economies of scope hypothesis. However, their analysis never includes direct economies of scope measurements. Rather, their main point relies on time-trend dummy analysis, which demonstrates something other than SOX is contributing to the IPO decline.

I find the following results. First, I find direct evidence for the *economies of scope hypothesis*. Private firms with less than $50 million in sales are more likely to be acquired than to IPO when their industry has higher economies of scope. However, despite the prior finding, I do not find evidence that 3-year buy-and-hold returns for IPOs are negatively impacted with high economies of scope levels. Finally, I find economies of scope is negatively related to firms

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[4] The Global Settlement was finalized on April 28, 2003 among the SEC, NASD, the New York Stock Exchange (NYSE), the National Association of State Securities Administrators (NASAA), and the New York State Attorney General which outlined penalties and reforms based on conflicts of interest between research and investment banking.

adopting a dual tracking strategy, but does not explain sell-out premiums for acquired private firms.

This study contributes to the IPO debate. First, using the data envelopment analysis (DEA) methodology of Demerjian et al. (2012, 2013), I calculate a direct metric for measuring economies of scope measurements (EOS) for Fama-French (1997) industries. Second, I directly test the economies of scope hypothesis while using DES. Third, to resolve contradictory findings relating IPOs with competitive markets[5], I use EOS to provide insight into the trade sale/IPO decision for private firms. Finally, findings may help guide future policy.

The remainder of this paper is as follows. Section II reviews the prior literature on the competing hypotheses for the U.S. IPO market decline. Section III develops our hypotheses on the economies of scope effect on the both IPOs and trade sales of private firms. Section IV explains the research approach. Section V introduces and describes the data sources and sample. Section VI presents the results. Section VI summarizes the findings and concludes.

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[5] Brau, Francis, and Kohers (2003) find private firms prefer an acquisition over an IPO in competitive industries. However, Bayar and Chemmanur (2012) find the opposite result.

LITERATURE REVIEW

Regulatory Overreach

The *regulatory overreach hypothesis*[6] argues SOX, Regulation FD, the 2003 Global Settlement, order-handling rules, and reductions in quoted spreads have created an environment unsuitable for small firms. Initial focus centered solely on the direct and indirect costs of SOX. Commentators suggest the SOX implementation costs are disproportionally greater for small firms because most of the costs are fixed (Holmstrom and Kaplan, 2003; IPO Task Force, 2011). A number of empirical studies find evidence indicating small firms were disproportionally effected by SOX[7]. These findings extend to IPOs since most originate as small firms. Thus, SOX may act as a deterrent for small firms entering the public market. Furthermore, Bova et al. (2013) discover SOX decreased the likelihood that US small private companies would go public and instead choose to be acquired.

However, other studies find conflicting results. Brau and Fawcett (2006) survey CFOs who either did not file or withdrew from an IPO and report SOX is not a significant concern in their decisions. Johnson and Madura (2009) find U.S. IPOs have less valuation uncertainty after post-SOX due to decreases in asymmetric information. Doidge, Karolyi, and Stulz (2013) examine the effects of globalization on IPOs worldwide. They note while there has been an IPO decline in both

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[6] Gao et al. (2013) present the regulatory overreach hypothesis as a catch-all for arguments suggesting the lack of IPO activity is due to SOX, Regulation FD, the 2003 Global Settlement, and/or analyst coverage.
[7] GOA (2006); Chhaochharia and Grinstein (2007); Zhang (2007); Engel, Hayes, and Wang (2007); Wintoki (2007); Ahmed et al. (2010); Bartlett (2009); Kamar, Karaca-Mandic, and Talley (2009); Iliev (2010); Kang, Liu, and Qi (2010).

the U.S. and Europe, regulatory changes do not explain dip in U.S. IPOs. Gao et al. (2013) provide counterevidence for the detrimental effects of SOX. They demonstrate small firms were unprofitable prior to SOX and even after removing associated SOX costs small firms remain unprofitable after SOX implementation.

Practitioners often cite changes in tick sizes and analyst coverage as reasons for U.S. IPO decline (Weild and Kim, 2008, 2009 and 2010; Weild, Kim, and Newport 2012 and 2013; and IPO Task Force, 2011). They argue diminished spreads removed compensation for capital investment, research, and sales support for smaller firms and therefore led to decreased liquidity for those firms. The academic literature provides some support for their assertions. Kadapakkam, Krishnamurthy, and Tse (2005) study brokers' incentives for using stock splits during the 1/8th pricing period and decimalization. Their results show decimalization leads to decreases in average buy order size, frequency of small trades, and order imbalance toward the buy side. Furthermore, while there is evidence of positive abnormal returns around ex-date during the 1/8th pricing period, they do not find this in the decimalization period.

Prior studies show analyst coverage can increase share value[8]. Both Jegadeesh and Kim (2010) and Groysberg (2013) note the number of analysts has declined since the Global Settlement. Mola, Rau, and Khorana (2012) investigate the impact of analyst coverage on firms following the Global Settlement. Using a matched sample, they find firms that lose coverage post-IPO experienced less liquidity, trading volume, institutional ownership and are more likely to delist. They conclude the Global Settlement provides disincentives for analysts in traditional soft-dollar brokerage houses to cover small or mid-sized firms because these firms do not produce order flows to offset the costs. Davidoff and Rose (2014) provide another explanation by examining the

[8] Womack, 1996; Barber et al., 2001; Irvine, 2003; Jegadeesh et al., 2004; Bradley, Jordan, and Ritter, 2008; Demiroglu and Ryngaert, 2010; Loh and Stulz, 2011

lifecycle of small firms. They believe investors have grown disinterested in small IPOs because of their below market performance and supply side changes are the reason for the disappearance in IPOs. Gao et al. (2013) contradict the previously mentioned studies as they find analyst coverage remained at similar levels for the 3 years following an IPO.

Economies of Scope

In response to the regulatory overreach arguments, Gao et al. (2013), Ritter, Signori, and Vismara (2013), and Ritter (2014) offer the *economies of scope hypothesis* as a competing explanation. They argue getting big fast is more important than it used to be due to increases in globalization and technological innovation that has decreased profitability among small firms. Consequently, for small firms, growing organically is an inferior strategy to growing quickly through mergers and acquisitions. Therefore, small firms are more apt to making acquisitions or selling out in a trade sale than conducting an IPO.

While they do not use a direct economies of scope metric, Gao et al. observe indirect evidence consistent with their hypothesis while inconsistent with the regulatory overreach hypothesis. They report the percentage of unprofitable small firms has increased substantially since 1997. Furthermore, among small firms that do go public, many are involved in M&A deals as either a target or acquirer. In time-series analysis, they observe a negative time-trend in scaled IPO volume, which is economically and statistically greater for small firms than large firms, while finding no relation between SOX implementation and scaled IPO volume. Ritter et al. expand upon the prior findings by investigating Europe's IPO decline. Though Ritter et al. conclude market conditions partially explain the decline of small firm IPOs, they report the same negative time-trend pattern without the presence of regulatory overreach arguments.

HYPOTHESES

In this section, I develop hypotheses extending the study of Gao et al. (2013) which include a direct measurement for economies of scope. In addition, I develop hypothetical extensions specifically for small firm IPOs since the decline (increase) in IPOs (trade sales) is greater than large firm IPOs (Gao et al., 2013; Davidoff and Rose, 2014). Therefore, following Gao et al., the first hypothesis is as stated:

Hypothesis 1: Private firms in industries with large economies of scope are less likely to exit via IPO, ceteris paribus.

Hypothesis 1a: Small private firms in industries with large economies of scope are less likely to exit via IPO, ceteris paribus.

Intuitively, if economies of scope limit IPOs as an exit mechanism then private firms will increase their propensity for trade sales. Gao et al. (2013) and Ritter et al. (2013) provide indirect support for this conjecture in the U.S. and European markets respectively. Consequently, the second hypothesis is as follows:

Hypothesis 2: Private firms in industries with large economies of scope are more likely to exit via trade sale, ceteris paribus.

Hypothesis 2a: Small private firms in industries with large economies of scope are more likely to exit via trade sale, ceteris paribus.

Economies of scope should depress the profitability of small firms. Therefore, investors should earn lower returns for small firm IPOs. Gao et al. (2013) calculate three-year buy-and-hold returns of IPOs and report small firms underperform on both market value (-19.5%) and style adjusted (-30.3%) basis from 2001-2009. Similarly, Ritter et al. (2013) find European small firm IPOs have a three-year buy-and-hold average return of -2.9% from 1995-2008, relative to 14.6% for large firm IPOs. Consequently, I predict the following:

Hypothesis 3: Small firm initial public offerings in industries with large economies of scope underperform on three-year buy-and-hold basis, ceteris paribus.

I extend the analysis by investigating if economies of scope affect how firms approach the IPO/trade sale decision. Since the economies of scope hypothesis predicts lower potential returns for both IPO and trade sales, then private firms should look for alternative strategies that maximize their value. One such strategy is the practice of dual-tracking. Dual-tracking occurs when a target files to go public, but enters into negotiations with a buyer simultaneously. In theory, the target undergoes the filing process expense to both signal their quality and alleviate asymmetric information between the buyer and target. Dual-tracking can be subdivided into two segments: 1) public dual-tracking where the target is acquired after their IPO and 2) private dual-tracking where the target is acquired before the IPO process can complete. Empirical evidence by Brau, Sutton, and Hatch (2010) suggest dual-tracking is a preferential option to solely committing to either an IPO or trade sale. They discover firms who utilize a private dual-tracking strategy earn a premium of 22-26% over a single-track strategy (acquisition alone) and a public dual-tracking strategy earn a premium of 18-21% over a single-track strategy. Consequently, I expect firms facing economy of scope pressure to seek such a strategy to increase their eventual exit.

Hypothesis 4: Private firms in industries with large economies of scope have an increased propensity to adopt dual-tracking strategies, ceteris paribus.

Hypothesis 5: Private firms in industries with large economies of scope receive a higher risk-adjusted payoff with a dual-track private sell-out than a single-track (dual-track) trade sell, ceteris paribus.

METHODS

I calculate economies of scope (EOS) measurements using data envelopment analysis (DEA) to directly test the *economies of scope hypothesis*. While frontier efficiency methods are commonly used in the economics literature, DEA has recently been applied to an increasing number of banking, insurer, and financial studies (Habib and Ljungvist, 2005; Nguyen and Swanson, 2007; Cummins et al., 2010; and Leverty and Qian, 2011). DEA methodology has two advantages over regression analysis. First, DEA provides an ordered ranking compared to the best possible performance where regression analysis provides efficiency that is relative to the average performance. Second, DEA allows for inputs and outputs to have different weights among firms whereas other efficiency measures (i.e. ROA) require fixed weighting schemes.

DEA estimates an optimal frontier for each firm based on its inputs and outputs. Efficiency scores range from 0 to 1, where 1 indicates the firm is operating at optimal performance. I follow Demerjian et al.'s method (2012, 2013) for output and input selection. The output is Total Revenue of the firm (SALE). The inputs are 1) Cost of Goods Sold (COGS), 2) Selling, General & Administrative Expense (XSGA), 3) Net Property, Plant, & Equipment (PPENT), 4) Capitalized Operating Leases (MRC1, MRC2, MRC3, MRC4, and MRC5) which is calculated as the discounted present value of the next five years of required operating lease payments with a discount rate of 10%, 5) Capitalized Research & Development (XRD) which is calculated as $RD_{cap} = \sum_{t=-4}^{0}(1 + 0.2t) \times RD_{exp}$, 6) Goodwill (GDWL) which is calculated as the premium paid over the fair value of a business acquisition, and 7) Other Intangibles (INTAN – GDWL) which reflects the other acquired and capitalized intangibles such as client lists, patent costs, and copyrights. I define economies of scope (*EOS*) as the efficiency of diversified firms for each Fama-French (1997) industrial classification in each year. I follow Denis et al. (2002) by designating firms as diversified if they report more than one segment for that given year as reported in Compustat Segments.

After creating the EOS metric, I test the impact industry specific economies of scope on the exit strategies of private firms. I follow Brau et al. (2003), Bayar and Chemmanur (2012), and Bova et al. (2014) and test for the IPO versus trade sale decision by controlling for industry-related, marketing-timing, deal-related, and demand-for-fund factors. I test hypotheses 1 and 2 with Equation 1:

$$
\begin{aligned}
IPOd = \alpha &+ \beta_1 EOS_i + \beta_2 SMALL_i + \beta_3 EOS * SMALL_i + \beta_4 LIQUIDITY_i + \beta_5 HHI_i + \beta_6 PB_i \\
&+ \beta_7 IND\_DA_i + \beta_8 IND\_TAN_i + \beta_9 IND\_MTB_i + \beta_{10} HITECH_i + \beta_{11} MKTRF_i \\
&+ \beta_{12} MKTRF\_LAG_i + \beta_{13} HML_i + \beta_{14} HML\_LAG_i + \beta_{15} SMB_i + \beta_{16} SMB\_LAG_i \\
&+ \beta_{17} RF_i + \varepsilon_i
\end{aligned}
\tag{1}
$$

where *IPOd* is equal to 1 for IPO exits, and 0 for trade sales, *EOS* is the economies of scope for the firm's industry in the year they exit, and *SMALL* equals 1 if the firm had $50 million ($2009) or less in total sales in year prior to exit and 0 otherwise. Definitions for the remaining independent variables are available in the appendix.

In order to test hypothesis 3, I calculate the buy-and-hold abnormal return, $BHAR_{i,t}$, for each IPO firm with respect to the CRSP value-weighted index. The buy-and-hold returns are calculated from the first CRSP-reported closing price through the earlier of the third-year anniversary of the IPO, the delisting date, or December 31, 2014. Small and large company IPOs are defined based on whether the pre-IPO last twelve months sales are less than or greater than $50 million. IPOs are also subdivided into tertiles based upon the EOS for their industry in their

IPO year. All returns include dividends and capital gains, including the index returns. I calculate $BHAR_{i,t}$ using the equation:

$$BHAR_{i,t} = \prod_{t=1}^{\min(t,delist)} (1 - R_{i,t}) - \prod_{t=1}^{\min(t,delist)} (1 - R_{m,t}), \quad (2)$$

Where $R_{i,t}$ is the net return in period t on stock I and $R_{m,t}$ is the net return in period t on the value-weighted market.

To test if high economies of scope influence private firms to take a trade sale over a dual-tracking strategy, I follow Brau et al. (2010) and control industry type, firm size, VC-backing, and market environment. I test hypothesis 4 with Equation 3:

$$(Track = 1\ or\ 2) = \alpha + \beta_1 EOS + \beta_2 SMALL + \beta_3 HITECH + \beta_4 ASSETS + \beta_5 VC + \beta_j TimeDummys + \varepsilon \quad (3)$$

where *Track* equals 1 for single-track sell-outs and equals 2 for either dual private sell-outs or dual public sell-outs.

To test if EOS impacts the premium in takeovers, I follow Brau et al. (2010) and control for if the acquirer and target are in the same industry, the method of payment, industry type, target size, and VC-backing. I test hypothesis 5 with Equation 4:

$$PREMIUM = \alpha + \beta_1 EOS + \beta_2 SMALL + \beta_3 DUAL + \beta_4 FOCUS + \beta_5 STOCK + \beta_6 MIX + \beta_7 HITECH + \beta_8 ASSETS + \beta_9 VC + \beta_j TimeandIndEffects + \varepsilon_i \quad (4)$$

where *PREMIUM* is the transaction value divided by the sell-out firm's sales in the period prior to the takeover announcement, *DUAL* is equal to 1 if the sell-out target is a private that filed for an IPO and later withdrew or if the sell-out target is a formerly private firm that completed an IPO and was acquired within a year of the IPO, 0 otherwise. Definitions for all variables are available in the appendix.

DATA

The IPO sample includes U.S. IPOs from 2007-2014 with an offer price of at least $5 per share, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, financial firms, and stocks not listed on CRSP. The IPO sample is obtained from Jay Ritter's IPO website along with Thomson Financial Securities Data and SEC filings on EDGAR. I obtain data from Compustat Fundamentals and Segment databases for the DEA inputs and outputs. I collect the following variables for all firms from Compustat: Total Revenue (SALE), Cost of Goods Sold (COGS), Selling, General & Administrative Expense (XSGA), Net Property, Plant, & Equipment (PPENT), Capitalized Operating Leases (MRC1, MRC2, MRC3, MRC4, and MRC5) Capitalized Research & Development (XRD), Goodwill (GDWL), and Other Intangibles (INTAN – GDWL). I acquire firm return data from the Center for Research in Security Prices (CRSP). I collect acquisition data from Bloomberg. Following Brau et al. (2010) I use a $50 million takeover cut-off. I require firms in the dual tracking sample to have values for both assets and sales prior to takeover. The final sample includes 626 IPOs and 388 Trade Sales for IPO versus trade sale analysis and 188 single-track sell-outs, 17 dual private sell-outs, and 5 dual public sellouts.

Table I reports the means, medians, and standard deviations for the output and inputs of diversified firms from Compustat during the 2007-2014 time period. The sample includes 11,118 firm-years that are used for calculating *EOS* for each Fama-French (1997) industry per year. Table II presents the means, medians, and standard deviations for the EOS measure by Fama-French industry. The highest *EOS* industries are Shipping Containers, Defense, and Shipbuilding and Railroad Equipment, with mean values of 0.992, 0.988, and 0.980 respectively. The lowest *EOS* industries are Pharmaceutical Products, Petroleum and Natural Gas, and Precious Metals with mean values of 0.442, 0.535, and 0.565. Examining the standard deviations reveals some industries are more stable than others with respect to efficiency among diversified firms. The most stable industries are Shipping Containers, Defense, and Shipbuilding and Railroad Equipment while Electrical Equipment, Medical Equipment, and Pharmaceutical Products experience the most fluctuation in terms of efficiency.

RESULTS

Table III provides summary statistics and univariate results for the IPO (Panel A) versus trade sale (Panel B) decision logit model. There are marked differences between both samples. The trade sale sample has greater annual sales and liquidity in their sellouts relative to the IPO sample. However, the IPO sample faces greater industry competition, have greater market-to-book ratios, and better time the market than the trade sale sample. The key independent variables of *EOS* and *SMALL* do not appear to be significantly different between the samples. Both the IPO and trade sale samples face similar efficiency by diversified firms in their industries and have similar proportions of firms with sales less than $50 million ($2009). I conduct multivariate setting to determine if the key variables are related to the exit decision.

Table IV reports the results for the IPO versus trade sale decision logit model. The first specification is the base while the second specification includes an interaction term between *EOS* and *SMALL*. The variables, *EOS* and *SMALL* are insignificant in both specifications. This implies that economies of scope nor having a small level of sales factors into a firm's decision to either IPO or be acquired. As a result, I do not find evidence supporting hypothesis 1. However, the interaction of both, *EOS*SMALL*, is significant and negative in the second specification. This result implies that firms with sales less than $50 million ($2009) facing elevated levels of economies of scope for their industries are less likely to pursue an IPO. This finding is consistent with the economies of scope hypothesis of Gao et al. (2013). Consequently, I find support for hypothesis 2; small private firms in industries with large economies of scope are more likely to exit via trade sale.

I test if small firm IPOs in industries with large economies of scope underperform on three-year buy-and-hold basis and present the results in Table V. I subdivide the sample into firms between Small and Large company IPOs (based on whether the pre-IPO last twelve months sales are less than or greater than $50 million) and tertiles based upon the IPO's *EOS* for their industry. Interestingly, the sample of 270 Small IPOs have outperformed the market by 7.19% over this period while the sample of 356 Large IPOs have underperformed the market by 9.44%. Examining the results further reveals most of the Small IPOs return is driven mainly by the Small IPOs in the Bottom *EOS* Tertile. However, there is not sufficient evidence to confirm hypothesis 3. The only significant difference in returns occurs between the Small and Large sample of the Bottom EOS Tertile.

Due to the impact of economies of scope on the exit decisions of private firms I examine how dual-track strategies may increase the premium on a sell-out. Table VI provides statistics for the means, medians, and standard deviation for the single and dual tracking samples. I present each strategy separately, but I combine the dual-track private sellout and dual-track public sellouts for the purposes of conducting univariate tests with the single-track sellouts sample due to the low number of observations. The single-track and dual-track samples are remarkably similar except for two independent variables. Single-track firms face great economies of scope and have less VC backing compared to dual-track firms. The difference in economies of scope runs counter to what was hypothesized, I conduct multivariate testing to determine if that is the case.

Table VII reports the results for the single-track versus dual-track decision logit model. The first specification is the base while the second specification includes an interaction term between *EOS* and *SMALL*. The variable, *EOS,* is significant and negative in both specifications. This implies that firms facing high levels of economies of scope in their industry are more likely to engage in a single-track strategy than to attempt a dual-track strategy. Consequently, I do not find any evidence to support hypothesis 4; Private firms in industries with large economies of scope have an increased propensity to adopt dual-tracking strategies. Instead I find evidence to support the exact opposite. This may imply on average firms do not see any value from decreasing asymmetric information to get a better valuation when confronted with high levels of economies of scope. Furthermore, both *SMALL* and the interaction term, *EOS * SMALL*, are insignificant, which implies smaller firms are not disproportionally affected.

In the final part of the analysis, I examine if elevated levels of economies of scope impact the premium received with either single-track or dual-track strategies. Table VIII reports the results for the cross-sectional regression of sell-out premium for the full sample. The variables, *EOS*, *SMALL,* and *EOS*SMALL* are insignificant in both specifications. This implies that economies of scope nor having a small level of sales factors into the sell-out premiums for either of these strategies. Furthermore, *DUAL* is insignificant in both specifications. This implies that the dual-track strategy of either a private or public sell-out explain the premiums of the sample. Therefore, I do not find any evidence to support hypothesis 5; private firms in industries with large economies of scope receive a higher risk-adjusted payoff with a dual-track private sell-out than a single-track sell-out. Instead, I find that single-track and dual-track strategies are not different from one another.

CONCLUSION

I directly test the *economies of scope hypothesis* of Gao, Ritter, and Zhu (2013) using the data envelopment analysis (DEA) methodology of Demerjian et al. (2012, 2013). Following their approach, I develop a metric for measuring economies of scope among diversified firms. I find support for the *economies of scope hypothesis*. Private firms with less than $50 million in sales are more likely to be acquired than to IPO when their industry has higher economies of scope. However, I do not find that economies of scope negatively impact 3-year buy-and-hold returns for IPOs. From an exit prospective, I find economies of scope are negatively related to firms adopting a dual tracking strategy, but does not explain sell-out premiums for acquired private firms. An extension of the time period to include regulatory changes, which include SOX and market rule changes would be a fruitful area for future research.

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APPENDIX

APPENDIX 1: VARIABLE DEFINITIONS

Appendix A: Variable Definitions

$EOS_{i,t}$	Economies of scope measurement for industry *i* in year *t*.
IPOd	Equals 1 if firm *i* chooses an IPO and 0 if firm *i* chooses to be acquired via a trade sale.
SMALL	Equals 1 if the firm had $50 million ($2009) or less in total sales in year prior to exit strategy and 0 otherwise.
HHI	Herfindahl Index for the private firm's industry. An IPO may be favored if the industry has high concentration because of antitrust concerns. A trade sale may be favored in a high concentration industry since intense competition may limit firm survival. (Audretsch 1995).
PB	Private Benefits is a dummy variable equal to 1 if the firm belongs to either one of the following industry groups: two-digit SIC codes 13 (oil & gas production), 28 (chemicals and allied products), 29 (oil refining), and 37 (transportation equipment). Rajan and Wulf (2006) observe CEO and CEO-Divisional Manager perk consumption is highest in these industry groups. Bayar and Chemmanur (2011, 2012) predict founders and entrepreneurs are more likely to remain as higher management after an IPO while they are more likely to be released following a trade sale. Therefore, founders and entrepreneurs in these industry groups have an incentive for an IPO so they can retain their private benefits.
IND_DA	Industry mean (two-digit SIC grouping) leverage ratio calculated as total debt scaled by total assets. An IPO may be favored in a high leverage industry since firms have been scrutinized by lenders and therefore have lower investigation costs for the equity issue (Harris and Raviv 1990). On the other hand, high leverage may influence firms to adopt conservative restructuring.
IND_TAN	Average tangible assets / total assets ratio (net property and equipment scaled by total assets) for the firm's two-digit SIC industry group. A firm with a higher tangible asset ratio should favor IPO since it will be easier for investors to value their underlying assets.
IND_MTB	Average market-to-book ratio for the private firm's industry. The predicted relation is ambiguous since a higher market-to-book ratio provides incentives for higher valuations for both IPOs and trade sales.

HITECH	Indicator variable equal to 1 for private firms in an high technology industry. The predicted relation is ambiguous since high tech firms receive higher investor attention (Maksimovic and Pichler 2001), but also receive relatively high premiums compared to other industries (Kohers and Kohers 2000).
MKTRF	Quarterly calendar market return minus three-month T-bill rate.
MKTRFl	Lagged quarterly calendar market return minus three-month T-bill rate.
HML	Quarterly calendar return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks.
HMLl	Lagged quarterly calendar return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks.
SMB	Quarterly calendar return on a portfolio that is long on small capitalization stocks and short on large capitalization stocks.
SMBl	Lagged quarterly calendar return on a portfolio that is long on small capitalization stocks and short on large capitalization stocks.
RF	Three-month T-bill rate.
LIQUIDITY	Percentage of the offer in cash for private targets and the ratio of secondary shares offered to total shares for IPO firms. Brau et al. (2003) predicts insiders with greater liquidity needs will select a trade sale since it usually provides greater liquidity than an IPO.
TRACK	Equals 1 if the firm uses a dual track exit strategy and 0 if the firm uses a single track exit strategy.
PREMIUM	The transaction value, or the amount paid for the sell-out firm, divided by the sell-out firm's sale in the period prior to the takeover announcement.
DUAL	DUAL equals to 1 if the sell-out target is a private firm that filed for an IPO and later withdrew or if the sell-out target is a formerly private firm that completed an IPO and was acquired within a year of the IPO and 0 otherwise.

FOCUS	Equal to 1 if the acquirer and sell-out target are from the same 4-digit SIC code and 0 otherwise. Brau et al. (2010) find targets in the same industry as the buyer earn 7% greater in premiums.
STOCK	Equal to 1 for pure stock offers and 0 otherwise. Brau et al. (2003, 2010) predict pure stock offers will have the highest premiums compared to all cash or mixed offers since the seller's risk is highest.
MIX	Equal to 1 for takeovers paid with a mixture of stock and cash; and 0 otherwise. Brau et al. (2003, 2010) predict mixed offers will have higher premiums than all cash offers, but lower premiums than pure stock offers.
ASSETS	The natural logarithm of the sell-out firm's total assets in the period prior to the acquisition.
VC	Equal to 1 if the firm is venture capital backed and 0 otherwise. VC backed firms historically receive higher premiums relative to non-VC backed firms.

APPENDIX 2: SUMMARY STATISTICS FOR DIVERSIFIED FIRMS

Table I
Summary Statistics for Diversified Firms

Table I reports the means, medians, and standard deviations for the output and inputs of sample firms in Compustat during the 2007-2014 time period. The output and inputs are based on the methodology of Demerjian et al. (2012, 2013). The output is Total Revenue of the firm (SALE). The inputs are 1) Cost of Goods Sold (COGS), 2) Selling, General & Administrative Expense (XSGA), 3) Net Property, Plant, & Equipment (PPENT), 4) Capitalized Operating Leases (MRC1, MRC2, MRC3, MRC4, and MRC5) which is calculated as the discounted present value of the next five years of required operating lease payments with a discount rate of 10%, 5) Capitalized Research & Development (XRD) which is calculated as $RD_{cap} = \sum_{t=-4}^{0}(1 + 0.2t) \times RD_{exp}$, 6) Goodwill (GDWL) which is calculated as the premium paid over the fair value of a business acquisition, and 7) Other Intangibles (INTAN – GDWL) which reflects the other acquired and capitalized intangibles such as client lists, patent costs, and copyrights. I follow Denis et al. (2002) by designating firms as specialized if they report as a single segment and diversified if they report more than one segment for that given year as reported in Compustat Segments. Dollar values are in millions (2014 purchasing power).

	N	Mean	Median	Std. Dev.
Total Revenue	11,118	$7,303.76	$947.44	$25,638.36
Cost of Goods Sold	11,118	$4,925.98	$581.47	$20,080.41
Selling, General & Admin	11,118	$1,223.15	$161.87	$3,813.77
Net Property, Plant & Equipment	11,118	$2,442.69	$181.97	$11,050.67
Capitalized Operating Leases	11,118	$165.38	$23.27	$648.71
Research & Development Expense	11,118	$654.36	$3.77	$2,832.16
Goodwill	11,118	$1,163.83	$63.54	$4,648.25
Other Intangibles	11,118	$683.18	$23.68	$3,906.62

APPENDIX 3: SUMMARY STATISTICS

Table II
Summary Statistics

Table II presents the means, medians, and standard deviations for the EOS measure by Fama-French industry for 2007-2014. The output and inputs are based on the methodology of Demerjian et al. (2012, 2013). The output is Total Revenue of the firm (SALE). The inputs are 1) Cost of Goods Sold (COGS), 2) Selling, General & Administrative Expense (XSGA), 3) Net Property, Plant, & Equipment (PPENT), 4) Capitalized Operating Leases (MRC1, MRC2, MRC3, MRC4, and MRC5) which is calculated as the discounted present value of the next five years of required operating lease payments with a discount rate of 10%, 5) Capitalized Research & Development (XRD) which is calculated as $RD_{cap} = \sum_{t=-4}^{0}(1 + 0.2t) \times RD_{exp}$, 6) Goodwill (GDWL) which is calculated as the premium paid over the fair value of a business acquisition, and 7) Other Intangibles (INTAN – GDWL) which reflects the other acquired and capitalized intangibles such as client lists, patent costs, and copyrights. I follow Denis et al. (2002) by designating firms as diversified if they report more than one segment for that given year as reported in Compustat Segments. Dollar values are in millions.

Industry	No. of Firms	Mean	Median	Std. Dev.
Agriculture	72	0.869	0.887	0.085
Food Products	248	0.869	0.890	0.050
Candy & Soda	51	0.909	0.886	0.062
Beer & Liquor	35	0.927	0.935	0.049
Tobacco Products	13	0.960	0.950	0.031
Recreation	80	0.782	0.836	0.127
Entertainment	186	0.580	0.580	0.110
Printing and Publishing	65	0.909	0.914	0.043
Consumer Goods	193	0.869	0.864	0.040
Apparel	159	0.915	0.898	0.039
Healthcare	198	0.881	0.904	0.063
Medical Equipment	425	0.679	0.685	0.159
Pharmaceutical Products	866	0.442	0.440	0.156
Chemicals	306	0.925	0.933	0.046
Rubber and Plastic Products	84	0.912	0.970	0.136
Textiles	39	0.964	0.963	0.020
Construction Materials	253	0.927	0.928	0.051
Construction	140	0.816	0.819	0.086
Steel Works Etc.	165	0.898	0.915	0.047
Fabricated Products	30	0.977	0.980	0.019
Machinery	478	0.875	0.886	0.062
Electrical Equipment	243	0.780	0.846	0.185
Automobiles and Trucks	225	0.952	0.961	0.041
Aircraft	88	0.953	0.944	0.029
Shipbuilding, Railroad Equipment	35	0.980	0.978	0.014
Defense	28	0.988	0.986	0.010
Precious Metals	84	0.565	0.536	0.135
Non-Metallic and Industrial Metal Mining	51	0.641	0.595	0.137
Coal	18	0.880	0.892	0.118
Petroleum and Natural Gas	517	0.535	0.468	0.143

(Table II continued)

Communication	464	0.745	0.724	0.094
Personal Services	172	0.845	0.861	0.057
Business Services	1868	0.583	0.571	0.104
Computers	472	0.752	0.779	0.086
Electronic Equipment	761	0.790	0.827	0.097
Measuring and Control Equipment	278	0.789	0.789	0.079
Business Supplies	157	0.943	0.949	0.032
Shipping Containers	37	0.992	0.994	0.009
Transportation	282	0.854	0.852	0.054
Wholesale	470	0.826	0.816	0.063
Retail	568	0.878	0.871	0.046
Restaurants, Hotels, Motels	214	0.831	0.845	0.090

APPENDIX 4: SUMMARY STATISTICS AND UNIVARIATES FOR IPO VERSUS TRADE SALE DECISION

Table III
Summary Statistics and Univariates for IPO versus Trade Sale Decision

Table III provides statistics for the means, medians, and standard deviation for the IPO versus trade sale decision logit model. *EOS* is the economies of scope measurement for industry i in year t. *SMALL* equals 1 if the firm had $50 million ($2009) or less in total sales in year prior to exit strategy and 0 otherwise. *Sales* is the dollar amount of total revenue in millions. LIQUIDITY is the percentage of the offer in cash for private targets and the ratio of secondary shares offered to total shares for IPO firms. *HHI* is the Herfindahl Index for the private firm's industry. *PB* is a dummy variable equal to 1 if the firm belongs to either one of the following industry groups: two-digit SIC codes 13 (oil & gas production), 28 (chemicals and allied products), 29 (oil refining), and 37 (transportation equipment). *IND_DA* is the industry mean leverage ratio calculated as total debt scaled by total assets. *IND_TAN* is the average tangible assets / total assets ratio (net property and equipment scaled by total assets) for the firm's industry group. *IND_MTB* is the average market-to-book ratio for the private firm's industry. *HITECH* is the indicator variable equal to 1 for private firms in a high technology industry. *MKTRF* is the quarterly calendar market return minus three-month T-bill rate. *MKTRFl* is the lagged quarterly calendar market return minus three-month T-bill rate. *HML* is the quarterly calendar return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks. *HMLl* is the lagged quarterly calendar return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks. *SMB* is the quarterly calendar return on a portfolio that is long on small capitalization stocks and short on large capitalization stocks. *SMBl* is the lagged quarterly calendar return on a portfolio that is long on small capitalization stocks and short on large capitalization stocks. *RF* is the three-month T-bill rate. Industries are defined as Fama and French (1997) 48-industry dummies. Significance at the 10%, 5%, and 1% levels are noted as *, **, and *** respectively.

Panel A: IPO Sample

	N	Mean	Median	Std. Dev.
EOS	626	0.6933	0.7150	0.1726
SMALL	626	0.4313	0	0.4957
SALES	626	711.66	68.27*	6183.43
LIQUIDITY	626	0.1385***	0***	0.0467
HHI	626	0.0517**	0.0486*	0.0260
PB	626	0.2732	0	0.4459
IND_DA	626	0.6889	0.3819	1.9374
IND_TAN	626	0.1713	0.1161***	0.1251
IND_MTB	626	2.0332***	1.9587***	0.6189
HITECH	626	0.0288	0.0000	0.1672
MKTRF	626	0.0428***	0.0474**	0.0566
MKTRFl	626	0.0441***	0.0475**	0.0545
HML	626	-0.0053	-0.0043	0.0407
HMLl	626	-0.0028*	-0.0032*	0.0443
SMB	626	-0.0005	-0.0035	0.0327
SMBl	626	-0.0012*	-0.0010	0.0331
RF	626	0.0023*	0*	0.0045

(Table III continued)

Panel B: Trade Sale Sample

	N	Mean	Median	Std. Dev.
EOS	388	0.6931	0.7150	0.1919
SMALL	388	0.4046	0	0.4915
SALES	388	598.27	79.319	4371.38
LIQUIDITY	388	0.3647	0.0306	0.3493
HHI	388	0.0566	0.0496	0.0376
PB	388	0.2526	0	0.4351
IND_DA	388	0.6296	0.3989	2.3648
IND_TAN	388	0.1797	0.1215	0.1243
IND_MTB	388	1.8614	1.8543	0.5814
HITECH	388	0.0361	0	0.1867
MKTRF	388	0.0266	0.0402	0.0773
MKTRFl	388	0.0275	0.0452	0.0812
HML	388	-0.0060	-0.0043	0.0473
HMLl	388	-0.0083	-0.0065	0.0455
SMB	388	0.0010	-0.0019	0.0346
SMBl	388	0.0027	-0.0006	0.0348
RF	388	0.0018	0.0001	0.0037

APPENDIX 5: LOGIT MODEL FOR IPO VERSUS TRADE SALE DECISION

Table IV

Logit Model for IPO versus Trade Sale Decision

Table IV reports the results for the IPO versus trade sale decision logit model. The dependent variable, IPOd, equals 1 if firm i chooses an IPO and 0 if firm i chooses to be acquired via a trade sale. *EOS* is the economies of scope measurement for industry i in year t. *SMALL* equals 1 if the firm had $50 million ($2009) or less in total sales in year prior to exit strategy and 0 otherwise. LIQUIDITY is the percentage of the offer in cash for private targets and the ratio of secondary shares offered to total shares for IPO firms. *HHI* is the Herfindahl Index for the private firm's industry. *PB* is a dummy variable equal to 1 if the firm belongs to either one of the following industry groups: two-digit SIC codes 13 (oil & gas production), 28 (chemicals and allied products), 29 (oil refining), and 37 (transportation equipment). *IND_DA* is the industry mean leverage ratio calculated as total debt scaled by total assets. *IND_TAN* is the average tangible assets / total assets ratio (net property and equipment scaled by total assets) for the firm's industry group. *IND_MTB* is the average market-to-book ratio for the private firm's industry. *HITECH* is the indicator variable equal to 1 for private firms in the high technology industry. *MKTRF* is the quarterly calendar market return minus three-month T-bill rate. *MKTRFl* is the lagged quarterly calendar market return minus three-month T-bill rate. *HML* is the quarterly calendar return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks. *HMLl* is the lagged quarterly calendar return on a portfolio that is long on high book-to-market stocks and short on low book-to-market stocks. *SMB* is the quarterly calendar return on a portfolio that is long on small capitalization stocks and short on large capitalization stocks. *SMBl* is the lagged quarterly calendar return on a portfolio that is long on small capitalization stocks and short on large capitalization stocks. *RF* is the three-month T-bill rate. Industries are defined as Fama and French (1997) 48-industry dummies. All regressions include calendar year dummies.

(Table IV continued)

Variable	(1)	(2)
EOS	2.590	6.691
	0.86	1.62
SMALL	0.154	-0.209
	0.72	-0.69
EOS*SMALL		-4.235
		-2.17
LIQUIDITY	-19.841	-23.566
	-5.25	-4.54
HHI	-33.738	-31.947
	-3.34	-2.97
PB	-1.443	-1.468
	-0.94	-0.89
IND_DA	-0.086	-0.119
	-0.69	-0.85
IND_TAN	15.466	19.549
	3.06	2.91
IND_MTB	2.447	3.176
	1.78	1.91
HITECH	-1.514	-2.176
	-0.96	-1.33
MKTRF	3.776	4.075
	0.4	0.43
MKTRFl	12.145	15.893
	1.23	1.53
HML	-23.223	-26.441
	-1.79	-1.91
HMLl	26.233	23.800
	2.01	1.73
SMB	18.038	15.919
	1.14	0.97
SMBl	-11.307	-13.812
	-0.68	-0.83
RF	-14.741	-37.915
	-0.09	-0.23
Intercept	-0.675	-3.075
	-0.23	-0.84
Pseudo R^2	0.9551	0.9597
Observations	1,014	1,014

APPENDIX 6: 3-YEAR BUY-AND-HOLD RETURNS FOR IPOS BY SALES AND ECONOMIES OF SCOPE

Table V
3-Year Buy-and-Hold Returns for IPOs by Sales and Economies of Scope

Table V presents buy-and-hold returns for the sample of 626 IPOs from 2007-2014. Buy-and-hold returns are calculated from the first CRSP-reported closing price through the earlier of the third year anniversary of the IPO, the delisting date, or December 31, 2014. Small and large company IPOs are defined on the basis of whether the pre-IPO last twelve months sales are less than or greater than $50 million ($2009). *EOS* is the economies of scope measurement for industry i in year t. Market-adjusted returns are the difference between Unadjusted Returns and the CRSP value-weighted index returns. All returns include dividends and capital gains, including the index returns. Significance at the 10%, 5%, and 1% levels are noted as *, **, and *** respectively.

	No. of IPOs	Average First-Day Return	Unadjusted Return	Market-Adjusted Return
Small	270	13.79%	29.72%	7.19%
Large	356	19.34%	18.23%	-9.44%
Top EOS Tertile	61	15.07%	15.48%	-14.09%
Small	16	14.83%	12.92%	-14.80%
Large	45	15.16%	16.43%	-13.82%
Middle EOS Tertile	113	18.19%	15.18%	-10.56%
Small	38	11.71%	-2.18%	-22.26%
Large	75	21.30%	23.50%	-4.96%
Bottom EOS Tertile	452	16.92%	26.15%	1.31%
Small	216	14.06%	36.41%	13.87%*
Large	236	19.51%	16.88%	-10.05%

APPENDIX 7: SUMMARY STATISTICS AND UNIVARIATES FOR SINGLE AND DUAL TRACKING SAMPLE

Table VI
Summary Statistics and Univariates for Single and Dual Tracking Sample

Table VI provides statistics for the means, medians, and standard deviation for the single and dual tracking samples. The single track acquisition sample consists of private firms that are acquired in a trade sale without filing for an IPO. The dual track private acquisition sample consists of private firms that are acquired in a trade sale, but withdrew their IPO filing. The dual track public acquisition sample consists of formerly private firms that completed an IPO, but were acquired within a year of the IPO. *PREMIUM* is the transaction value, or the amount paid for the sell-out firm, divided by the sell-out firm's sale in the period prior to the takeover announcement. *EOS* is the economies of scope measurement for industry i in year t. *SMALL* equals 1 if the firm had $50 million ($2009) or less in total sales in year prior to exit strategy and 0 otherwise. *FOCUS* is equal to 1 if the acquirer and sell-out target are from the same 4-digit SIC code and 0 otherwise. *STOCK* is equal to 1 for pure stock offers and 0 otherwise. *MIX* is equal to 1 for takeovers paid with a mixture of stock and cash; and 0 otherwise. *HITECH* is the indicator variable equal to 1 for private firms in a high technology industry. *ASSETS* is the natural logarithm of the sell-out firm's total assets in the period prior to the acquisition. *VC* is equal to 1 if the firm is venture capital backed and 0 otherwise. Differences of means and medians are tested between single track acquisitions and dual track acquisitions. Significance at the 10%, 5%, and 1% levels are noted as *, **, and *** respectively.

Panel A: Single Track Acquisitions

	N	Mean	Median	Std. Dev.
PREMIUM	188	401.93	1.6587	3578.83
EOS	188	0.7601***	0.7895**	0.1640
SMALL	188	0.4415	0	0.4979
FOCUS	188	0.1702	0	0.3768
STOCK	188	0.0319	0	0.1762
MIX	188	0.1170	0	0.3223
HITECH	188	0.1064	0	0.3092
ASSETS	188	4.4963	4.2736	2.0952
VC	188	0.0745***	0***	0.2632

Panel B: Dual Track Private Acquisitions

	N	Mean	Median	Std. Dev.
PREMIUM	17	68.26	0.7669	250.735
EOS	17	0.6809	0.716	0.2097
SMALL	17	0.4118	0	0.5073
FOCUS	17	0.1176	0	0.3321
STOCK	17	0.0588	0	0.2425
MIX	17	0.1765	0	0.3930
HITECH	17	0.0588	0	0.2425
ASSETS	17	4.7062	4.2324	2.141
VC	17	0.4706	0	0.5145

(Table VI continued)

Panel C: Dual Track Public Acquisitions

	N	Mean	Median	Std. Dev.
PREMIUM	5	8.3356	7.3924	2.4058
EOS	5	0.5488	0.5290	0.0651
SMALL	5	0	0	0
FOCUS	5	0.4000	0	0.5477
STOCK	5	0	0	0
MIX	5	0.2000	0	0.4472
HITECH	5	0	0	0
ASSETS	5	4.9378	4.9388	0.8485
VC	5	0.2000	0	0.4472

APPENDIX 8: LOGISTIC REGRESSION OF TRACK DECISION

Table VII
Logistic Regression of Track Decision

This table reports the results for the single track versus dual track exit strategies. The dependent variable, TRACK, equals 1 if the firm uses a dual track exit strategy and 0 if the firm uses a single track exit strategy. A single track firm is a private firm that is acquired in a trade sale without filing for an IPO. A dual track firm is either a private firm that is acquired in a trade sale, but withdrew their IPO filing or formerly private firm that completed an IPO, but were acquired within a year of the IPO. *EOS* is the economies of scope measurement for industry i in year t. *SMALL* equals 1 if the firm had $50 million ($2009) or less in total sales in year prior to exit strategy and 0 otherwise. *HITECH* is the indicator variable equal to 1 for private firms in a high technology industry. *ASSETS* is the natural logarithm of the sell-out firm's total assets in the period prior to the acquisition. *VC* is equal to 1 if the firm is venture capital backed and 0 otherwise. All specifications include year dummies.

Variable	(1)	(2)
EOS	-3.155	-3.311
	-1.97	-1.71
SMALL	-1.07	-1.357
	-1.61	-0.66
EOS*SMALL		0.429
		0.14
HITECH	0.125	0.144
	0.11	0.13
ASSETS	-0.094	-0.092
	-0.55	-0.53
VC	2.017	2.024
	3.47	3.47
Intercept	0.752	0.837
	0.45	0.47
Pseudo R^2	0.1707	0.1709
Observations	210	210

APPENDIX 9: CROSS-SECTIONAL REGRESSION OF SELL-OUT PREMIUM

Table VIII
Cross-Sectional Regression of Sell-Out Premium

This table reports the results for the cross-sectional regression of sell-out premium for the sample. The dependent variable, *PREMIUM,* is the transaction value, or the amount paid for the sell-out firm, divided by the sell-out firm's sale in the period prior to the takeover announcement. *EOS* is the economies of scope measurement for industry i in year t. *SMALL* equals 1 if the firm had $50 million ($2009) or less in total sales in year prior to exit strategy and 0 otherwise. *DUAL* equals to 1 if the sell-out target is a private firm that filed for an IPO and later withdrew or if the sell-out target is a formerly private firm that completed an IPO and was acquired within a year of the IPO and 0 otherwise. *FOCUS* is equal to 1 if the acquirer and sell-out target are from the same 4-digit SIC code and 0 otherwise. *STOCK* is equal to 1 for pure stock offers and 0 otherwise. *MIX* is equal to 1 for takeovers paid with a mixture of stock and cash; and 0 otherwise. *HITECH* is the indicator variable equal to 1 for private firms in a high technology industry. *ASSETS* is the natural logarithm of the sell-out firm's total assets in the period prior to the acquisition. *VC* is equal to 1 if the firm is venture capital backed and 0 otherwise. All specifications include industry and year dummies.

Variable	(1)	(2)
EOS	1998.327	927.448
	1.03	0.4
SMALL	999.007	-882.582
	1.50	-0.39
EOS*SMALL		2574.415
		0.86
DUAL	-378.559	-413.571
	-0.44	-0.48
FOCUS	-532.053	-580.671
	-0.78	-0.84
STOCK	1259.782	1424.196
	0.87	0.97
MIX	1776.978	1756.858
	2.33	2.3
HITECH	-30.908	-52.6675
	-0.03	-0.05
ASSETS	65.115	76.5615
	0.39	0.45
VC	991.095	1047.986
	1.15	1.21
Intercept	-2878.87	-2184.98
	-1.51	-1.06
R^2	0.1130	0.165
Observations	210	210

PART 3: DO PIPOS DECREASE IPO UNCERTAINITY?

PART 3

INTRODUCTION

In recent years, capital markets for private equity investments have undergone a significant transformation. Since 2009, both the number and total dollar amount of private placements has increased and is now considerably larger than both public debt and public equity offerings (Ivanov and Bauguess, 2013 and Bauguess, Gullapalli, and Ivanov, 2015). More importantly, some private firms have utilized later stage rounds to obtain funding comparable to traditional initial public offerings (IPOs). For funding of greater than $40 million, both academics and practitioners have labeled this later stage financing as private IPOs (PIPOs) (Brown and Wiles, 2015; CB Insights, 2015; Zörgiebel, 2016). Interestingly, some firms that undergo PIPOs eventually do pursue IPOs. Despite this paradigm shift, no study has investigated the benefits of PIPOs for firms which eventually go public via an IPO. This paper fills this gap in the literature by examining whether PIPOs decrease information asymmetry when firms eventually go public.

Theoretically, PIPOs can mitigate problems of adverse selection and moral hazard because private placements can signal undervaluation (Hertzel and Smith, 1993) and provide more effective monitoring (Shleifer and Vishny, 1986 and Wruck, 1989). Consequently, firms with larger, more recent, and frequent PIPOs should experience less underpricing and post-IPO volatility. Using a sample of 1,002 U.S. IPOs from 2005-2016, I find support for this argument: a percentage increase in the ratio of PIPO funding to market value of equity at IPO reduces the first-day return by 2.53%. This result implies firms with larger PIPOs potentially reduce moral hazard and signal their true value prior to going public. However, I do not find support that larger PIPOs reduce post-IPO volatility.

I also test if the length of time between a firm's PIPO and IPO impacts the firm's valuation when it goes public. Folta and Janney (2004) suggest firms with more recent private placements have less information asymmetry. Following a private placement, confidence in the signal decreases since business conditions and opportunities can change over time. Results indicate a negative relation between the length of time since a PIPO and first-day returns. Each additional year between the latest PIPO and IPO date is associated with an 8.66% increase in first-day returns.

Folta and Janney (2004) also propose firms with more numerous private placements experience less information asymmetry. First, offerings to multiple sophisticated investors can indicate the firm can convey true valuation. Second, offerings to existing investors should provide a positive signal of either continued or increased confidence in the firm's prospects. Consequently, I test if the number of PIPOs reduce uncertainty at IPO. Contrary to Folta and Janney, I find firms with more PIPOs experience greater underpricing. Each additional PIPO is related with a 2.79% increase in first-day returns. I do not find any association between the number of PIPOs with post-IPO volatility.

This study provides a number of distinct contributions. First, it describes and provides information about the PIPOs market. To the best of my knowledge the PIPO market has not been thoroughly examined by any other academic study. Second, it provides evidence for how PIPOs can reduce information asymmetry in firms that eventually go public. This information can provide practitioners with strategic insights for lowering their firm's cost of equity when they file for their IPO. Third, the results may benefit regulators in private placement rule making. Discussion concerning investor protection is routine among all private securities, especially in terms of equity investments.

The remainder of this paper is as follows. Section II reviews the prior literature on privately placed equity. Section III develops the hypotheses relating PIPOs with information asymmetry as measured with underpricing and post-IPO volatility. Section IV outlines the methods used in the study. Section V describes the dataset. Section VI presents the results. Section VI summarizes the findings and concludes.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Despite the growing use of PIPOs prior research has focused on the equity choice between private investment in public equity (PIPEs) and seasoned equity offerings (SEOs). Hertzel and Smith (1993) find firms will choose PIPEs over SEOs when management believes the firm is undervalued. They propose direct negotiation between private investors and management leads to the discovery of the firm's true value. Dai (2007) explain PIPEs can serve as an additional round of venture capital for companies that went public too early. Chaplinsky and Haushalter (2010) find the choice of contracting terms for PIPEs varies widely and is associated with issuer risk. Chen, Dai, and Schatzberg (2010) demonstrate stronger support that firms will choose PIPEs over SEOs when there is a high likelihood of undervaluation and where cost advantages exist.

Folta and Janney (2004) investigate if PIPEs increase a firm's longer-term competitive advantage. Using a sample of biotech firms, they observe the occurrence of obtaining PIPEs increases a firm's ability to gain financial capital, research partners, and commercial partners. Furthermore, they demonstrate the timing of PIPEs has positive long-term implications. Firms with more recent placements increase their ability to acquire financial capital and both research and commercial partners. In addition, firms issuing a greater number of private placements are more apt at acquiring financial capital. Overall, their results indicate PIPEs by certified investors help attenuate informational asymmetries by providing signals or enhancing monitoring.

Wu (2004) examines the choice between SEOs and PIPEs for high-technology post-IPO firms. She finds firms choosing PIPEs have higher information asymmetry than firms choosing IPO. She also finds evidence suggesting PIPE investors do not engage in more monitoring than SEO investors.

Rock (1986) develops a model to explain the underpricing of IPOs. In his model, informed investors have superior information about a new firm's opportunities than either the firm or all other investors. Consequently, if new shares are priced appropriately then informed investors will crowd out other investors for good issues, but withdraw from the market on bad issues. The uninformed investors realize if they have access to a new issue then it must be a bad issue. Therefore, the firm offers their shares at a discount to guarantee full subscription of their issue. Consequently, firms with greater levels of information asymmetry experience greater underpricing and volatility (Ritter, 1984; Beatty and Ritter, 1986; Lowry, Officer, Schwert, 2010).

Theoretically, private placements can mitigate information asymmetry problems (Wruck, 1989; Hertzel and Smith, 1993). Myers and Majluf (1984) demonstrate if managers act in the interest of existing shareholders who are passive, then prospective investors, who are uninformed, will assume any equity issue means the firm is overvalued. Therefore, managers of undervalued firms with profitable investment opportunities, but lacking financial slack will choose not to issue equity when the share of existing assets transferred to prospective stockholders exceeds the share of increased firm value retained by existing stockholders. Myers and Majluf suggest firms can alleviate underinvestment if managers disclose their private information during negotiations (e.g. merger discussions). Hertzel and Smith extend Myers and Majluf's (1984) model to add private placements as a possible choice. They show private placements aid in solving the underinvestment problem. Firms experience a 1.7% increase in firm value after announcing the issuance of private placements.

Prior studies have investigated how blockholders can increase monitoring of management. Shleifer and Vishny (1986) demonstrate blockholders improve monitoring incentives. Furthermore, Wruck (1989) shows private placements can potentially provide more effective monitoring. Hertzel and Smith (1993) reason investment by private investors tied with management's decision to bypass the public market signals that management believes the firm is undervalued. Consistent with benefits of increased monitoring, I expect firms with larger PIPOs will incur less underpricing and volatility than firms with less PIPOs.

Hypothesis 1: Firms offering larger percentages of PIPOs relative to total equity experience less underpricing, ceteris paribus.

Hypothesis 2: Firms offering larger percentages of PIPOs relative to total equity experience less volatility post-IPO, ceteris paribus.

Folta and Janney (2004) suggest firms should have less information asymmetry when a private equity placement is more recent. As time passes, confidence in the signal from the private equity placement PIPOs will decrease since business conditions and opportunities change. Thus, I expect firms with more recent placements incur less underpricing and volatility.

Hypothesis 3: Firms with more recent PIPOs experience less underpricing, ceteris paribus.

Hypothesis 4: Firms with more recent PIPOs experience less volatility post-IPO, ceteris paribus.

Finally, Folta and Janney (2004) indicate firms should have less information asymmetry when they have repeatedly offered private equity placements for two reasons. First, offerings to multiple sophisticated investors can indicate the firm is more apt at conveying its true valuation. Second, offerings to existing investors should provide a positive signal of either continued or increased confidence in the firm's prospects along with effective managerial monitoring. Consequently, I expect firms with a greater number of PIPOs to incur less underpricing and volatility.

Hypothesis 5: Firms with more offerings of PIPOs experience less underpricing, ceteris paribus.

Hypothesis 6: Firms with more offerings of PIPOs experience less volatility post-IPO, ceteris paribus.

METHODS

This study follows the approach outlined in Loughran and McDonald (2013) for testing the effect of PIPO activity on first-day returns and volatility. The first dependent variable, *First-Day Returns*, is defined as the percentage change from the offer price to the closing price. The second dependent variable, *Post-IPO Return Volatility*, is defined as the market model root-mean square error for each IPO over day +5 to day +64 relative to their IPO date. The value is multiplied by 1,000.

The following independent variables test the hypotheses regarding PIPO activity for both dependent variables. *PIPO* is a dummy variable set to one if the firm issued a private IPO, else zero. *PIPO%* is defined as the percentage of the total dollar amount received in PIPOs relative to the market value of equity at the time of IPO. Both the PIPOs and market value of equity are converted to 2016 dollars. *Recent dummy* is a dummy variable set to one if the firm issued a private IPO within the year prior to conducting their IPO, else zero. *PIPO Count* is defined at the number of private IPOs the firm issued prior to their IPO.

In addition to the variables of interest, this study also uses control variables from the IPO literature that have been shown to explain first-day returns and post-IPO return volatility:

Up Revision: The percentage upward revision from the mid-point of the filing range if the offer price is greater than the mid-point, otherwise zero. Loughran and Ritter (2002) propose that firms may increase the offer price to serve as a positive signal to potential investors. Bradley and Jordan (2002), Lowry and Schwert (2004), and Loughran and McDonald (2013) find a positive relation between up revision of the offer price and first-day returns. Therefore, I expect a positive relation between up revision and the dependent variables.

VC dummy: Dummy variable set to one if the IPO is backed by venture capital, otherwise zero. Bajo et al. (2016) argue Venture Capital (VC)-backed firms are typically younger, higher growth companies and are expected to have greater uncertainty on their valuation. I expect a positive relation between VC backed companies and the dependent variables.

Top-tier dummy: Dummy variable set to one if the IPO's lead underwriter has a value of eight or more using Carter and Manaster (1990) rankings as updated on Jay Ritter's IPO website, otherwise zero. Loughran and Ritter (2004) observe a positive relation between underwriter rank and underpricing. They argue this relation is due to two factors. First, firms are placing a greater value on obtaining analyst coverage. Second, firms are willing to have greater underpricing due to the practice of investment bankers spinning shares to venture capitalists and executives at other firms that could potentially file for an IPO. Consequently, the larger underpricing in the spun shares influence decision makers at the potential firm to continue their relationship with the investment bank. Therefore, I expect a positive relation between lead underwriter rank and the dependent variables.

Positive EPS dummy: Dummy variable set to one if the IPO has positive earnings per share (EPS) in the 12 months prior to going public, otherwise zero. Loughran and McDonald (2013) find a negative relation between positive trailing EPS and lower levels of post-IPO return volatility. Gao, Ritter, and Zhu (2013) observe a decrease in profitability among small IPO firms with 58% having negative EPS in 1980-2000 compared to 73% in 2001-2011. Consequently, profitability may serve as a robust signal in current IPO market. Therefore, I expect a negative relation between positive EPS and the dependent variables.

Prior Nasdaq 15-day returns: The buy-and-hold returns of the CRSP Nasdaq value-weighted index over the 15-trading days prior to the IPO date. Multiple IPO studies including Loughran and Ritter (2002), Hanley and Hoberg (2012), and Loughran and McDonald (2013) use prior Nasdaq returns to control for IPO hot markets. Consequently, I expect a positive relation between prior Nasdaq returns and the dependent variables.

Share overhang: The number of shares retained divided by the number of shares in the initial offering. Aggarwal, Krigman, and Womack (2002) argue managers strategically underprice IPOs to generate information momentum by attracting attention to the stock and thereby maximizing their own wealth when the lockup period ends. Ofer and Richardson (2003) explain if the public float is small relative to the shares retained by insiders then the market price will be higher due to a negatively sloped demand for shares. Consequently, I expect a positive relation between share overhang and the dependent variables.

Sales: The natural log of trailing firm annual sales in millions of dollars. Loughran and McDonald (2013) find a negative relation between sales and lower levels of post-IPO return volatility. I expect a negative relation between sales and the dependent variables.

DATA

The IPO sample includes 1,002 U.S. IPOs over 2005-2016 with an offer price of at least $5 per share, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, financial firms, and stocks not listed on CRSP. The IPO sample is obtained from Jay Ritter's IPO website along with Thomson Financial Securities Data and SEC filings on EDGAR[1]. The PIPO sample includes 303 PIPOs from firms that eventually undergo an IPO. PIPOs are defined as equity financing of $40 million or more in growth rounds (Series B or later). Both PIPOs and total market equity at IPO are adjusted to 2016 dollars using inflation rates provided by the Bureau of Labor Statistics. The PIPO sample is obtained from CrunchBase Pro. The final sample includes 799 traditional IPOs, firms that do not participate in PIPOs, and 203 firms that participate in PIPO activity.

Table I presents summary statistics for the 303 PIPOs of firms that eventually undergo an IPO for the years 2000-2016. The number of PIPOs increase substantially starting in 2004 with 8 and peak prior to the financial crisis in 2007 with a total of 34. The average size of a PIPO is approximately $85.5 million while the median size is $59 million. There is also a wide distribution in the size of PIPOs among firms with the minimum at $40 million while the largest is $1,068 million. Due to the wide distribution of funding, PIPOs exhibit a standard deviation of $98.5 million over the sample period.

Table II provides the summary statistics for the traditional IPO and the firms with PIPOs samples in Panel A and B respectively. There are marked differences between samples. The first-day

[1] I thank Jay Ritter for providing his IPO Data for this study. It can be found at https://site.warrington.ufl.edu/ritter/ipo-data/

returns (13.31% vs 24.62%) and post-IPO return volatility (3.47% vs 4.33%) are lower for the traditional IPO sample relative to the firms with PIPOs sample. Furthermore, firms with PIPOs compared to traditional IPOs have a greater percentage of VC-backing (97% vs. 44%) and underwriting by a prestigious investment bank (91% vs. 76%). However, PIPOs with IPOs are less profitable (48% vs. 17%) and generate less revenue prior to going public ($95.5 million vs. $734 million) compared to other IPOs. I perform univariate analysis between the groups to confirm their differences.

Table III reports the correlations between the variables used in the regression analysis. PIPO%, PIPO Clock, and PIPO Count have a negative association with First-Day Returns. Furthermore, PIPO Clock has a negative association with Post-IPO Return Volatility while PIPO Count has a positive relation. Other notable correlations with the PIPO related variables exist. All PIPO variables are highly positively linked to the VC dummy, but highly negatively correlated with the EPS dummy. There also is large positive correlation among the PIPO variables. Following Loughran and McDonald (2013), each PIPO variable has its own separate regression due to the high level of correlation among the PIPO variables.

RESULTS

Univariate

Table IV reports differences in means and medians for variables between traditional IPOs and firms with PIPOs. Univariate results show traditional IPOs have lower first-day returns and post-IPO return volatility than firms with PIPOs. PIPOs with IPOs have greater upward price revisions, higher amounts of venture capital backing, more prestigious lead underwriters at IPO, and greater amounts of share overhang. Moreover, traditional IPOs are more profitable and have a greater amount in sales than PIPOs with IPOs. These findings provide initial evidence against PIPOs decreasing information asymmetry in firms that eventually engage in an IPO. Instead, PIPOs may have the opposite effect. Investors may see PIPOs as a means for firms to exaggerate their valuations. Brown and Wiles (2015) find a quarter of their Unicorn[2] sample have valuations at exactly $1 billion, which is highly unlikely to occur naturally.

Mean first-day returns by year are reported in Table V. The percentage of firms with PIPOs increased in 2010 where they represent over 20% of total IPOs. In addition, mean first-day returns are significantly higher for firms with PIPOs than traditional IPOs in 5 of the 12 years. Overall, traditional IPOs average a mean first-day return of 13.31% compared to firms with PIPOs that average 24.62% and difference is statistically significant. Furthermore, this trend is more pronounced in recent years. Both years 2015 and 2016 observed a four-fold and three-fold difference, respectively, in underpricing between traditional IPOs and firms with PIPOs.

[2] A Unicorn is a private firm valued at more than $1 billion

Table VI shows mean first-day returns by Fama-French industrial classification. Firms with PIPOs are present in 16 of the 42 industries. Pharmaceutical Products and Business Services have the greatest number of firms with PIPOs with 92 and 56, respectively. Mean first-day returns are significantly higher for firms with PIPOs compared to traditional IPOs in Healthcare, Pharmaceutical Products, Business Services, and Retail. Firms with PIPOs have a mean first-day return of 24.62% compared to 12.58% for traditional IPOs based on matching industries and is statistically significant.

Multivariate

Table VII presents underpricing regressions for measuring the effect of PIPO activity on first-day returns of the IPO sample. The variable, *PIPO*, is positive and significant, which implies firms with PIPOs average a first day return 7.67% higher than those without PIPOs. *PIPO%* is negative and significant indicating that a percentage increase in the ratio of PIPO funding to market value of equity at IPO reduces the first-day return by 2.53%. This result supports hypothesis 1, firms offering larger percentages of PIPOs relative to total equity experience less underpricing. This finding is consistent with the benefits of increased monitoring as noted in Shleifer and Vishny (1986), Wruck (1989), and Hertzel and Smith (1993).

PIPO Clock is positive and significant. This finding supports hypothesis 3, firms with more recent PIPOs experience less underpricing. Each additional year between the latest PIPO and IPO date is associated with a 8.66% increase in first-day returns, recent PIPOs have a stronger signal to the market, but as time passes confidence in the signal from the PIPOs deceases since business conditions and opportunities change. This finding is similar to Folta and Janney (2004) who find firms have less information asymmetry when a PIPE is more recent.

The final PIPO variable, PIPO Count, is positive and significant. This result is inconsistent with hypothesis 5: firms with more PIPOs should experience less underpricing. I find each additional PIPO is related to 2.79% increase in first-day returns. A possible explanation for this finding could be that additional PIPOs are a bad signal. Brown and Wiles (2015) report that 38 of 142 Unicorns have valuations of exactly $1 billion dollars. They hypothesize the valuations they receive may not reflect their true value, but rather are being to used to market themselves to potential employees and consumers. Consequently, the market may be aware of this and take that into account when valuing the firm's IPO.

Table VIII reports regressions measuring the effect of PIPO activity on post-IPO return volatility of the IPO sample. Unlike the results with the first-day mean return, all PIPO variables are insignificant in explaining post-IPO volatility. These results indicate that hypotheses 2, 4, and 6 are unsupported. This may suggest PIPOs do not impact post-IPO volatility.

ROBUSTNESS

The probability of firms receiving PIPOs may be endogenous based upon firm-specific characteristics. The potential bias is addressed with propensity score matching where members of the treatment group, firms that participate in PIPOs, match with a member of the non-treatment group, firms that do not participate in PIPOs. Following Lee and Wahal (2004) and Hull (2013), this study matches firms using one-to-one nearest-neighbors propensity score matching with replacement. Caliendo and Kopeining (2005) suggest matching with replacement for small sample sizes to increase the average match quality and reduce bias. The first stage utilizes a probit regression where the dependent variable is equal to one for firms receiving PIPOs and zero for firms that did not receive PIPOs with the same independent variables as described earlier: Up Revision, VC dummy, Top Tier dummy, Positive EPS dummy, Prior NASDAQ 15-day returns, Share Overhang, and Log of Sales. The propensity score also uses IPO year and requires matches be in the same one-digit SIC code to ensure greater comparability. The second stage employs multivariate analysis on the matched sample of treatment and non-treatment members.

Table IX reports the mean differences in first-day returns and post-IPO return volatility between firms that participate in PIPOs and propensity score matched firms that do not participate in PIPOs. The variable, PIPO, is positive and significant, which implies firms with PIPOs average a first day return 5.44% higher than those without PIPOs. This implies with everything else being constant that having a PIPO increases IPO underpricing. The result for PIPO% are insignificant. These results do not support hypothesis 1 and 5. Therefore, based upon the matched underpricing regressions, do not demonstrate blockholders improve monitoring incentives (Shleifer and Vishny, 1986; Wruck, 1989) or decrease information asymmetry (Folta and Janney, 2004) with respect to firms that participate in PIPOs.

Table X reports the mean differences in first-day returns and post-IPO return volatility between firms that participate in PIPOs and propensity score matched firms that do not participate in PIPOs. Similarly, to unmatched post-IPO return volatility regressions, all PIPO variables are insignificant. These results indicate that hypotheses 2 and 6 are unsupported. This provides more support that PIPO activities do not factor into the volatility of IPOs after their initial day of trading.

CONCLUSION

Despite the recent shift in public to private equity financing, no study has invested the benefits of PIPOs for firms, that eventually file for IPO. This paper finds that firms with PIPOs experience less underpricing when the percentage of PIPO investment is greater relative to total equity at IPO. A one percentage increase in the ratio of PIPO funding to market value of equity at IPO reduces the first-day return by 2.53%. This finding suggests there are benefits due to increased monitoring. I also find support that more recent PIPOs have less underpricing compared to earlier PIPOs. I find that each additional year between the last PIPO and the IPO date is associated with a 8.66% increase in first-day returns. This finding is consistent with the PIPO signal losing strength as business opportunities change over time.

I do not find support that the number of PIPOs decrease information asymmetry. I find each additional PIPO is related to 2.79% increase in first-day returns. A possible reason for this finding could be that firms that repeatedly go back for PIPOs send a bad signal to the market.

In matched sample results, undergoing a PIPO appears to increase IPO underpricing. Firms with PIPOs average a first day return 5.44% higher than those without PIPOs. This implies that having a PIPO is does not decrease information asymmetry. I do not find support that PIPO activity is related to post-IPO volatility. All results indicate that the market does not factor PIPOs into post-IPO volatility.

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APPENDIX

APPENDIX 1: VARIABLE DEFINITIONS

Appendix A: Variable Definitions

First Day Returns	Defined as the percentage change from the offer price to the closing price.
Post IPO Return Volatility	The market model root-mean square error for each IPO over day +5 to day +64 relative to their IPO date. The value is multiplied by 1,000.
PIPO	Dummy variable set to one if the firm issued a private IPO, else zero.
PIPO%	Percentage of the total dollar amount received in PIPOs relative to the market value of equity at time of IPO (Both converted to 2016 dollars).
PIPO Clock	The number of days between the most recent PIPO and IPO date divided by 365.25.
PIPO Count	The number of private IPOs the firm issued prior to their IPO.
Up Revision	Percentage upward revision in the offer price from the mid-point of the filing range if the offer price is greater than the mid-point, ((offer price - mid-point)/mid-point) x 100 if offer price > midpoint, else zero.
VC dummy	Dummy variable set to one if the IPO is backed by venture capital, else zero.
Top Tier dummy	Dummy variable set to one if the lead underwriter of the IPO has an updated Carter and Manaster (1990) rank of eight or more, else zero.
Positive EPS dummy	Dummy variable set to one if trailing EPS is positive at the time of the IPO, else zero.
Prior Nasdaq 15-Day Returns	The buy-and-hold returns of the CRSP Nasdaq value-weighted index on the 15-trading days prior to the IPO date, ending on day t-1.
Share Overhang	Defined as the number of shares retained divided by the number of shares in the initial offering.
Sales	Trailing annual firm sales in millions of dollars at the time of the IPO.

APPENDIX 2: SUMMARY STATISTICS FOR PIPOS THAT EVENTUALLY IPO, 2000-2016

Table I

Summary Statistics for PIPOs that Eventually IPO, 2000-2016

The sample includes 303 private IPOs from firms that eventually undergo an IPO. Private IPOs are defined as equity financing of $40 million or more in growth rounds. Dollar figures are adjusted to 2016 dollars. The sample includes IPOs with an offer price of at least $5 per share, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, financial firms, and stocks not listed on CRSP. The private IPO sample is obtained from CrunchBase Pro. The IPO sample is obtained from Jay Ritter's IPO website along with Thomson Financial Securities Data and SEC filings on EDGAR.

Year	No. of PIPOs	Mean Size	Median Size	Min. Size	Max. Size	Std. Dev.
2000	8	$59,629,566	$52,726,530	$41,626,210	$104,245,250	$20,629,693
2001	7	$63,114,670	$51,705,880	$40,943,810	$136,018,030	$33,493,631
2002	5	$50,035,824	$47,260,180	$40,261,032	$60,391,548	$9,138,152
2003	5	$60,682,882	$65,677,910	$43,323,850	$72,758,530	$11,447,803
2004	18	$74,875,388	$53,493,511	$40,791,050	$322,081,100	$65,523,340
2005	13	$78,769,996	$62,032,890	$42,078,850	$245,857,430	$55,697,771
2006	17	$132,573,571	$58,111,421	$42,836,630	$1,067,758,230	$244,447,827
2007	34	$79,540,199	$59,478,885	$40,204,777	$277,327,410	$54,130,817
2008	12	$88,865,931	$56,823,105	$40,824,369	$284,137,930	$72,355,084
2009	27	$76,429,810	$63,614,040	$42,484,177	$225,789,320	$39,833,726
2010	25	$85,409,978	$60,921,520	$43,130,234	$332,299,200	$66,754,482
2011	23	$161,500,776	$74,738,199	$42,738,133	$1,041,491,564	$230,789,373
2012	30	$69,656,526	$57,644,896	$40,571,670	$208,664,373	$36,148,649
2013	25	$66,837,039	$50,643,710	$41,388,880	$173,117,260	$38,378,336
2014	26	$91,895,749	$66,940,417	$40,869,941	$225,000,001	$48,764,515
2015	27	$71,131,510	$65,952,556	$40,465,610	$202,341,625	$34,233,387
2016	1	$53,195,020	$53,195,020	$53,195,020	$53,195,020	$0
Total	303	$85,497,484	$59,052440	$40,204,777	$443,143,374	$98,551,855

APPENDIX 3: SUMMARY STATISTICS FOR IPO SAMPLE, 2005-2016

Table II
Summary Statistics for IPO Sample, 2005-2016

The sample includes 1,002 U.S. IPOs with an offer price of at least $5 per share, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, financial firms, and stocks not listed on CRSP. Panel A presents summary statistics for Traditional IPOs, IPOs that do not participate in private IPOs prior to going public and Panel B presents summary statistics for IPOs that participate in private IPOs prior to going public. The sample is obtained from Jay Ritter's IPO website along with Thomson Financial Securities Data and SEC filings on EDGAR. *First-Day Returns* is defined as the percentage change from the offer price to the closing price. *Post IPO Return Volatility* is the market model root-mean square error for each IPO over day +5 to day +64 relative to their IPO date. The value is multiplied by 1,000. *Up Revision* is defined as the percentage upward revision in the offer price from the mid-point of the filing range if the offer price is greater than the mid-point, ((offer price - mid-point)/mid-point) x 100 if offer price > midpoint, else zero. *VC dummy* is a dummy variable set to one if the IPO is backed by venture capital, else zero. *Top Tier dummy* is a dummy variable set to one if the lead underwriter of the IPO has an updated Carter and Manaster (1990) rank of eight or more, else zero. *Positive EPS dummy* is a dummy variable set to one if trailing EPS is positive at the time of the IPO, else zero. *Prior Nasdaq 15-Day Returns* is defined as the buy-and-hold returns of the CRSP Nasdaq value-weighted index on the 15-trading days prior to the IPO date, ending on day t-1. *Share Overhang* is defined as the number of shares retained divided by the number of shares in the initial offering. *Sales* is defined as the trailing annual firm sales in millions of dollars at the time of the IPO. *PIPO%* is defined as the percentage of PIPOs relative to the market value of equity at time of IPO in 2016 dollars. *PIPO Clock* is the number of days between the most recent PIPO and IPO date divided by 365.25. *PIPO Count* is defined as the number of private IPOs the firm issued prior to their IPO.

Panel A: Summary Statistics – Traditional IPO sample, 2005-2016

Variables	Mean	Std. Dev.	5th	Median	95th
First Day Returns	13.31%	21.88%	-10.00%	7.50%	58.40%
Post IPO Return Volatility	3.47%	1.46%	1.63%	3.26%	5.85%
Up Revision	4.50%	10.57%	0%	0%	18.78%
VC dummy	0.44	0.50	0	0	1
Top Tier dummy	0.76	0.43	0	0	1
Positive EPS dummy	0.48	0.50	0	0	1
Prior Nasdaq 15-Day Returns	0.88%	3.23%	-4.52%	0.97%	6.02%
Share Overhang	3.40	4.15	1.00	2.77	6.92
Sales	734.0	5,588.9	0.1	80.5	2219.2

Panel B: Summary Statistics – Firms with PIPOs sample, 2005-2016

Variables	Mean	Std. Dev.	5th	Median	95th
First Day Returns	24.62%	35.41%	-10.31%	13.33%	91.49%
Post IPO Return Volatility	4.33%	1.89%	2.34%	4.08%	6.60%
PIPO%	24.21%	22.42%	4.81%	17.26%	70.62%
PIPO Clock	0.39	0.49	0	0	1
PIPO Count	2.37	2.44	0.25	1.50	3.16
Up Revision	5.61%	10.10%	0%	0%	19.9%
VC dummy	0.97	0.18	1	1	1
Top Tier dummy	0.91	0.28	0	1	1
Positive EPS dummy	0.17	0.37	0	0	1
Prior Nasdaq 15-Day Returns	0.97%	3.33%	-4.60%	0.66%	6.10%
Share Overhang	4.29	2.50	1.78	3.68	8.73
Sales	95.5	297.9	0.1	24.7	308.6

APPENDIX 4: CORRELATIONS FOR THE FULL SAMPLE OF IPOS, 2005-2016

Table III
Correlations for the Full Sample of IPOs, 2005-2016

The sample includes 1,002 U.S. IPOs with an offer price of at least $5 per share, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, financial firms, and stocks not listed on CRSP. The sample is obtained from Jay Ritter's IPO website along with Thomson Financial Securities Data and SEC filings on EDGAR. *First-Day Returns* is defined as the percentage change from the offer price to the closing price. *Post-IPO Return Volatility* is the market model root-mean square error for each IPO over day +5 to day +64 relative to their IPO date. The value is multiplied by 1,000. *PIPO%* is defined as the percentage of PIPOs relative to market value of equity at time of IPO in 2016 dollars. *PIPO Clock* is the number of days between the most recent PIPO and IPO date divided by 365.25. *PIPO Count* is defined as the number of private IPOs the firm issued prior to their IPO. *Up Revision* is defined as the percentage upward revision in the offer price from the mid-point of the filing range if the offer price is greater than the mid-point, ((offer price - mid-point)/mid-point) x 100 if offer price > midpoint, else zero. *VC dummy* is a dummy variable set to one if the IPO is backed by venture capital, else zero. *Top Tier dummy* is a dummy variable set to one if the lead underwriter of the IPO has an updated Carter and Manaster (1990) rank of eight or more, else zero. *Positive EPS dummy* is a dummy variable set to one if trailing EPS is positive at the time of the IPO, else zero. *Prior Nasdaq 15-Day Returns* is defined as the buy-and-hold returns of the CRSP Nasdaq value-weighted index on the 15-trading days prior to the IPO date, ending on day t-1. *Share Overhang* is defined as the number of shares retained divided by the number of shares in the initial offering. *Natural Log of Sales* is defined as the natural log of trailing annual firm sales in millions of dollars at the time of the IPO.

Table III (continued)

	First Day Returns	Post IPO Return Volatility	PIPO%	PIPO Clock	PIPO Count	Up Revision	VC dummy	Top Tier dummy	Positive EPS dummy	Prior Nasdaq 15 day returns	Share Overhang	Log(Sales)
First-Day Returns	1.000											
Post-IPO Return Volatility	0.131	1.000										
PIPO%	-0.257	0.012	1.000									
PIPO Clock	-0.069	-0.057	0.103	1.000								
PIPO Count	-0.052	0.169	0.276	-0.182	1.000							
Up Revision	0.331	0.157	-0.258	0.065	-0.050	1.000						
VC dummy	0.051	0.109	0.073	-0.009	0.050	0.040	1.000					
Top Tier dummy	0.127	-0.011	-0.284	-0.158	0.086	-0.039	-0.059	1.000				
Positive EPS dummy	-0.038	-0.037	-0.059	0.312	-0.047	0.114	-0.132	-0.046	1.000			
Prior Nasdaq 15-Day Returns	0.027	0.023	0.091	-0.011	0.006	-0.015	0.136	0.060	-0.085	1.000		
Share Overhang	0.255	0.059	-0.292	-0.117	0.228	0.135	-0.081	0.215	0.057	-0.028	1.000	
Log(sales)	0.112	-0.067	-0.184	0.250	0.149	0.172	-0.143	0.239	0.308	0.021	0.359	1.000

APPENDIX 5: DIFFERENCES OF MEANS AND MEDIANS - UNIVARIATE ANALYSIS

Table IV
Differences of Means and Medians - Univariate Analysis

Table V reports differences in means and medians of regression variables between Traditional IPOs and firms with PIPOs. *First-Day Returns* is defined as the percentage change from the offer price to the closing price. *Post-IPO Return Volatility* is the market model root-mean square error for each IPO over day +5 to day +64 relative to their IPO date. The value is multiplied by 1,000. *Up Revision* is defined as the percentage upward revision in the offer price from the mid-point of the filing range if the offer price is greater than the mid-point, ((offer price - mid-point)/mid-point) x 100 if offer price > midpoint, else zero. *VC dummy* is a dummy variable set to one if the IPO is backed by venture capital, else zero. *Top Tier dummy* is a dummy variable set to one if the lead underwriter of the IPO has an updated Carter and Manaster (1990) rank of eight or more, else zero. *Positive EPS dummy* is a dummy variable set to one if trailing EPS is positive at the time of the IPO, else zero. *Prior Nasdaq 15-day Returns* is defined as the buy-and-hold returns of the CRSP Nasdaq value-weighted index on the 15-trading days prior to the IPO date, ending on day t-1. *Share Overhang* is defined as the number of shares retained divided by the number of shares in the initial offering. *Natural Log of Sales* is defined as the natural log of trailing annual firm sales in millions of dollars at the time of the IPO.

Variable		Traditional IPOs	Firms with PIPOs	Difference	p-value
First-Day Returns	Mean	13.31%	24.62%	**-11.31%**	<.001
	Median	7.50%	13.33%	**-5.83%**	<.001
Post-IPO Return Volatility	Mean	3.47%	4.33%	**-0.86**	<.001
	Median	3.26%	4.08%	**-0.82**	<.001
Up Revision	Mean	4.50%	5.61%	-1.11	0.177
	Median	0.00%	0.00%	**0.00**	0.019
VC dummy	Mean	0.44	0.97	**-0.53**	<.001
	Median	0.00	1.00	**-1.00**	<.001
Top Tier dummy	Mean	0.76	0.91	**-0.15**	<.001
	Median	0.00	1.00	**-1.00**	<.001
Positive EPS dummy	Mean	0.48	0.17	**0.31**	<.001
	Median	0.00	0.00	**0.00**	<.001
Prior Nasdaq 15-Day Returns	Mean	0.88%	0.97%	-0.09	0.745
	Median	0.97%	0.66%	0.31	0.974
Share Overhang	Mean	3.40	4.29	**-0.89**	0.004
	Median	2.77	3.68	**-0.91**	<.001
Natural Log of Sales	Mean	1.40	0.27	**1.13**	<.001
	Median	1.91	1.39	**0.52**	<.001
Observations		799	203		

APPENDIX 6: MEAN FIRST-DAY RETURNS BY YEAR, 2005-2016

Table V
Mean First-day Returns by Year, 2005-2016

The sample includes 1,002 U.S. IPOs with an offer price of at least $5 per share, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, financial firms, and stocks not listed on CRSP. Statistics are subdivided between Traditional IPOs, IPOs that do not participate in private IPOs prior to going public and IPOs that participate in private IPOs prior to going public. The sample is obtained from Jay Ritter's IPO website along with Thomson Financial Securities Data and SEC filings on EDGAR. First Day Returns is defined as the percentage change from the offer price to the closing price. Significance at the 10%, 5%, and 1% levels are noted as *, **, and *** respectively.

	Number of IPOs		Mean First-Day Return		
Year	Traditional IPOs	Firms with PIPOs	Traditional IPOs	Firms with PIPOs	Difference
2005	108	5	10.49%	0.90%	9.59%
2006	103	8	12.09%	13.57%	-1.48%
2007	96	19	16.80%	17.52%	-0.72%
2008	15	1	6.44%	-1.67%	8.11%
2009	33	4	7.14%	32.50%	-25.36%
2010	52	17	8.26%	7.41%	0.85%
2011	44	15	13.59%	25.56%	-11.97%*
2012	58	14	22.40%	15.52%	6.88%
2013	82	30	18.35%	33.29%	-14.94%**
2014	106	44	14.25%	27.54%	-13.29%**
2015	58	33	8.17%	32.21%	-24.04%***
2016	44	13	11.31%	32.64%	-21.33%**
Total	799	203	13.31%	24.62%	-11.31%***

APPENDIX 7: MEAN FIRST-DAY RETURNS BY FAMA AND FRENCH INDUSTRIAL CLASSIFICATION

Table VI
Mean First-day Returns by Fama and French Industrial Classification

This table provides statistics for Fama and French Industrial Classifications in which firms with PIPOs participate in relative to Traditional IPOs. The sample includes U.S. IPOs with an offer price of at least $5 per share, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, financial firms, and stocks not listed on CRSP. Statistics are subdivided between Traditional IPOs, IPOs that do not participate in private IPOs prior to going public and IPOs that participate in private IPOs prior to going public. The sample is obtained from Jay Ritter's IPO website along with Thomson Financial Securities Data and SEC filings on EDGAR. First Day Returns is defined as the percentage change from the offer price to the closing price. Significance at the 10%, 5%, and 1% levels are noted as *, **, and *** respectively.

	Number of IPOs		Mean First-day Return		
Industrial Classification	Traditional IPOs	Firms with PIPOs	Traditional IPOs	Firms with PIPOs	Difference
Healthcare	30	6	9.55%	33.29%	-23.74%**
Medical Equipment	52	10	11.87%	14.60%	-2.73%
Pharmaceutical Products	135	92	7.01%	20.02%	-13.01%***
Chemicals	15	3	3.78%	4.91%	-1.13%
Construction	12	1	5.38%	47.38%	-42.00%
Electrical Equipment	5	1	11.03%	50.30%	-39.27%
Automobiles & Trucks	6	1	8.01%	41.06%	-33.05%
Petroleum & Natural Gas	17	2	4.96%	14.45%	-9.49%
Utilities	2	2	2.43%	16.24%	-13.81%
Communication	24	5	5.05%	1.96%	3.09%
Business Services	201	56	17.86%	35.65%	-17.79%***
Computers	18	9	23.40%	31.33%	-7.93%
Electronic Equipment	48	7	13.10%	19.05%	-5.95%
Measuring & Control Equipment	6	4	0.50%	7.64%	-7.14%
Wholesale	16	1	3.42%	-2.27%	5.69%
Retail	49	3	20.77%	48.66%	-27.89%*
Total	636	203	12.58%	24.62%	-12.04%***

APPENDIX 8: UNDERPRICING REGRESSIONS

Table VII
Underpricing Regressions

This table presents regressions for the sample of 1,002 U.S. IPOs with an offer price of at least $5 per share, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, financial firms, and stocks not listed on CRSP. The sample is obtained from Jay Ritter's IPO website along with Thomson Financial Securities Data and SEC filings on EDGAR. The dependent variable, *First-Day Returns*, is defined as the percentage change from the offer price to the closing price. *PIPO* is a dummy variable set to one if the firm participates in a private IPO, else zero. *PIPO%* is defined as the percentage of PIPOs relative to market value of equity at time of IPO in 2016 dollars. *PIPO Clock* is the number of days between the most recent PIPO and IPO date divided by 365.25. *PIPO Count* is defined as the number of private IPOs the firm issued prior to their IPO. *Up Revision* is defined as the percentage upward revision in the offer price from the mid-point of the filing range if the offer price is greater than the mid-point, ((offer price - mid-point)/mid-point) x 100 if offer price > midpoint, else zero. *VC dummy* is a dummy variable set to one if the IPO is backed by venture capital, else zero. *Top Tier dummy* is a dummy variable set to one if the lead underwriter of the IPO has an updated Carter and Manaster (1990) rank of eight or more, else zero. *Positive EPS dummy* is a dummy variable set to one if trailing EPS is positive at the time of the IPO, else zero. *Prior Nasdaq 15-Day Returns* is defined as the buy-and-hold returns of the CRSP Nasdaq value-weighted index on the 15-trading days prior to the IPO date, ending on day t-1. *Share Overhang* is defined as the number of shares retained divided by the number of shares in the initial offering. *Natural Log of Sales* is defined as the natural log of trailing annual firm sales in millions of dollars at the time of the IPO. All regressions include an intercept, Fama and French (1997) 48-industry dummies, and calendar year dummies. The t-statistics are in parentheses with the standard errors clustered by year and industry.

Variables	(1)	(2)	(3)	(4)	(5)
PIPO		7.67			
		(4.48)			
PIPO%			-2.53		
			(-1.90)		
PIPO Clock				8.66	
				(1.97)	
PIPO Count					2.79
					(3.02)
Control Variables					
Up Revision	0.63	0.62	0.63	0.62	0.63
	(2.36)	(2.14)	(2.36)	(2.45)	(2.39)
VC dummy	10.15	8.14	10.29	9.34	8.97
	(4.43)	(3.24)	(4.40)	(3.36)	(2.52)
Top Tier dummy	4.21	2.96	4.29	3.31	3.53
	(3.36)	(9.73)	(3.46)	(2.42)	(4.29)
Positive EPS dummy	0.68	1.03	0.67	0.99	0.96
	(1.55)	(0.61)	(0.44)	(0.59)	(0.59)
Prior Nasdaq 15-Day Returns	0.47	0.48	0.47	0.48	0.48
	(2.61)	(2.87)	(2.60)	(2.76)	(2.85)
Share Overhang	0.61	0.57	0.62	0.56	0.58
	(1.50)	(1.47)	(1.50)	(1.47)	(1.51)
Natural Log of Sales	-0.31	-0.24	-0.31	-0.15	-0.30
	(-0.67)	(-0.49)	(-0.68)	(-0.35)	(-0.63)
No. of observations	1,002	1,002	1,002	203	1,002
Fama and French 48-industry dummies	Yes	Yes	Yes	Yes	Yes
Calendar year dummies	Yes	Yes	Yes	Yes	Yes
R^2	23.33%	24.38%	23.34%	24.02%	23.77%

APPENDIX 9: VOLATILITY REGRESSIONS

Table VIII
Volatility Regressions

This table presents regressions for the sample of 1,002 U.S. IPOs with an offer price of at least $5 per share, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, financial firms, and stocks not listed on CRSP. The sample is obtained from Jay Ritter's IPO website along with Thomson Financial Securities Data and SEC filings on EDGAR. The dependent variable, *Post-IPO Return Volatility*, is the market model root-mean square error for each IPO over day +5 to day +64 relative to their IPO date. The value is multiplied by 1,000. *PIPO* is a dummy variable set to one if the firm participates in a private IPO, else zero. *PIPO%* is defined as the percentage of PIPOs relative to market value of equity at time of IPO in 2016 dollars. *PIPO Clock* is the number of days between the most recent PIPO and IPO date divided by 365.25. *PIPO Count* is defined as the number of private IPOs the firm issued prior to their IPO. *Up Revision* is defined as the percentage upward revision in the offer price from the mid-point of the filing range if the offer price is greater than the mid-point, ((offer price - mid-point)/mid-point) x 100 if offer price > midpoint, else zero. *VC dummy* is a dummy variable set to one if the IPO is backed by venture capital, else zero. *Top Tier dummy* is a dummy variable set to one if the lead underwriter of the IPO has an updated Carter and Manaster (1990) rank of eight or more, else zero. *Positive EPS dummy* is a dummy variable set to one if trailing EPS is positive at the time of the IPO, else zero. *Prior Nasdaq 15-Day Returns* is defined as the buy-and-hold returns of the CRSP Nasdaq value-weighted index on the 15-trading days prior to the IPO date, ending on day t-1. *Share Overhang* is defined as the number of shares retained divided by the number of shares in the initial offering. *Natural Log of Sales* is defined as the natural log of trailing annual firm sales in millions of dollars at the time of the IPO. All regressions include an intercept, Fama and French (1997) 48-industry dummies, and calendar year dummies. The t-statistics are in parentheses with the standard errors clustered by year and industry.

Variables	(1)	(2)	(3)	(4)	(5)
PIPO		0.05			
		(0.22)			
PIPO%			-0.02		
			(-0.14)		
PIPO Clock				0.07	
				(0.21)	
PIPO Count					0.17
					(0.70)
<u>Control Variables</u>					
Up Revision	0.01	0.01	0.01	0.01	0.01
	(2.29)	(2.32)	(2.28)	(2.36)	(2.43)
VC dummy	0.83	0.81	0.83	0.82	0.76
	(4.55)	(4.60)	(4.78)	(5.03)	(5.24)
Top Tier dummy	-0.30	-0.31	-0.30	-0.31	-0.34
	(-3.56)	(-2.86)	(-3.29)	(-3.11)	(-3.33)
Positive EPS dummy	-0.04	-0.04	-0.04	-0.04	-0.02
	(-0.53)	(-0.59)	(-0.53)	(-0.54)	(-0.42)
Prior Nasdaq 15-Day Returns	-0.02	-0.02	-0.02	-0.02	-0.02
	(-2.18)	(-2.11)	(-2.19)	(-2.19)	(-2.03)
Share Overhang	0.02	0.02	0.02	0.02	0.02
	(1.86)	(1.88)	(1.86)	(1.92)	(1.93)
Natural Log of Sales	-0.13	-0.13	-0.13	-0.13	-0.13
	(-3.37)	(-3.53)	(-3.37)	(-3.60)	(-3.39)
No. of observations	1,002	1,002	1,002	203	1,002
Fama and French 48-industry dummies	Yes	Yes	Yes	Yes	Yes
Calendar year dummies	Yes	Yes	Yes	Yes	Yes
R^2	29.52%	29.53%	29.52%	29.53%	29.92%

APPENDIX 10: PROPENSITY SCORE MATCHED UNDERPRICING REGRESSIONS

Table IX
Propensity Score Matched Underpricing Regressions

This table presents regressions for the sample of 203 matched pairs of firms that participate in PIPOs and propensity score matched IPOs. The matching method uses one-to-one nearest-neighbors propensity score matching with replacement. The first stage utilizes a probit regression where the dependent variable is equal to one for firms receiving PIPOs and zero for firms that did not receive PIPOs with the same independent variables as described earlier: Up Revision, VC dummy, Top Tier dummy, Positive EPS dummy, Prior NASDAQ 15-day returns, Share Overhang, and Log of Sales. The propensity score also uses IPO year and requires matches be in the same one-digit SIC code to ensure greater comparability. The second stage employs multivariate analysis on the matched sample of treatment and non-treatment members. The dependent variable, *First-Day Returns*, is defined as the percentage change from the offer price to the closing price. Independent variables are defined as earlier. All regressions include an intercept, Fama and French (1997) 48-industry dummies, and calendar year dummies. The t-statistics are in parentheses with the standard errors clustered by year and industry.

Variables	(1)	(2)	(3)	(5)
PIPO		5.44		
		(11.23)		
PIPO%			-5.80	
			(-1.10)	
PIPO Count				1.18
				(1.42)
Control Variables				
Up Revision	0.52	0.54	0.51	0.53
	(1.60)	(1.63)	(1.53)	(1.59)
VC dummy	1.54	1.54	1.61	1.22
	(0.26)	(0.25)	(0.28)	(0.20)
Top Tier dummy	10.02	10.24	9.48	10.04
	(3.38)	(3.44)	(3.30)	(3.46)
Positive EPS dummy	-6.87	-6.61	-6.86	-6.71
	(-3.79)	(-3.32)	(-3.82)	(-3.79)
Prior Nasdaq 15-Day Returns	0.01	0.06	0.02	0.04
	(0.03)	(0.14)	(0.04)	(0.09)
Share Overhang	2.52	2.42	2.52	2.45
	(1.99)	(2.10)	(1.96)	(2.02)
Natural Log of Sales	-0.70	-0.78	-0.66	-0.74
	(-0.94)	(-1.02)	(-0.86)	(-0.95)
No. of observations	406	406	406	406
Fama and French 48-industry dummies	Yes	Yes	Yes	Yes
Calendar year dummies	Yes	Yes	Yes	Yes
R^2	22.71%	23.35%	22.83%	22.81%

APPENDIX 11: PROPENSITY SCORE MATCHED VOLATILITY REGRESSIONS

Table X
Propensity Score Matched Volatility Regressions

This table presents regressions for the sample of 203 matched pairs of firms that participate in PIPOs and propensity score matched IPOs. The matching method uses one-to-one nearest-neighbors propensity score matching with replacement. The first stage utilizes a probit regression where the dependent variable is equal to one for firms receiving PIPOs and zero for firms that did not receive PIPOs with the same independent variables as described earlier: Up Revision, VC dummy, Top Tier dummy, Positive EPS dummy, Prior NASDAQ 15-day returns, Share Overhang, and Log of Sales. The propensity score also uses IPO year and requires matches be in the same one-digit SIC code to ensure greater comparability. The second stage employs multivariate analysis on the matched sample of treatment and non-treatment members. The dependent variable, *Post-IPO Return Volatility*, is the market model root-mean square error for each IPO over day +5 to day +64 relative to their IPO date. The value is multiplied by 1,000. Independent variables are defined as earlier. All regressions include an intercept, Fama and French (1997) 48-industry dummies, and calendar year dummies. The t-statistics are in parentheses with the standard errors clustered by year and industry.

Variables	(1)	(2)	(3)	(5)
PIPO		-0.10		
		(-0.32)		
PIPO%			-0.19	
			(-0.67)	
PIPO Count				0.02
				(0.08)
<u>Control Variables</u>				
Up Revision	0.00	0.00	0.00	0.00
	(0.77)	(0.56)	(0.62)	(0.62)
VC dummy	1.87	1.87	1.87	1.86
	(1.99)	(1.98)	(1.98)	(2.07)
Top Tier dummy	0.12	0.12	0.10	0.12
	(0.38)	(0.38)	(0.34)	(0.38)
Positive EPS dummy	-0.05	-0.06	-0.05	-0.05
	(-0.16)	(-0.18)	(-0.16)	(-0.17)
Prior Nasdaq 15-Day Returns	-0.06	-0.06	-0.06	-0.06
	(-2.09)	(-2.03)	(-2.08)	(-2.02)
Share Overhang	0.04	0.04	0.04	0.04
	(1.66)	(1.81)	(1.64)	(2.00)
Natural Log of Sales	-0.03	-0.03	-0.03	-0.03
	(-0.78)	(-0.67)	(-0.71)	(-0.70)
No. of observations	406	406	406	406
Fama and French 48-industry dummies	Yes	Yes	Yes	Yes
Calendar year dummies	Yes	Yes	Yes	Yes
R^2	29.63%	29.71%	29.67%	29.64%

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2017 - Present	Assistant Professor of Finance, Monmouth University, West Long Branch, NJ
2016 - 2017	Visiting Instructor of Finance, The University of Mississippi, University, MS

EDUCATION

2011 - 2017	The University of Mississippi School of Business Administration Ph.D. Finance Candidate
2006 - 2008	The University of South Alabama The Mitchell College of Business Master of Business Administration
2002 - 2006	The University of South Alabama College of Arts & Sciences Bachelor of Science, *magna cum laude* Major: Biological Sciences Minor: Computer Science

REFEREED ARTICLES

Cole, B. M., Daigle, J. A., & Van Ness, B. F., 2015, Do Tweets Matter for Shareholders? An Empirical Analysis, *Journal of Accounting and Finance*, No. 15, 39-52.

- Southern Finance Association, Key West, Florida, November 2014*
- Financial Management Association, Nashville, Tennessee, October 2014
- Eastern Finance Association, Pittsburgh, Pennsylvania, April 2014*

NON-REFEREED ARTICLES

Cole, B. M., Daigle, J. A., Van Ness, R. A. & Van Ness, B. F., Do High Frequency Traders Care about Earnings Announcements? An Analysis of Trading Activity before, during, and after Regular Trading Hours, The Handbook of High Frequency Trading, Edited by Greg N. Gregoriou, Elsevier, 2015.

* denotes presentation made by co-author

WORKING PAPERS

Daigle, J. A., K. P. Fuller, A. P. Liebenberg, & S. M. Moser, 2017, "The Determinants of Private Equity Holdings in the U.S. Insurance Industry" targeted for *Journal of Insurance Issues*.

- Eastern Finance Association, Pittsburgh, Pennsylvania, April 2014
- American Risk and Insurance Association, Washington D.C., August 2013

Do Economies of Scope Limit IPOs?

Do PIPOs Decrease IPO Uncertainty?

WORKS IN PROGRESS

What Factors Cause Firms to Choose between an IPO or Regulation A+ Offering?

Should the SEC Revise Accredited Investor Requirements?

CONFERENCE PARTICIPATION

Program Committee:

- Financial Management Association Annual Meeting, Las Vegas, Nevada, October 2016
- Financial Management Association Annual Meeting, Orlando, Florida, October 2015
- Eastern Finance Association Annual Meeting, New Orleans, Louisiana, April 2015
- Financial Management Association Annual Meeting, Nashville, Tennessee, October 2014

Discussant:

- Eastern Finance Association Annual Meeting, New Orleans, Louisiana, April 2015
- Financial Management Association Annual Meeting, Nashville, Tennessee, October 2014
- Eastern Finance Association Annual Meeting, Pittsburgh, Pennsylvania, April 2014
- Financial Management Association Annual Meeting, Chicago, Illinois, October 2013
- American Risk and Insurance Association Annual Meeting, Washington D.C., August 2013

Session Chair:

- Eastern Finance Association Annual Meeting, New Orleans, Louisiana, April 2015
- Financial Management Association Annual Meeting, Nashville, Tennessee, October 2014

TEACHING EXPERIENCE

Visiting Instructor, The University of Mississippi, 2016-2017

- Business Finance I Student Evaluation Results (Ratings out of 5):
    - Spring 2017 – 4.31 and 4.22
    - Fall 2016 – 4.40, 4.18, and 4.61
- Essentials of Finance
    - Spring 2017 – 4.21

Graduate Instructor, The University of Mississippi, 2012-2016

- Business Finance I Student Evaluation Results:
    - Spring 2016 – 4.66 and 4.64
    - Fall 2015 – 4.79 and 4.82
    - Summer 2015 – 4.80
    - Spring 2015 – 4.55 and 4.79
    - Fall 2014 – 4.54
    - Spring 2014 – 4.23
    - Fall 2013 – 4.16
    - Summer 2013 – 4.60
    - Summer 2012 – 3.93

ACADEMIC & PROFESSIONAL SERVICE

Faculty Advisor for Tennessee Valley Authority Investment Challenge: 2016-2017

Investing Basics. Lecture presented at Computer Technology Services Inc., Mobile, AL, March 2015

Referee for *The Financial Review*: 2012-2014