

THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF ECONOMICS

IPO UNDERPRICING: EXPLAINING THE FIRST DAY PRICE JUMP

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Spring 2016

A thesis
submitted in partial fulfillment
of the requirements
for baccalaureate degrees
in Economics, Finance, and Mathematics
with honors in Economics

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ABSTRACT

Initial public offerings, or IPOs, are notorious for being underpriced. In this paper, we examine some potential causes of this phenomenon using United States IPO data from 2000 to 2014. We conclude using regression analysis and reasoning that the presence of a top investment bank as underwriter on an IPO tends to increase underpricing. We also show that membership in the technology sector is another factor that increases underpricing, more so than the underwriter. We discuss other factors such as incentives, information asymmetry, and the winner's curse, that are also likely to cause underpricing but more difficult to analyze. The paper provides a comprehensive look at the causes of United States IPO underpricing in the last fifteen years.

TABLE OF CONTENTS

LIST OF FIGURES	iii
LIST OF TABLES	iv
ACKNOWLEDGEMENTS	v
1. Introduction	1
2. Literature Review	3
3. The Effect of the Underwriting Bank	8
4. The Tech Effect	17
5. Other Factors	26
6. Conclusion	32
BIBLIOGRAPHY	34

LIST OF TABLES

Table 1 IPOs that went negative for top and non-top underwriters.	12
Table 2 IPOs that went or zero negative for top and non-top underwriters.	13
Table 3 Number and portion of tech and non-tech IPOs with top and non-top underwriters. .	23

LIST OF FIGURES

Figure 1 Regression of underwriter on underpricing	11
Figure 2 Regression of technology on underpricing.....	18
Figure 3 Regression of underwriter and technology on underpricing.....	22

ACKNOWLEDGEMENTS

I'd like to thank Professor Joris Pinkse, my thesis advisor, as well as Professor James Tybout, who teaches the thesis writing class.

1. Introduction

An initial public offering, or IPO, is when a privately held company's owners decide to offer shares of their company for sale to the general public for the first time. This is a good way to raise a large amount of money for the firm, and also a way for the founders of a profitable startup to cash in on their efforts. The IPO allows those interested in being stockholders in the company to purchase shares of the company from the previously exclusive group of owners. After the IPO, the company's shares are traded on the open market, just like any other stock. The transition from private to public is a complicated one, and most IPOs today are underwritten by a bank or group of banks. One phenomenon that has been observed in most IPOs to date is a first day price jump. That is, the stock of the company jumps up a significant amount on its first day of trading. In the United States from 1980 to 2009, the average IPO experienced a 22.2% jump on the first day of trading (Ritter, 2010). This is obviously profitable to investors who purchased the stock at the initial price, but it means these companies are leaving money on the table. It shows people were willing to purchase the stock for a price more than 20% higher on average than the initial offer. Why are these companies leaving money on the table? That is one of the questions this thesis will attempt to answer.

There are three major methods for offering an IPO: book building, fixed price, and auction. The fixed price method is the simplest. In it, a price is decided in advance, and shares are allocated among the underwriting bank's clients. The book building method is a little more complicated, but it is the most common method in the United States. Through this method, the underwriting bank meets with clients and "builds a book" of investors. The bank sets a price range for the IPO, and investors can bid within that price range. Once the book is complete and all shares are accounted for, the shares are allocated and public trading can begin. The final

method, auction, is much less common than the other two. In it, all potential investors name a price they are willing to pay and how many shares they are willing to buy. Shares are then allocated at the highest price possible that would allow all shares to be purchased. This method allows ordinary investors to be more involved because it is more difficult for the underwriting bank to favor its clients. These terms are important to understand when it comes any type of meaningful research on IPOs.

There are several potential factors that could cause underpricing in IPOs. We will attempt to uncover some of them using United States IPO data from 2000 to 2014. One potential source of underpricing is the presence of a top tier investment bank as an underwriter. Underpricing benefits the bank, so the question as to whether top underwriters are better at making it happen is a valid one to ask. Another potential source of underpricing is membership in the technology sector. This also makes sense as a potential source of underpricing, as technology stocks possess many qualities, such as volatility, that could make them more susceptible to underpricing. This paper will use regression analysis on the data to help determine whether or not technology and underwriter have an effect on underpricing.

There are other potential causes for underpricing, economic factors like incentives that may not be measured by data. A review of literature will be conducted to glean some of these factors. They will be discussed alongside the ones that have been mentioned. Overall, this paper will attempt to provide a comprehensive look at recent IPO underpricing in the United States. It will seek proof of some causes through data, and where data cannot be used, through reason. It will attempt to answer the question, “Why are IPOs underpriced?”

2. Literature Review

There already exists a broad range of literature about the IPO underpricing phenomenon. Economists and scholars of finance have attributed first-day underpricing to a variety of factors, some controllable, some not. University of Florida professor Jay Ritter has made it his life's work to study IPOs, and many of his research projects have involved underpricing in some way. He deals specifically with the topic of underpricing in quite a few papers, and many of his studies will be discussed here. Beyond Ritter, there exist several other sources of literature on the topic from a variety of countries. This review will summarize some of the main factors that economists have previously come up with to help explain why IPO's often experience high price jumps during the first day of trading.

Timing of an IPO is often cited as a reason for price increase. In Ritter & Welch (2002), the researchers hypothesize that market conditions play a huge role in when an IPO goes public. They cite examples of underwriting banks urging companies to withdraw their IPO if market valuations are lower than expected. Lowry & Schwert (2002) suggest that firms try to time IPOs in periods of high optimism in the market. This results in investors being willing to pay more for shares of the company than the owners of the company think it is worth. In this scenario, it might look as if firms are leaving money on the table, but to them it is not an issue because they value their company less than the market does. Loughran & Ritter (2002) note empirically that underpricing is more severe after the market rises, which supports this timing theory. (2002 was apparently a popular year for IPO research, presumably due to the prevalence of IPO underpricing during the dot-com bubble that had recently burst.) From these papers, we gather that companies, with the encouragement of underwriting banks, tend to release IPOs in times of optimism, where they know they are likely to get both a good initial price and a first day price

increase. This can also help explain why firms don't seem to mind when their IPO leaves money on the table.

Though much of the literature seems to agree that timing is a factor in underpricing, there is not as much cohesion in the theory that information asymmetry has a big role. An empirical study of IPOs in Taiwan (Chen & Kao, 2006) concluded that information asymmetry between institutional investors and individual investors had a big role in underpricing. This was supported by a reduction in underpricing when Taiwanese law excluded institutional investors from certain IPOs. Jagannathan & Sherman (2006) agree with the point that information asymmetry is an issue, but their paper only discusses auction IPOs. Pons-Sanz (2005) also cites information asymmetry as a source of underpricing in Spanish IPOs. However, many researchers have found opposite results. Pu & Wang (2009) used data from before and after the lifting of Chinese government restrictions on IPO methods to determine that information asymmetry only explained a small portion of underpricing. And Ritter, an expert on the topic, states in Ritter & Welch (2002) that information asymmetry is not a primary cause of underpricing. He explains that the dot-com bubble, where IPO underpricing was very severe, provides evidence that there is more than just information asymmetry going on. Regardless of the differences of opinion on information asymmetry that we have discussed, each researcher that mentions it does seem to agree that it does cause underpricing to some extent. The magnitude of its effect, however, is not agreed upon.

A potential cause somewhat related to information asymmetry is proposed in Booth & Booth (2003). They write:

“Divergence of opinion causes the aggregate demand curve for a firm's shares to be downward sloping. If there is no wealth or ownership constraint, offer price will be set at a level that the investor with the highest valuation will be willing to bear, and this investor will buy the entire issue. However, to achieve stock exchange listing requirements, shares have to be more widely distributed at the IPO, which means the offer price has to be set at or below the market-clearing

price. If at least one investor with a valuation higher than the offer price is rationed, excess demand for the shares is created and the issue is oversubscribed at the offer price. In the secondary market, ownership constraint is relaxed, optimistic investors who are rationed at the IPO will bid up the share price and result in a price run-up.”

This argument is backed up by data in the paper. The theory is related to information asymmetry in that this asymmetry could cause divergence of opinion, but it is not the only possible cause.

This could also help explain why tech stocks tend to experience more underpricing than stocks in other sectors. Technology stocks are some of the most difficult stocks to value, due to the inherently volatile nature of that market. This difficulty in valuation would lead to increased divergence of opinion, which Booth & Booth say would lead to increased underpricing and a first-day jump.

Other pieces of literature propose some economic concepts that could help explain underpricing. The free rider problem and the winner’s curse are economic inefficiencies that often show up in auction type games. As such, an auction IPO is susceptible to these factors. Many auction IPOs are in the format Google used in 2004. In Google’s IPO, investors specified how many shares they wanted and how much they were willing to pay. The shares were then allocated to the highest bidders available, but these investors all paid the same price: that of the lowest bid that received an allocation. In this format, free rider problem arises because an uninformed investor can just bid an unreasonable high number for the shares they want, assume everyone else has done their research, and receive guaranteed shares for a fair price. The winner’s curse is the tendency for the winner(s) of an auction to overpay for an auctioned good whose value is difficult to reliably determine. Now, the savvy reader might realize that the winner’s curse actually drives the price of an auctioned good up, thereby reducing underpricing in the IPO case. However, Jagannathan & Sherman (2006) state:

“The free rider problem and the winner’s curse hamper price discovery and discourage investors from participating in auctions.”

This leads to built-in underpricing to compensate for these inefficiencies. When the compensation is larger than the issue, underpricing occurs.

These arguments are convincing, but specific to auction IPOs. Auction IPOs are fairly uncommon compared to fixed-price and book building methods. However, Chen & Kao (2006) mention in their Taiwan IPO research that the winner's curse issue can extend to fixed-price IPOs, which is what they studied. Furthermore, Booth & Booth never actually mention the winner's curse, but their "divergence of opinion" theory hints at a sort of winner's curse in the secondary market (the stock exchange, not the initial allocation). Because there is a divergence of opinion on the value of a newly offered stock, those who are willing to pay the most for it are the ones that end up purchasing it on the exchange. This drives up the price in a way similar to the way the winner's curse drives up the price of an auctioned good. This leads to a first-day price jump, which is the measuring stick of how much an IPO is underpriced. The nice part about this is that it can help explain underpricing across all types of IPOs, not just auctions.

Another factor that is mentioned in many different papers is the incentive that underwriting banks have to underprice. Underpricing is an indirect form of compensation for the banks because they are able to reward their clients with shares that jump up in value on the first day of trading. Loughran & Ritter (2002) searched for the reason that companies going public do not seem to be upset with the money they leave on the table due to underpricing. They found that the IPOs that tend to experience the most underpricing are often ones where the price was revised upward at least once before the allocation. This means that the company may have lost money to underpricing but still made more money on the IPO than they originally expected. The same paper also notes the interesting fact that the average amount of money left on the table by an IPO tends to be about double the amount paid in fees to the underwriting bank(s). Perhaps

banks and companies reach unofficial agreements involving underpricing as an indirect form of payment for a successful IPO. Loughran & Ritter's discovery in their 2004 paper that top-tier underwriters tend to underprice more supports this notion; as the better the bank, the more compensation, direct and indirect, they are likely to receive. This paper also explores a similar concept but on the part of the company. Many IPOs now have a portion of their shares allocated to the personal brokerage accounts of top executives of the company. This gives executives an incentive to encourage underpricing, as it would make them personally richer. Pons-Sanz (2005) provides evidence of another incentive for underpricing: the negative consequences for the banks of underpricing are much less severe than those of overpricing. Based on his data, he states:

“Institutions receive nearly 75% of the profits in underpriced issues, while they have to bear only 56% of the losses in overpriced offerings.”

This suggests an incentive on the part of the underwriter to underprice, as it is less risky to err on the side of underpricing than overpricing. Lowry & Schwert purport a similar view in their 2001 examination of the IPO pricing process. These papers taken together highlight the web of incentives, especially on the part of the underwriting bank(s), to underprice an IPO.

The literature that we have reviewed provides several different potential explanations for the phenomenon known as underpricing that tends to manifest itself in initial public offerings. Whether it is the timing of the IPO, information asymmetry, or the incentives that underwriters have to underprice, each explanation has its pros and cons. One thing that is clear is that there is no simple answer to the question we are asking. IPO underpricing has many causes that can vary based on type, sector, or a number of other factors. We will explore these causes in the rest of the thesis.

3. The Effect of the Underwriting Bank

The review of the literature already existing about the IPO underpricing phenomenon has turned up several potential factors, all of which are likely to have varying effects on the existence and degree of underpricing. In the next few sections of the thesis, we will go through each of these factors in an attempt to come up with a unifying theory of why IPO underpricing occurs and how it can be measured. We will first examine the factors individually, using a variety of statistical tools to determine the magnitude of their correlation with first-day underpricing. We will then attempt to explain these results using other resources, including material from the literature review, outside resources, observations, and other sources. We will then observe how the variables interact statistically and otherwise in an attempt to come up with a unifying theory. Again, an explanation will be provided that goes deeper than just the numbers. Finally, we will draw conclusions based on the data and attempt to bring everything together with a model that incorporates the wide variety of factors.

In following this methodology, the first factor that we will observe is the company's choice of underwriter. A company that decides to go public cannot accomplish that task alone. There are several parts to the IPO process that need to be handled by seasoned financial professionals. SEC policies must be obeyed, and there are filings that must be completed and regulatory restrictions that must be adhered to. As a result, companies that intend to go public generally hire an investment bank (or group of banks) to guide them through the IPO process. A bank that assists a company in going public is called an underwriter. If a group of banks is used, one of them is generally given more authority than the rest. This bank is then called the lead underwriter. The underwriters handle the regulatory aspects of the IPO, but they also handle a lot of the marketing for the new security. After all, an IPO is selling a product, the stock of the company, to investors and institutions. The underwriter helps the company choose a price or

price range at which to offer the stock. If the book building method is used (which is usually is), the underwriter allocates (sells) the stock amongst its clients, usually big institutions like hedge funds and mutual funds. Because the underwriter has so much say over pricing of the new stock, it is natural to suspect that the underwriter might have some control over underpricing as well.

The literature review revealed that some economists believe underpricing is a form of indirect compensation to the underwriting bank, intentionally supplied by the company. Others believe company executives and their families directly benefit from underpricing, as they can line their personal brokerage accounts with stock that will soon shoot upwards. Still others think underpricing is an underhand tactic used by some banks to dishonestly squeeze money out of the companies they are supposed to be helping. Whatever the intention, underpricing generally does benefit the underpricing bank, as it allows them to reward their clients by selling them stock that jumps up in price. Whether that benefit is attained through dishonesty is up for debate, but it is worth looking into.

Ritter & Loughran (2004) wrote that top-tier underwriters tended to underprice more. This is a claim that is worth investigating today, to check if it still holds. Using a dataset from IPOScoop.com that contains a list of all U.S. IPOs from the beginning of 2000 to the end of 2014, along with their first-day jump and underwriter, we can test this claim. We need to manipulate the data in some way, however, to “measure” the strength of the underwriters. Ritter and Loughran faced a similar problem in 2004, which they solved by giving each underwriter a rank, ranging from negative nine to positive nine, which they used as a measurement. However, due to the process they used, each underwriter usually ended up coming out on one extreme of the scale. Almost all of them were either a negative nine or a positive nine, or something very close. Because of this, it seems simpler and easy to understand to create a dummy variable with value one if the underwriter is considered a “top bank,” and zero if not. In this way we can check

whether or not the underwriting bank is related to amount of underpricing, and get a rough estimation of what that relation might be. We can then run regressions on these groups and check whether or not a statistically significant correlation occurs.

The first thing that must be done is determining which banks are “top banks.” If you were to ask anyone on Wall Street who the top ten or so banks are, the answers would vary, but most would probably include Goldman Sachs, J.P. Morgan, Morgan Stanley, Bank of America, Deutsche Bank, Citi, Credit Suisse, Barclays, and UBS. These are considered “bulge-bracket investment banks.” The data goes back some time, however, so we cannot only rely on today’s top banks. Ask the same question before the 2008 financial crisis, and the answers would be similar, but also likely to include Merrill Lynch and Lehman Brothers, two firms that were hit hardest by the crisis and eventually bought by other firms on the list (Merrill by Bank of America and Lehman by Barclays). So we define the “top” underwriters as the eleven banks mentioned here. To simplify the data for cases where multiple underwriters are used, only the lead underwriter was looked at. This allows us to put a number on each IPO and look at the effects a top underwriter may have. Some might not agree fully with all of the banks on this list, but most will likely agree with most of them, and swapping out one or two near the bottom isn’t likely to change whether or not a correlation arises.

After using this method to define which IPOs had a top underwriter, we can now determine the effect an underwriter can have. Regressing underpricing on the underwriter dummy variable gave a coefficient of 5.88% (standard error: 1.18%) and a constant of 9.36% (standard error: 0.967%), as seen below.

Figure 1 Regression of underwriter on underpricing.

. regress upr uw

Source	SS	df	MS			
Model	1.92245969	1	1.92245969	Number of obs =	2518	
Residual	194.438029	2516	.077280616	F(1, 2516) =	24.88	
Total	196.360489	2517	.078013702	Prob > F =	0.0000	
				R-squared =	0.0098	
				Adj R-squared =	0.0094	
				Root MSE =	.27799	

upr	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
uw	.0588163	.0117925	4.99	0.000	.0356924	.0819403
_cons	.0936104	.009661	9.69	0.000	.0746661	.1125546

Similar results were obtained using only the data from after the financial crisis (2009-2014). A coefficient of 5.51% (standard error: 1.87%) and a constant of 9.17% (standard error: 1.58%) were observed. Both of these are statistically significant, and they are not very different from each other. This suggests that whether or not a company has a top underwriter is positively correlated with first day underpricing and that this has not changed much since after the financial crisis. This is consistent with what Ritter & Loughran suggested in 2004.

The data tells us that underwriter rank and underpricing are correlated, but it doesn't tell us why. There are several details about IPOs that can help explain why this is occurring. One potential explanation is that top underwriters are more likely to underwrite IPOs that are highly anticipated. Highly anticipated IPOs tend to jump up in price on the first day due to investor excitement about owning the new stock. Perhaps underwriters seek to land work on hyped-up IPOs as a way of boosting their prestige and revenue. If this is the case, it makes sense that top underwriters would land them more often. Or perhaps highly anticipated IPO companies seek out top underwriters due to all of the hype. Either way, there is a chance that top underwriters don't

cause underpricing at all, rather that they simply tend to work on IPOs that are more highly anticipated. Another possible explanation is that top underwriters boost the anticipation on IPOs they work on, which leads to price jumps. This possibility would mean that top underwriters are causing underpricing, even if inadvertently. Because it is difficult to measure “anticipation” on an IPO, we cannot know for sure, but the “hype” factor does seem like it might explain some of the correlation between top underwriters and greater underpricing.

Another factor that could help explain this correlation is the fact that an IPO is generally considered successful when it gains in price on the first day by a moderate amount. A high gain is bad because it means money was left on the table, and a negative change means public perception about the value of the company soured. Both indicate the IPO was mispriced, but a negative change is generally considered much worse than a positive one. Perhaps the top banks are generally better at ensuring the IPOs they underwrite do not go negative. Or perhaps they only agree to underwrite IPOs they know will be successful. Either way, this would certainly lead to higher values for first day change. It also makes sense that it could be a potential factor. Fortunately, this is something we can measure. We can look at the number of instances in the data where a top underwriter’s IPO went negative, and compare that to the other group. Out of 1690 IPOs with a top underwriter, 387 went negative after the first day, or 22.90%. Among 828 IPOs without a top underwriter, 192 went negative, or 23.19%, as seen below.

Table 1 IPOs that went negative for top and non-top underwriters.

Negative IPOs	Non-Top Uwr.	Top Underwriter
Num. Negative	192	387
Total	828	1690
Percentage	23.19%	22.90%

So there is a difference, but not a big one. However, when we expand the calculation to include IPOs that didn't change in price at all (a first day change of 0%), top underwriters had 510 negative or zero (30.18%) and the rest had 294 (35.51%), as seen below.

Table 2 IPOs that went or zero negative for top and non-top underwriters.

Neg./Zero IPOs	Non-Top Uwr.	Top Underwriter
Num. Neg./Zero	294	510
Total	828	1690
Percentage	35.51%	30.18%

This is reasonable to look at because IPOs that do not change in price at all on the first day are considered somewhat unsuccessful because they are expected to rise at least a little bit. This difference of about 5% between top and non-top underwriters isn't huge, but it does indicate that the better underwriters tend to have more successful IPOs, which makes sense and can help explain some of the reason why these top underwriters experience higher underpricing numbers, on average.

Another potential explanation comes from the fact that underpriced IPOs are generally beneficial to the underwriting bank. As part of the bookbuilding method, which almost all U.S. IPOs use, these banks allocate shares of the IPO among their clients before the shares begin publicly trading. An underpriced IPO would cause a jump in the prices of these shares, thus benefiting the bank's clients. In this way, the underwriting banks can reward loyal clients with IPO shares that are about to jump in price. It can be a surefire way for a bank to make its clients money. This factor is why underpriced IPOs are considered a form of indirect compensation for the bank. As mentioned in the literature review, Loughran & Ritter (2002) said the average

amount of money left on the table by an IPO tends to be about double the amount paid in fees to the underwriting bank(s). So, perhaps the reason why better banks tend to have more underpriced IPOs is that they are being indirectly compensated for their status as a top bank. Whether this is something agreed upon by the company and the bank, or some sort of unspoken agreement is impossible to determine, but it makes sense that indirect compensation could be part of the reason that better banks tend to underprice more.

Even if indirect compensation explains part of the story, it does not mean the company going public agreed to this extra compensation. There needs to be a reason that the owners of the company would let banks underprice their IPO. And even if an unofficial understanding was in place, underpricing to the extent of twice the fees being paid to the banks seems a bit high. Why then do companies never seem to be very bothered that their company went public for a price that was significantly lower than it potentially could have been? Loughran & Ritter (2004) also found something that can help explain this. They discovered that more and more IPOs were allocating shares to the personal brokerage accounts of top executives of the company and their families. In startup companies, the top executives often are the ones who own the equity, and the ones who would be leaving money on the table in an underpriced IPO. Therefore if these allocations to their personal accounts shoot up in value along with the rest of the shares, they may not be quite as bothered by the underpricing, since it is benefiting them directly. When Loughran & Ritter found this in 2004, it was still a fairly recent trend, so it is likely that it still continues to the present day, and can therefore be applied to the entire dataset (2000-2014). This helps explain why companies going public are not bothered by the amount of underpricing that tends to occur. It can also help explain why steeper underpricing is tolerated from top banks. Better banks are likely more skilled and experienced at designing allocations that maximize benefits to top executives and their families while still maintaining the ability to turn a profit

from the whole deal. Thus, these banks can get away with higher underpricing without angering their clients.

Another potential explanation can be gleaned from an examination of the incentives at play for a bank when it works to set the price of a new stock. There are two ways that an IPO can reflect badly on the underwriter after its first day of trading: it can drop in value, or it can rise in value so much that it is clear the price set was incorrect. Now, to be clear, neither of these means the IPO was a failure, just that the underwriting bank made a mistake. Of the two, a drop in value is considered worse for the underwriter than almost any amount of excessive gain. From this analysis, we can see the underwriter is incentivized to price the IPO lower than it might normally if the consequences for a gain and a loss were equal. This can obviously cause underpricing across the board. How can this explain why better underwriters underprice more? Perhaps they are more risk averse, and that is why they are better underwriters. The fact that intentional underpricing minimizes risk is a very interesting aspect of IPOs and can help explain the effect the underwriter has on an IPO's price jump.

Now, to this point, it is potentially feasible that the explanations in this section could all be true and applicable to an underwriting bank without the bank having done anything illegal or unethical. However, the possibility of dishonesty as an explanation cannot be ignored. Some Wall Street banks have been shown to be dishonest before; the 2008 financial crisis is a reminder of this fact. The reason some banks are considered better than others is because they are better at turning a profit. Perhaps the reason some banks make more than others is because they are more willing to be dishonest. If this is true, then it makes sense that top banks could be considered more likely to break the rule. Then the correlation between top banks and underpricing could simply be caused by a correlation between dishonesty and underpricing. It is impossible to measure dishonesty, since so much of it goes unnoticed and unpunished, but we can speculate

about it as a potential cause. We have established before that underpricing is beneficial to the underwriter at the expense of the company, so it makes sense that dishonest banks or perhaps dishonest teams within the banks are more likely to underprice using unethical means than other teams and other banks. This could explain some of the reason why top banks have been observed to underprice more.

Overall, this paper attempts to uncover some of the reasons behind IPO underpricing. In looking at the data, a correlation has been found between top banks and amount of underpricing. This tells us that the choice of underwriter does matter when it comes to predicting and explaining underpricing, and this section attempts to show why. It is clear that the underwriting bank has a big say in the underpricing of an IPO, as they are the ones who set the price and eventually sell the stock. After reviewing the data and looking at potential answers, it seems clear that there is reason to believe that top underwriters are more likely to experience IPOs with higher underpricing.

4. The Tech Effect

Having established that a newly-public company who chooses a top underwriter is likely to experience a higher first day price jump than one who doesn't, we now move to another factor that seems connected with underpricing: the type of industry the company is involved in. More specifically, whether or not the company is a "technology" company. Tech stocks, as stocks that fall under this category are often called, are generally companies that provide products or services focusing on things like electronics, scientific development, and software. There is, however, no hard and fast definition of what defines a technology stock. Some sectors overlap (for example: are biotechnology stocks considered technology or healthcare?). For the purposes of this section, we have relied on Yahoo Finance's classification of stocks to determine which stocks are technology stocks and which are not. Yahoo is a large company and is generally reliable, and Yahoo Finance is widely used by investors to research stocks and stock performance. By cross referencing Yahoo Finance's classification of stocks by sector with the data on IPO underpricing we observed before, we are able to get a good picture of the effect being in the technology sector has on underpricing. Other parts of the paper have touched upon the belief that technology stocks are more likely to experience underpricing than other industries and sectors. This section will back that suspicion up with data and attempt to uncover some of the underlying causes of such an effect.

In gathering data on technology's relationship to underpricing, we started with the dataset from the last section that was obtained from IPOscoop.com. This data was then cross-referenced, using ticker symbols, with Yahoo Finance data on sectors. Unfortunately, this method was unable to obtain data for stocks that no longer have ticker symbols, either because they have been acquired, gone private again, or gone out of business. This is unfortunate and somewhat limiting, but it does leave us with 1378 observations, 175 of which are tech and 1140 of which

are not. Eliminating companies that are no longer publicly traded is unfortunate, but it eliminates companies from both tech and non-tech sectors, so its effect on the data isn't as bad as it could be. Running a regression of a dummy variable for technology (1 if the stock is a tech stock, 0 if it is not) on underpricing percentage, using the data we have, yielded a coefficient of 16.46% (standard error of 2.26%) and a constant of 12.86% (standard error of 8.03%), as seen below.

Figure 2 Regression of technology on underpricing.

`. regress upr tech`

Source	SS	df	MS			
Model	4.14054859	1	4.14054859	Number of obs =	1378	
Residual	106.854071	1376	.077655575	F(1, 1376) =	53.32	
Total	110.994619	1377	.080606114	Prob > F =	0.0000	
				R-squared =	0.0373	
				Adj R-squared =	0.0366	
				Root MSE =	.27867	

upr	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
tech	.1646272	.0225455	7.30	0.000	.1204001	.2088544
_cons	.1286157	.0080344	16.01	0.000	.1128547	.1443767

This indicates a rather large and statistically significant correlation between technology and underpricing: technology stocks on average jumped up 29.32%, while non-tech stocks on average jumped just 12.86%. This large difference is an interesting, though not unexpected, observation.

Though the data has established a connection between underpricing and the technology sector, it tells us little about why this connection exists. There are several underlying factors that might help explain this phenomenon. The first of these factors is related to something that was discussed in the last section. In it, we discussed that one of the possible reasons top-tier underwriters underprice more than others is related to their increased likelihood to land work on highly anticipated IPOs. A type of “hype” factor was discussed, in that highly anticipated IPOs

tend to jump up in price due to the added demand for their stock caused by investor excitement. Could this be the driving force behind the correlation? One thing that is hard to argue with is the high level of anticipation that seems to surround technology stocks. From the dotcom bubble to the rise of Silicon Valley, technology is something that fascinates investors. The volatile conditions offer a high risk, high reward environment that appeals to many. New tech startups spring up all the time, and the ones that make it big inevitably go public eventually (think Twitter, Facebook, etc.). Most lists from investment sites regarding highly anticipated IPOs consist almost solely of tech stocks (examples: Forbes, 2012; NASDAQ, 2015). The connection between hype and technology is hard to miss. It is difficult to prove the connection between hype and underpricing (hype isn't exactly something that is easily measured), but it makes logical sense that it exists. Hype is something that drives up investors' desire for a particular stock but doesn't really change the financials and fundamentals of the company. This means it isn't likely to increase offer price as much as it increases trading price, as institutions that receive initial allocations are more likely to see through the hype than the average retail investor. So with an established connection between technology and hype, and another very likely connection between hype and underpricing, it makes sense that a type of "hype" factor could be a driving force behind the relationship between tech IPOs and underpricing. Exactly how much of the effect this factor is responsible for is difficult, however, to really measure.

Another factor that could be behind the effect technology seems to have is the difficulty in valuing technology companies compared to some other sectors. A traditional and widely used model for valuing stocks is the discounted cash flow model, or DCF. In a DCF, a company's cash flows are projected out for a specified amount of years, usually ten, using a specific technique. Beyond ten years, a growing perpetuity is then projected to represent the rest of the company's lifetime. These cash flows are then discounted back to present value using the time

value of money with a certain interest rate, which also must be predicted or estimated. Robin & Malak (2015), in a brief paper written for the stock valuation company Cogent Valuation, explain some of the difficulties in using this traditional and easy model on technology stocks.

They explain:

“Early-Stage Technology Companies (‘ESTCs’), such as pharmaceutical developers and computer chip designers, differ greatly from more mature businesses in other industries. Specifically, ESTCs are commonly characterized by ongoing losses, little or no revenues, labor-intensive R&D work as a primary function, and an inability to obtain commercial loans. Financings for such companies are held as cash, which is quickly depleted (or ‘burned’) by the high personal costs and materials expenses associated with R&D. The resulting financial profile renders traditional valuation techniques inadequate. The traditional valuation model is not a universal one, and cannot be expected to suggest reliable valuation indications for all companies in every industry. ESTCs inherently require sophisticated and unique approaches for determining their value.”

Their paper focuses on ESTCs, as they described, but most of these factors carry over to technology companies in general, especially those that are about to have an IPO. Technology companies can be difficult to predict, especially because a company can have negative earnings and still be considered successful based on user base and potential for future profit. Twitter, for example, had yet to turn a profit when it launched its IPO in 2013. This type of story is not uncommon in the technology sector. Factors like these make technology stocks in general very difficult to value, and technology IPOs even more so, as IPOs in general are already difficult to value. The added risk to investors posed by valuation difficulties is something that would increase underpricing. Due to the uncertainty, underwriting banks are forced to lower the offer price to ensure all of the shares are allotted before the stock begins trading. This sets the stage for a price jump on the first day of trading. All factors considered, it makes sense that the difficulty posed by valuing tech stocks could have something to do with the increased underpricing they experience.

A somewhat related factor that could also play a part is the increased volatility

technology stocks experience compared to other industries. Marc Davis of Investopedia reported in 2012 that:

“Technology was the most volatile sector, according to a 2009 study conducted by a firm that tracked U.S. stock performance in the S&P 500 index. According to data analyzed by Birinyi Associates Inc., after reporting quarterly earnings, tech sector stocks averaged 4.8% moves in after-hours trading, and 3.4% during regular trading hours during the period studied.”

Technology has historically been one of the more volatile sectors in the S&P 500, so it makes sense that this volatility would carry over to stocks not in the index. The added volatility present in the technology sector could have something to do with underpricing. Volatility adds a layer of uncertainty for investors. This uncertainty, much like the uncertainty that arose from valuation difficulties as explained in the previous paragraph, is something that adds risk. This in turn, again like in the previous paragraph, requires a lower offer price from the underwriting banks in the initial allocation, as a sort of “compensation” for additional risk. When the stock opens for trading to the general public, more investors, including those tolerant of risk, become involved, and increased underpricing occurs. In this way, the added volatility of the technology sector is one potential cause for the increased underpricing that the sector experiences.

In the literature review, we discussed a paper by Booth & Booth (2003) that proposed the idea that divergence of opinion on the value of a stock could increase underpricing. The basic idea was that investors have different opinions about the value of a new stock. If it were possible, the investor with the highest valuation would buy all of the initial allocation of the stock, and the company would be happy to let this happen, as this investor is the one with the highest offer. However, this scenario is impossible because new issues must meet listing requirements for stock exchanges, and thus must spread out the initial allocation to less optimistic investors. However, once the stock begins publicly trading, the more optimistic investors are free to buy whatever they want, and the price increases, causing the first day jump that defines underpricing.

Booth & Booth were referring to all IPOs, and did not single out tech stocks, as all IPOs tend to have a divergence of opinion on their value because it is difficult to put a valuation on a stock without much public information. However, technology IPOs, due to their inherent difficulty in valuation that was discussed previously coupled with the valuation difficulty that comes from being a new issue, have an increased divergence of opinion in valuation. That is, the difference between the average investor's outlook and the most optimistic outlooks is greater. Thus, following the logic Booth & Booth discussed, the price jump once the stock begins trading is also greater. This factor is something that can help explain why technology IPOs tend to underprice significantly more than their non-tech counterparts.

Having explained some of the factors behind the added underpricing from the technology sector and from top underwriters, it is useful to look at the interaction between the two factors. When dummy variables for both technology and top underwriter are regressed on underpricing, the underpricing coefficient is 2.82% (standard error 1.74%), the technology coefficient is 16.12% (standard error 2.26%) and the constant is 10.79% (standard error 1.51%), as seen below:

Figure 3 Regression of underwriter and technology on underpricing.

`. regress upr tech uw`

Source	SS	df	MS	Number of obs = 1378		
Model	4.34413196	2	2.17206598	F(2, 1375) =	28.00	
Residual	106.650487	1375	.077563991	Prob > F	= 0.0000	
Total	110.994619	1377	.080606114	R-squared	= 0.0391	
				Adj R-squared	= 0.0377	
				Root MSE	= .2785	

upr	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
tech	.1611769	.0226326	7.12	0.000	.1167788	.205575
uw	.028209	.0174119	1.62	0.105	-.0059478	.0623658
_cons	.1078869	.0151057	7.14	0.000	.0782542	.1375196

Interestingly, the coefficient on top underwriters is no longer significant at the 10% level, though it is very close. The technology effect, however, is almost unchanged, and still very statistically significant. Unfortunately, this regression is limited to the 1378 observations that had a value for the “tech” dummy variable, so perhaps some of the underwriter effect disappeared with that data. Or perhaps much of the underwriter effect is simply a result of the technology effect. One of the factors discussed in the underwriter section was that top underwriters are more likely to be able to land highly anticipated IPOs, which can be linked to increased underpricing. It makes sense then, since tech IPOs are highly anticipated, that tech IPOs are more likely to have top underwriters. Fortunately, this is something we can observe. Below is a table showing the breakdown of the two dummy variables for the 1378 observations:

Table 3 Number and portion of tech and non-tech IPOs with top and non-top underwriters.

Number	Tech	Not Tech	Total
Top UW	150	884	1034
Not Top UW	25	319	344
Total	175	1203	1378

Portion	Tech	Not Tech	Total
Top UW	0.11	0.64	0.75
Not Top UW	0.02	0.23	0.25
Total	0.13	0.87	1.00

Of the 1034 technology IPOs, 150, or 85.71%, had top underwriters. Of the non-technology IPOs, 884, or 73.48%, had top underwriters. So technology stocks are more likely to have a top underwriter, though not by much. This effect, though interesting, does not fully explain why the

underwriter coefficient greatly diminishes when regressed along with technology.

One thing that must be noted is, of the 1378 stocks from the dataset that are still in existence today, a total of 1034 had a top underwriter. This comes out to 75.04%. Of the stocks that are not still around today, 67.12% had a top underwriter. This tells us two things. First, that most IPOs have a top underwriter. This makes sense, as new issues are a primary function of any top investment bank. More importantly, this data tells us that stocks that went out of business, were acquired, or went private again were less likely to have a top underwriter. This could mean that having a top underwriter helps a company survive in the long run. It could also mean that top underwriters only work on IPOs that they see being successful long term. Perhaps more likely is that top underwriters are more likely to work with companies that they see as having certain financial drivers, and these drivers are also something that promotes long-term success. Whatever the case, this effect is interesting to note. It gives us more of an understanding of what types of deals top underwriters work on.

However, that information does not fully explain why the underwriter effect diminishes more than the tech effect when both are regressed together. One possible explanation is the correlation between technology and underwriter. This was discussed previously. Also discussed previously was the many points of data that were left out due to inability to look up ticker symbols for them. This could have an effect on the data that is diminishing the underwriter effect. Another possibility is that underwriters do not really have much of an effect at all. While this is certainly possible, it seems a bit implausible because of the statistically significant impact underwriters have that was found in the previous section. Also, though the underwriter effect in the most recent regression is not significant at the 10% level, it is very close (p-value of .105). This, coupled with the reasons discussed in the previous section as to why and underwriter effect makes a lot of sense, point to the conclusion that the underwriter effect is real, just perhaps not as

significant as the regression in the previous section seemed to indicate.

A final potential cause of the lessened effect is the difficulty that is posed by using dummy variables. While they are useful in that they make data collection easier, dummy variables have their downsides. They are not as accurate perhaps some sort of scale would be. As mentioned in the previous section, Loughran & Ritter (2004) did in fact use a scale to rank underwriters, ranging from negative nine to positive nine, but almost all of the underwriters came out on one extreme or the other, making the scale not much different from a dummy variable. This brings up the issue that some things are difficult to assign a numerical value to. Underwriter quality is one such thing. Regardless of this difficulty, the previous section was able to establish that underwriter quality and underpricing were indeed correlated. Perhaps the correlation would be stronger if a more precise measurement for underwriters were used. Unfortunately, such a system does not exist, but it does seem very likely that underwriter rank and underpricing do indeed have a relationship.

One thing that does seem clear based on this analysis is that being a technology IPO has a greater correlation with underpricing than having a top underwriter. Though both appear to have an effect, the technology coefficient is far greater in both the individual and joint regressions. Why technology has an effect is not certain, but things like high anticipation, volatility, divergence of opinion, and difficulty in valuation certainly seem to come into play. Overall, based on the data, it seems clear that being in the technology sector increases the likelihood that an IPO will experience a higher degree of underpricing.

5. Other Factors

Having discussed the effects that choice of underwriter and membership in the technology sector have on the amount of underpricing an IPO experiences, and having observed the statistical backing of these effects using United States IPO data since 2000, we now must consider factors that are more difficult or perhaps impossible to measure using data. When considering what comes into play in determining a new IPO's price, there are several things that happen behind the scenes that the everyday investor does not have access to. This makes measuring or analyzing these effects more difficult. While every investor knows what sector an IPO operates in or who the underwriting bank is, the public does not have access to the discussions that go on at the underwriter's offices or the discussions between the underwriter's employees and the company's ownership. Unfortunately, these areas are where several of the factors that will be discussed in this section are observed. Things like conflicting incentives, information asymmetry, and the winner's curse cannot accurately be measured by data, and cannot be definitively observed. This section will deal with these factors and any other aspects of the IPO process that could have an effect on underpricing but haven't been discussed. It is worth talking about these factors despite lack of measurements and data because they play a big part in the degree of underpricing, and even interact with the things we have discussed. For example, information asymmetry was one of the potential reasons technology stocks tended to underprice more, but the effect of information asymmetry might be much greater. This section will discuss these factors and those like them that play a role in IPO underpricing.

The first factor we will discuss is information asymmetry. Information asymmetry is a very broad term that could affect IPOs in a number of different ways. In the literature review, we discovered that much of the literature is divided as to the magnitude of the role information asymmetry plays. Ritter & Welch (2002) stated that information asymmetry is not a primary

cause of underpricing (recall Ritter is somewhat of an expert on the topic). However, many other papers seem to dispute this claim, such as Chen & Kao (2006), Jagannathan & Sherman (2006), and Pons-Sanz (2005). These papers claim that information asymmetry is in fact a primary cause, citing data in their various geographical and topical concentrations. Regardless of the disagreement, all of the literature that mentions it does seem to admit that information asymmetry plays some type of role, if not a primary one.

As mentioned above, information asymmetry is a very broad term. In general in economics, it refers to the disparity of information between two or more parties that could potentially lead to market inefficiencies. For example, a person who isn't healthy has more information about their health than a health insurance company, and is therefore more likely to purchase health insurance. This drives up the cost of health insurance for everyone, because the insurance company doesn't know who is healthy and who is not. In IPOs, the owners of the company likely have more information about their company than the underwriting bank, which in turn likely has more information about the company than investors. Even among investors, it has been said that institutional investors (banks, hedge funds, etc.) have more information than retail investors (everyday people) (Chen & Kao, 2006). These multiple sources of asymmetry could be linked to underpricing. There are a few different ways this could occur. The owners of the company, having more information about their own company than pretty much everyone else, could potentially see their company as less valuable than everyone else and encourage the bank to price their IPO lower, to ensure that it sells. Investors, not knowing the company is less valuable than they think, will buy the stock, drive the price up, and cause underpricing. If the owners view the company as more valuable than others, they will likely choose to stay private for the time being, which is why "overpricing" usually doesn't happen. This creates a downward bias in initial IPO pricings relative to investor views of value, and thus creates underpricing.

Thus, it makes a lot of sense that this type of information asymmetry, which arises because the owners have more information than investors, could be a contributor to underpricing.

Information asymmetry between other parties could also contribute. The fact that the owners of the company have more information than the underwriting bank could cause underpricing as well. Banks are under pressure for the price of an IPO they underwrite to go up. IPOs that drop in price are seen as a failure on the part of the bank. Banks also like to reward their loyal clients with shares in an IPO that jumps in price. Because the company having the IPO likely has more information than the bank, the bank may drop the price they allocate the initial shares at to ensure the price jumps. This extra drop in price would be likely to cause underpricing, and is yet another example of the inefficiencies that information asymmetry can cause.

Information asymmetry between institutional investors and regular investors has also been shown to contribute to underpricing. Chen & Kao (2006) indicated that underpricing occurs as a result of this asymmetry because regular investors know they are less informed than institutional investors and thus must be compensated for this or they will not join the market. Chen & Kao's research uses data from Taiwan to support their conclusion, so it may not apply to the United States (where this paper focuses) but their results are interesting and are worth mentioning because they help shed further light on how information asymmetry can induce underpricing.

We've covered information asymmetry between the company and investors, the company and banks, and even between different types of investors. All seem to have reasonable explanations as to how they could contribute to underpricing. What we have not discussed yet is the last possibility: differences in information between the underwriting bank and investors. This could also contribute to underpricing. If underwriting banks, which set the price of a new issue,

have more information than the investors purchasing the initial allocation, and the investors know this, the bank may be forced to lower the price to compensate these investors for their lack of knowledge. Otherwise, they will not be interested in purchasing. Then, when the stock hits the open market, market forces push the price up and result in underpricing. From the examples so far, it seems clear that information asymmetry of any sort when it comes to IPOs can reasonably be expected to cause underpricing.

This raises the question, then, as to whether the information asymmetry actually exists. With laws mandating public disclosure of certain information about companies and research on companies readily available online, how much more information do certain agents have than others? It is very difficult to measure this using data, but it does make a lot of sense that the owners of a company would have more information on that company than banks and investors. Private companies aren't required to disclose as many things as public companies are, so it makes sense that the owners would know more than others. Additionally, it makes sense that a bank working closely with said company on an IPO would have more information than the average investor. So yes, it does seem likely that information asymmetry exists, and it also seems likely based on what we have discussed that this asymmetry does play a role in underpricing. The extent of this role is very difficult to measure, but this discussion shows that it is very likely to exist.

Another factor that is difficult to measure or prove but that likely has an effect on underpricing is the existence of incentives to underprice on the part of underwriting banks and even on the part the company's owners. First, let's discuss the incentives banks have to underprice. This has been mentioned before in this paper, so it isn't necessary to go into detail, but basically, banks generally allocate shares of IPOs to their clients, so if the price goes up, the bank's clients benefit. Because the bank wants its clients to benefit, it has an incentive to

underprice. An IPO is also viewed as a failure on the part of the bank if it is overpriced, but is viewed positively if it is underpriced moderately. This gives the bank an additional incentive to underprice. Overall, there are a lot of incentives in play for a bank to underprice, so it makes sense that this could introduce a bit of a downward bias in the price of new issues.

It makes sense that banks have incentives to underprice, but it might be a bit more difficult to believe that the owners of a company have an incentive to underprice. If an IPO is underpriced, the company has essentially left money on the table. However, the fact that an IPO is considered successful if it is moderately underpriced comes into play here again. The company looks good if it underprices a little because it shows there is demand for their stock. It looks bad if the stock is overpriced. A jump in price also indicates good news for future equity offerings, so it isn't the end of the world. There is another incentive as well. Loughran & Ritter (2004) mentioned that more and more companies are allocating IPO shares into personal brokerage accounts of their top executives and these executives' families. This means the executives would benefit from underpricing despite the fact that they are leaving money from the table. So the incentive exists for agents from the company to underprice as well which explains why they might not be upset if the underwriting bank underprices. Given these incentives on the part of the bank and company, it makes sense that underpricing occurs.

A final factor that we will discuss in this section is the presence of the winner's curse. The winner's curse is the tendency for the winner of an auction to overpay for the good being auctioned. This is because the person among those bidding in an auction who has the highest estimate of an item's value is the one who will usually win. If the item's actual value is near the middle of all valuations, then it makes sense that the winner tends to overpay. In terms of an IPO, the actual value of the initial allocation is unknown to the investors considering purchasing it. Even non-auction IPOs are sort of like an auction in that only investors who value the stock at

or above the price will consider purchasing it. These investors know the winner's curse exists, and thus they revise their valuation of the IPO down to compensate. Then, when the IPO hits the market, its value jumps up to market value. Thus, the existence of the winner's curse can add to underpricing. Not all of the literature that we reviewed mentioned the winner's curse, but those papers that did generally agreed that it had an effect. Unfortunately, this is also something that is fairly difficult to prove with data due to the difficulty of gathering data on the subject. It is difficult to measure how much of underpricing is caused by the winner's curse.

Overall, the winner's curse, conflicting incentives, and information asymmetry all seem likely to have a role in underpricing. Unfortunately, it is rather difficult to measure or prove the role these factors play. One can gather data on technology stocks and underwriters, but it is a bit tougher to gather data on asymmetry and other similar aspects. Furthermore, it is difficult to tell how much of a role these effects have. What we can do is say that it makes sense that the factors we discussed in this section lead to increased underpricing. There are logical reasons that they would and it seems reasonable to assume they exist, based on the information presented here.

6. Conclusion

IPO underpricing is a phenomenon that occurs in IPO markets worldwide. The tendency for IPOs to jump in price on their first day of trading is something that has inspired study from a wide variety of economists and financial experts. In the review of literature, we examined some of the work that had been previously done on the topic of IPO underpricing and came up with several potential theories as to why this tends to occur. From there, we examined two possible causes, the presence of a top underwriter and membership in the technology sector, that had been theorized to increase underpricing.

We examined these two variables using United States IPO data from 2000 to 2014 and used regressions to determine correlation. Through this analysis, we first observed a correlation between hiring a top underwriter and amount of underpricing. After discussing the circumstances that tend to surround top underwriters and IPOs, we determined that this correlation made sense due to things like the benefits underpricing confers on a bank, the likelihood of top underwriters to get highly anticipated IPOs, and potential additional compensation a bank receives from underpricing. Top underwriters tend to exceed lesser banks in most of these categories, and it makes sense that they are able to take advantage of the factors that their stature offers. From this analysis, we concluded that there is definitely a correlation between having a top underwriter and underpricing, but that it is also very likely and reasonable to claim that having a top underwriter causes additional underpricing. It is very difficult to prove causation, but in this case it makes a lot of sense to speculate that causation exists between top underwriters and underpricing.

We next observed a correlation between whether the company was in the technology industry and amount of underpricing. This was explained due to factors such as the increased volatility of the technology sector, the high level of anticipation technology stocks tend to receive, and the added difficulty in valuing technology stocks. We discussed these factors and a

few others in depth, and concluded definitely that technology stocks and underpricing are correlated, and also that it is likely that being in the technology industry causes underpricing. Again, causation is difficult to prove, and many of the factors technology stocks possess are also potential causes of underpricing, but there is an undeniable link between the two.

We next observed the effect of technology stocks and underwriter at the same time. When regressed together we found that the effect of being a technology company far outshone the effect of having a top underwriter. We proposed a few reasons for this, such as the fact that top underwriters tend to land highly anticipated tech IPOs. It was eventually concluded that though tech might have a greater effect, both have their place and it is difficult to determine the percentage of underpricing that each one causes.

Beyond factors that can be observed using data, there are other factors that could possibly affect and cause underpricing. We discussed information asymmetry, conflicting incentives, and the winner's curse as effects that are somewhat difficult or impossible to measure using data. These factors make sense as potential causes of IPO underpricing due to the way IPOs are set up and the way market participants interact with each other.

Overall, IPO underpricing is a very complicated phenomenon that cannot be succinctly explained with one underlying cause. There are so many factors that contribute that it is impossible to single out one and determine its level of effect. What we can do is examine these potential factors and theorize their effect using data and reasoning. In this way, we determined that it is likely that both top underwriters and the technology sectors increase underpricing, but that there are a host of other factors involved. Hopefully IPO underpricing continues to be researched and analyzed, as it is a very exciting area of economics and finance with a lot to be discovered.

BIBLIOGRAPHY

- Booth, J. & Booth, L. (2003). Agreeing to Disagree: Why IPOs are Underpriced? Working Paper.
- Chen, A., & Kao, L. (2006). The Benefit of Excluding Institutional Investors From Fixed-Price IPOs: Evidence from Taiwan. *Emerging Markets Finance & Trade*, 42(6), 5-24.
- IPO Scoop. "IPO Data 2000 to Present." IPOSCOOP.com. IPOSCOOP.com, Web. Jan. 2015.
- Jagannathan, R., Sherman, A. E., & National Bureau of Economic Research. (2006). *Why do IPO Auctions Fail?*. Cambridge, Mass: National Bureau of Economic Research.
- Khan, Samir. "A List of All Yahoo Finance Stock Tickers." Invest Excel. Invest Excel, 07 Jan. 2015. Web. Jan. 2015.
- Loughran, T., & Ritter, J. (2002). Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs? *The Review of Financial Studies*, Vol. 15, No. 2, pp. 413-443.
- Loughran, T., & Ritter, J. (2004). Why has IPO Underpricing Changed Over Time? *Financial Management*, 33(3), 5-37.
- Lowry, M., Schwert, G. W., & National Bureau of Economic Research. (2001). *Biases in the IPO Pricing Process*. Cambridge, MA: National Bureau of Economic Research.
- Lowry, M & Schwert, G. (2002). IPO Market Cycles: Bubbles or Sequential Learning? *The Journal of Finance*. 1171-1200.
- Pons-Sanz, V. (2005). Who Benefits from IPO Underpricing? Evidence from Hybrid Bookbuilding Offerings.
- Pu, D. & Wang, S. (2009) "Empirical research on the underpricing of initial public offerings in China," *Industrial Engineering and Engineering Management*, 2009. IE&EM '09. 16th International Conference on , vol., no., pp.127,132, 21

Ritter, J. & Welch, I. (2002). A Review of IPO Activity, Pricing, and Allocations. *The Journal of Finance*. Vol. LVII, No. 4

Tse, Y. K., & Yu, T. (2006). An Empirical Examination of IPO Underpricing in the Chinese A-share Market. *China Economic Review*, 17(4), 363-382.

Yahoo! "Yahoo! Finance." Yahoo Finance. Yahoo!, Web. Jan. 2015.

Academic Vita

Ryan Sosnader

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Education

The Pennsylvania State University – University Park, PA **Expected Graduation May 2016**

- Bachelor of Science in Economics, Finance, and Mathematics (triple major)
- SAT: 790 Math, 770 Reading, 780 Writing
- Member of the Schreyer Honors College and Paterno Fellows Program
- Scholarship Recipient from the College of the Liberal Arts and Schreyer Honors College

Experience

Bank of America Merrill Lynch – New York, NY **June – August 2015**

- Interned in the Sales & Trading division of Bank of America Merrill Lynch
- Rotated through three trading desks: Equity Portfolio Products, G10 Foreign Exchange, and Equity Derivatives
- Assisted traders, analyzed data, presented trade ideas, and shadowed traders to learn what the job takes
- Received and accepted a full time offer on the Single Stock Equity Derivatives Trading desk beginning August 2016

Gap International, Inc. – Springfield, PA **May – August 2014**

- Intern for a transformational business consulting firm
- Utilized knowledge of statistics to analyze performance data; reported findings to company vice presidents
- Assisted with the development of an employee database; used knowledge of Microsoft Excel to expedite the process
- Developed temporary employee database in Excel for use while the project was in progress

Penn State Economics REU Program – University Park, PA **January – May 2014**

- Received funding to work with Penn State economics professor Neil Wallace on a semester-long research project
- Wrote a research paper titled *The Value of Bitcoin: An Analysis Using an Overlapping Generations Model*
- Used modeling and statistics to analyze and predict the behavior of the crypto-currency Bitcoin

Barakate Farm – Bobo-Dioulasso, Burkina Faso **September – December 2013**

- Worked in a group of four to create a 100-page business plan for a \$185,000 company in Burkina Faso, Africa
- Developed the plan in one semester as an assignment for Honors Finance 301
- Constructed financial statements for one year and projections for six years based on company documents
- Researched, established, outlined, and presented a long-term strategy for the company

HighPoint Solutions, LLC – East Norriton, PA **May – August 2013**

- Intern for a company with a wide array of clients in the healthcare and life sciences industries
- Edited hundreds of individual webpages while gaining proficiency in HTML code
- Completed projects involving website creation and editing, including work on the company's own website
- Designed template documents for use in project assignment and resource management

Activities

Alpha Gamma Rho Fraternity **September 2013 – Present**

- Executive Board Member – VP of Finance (Treasurer): December 2014 to present
- Participate in various philanthropy events as well as volunteer work
- Participate in the Penn State Dance Marathon (THON) to raise money for children with pediatric cancer

Penn State Economics Association **September 2012 – Present**

- Print Education Associate: September 2013 to September 2014
- Assisted with educating the association on current economic news and events
- Wrote articles for the association's weekly and monthly publications, as well as the PSUEA Education Blog

Penn State Investment Association **September 2013 – Present**

- Member of the Information Technology sector of the PSIA
- Attended weekly meetings designed to teach and discuss topics relevant to finance and investment
- Participated in the PSIA's stock pitch competition; researched and analyzed a company using a discounted cash flow

Eagle Scout Project **March 2012**

- Created and led a project that involved collecting and recycling over 1,000 unwanted computers.
- Organized and promoted the collection, recruited volunteers, coordinated transportation, and facilitated recycling throughout the course of the project