Auctions as an Alternative to Book Building in the IPO Process: An Examination of Underpricing for Large Firms in France

John Mekjian

Professor James W. Roberts, Faculty Advisor
Professor Marjorie B. McElroy, Faculty Advisor

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Abstract

A relevant factor in determining the quality of an initial public offering (IPO) mechanism is the level and variability of underpricing that occurs. The percentage difference between the IPO price and the closing price after one day of trading is a common way to define the "underpricing" of the stock. Although companies may value a small amount of positive underpricing, they certainly want this to be controlled. Both extreme positive and extreme negative underpricing are undesirable for a company. Building off of a paper that found a lower mean and variability of underpricing for firms that use the auction IPO mechanism as opposed to the book building IPO mechanism, this paper argues that auctions are not disadvantaged when only large firms are considered. Although this paper finds that the book building mechanism controls underpricing better than the auction mechanism, the advantage disappears when considering only large firms. This analysis is relevant because, aside from two companies, only small companies have used the auction IPO mechanism in the United States. Due to the lack of auction IPOs in the United States, this paper uses French data in its analysis. By showing that large firms using the auction mechanism are not disadvantaged when compared to large firms using the book building mechanism, this paper attempts to encourage large firms in the United States to consider using the auction method for their IPOs.

JEL classification: G12; G14; G20; G30

Keywords: IPO; Underpricing; Auction

I. Introduction

Motivation:

When LinkedIn conducted its initial public offering (IPO) in May 2011, the offer price was $45 per share.[1] After one day of trading, the stock closed at $94.25 per share.[2] The LinkedIn IPO exhibited a substantial amount of "first day underpricing," which is defined as the percentage difference between the closing price on the first day of trading and the offer price.[3] Specifically, LinkedIn experienced 109% underpricing. Had LinkedIn priced its offering at $94.25, the company and selling stockholders would have received an additional $386 million. Instead, the beneficiaries of the $386 million were the investors who were fortunate enough to receive shares in the discretionary allocation of the initial shares. Investors that receive shares in the initial allocation of shares often have a relationship with the firm. For example, a major client of the underwriting bank is more likely to receive shares in an IPO than an unknown retail investor.[4] As highlighted earlier with regards to LinkedIn, a substantial amount of underpricing can cost companies millions of dollars of equity. While the LinkedIn IPO is an extreme example, underpricing exists in almost every IPO. Loughran and Ritter (2002) claimed that the "average IPO leaves $9.1 million on the table."[5] Determining that the auction IPO mechanism controls underpricing[6] better than the book building mechanism adds support to the literature that the auction mechanism is superior.

Furthermore, only two of the 22 auction IPOs that have been conducted in the United States since 1999 have been by large companies.[7] However, I hypothesize that the auction mechanism does not lose its advantage at controlling underpricing when only large firms are considered. In addition to testing the overall control of underpricing by each mechanism, I also test to see how the mechanisms control underpricing when focusing on large firms in hopes that this analysis will demonstrate that large firms in the United States should strongly consider the auction mechanism for their IPOs.

Background:

Ritter (1998) stated "an initial public offering (IPO) occurs when a security is sold to the general public for the first time, with the expectation that a liquid market will develop." IPOs are conducted for a myriad of reasons. A few key reasons include the opportunity to add equity

[1] Offering price obtained from prospectus. Accessed through SEC EDGAR.
[2] Closing price obtained from Yahoo Finance.
[3] Underpricing can be measured as the percentage difference between the closing price after any number of days of trading (e.g. 1 day, 1 week, 1 month) and the offer price.
[4] Retail investor defined as an individual who buy and sell securities for their own personal account rather than for an organization. This is in contrast to an institutional investor, which means the investor is an institution that trades large quantities of securities.
[5] Loughran and Ritter (2002) claimed that, from 1990-1998, a total of $27 billion was "left on the table" by IPOs. The amount "left on the table" is calculated by adding up the difference between first day closing price and offer price for all the IPOs.
[6] "Controls underpricing" means does a better job at minimizing both mean and variability of underpricing.
[7] Only 2 of 22 companies had market capitalizations after the offering greater than $800M. Additionally, only 6 of 22 companies had market capitalizations after the offering greater than $200M. Data comes from SEC EDGAR database.

capital, enhance exposure, and increase liquidity for owners. While there are many different ways in which an IPO can be executed, the book building mechanism has become the dominant IPO procedure[8] in most major world markets. This has occurred over the last 20 years.[9] The rise of the book building mechanism has come at the expense of two other popular mechanisms: the fixed-price and auction mechanisms.

Jagannathan and Sherman (2007) noted that the debate on IPO methods in the US has generally focused on the auction and book building mechanisms. I also will focus my work on these two methods. Scholars have argued the superiority of each mechanism by citing a number of factors that suggest the quality of one mechanism over the other. Due to the major impact that underpricing has on proceeds[10], as seen in the LinkedIn IPO, underpricing is one frequently cited factor.[11] While many scholars argue that small, positive underpricing can be optimal, scholars unanimously agree that excessive positive or negative underpricing is suboptimal from the perspective of the issuing firm. Extreme positive underpricing (i.e. the closing price is greater than the IPO price) is a problem because it means that firms have "left money on the table."[12] Firms that conduct IPOs with substantial underpricing likely would have received greater proceeds by setting a higher initial price. Extreme negative underpricing (overpricing) is also undesirable because a rapidly falling stock price can hurt shareholder confidence in the company, cause a selling panic leading to an artificially depressed price, and anger investors who bought shares at the offer price.[13] Since both extreme positive and negative values of underpricing are undesirable, determining that one IPO mechanism tends to offer stocks with a lower variability of underpricing[14] while maintaining a small, positive mean of underpricing adds support to the literature that that mechanism is better.

In this paper, I focus on whether auctions control underpricing better than the book built mechanism when looking at large firms. This question is relevant because, with two exceptions[15], only small firms have completed auctions in the United States for their IPOs. However, the auction mechanism should not perform worse for large companies. The reasoning behind this will be discussed further in detail later in the paper. While I would like to look at underpricing for large firms that issued stock with an auction in the United States, there are only two data points, making an analysis of large US firms using the auction mechanism impossible. Therefore, I use data from France from 1991-1998. French stock data in the 1990s constitutes a rich arena with which to compare auctions to book built IPOs. There were a significant number of both types of IPOs, enabling me to draw meaningful conclusions when comparing the two mechanisms. Additionally, while there are a few differences that will be pointed out later in the

[8] "Method", "procedure", "process", and "mechanism" are all used interchangeably.

[9] Sherman (2002) stated that book building was dominant in Japan, France, Argentina, Italy, Portugal, Singapore, Switzerland, and the U.K ever since it spread in the 1990s. Bookbuilding is also dominant in the US.

[10] Proceeds defined as the amount of money raised by the company through the stock issuing.

[11] Examples include Derrien and Womack (2003); Pukthuanthong, Varaiya, and Walker (2007); Lowry, Officer, and Schwert (2010); and Kaneko and Pettway (2008).

[12] Loughran and Ritter (2002) claimed that, from 1990-1998, a total of $27 billion was "left on the table" by IPOs. This is calculated by adding up the difference between first day closing price and offer price for all the IPOs. LinkedIn left $386 million on the table in its IPO.

[13] In the book building mechanism, shares are allocated at the discretion of the underwriter. Often shares are allocated to important institutional investors. These investors hate to see share prices fall following the IPO because it means they are losing money on their investment. Negative underpricing can damage the relationship between the firm, underwriter, and investors.

[14] "Variability of underpricing" and "volatility of underpricing" are used interchangeably.

[15] These exceptions are Google and Interactive Brokers.

paper, the two mechanisms used in France function in a similar way and operate under similar regulations to the two mechanisms in the United States.

Derrien and Womack (2003) conducted a similar analysis, and this paper draws heavily from their work. They focused on the mean and variance of underpricing in the book building and auction mechanisms, looking closely at how underpricing differed in times of high market returns using French IPO data from 1992-1998. In my analysis, I focus on the IPOs of large firms.[16] I hypothesize that the mean and variance of underpricing will still be lower for auctions as compared to book building IPOs even for these large firms. The primary reasoning behind this hypothesis is that auctions theoretically incorporate information on the entire market demand, while book built IPOs only obtain demand information from a subset of the population. In theory, this should result in the auction mechanism better discovering the market price, thus resulting in a lower mean and variability of underpricing. This theory will be further explained later in the paper.

First, I will describe the two mechanisms and the critical differences between them. Then, I will contextualize this paper within the literature comparing auction and book built IPOs. This will lead into a discussion of my model and the theory behind my hypothesis. From there, I will describe the data being used and present the results from the tests. I will conclude by discussing the results and explaining my conclusions.

II. Explanation of Mechanisms

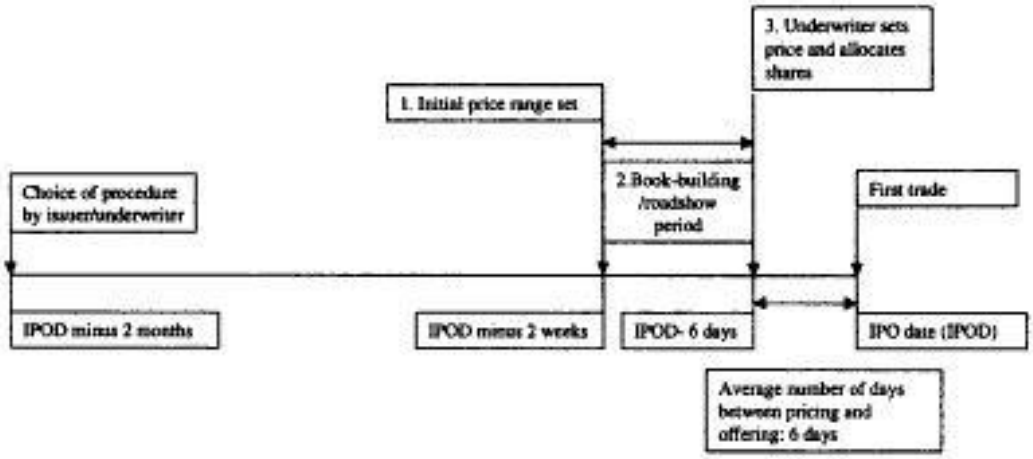
Before comparing the quality of the mechanisms, it is important to discuss the differences in how the two procedures function. The descriptions of these two methods used in France draw extensively from Derrien and Womack (2003).

Book building Procedure (in France, called the *Placement Garanti*):

In the Placement Garanti (PG), the process begins when the underwriter, which is the bank that helps conduct the offering and gets part of the proceeds from the IPO, and the company issuing stock set a price range within which they want to set the IPO price. Then, the underwriter embarks on a "road show," presenting the stock to a number of institutional investors. These institutional investors then place non-binding indications of interest in the stock. That is, they discuss their level of interest in the stock. After completing the road show, the issuing firm and underwriter set a price based on these indications of interest. After choosing the price, the underwriter allocates the shares at its discretion. A timeline of the events leading up to the IPO is pictured below. This picture comes from Derrien and Womack (2003).

[16] Henceforth, characterizing a company as "large" refers to its market capitalization.

Figure 1 – Timeline of events leading up to the IPO for the book building procedure



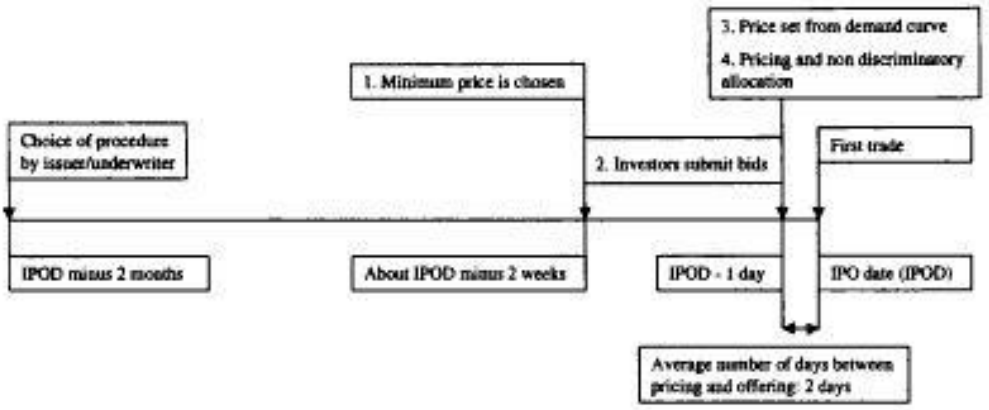
Timing of the bookbuilding procedure (PG)
Step 1: Underwriter sets initial price range, advertises offering through road-show
Step 2: Investors submit price/quantity indications of interest during roadshow
Step 3: Underwriter sets price and allocates with complete discreation.

Auction Procedure (In France, called *Offre à Prix Minimal*, formerly called *Mise en vente*):

In the Offre à Prix Minimal (OPM) mechanism, the underwriter and issuer set a minimum acceptable price, typically about one week before the IPO. One day prior to when the IPO is set to trade, investors make bids on the offering. Any investor can bid on the offering, and this bid includes the price the investor is willing to pay and the desired number of shares. The market authority, the Société des Bourses Françaises (SBF), then computes a cumulative demand curve. The issuer, underwriter, and SBF negotiate the offer price and set a maximum price. The maximum price is the price at which all bids that are above this amount are rejected. The maximum price is implemented to mitigate the "free-rider" problem and encourage investors to provide truthful disclosures of their valuations of the firm. By setting a maximum price, investors cannot give unreasonably high bids that will guarantee them shares and allow them to "free-ride" on the valuations of other investors. Often, the issuer, underwriter, and SBF decide to set the price below the market clearing level in order to achieve a small degree of positive underpricing. If, in fact, the price is set below the market clearing price, shares are allocated on a pro rata basis to all investors who bid at prices at or above the offer price and below the maximum price.[17] Even if investors bid higher for the stock, all investors that bid at a price equal to or greater than the offer price pay the offer price. A timeline of an OPM is pictured below. This picture comes from Derrien and Womack (2003).

[17] For example, suppose the firm is offering 100 shares of stock and the market clearing price is $50. If the price is set at $40, chances are more investors bid at a level between $40 and $50. That is, there might be bids that total 150 shares above $40 and yet still below the maximum price. In this case, each investor would get 2/3 of their requested allocation of shares so that only 100 shares are sold.

Figure 2 – Timeline of events leading up to the IPO for the auction procedure



Timing of the auction procedure (OPM)
Step 1: The minimum price is chosen
Step 2: Investors submit price / quantity bids
Step 3: IPO price and upper limit are chosen
Step 4: Non-discriminatory pro rata allocation to investors with bids between IPO price and upper limit

Differences:

The key differences between the two mechanisms are that, in the auction method, any investor is able to participate and each investor has the opportunity to receive shares because shares are allocated in a non-discretionary matter. With the book building method, the underwriter goes on a road show to target certain investors and then proceeds to allocate shares to investors in a discretionary manner. These two differences have major implications for how the two methods function.

It is important to clarify that both the auction and book building mechanism have discretion over the price of the IPO. In the auction method, the underwriter, issuing firm, and SBF negotiate a price, and this price is typically set below the market clearing price. In the book building mechanism, the underwriter and issuing firm decide on a price, and they typically try to set the offer price slightly below the price that they expect the market to value the stock at.

III. Comparison of Auction and Book Built IPOs

Potential Advantages of Auctions as Compared to Book Building:

Scholars advocating for the viability of the auction mechanism as an alternative to the book building method have advocated the superiority of the auction procedure across a number of dimensions. Some of the ways in which the auction mechanism is allegedly better are listed below.

Control of Underpricing:

Scholars have theoretically and empirically argued that auctions control underpricing better than the book building mechanism.[18] As has been discussed previously, underpricing is one of the most important factors in determining the quality of an IPO mechanism. The ability of each mechanism to control underpricing will be tested later in this paper.

Greater Secondary Market Liquidity:

Pham, Kalev, and Steen (2003) stated that higher trading liquidity is "a factor often considered to be one of the important objectives of any IPO. In particular, a higher level of liquidity reduces transaction costs in future equity raisings (Ibbotson and Ritter, 1995), increases firm value (Amihud and Mendelson, 1986), provides a better environment for managerial incentive schemes and improves market monitoring by encouraging information dissemination by speculators (Holmström and Tirole, 1993). In addition, promoting trading liquidity through ownership dispersion may engender an effective mechanism to impede future hostile takeovers (Shleifer and Vishny, 1986)."

Postlisting trading volume is a widely accepted proxy for liquidity.[19] Lowry, Officer, and Schwert (2010) found that auctions in the United States had higher postlisting trading volume than comparable book built firms. I hypothesize that auctions have higher postlisting trading volume because, due to the nature of the mechanism, a broader shareholder base is recruited. This is because any investor has the opportunity to participate in the auction, whereas the underwriter decides the allocation in the book building mechanism. This leads me to believe that auctions are likely to have more shareholders, which is equivalent to saying that auctions develop broader shareholder bases. Pham, Kalev, and Steen (2003) stated that "a broader shareholder base is often thought to provide higher trading liquidity." Therefore, I believe it is because of differences in the allocation method of the two mechanisms that result in auctions having greater secondary market liquidity and reaping the benefits associated with greater liquidity.

Lower Underwriter Spreads:

Chen and Ritter (2000) found that, from 1995 to 1998 in the United States, more than 90 percent of issuers paid gross spreads of exactly seven percent.[20] Pukthuanthong, Varaiya, and Walker (2007) found similar results in their analysis of US auctions from 1999-2004 and comparable book built IPOs. Like Chen and Ritter (2000), they found that book built IPO spreads were clustered around seven percent while the mean auction spread was significantly lower.

Google completed its IPO with the auction mechanism and had an underwriter spread of 2.8%.[21] Given that the gross proceeds equaled $1.67 billion, had the underwriter spread been

[18] Papers arguing that auctions control underpricing better include Derrien and Womack (2003); Lowry, Officer, and Schwert (2010); Kaneko and Pettway (2003); Pettway, Thosar, and Walker (2008); and Pukthuanthong, Varaiya, and Walker (2007).
[19] Pham, Kalev, and Steen (2003) and Degeorge, Derrien, and Womack (2007) used trading volume as a proxy for liquidity.
[20] The "spread" is the percent of the gross proceeds that is paid to the underwriters for their work in the IPO.
[21] Information from SEC EDGAR database.

7%, the underwriters would have received an *additional* $70 million. Instead, Google was able to receive that $70 million in additional equity. While Google conducted a very large IPO, the point remains that slight differences in underwriter spread can significantly affect the net proceeds to the issuing firm.

The explanation for lower underwriter spreads in the auction method is that the underwriter does not have as much work when the auction mechanism is used. In the book building mechanism, the underwriter must actively market the stock and conduct a road show while the underwriter does not have the same responsibilities in the auction mechanism. It is understandable why the underwriter receives a lower fee.

Criticisms of Auctions as Compared to Book Building:

Scholars have criticized the auction method for a number of different reasons. Some of the main criticisms are noted below. In addition, I include why the book building mechanism is not subject to the same criticism.

Undersubscription:

Jagannathan and Sherman (2007) found that a major problem with auctions is the unexpectedly large fluctuations in the number of participants. While having far too many bidders can lead to an inflated price, a much greater problem is having too few bidders to the point where the offering is undersubscribed, defined as when there are more shares being offered than have been requested. Undersubscription is a major problem because, if the firm continues with the IPO, the offer price will be set at a much lower price than expected and proceeds from the IPO will also be much smaller than expected. Undersubscription is a much greater risk under the auction method than the book building mechanism because book built offerings are typically firm-commitment offerings. In this type of offering, the issuing firm sells all of the stock to the underwriter, and then the underwriter is responsible for selling to investors. Therefore, the issuing firm will not be accountable for undersubscription under the book building mechanism. However, auctions are not done as firm-commitment offerings, and thus the issuing firm is responsible for unsold shares.

Price Support:

Lowry, Officer, and Schwert (2010) noted that the underwriter in the book building mechanism often guarantees to buy shares once the stock begins trading if the price begins falling. Essentially, the underwriter commits to propping up demand in the first few days of trading, thus ensuring that the stock price will not plummet following the offering. This type of guarantee is non-existent in the auction mechanism.

Greater and Better Analyst Coverage:

Degeorge Derrien Womack (2007) promoted the "analyst hype" hypothesis as the reason that book built IPOs are chosen over auctions. This hypothesis is that "corporate issuers and investment banks are in a *quid pro quo* relationship that extends beyond the obvious direct costs. That is, issuers are willing to pay the higher direct and indirect costs of bookbuilding in

exchange for increased and more favorable research coverage because analyst coverage is important to them." In this paper, the authors found that book built IPOs do receive greater analyst coverage than auctions and receive more favorable recommendations from analysts of the lead underwriter. Greater and more favorable analyst coverage is obviously valued because these analyst reports influence the market's valuation of the company.

Free-Riding and Overpricing:

Small investors have the incentive to "free-ride" in the auction mechanism. "Free-riders" submit bids far above any reasonable valuation in order to essentially guarantee themselves shares in the offering. In doing so, they assume that the price of the stock will not be significantly affected by their small bid and will instead reflect the valuation of other investors who have invested time and energy in an attempt to correctly value the stock. If too many people free-ride, the market demand curve will suggest a higher value for the stock than the actual market valuation. This will lead to overpricing and a fall in the stock price in the secondary market, which is undesirable because overpricing affects the perception of the firm and angers investors who received shares in the IPO (and therefore lost value on their investment). Free-riding is not really an issue in the book building mechanism because investors do not give commitments to buy the stock before the stock has been priced. The French auction method attempts to combat the problem of free-riding by setting a maximum bid price at which all bids above the maximum price are thrown out.[22]

Lack of Long-Term Relationships:

Sherman (2000) noted that one advantage of book building is that underwriters have relationships with many of the investors that they allocate shares to. Since underwriters underwrite numerous IPOs, there is often an unofficial agreement that investors fortunate enough to receive shares act responsibly with those shares or else they risk losing out on future IPO allocations with that underwriter. When shareholders "act responsibly," it is in the interest of the issuing firm. For example, shareholders are discouraged from "flipping" their shares. "Flipping " is defined as an IPO shareholder selling their allocation in the first day of trading. Typically shareholders will flip in order to capture positive returns or to get out of an IPO that has a falling price. Flipping in a "hot" IPO (one where the price is above the offer price) hurts the issuing firm because the price would go even higher if the shares were not supplied to the market. Flipping in a "cold" IPO (one where the price is below the offer price) hurts the issuing firm because selling stock into a declining market creates a vicious cycle, and the firm's value is depreciated. In the book building mechanism, the underwriter is better able to leverage its relationships with investors in the IPO to protect the issuing firm from having its shares flipped.

[22] The use of a maximum price to combat free-riding is discussed in Derrien and Womack (2003) and Degeorge, Derrien, and Womack (2007).

IV. **Theory**

Why the Auction Mechanism Better Controls Underpricing than the Book Building Mechanism:

Standard Economic Theory:

It is easy to explain why there should be a low variability of underpricing with the auction method if employing standard economic assumptions. Assumptions include: all bidders have access to the stock, have complete information, and submit their true valuation of the stock in the bid. Additionally, there are no conflicts of interest. If these assumptions hold true, the market clearing price in the auction will exactly equal the price that the stock is truly valued at by the market.

Even while keeping these same assumptions, the book building mechanism will not discover the true market value of the stock. This is because the underwriter only gathers demand information from a subset of the market (this subset being the investors that the underwriter talks to during the road show) and then has the discretion to allocate shares preferentially. By not gathering total market demand information, the book building mechanism will not discover the true market valuation of the stock (assuming that the sample does not perfectly reflect the market, which would be a statistical anomaly). As a result, the book building mechanism should exhibit a greater variability of underpricing than the auction mechanism.[23]

Conflict of Interest:

Another major reason that I hypothesize that the auction procedure controls underpricing better than the book building process is due to the potential conflict of interest resulting from the preferential allocation of shares in the book building mechanism. The preferential allocation of shares in the book building mechanism is a great responsibility for the underwriter, and there have been a number of allegations that underwriters have abused this privilege.

After the technology stock bubble of 1999-2000 burst, the process of "spinning" received a substantial amount of regulatory and legal attention in the United States, and there were large settlements and several prosecutions of business executives (Liu and Ritter, 2010). Liu and Ritter (2010) defined spinning as the "allocation by underwriters of the shares of hot initial public offerings (IPOs) to company executives in order to influence their decisions in the hiring of investment bankers and/or the pricing of their own company's IPO. The term 'spinning' refers to the fact that the shares are often immediately sold in the aftermarket, or 'spun,' for a quick profit, and an IPO is termed 'hot' if it is expected to jump in price as soon as it starts trading."

While the preferential allocation does cause the book building mechanism to stray away from discovering market demand, there is also a temptation for the underwriter to excessively underprice the stocks that are spun. The underwriter may lower the price and allocate shares to major company executives in hopes of securing future business with those business executives. This absolutely makes sense from the perspective of the underwriter. The underwriter typically

[23] The theory that the auction mechanism should incorporate the entire market demand while the book building mechanism does not, and, as a result, the auction mechanism should control underpricing better is also supported by Lowry, Officer, and Schwert (2010).

receives seven percent of the gross proceeds as its commission. While lowering the price of one offer will cut into the underwriter's earnings on that deal, being chosen as the underwriter for another deal would be far more lucrative than the slight decrease in proceeds due to the lower stock price.

Spinning is just one example of how the underwriters have used their position as share allocator to engage in implied and explicit quid pro quo arrangements. Another example is called laddering, which is defined by Pukthuanthong Varaiya and Walker (2007) as the agreement that, in exchange for receiving shares in the initial allocation, investors will buy additional stock in the secondary market in order to artificially boost the price of the stock following the offering.

Spinning and laddering are two examples of quid pro quo agreements that have occurred between underwriters and investors, with little concern shown for the issuing firm. Due to the underwriters' ability to preferentially allocate shares, they hold leverage that they can bargain with. Investors desire IPO shares when the offer is underpriced. Therefore, the underwriter has more bargaining power with greater underpricing.

The incentive for underwriters to excessively underprice exists and is a far greater concern in the book building procedure. It is hard to come up with a scenario where there is a conflict of interest in the auction mechanism. After all, the price is chosen *after* the official bids have been submitted. Therefore, unlike in the book building mechanism, the underwriter does not have the opportunity to market the stock after the price is known, and the pricing information is integral to knowing whether the stock is a good buy. In the auction mechanism, the underwriter could guess that the stock should be a good buy. However, the underwriter cannot be sure of the number of shares demanded and the price. With the book building mechanism, the underwriter can market the stock after the price is known and after surveying demand.

In summary, the risk of a conflict of interest that would lead to excessive underpricing is far greater in the book building mechanism. This is because the underwriter can utilize underpricing for personal enrichment due to the freedom it has to preferentially allocate shares under the book building mechanism.

<u>A Comparison of Underpricing Between the Auction and Book Building Methods for Large Firms:</u>

The book building mechanism should definitely improve its control of underpricing when the firm is larger. Lowry, Officer, and Schwert (2010) stated that "the greater amount of information available about more established firms should enable underwriters to more precisely estimate market demand for their shares, and therefore more accurately value these companies, meaning the dispersion of initial returns across these firms will be relatively low." This paper suggests that "a more established firm" means a firm that is older, from a well-known industry, and receives substantial media coverage. I allege that there tends to be more information available about larger firms. In my sample, larger firms tend to be older.[24] I hypothesize that firms that are larger and older tend to receive more media coverage, and, as a result, there is more information available at the time of the offering. This additional information enables the underwriter to more accurately value the company and assess the market demand for the stock. Therefore, the mean and variability of underpricing when only considering large firms using the

[24] Correlation equals .2330

book building mechanism will be lower than the mean and variability of underpricing when considering all firms that use the book building mechanism.

In the auction method, the entire market demand is taken into account both before the IPO and once trading begins (this is in contrast to the book building mechanism, which takes into account a subset of market demand before the offering and is priced at the discretion of the underwriter without a firm idea of the demand of the stock). As a result, it seems that the auction mechanism should not improve its control of underpricing as much as the book building mechanism should improve, since the market demand should theoretically be the same both before the after the offering whether or not the firm is large or small.[25] However, I do think that the auction mechanism will improve by about as much. Sherman, who has written a number of papers detailing the advantages of the book building process over the auction mechanism, admitted in Sherman (2005) the "circumstances under which auctions may have an advantage." She stated:

> "auctions are more likely to be optimal if pre-existing, 'serendipitous' information about the issuer is widely dispersed among investors. Thus, auctions are more likely to be chosen…for companies with a large but scattered customer and/or employee base and, in general, for companies and industries that are well established and well understood. On the other hand, if the auction method is chosen by a small, obscure company in an industry that investors are not familiar with, the choice may signal that the issuer is trying to discourage investors from closely scrutinizing the offering."

Sherman suggests that firms with more information available about them will be valued better under the auction mechanism than obscure firms. I have already argued that larger firms tend to have more information available about them, and I extrapolate to argue that the auction mechanism controls underpricing better with large firms because investors are more likely to be familiar with the company and thus more likely to submit well-informed bids with the investors' true valuations.

V. **Data**

The data set consists of 237 companies listed between 1991 and 1998 on either the Second Marchè or Nouveau Marchè. 243 companies in total were listed on these two exchanges, but I eliminated 6 due to missing data. There were a very small number of IPOs that occurred on a different French exchange, but, apart from those IPOs, the 243 companies represent all the IPOs listed in France between 1991 and 1998. 34 of these companies used the fixed-price method, which is the other IPO mechanism. Since I am not interested in testing the fixed-price method, I remove these 34 observations from the data. Therefore, the total number of observations is 203. The list of 243 companies and the type of IPO mechanism used were graciously given to me by Professor Francois Derrien. This data set was collected for use in Degeorge and Derrien (2001).

[25] The necessary assumptions are that all investors have submitted their true valuations of the company and that knowing the aggregate demand information (revealed by the price of the offering) will not change their valuations.

Variables Used in Regression:

- Underpricing (y_1)
- Volatility of Underpricing (y_2)
- Auction Dummy
- Market Capitalization
- Firm Age
- High-tech Dummy
- Market Return
- Market Volatility

Underpricing is calculated by measuring the percentage difference between the offer price (primarily from SDC Platinum with missing data filled by Bloomberg) and the closing price on the 21st day of trading (from Datastream). Typically I would also look at underpricing by calculating the difference between the offer price and the closing price on the first day of trading. However, there is potentially a problem in the data that would come into play by calculating underpricing using the first-day closing price. I do not question the accuracy of the data, but it seems that there are an abnormally high number of occurrences where the first day of Datastream matches the offer price. Although Lowry, Officer, and Schwert (2010) found that 12% of all IPOs from 1965-2005 have zero percent first-day underpricing, my data shows above 50% of offerings exhibit zero percent first-day underpricing.[26] This leads me to believe that Datastream often picks up the offer price in its data rather than the first trading day closing price. In order to mitigate this problem, I use 21-day underpricing so that all the stocks have begun moving. While this may lead to bias in the data because sometimes "21-day" actually means "some number between 1 and 21," it is the best data that I am capable of gathering. In addition, I see no reason that firms using one of the mechanisms would be more likely to suffer from this data problem than the other mechanism. Therefore, I expect this data issue to not bias the results, since the problem should be randomly distributed between the two mechanisms.

The volatility of underpricing is defined as the square of unexpected underpricing. It is measured by taking the error term in the underpricing regression (defined as the difference between the expected amount of underpricing and the actual amount of underpricing) and squaring it. The regression that is used to find the expected value of underpricing will be explained later.

One independent variable is an auction dummy. I expect the coefficient on this to be negative, indicating that there is less underpricing, all other things equal, for a firm using the auction mechanism.

Market capitalization is calculated by multiplying the number of shares outstanding directly following the offer (from Datastream) by the offer price (primarily from SDC Platinum with missing data filled by Bloomberg).[27] Market capitalization is a common way to measure the size of the firm. This is the key independent variable that I will be testing. If my hypothesis

[26] Zero percent first-day underpricing likely occurs in 12% of offerings because many underwriters commit to buying up shares so that the stock price does not fall in the first day. Therefore, the underwriter will meet the supply of stock so that the stock makes a zero, rather than a negative, first day return.

[27] "Number of shares sold in the offering" is defined as the shares offered in the offering. "Number of shares outstanding directly following the offering" is defined as the sum of the "number of shares sold in the offering" and the shares held by insiders.

is correct, the coefficient will be negative. As the company gets larger, its underpricing should decrease because larger companies are easier to value.

Other independent variables are the firm age and a dummy variable indicating that the firm is a high-tech company. Typically, older firms are easier to value, and thus I expect a negative coefficient on the age variable. The age of the firm was collected from primarily SDC Platinum, but, when data was missing in SDC Platinum, I gathered data from Zephyr database, a product offered by Bureau van Dijk. I was unable to collect the age for 19 firms, and, to account for this, I use the average age of the other 184 observations. High-tech firms are more difficult to value because they are typically fast-growing companies whose success is contingent upon how well they grow, and therefore I expect a positive coefficient on the high-tech dummy. The high-tech data was collected primarily from SDC Platinum with missing data filled by Bloomberg.[28]

Finally, I add a market return variable and a market volatility variable.[29] Market return is calculated as a weighted average of the CAC40 index. This is the main market index in France, comparable to the S&P 500 in the United States. This market return average is calculated by multiplying the average daily return of trading days 1-21 prior to the offering (about 1 calendar month) by 3, multiplying the average daily return of trading days 22-42 prior to the offering by 2, and finding the average daily return of trading days 43-63 prior to the offering. Then I add all of these numbers and divide by 6 to come up with the market return variable. By doing this, I calculate the market return by taking a weighted average of the market return values over a period of about 3 months before the offering with greater weight assigned to the months closer to the offering.[30] Market volatility is found by calculating the standard deviation of the CAC40 index values in the trading days 1-21 prior to the IPO.[31] I expect the market return variable to have a positive coefficient. There have been a number of studies documenting a significant positive relationship between the "hotness" of the market (the return of the market) and the degree of underpricing.[32] I also expect the coefficient on the market volatility variable to have a positive coefficient. Derrien and Womack (2003) found that the market volatility leading up to the IPO has a significantly positive relationship with the level and variance of underpricing.

VI. **Analysis**

The data did not return the results that I expected. First, I present the overall summary statistics, then the summary statistics for strictly the auctions, and finally the summary statistics for strictly the book built IPOs.

[28] Derrien Womack (2003) and Lowry Officer Schwert (2010) used these two variables as firm-specific proxies in their analysis.
[29] Derrien and Womack (2003) included these as regressors and found that they are highly explanatory of underpricing.
[30] Derrien and Womack (2003) calculated market return in a similar way to the way I have described.
[31] The calculation for market volatility is also motivated by a similar calculation in Derrien and Womack (2003).
[32] Derrien and Womack (2003); Degeorge, Derrien, and Womack (2007); and Lowry, Officer, and Schwert (2010) empirically documented this relationship.

Description of Variables:

- *firm_age* is the age of the firm at the time of the IPO.
- *shares_out* is the total number of shares outstanding after the IPO in thousands.
- *shares_off* is the total number of shares offered in the IPO in thousands.
- *high_tech* is a dummy variable equal to "1" if the company operates in a high-tech industry.
- *market_ret* is the return of the market at the time of the IPO. It is calculated as a weighted average of the daily return of the CAC40 index, an index of the 40 largest companies listed on the French Stock Exchange. Daily return is calculated as the percentage difference between that day of trading and the previous day of trading. These results are then averaged over the 63 days of trading prior to the IPO (about 3 calendar months). The average of daily returns for trading days 43-63 prior to the IPO is computed. The average of daily returns for trading days 22-42 prior to the IPO is multiplied by 2. The average of daily returns for trading days 1-21 prior to the IPO is multiplied by 3. These three numbers are then added together and divided by 6.[33]
- *market_vol* is the market volatility at the time of the offering. It is calculated by taking the standard deviation of daily returns (expressed as a percentage) of the CAC40 index, an index of the 40 largest companies listed on the French Stock Exchange for trading days 1-21 prior to the IPO (about 1 calendar month).[34]
- *proceeds* is the total amount of money raised in the IPO in thousands of Euros. It is calculated by multiplying the number of shares offered in the IPO, *shares_off*, by the offer price of the IPO.
- *uprice1* is the 1-day underpricing of the IPO. It is calculated by taking the percentage difference between the closing price on the 1st day of trading and the offer price of the IPO.
- *uprice10* is the 10-day underpricing of the IPO. It is calculated by taking the percentage difference between the closing price on the 10^{th} day of trading and the offer price of the IPO.
- *uprice21* is the 21-day underpricing of the IPO. It is calculated by taking the percentage difference between the closing price on the 21^{st} day of trading and the offer price of the IPO.
- *market_cap* is the market capitalization of the firm following the offering in thousands of Euros. It is calculated by multiplying the number of shares outstanding following the offering, *shares_out*, by the offer price of the IPO.
- *ln_mark_cap* is the natural logarithm of *market_cap*.
- *vol_uprice* is the volatility of underpricing using *uprice21*. It is calculated by running the basic regression in Table 4 (pictured below). This regression considers all firm and market specific factors that I have identified to potentially influence the underpricing of the IPO without including the auction dummy. The difference between this predicted value of underpricing for each firm and the observed value of underpricing is then squared to come up with the deviation from the predicted value of underpricing for each firm. [35]

[33] Calculation for *market_ret* is comparable to the method used in Derrien and Womack (2003).
[34] Calculation for *market_vol* is comparable to the method used in Derrien and Womack (2003).
[35] Calculation for *vol_uprice* is comparable to the method used in Derrien and Womack (2003).

Tables:

Table Specifications:

- *mean* is the mean value
- *p50* is the observation at the 50th percentile, which is also known as the median.
- *sd* is the standard deviation.
- *min* is the minimum value of the observations.
- *max* is the maximum value of the observations.

Table 1 – All observations, descriptive statistics

	mean	p50	sd	min	max
firm_age	18.87	14.00	20.00	0.00	137.00
shares_out	2595.02	1305.00	6030.51	190.00	80000.00
shares_off	685.56	288.00	1697.21	31.50	21000.00
high_tech	0.37	0.00	0.49	0.00	1.00
market_ret	0.13	0.13	0.15	-0.28	0.50
market_vol	1.09	1.11	0.27	0.56	2.00
proceeds	15505.89	6906.14	23814.67	950.05	170635.92
uprice1	8.63	0.01	24.87	-27.00	253.15
uprice10	24.25	11.89	39.04	-30.00	259.64
uprice21	24.64	10.51	42.33	-33.59	223.73
market_cap	65633.72	32901.76	108874.90	4576.53	935427.19
ln_mark_cap	10.54	10.40	0.94	8.43	13.75
vol_uprice	1647.65	485.37	4444.64	0.01	40791.73
N	203				

Table 2 – Auction observations, descriptive statistics

	mean	p50	sd	min	max
firm_age	20.96	15.00	21.58	0.00	137.00
shares_out	1478.00	1127.00	997.19	315.00	5488.00
shares_off	229.56	170.00	192.20	31.50	1076.88
high_tech	0.32	0.00	0.47	0.00	1.00
market_ret	0.10	0.12	0.15	-0.24	0.46
market_vol	1.07	1.10	0.28	0.56	1.68
proceeds	6361.40	3811.25	6676.23	950.05	35296.89
uprice1	10.31	0.04	20.40	-16.73	113.64
uprice10	26.14	15.61	37.28	-30.00	195.10
uprice21	28.07	15.57	42.77	-33.59	214.55
market_cap	40114.47	27858.35	35329.19	9488.93	199449.86
ln_mark_cap	10.34	10.23	0.68	9.16	12.20
vol_uprice	1624.05	382.41	4431.92	0.04	33829.60
N	91				

Table 3 – Book built observations, descriptive statistics

	mean	p50	sd	min	max
firm_age	17.18	12.00	18.54	1.00	135.00
shares_out	3502.61	1528.00	7970.01	190.00	80000.00
shares_off	1056.07	489.80	2214.29	66.67	21000.00
high_tech	0.42	0.00	0.50	0.00	1.00
market_ret	0.15	0.16	0.16	-0.28	0.50
market_vol	1.10	1.13	0.25	0.59	2.00
proceeds	22935.78	11122.09	29524.48	2540.81	170635.92
uprice1	7.27	0.00	28.00	-27.00	253.15
uprice10	22.71	8.39	40.51	-25.49	259.64
uprice21	21.86	8.38	41.96	-28.10	223.73
market_cap	86368.11	38407.62	139971.36	4576.53	935427.19
ln_mark_cap	10.71	10.56	1.08	8.43	13.75
vol_uprice	1666.83	543.73	4474.76	0.01	40791.73
N	112				

Table 4 - Basic regression used to calculate *vol_uprice*

	(1) uprice21
ln_mark_cap	0.193 (2.930)
firm_age	-0.259*** (0.0935)
high_tech	6.179 (6.770)
market_ret	59.10*** (15.24)
market_vol	17.75* (10.11)
_cons	-1.769 (33.85)
N	203
R-sq	0.083
adj. R-sq	0.060
F	4.991
df_m	5
df_r	197

Standard errors in parentheses
* p<.1, ** p<.05, *** p<.01

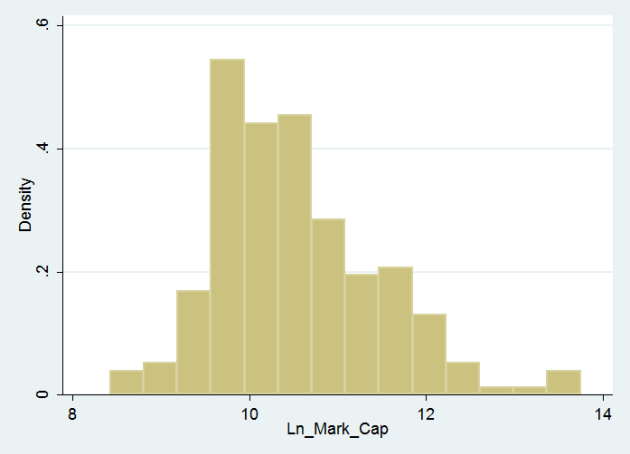
Discussion:

The data shows that auctions, on the whole, have a higher mean level of underpricing. *uprice10 and uprice21* yield a mean value of 26.14 (*sd*=37.28) and 28.07 (*sd*=42.77), respectively, for the auction observations. This is in comparison to a mean value of 22.71 (*sd*=40.51) and 21.86 (*sd*=41.96) for the same variables using the book building observations. The median is also substantially lower for the book building mechanism. The auction mechanism does fare better when looking at *vol_uprice*. The auction mechanism has a mean of 1624.05(*sd*=4431.92) with a median value of 382.41. The book building mechanism, on the other hand, has a mean of 1666.83(*sd*=4474.76) with a median value of 543.73.

While these results are not what I was expecting, I will run regressions to see if the differences in underpricing between the two mechanisms can be explained by firm-specific factors such as age of the firm, size of the firm, or whether it is high-tech. In addition, I will check to see if differences in underpricing can be explained by market-specific factors such as the return of the market and the volatility of the market. For example, the difference in underpricing may be explained by the fact that larger companies (and thus those who tend to have more information available about them and are therefore easier to price) typically use the book building mechanism. Table 2 shows that the mean and median market capitalization for firms that use the auction mechanism are 40114 and 27858, respectively. Table 3 shows that the mean and median market capitalization for firms that use the book building mechanism are 86368 and 38408, respectively. This differentiation may explain the difference in underpricing. The regressions should account for factors such as market capitalization that may explain any difference in underpricing that is not a function of the type of mechanism being used.

Before running the regressions, I will examine only the observations that have market capitalizations greater than the median market capitalization of all the observations. These data are described in Table 5 and Table 6 (pictured below). This is a fair way to stratify the data because, as seen in Figure 3 below, the natural logarithm of market capitalization (which is the variable that I will be using in my regressions) is approximately normally distributed (although there is a slight skew right). Table 5 and Table 6 are relevant because I am testing not only whether auctions on the whole demonstrate lower mean and variability of underpricing but also whether auctions perform better for large companies. Therefore, these tables will allow me to compare the two mechanisms for only the firms with a greater than average market capitalization.

Figure 3- Distribution of values for *ln_mark_cap*



Tables:

Table 5 – Auction observations if the market capitalization is greater than the median market capitalization for all the observations (As seen in Table 1, this number equals 32901.76)

	mean	p50	sd	min	max
firm_age	21.97	15.00	24.95	0.00	137.00
shares_out	2142.97	1983.50	1242.48	1000.00	5488.00
shares_off	304.10	229.19	215.93	100.00	1076.88
high_tech	0.31	0.00	0.47	0.00	1.00
market_ret	0.10	0.12	0.11	-0.19	0.26
market_vol	1.07	1.13	0.32	0.56	1.68
proceeds	10054.46	7472.70	7468.88	3353.90	35296.89
uprice1	5.91	0.00	13.07	-16.73	48.21
uprice10	18.89	9.96	25.98	-30.00	84.01
uprice21	18.13	10.02	29.09	-33.59	105.60
market_cap	69595.47	55111.78	40904.50	33539.00	199449.86
ln_mark_cap	11.01	10.92	0.52	10.42	12.20
vol_uprice	759.43	278.39	1082.12	3.13	4498.26
N	36				

Table 6- Book built observations if the market capitalization is greater than the median market capitalization for all the observations (As seen in Table 1, this number equals 32901.76)

	mean	p50	sd	min	max
firm_age	22.22	19.00	22.19	1.00	135.00
shares_out	5066.63	2618.00	10143.72	1016.00	80000.00
shares_off	1397.32	682.21	2717.27	200.00	21000.00
high_tech	0.34	0.00	0.48	0.00	1.00
market_ret	0.14	0.14	0.17	-0.28	0.50
market_vol	1.09	1.14	0.25	0.59	2.00
proceeds	34652.90	20562.98	34241.12	6098.00	170635.92
uprice1	7.72	0.00	33.03	-27.00	253.15
uprice10	20.18	6.74	42.24	-25.49	259.64
uprice21	19.37	8.00	42.25	-28.10	223.73
market_cap	135869.88	79235.02	167388.70	33752.43	935427.19
ln_mark_cap	11.43	11.28	0.80	10.43	13.75
vol_uprice	1654.61	472.39	5543.39	0.01	40791.73
N	65				

Discussion of Results:

Tables 5 and 6 are supportive of my second hypothesis, which is that auctions are not disadvantaged when used by large companies. In fact, auctions with this subset of the data improve underpricing more than the book built IPOs. *uprice10* has a mean value of 18.89 (*sd*=25.98) for auctions and 20.18 (*sd*=42.24) for book building. *uprice21* has a mean value of 18.13 (*sd*=29.09) for auctions and 19.37 (*sd*=42.25) for book building. Under the auction mechanism, the mean of *vol_uprice* equals 759 (*sd*=1082) while the mean of *vol_uprice* equals 1655 (*sd* = 5543) under the book building mechanism. While these statistics are relevant, the regressions should show whether these differences are a function of the mechanism used or other factors such as the age of the firm.

Regression 1:

This regression includes all observations and has *uprice21* as the dependent variable.

	(1) uprice21	(2) uprice21	(3) uprice21	(4) uprice21	(5) uprice21
auction	6.212	224.9	165.8**	240.2*	12.49**
	(5.984)	(137.5)	(80.35)	(133.3)	(5.871)
ln_mark_cap		-5.297	5.794*	-4.471	1.918
		(6.892)	(3.489)	(6.637)	(2.890)
large		-36.30		-32.68	
		(141.4)		(143.1)	
firm_age		-0.328**	-0.344***	-0.357***	-0.298***
		(0.159)	(0.107)	(0.106)	(0.0995)
high_tech		7.595	8.948	9.414	7.814
		(9.139)	(6.966)	(6.865)	(6.818)
market_ret		69.48***	66.93***	70.50***	65.68***
		(22.27)	(14.98)	(15.42)	(14.88)
market_vol		15.78	18.64*	21.11**	19.83**
		(14.93)	(10.13)	(9.773)	(9.979)
large_auc		-380.6		-366.9	
		(405.5)		(384.8)	
large_marcap		5.440		5.084	
		(11.87)		(11.96)	
auc_marcap		-21.73*	-14.66*	-21.87*	
		(13.04)	(7.499)	(12.82)	
lar_mc_auc		34.28		32.94	
		(35.50)		(33.67)	
auc_age		-0.0418			
		(0.214)			
auc_tech		4.723			
		(14.56)			
auc_markr		4.536			
		(32.43)			
auc_markv		10.99			
		(19.64)			
_cons	21.86***	43.73	-68.61*	28.80	-28.55
	(3.966)	(74.56)	(39.16)	(70.67)	(34.19)
N	203	203	203	203	203
R-sq	0.005	0.159	0.120	0.157	0.102
adj. R-sq	0.000	0.091	0.088	0.109	0.075
F	1.077	2.574	4.495	3.530	5.106
df_m	1	15	7	11	6
df_r	201	187	195	191	196

Standard errors in parentheses
* p<.1, ** p<.05, *** p<.01

uprice21 is the 21-day underpricing. The observed values are calculated by finding the the percentage difference between the closing price on the 21st day of trading and the offer price of the IPO. *auction* is a dummy variable equal to "1" if the mechanism used was an auction. *ln_mark_cap* is the natural logarithm of the market capitalization (calculated by multiplying the number of shares outstanding following the offering by the offer price of the IPO, measured in thousands of Euros) of the firm following the offering. *large* is a dummy variable equal to "1" if the firm is greater than the 75th percentile of the market capitalization of all the observations (as seen in Table 1, this number is equal to 64028). *firm_age* is the age of the firm at the time of the offering. *high_tech* is a dummy variable equal to "1" if the firm operates in a high-tech industry. *market_ret* is a weighted average of the daily returns of the CAC40 index over approximately 3 calendar months prior to the IPO. *market_vol* is the standard deviation of daily returns of the CAC40 index over approximately 1 calendar month prior to the IPO. *large_*auc is an interaction of *large* and *auction*. *large_marcap* is an interaction of *large* and *ln_mark_cap*. *auc_marcap* is an interaction of *auction* and *ln_mark_cap*. *lar_mc_auc* is an interaction of *large*, *ln_mark_cap*, and *auction*. *auc_age* is an interaction of *auction* and *firm_age*. *auc_tech* is an interaction of *auction* and -*high_tech*. *auc_markr* is an interaction of *auction* and *market_ret*. *auc_markv* is an interaction of *auction* and *market_vol*.

Column (1) of Regression 1 includes a regression with only *auction* as an explanatory variable. This regression shows that the degree of underpricing is not statistically different between auctions and book built IPOs at any standard significance level.

Column (2) of Regression 1 has the most explanatory variables and, except for the interaction of *auction* and *ln_mark_cap*, interaction variables of firm and market specific factors with *auction* (*auc_marcap*, *auc_age*, *auc_tech*, *auc_markr*, and *auc_markv*) are not close to being individually or jointly significant.[36] None of the interaction variables have t-statistics with absolute values greater than 1. This regression shows that the firm and market factors do not affect the auction or book building method differently.

Column (3) of Regression 1 includes only the firm and market specific factors as well as one interaction variable, *auc_marcap*. This regression allows me to calculate the value of *ln_mark_cap* at which the predicted value for *uprice21* is equal for auctions and book built IPOs. Since only the variables *auction* and *auc_marcap* are affected by which mechanism is used, the value of market capitalization at which the regression estimates equal underpricing for the two methods can be calculated by solving the following equation when conditioning that *auction* = 1.

$$B_1\ auction + B_2\ auc\_marcap = 0$$

When conditioned that *auction* = 1, the equation becomes :

$$B_1 + B_2\ ln\_mark\_cap = 0$$

Plugging in values using Column (3) of Regression 1, the equation takes the form below:

$$165.8 - 14.66 * ln\_mark\_cap = 0$$

$$ln\_mark\_cap = 11.31$$

Given that $B_1 > 0$ and $B_2 < 0$, the above value of *ln_mark_cap* represents the minimum value at which the auction mechanism is predicted to have a *lower* mean value of underpricing. The question then becomes: how frequently is *ln_mark_cap* > 11.31? 42 of the 203 observations have values of *ln_mark_cap* > 11.31, or slightly greater than 20% of the observations. 11 of these observations use the auction mechanism. Since there are 91 observations that use the auction mechanism, 12% of auctions have values of *ln_mark_cap* > 11.31. Column (3) of Regression 1 suggests that the auction mechanism improves its ability to control underpricing when the firms get larger moreso than the book building mechanism. In fact, when *ln_mark_cap* > 11.31, the auction mechanism is predicted to yield a lower level of underpricing than the book building mechanism.

Column (4) of Regression 1 uses the dummy variable, *large*, to compare the degree of underpricing between large auctions and large book built IPOs. *Large* is equal to "1" if the firm has a market capitalization greater than the 75th percentile for all observations. Similar to the calculation above, I will look at the value of *ln_mark_cap* at which the regression predicts an equal level of underpricing for the two mechanisms. The equation is listed below:

$$B_1\ auction + B_2\ large\_auc + B_3\ auc\_marcap + B_4\ lar\_mc\_auc = 0$$

[36] F-statistic = .75, which yields a p-value of .5882

When conditioned that *auction* = 1 and *large* = 1, the equation becomes:

$$B_1 + B_2 + B_3\ ln\_mark\_cap + B_4\ ln\_mark\_cap = 0$$

$$B_1 + B_2 + (B_3 + B_4)\ ln\_mark\_cap = 0$$

Plugging in numbers from Column (4) of Regression 1, the equation becomes:

$$240.2 - 366.9 + (-21.87 + 32.94)*ln\_mark\_cap = 0$$

$$-126.7 + 11.07*ln\_mark\_cap = 0$$

$$ln\_mark\_cap = 11.45$$

Since $(B_1 + B_2) < 0$ and $(B_3 + B_4) > 0$, the above value of *ln_mark_cap* represents the minimum value at which the regression predicts *greater* underpricing for the auction mechanism. For reference, 36 of 203, or about 18%, of observations have values of *ln_mark_cap* > 11.45. This result suggests that large firms using the auction mechanism are expected to have a *greater* level of underpricing than large firms using the book building method, which is contrary to results from Column (3) of Regression 1.

Column (5) of Regression 1 does not support my hypothesis. Using only firm and market specific explanatory variables, the coefficient on *auction* becomes statistically significant at a 5% level. This suggests that the auction mechanism, when accounting for differences in firms and the market climate, results in a higher level of underpricing.

Regression 2:

This regression uses the same variables. However, only firms with market capitalizations greater than the median overall market capitalization are used (as seen in Table 1, this median market capitalization equals 32901.76).

	(1) uprice21	(2) uprice21	(3) uprice21	(4) uprice21	(5) uprice21
auction	-1.234	-29.34	-36.72	20.11	7.627
	(7.134)	(408.0)	(123.8)	(387.3)	(6.963)
ln_mark_cap		1.174	12.40***	1.250	13.17***
		(19.55)	(3.252)	(18.59)	(3.282)
large		42.39		52.80	
		(245.8)		(238.6)	
firm_age		-0.217	-0.265**	-0.251**	-0.275***
		(0.141)	(0.109)	(0.0975)	(0.104)
high_tech		18.64	9.885	9.571	9.707
		(12.61)	(9.294)	(8.869)	(9.300)
market_ret		57.64**	63.37***	67.08***	63.59***
		(23.63)	(19.15)	(19.74)	(19.17)
market_vol		23.42	23.07	25.54*	22.07
		(23.06)	(15.12)	(14.88)	(14.72)
large_auc		-139.1		-164.4	
		(542.5)		(557.9)	
large_marcap		-1.448		-2.284	
		(22.22)		(21.41)	
auc_marcap		4.343	4.001	-0.851	
		(37.84)	(11.27)	(36.20)	
lar_mc_auc		10.80		13.49	
		(49.03)		(50.14)	
auc_age		-0.0679			
		(0.195)			
auc_tech		-25.16			
		(16.15)			
auc_markr		13.60			
		(44.83)			
auc_markv		2.010			
		(28.81)			
_cons	19.37***	-43.36	-153.7***	-44.24	-161.2***
	(5.252)	(206.8)	(41.47)	(197.2)	(42.94)
N	101	101	101	101	101
R-sq	0.000	0.205	0.144	0.184	0.143
adj. R-sq	-0.010	0.065	0.080	0.084	0.089
F	0.0299	2.111	3.725	2.834	4.195
df_m	1	15	7	11	6
df_r	99	85	93	89	94

Standard errors in parentheses
* p<.1, ** p<.05, *** p<.01

uprice21 is the 21-day underpricing. The observed values are calculated by finding the the percentage difference between the closing price on the 21st day of trading and the offer price of the IPO. *auction* is a dummy variable equal to "1" if the mechanism used was an auction. *ln_mark_cap* is the natural logarithm of the market capitalization (calculated by multiplying the number of shares outstanding following the offering by the offer price of the IPO, measured in thousands of Euros) of the firm following the offering. *large* is a dummy variable equal to "1" if the firm is greater than the 75th percentile of the market capitalization of all the observations (as seen in Table 1, this number is equal to 64028). *firm_age* is the age of the firm at the time of the offering. *high_tech* is a dummy variable equal to "1" if the firm operates in a high-tech industry. *market_ret* is a weighted average of the daily returns of the CAC40 index over approximately 3 calendar months prior to the IPO. *market_vol* is the standard deviation of daily returns of the CAC40 index over approximately 1 calendar month prior to the IPO. *large_*auc is an interaction of *large* and *auction*. *large_marcap* is an interaction of *large* and *ln_mark_cap*. *auc_marcap* is an interaction of *auction* and *ln_mark_cap*. *lar_mc_auc* is an interaction of *large*, *ln_mark_cap*, and *auction*. *auc_age* is an interaction of *auction* and *firm_age*. *auc_tech* is an interaction of *auction* and -*high_tech*. *auc_markr* is an interaction of *auction* and *market_ret*. *auc_markv* is an interaction of *auction* and *market_vol*.

Column (1) of Regression 2 runs the regression with only *auction* as an independent variable. The regression shows that auctions have a lower level of underpricing when using only observations greater than the median overall market capitalization, although the difference is not statistically significant.

Column (2) of Regression 2 runs a regression with variables that interact *auction* and all the firm and market specific factors. None of these interaction variables are individually or jointly significant[37], which means that the influence of firm and market factors does not affect the auction or book building mechanism differently.

Column (3) of Regression 2 allows me to calculate the value of *ln_mark_cap* at which the predicted value for *uprice21* is equal for auctions and book built IPOs. Since only the variables *auction* and *auc_marcap* are affected by which mechanism is used, the value of market capitalization at which the regression estimates equal underpricing for the two methods can be calculated by solving the following equation when conditioning that *auction* = 1.

$$B_1\ auction + B_2\ auc\_marcap = 0$$

When conditioned that *auction* = 1, the equation becomes :

$$B_1 + B_2\ ln\_mark\_cap = 0$$

Plugging in numbers from Column (3) of Regression 2, the equation becomes:

$$-36.72 + 4.001 * ln\_mark\_cap = 0$$

$$ln\_mark\_cap = 9.18$$

Since $B_1 < 0$ and $B_2 > 0$, the above value of *ln_mark_cap* represents the minimum point at which the regression predicts a *greater* value of underpricing if the firm is an auction. As seen in Table 1, the median value for *ln_mark_cap* equals 10.4 (which is greater than 9.18). Therefore, Column (3) of Regression 2 predicts a *greater* level of underpricing for all auction IPOs when accounting for firm and market specific factors, and, as the size of the firm grows, the difference in underpricing becomes more substantial.

Column (4) of Regression 2 uses the dummy variable, *large*, to compare the degree of underpricing between large auctions and large book built IPOs. Similar to the calculation above, I will look at the value of *ln_mark_cap* at which the regression predicts an equal level of underpricing for the two mechanisms. The equation is listed below:

$$B_1\ auction + B_2\ large\_auc + B_3\ auc\_marcap + B_4\ lar\_mc\_auc = 0$$

When conditioned that *auction* = 1 and *large* = 1, the equation becomes:

$$B_1 + B_2 + B_3\ ln\_mark\_cap + B_4\ ln\_mark\_cap = 0$$

$$B_1 + B_2 + (B_3 + B_4)\ ln\_mark\_cap = 0$$

[37] F-statistic = .53, which yields a p-value of .7552

Plugging in numbers from Column (4) of Regression 2, the equation becomes:

$$20.11 - 164.4 + (-.851 + 13.49)*ln\_mark\_cap = 0$$

$$-144.29 + 12.64*ln\_mark\_cap = 0$$

$$ln\_mark\_cap = 11.42$$

Since $(B_1 + B_2) < 0$ and $(B_3 + B_{4)} > 0$, the above value of *ln_mark_cap* represents the minimum value at which the regression predicts *greater* underpricing for the auction mechanism. 36 of 203, or about 18% of total observations have values of *ln_mark_cap* > 11.42. Since *large* describes 25% of the observations and 18% of the observations have values of *ln_mark_cap* > 11.42, Column (4) of Regression 2 predicts a *greater* value of underpricing for most of the firms that are *large* if the auction mechanism is used. This regression contradicts my hypothesis that large auctions would have a lower mean value of underpricing than large book built IPOs.

Column (5) of Regression 2 provides additional evidence that auctions using this subset of the data exhibit a greater level of underpricing when accounting for firm and market specific factors, due to the fact that the coefficient on *auction* is positive. However, it should be noted that the coefficient on *auction* in Column (5) of Regression 2 is not statistically significant.

Regression 3:

Regression 3 uses all the observations and all the same explanatory variables as Regression 1. However, the dependent variable is *vol_uprice* instead of *uprice21*.

	(1) vol_uprice	(2) vol_uprice	(3) vol_uprice	(4) vol_uprice	(5) vol_uprice
auction	-42.78	18849.2	15909.2*	20747.4	258.3
	(628.1)	(13982.7)	(9087.3)	(13786.7)	(593.8)
ln_mark_cap		-204.1	320.5	-108.3	-75.23
		(354.2)	(362.9)	(346.1)	(265.3)
large		20802.9		21857.1	
		(17550.7)		(18498.5)	
firm_age		-28.25*	-28.43**	-26.96**	-23.71**
		(15.13)	(11.37)	(10.66)	(9.151)
high_tech		1069.0	1354.9*	1352.7*	1239.1
		(968.1)	(807.9)	(797.9)	(770.0)
market_ret		3120.8*	2840.9**	3007.2**	2714.0***
		(1734.7)	(1092.1)	(1179.8)	(1027.8)
market_vol		-803.1	-422.2	-151.7	-300.9
		(1702.8)	(1019.7)	(928.1)	(986.2)
large_auc		-61859.3**		-61283.5**	
		(31271.3)		(28411.3)	
large_marcap		-1578.3		-1678.2	
		(1395.5)		(1473.2)	
auc_marcap		-1941.1	-1496.7*	-1948.9	
		(1334.4)	(844.9)	(1304.2)	
lar_mc_auc		5316.5*		5249.7**	
		(2698.0)		(2441.2)	
auc_age		3.067			
		(20.66)			
auc_tech		696.3			
		(1823.0)			
auc_markr		170.6			
		(2922.3)			
auc_markv		1349.0			
		(1882.5)			
_cons	1666.8***	3656.9	-1808.2	1835.7	2282.6
	(423.0)	(3864.8)	(3180.4)	(3806.6)	(2462.6)
N	203	203	203	203	203
R-sq	0.000	0.097	0.062	0.094	0.045
adj. R-sq	-0.005	0.024	0.028	0.042	0.016
F	0.00464	1.377	2.256	1.860	2.880
df_m	1	15	7	11	6
df_r	201	187	195	191	196

Standard errors in parentheses
* p<.1, ** p<.05, *** p<.01

vol_uprice is the volatility of underpricing. It is calculated by squaring the difference between the observed value of 21-day underpricing and the predicted value based off the regression in Table 4. *auction* is a dummy variable equal to "1" if the mechanism used was an auction. *ln_mark_cap* is the natural logarithm of the market capitalization (calculated by multiplying the number of shares outstanding following the offering by the offer price of the IPO, measured in thousands of Euros) of the firm following the offering. *large* is a dummy variable equal to "1" if the firm is greater than the 75th percentile of the market capitalization of all the observations (as seen in Table 1, this number is equal to 64028). *firm_age* is the age of the firm at the time of the offering. *high_tech* is a dummy variable equal to "1" if the firm operates in a high-tech industry. *market_ret* is a weighted average of the daily returns of the CAC40 index over approximately 3 calendar months prior to the IPO. *market_vol* is the standard deviation of daily returns of the CAC40 index over approximately 1 calendar month prior to the IPO. *large*_auc is an interaction of *large* and *auction*. *large_marcap* is an interaction of *large* and *ln_mark_cap*. *auc_marcap* is an interaction of *auction* and *ln_mark_cap*. *lar_mc_auc* is an interaction of *large*, *ln_mark_cap*, and *auction*. *auc_age* is an interaction of *auction* and *firm_age*. *auc_tech* is an interaction of *auction* and *high_tech*. *auc_markr* is an interaction of *auction* and *market_ret*. *auc_markv* is an interaction of *auction* and *market_vol*.

Column (1) of Regression 3 shows that the volatility of underpricing is lower for auctions. However, the difference is not statistically significant.

Column (2) of Regression 3 shows that the interaction variables of *auction* with firm and market specific factors are not individually or jointly significant at any significance level,[38] which suggests that market and firm specific factors do not affect the mechanisms differently. It should also be noted that Column (2) of Regression 3 does not explain the data very well. The overall F-statistic is not statistically significant at any standard significance level.

Column (3) of Regression 3 allows me to calculate the value of *ln_mark_cap* at which the predicted value for *vol_uprice* is equal for auctions and book built IPOs. Since only the variables *auction* and *auc_marcap* are affected by which mechanism is used, the value of market capitalization at which the regression estimates equal volatility of underpricing for the two methods can be calculated by solving the following equation when conditioning that *auction* = 1.

$$B_1\ auction + B_2\ auc\_marcap = 0$$

When conditioned that *auction* = 1, the equation becomes :

$$B_1 + B_2\ ln\_mark\_cap = 0$$

Plugging in numbers from Column (3) of Regression 3, the equation becomes:

$$15909.2 - 1496.7 * ln\_mark\_cap = 0$$

$$ln\_mark\_cap = 10.63$$

Since $B_1 > 0$ and $B_2 < 0$, the above value of *ln_mark_cap* represents the minimum value at which the regression predicts *lower* volatility of underpricing for the auction mechanism. 79 out of the 203 observations have values of *ln_mark_cap* > 10.63, or about 39% of the observations. 26 of these observations use the auction method, or about 29% of the auctions have values of *ln_mark_cap* > 10.63. Column (3) of Regression 3 suggests that the auction mechanism improves its control of the variability of underpricing more so than the book building mechanism as market capitalization increases. When *ln_mark_cap* > 10.63, the regression predicts the auction mechanism will demonstrate a lower variability of underpricing when all other variables are held constant.

Column (4) of Regression 3 uses the dummy variable, *large*, to compare the degree of underpricing between large auctions and large book built IPOs. Similar to the calculation above, I will look at the value of *ln_mark_cap* at which the regression predicts an equal level of underpricing for the two mechanisms. The equation is listed below:

$$B_1\ auction + B_2\ large\_auc + B_3\ auc\_marcap + B_4\ lar\_mc\_auc = 0$$

When conditioned that *auction* = 1 and *large* = 1, the equation becomes:

$$B_1 + B_2 + B_3\ ln\_mark\_cap + B_4\ ln\_mark\_cap = 0$$

[38] F-statistic = .78, which yields a p-value of .5673

$$B_1 + B_2 + (B_3 + B_4)\ ln\_mark\_cap = 0$$

Plugging in numbers from Column (4) of Regression 3, the equation becomes:

$$20747.4 – 61283.5 + (-1948.9 + 5249.7)*ln\_mark\_cap = 0$$

$$-40536.1 + 3300.8*ln\_mark\_cap = 0$$

$$ln\_mark\_cap = 12.28$$

Since $(B_1 + B_2) < 0$ and $(B_3 + B_4) > 0$, the above value of *ln_mark_cap* represents the minimum value at which the regression predicts *greater* underpricing for the auction mechanism. Only 8 of 203, or about 4% of total observations have values of *ln_mark_cap* > 12.28. This result suggests that the auction mechanism controls variability of underpricing better than the book building mechanism except at very extreme values of *ln_mark_cap*. Therefore, it is a stretch to say that the results contradict my hypothesis that large firms exhibit a lower variability of underpricing under the auction mechanism, even though the coefficient on *ln_mark_cap* > 0.

Column (5) of Regression 3 suggests that auctions have greater volatility of underpricing than book built IPOs when controlling for firm and market specific factors, although the result is not statistically significant. This contradicts my hypothesis.

Regression 4:

Regression 4 uses the same variables as Regression 3, except that, in Regression 4, only firms with market capitalizations greater than the median overall market capitalization are used. (As seen in Table 1, the median overall market capitalization is equal to 32901.76). Although I include this regression and discuss the implications of the coefficients (as I have with the other regressions), note that none of the columns are jointly significant. The overall F-statistics are not statistically significant at a 5% level. Therefore, the results have very little significance. Nonetheless, I will discuss the results as I have with the previous regressions.

	(1) vol_uprice	(2) vol_uprice	(3) vol_uprice	(4) vol_uprice	(5) vol_uprice
auction	-895.2	1692.3	1713.5	13015.0	-817.5
	(712.1)	(21145.0)	(8183.1)	(19937.7)	(786.8)
ln_mark_cap		-158.2	44.28	-223.2	-0.00453
		(1815.5)	(256.6)	(1254.5)	(227.7)
large		20089.9		21826.7	
		(27123.4)		(23341.6)	
firm_age		-19.66	-18.15*	-16.72*	-17.58*
		(15.49)	(10.45)	(9.037)	(9.576)
high_tech		2754.6	1957.3*	1836.9*	1967.5*
		(1688.3)	(1147.3)	(1065.0)	(1159.6)
market_ret		543.7	837.5	1102.4	825.1
		(2785.2)	(1831.1)	(1978.8)	(1838.7)
market_vol		-1322.1	-586.2	-290.7	-528.9
		(2830.2)	(1710.6)	(1546.5)	(1598.9)
large_auc		-45897.4		-52285.2	
		(34183.8)		(37007.5)	
large_marcap		-1523.2		-1662.2	
		(2363.8)		(1971.5)	
auc_marcap		-269.7	-228.3	-1201.1	
		(2041.8)	(774.1)	(1850.5)	
lar_mc_auc		3769.7		4391.1	
		(3000.0)		(3204.0)	
auc_age		7.813			
		(16.61)			
auc_tech		-2661.9			
		(1733.3)			
auc_markr		-376.5			
		(2987.6)			
auc_markv		1921.7			
		(2920.3)			
_cons	1654.6**	3257.7	1416.5	2994.8	1845.4
	(689.1)	(18528.6)	(3360.0)	(12940.2)	(3678.1)
N	101	101	101	101	101
R-sq	0.009	0.150	0.073	0.126	0.072
adj. R-sq	-0.001	0.000	0.003	0.018	0.013
F	1.580	0.936	1.169	0.851	1.359
df_m	1	15	7	11	6
df_r	99	85	93	89	94

Standard errors in parentheses
* p<.1, ** p<.05, *** p<.01

vol_uprice is the volatility of underpricing. It is calculated by squaring the difference between the observed value of 21-day underpricing and the predicted value based off the regression in Table 4. *auction* is a dummy variable equal to "1" if the mechanism used was an auction. *ln_mark_cap* is the natural logarithm of the market capitalization (calculated by multiplying the number of shares outstanding following the offering by the offer price of the IPO, measured in thousands of Euros) of the firm following the offering. *large* is a dummy variable equal to "1" if the firm is greater than the 75th percentile of the market capitalization of all the observations (as seen in Table 1, this number is equal to 64028). *firm_age* is the age of the firm at the time of the offering. *high_tech* is a dummy variable equal to "1" if the firm operates in a high-tech industry. *market_ret* is a weighted average of the daily returns of the CAC40 index over approximately 3 calendar months prior to the IPO. *market_vol* is the standard deviation of daily returns of the CAC40 index over approximately 1 calendar month prior to the IPO. *large*_auc is an interaction of *large* and *auction*. *large_marcap* is an interaction of *large* and *ln_mark_cap*. *auc_marcap* is an interaction of *auction* and *ln_mark_cap*. *lar_mc_auc* is an interaction of *large*, *ln_mark_cap*, and *auction*. *auc_age* is an interaction of *auction* and *firm_age*. *auc_tech* is an interaction of *auction* and *high_tech*. *auc_markr* is an interaction of *auction* and *market_ret*. *auc_markv* is an interaction of *auction* and *market_vol*.

Column (1) of Regression 4 shows that firms that use the auction mechanism tend to have lower volatility of underpricing, although this difference is not statistically significant.

Column (2) of Regression 4 shows that the interaction variables between *auction* and firm and market specific factors are not individually or jointly significant,[39] which suggests that market and firm specific factors do not affect the mechanisms differently.

Column (3) of Regression 4 allows me to calculate the value of *ln_mark_cap* at which the predicted value for *vol_uprice* is equal for auctions and book built IPOs. Since only the variables *auction* and *auc_marcap* are affected by which mechanism is used, the value of market capitalization at which the regression estimates equal volatility of underpricing for the two methods can be calculated by solving the following equation when conditioning that *auction* = 1.

$$B_1\ auction + B_2\ auc\_marcap = 0$$

When conditioned that *auction* = 1, the equation becomes :

$$B_1 + B_2\ ln\_mark\_cap = 0$$

Plugging in numbers from Column (3) of Regression 4, the equation becomes:

$$1713.5 - 228.3 * ln\_mark\_cap = 0$$

$$ln\_mark\_cap = 7.505$$

Since $(B_1 + B_2) > 0$ and $(B_3 + B_4) < 0$, the above value of *ln_mark_cap* represents the minimum value at which the regression predicts *lower* underpricing for the auction mechanism. Since the median value of *ln_mark_cap* is found in Table 1 to equal 10.4 (which is greater than 7.505), Column (3) of Regression 4 suggests that the volatility of underpricing is predicted to be lower at all values of market capitalization for auctions, and the difference in volatility of underpricing is more pronounced as the size of the firm increases. This result supports my hypothesis that the auction mechanism leads to a lower variability of underpricing.

Column (4) of Regression 4 uses the dummy variable, *large*, to compare the degree of underpricing between large auctions and large book built IPOs. Similar to the calculation above, I will look at the value of *ln_mark_cap* at which the regression predicts an equal level of underpricing for the two mechanisms. The equation is listed below:

$$B_1\ auction + B_2\ large\_auc + B_3\ auc\_marcap + B_4\ lar\_mc\_auc = 0$$

When conditioned that *auction* = 1 and *large* = 1, the equation becomes:

$$B_1 + B_2 + B_3\ ln\_mark\_cap + B_4\ ln\_mark\_cap = 0$$

$$B_1 + B_2 + (B_3 + B_4)\ ln\_mark\_cap = 0$$

[39] F-statistic = .78, which yields a p-value of .5640

Plugging in numbers from Column (4) of Regression 4, the equation becomes:

$$13015 - 52285.2 + (-1201.1 + 4391.1)*ln\_mark\_cap = 0$$

$$-39270.2 + 3190*ln\_mark\_cap = 0$$

$$ln\_mark\_cap = 12.31$$

Since $(B_1 + B_2) < 0$ and $(B_3 + B_4) > 0$, the above value of *ln_mark_cap* represents the minimum value at which the regression predicts *greater* underpricing for the auction mechanism. Only 7 of 203, or about 3% of total observations have values of *ln_mark_cap* > 12.31. This result suggests that the auction mechanism controls variability of underpricing better than the book building mechanism except at very extreme values of *ln_mark_cap*. Therefore, it is a stretch to say that the results contradict my hypothesis that large firms exhibit a lower variability of underpricing under the auction mechanism, even though the coefficient on *ln_mark_cap* > 0.

Column (5) of Regression 4, which has a negative value for *auction* when accounting for firm and market specific factors, supports my hypothesis that the auction mechanism results in a lower volatility of underpricing.

Fit of the Data:

Overall, the explanatory variables do a poor job of predicting the mean and variability of underpricing, demonstrated by low values of R^2 in all Columns of Regression 1-4. The low values of R^2 are certainly a shortcoming of this paper. The R^2 values are especially low for Regressions 3 and 4, which estimate the variability of underpricing. Given that my regression specifications generally follow the specifications used by scholars when testing underpricing and that *all* the different columns return low values for R^2, I hypothesize that the low R^2 values are because I use 21-day underpricing. There are a number of factors and events that can happen between trading days 1 and 21 that would introduce a substantial amount of chaos in the data. One example would be a macroeconomic shock. With first-day underpricing, the window for factors not related to the IPO to affect the price of the stock is much smaller, and thus the relationship between the IPO factors (the mechanism used, market factors, and firm factors) and the underpricing should be much stronger with first-day underpricing. However, due to the limitations in my data, I am unable to test this hypothesis that the correlation between my independent variables and first-day underpricing would be much higher than the correlation between my independent variables and 21-day underpricing.

While the independent variables do not explain the underpricing very well, I still think that using 21-day underpricing is a valid analysis, as it arguably can be a better indicator of underpricing than first-day underpricing. Underwriters often have agreements to support the price of the IPO in the first couple days of trading by buying up shares if the stock price begins to fall, which leads to an artificial representation of the market demand in the first few days of trading. In addition, stocks are often highly volatile in the first couple days of trading and not just the first day. The 21-day underpricing shows the value of the stock after the secondary market has presumably "settled." 21-day underpricing is also the metric used in the analysis by Lowry, Officer, and Schwert (2010).

VII. **Discussion of Results**

The two hypotheses proposed in this paper are that: 1) Auctions would exhibit a lower mean and variability of underpricing and 2) This advantage would hold for large firms.

The first hypothesis was largely proven to be wrong. Column (5) of Regression 1 shows that, when controlling for firm and market specific factors, auctions exhibit a greater level of underpricing, significant at a 5% level. Column (5) of Regression 3 shows that, when controlling for firm and market specific factors, auctions also exhibit greater variability of underpricing, although this result is not statistically significant.

These results are contradictory to the results found in Derrien and Womack (2003); Lowry, Officer, and Schwert (2010); Kaneko and Pettway (2003); Pettway, Thosar, and Walker (2008); and Pukthuanthong, Varaiya, and Walker (2007). These papers all found that auctions have lower levels of underpricing, defined over various lengths of time (1-day, 10-day, 21-day), than book built IPOs. These papers looked at data in France, the United States, and Japan.

I have some explanations for these findings. The first consideration is errors in the data or in the data collection process. A second consideration is that the considerable overlap between the SDC data and the Datastream data (the fact that Datastream yielded an unrealistically high number of zero returns for one-day underpricing) could have skewed the data due to the fact that I probably calculated 21-day underpricing after fewer than 21 days of trading for many of the stocks. However, given that there are zero returns for about 12% of IPOs in the United States (Lowry, Officer, Schwert; 2010), I did not think it fair to set the first day of trading to be the day that the stock first moved. Of course, there is the possibility that book built IPOs do control underpricing better than auctions. Despite the substantial amount of empirical evidence that contradicts this theory, there are papers supporting this hypothesis. Benveniste and Wilhelm (1997) argued theoretically that the book building mechanism "makes better use of information about market demand conditions." Sherman (2000) argued that the book building mechanism results in lower underpricing due to the long-term relationships that form between investors and underwriters due to the preferential allocation of shares. The theory is that, since investors will receive shares in future IPOs due to their relationship with the underwriter, they require less underpricing in the current offering.

While the data do not support my first hypothesis, the data show that the auction mechanism improves the control of underpricing at least as much as the book building mechanism when considering large firms, which does support my hypothesis. Column (5) of Regression 2 shows that auctions result in greater underpricing, although, unlike in Column (5) of Regression 1, this result is not statistically significant. Therefore, the auction mechanism seems to improve at least as much as the book building mechanism when dealing with large firms since the result is significant when the data are not stratified and is not significant when the data are stratified to only include the largest 50% of firms. Column (5) of Regression 4 shows that, when controlling for firm and market specific factors, large auctions exhibit *lower* variability of underpricing than large book built IPOs. However, this result is the opposite of what is found in Column (5) of Regression 3, which shows that, when controlling for firm and market specific factors, auctions have *greater* variability of underpricing. While the results in Column (5) of Regression 3 and 4 are not significant, the data still show that the auction mechanism exhibits *lower* variability of underpricing when the data are stratified to only include the largest 50% of firms, while the data show that the auction mechanism exhibits *greater*

variability of underpricing when the data are not stratified. Therefore, I suggest that the auction mechanism controls the variability of underpricing better when considering large firms.

VIII. **Conclusion**

This paper explored whether the auction mechanism is superior to the book building mechanism at controlling underpricing, with a particular focus on how the IPO mechanisms compared when focusing on large firms. The motivation for this topic came from the surprising level of popularity of the book building mechanism in the United States despite a number of perceived advantages of the auction mechanism. Some of these perceived advantages include more accurate pricing, lower underwriter spreads, and lower risk of conflict of interest. Despite these perceived advantages, there have only been 22 auctions in the United States since 1999, compared to 1932 book built IPOs.[40] Of these auctions, only 2 of them have been conducted by large firms, which surprised me. In order to test my theory that the auction mechanism deserves to be considered by large firms, I researched both whether the auction mechanism controlled underpricing better than the book building mechanism and how the mechanisms performed when considering large firms. The goal of this paper was to show that auctions are not disadvantaged at controlling underpricing when considering large firms, and I wanted to use these findings to argue that large US firms should strongly consider using the auction mechanism for their IPO.

The evidence was inconclusive. I found that the book building mechanism results in a lower level of underpricing, although this advantage was not significant when looking at only firms with market capitalizations greater than the median overall market capitalization. In addition, the book building mechanism results in a lower variability of underpricing. However, the auction mechanism results in a lower variability of underpricing when only considering firms with market capitalizations greater than the median overall market capitalization. Neither of these results dealing with the variability of underpricing is statistically significant.

Even though the results of this paper do not add much support to the argument that the auction mechanism is a viable alternative to the book building mechanism for large firms, I believe that the topic merits further consideration for a couple of reasons. First of all, the findings in this paper contradict many empirical studies that find that the auction mechanism controls underpricing better than the book building mechanism. I hope that future papers continue to examine the ability of each mechanism to control underpricing by using different data sets and different explanatory variables. Secondly, I believe that the auction mechanism should be more attractive to firms for reasons beyond the control of underpricing. Some of the criticisms of auctions (lack of marketing and lower analyst coverage) should be less critical for larger and more widely known firms. A large, well-known firm does not need the underwriter to market the firm as much and is unlikely to suffer from a lack of analyst coverage. In addition, some of the alleged advantages of auctions (lower underpricing and lower underwriter spreads) should be accentuated with large firms. After all, since underwriter spreads and underpricing are measured as percentages, the absolute impact is greater with larger offerings. Testing these theories would shed more light on the viability of the auction mechanism for large firms.

[40] Number of book built IPOs comes from IPO data from J. R. Ritter.

IX. **References**

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