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## **PERFORMANCE OF INITIAL PUBLIC OFFERINGS IN THE SHORT-RUN**

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## **ABSTRACT**

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Previous studies have indicated that Initial Public Offerings are underpriced on average. The offer prices of the shares are, on average, set below the prices investors are willing to pay when the stock starts trading. Issuing firms, therefore, lose substantial money at the time of new issue. Multiple reasons have been suggested to explain this phenomenon, including, investment banks' monopoly after Glass Steagall Act; regulatory structures; information asymmetry; managerial conflicts; and behavioral explanations. This thesis focuses on information asymmetry and sector dynamics of offerings, that could explain IPO underpricing in five global markets between 2005 and 2015. I have analyzed 2,731 deals across US, UK, Japan, Singapore, & Hong Kong, and found out that IPO underpricing existed in all countries. Oversubscription of IPOs, total IPO proceeds in the offering, period of issue, and Stock markets performance were found to be the influencing factors in IPO underpricing.

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**LIST OF SYMBOLS AND ABBREVIATIONS**

2-SLS	Two-stage Least Squares
ANOVA	Analysis of Variance
APR	Annual Percentage Rate
BLUE	Best Linear Unbiased Estimator
CAPEX	Capital expenditure
CAPM	Capital Asset Pricing Model
CDO	Collateralized Debt Obligation
CGT	Capital Gains Tax
GBP	Great Britain Pound
HKD	Hong Kong Dollar
IPO	Initial Public Offering
JPY	Japanese Yen
LSE	London Stock Exchange
NYSE	New York Stock Exchange
OLS	Ordinary Least Squares
OPEX	Operating expenditure
SGD	Singapore Dollar
USD	United States Dollar
WACC	Weighted Average Cost of Capital

# 1 INTRODUCTION

## 1.1 Background

Initial Public Offering (IPO) is the first time the stock of the company is offered to the public. Through this process, a private company transforms into a public company. Companies raising capital seek help of underwriting firms, such as investment banks, to list their issues on the stock markets. Companies choose to go public for cash injection for expansion, liquidity needs, credibility to meet federal regulations, and determining accurate value of the company, which is difficult for a private stock. Unlike debt, an offering company is never required to pay back the capital to shareholders (Brealey, 2011).

When the stock price on the first trading day is higher than the offering price, an IPO is considered to be underpriced. Underpricing of IPOs have puzzled the proponents of efficient market hypothesis (explained later) who imply that abnormal returns cannot be earned by “beating the market,” as all relevant information and knowledge is incorporated into the share’s price (Fama et. al, 1993). A higher stock price on the close of first trading will enable investors to benefit with abnormal returns from mispricing.

Some empirical evidence suggests that underpricing depends on the market activity. Ritter (1987) found out that not all firms witnessed positive returns on first day after offer; in fact, 46% of the firms did not have underpriced shares. He also suggested that when the market activity is higher and many offerings are coming to the market, underpricing would be higher. On the other hand, when there is little activity in the market in terms of new issues, underpricing of shares would be lower. Further, he studied the IPO returns in the US market between 1993 and 2000, and found out that average first day return was 22.99%. Empirical evidence suggests that in the long-run – three to five years - stocks underperform their benchmark index (Ritter, 1991; Loughran & Ritter, 1995). Also, higher ex-ante uncertainty about the issue leads to greater underpricing (Beatty & Ritter, 1986a).

This study focuses on IPOs between 2005-2015 across USA, UK, Singapore, and Japan (“markets”), where a total of more than \$500b were raised during the period. This period experienced both hot issue market (2004-2006), and cold issue market (2008-2013). In

Figure 1, we see that United States led the global markets with a total of more than \$370b, with Hong Kong registering \$9b; United Kingdom, \$96b; Singapore, \$5b; and Japan, \$21b.

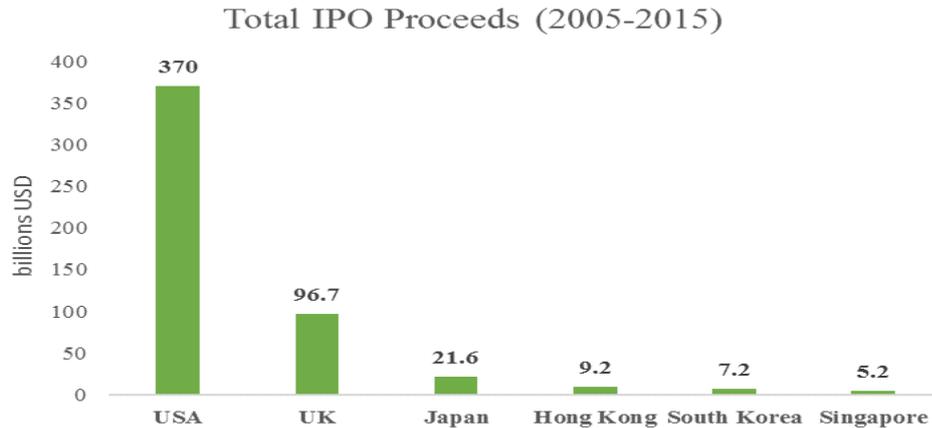


Figure 1 – Global IPO Proceeds (2005-2015)

In Figure 2, we can see that Financial sector had the highest amount of proceeds equaling \$170b in these markets, followed by Technology sector and Energy and Power Sectors which registered \$70b and \$52b respectively during the period, while Government and Agencies raised only \$0.2b during these ten years.

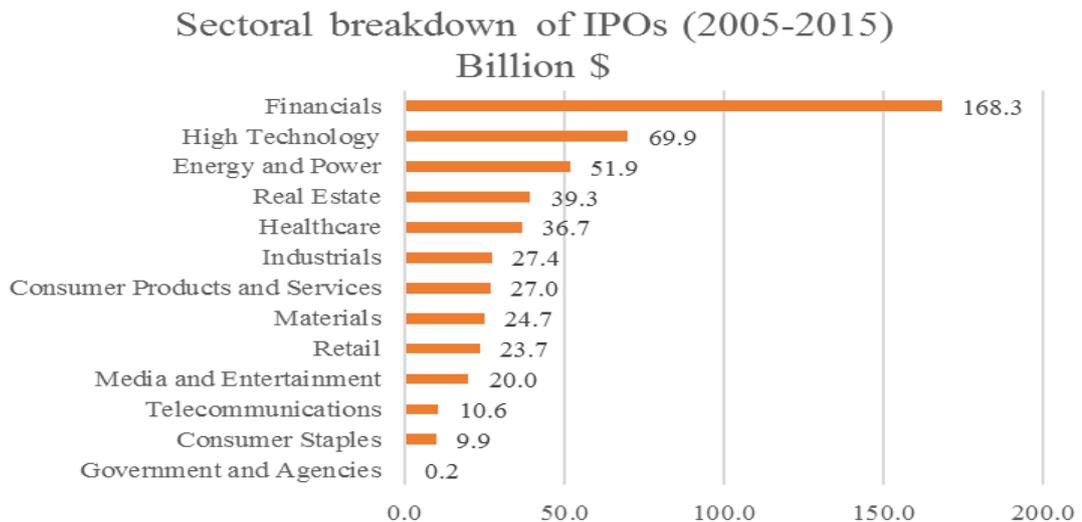


Figure 2 – Sectoral percentages of Global IPOs

Year 2005 had the highest number of IPOs across the markets totaling 563 deals, while 2009, which coincided with Financial Crises, had the lowest IPOs totaling 129. Between 2007,

which witnessed 504 IPOs, and 2008 when total IPOs were 147, the slump was more than 70% YoY (Figure 3). These figures are based on the sample of IPO data that I collected; actual number of IPOs was more than mentioned here, which had to be excluded due to non-availability of critical information.



Figure 3 – Global IPOs by years

Figure 4 presents total IPO proceeds between 2005-2015. Year 2007 witnessed the highest total of capital raised equaling \$83b, while Year 2008 only registered \$10b in capital raise across the markets, of which more than \$7b were raised in the US alone. Recovery started during Year 2010 which witnessed a YoY growth of 70% in total capital raised compared to Year 2009. There was a slump in the growth rate in Year 2011 with 18.75% growth YoY. While, Year 2012 registered a growth of 87% YoY in total capital raised, it was not until 2013 where markets started to reach the pre-financial crisis volume of total capital.

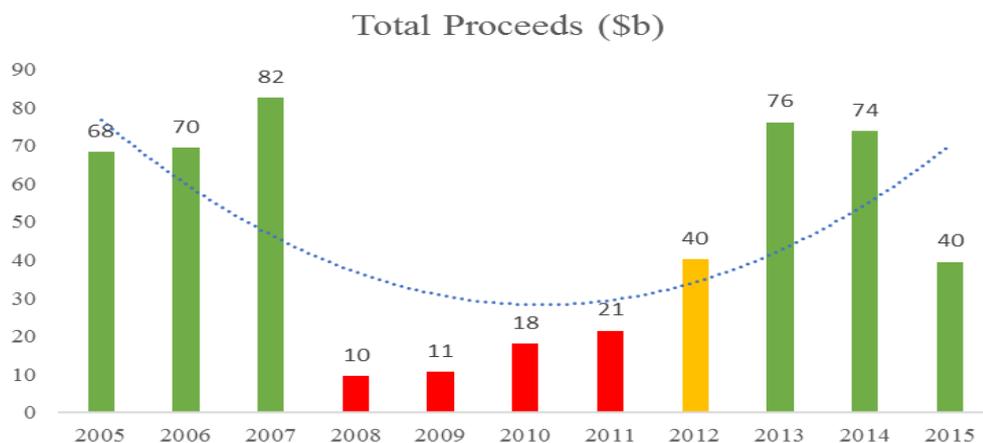


Figure 4 – Global IPO Proceeds (USD)

## **1.2 Problem Discussion**

Substantial academic literature exists on IPO underpricing within the confines of existing theories on the subject. Research has been predominantly limited to the US, European, or the Chinese market as standalone markets. No paper has comprehensively studied and addressed the phenomenon across multiple markets and theoretical frameworks simultaneously. A number of reasons has been put forward to explain underpricing. For example, adverse selection and information asymmetry hypothesized by Rock (1986a) asserts that non-informed investors will have a negative expected yield. Information asymmetry including the cascades hypothesis, the signaling hypothesis, winner's curse hypothesis (Ibbotson & Jaffe, 1975a) all cast light on underpricing. Ruud (1993a) studied the relationship between investment banks and the issuing firms, and concluded that underwriter's price support will lead to skewed returns even if the prices are set at the expected market value. Information quality also influences IPO underpricing; with greater information asymmetry, a higher degree of accounting conservatism is required. Besides information quality and information asymmetry, other explanations have been suggested to explain IPO underpricing. Ritter and Welch (2002) posited that trading volume and underpricing are directly related; a lower trading volume in the aftermarket would mean a lower underpricing. Further, Chang et. al (2008) documented that IPO offer prices are inversely related to the initial return in the secondary market. Some academics have also studied IPO underpricing from a behavioral finance perspective; for example, social comparison theory suggests that during uncertainty, individuals make their decisions by following general behavior of the public (Chang, 2011). He inferred that when underwriters and the issuing firms are not certain about the estimated market values, they resort to comparable deals in the same industries to come up with an IPO price.

## **1.3 Research Question**

While many theories have been suggested and discussed, application of these theories maybe limited to a single market. Since, no single theory can accurately describe IPO underpricing across markets, all the markets will be studied in the context of existing academic literature, with emphasis on sectoral, country-wide, periodic, size level characteristics that could

influence IPO underpricing. To explain IPO underpricing across the markets, USA, UK, Singapore, Hong Kong, and Japan, the research question is formulated as following:

**How do sectoral, country-wide, periodic, and size level characteristics explain IPO underpricing in markets in light of existing theoretical framework?**

This study examines more than 2,731 IPOs in the markets with no missing information. I have compiled offer prices; stock prices; inflation rates; interest rates, where t-bills are used as proxy; and Stock market returns to study underpricing on the first trading day. This research extends existing literature by incorporating countries that differ culturally, economically, socially, and politically. This original contribution will help us understand the linkages and similarities, or a lack thereof, across markets.

#### **1.4 Thesis Structure**

This thesis is structured as following. Literature review is done in Chapter 2, where existing academic literature on IPO underpricing are discussed. A snapshot of USA's, UK's, Hong Kong's, Singapore's, and Japan's, IPO markets over the years is given in Chapter 3. Data and Methodology is discussed in Chapter 4. Results and Discussion is done in Chapter 5. In Chapter 6 concludes the thesis by highlighting key results, limitations, and future possible researches that can be carried out or replicated using the data I have provided conclusion is given with limitations of the research.

## **2 LITERATURE REVIEW**

In this section, relevant academic literature on IPO underpricing are discussed. I have defined IPO, IPO process, and major players and stakeholders in the IPO process. I have then proceeded to discuss theories including, adverse selection theory, signaling theory, information generation cost theory, institutional explanation and deliberate underpricing due to litigation, ownership retention theory, underwriter reputation, behavioral theories, and the presence of institutional investors in the pre-IPO capital structure.

### **2.1 Initial Public Offering**

The first sale of stock issued by a company to general public is called Initial Public Offering. Prior to IPO, a company is a private company with limited shareholders. After the IPO, the investor buying a single stock of the issuing company becomes the owner of the company. An investor can be a private individual, a group of individuals, or institutional investors, such as endowment funds, pension funds, insurance companies, et cetera. These issued stocks are then traded on stock exchanges and prices are subject to demand and supply. (Investopedia, 2017a)

Companies choose to go public for various reasons. An issuing company can raise significant capital for its growth and expansion needs from a diversified pool of investors. Liquidity also becomes an added advantage for public shares, as valuation becomes easier than a private company. Employee Stock Option Plans (ESOP) can help attract and retain better talent. Closer scrutiny by external analysts and investors may help the company to negotiate better interest rates when issuing debt. Most importantly, perhaps, acquisitions can be done smoothly in return for shares of stock. While IPO offers many benefits to the issuing company, it also restricts the companies to strict rules and regulations (Mudambi et. al, 2012). Private companies are not required to disclose financial reporting and results, but once a company becomes public and trades on a stock exchange, it is required by law to disclose accurate financial results periodically. Public dissemination of information might be useful for competitors and suppliers; increased litigation, accounting, and marketing costs; agency problems and increased control with shareholders who can influence the

company through board of directors; regulatory issues such as private securities class action lawsuits, can all influence a company negatively (Lin and HSU, 2008)

IPO process is discussed in the following section.

## 2.2 IPO Process

The IPO Process involves five steps (Jenkinson, 2001):



Source: (Jenkinson, 2001)

Figure 5 – IPO Process

The issuing company first selects the market it wants to issue the list itself in. Listing in a foreign country is possible and has been done by many companies for better liquidity, less stringent regulations, and industry relevance. Ali Baba, a Chinese company, chose NYSE for going public mainly because of industry relevance. Several shipping companies have chosen Oslo Stock Exchange in the past for the same reason.

Once the market is selected, the company proceeds to choose an underwriter, which is typically an investment bank. For large deals, or risky deals, a syndicate is chosen which is a group of underwriters.

Prospectus is a formal legal document that provides details about the investment offering for sale to the public (Investopedia, 2017b). It includes the legal name of the entity issuing the stock, the amount and type of securities sold, name of company's principals, and underwriters fees. To mitigate ensuing legal risks, the company also mentions general risks of investing in stocks, amount of management experience, and a table outlining the number of shares owned by the management.

Roadshows are often critical to the success of the offering. The company presents the offer to potential investors, fund managers, and analysts. These presentations include company's history, growth plans, information about the company's current assets, and allows the

company to answer questions raised by analysts and potential investors. Underwriters use this information to gauge demand and price the offer accordingly (Koba, 2017).

The final step in the IPO process is share allocation. When the offer price is decided, investors subscribe to the stock. If there are more investors willing to buy the offering than the number of shares offered, a stock is called oversubscribed. Investment banks use book-building to allocate stocks to investors. Most shares are allocated to investors with high non-binding bids. Stocks can also be allocated by lottery or over-allotment option. In lottery, two different groups are allocated the shares; retail and institutional investors. Green-shoe, or over-allotment option allows the investment bank to sell more shares than planned in case of oversubscription (Wilhelm, 1999).

After all the legal formalities and shares allocation processes are completed, the issuing company can be listed on the stock exchange. The opening price of the share is the offer price set by underwriters, which may change significantly during the course of the first trading day. An underpriced IPO, which is the focus of this thesis, will give investors a quick profit.

Before proceeding to reviewing academic literature on IPO pricing, underpricing, and performance, I have discussed types of underwriting commitments in the following section to set the scene for further discourse.

### **2.3 Types of underwriting commitments**

In a firm commitment underwriting, the underwriter guarantees to purchase all the shares offered for sale regardless of how successful it was in selling them to public. Most issuing firms favor this type of commitment, as it guarantees them the desired capital without any risk on their part. Standby underwriting agreement is closely related to firm commitment, where underwriter purchases all shares that are not purchased by current shareholders. In fledgling and highly sensitive industries such as biotech, underwriters go for a market out clause. Since firm commitment means that the underwriter is taking substantial risk on his books, therefore, to mitigate this risk, the market-out clause enables the underwriter to disown liability in case of events that could substantially hamper the quality of securities.

Another type of underwriting commitment is best efforts basis, where investment bank/underwriter promises to sell the issue to the public, but is not obligated to buy the shares if they remain unsold. In an all or none underwriting agreement, the issuer either gets all the proceeds from the sale of securities, or the issue is cancelled with funds returned to investors in case of all securities not being sold (Williamson, 1988).

Most theoretical models are based on the hypothesis of asymmetrical information among the issuers, underwriters, investors, and, therefore, adverse selection. Some of the relevant theories are discussed below.

## **2.4 Adverse Selection Theory**

Adverse selection theory posited by Rock (1986b) stratifies investors into two groups: (1) informed investor, and (2) uninformed investor (Cole and Eisenbeis, 1995). Informed investors and investment banks, according to Rock (1986c), have the perfect knowledge and know the true value of the issuing firm, and therefore, the issuing firm should rely on underwriter's audit for this information. However overly simplistic, this theory does provide some insights.

When informed and less informed investors are in competition with each other, the latter can be faced with the problem of adverse selection: if the offering price is less than the value of the offering, less informed investors will be limited; while in the case in which the offering price is greater than the expected value, they will obtain all the requested shares. This is called winner's curse hypothesis. The expected yield of less informed investors, which is the difference between the offer price and the expected value, will be negative if all the shares are allocated to them.

Rock's (1986d) model was further modified by Beatty & Ritter (1986b) to analyze uncertainty in the valuation of the issuing company and its impact on underpricing. They found out that a company with higher degree of ex-ante uncertainty will encourage more investors to subscribe to the issue, thereby rendering the problem of adverse selection even worse. This greater risk has to be compensated by setting the offer price below the real expected value so that the investors can have a higher expected yield. To gauge ex-ante

uncertainty, they used the age of the company, sales revenue, volume of the offer as proxies in the empirical part.

Extending the theoretical framework of information asymmetry further, Allen and Faulhaber (1989a) suggested that external investors do not have the information available about the quality of investment projects as the issuing company does. Companies who expect better profitability will ‘generate underpricing’ by holding a certain quantity of shares themselves. This sends a signal to the investors that only successful companies, or companies with better profitability expectations can afford to underprice as they can, then, place successive placements at more favorable prices. This is an extension of original idea put forward by Ibbotson (1975), according to which the issuing companies want to “leave a good taste in mouth” by selling a limited number of underpriced shares initially, and then placing the remainder at more favorable prices. These findings were consistent with the findings of Ibbotson and Jaffe (1975b) and Ritter (1984).

Welch (1989a) differed from Allen and Faulhaber (1989b) in his theory on underpricing. While he agreed that every issuing company’s goal is to maximize total profits before and after the IPO, he suggested that poor quality companies have other direct costs, excluding underpricing, that they must bear in order to imitate high quality companies. He attributed certainty between the IPO and successive offer as a factor in determining quality. If potential investors can identify a “poor-quality” company with a high probability, then the cost of underpricing for those companies becomes even higher as they have already been identified as “bad”, and the incentive to underprice shares becomes less. “Good” companies only sustain a level of underpricing that will result in division of equilibrium, and if underpricing is a sign of good company that can sustain these costs, then those companies leverage this fact in subsequent offerings. Both Welch (1989b) and Allen and Faulhaber (1989c) agreed that underpricing is used to facilitate returning to the market after the IPO.

The information cost to a marginal shareholder is greater than institutional investors, who have a lower cost of acquiring information about the quality of the company. These singles investors recuperate their information cost after the offering, only if the issue was underpriced. By using underpricing as an instrument to achieve “elevated dispersion” in the post-offering ownership, the company gets greater liquidity of the shares at a lower cost of

capital. Without underpricing, there will be no elevated oversubscription and the shares would be distributed to a large number of single shareholders. Therefore, to compensate the investors, ex-poste, for the costs sustained, ex-ante, it is necessary to have a higher underpricing. There was a strong positive correlation between underpricing and information costs (Booth and Chua, 1996).

Brennan and Franks (1997) further extended the theory and proposed “reducing monitoring hypothesis”. They suggested that through underpricing, and consequent oversubscription achieved as a result of underpricing, the management of the issuing firm tries to achieve a diffusion of ownership. A scattered post-IPO ownership will be an impediment to the potential shareholders to monitor the management. Empirical evidence showed that investors who demanded higher quantities of securities were systematically limited to accumulate a large chunk of the offering. However, this systematic “weeding-out” was not done following a prefixed rule like the repartition pro-quota, instead it is conducted with discretion in connivance with the underwriter. A strong positive correlation was found between underpricing and a scattered ownership of the company post-IPO. Underpricing and the control of management/shareholders following the IPO had a negative correlation.

## **2.5 Information Generation Cost Theory**

Information Generation Cost Theory is an extension of realm of adverse selection theory, which highlights how asymmetric information, and conflicts of interest between the issuer and investment bank impact pricing of IPOs. The underwriter wants to fix a low offer price of the securities to optimize the cost of marketing and distribution, while the issuer has incentive to not leave “money on the table”. Brokerage problem can be mitigated by increased competitiveness in sell-side of investment banking, and by having a contractual framework that links underwriter’s compensation to the placement price (Baron and Homstrom, 1980).

Issuing firm, normally, has no information on the state of market or the potential demand for securities. Investment banks on the other hand have significant access to the market data, analyst reports, state of market, health of economy, and also the marketing activity in the distribution phase of the securities, which the issuing firm does not have (Baron, 1982). Due

to the nature of information, which is asymmetric, moral hazard stems as a result. He suggested a contract in which the underlying firm communicates its choice of optimal offer price to the investment bank, while compensating the latter for the information cost. This contract reduces uncertainty, and helps both contracting parties to come to an optimal price, which is usually higher than the price in absence of the information.

Benveniste and Spindt (1989) postulated that asymmetric information problem can be solved by using the firm commitment placement mechanism. The investment bank can obtain “indicators of interest” from the institutional investors, who will indicate a non-binding indicative price in the pre-marketing phase of IPO. This solution can only be considered if investors are willing to reveal the accurate price at which they will subscribe to the issue; to encourage investors to divulge correct information, underwriter must fix a mechanism to allocate securities and a greater profit for those who divulge information. This can maximize total earnings for the issuing company, and divulging investors, because the offering price is lower than the equilibrium price derived using information of all participants of the market.

Investment banks serve as certifiers for the offering price and signal quality of the issuing company to the external investors (Booth and Smith II, 1986). By investing in information, an underwriter can fix the price of placement and indicate the issue to be of good quality. To preserve its reputational capital and market share, the underwriter may not act in an opportunistic manner. This can also solve the problem of asymmetric information.

## **2.6 Behavioral theories**

Behavioral finance theories offer an alternative explanation to Efficient Markets Hypothesis to understand the puzzle of IPO underpricing. In this section, I have discussed few theories of behavioral finance that may be useful in getting a different perspective and approach to understanding underpricing phenomenon.

### **2.6.1 Loss Aversion Theory**

Aversion to loss is a possible reason why IPOs are underpriced. The underwriting firm deliberately underprices the issuing stock to make it easier for them to market the issue. By intentionally underpricing the issue, the underwriter mitigates the probability of loss of capital, which may result from undersubscription if the stock is initially priced too high. This is supported by empirical evidence that investment banks are risk averse (Adams and Thornton, 2011).

### **2.6.2 Ownership retention theory**

Ownership retention theory also explains the underpricing phenomenon; by underpricing the issue, the firm is able to generate excess demand for the security, and spread the offering among a diversified base of investors. As discussed in adverse selection theory, this helps management to retain control, as no single investor or a group of institutional investors would hold large power through directorship on the board of the company.

### **2.6.3 Signaling theory and stock valuation**

Issuing firms can “signal” the quality of the offering by reducing the offering price. If the issuing firm has excellent growth potential, then, it is willing to “leave the money on the table” and recuperate the potential losses in secondary offerings.

### **2.6.4 Investor overconfidence**

Ljungqvist and Wilhelm (2003) and Loughran and Ritter (2004) found out that there are inherent behavioral biases in equity markets. Excessive investor optimism, particularly with investors having less information, leads to price leaps on the trading day. This is supported by the fact that issuing firms experience subsequent low returns during the first few years of trading.

### **2.6.5 Winner's curse**

By underpricing the issue, the issuing firm helps uninformed investors to avoid the “lemon” problem, and have a chance to earn positive returns (Rock, 1986e). As discussed, asymmetric information models of underpricing assume that one party among the contracting parties, issuer, underwriter, and investors, has more information than the other party. Informed investors bid for stocks which are attractively priced, while uninformed investors impose “winner's curse” on them by indiscriminately subscribing to the offerings. In some cases, uninformed investors will have entire allocation of overpriced stocks allocated to them, resulting in negative average returns (Akerlof, 1970).

### **2.6.6 Lawsuits, legal liability, and price-support**

Investment banks are risk averse, and reduce the offering price of the security to avert any lawsuits that might result if the IPO breaks below the issue price. Investment banks are obligated to prevent any massive price movements subsequent to the issue, and typically take warrants as compensation.

### **2.6.7 Cascades**

Informational cascades develop in some IPOs when investors, contrary to their own information, base their bids on the bids of previous investors. If IPO issue has had successful sales, then it would be interpreted by investors as favorable information, conversely, disappointing sales will dissuade investors from partaking in the new issue. Early investors demand underpricing for committing to the IPO, and thus start a positive cascade. Leading investment banks with solid reputation do not necessarily underprice the issue because of cascading, as they maintain utmost secrecy over the development of demand of the security. One possible strategy to mitigate the impact of cascades, although not without significant disadvantage to the issuing firm, is an open communication strategy; investors learn about the company through distribution of signals. Investors gain information advantage over the company, and therefore, a negative sentiment of one investor can transmit through the

investor chain and lead to a failed IPO. Preventing free communication can help the issuing company and underwriter to mitigate the risk (Boehmer and Fische, 2000).

### **2.6.8 Mental Accounting and Prospect Theory**

Carrying Thaler's (1985) work on mental accounting and behavioral biases that are inherent in IPOs forward, Loughran and Ritter (2004) argued that offering firms do not calculate the "lost earnings" from underpricing because they analyze the total proceeds cumulatively, as a sum of proceeds raised in the market as prices jump in the after-market and potential "loss of wealth" from underpricing. Issuing firm's frame of reference for valuation is the initial price indicated in the IPO's registration statement, against which profit and loss are evaluated.

## **2.7 Institutional Theories**

While lawsuit avoidance maybe a second-order driver of IPO pricing in Finland (Keloharju, 1993), Sweden (Rydqvist, 1997), Japan (Beller et. al, 1992), Switzerland (Kunz and Aggarwal, 1994), and Australia (Lee et.al, 1996), issuing firms in the aforementioned countries still experience underpricing. In the USA, however, lawsuit avoidance hypothesis has taken some favor in the investment community; Logue (1973) and Ibbotson (1975) asserted that firms intentionally engage in underpricing phenomenon to avert possible lawsuits from disgruntled shareholders unhappy with the performance of the stock. Other reasons given by theorists favoring institutional explanations to understanding IPO underpricing are price stabilization and tax advantages. Legal liability, price stabilization, and possible tax advantages to understand underpricing phenomenon are discussed in the following section.

### **2.7.1 Legal liability**

Empirical evidence suggests that at least 15% of the total IPO proceeds between 1988 and 1995 were awarded to plaintiffs for violations related to non-disclosure of non-material facts

(Lowry and Shu, 2002a). Hughes and Thakor (1992) argued that the probability of lawsuits resulting from IPO performance is directly correlated to the magnitude of the total IPO proceeds: the larger the IPO proceeds, the higher is the probability of lawsuits. Investment banks and leading boutique underwriters also underprice as they believe the damage to their reputational capital emanating from lawsuits would be too high to recuperate. Therefore, to avoid (a) the probability of lawsuit, (b) adverse ruling in case a lawsuit is filed, and (c) the resultant cost damages from the lawsuit, the issuing company in connivance with the underwriter(s) deliberately engage in underpricing.

Before the promulgation of Securities Act 1933 in the USA, investment banks and issuing firms were not liable for any subsequent damages to the investors resulting from IPO underperformance. Tinic (1988) did a comparative analysis of the IPOs between 1923-1930, and 1966-1971; he found out that underpricing before the legislation was 5.1%, while post-legislation, it doubled to 11.3%.

The above findings were dismissed by Lowry and Shu (2002b), who argued that underpricing has to be studied by taking into account the simultaneity problem. Companies, according to Low and Showry (2002c) underprice taking into consideration the probability of being sued. Therefore, the level of underpricing is correlated with the probability of resulting lawsuits. They further suggested that Ordinary Least Squares estimates will result in biased estimates, and posited that 2SLS may be used by incorporating prior market information, and the issuing firm's expected stock turnover in the litigation equation. They found out that OLS and 2-SLS produce radically different results; OLS output will lead to the conclusion that underpricing will be less with higher lawsuits, while 2-SLS model indicates that firms will engage in more underpricing with increasing lawsuits.

### **2.7.2 Price Stabilization**

Ruud (1993b) hypothesized that underpricing is not a result of deliberate action, rather offerings which are expected to have a price fall on the first trading day are stabilized. He suggested that underpricing returns do not form a symmetric distribution around positive

mean, instead they approach zero and rarely fall below zero. Price stabilization eliminates left tail of distribution returns thereby giving impression that the security was underpriced.

Asquith et.al (1998) empirically disproved that underpricing is a result of price stabilization; they found out that the mean of initial return distribution of “unsupported offerings” was not zero, which it should have been if Ruud’s (1993c) findings were to be trusted. Instead the mean of initial return distribution was 19%. Price stabilization theory has been rejected by Benveniste et. al (1998), Chowdhry and Nanda (1996), and has failed to garner much support in the academic community due to lack of empirical evidence.

### **2.7.3 Tax Advantages**

Sweden witnessed an average underpricing of 42% during 1980-1990, when Swedish tax laws had a higher tax rate on income tax than capital gains tax. This underpricing was reduced to 8% between 1991-1995, when new tax laws subjected underpricing gains to tax (Rydqvist, 1997). Companies before the promulgation of the new law were compensating their managers and employees by allocating appreciating assets in lieu of wages.

In the USA, for holders of stock options, tax payment is done in two steps: when the option is exercised, the difference between strike price and “fair market value” is paid. Second, when the stock is sold, capital gains tax is paid in the amount of the difference between the sale price and “fair market value”. CGT is a deferred tax liability, and companies to prefer keep the “fair market value” as low as possible. This incentivizes firms to engage in underpricing.

This ends the section on theories explaining IPO underperformance. The next section will discuss the IPO market of USA, UK, Singapore, Hong Kong, Japan, and Singapore.

### **3 IPO MARKETS**

In this chapter, the IPO markets in USA, Singapore, UK, Hong Kong, and Japan are discussed.

#### **3.1 IPO markets in the USA**

USA has multiple capital markets offering sophisticated and customized securities offerings. These stock exchanges are listed below:

- (1) New York Stock Exchange (NYSE)
- (2) National Association of Securities Dealers Automated Quotation System, NASDAQ
- (3) American Stock Exchange (AMEX)
- (4) Boston Stock Exchange (BSE)
- (5) Chicago Board Options Exchange (CBOE)
- (6) Chicago Board of Trade (CBOT)
- (7) International Stock Exchange (MS4X)
- (8) National Stock Exchange (NSX)
- (9) Philadelphia Stock Exchange (PHLX)

Most of the stock offerings happen either in the NYSE or NASDAQ, while CBOE, COBOT, AMEX deal almost exclusively with options, derivatives, and other goods. For USA, this study only NYSE and NASDAQ are discussed in this study.

##### **3.1.1 The New York Stock Exchange**

The New York Stock Exchange, NYSE, or The Big Board is the world's largest stock exchange by market capitalization exceeding \$20 trillion, with over \$170b of securities traded every day. Established in 1792 as a result of Buttonwood Agreement between 24 brokers, the exchange initially catered to trading of War Bonds, and governmental securities. Bank of New York was the first institution whose shares traded at NYSE. Before 2005,

NYSE was a private company, and only became public upon acquisition of Archipelago. In 2007, NYSE merged with Euronext exchange to become NYSE Euronext (NYSE, 2016).



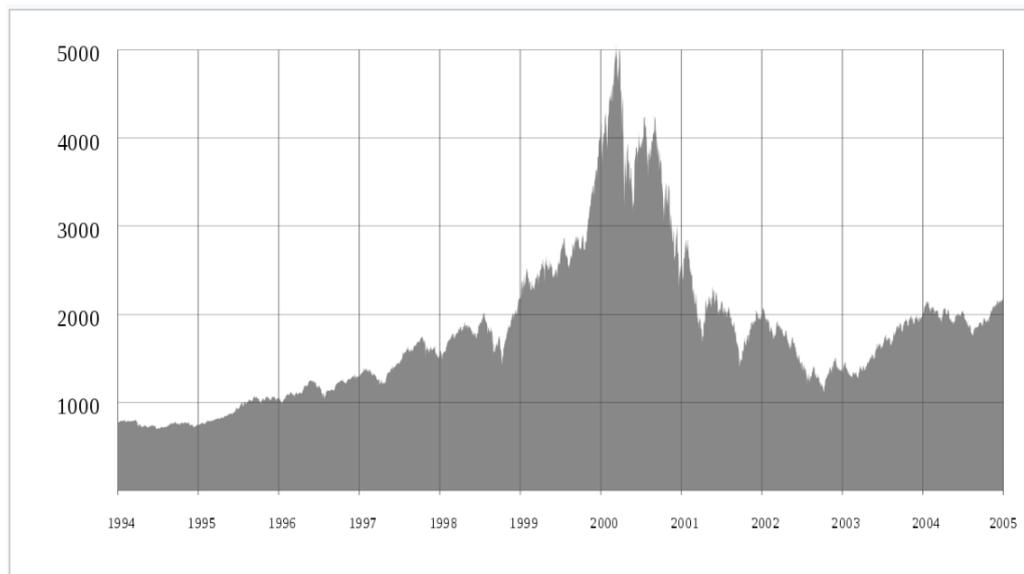
Source: Yahoo! Finance

Figure 6 – NYSE Performance (1982-2017)

In Figure 6 the dip in the NYSE Composite Index during Financial Crises of 2008 can be observed.

### 3.1.2 NASDAQ

National Association of Securities Dealers Automated Quotation System, abbreviated as NASDAQ, is an electronic platform for buying and selling shares of stock. It is the world's second largest stock exchange after NYSE, with market capitalization exceeding \$7 trillion. It was created as a viable and fully automated platform and alternative to conventional stock exchanges. More than 3,000 stocks are listed on NASDAQ with blue chip stocks like Apple, Google, Facebook, and Amazon all forming a part of the composite index (NASDAQ, 2017).



Source: Yahoo! Finance

Figure 7 – NASDAQ Performance

Figure 7 shows that between 1971 and 2015, NASDAQ had a CAGR of 9.2%, this includes the dot-com bubble, when the index suffered massive losses, losing almost 80% of its value in March 2000. The index registered returns of over 18% post-recession from 2009 onward.

### 3.2 Singapore Stock Exchange

Singapore Stock Exchange is the largest stock exchange in Singapore and of the largest in South East Asia. It's total market capitalization exceeds \$8b. Figure 8 highlights the performance of the stock exchange:



Source: Yahoo! Finance

Figure 8 – Singapore Stock Exchange performance

### 3.3 Tokyo Stock Exchange

Tokyo Stock Exchange, abbreviated as TSE, is the world's third largest stock exchange company, with a market capitalization of over \$4 trillion and having a listing of more than 2,500 stocks. Famous Japanese brands such as, Toyota, Honda, Mitsubishi, Japan Airlines are listed on TSE. As with other stock exchanges and countries, we can see in Figure 9 that the value went down during Financial Crises.

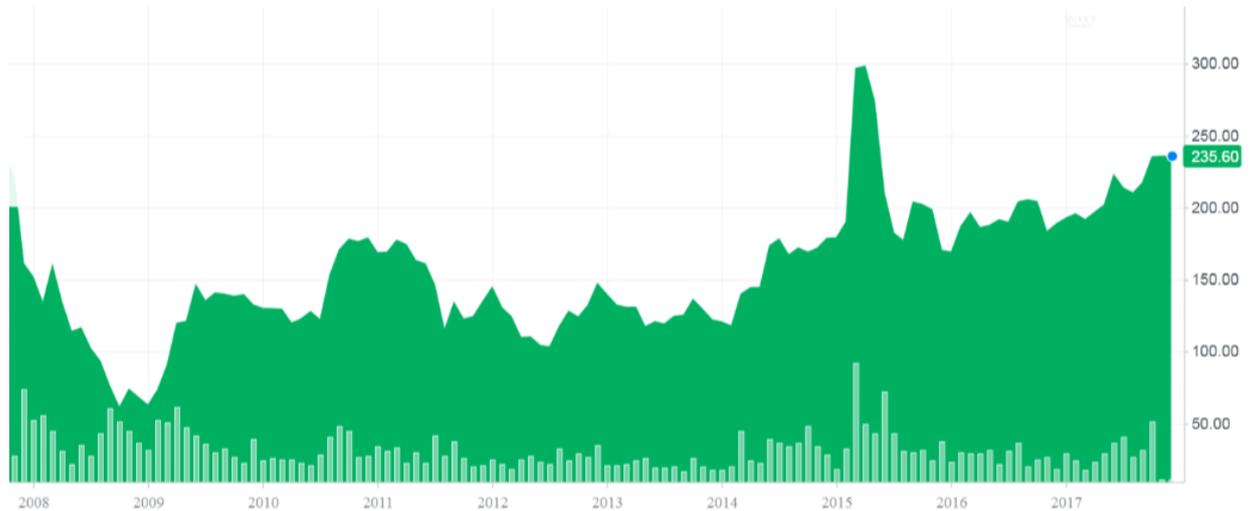


Source: Yahoo! Finance

Figure 9 – Tokyo Stock Exchange performance

### 3.4 Hong Kong Stock Exchange

Hong Kong Stock Exchange or SEHK, is the sixth largest stock exchange in the world. It's the third largest stock exchange in Asia, behind Tokyo Stock Exchange, and Shanghai Stock Exchange. It has more than 2,000 companies listed, and its market capitalization is over HKD 30 trillion.



Source: Yahoo! Finance Figure 10 – Hong Kong Stock Exchange Performance

It can be observed that during 2008-2011 Global Financial Crises, all the stock exchanges in major global economies slid down, and started to recover after 2012.

## 4 DATA AND METHODOLOGY

### 4.1 Structure

In order to answer my research question as comprehensively as possible, I have formulated four hypotheses. I will use regression analysis to test these hypotheses. After having collected data across markets in the countries under study, I have cleaned, trimmed, and optimized enormous amount of original data. As the focus of my study is underpricing, IPO underpricing will be taken as a dependent variable. Explanatory variables will be chosen separately for each hypothesis, and the regression results will reveal explanatory relationship between the variables with significance levels. After running regression, I have drawn inferences on the formulated hypotheses, and studied how much relevance existing academic literature holds in explaining IPO underpricing in leading global markets.

### 4.2 Hypotheses

Hypotheses formulated for the purpose of my thesis in this section is empirically tested to answer the research question in light of the existing academic literature on IPO (under)pricing. I have discussed these theories in Part 2 of this work, and have also provided an overview of the stock markets of the countries under consideration for this study to give ample context to the reader. I believe that this work includes comprehensive data, which is characterized by multi-periodicity, and encompasses various industries and countries to provide meaningful inferences and results. Hypotheses are as following:

**Hypothesis 1:** IPOs have been fairly priced between 2005-2015

Efficient markets hypothesis suggests that it is impossible to beat the market as all information pertaining to the stock is encapsulated in the stock price. It is impossible for investors to purchase undervalued stocks or sell stocks for inflated prices. But empirical evidence suggests otherwise. Empirically most markets are shown to have underpricing.

Hypothesis 1 will be rejected, if I find significant underpricing or overpricing compared to the offering price of the stock.

**Hypothesis 2:** IPO underpricing is unaffected by the period's IPO activity

Ljungqvist et.al (2004) suggested that investor sentiment drives IPO activity. This can be linked to “hot” and “cold” markets theory posited by Ibbotson and Jaffe (1975c), who suggested that issuing firms take advantage of period characterized by increased activity, and therefore, there is a strong and positive correlation between IPO underpricing and market activity. Rejecting this hypothesis would mean that underpricing is higher in “hot” markets, and lower in “cold” markets. Years 2005, 2006, 2007, 2013, 2014, and 2015 are “hot-years”. And Years 2008-2012 are “cold years”.

**Hypothesis 3:** Underpricing is independent of the firm's size and total offering

I discussed in the literature review that larger firms which have comparatively bigger capital can afford to underprice their stock as the total proceeds can be recuperated later. I will analyze the firms based on the total amount of proceeds obtained from the offering and study the underpricing mechanism across firms of different offering sizes.

**Hypothesis 4:** Stock market has no effect on IPO underpricing

There is not a substantial amount of existing academic literature that discuss the impact of macroeconomic variables on IPO underpricing. I have taken interest rates (yearly), inflation (monthly), and Stock Indices to study the relationship between macroeconomic variables and IPO underpricing. I have used S&P 500, Nikkei 500, and FTSE-All Shares Indices in regression.

**Hypothesis 5:** Oversubscribed shares will have higher underpricing than undersubscribed shares.

The goal of investment bankers' underwriting the deal is to price the issue at the exact price at which all the offering would be sold, so there will be no shortage or oversupply of

securities. Undersubscription could be a result of higher offering price, and therefore, less demand for the security. I have studied if underpricing had an impact on oversubscription or undersubscription of the IPOs.

### 4.3 Data

I used Thomson One Banker to download data on the IPOs between 2005-2015 in the US, UK, Singapore, Japan, and Hong Kong. Total number of IPOs during that period exceeded 5000, however, many details from the data were missing, which rendered some data meaningless. After checking each IPO on the completeness of data, I trimmed the data to 2,731 IPOs in the aforementioned countries using the following filters: total number of shares offered were not an input in regression or descriptive statistics.

- (1) **Issuer:** This refers to the firm issuing the IPO. The number totaled 2,731.
- (2) **Nation:** The country in which the offering was issued.
- (3) **Macro Description:** This refers to the industry classification; in our data we have, Consumer Products and Services, Consumer Staples, Energy and Power, Financials, Healthcare, High Technology, Industrials, Materials, Media and Entertainment, Real Estate, Retail, Telecommunications, and Government and Agencies.
- (4) **Issue Date:** The date when the stock was issued. This is in the format mm.dd.yy.
- (5) **First trade date:** Date of first trading of the stock on the exchange.
- (6) **Proceeds:** The total amount of money received by the issuing firm from the IPO.
- (7) **Oversubscription or undersubscription:** A stock is considered to be undersubscribed if the demand of the shares offered is less than the total offering. Conversely, an oversubscribed offering will have less supply of the shares than demanded by the investors. Thomson One data did not specifically have

undersubscription or oversubscription categories, to calculate if the offering was under/oversubscribed, I subtracted “total offered amount” from “total proceeds”. If total proceeds exceeded the offered amount, the securities offering is considered to be oversubscribed, and vice-versa.

- (8) **Offer Price:** The price at which the stock was offered. Perhaps this is the most critical variable in my work and analysis.
- (9) **Total shares offered in the market:** The number of shares offered by the issuer.
- (10) **Periodicity of stock prices:**
- Stock price 1-day after offer (closing trade price)

Collecting comprehensive data on the IPOs and transforming it into meaningful information was indeed a very time-consuming task. Each stock had to be meticulously studied for completeness, relevance, and currency of data. Unfortunately, while the database offered the nation of offering, it had no information on the stock exchanges where the IPOs were issued.

The main cause of excluding some data was the missing variables that I deemed to be critical in my analysis. For example, some firms that witnessed mergers, demergers, acquisitions, bankruptcy, and other events were excluded from this study. Since this study has a broader focus to understand underpricing in leading global markets, no company specific data was collected using prospectuses, websites, analyst recommendations, reports, and other proprietary information.

#### **4.4 Computing underpricing**

A simple and intuitive method of measuring underpricing is the return on first trading day after offer. A large return implies that the offer price was set too low, causing an increase in the price on the next trading day after offer. A negative return means that the stock was overpriced. Many academics and researchers have used market return model, which adjusts the initial return by subtracting the market return on the same day and can also include beta.

I have chosen to use simple underpricing calculation for Japan, Hong Kong, and Singapore, and US and UK. Due to the sheer magnitude of the data, daily returns for stock exchanges in Japan, Hong Kong, and Singapore were not available on Thomson one, therefore simple initial return calculation will suffice. This model is consistent with previous findings of Lowry and Schwert (2001a), and Derrien and Womack (2003a), which are discussed in the following sections.

The formula for computing underpricing using simple initial return method is as following:

$$R_i = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

$R_i$  = return of stock “i”

$P_{i,t}$  = closing price of the stock on first trading day

$P_{i,t-1}$  = Offer price of the stock

As discussed above, the formula is used for calculation of simple return on first trading day. Some academics use opening price on the first day as an alternative to the closing price, and others use mid-day prices. I argue that the opening prices do not reflect investors’ sentiment aptly and do not capture all relevant market information; the opening prices only include the bids offered before the trading or issuance of the IPO. Eckbo (2008) suggested that underpricing mechanics can be gauged by studying the closing stock price on the first trading day, as all information will be included in the price of the stock, at least in developed capital markets.

Lowry and Schwert (2001b), and Derrien and Womeck (2003b) postulated that the difference between market-adjusted model, and simple-return model of underpricing is of marginal importance as is not significant to the performance of the IPO. However, time lag between IPO issue, and market move can be significant in some markets.

## 4.5 Regression

Regression analysis is used for estimating relationships between variables. In this study of understanding the relationship between a dependent variable – underpricing – and independent variables, regression can tell us how the value of the dependent variable changes in response to changes in independent variables. To estimate regression function, most commonly we use conditional expectation, which is the expected value of a random variable if certain set of conditions occur.

Regression modeling can be done through linear regression or non-linear regression. Both linear and non-linear regression equations seek to graphically plot the response of independent variables on dependent variable. Multiple linear regression uses two or more independent variables to study the response of dependent variable. Linear regression can be estimated by either Ordinary Least Squares method (OLS), or Maximum Likelihood method (ML). In this study I am using multiple linear regression and Ordinary Least Squares Method for simplicity in understanding the work, and applicability of this work to future research in the field. The following equation describes a linear regression model:

**Linear Regression:**  $Y = p + qX + e$

The regression equation generates a straight line that best approximates individual data points.

In this study, I have modeled four regressions, which are given as following:

$$(1) \quad y = \alpha + \beta_1([\ln proceeds]) + \beta_2(Stock\ Indices) + \beta_3(inflation) + \beta_4(interest\ rates) + \epsilon$$

Equation 1 will model underpricing based on independent variables without the fixed effect for years and industries.

$$(2) \quad y = \alpha + \beta_1([\ln proceeds]) + \beta_2(Stock\ Indices) + \beta_3(Year\ 2005) + \beta_4(Year\ 2006) + \beta_5(Year\ 2006) + \beta_6(Year\ 2007) + \beta_7(Year\ 2008) + \beta_8(Year\ 2009) + \beta_9(Year\ 2010) + \beta_{10}(Year\ 2011) + \beta_{11}(Year\ 2012) + \beta_{12}(Year\ 2013) + \beta_{13}(Year\ 2014) + \beta_{14}(Year\ 2015) + \epsilon$$

Equation 2 will model underpricing relationships taking into account the Fixed Years effect and removing interest rates and inflation from the equation.

$$(3) \quad y = \alpha + \beta_1([\ln proceeds]) + \beta_2(Stock\ Indices) + \beta_3(s1) + \beta_4(s2) + \beta_5(s3) + \beta_6(s4) + \beta_7(s5) + \beta_8(s6) + \beta_9(s7) + \beta_{10}(s8) + \beta_{11}(s9) + \beta_{12}(s10) + \beta_{13}(s11) + \epsilon$$

Equation 3 will model underpricing relationships taking into account the Fixed Industries effect and removing interest rates and inflation from the equation.

$$(4) \quad y = \alpha + \beta_1(\ln proceeds) + \beta_2(\text{Stock Indices}) + \beta_3(y_1) + \beta_4(y_2) + \beta_5(y_3) + \beta_6(y_4) + \beta_7(y_5) + \beta_8(y_6) + \beta_9(y_7) + \beta_{10}(y_8) + \beta_{11}(y_9) + \beta_{12}(y_{10}) + \beta_{13}(y_{11}) + \beta_{14}(s_3) + \beta_{15}(s_4) + \beta_{16}(s_5) + \beta_{17}(s_6) + \beta_{18}(s_7) + \beta_{19}(s_8) + \beta_{20}(s_9) + \beta_{21}(s_{10}) + \beta_{22}(s_{11}) + \beta_{23}(s_{12}) + \epsilon$$

Equation 4 will model underpricing relationships taking into account the Fixed Industries and years effect and removing interest rates and inflation from the equation.

Table 1 describes the regression input:

Table 1 – Regression inputs

$\alpha$	intercept
$\beta_n$	Coefficients
y1	2005
y2	2006
y3	2007
y4	2008
y5	2009
y6	2010
y7	2011
y8	2012
y9	2013
y10	2014
y11	2015
s1	Consumer Products and Services
s2	Consumer Staples
s3	Energy and Power
s4	Financials
s5	Healthcare
s6	High Technology
s7	Industrials
s8	Materials
s9	Media and Entertainment
s10	Real Estate
s11	Retail
s12	Telecommunications

#### 4.5.1 Dependent variable

In this research I have chosen the percentage change in stock price one day after offer as a dependent variable. I will test Y (dependent variable - % change in stock price one day after offer) against independent variables. The goal is to study what factors might influence the performance of IPO.

For regression, I have used the following dependent variable:

- First day trading return

Descriptive statistics for the above variables are provided on a cumulative level, as well as on a sliced level segmented based on countries and industries.

#### 4.5.2 Independent variables

Various academics have pointed out the influential role of macroeconomic variables on IPO performance. I have included the following independent variables in this study:

- (1) **Inflation rate:** With escalating inflation, the Central Banks raise the interest rates to control money supply. When interest rates increase, investors prefer to park their funds in less-risky securities, which result in less liquidity in the system. With less liquidity, the demand of the goods decreases, and the interplay of demand and supply pushes down the general prices. Increased inflation can result in bearish markets, as stocks and shares become less attractive when investors use other fixed-income instruments, such as, money market funds, mutual funds, and timed deposits. A lower demand for shares results in lower prices. Inflation directly impacts the Price-earnings ratio and increases the required rate of return for the security; this brings down the valuation of the stock up to a point where expected earnings yield offset inflation. While empirical research has shown consistently that stocks are a good hedge against inflation in the long-run, this study is focused on short-term. Therefore, including inflation will give us a good idea of the correlation between IPO performance and inflation. I have chosen yearly CPI index for all the countries. The data was obtained from the websites of the Central Banks.
- (2) **Interest rates:** Two equally compelling arguments have been put forward to describe relationship between interest rates and stock performance. On one side, rising interest rates signal a broad-based improvement in the economy; rising wages, higher spending, which leads to increased stock price. On the other hand, rising interest rates mean that companies have to pay a higher cost of interest, which results in a bigger portion of spending on the income statement, therefore leading to lower profits, and subsequently, lower earnings on stock. I have obtained data on yearly basis for the countries using multiple sources. T-bill rates are used as proxies for interest rates.
- (3) **Stock Indices:** I have chosen FTSE all shares index, S&P 500, and Nikkei Index, to study the relationship between the IPO underpricing and stock market return.
- (4) **Dummy variables:** Dummy variables or indicator variables take the value of either 0 or 1 to describe the effect on outcome. These are treated as quantitative variables, which take the value of either 0 or 1, depending on how they are categorized. I have chosen to model underpricing by regressing independent variables (prime variables) and control variables (years and industries) to account for the fixed industry and year effect.

### 4.5.3 Ordinary Least Squares

Ordinary Least Squares (OLS) method finds the line of best fit for a dataset.

Line of best fit depicts points plotted on a straight line and shows if the variables, dependent and independent, appear to be correlated. I will use the line of best fit to study the relationship between underpricing, my dependent variable, and independent variables that will assume different values based on formulated hypotheses presented earlier. Underpricing, a dependent variable in this study, will be plotted on Y-axis, while independent variables will be plotted on X-axis.

OLS minimizes the sum of the squares of errors generated by the equations, for example, differences in squared residuals from observed model and anticipated model. Once equation is generated, I will get coefficients that will be used to determine the level of dependence. It is of considerable significance to this study that parameters demonstrate BLUE characteristics. The following section sheds light on BLUE parameters.

### 4.5.4 BLUE parameters

BLUE parameters are ordinary assumptions of OLS, and are mentioned here for discussion purposes only. Estimated parameters are not tested in this study for BLUE properties.

Best Linear Unbiased Estimators are attributed to Gauss Markov theorem (Gujarati & Porter, 2009). BLUE properties of regression should be fulfilled when the necessary assumptions of linear regression model hold. If the errors have expectation of zero, are uncorrelated, and have equal variances, then OLS gives coefficients which exhibit BLUE properties. Following are the properties of BLUE estimators:

$$y_i = \sum_{j=1}^K \beta_j X_{ij} + \varepsilon_i \quad \forall i = 1, 2, \dots, n$$

$\beta_j$  = non-random and unobservable parameters

$X_j$  = explanatory variables

$\mathcal{E}$  = error term

(1) The estimator with the lowest error term is the best estimator as it is likely to be close to the parameter  $\beta$ . The following conditions must hold true:

(i)  $\mathbb{E}[\varepsilon_i] = 0$ . - mean of errors should be zero

(ii) Homoskedasticity  $\text{Var}(\varepsilon_i) = \sigma^2 < \infty$ ,

(iii) And distinct error terms must not be correlated  $\text{Cov}(\varepsilon_i, \varepsilon_j) = 0, \forall i \neq j$ .

(2) Regression should have linear coefficients.

$$\hat{\beta}_j = c_{1j}y_1 + \dots + c_{nj}y_n$$

(3) The estimator should be unbiased. It is unbiased only and when the following holds true:

$$\mathbb{E}[\hat{\beta}_j] = \beta_j$$

I will now put forward the assumptions of linear regression. These assumptions are taken directly from R-statistics webpage.

1. The regression model is linear in parameters.
2. The conditional mean of residuals is zero.
3. There is no autocorrelation between error terms.
4. The residuals have homoscedasticity or constant variance.
5. The dependent variable and error terms have no correlation.
6. The number of observations must be greater than Xs.
7. There is no perfect multicollinearity.
8. The residuals are normally distributed.
9. The explanatory variables do not have outliers but do have some variance.

10. The regression model is free of specification bias, meaning that relationships between variables are modeled correctly.

#### 4.5.5 Which assumptions will hold?

- The regression model is linear in parameters: the parameters will be kept linear and not quadratic.
- The conditional mean of residuals is zero: Inclusion of constant in the equation will ensure that the assumption is fulfilled.
- The dependent variable and error terms have no correlation: This assumption will not hold because of the specification error emanating from omitted variable. The explanatory variables might not be uncorrelated to the error term if explanatory variable is omitted. This could violate the properties of unbiased estimator.
- There is no autocorrelation between error terms: I am working with cross-sectional data, and autocorrelation is a problem when working with time series data.
- The number of observations must be greater than Xs: I have a sample of 2,731 IPOs; therefore, they will always exceed X and the assumption will be met.
- The explanatory variables do not have outliers but do have some variance: there are variances in the variables, this assumption will be met.
- The residuals are normally distributed: the size is large and therefore the population will have a normal distribution.
- Specification bias might occur as different variables will be included for testing the formulated hypotheses. This assumption may or may not be violated in this study.
- To control heteroscedasticity, I will use Robust Standard Errors.
- Multicollinearity is unanticipated.

## 5 RESULTS & DISCUSSION

In this section, I have discussed the results of underpricing in USA, UK, Hong Kong, Singapore, and Japan. I have provided descriptive statistics on a country level and industry level to study underpricing, and then provide statistics and regression results on a country level to study deeply about each individual market from our sample data. I have also provided and analyzed sector specific, and period specific descriptive data.

### 5.1 United States of America

A total of 1,301 IPOs was studied and analyzed between 2005 and 2015 in the USA. The analyzed IPOs include all exchange operators in the USA. These IPOs span multiple sectors, which are discussed in detail later. After filtering and cleaning data, the total amount raised in the USA from IPO proceeds between 2005 and 2015 was \$359 billion. Year-wise and sector wise breakup is as following:

Table 2 – Sector IPO proceeds (\$) - USA

Industrial Sector	Sum of Proceeds Amt inc. Over Sold - sum of all Mkts (\$ mil)
Consumer Products and Services	14,747
Consumer Staples	4,828
Energy and Power	45,709
Financials	123,491
Healthcare	30,861
High Technology	52,646
Industrials	18,103
Materials	12,469
Media and Entertainment	12,455
Real Estate	24,714
Retail	10,467
Telecommunications	8,199
<b>Grand Total</b>	<b>358,689</b>

As shown in Table 2, Financials sector lead the IPO markets during the period 2005-2015 constituting 34% of the total proceeds, and amounting to approximately \$125b. It was followed by High Technology sector which raised \$53b during the same period, and Energy and Power sector which constituted 13% of the total proceeds and amounted to \$46b in

proceeds raised. Consumer staples and Telecommunication sectors were at the bottom in terms of total IPO proceeds, constituting 1% and 2% respectively, and amounting to a combined \$13b in these ten years. Figure 11 shows the constituent percentages of sectors in total proceeds.

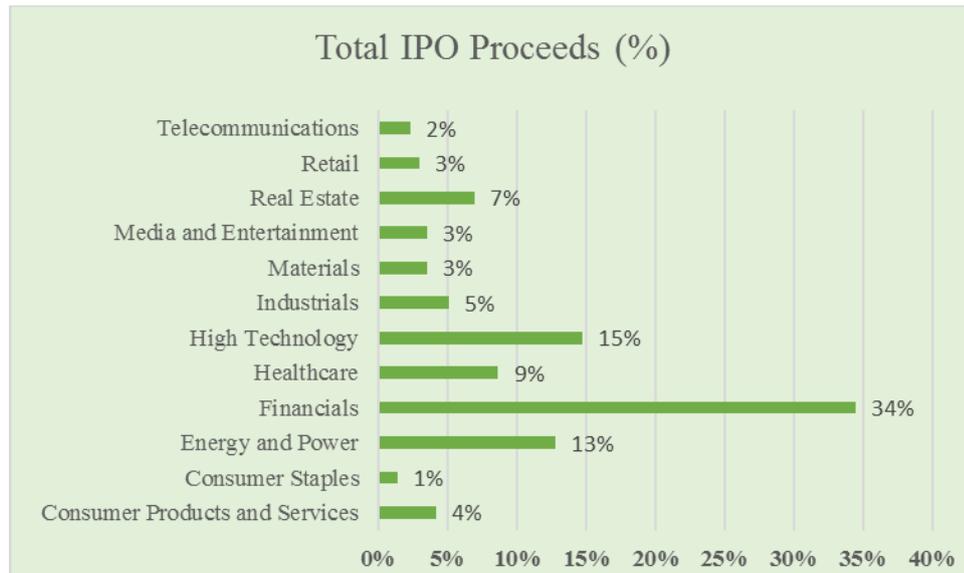


Figure 11 – Sector constitution in IPOs - USA

As shown in Figure 12, the Year 2005 in the USA, total proceeds were \$51b which constituted 14% of the total proceeds during 2005-2015. Year 2006 witnessed a decline of 17% YoY in terms of total proceeds, raising \$43b in total IPO proceeds. Year 2007 registered an increase of 38% YoY, and total IPO proceeds amounted to \$59b in 2007. Year 2008 witnessed the worst slump declining by a whopping 88% YoY in terms of total IPO proceeds, and only managed to register a total of \$7b during the year in IPO proceeds. Year 2009 showed the same signs, with a mere \$7.2b raised in total IPO proceeds. Year 2010 registered an increase of 19% YoY, with \$8.6b in total IPO proceeds. Years 2011 and 2012 showed massive recovery signs, registering a substantial increase of 84% and 127% YoY respectively, and registering \$16b and \$36b respectively in total proceeds. In Year 2013, the total proceeds crossed \$50b for the first time after 6 years, amounting to \$60b. The economy slowed down slightly in 2013, when total proceeds declined by \$10b YoY to \$49b. A pictorial representation of the periodic IPO activity is shown in Figure 12, lines fill in red

show cold-periods or bearish markets, where green-fill represents recovery or bullish markets.

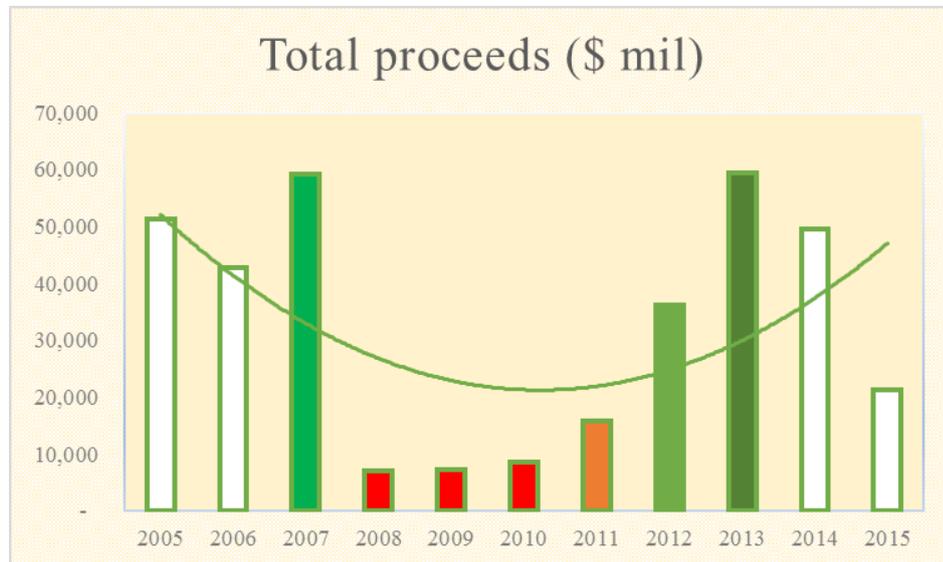


Figure 12 – Total IPO proceeds (yearly)

The above analysis provides ample framework for further discussion. I will now share the descriptive statistics on a cumulative level (across all industries) and years. Following that, I will do an industry specific analysis and discuss the results.

### 5.1.1 Underpricing results

Table 3 summarizes the results of descriptive statistics of IPO underpricing between 2005-2015 for USA.

Table 3 – Cumulative stats USA

<b>Descriptive statistics</b>	
<b>Mean</b>	18.4%
<b>Median</b>	4.4%
Mode	0
Standard Deviation	94.6%
Sample Variance	0.89
<b>Kurtosis</b>	686.28
<b>Skewness</b>	23.82
Range	29.99
Minimum	-0.99
Maximum	29.00
<b>Count</b>	1301.00
Largest(1)	29.00
Smallest(1)	-0.99
Confidence Level(95.0%)	0.05
75th percentile	19.7%

These calculations are done using simple initial return pricing. The difference between market adjusted pricing and simple initial return calculation was found out to be very insignificant, when considering the mean and standard deviation (Hunger, 2012a). The median underpricing in USA between 2005-2015 was found out to be 4.4%, indicating that more than 50% observations exhibited an initial return of 4.4%. Median, which is 4.4%, is lower than mean of 18.4%, means the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a very high skewness of 23.82. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 20%. 25<sup>th</sup> percentile showed 0.00%, which means that some observations contribute heavily to the mean.

A kurtosis of 686 is extremely high, and therefore, the distribution has thicker and longer right tail than left tail. The distribution of returns is not normally distributed.

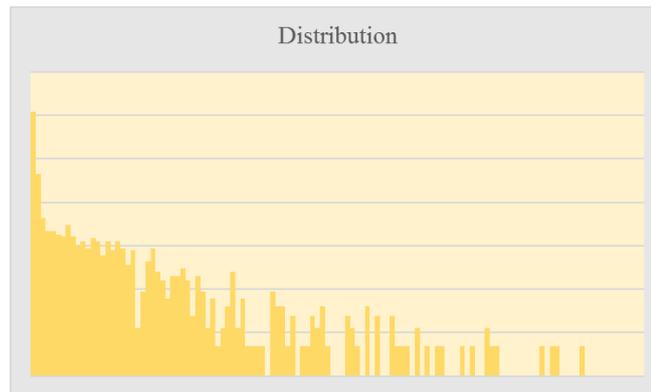


Figure 13

It is evident from Figure 13 that returns are not normally distributed. Non-normality of data can be ignored as the data size is large and, according to Gujarati & Porter (2009), means of sample from a population approach a normal distribution when the number of observations is large.

It is evident for USA that IPO offerings have not been fairly priced between 2005-2015. Regression results will confirm that.

Furthering the discussion and delving deeper into our analysis on IPO underpricing, I will now do a periodic analysis using descriptive statistics and couple the periodic analysis with industry. This periodic analysis is for the period of this study, which is between 2005 and 2015.

### **(1) Year 2005 – Hot period**

A total of 217 Initial Public Offerings happened in the USA in 2005 raising over \$51b, and suggesting an underpricing of 9.5% on average. Descriptive statistics for year 2005 in the USA are given in Table 4:

Table 4 – 2005 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
<b>2005</b>			
Consumer Products and Services	6%	790	5
Consumer Staples	31%	1,221	11
Energy and Power	19%	3,053	18
Financials	5%	24,004	72
Healthcare	16%	2,064	24
High Technology	13%	4,161	27
Industrials	6%	2,689	14
Materials	-5%	4,082	10
Media and Entertainment	18%	1,569	5
Real Estate	1%	3,609	11
<b>2005 Total</b>	<b>9.5%</b>	<b>51,279</b>	<b>217</b>

Consumer staples sector had the highest underpricing in 2005, followed by Media and Entertainment which showed a return of 18% on average. All sectors showed that stocks were underpriced in 2005 in the USA, except for Materials which registered an average overpricing of -5%.

Table 5 – 2005 stats U.S.

<b>Descriptive Statistics 2005</b>	
Mean	9.5%
Median	1.6%
Standard Deviation	21.5%
Sample Variance	0.05
Kurtosis	7.79
Skewness	1.55
Range	2.00
Minimum	-0.94
Maximum	1.059574
Count	217
Confidence Level(95.0%)	0.02881
75th percentile	14.89%

From Table 5, IPO's were underpriced by an average of 9.5% in 2005. The median underpricing 2005 was found out to be 1.6%, indicating that more than 50% observations exhibited an initial return of more than 1.6%. Median, which is lower than mean signals the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.55. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 15%.

## (2) Year 2006 – Hot period

In 2006, a total of 174 IPOs raised over \$42b and exhibited an underpricing of approximately 16%. Following are the descriptive statistics.

Table 6 - 2006 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
<b>2006</b>			
High Technology	36%	2,925	29
Consumer Staples	29%	799	4
Retail	22%	1,198	6
Industrials	18%	4,558	14
Energy and Power	15%	5,909	24
Consumer Products and Services	12%	4,257	13
Media and Entertainment	11%	755	3
Financials	11%	15,785	36
Healthcare	9%	1,822	28
Real Estate	5%	2,269	6
<b>2006 Total</b>	<b>16%</b>	<b>42,732</b>	<b>174</b>

On average, High Technology showed the highest underpricing of 36%, followed by Consumer Staples and Retail sector, both of which exhibited underpricing of 29%, and 22% on average. Lowest underpricing was in Healthcare, 9%, and the Real Estate sector which had an underpricing of 5%. Financial sector dominated the total proceeds section during the year with a total of more than \$15b raised.

Table 7 - 2006 IPOs stats U.S.

<b>Descriptive statistics - 2006</b>	
<b>Mean</b>	15.6%
<b>Median</b>	5.4%
Standard Deviation	0.29
Sample Variance	8.4%
Kurtosis	5.27
<b>Skewness</b>	2.20
<b>Range</b>	1.85
Minimum	-0.54
Maximum	1.31
Sum	27.18
<b>Count</b>	174.00
Confidence Level(95.0%)	0.04
75th percentile	0.18

Table 7 demonstrates that IPO's were underpriced by an average of 16% in 2006. The median underpricing 2006 was found out to be 5.4%, indicating that more than 50% observations exhibited an initial return of more than 5.4%. Median, which is lower than mean signals the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 2.20. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 18%.

### (3) Year 2007 – Hot Period

In 2007, a total of 200 IPOs raised over \$59b and exhibited an underpricing of approximately 16%. Following are the descriptive statistics.

Table 8 - 2007 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
<b>2007</b>			
Media and Entertainment	35%	1,526	3
Consumer Products and Services	35%	2,012	12
Industrials	31%	1,887	11
High Technology	24%	6,047	39
Retail	22%	504	4
Telecommunications	14%	2,294	7
Consumer Staples	13%	149	1
Financials	13%	32,729	57
Energy and Power	12%	5,835	21
Healthcare	7%	3,230	35
<b>2007 Total</b>	<b>16%</b>	<b>59,116</b>	<b>200</b>

Table 8 shows the sector proceeds, total IPOs, and underpricing %. Media and Entertainment, Consumer Products and Services, and Industrials all exhibited an underpricing of over 30% on average, followed by High Technology and Retail that registered underpricing of over 20% on average. Lowest underpricing was in Healthcare sector amounting to 7%. Financials again dominated the year by the highest number of offerings and total proceeds raised.

Table 9 - 2006 IPOs stats U.S.

<b>Descriptive statistics - 2007</b>	
<b>Mean</b>	16.3%
Median	4.21%
Standard Deviation	37.8%
<b>Sample Variance</b>	0.14
<b>Kurtosis</b>	29.00
Skewness	3.98
Range	4.35
Minimum	-0.91
<b>Maximum</b>	3.44
Sum	32.51
Count	200.00
Confidence Level(95.0%)	0.05
75th percentile	19.9%

In Table 9, we see that IPO's were underpriced by an average of 16% in 2007. The median underpricing 2006 was found out to be 4.2%, indicating that more than 50% observations exhibited an initial return of more than 4.2%. Median, which is lower than mean signals the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 3.98. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 20%.

#### **(4) Year 2008 – Cold Issue period**

In 2008, a total of just 20 IPOs raised a little over \$7b and exhibited an underpricing of approximately 6%. Following are the descriptive statistics.

Table 10 - 2008 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
<b>2008</b>			
Healthcare	31%	239	4
Materials	20%	1,272	2
Industrials	14%	580	3
Energy and Power	6%	2,137	5
Consumer Products and Services	2%	443	4
Real Estate	0%	476	2
Financials	-3%	1,047	6
Media and Entertainment	-4%	189	1
High Technology	-11%	749	3
<b>2008 Total</b>	<b>6%</b>	<b>7,132</b>	<b>30</b>

Healthcare sector in 2008 dominated IPO underpricing with over 31% return on average; it was followed by Materials and Industrials sector, which reported 20%, and 14% initial return respectively. Lowest underpricing was found in High Technology sector, which demonstrated that, on average, IPOs were overpriced by 11%.

Table 11 - 2008 IPOs stats U.S.

<b>Descriptive Statistics</b>	
<b>Mean</b>	6.2%
<b>Median</b>	-1.5%
Standard Deviation	24.9%
Sample Variance	0.06214
Kurtosis	6.33
<b>Skewness</b>	2.25
<b>Range</b>	1.21
Minimum	-0.21
Maximum	1.00
Sum	1.86
<b>Count</b>	30.00
Confidence Level(95.0%)	0.09
75th percentile	9.0%

Table 11 shows that IPO's were underpriced by an average of 9% in 2008. The median underpricing 2008 was found out to be -1.5%, indicating that more than 50% observations were overpriced. Median, which is lower than mean signals the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 2.25. There is evidence of more data in the right tail

than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 9%.

### Year 2009 – Cold Period

In 2009, a total of just 19 IPOs raised a little over \$7b and exhibited an underpricing of approximately 20%. Following are the descriptive statistics.

Table 12 - 2009 IPOs US.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
<b>2009</b>			
Consumer Products and Services	139%	414	1
High Technology	24%	2,684	5
Retail	18%	971	2
Financials	17%	1,012	4
Telecommunications	13%	279	1
Media and Entertainment	12%	1,093	1
Materials	0%	151	1
Real Estate	-1%	721	4
<b>2009 Total</b>	<b>20%</b>	<b>7,325</b>	<b>19</b>

Consumer Products and services had only one IPO and that was underpriced by 139%. High Technology stocks raised \$2.6b in total proceeds and were observed to be underpriced by 24%, Retail, Financials, Telecommunications, and Media and Entertainment sectors all exhibited underpricing by over 10% on average (Table 12).

Table 13 - 2009 IPOs stats U.S.

Descriptive Statistics	
Mean	20.2%
Median	12.0%
Standard Deviation	32.1%
Sample Variance	0.103
Kurtosis	10.986
Skewness	3.061
Minimum	-0.029
Maximum	1.388
Count	19
Confidence Level(95.0%)	0.154836
75th percentile	25.1%

IPO's were underpriced by an average of 20% in 2009. The median underpricing 2009 was found out to be 12%, indicating that more than 50% observations were overpriced. Median, which is lower than mean signals the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 3.06. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 25%. (Table 13)

### Year 2010 – Cold period

In 2010, a total of just 53 IPOs raised a little over \$8b and exhibited an underpricing of approximately 5.6%. Tables 14 and 15 show the descriptive statistics.

Table 14 - 2010 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
<b>2010</b>			
Media and Entertainment	15%	62	1
Energy and Power	11%	2,061	6
Telecommunications	10%	164	2
Consumer Products and Services	10%	573	7
Materials	10%	92	1
Healthcare	8%	589	8
Financials	7%	2,075	8
Industrials	5%	576	4
Retail	-1%	331	2
Real Estate	-2%	909	5
<b>Grand Total</b>	<b>5.6%</b>	<b>8,683</b>	<b>53</b>

Table 14 shows that Media and Entertainment sector had only one IPO and was underpriced by 15% based on initial market-adjusted return. Energy and Power sector exhibited that the IPOs in 2010 in the US were underpriced by an average of 11%, and total proceeds over \$2b were raised in the year. Telecommunications, Consumer Products and Services, and Materials sector accounted for \$700b of total IPO proceeds and registered IPO underpricing of over 10% on average. Financials sector had the highest IPO proceeds totaling nearly \$2.1b and registering underpricing of 7%. Retail and Real Estate Sectors were overpriced on average, and raised \$1.2b during the year.

Table 15 – 2010 IPO stats U.S.

<b>Descriptive Statistics</b>	
<b>Mean</b>	5.6%
<b>Median</b>	0.4%
Standard Deviation	21.8%
Sample Variance	0.05
<b>Kurtosis</b>	10.86
<b>Skewness</b>	-0.89
Range	1.76
Minimum	-96.4%
Maximum	79.6%
<b>Count</b>	53
Confidence Level(95.0%)	0.06009
75th percentile	13.3%

As seen in Table 15 IPO's were underpriced by an average of 5.6% in 2010. The median underpricing 2010 was found out to be 0.4%, indicating that more than 50% observations were overpriced. Median, which is lower than mean signals the distribution is skewed to the right. Some large observations are pulling the distribution to the left, which can be corroborated by a negative skewness of -0.89. There is evidence of more data in the left tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 13.3%.

### **Year 2011 – Cold period**

In 2011, the market showed signs of recovery in terms of total IPO proceeds which doubled to \$16b from previous year. Average underpricing for the year was 10%. However, a total of just 33 happened. Table 16 and Table 17 give the descriptive statistics.

Table 16 - 2011 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
<b>2011</b>			
Materials	70%	20	1
Retail	47%	486	1
Consumer Staples	21%	1,086	1
High Technology	19%	1,987	11
Healthcare	2%	5,242	6
Energy and Power	1%	4,450	6
Financials	-1%	2,091	5
Industrials	-3%	530	1
Media and Entertainment	-22%	42	1
<b>2011 Total</b>	<b>10%</b>	<b>15,933</b>	<b>33</b>

Only one IPO happened in the Materials sector and was underpriced by 70%. High Technology Sector had 11 IPOs and managed to raise about \$2b with an underpricing of 19%. Largest IPO proceeds were in Healthcare totaling over \$5b and registering an underpricing of just over 2%. Financials sector raised \$2.1b and was overpriced on average by 1%.

Table 17 - 2011 stats U.S.

Descriptive Statistics	
<b>Mean</b>	10.1%
<b>Median</b>	0.3%
Standard Deviation	30.7%
Sample Variance	0.09
<b>Kurtosis</b>	4.04
<b>Skewness</b>	-0.48
Range	1.74
Minimum	-95.3%
Maximum	78.9%
Count	33
Confidence Level(95.0%)	0.108835
75th percentile	23.0%

Table 17 shows that IPO's were underpriced by an average of 10% in 2011. The median underpricing 2011 was found out to be 0.3%, indicating that more than 50% observations were overpriced. Some large observations are pulling the distribution to the left, which can be corroborated by a negative skewness of -0.48. There is evidence of more data in the left tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 23%.

### Year 2012 – Hot period

In the year 2012, total IPOs tripled from 33 in the previous year to 96, raising cumulatively over \$37b, which was more than 200% compared to the previous year. On average, the IPOs were underpriced by 63% and underpricing phenomenon was observed across all sectors without exception. Tables 18 and 19 show the descriptive statistics:

Table 18 - 2012 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
<b>2012</b>			
Consumer Products and Services	238%	1,036	7
Financials	105%	7,606	32
Consumer Staples	75%	1	2
Media and Entertainment	71%	19	1
Telecommunications	31%	108	1
High Technology	25%	17,811	17
Industrials	15%	1,764	4
Retail	14%	546	4
Energy and Power	7%	3,630	11
Healthcare	6%	523	8
<b>2012 Total</b>	<b>63%</b>	<b>36,185</b>	<b>96</b>

Consumer Products and Services sector raised over \$1b in seven IPOs and demonstrated an underpricing over 238%. Most interesting observation was found in the Financial sector, where a total of 32 IPOs managed to raise \$7.6b in total proceeds, showing an underpricing of 105%. High Technology sector also gained momentum and raised approximately \$18b, with an underpricing of 25%.

Table 19 - 2012 stats U.S.

<b>Descriptive Statistics</b>	
<b>Mean</b>	62.6%
<b>Median</b>	5.4%
Standard Deviation	321.5%
Sample Variance	10.3
<b>Kurtosis</b>	66.9
<b>Skewness</b>	7.9
Range	29.6
Minimum	-0.6
Maximum	29
Count	96
Largest(1)	29
Smallest(1)	-0.6
Confidence Level(95.0%)	0.651504
75th percentile	26.8%

As seen in Table 19, IPO's were underpriced by an average of 63% in 2012. The median underpricing 2012 was found out to be 5.4%, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 7.9. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 27%.

### **Year 2013 – Hot period**

Year 2013 can be categorized as truly a year of recovery with total IPO deals increasing by more than 200% raising a cumulative of \$59b. The average underpricing during the year was 18%, and all the industrial sectors exhibited underpricing. The descriptive statistics for the year are in Tables 20 and 21:

Table 20 - 2013 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
<b>2013</b>			
Industrials	73%	3,112	11
Retail	51%	2,890	9
Consumer Staples	36%	942	3
High Technology	30%	5,124	25
Healthcare	22%	6,985	40
Consumer Products and Services	18%	2,939	8
Media and Entertainment	11%	4,999	7
Energy and Power	7%	7,684	19
Materials	6%	1,141	6
Financials	3%	17,151	46
<b>2013 Total</b>	<b>18%</b>	<b>59,314</b>	<b>194</b>

Healthcare sector registered a total of 40 IPOs with \$7b raised and witnessed an underpricing of 22% on average. The largest underpriced stocks were in Industrials sector where \$3b were raised at over 73% underpricing. Retail sector raised \$3b with an average underpricing of 51%. Most industries with the exception of Energy and Power, Materials, and Financial sector registered an underpricing of over 20%. Largest IPO proceeds were in the Financial sector with over \$17b raised at an underpricing of just over 3%.

Table 21 - 2013 stats U.S.

Descriptive Statistics	
<b>Mean</b>	18.0%
<b>Median</b>	3.6%
Standard Deviation	54.3%
Sample Variance	0.3
<b>Kurtosis</b>	115.0
<b>Skewness</b>	9.6
Range	7.0
Minimum	-0.2
Maximum	6.8
Count	194
Largest(1)	6.8
Smallest(1)	-0.23
Confidence Level(95.0%)	0.08
75th percentile	24.1%

IPO's were underpriced by an average of 18% in 2013. The median underpricing 2013 was found out to be 3.6%, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a

positive skewness of 9.6. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 24.1%.

### Year 2014 – Hot period

In 2014, the total IPO activity cooled down slightly with 176 IPOs raising \$50b at an average underpricing of 18% approximately. All sectors showed underpricing with the exception of telecommunications which was fairly priced. Descriptive statistics are shown in Table 22 and Table 23 as following:

Table 22 - 2014 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
Consumer Staples	250.00%	3	1
Retail	35.65%	1,180	7
High Technology	29.87%	5,728	30
Healthcare	17.81%	6,027	62
Telecommunications	0	458	1
Consumer Products and Services	14.69%	651	4
Energy and Power	12.51%	8,656	15
Industrials	9.67%	1,746	8
Materials	8.95%	2,242	5
Financials	6.00%	17,591	33
Real Estate	0.46%	3,636	6
<b>Grand Total</b>	<b>17.5%</b>	<b>49,623</b>	<b>176</b>

Consumer and Staples deals were underpriced by over 250%, and raised nearly \$3m in total proceeds through a single IPO. High Technology sector raised \$5.7b through 30 IPOs and registered an underpricing of over 30%. There were 33 IPOs in the Financial sector during 2014 raising over \$17.5b at an average underpricing of 6%. Energy sector followed the Financial sector and raised the highest proceeds totaling over \$8.5b in 15 IPOs registering an underpricing of 12.5% on average, followed by Healthcare where \$6b were raised through 62 IPOs at an underpricing of 18% on average.

Table 23 - 2014 stats U.S.

<b>Descriptive statistics</b>	
<b>Mean</b>	17.5%
<b>Median</b>	7.2%
Standard Deviation	36.6%
Sample Variance	0.13
<b>Kurtosis</b>	13.81
<b>Skewness</b>	2.88
Range	3.49
Minimum	-0.99
Maximum	2.5
Count	176
Largest(1)	2.5
Smallest(1)	-0.99
Confidence Level(95.0%)	0.05
75th percentile	23.4%

From Table 23, we can see that IPO's were underpriced by an average of 17.5% in 2014. The median underpricing 2014 was found out to be 7.2%, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 2.88. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 23.4%.

### **Year 2015 – Hot period**

In 2015, a total of 109 IPOs raised over \$21b with an average underpricing of 19.2%. Only Consumer Staples sector and Energy and Power sectors registered an average overpricing of -4.65%. Descriptive statistics are given in Table 24 and Table 25.

Table 24 - 2015 IPOs U.S.

Industrial Sector	Premium over offer price	Sum of Proceeds (\$m)	Total IPOs
Consumer Products and Services	42.34%	1,633	7
Retail	37.39%	1,406	7
High Technology	27.11%	4,179	16
Healthcare	21.74%	4,140	42
Media and Entertainment	10.88%	495	2
Industrials	9.90%	661	4
Financials	6.71%	2,401	16
Real Estate	5.43%	2,775	6
Materials	5.08%	758	3
Consumer Staples	-4.64%	627	2
Energy and Power	-4.65%	2,293	4
<b>Grand Total</b>	<b>19.2%</b>	<b>21,367</b>	<b>109</b>

Healthcare sector had the largest number of IPOs with 42 deals raising just over \$4b and registering an underpricing of 22%. Highest underpricing was observed in Consumer Products and Services sector where the stocks were underpriced at an average of 42.34%, it was followed by Retail sector which registered \$1.4b in total IPO proceeds from 7 IPOs at an average underpricing of 37.3%. All sectors exceeded underpricing by 5%, with the exception of Consumer Staples and Energy and Power where about \$2.8b were raised through 6 IPOs, at a combined overpricing of 4.65% on average.

Table 25 - 2010 stats U.S.

Descriptive Statistics	
<b>Mean</b>	19.2%
<b>Median</b>	7.9%
Standard Deviation	38.2%
Sample Variance	0.15
<b>Kurtosis</b>	9.95
<b>Skewness</b>	2.80
Range	2.44
Minimum	-0.27
Maximum	2.17
Count	109.00
Largest(1)	2.17
Smallest(1)	-0.27
Confidence Level(95.0%)	0.07
75th percentile	25.5%

Table 25 shows that IPO's were underpriced by an average of 19.2% in 2015. The median underpricing 2015 was found out to be 7.9%, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 2.80. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 25.5%

### 5.1.2 Regression results

Table 26 – Regression results U.S.

Underpricing	[1]	[2]	[3]	[4]
<b>Proceeds</b>	-16.338 (-7.86)*	-16.739 (-7.79)*	-18.929 (-8.17)*	-18.081 (-7.72)*
<b>S&amp;P 500</b>	21.497 (-8.58)*	14.703 (0.61)	6.497 (0.64)	13.571 (0.56)
<b>Oversubscription</b>	0.0889 (1.59)	0.995 (1.78)	0.138 (2.41)**	0.118 (2.04)**
<b>Interest rates</b>	-0.93 (-0.58)			
<b>Inflation</b>	-1.187 (-0.45)			
<b>Constant</b>	0.82 (0.817)	0.223 (0.220)	0.613 (1.250)	0.381 (0.360)
<b>Industry</b>	No	No	Yes	Yes
<b>Year</b>	No	Yes	No	Yes
<b>R<sup>2</sup></b>	0.0789	0.0877	0.0827	0.106
<b>N</b>	1301	1301	1301	1301

\* Significant at 1% level of significance

\*\* Significant at 5% level of significance

(t-stats) are given in paranthesis

Table 26 gives the regression results for the USA. Based on these results, I conclude that IPOs were not fairly priced in the USA between 2005-2015 and reject Hypothesis 1. Results also show that underpricing was influenced by the periods, therefore, Hypothesis 2 is also rejected. IPO underpricing was not found to be independent of the firm's size (IPO

proceeds), hence Hypothesis 3 is rejected. There was a strong effect of stock market on IPO underpricing, leading me to reject Hypothesis 4. Hypothesis 5 is rejected because oversubscribed shares were found to have higher underpricing.

## 5.2 Japan

In this section, I have discussed the IPOs in Japan between 2005-2015. During this period, 527 IPOs happened, and raised \$19.8b across various industries. Descriptive statistics and sector-wise breakdown are given in the following sections:

Table 27 - Total IPO proceeds, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs
Consumer Products and Services	2,382	77
Consumer Staples	828	20
Energy and Power	82	5
Financials	1,433	19
Government and Agencies	152	1
Healthcare	844	35
High Technology	2,991	136
Industrials	1,877	52
Materials	961	26
Media and Entertainment	2,066	33
Real Estate	4,722	51
Retail	1,223	68
Telecommunications	244	4
<b>Grand Total</b>	<b>19,805</b>	<b>527</b>

Real Estate sector led the Japanese IPO market during the period cumulating nearly \$5b in total IPO proceeds spanning 51 IPO deals, and constituted 24% of the total proceeds. It was followed by High Technology sector, which raised nearly \$3b in total IPO proceeds with 136 deals, and accounted for 15% of the total proceeds. Consumer Products and Services accounted for 12% of the total proceeds, clocked over \$2b in proceeds with 77 IPO deals happening during the period. Financial sector registered total IPO proceeds of \$1.4b and had 19 deals accounting for 7% of the total proceeds. Telecommunications, Government and Agencies, and Energy and Power were had low IPO activity, and registered \$244m, \$152m, and \$82m respectively. Pictorial representation is given in Figure 14.

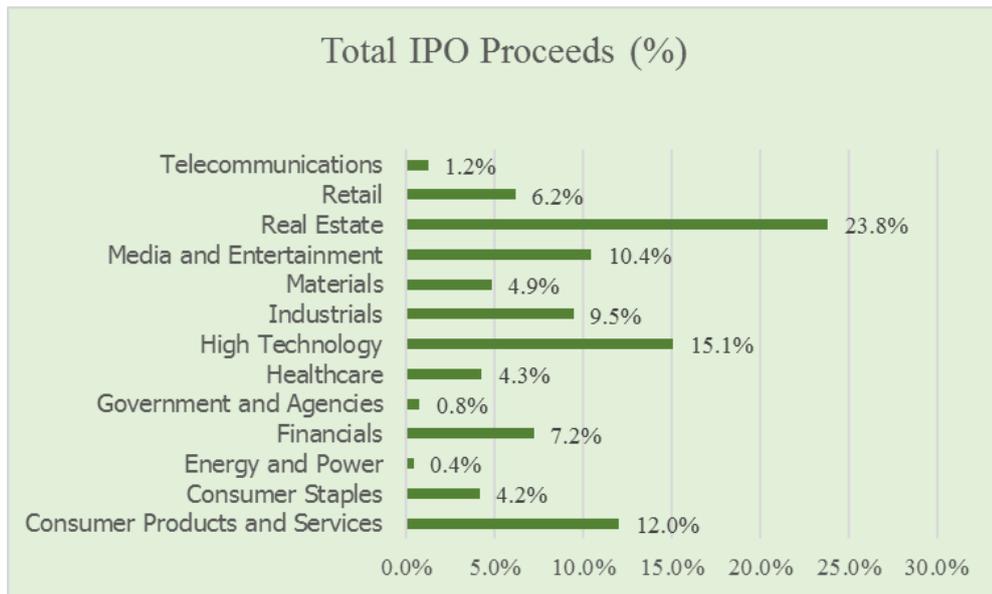


Figure 14 - Sector constitution in IPOs, Japan

Year 2006 witnessed the highest IPO activity in Japan, where a total of \$7.2b were raised through 135 IPOs. This followed a strong preceding year 2005, when 89 IPOs resulted in total proceeds amounting to \$3.6b. Total IPO activity slowed down from 2007 onward, unlike in the “Western” markets where it peaked, and amounted to only \$1.6b in total proceeds through 35 IPOs. The downward trend continued in 2008 till 2012, where a cumulative of \$3.5b were raised in 128 IPOs, which was slightly pulled up by 2010, where 16 IPOs amounting to \$1.6b in proceeds happened. Japanese market recovered in 2013, when it registered over \$1.6b in total proceeds through 35 IPO deals. The market declined again in 2014 and 2015, where cumulatively less than \$2b proceeds were collected through 53 deals across all sectors. Graphically, Figure 15 represents the split.



Figure 15 - Total IPO proceeds (yearly), Japan

The above analysis provides ample framework for further discussion. I will now share the descriptive statistics on a cumulative level (across all industries) and years. Following that, I will do an industry specific analysis and discuss the results.

### 5.2.1 Underpricing results

Following table summarizes the results of descriptive statistics of IPO underpricing between 2005-2015 for Japan.

Table 28 - Cumulative stats, Japan

Descriptive Statistics	
Mean	37.1%
Median	24.7%
Standard Deviation	53.44%
Sample Variance	28.5576
Kurtosis	1.91
Skewness	1.31
Range	325.89
Minimum	-0.44
Maximum	2.82
Count	527.00
Confidence Level(95.0%)	0.05
75th percentile	23.29

These calculations are done using non-market adjusted pricing due to non-availability of data for Japan. The median underpricing in Japan between 2005-2015 was found out to be 24.7%, indicating that more than 50% observations exhibited an initial return of 24.7%. Median, which is 24.7%, is lower than mean of 37.1%, means the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.31. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 23%.

Non-normality of data can be ignored as the data size is large and, according to Gujarati & Porter (2009), means of sample from a population approach a normal distribution when the number of observations is large.

We can observe in Japan that IPO offerings have not been fairly priced between 2005-2015.

Furthering the discussion and delving deeper into our analysis on IPO underpricing, I have done a periodic analysis using descriptive statistics and couple the periodic analysis with industry. This periodic analysis is for the period of this study, which is between 2005 and 2015.

### **(1) Year 2005 – Hot period**

In 2005, IPOs were underpriced by an average of 62% across all industries. Highest underpricing was found in Consumer Products and Services, which was underpriced by 98%.

Table 29 - 2005 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	126	10	98.7
Consumer Staples	255	8	49.0
Energy and Power	10	1	21.3
Financials	306	3	49.5
Healthcare	264	5	28.7
High Technology	304	19	77.4
Industrials	138	10	63.6
Materials	291	4	40.9
Media and Entertainment	665	5	39.8
Real Estate	928	11	65.3
Retail	166	11	50.0
Telecommunications	201	2	37.2
<b>Grand Total</b>	<b>3,654</b>	<b>89</b>	<b>61.8</b>

Table 29 shows that a total of 89 IPOs happened in Japan in 2005 and raised over \$3.6b in total proceeds. Real Estate Sector led the IPO market with over \$928m in total proceeds at an average of 65% underpriced securities. It was followed distantly by Media and Entertainment, which had 5 IPOs, clocked over \$650m in total proceeds, and exhibited underpricing of 40%. Least underpricing occurred in Energy and Power, where only one IPO raised \$10m at 21% underpriced securities. Financial sector also clocked in \$306m, and was found to be underpriced by 50% on average. High Technology had \$300m in total proceeds with average underpricing of 77%. None of the industries had overpriced securities offerings in 2005 in Japan.

Table 30 shows the descriptive statistics for the year.

Table 30 – 2005 stats, Japan

Descriptive Statistics	
Mean	61.85
Median	47.27
Standard Deviation	52.81
Sample Variance	27.89
Kurtosis	2.26
Skewness	1.30
Range	275.00
Minimum	-17.43
Maximum	257.58
Count	89.00
Confidence Level(95.0%)	11.12
75th percentile	86.236

Table 30 shows that the median underpricing 2005 was found out to be 47.27%, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.3. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 86.2%.

### Year 2006 – Hot period

As shown in Table 31, in 2006, a total of 135 IPOs happened in Japan, raising a little over \$7.2b, at an average underpricing of 33%. Real Estate sector led the overall IPO market in the country, with proceeds totaling over \$2.6b through 13 deals, at an average underpricing of 28%.

Table 31 - 2006 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	745	17	41.2
Consumer Staples	79	4	(2.8)
Financials	362	5	32.9
Government and Agencies	152	1	(1)
Healthcare	37	4	(2.5)
High Technology	798	39	34.4
Industrials	345	12	21.7
Materials	475	10	42.8
Media and Entertainment	1,129	6	28.2
Real Estate	2,639	13	28.3
Retail	465	22	31.2
Telecommunications	44	2	195.4
<b>Grand Total</b>	<b>7,270</b>	<b>135</b>	<b>33.2</b>

This was followed distantly by Media and Entertainment sector, where total IPO proceeds amounted to over \$1b in 6 IPO deals at an average underpricing of 28% again. Government and Agencies had one IPO during the year, which raised \$150m, and was found to be overpriced by 1%. Perhaps, the Government Agencies had no incentive to underprice the issue, this is confirmed by our literature review, where I have discussed management incentives to engage in the phenomenon of underpricing. Consumer Staples sector had raised \$79m in 4 IPO deals during the period, and was found to be overpriced at an average of

2.8%. Healthcare sector was also overpriced by 2.5%, and raised \$37m in total proceeds. Highest underpricing as found in Telecommunications sector, which raised just over \$40m at an average underpricing of over 195%.

Following are the descriptive statistics for the year in Table 32:

Table 32 – 2006 stats, Japan

<b>Descriptive Statistics</b>	
Mean	33.25
Median	16.59
Standard Deviation	49.46
Sample Variance	24.46
Kurtosis	2.14
Skewness	1.47
Range	260.32
Minimum	-26.98
Maximum	233.33
Count	135.00
Confidence Level(95.0%)	8.42
75th percentile	44.143

In Table 32, we can see that the median underpricing 2006 was found out to be 16.6%, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.47. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 44.14%.

### **Year 2007 – Cold Period**

In 2007, a total of 87 IPOs raised just a little over \$1.6b, exhibiting an average underpricing of 29%. Industrial sector led the IPO market in terms of total proceeds, which clocked in at \$382m, at an average underpricing of 8.8%. High Technology sector followed at number two spot in terms of total IPO proceeds, registering \$377m at an average underpricing of 47.5%. Consumer Products and Services had 8 IPOs, raised over \$250m, and exhibited an

underpricing of 9%. Consumer Staples had just two IPOs during the year, raising \$15m at an average underpricing of 27.6%. Media and Entertainment sector had six IPOs, and registered over \$38m in total proceeds, at an average underpricing of 25%. Real Estate sector had 8 IPOs totaling \$160m in total proceeds, at an average underpricing of 9.4%.

Table 33 – 2007 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	257	8	8.9
Consumer Staples	15	2	27.6
Energy and Power	25	1	20.7
Financials	177	4	50.5
Healthcare	60	6	(3.5)
High Technology	377	30	47.2
Industrials	382	6	8.8
Materials	34	3	31.1
Media and Entertainment	38	6	24.6
Real Estate	160	8	9.4
Retail	138	13	29.4
<b>Grand Total</b>	<b>1,663</b>	<b>87</b>	<b>28.7</b>

Healthcare sector raised \$60m in total proceeds through 6 IPOs and was overpriced by 3.5%. This was the only sector during the year which exhibited overpriced securities.

Following are the descriptive statistics for the year:

Table 34 – 2007 stats Japan

Descriptive Statistics	
Mean	28.68
Median	20.71
Standard Deviation	50.69
Sample Variance	25.70
Kurtosis	0.94
Skewness	1.15
Range	224.10
Minimum	-33.48
Maximum	190.63
Count	87.00
Confidence Level(95.0%)	10.80
75th percentile	54.117

From Table 34 we can see that the median underpricing 2007 was found out to be 20.7%, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of

1.15. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 54.11%.

### Year 2008 – Cold period

In 2008, a total of 38 IPOs raised just over \$747m at an average underpricing of 7%. This is similar to our findings for the US., where stocks were underpriced less during cold periods.

Table 35 – 2008 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	28	6	13.7
Consumer Staples	5	1	(2.2)
Financials	29	2	19.7
Healthcare	38	4	21.6
High Technology	177	6	47.8
Industrials	110	3	(14.4)
Materials	20	3	(19.6)
Media and Entertainment	24	5	4.5
Real Estate	296	5	(15.0)
Retail	19	3	(21.7)
<b>Grand Total</b>	<b>747</b>	<b>38</b>	<b>7.2</b>

Table 35 shows that Real Estate sector again led the market in terms of total proceeds, registering just under \$300m in total proceeds at an overpricing of 15%. This was followed distantly by High Technology sector, where six IPOs raised \$177m in total IPO proceeds at an average underpricing of 48%. Retail sector was overpriced by 22%, and raised just under \$20m in three IPO deals. Industrials sector, which raised \$100m in three IPOs was also found to be overpriced by 14.4%. Consumer Staples sector had just one IPO, clocking \$5m in total proceeds, at an average overpricing of 2.2%. Materials sector was also overpriced by 20%, and raised \$20m in three IPOs.

Table 36 gives descriptive statistics for the year:

Table 36 – 2008 stats, Japan

<b>Descriptive Statistics</b>	
Mean	7.18
Median	-7.01
Standard Deviation	42.00
Sample Variance	17.64
Kurtosis	2.26
Skewness	1.48
Range	193.95
Minimum	-43.95
Maximum	150.00
Count	38.00
Confidence Level(95.0%)	13.80
75th percentile	31.41775

The median underpricing 2008 was found out to be -7%, indicating that more than 50% observations were overpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.48. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 31.42%.

### **Year 2009 – Cold period**

In 2009 in Japan, a total of 16 IPOs raised just \$450m at an average underpricing of 37%. Industrials sector led the total IPO market, in terms of proceeds, totaling \$225m at an average overpricing of 3%. It was followed by Consumer Products and Services, where five IPOs raised \$107m at an average underpricing of 54%.

Table 37 – 2009 IPOs, Japan

<b>Industrial Sector</b>	<b>Total IPO Proceeds (\$mil)</b>	<b>Total IPOs</b>	<b>Under (over) pricing %</b>
Consumer Products and Services	107	5	53.9
Healthcare	50	3	12.2
High Technology	12	2	71.8
Industrials	225	3	(2.6)
Media and Entertainment	3	1	164.4
Retail	54	2	(7.7)
<b>Grand Total</b>	<b>450</b>	<b>16</b>	<b>37.0</b>

Table 37 shows that Media and Entertainment sector exhibited the highest underpricing at 164% through one IPO that raised \$3m. Retail sector, which raised \$54 m in two IPOs, was found to be overpriced by 8%.

Table 38 gives the descriptive statistics for 2009.

Table 38 – 2009 stats, Japan

<b>Descriptive Statistics</b>	
Mean	36.96
Median	23.80
Standard Deviation	55.99
Sample Variance	31.35
Kurtosis	0.79
Skewness	1.29
Range	184.91
Minimum	-20.47
Maximum	164.44
Count	16.00
Confidence Level(95.0%)	29.83
75th percentile	57.291

The median underpricing 2009 was found out to be 24%, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.29. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 57.3%.

### **Year 2010 – Cold period**

In 2010, there was a total of 16 IPOs that managed to register total proceeds of \$1.2b, and exhibited an average underpricing of 11.4%. The IPO market was led by Consumer Products and Services, which raised \$608m in five IPOs at an average underpricing of 13%. It was followed by Consumer Staples where just one IPO raised \$432m at an average overpricing of 3%.

Table 39 – 2010 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	608	5	12.6
Consumer Staples	432	1	(2.8)
Financials	10	1	(5.8)
Healthcare	40	2	7.6
High Technology	117	5	28.6
Industrials	7	1	(26.9)
Retail	6	1	(2.9)
<b>Grand Total</b>	<b>1,220</b>	<b>16</b>	<b>11.4</b>

From Table 39, we can see that the Financial sector had one IPO and clocked in \$10m of total IPO proceeds at an overpricing of 6%. Industrial sector, which also had just one IPO and raised \$7m, was found to have overpriced securities by 27%. Retail sector managed to raise just \$6m in total proceeds through one IPO and was overpriced by 3%. Only Healthcare, which raised \$40m in two IPOs, and High Technology, which raised \$117m in five IPOs, were overpriced at 8% and 29% respectively.

Table 40 gives the descriptive statistics for the year:

Table 40 – 2010 stats, Japan

Descriptive Statistics	
Mean	11.42
Median	-2.82
Standard Deviation	44.65
Sample Variance	19.94
Kurtosis	2.54
Skewness	1.84
Range	146.50
Minimum	-26.86
Maximum	119.64
Count	16.00
Confidence Level(95.0%)	23.79
75th percentile	11.994

The median underpricing 2010 was found out to be -3%, indicating that more than 50% observations were overpriced, as seen in Table 39. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.84. There is

evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 12%.

### Year 2011 – Cold Period

A total of 25 IPOs raised \$484m at an average underpricing of 14% in 2011. The IPO market was led by Industrials sector, which raised \$141m in total proceeds through four IPOs, and demonstrated an average underpricing of 8.3%. This was followed by Consumer Products and Services sector, where 5 IPOs raised \$115m at an underpricing of just under 2%.

Table 41 – 2011 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	115	5	1.8
Consumer Staples	5	1	(0.5)
Energy and Power	23	1	(2.1)
Financials	6	1	33.9
High Technology	76	5	60.4
Industrials	141	4	8.3
Materials	62	2	(4.6)
Real Estate	23	3	(3.8)
Retail	33	3	(1.7)
<b>Grand Total</b>	<b>484</b>	<b>25</b>	<b>14.0</b>

High Technology sector raised \$76m in total proceeds at an average underpricing of 60.4% in five IPOs. Retail, Real Estate, Materials, Energy and Power, and Consumer Staples sectors, were found to be overpriced by 2%, 4%, 5%, 2%, and 0.5% respectively.

Table 42 gives the descriptive statistics for the year 2011 in Japan.

Table 42 – 2011 stats, Japan

Descriptive Statistics	
Mean	13.98
Median	-2.11
Standard Deviation	39.51
Sample Variance	15.61
Kurtosis	1.72
Skewness	1.42
Range	164.40
Minimum	-41.07
Maximum	123.33
Count	25.00
Confidence Level(95.0%)	16.31
75th percentile	31.4

The median underpricing 2011 was found out to be -2.11%, indicating that more than 50% observations were overpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.42. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 31.4%.

### Year 2012 – Cold period

In 2012, a total of 33 IPOs raised over \$680m in total IPO proceeds at an average underpricing of 46%. Financial sector led the Japanese IPO market, and raised over \$280m in two IPO deals at an average underpricing of 23%. It was followed by High Technology sector, where a total of 8 IPOs, registered proceeds of \$107m at a massive underpricing of 95%.

Table 43 – 2012 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	67	6	14.3
Consumer Staples	19	1	67.2
Financials	283	2	23.0
Healthcare	90	4	14.0
High Technology	107	8	94.9
Industrials	26	2	60.6
Materials	33	2	(2.0)
Media and Entertainment	12	2	85.0
Real Estate	1	1	24.4
Retail	43	5	38.8
<b>Grand Total</b>	<b>682</b>	<b>33</b>	<b>46.0</b>

As seen in Table 43, only Materials sector, which had two IPOs and clocked in \$33m in total proceeds was found to be overpriced by 2%. Media and Entertainment raised \$12m at an average underpricing of 85%. Lowest underpricing was found in Consumer Products and Services sector, which raised \$67m in proceeds and exhibited average underpricing of 14.3%.

Following are the descriptive statistics for the year:

Table 44 – 2012 stats, Japan

<b>Descriptive Statistics</b>	
Mean	46.04
Median	26.32
Standard Deviation	63.60
Sample Variance	40.45
Kurtosis	4.80
Skewness	1.93
Range	298.61
Minimum	-16.67
Maximum	281.94
Count	33.00
Confidence Level(95.0%)	22.55
75th percentile	66.95

IPO's were underpriced by an average of 46% in 2012. The median underpricing 2012 was found out to be 26.3%, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.93. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 67%.

### **Year 2013 – Hot period**

Year 2013 showed signs of recovery in the Japanese IPO market, where a total of 35 IPOs raised over \$1.6b in total proceeds, at an average underpricing of 54%. The market was led by Real Estate sector, where five IPOs registered \$500m in total proceeds, at an average

underpricing of 17%. This was followed by High Technology sector, which clocked in \$300m through seven IPOs at an underpricing of 51%.

Table 45 – 2013 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	139	5	64.4
Energy and Power	23	2	14.8
Financials	258	1	5.0
Healthcare	93	3	98.3
High Technology	301	7	50.8
Industrials	229	6	76.1
Materials	29	1	31.5
Media and Entertainment	16	2	7.2
Real Estate	499	5	17.1
Retail	30	3	97.1
<b>Grand Total</b>	<b>1,618</b>	<b>35</b>	<b>53.9</b>

Lowest underpricing was found in Financial sector at 5%, where one IPO raised \$258m. Media and Entertainment was also relatively less underpriced at 7%, and raised \$16m in two IPOs. Healthcare sector was underpriced by over 98%, had three IPOs, and registered \$93m in total proceeds. Retail sector, which raised \$30m in three IPOs, was also underpriced by 97%.

Following are the descriptive statistics for the year:

Table 46 – 2013 stats, Japan

Descriptive Statistics	
Mean	53.89
Median	31.45
Standard Deviation	61.96
Sample Variance	38.40
Kurtosis	1.63
Skewness	1.47
Range	244.81
Minimum	-11.47
Maximum	233.33
Count	35.00
Confidence Level(95.0%)	21.29
75th percentile	68.857

From Table 46, we see that the median underpricing 2013 was found out to be 31.45 %, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.47. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 69%.

### Year 2014 – Hot period

In 2014, there were 23 IPO deals in Japan, which managed to register over \$1b in total proceeds at an average underpricing of 47%. High Technology sector led the total IPO market raising \$463m in seven IPO deals at an underpricing of 61%.

Table 47 gives sector split of the IPO deals.

Table 47 – 2014 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	98	5	25.4
Consumer Staples	9	1	5.2
Healthcare	118	3	120.9
High Technology	463	7	60.6
Industrials	249	2	9.1
Media and Entertainment	45	2	23.7
Real Estate	6	1	54.8
Retail	124	2	15.8
<b>Grand Total</b>	<b>1,111</b>	<b>23</b>	<b>46.6</b>

This was followed distantly by Industrial sector where two IPOs raised just under \$250m, and exhibited an underpricing of 9%. All sectors were underpriced without exception, with the highest underpricing found in the Healthcare sector at 121% in three deals that clocked in \$118m in total proceeds. Lowest underpricing was found in Consumer Staples sector at 5% in one IPO deal that raised \$9m in total proceeds.

Following are the descriptive statistics for the year:

Table 48 – 2014 stats, Japan

Descriptive Statistics	
Mean	46.57
Median	53.33
Standard Deviation	55.65
Sample Variance	30.97
Kurtosis	-0.79
Skewness	0.51
Range	189.51
Minimum	-29.90
Maximum	159.62
Count	23.00
Confidence Level(95.0%)	24.06
75th percentile	76.447

Table 48 shows that median underpricing 2014 was found out to be 53 %, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 0.5. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 76%.

### Year 2015 – Hot period

In 2015, there were 30 IPOs in Japan, which registered over \$900m in total proceeds and exhibited average underpricing of 38%. High Technology sector led the overall IPO market in terms of proceeds, registering \$257m in eight IPO deals at an average underpricing of 47%. This was followed by Real Estate sector, which raised \$170m in four IPOs at an average underpricing of 33%.

Table 49 – 2015 IPOs, Japan

Industrial Sector	Total IPO Proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	92	5	46.9
Consumer Staples	10	1	4.8
Healthcare	54	1	(12.0)
High Technology	257	8	47.2
Industrials	26	3	30.7
Materials	17	1	40.1
Media and Entertainment	134	4	36.8
Real Estate	170	4	32.9
Retail	146	3	49.5
<b>Grand Total</b>	<b>906</b>	<b>30</b>	<b>38.8</b>

Healthcare sector had one IPO, and raised \$54m exhibiting an overpricing of 12%. Highest underpricing was found in the Retail sector at 50%, where \$146m were raised in three IPOs. Consumer Products and Services raised \$92m in five IPOs and exhibited an underpricing of 47% on average. Lowest underpricing was observed in the Consumer Staples sector at 5%, which raised \$10m in one IPO.

Table 50 gives descriptive statistics for the year:

Table 50 – 2015 stats, Japan

<b>Descriptive Statistics</b>	
Mean	38.82
Median	29.68
Standard Deviation	47.31
Sample Variance	22.38
Kurtosis	0.43
Skewness	1.02
Range	184.74
Minimum	-19.38
Maximum	165.36
Count	30.00
Confidence Level(95.0%)	17.67
75th percentile	67.103

As shown in Table 50, median underpricing 2015 was found out to be 30 %, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.02. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 67%.

### **5.2.2 Regression results**

Table 51 gives the regression results for Japan. Based on these results, I conclude that IPOs were not fairly priced in the USA between 2005-2015 and reject Hypothesis 1. Results also show that underpricing was influenced by the periods, therefore, Hypothesis 2 is also rejected. IPO underpricing was not found to be independent of the firm's size (IPO proceeds), hence Hypothesis 3 is rejected. There was a strong effect of stock market on IPO

underpricing, leading me to reject Hypothesis 4. Hypothesis 5 is rejected because oversubscribed shares were found to have higher underpricing.

Table 51

<b>Underpricing</b>	[1]	[2]	[3]	[4]
<b>Proceeds</b>	-13.916 (-7.29)*	-13.918 (-7.23)*	-13.17 (-6.59)*	-14.259 (-7.25)*
<b>Nikkei 500</b>	33.863 (13.84)*	26.52 (11.852)*	45.637 (5.20)*	53.541 (-7.257)*
<b>Oversubscription</b>	0.024 (0.52)	0.0758 (1.42)	-0.1046 (2.06)**	0.09 (-1.67)***
<b>Interest rates</b>	-5.948 (-5.49)*			
<b>Inflation</b>	-3.618 (-1.23)			
<b>Constant</b>	-0.256 (-1.10)	0.676 (4.98)*	0.2755 (0.79)	1.426 (5.01)*
<b>Industry</b>	No	No	Yes	Yes
<b>Year</b>	No	Yes	No	Yes
<b>R<sup>2</sup></b>	0.1538	0.1559	0.1504	0.225
<b>N</b>	527	527	527	527

\* Significant at 1% level of significance  
 \*\* Significant at 5% level of significance  
 \*\*\* Significant at 10% level of significance

(t-stats) are given in parenthesis

### 5.3 Hong Kong

In Hong Kong a total of 161 IPOs happened, which managed to raise total proceeds of \$8.5b between 2005-2015. Descriptive statistics and sector-wise breakdown is given in the Table 52.

Table 52 - Total IPO proceeds (yearly)

Industrial Sector	Total IPO proceeds (\$mil)	Total IPOs
Consumer Products and Services	153	15
Consumer Staples	186	16
Energy and Power	159	4
Financials	1,069	28
Healthcare	199	5
High Technology	239	19
Industrials	1,213	33
Materials	1,130	14
Media and Entertainment	1,355	5
Real Estate	2,170	8
Retail	436	10
Telecommunications	188	4
<b>Grand Total</b>	<b>8,496</b>	<b>161</b>

From Figure 15, we can see that Real Estate sector led the IPO markets in Hong Kong between 2005-2015, accounting for 26% of the total IPO proceeds, and raising \$2.17b. It was followed by Media and Entertainment sector, which had five IPOs, and raised \$1.3b during the period. Industrial, Material, and Financial sector all managed to raise over \$1b in total IPO proceeds during the year. Industrial sector had the highest number of IPOs at 33 deals, followed by the Financial sector clocking in at 28 deals during the period. There was not much considerable IPO activity in the Consumer Products and Services sector, which raised a little over \$150m accounting for 2% of the total proceeds during the years. Energy and Power sector also accounted for 2% of the total proceeds and registered \$160m in total IPO proceeds.

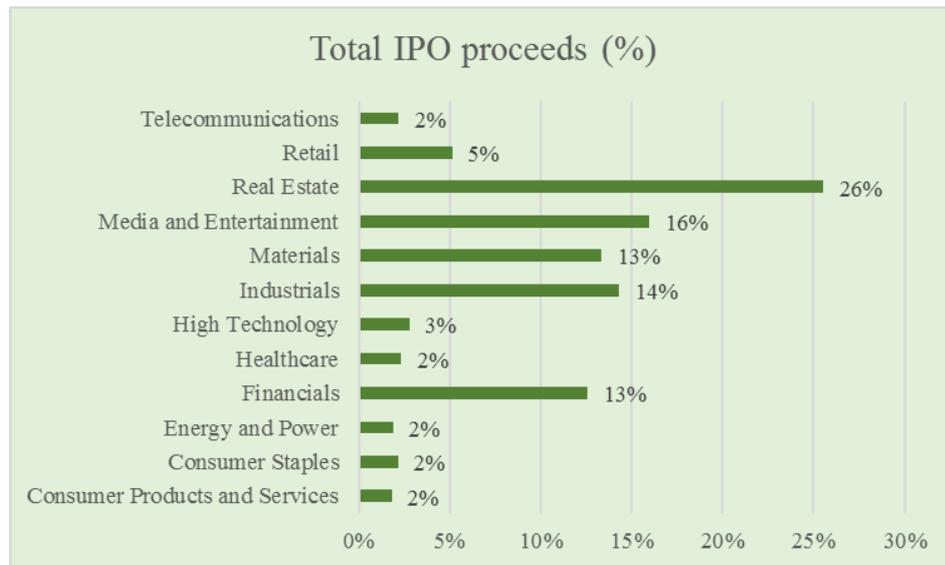


Figure 15 - Sector constitution in IPOs, HK

Figure 16 shows that Year 2006 witnessed the largest IPO proceeds in Hong Kong during the period, where 21 IPOs almost collected \$4b, registering an increase of over 400% from the preceding year 2005. In 2007, the total IPO proceeds clocked over \$2.5b and showed strong activity in the IPO markets with 19 deals. 2008 saw the worst period for IPO markets in Hong Kong, where only a paltry sum of \$22m was raised in five IPOs. Year 2009 showed some signs of recovery, and registered total proceeds of \$140m. The market again slowed down in 2010 and total proceeds dropped to less than \$90m during the year. The slow momentum continued through 2015, when a collective sum of \$700m was raised in five years. The IPO market in Hong Kong never crossed billion-dollar mark again in cumulative IPO proceeds during the period. I will, therefore, categorize 2005, 2006, and 2007 as “hot-issue” period, and 2008-2015 as “cold-issue” periods.



Figure 16 - Total IPO proceeds (yearly), HK

The above analysis provides ample framework for further discussion. I will now share the descriptive statistics on a cumulative level (across all industries) and years. Following that, I will do an industry specific analysis and discuss the results.

### 5.3.1 Underpricing results

Following table summarizes the results of descriptive statistics of IPO underpricing between 2005-2015 for Hong Kong.

Table 53 – Cumulative stats, HK

Descriptive Statistics	
Mean	6.63
Median	2.04
Standard Deviation	8.41
Sample Variance	0.71
Kurtosis	1.13
Skewness	1.43
Range	36.26
Minimum	-0.99
Maximum	35.27
Count	161.00
Confidence Level(95.0%)	1.31
75th percentile	10.56

These calculations are done using non-market adjusted pricing due to non-availability of data for Hong Kong. The median underpricing in Hong Kong between 2005-2015 was found out to be 2.04%, indicating that more than 50% observations exhibited an initial return of 2.04%. Median, which is 2.04%, is lower than mean of 6.63%, means the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.43. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 10.56%.

Results show that for Hong Kong that IPO offerings have not been fairly priced between 2005-2015.

Furthering our discussion and delving deeper into our analysis on IPO underpricing, I will now do a periodic analysis using descriptive statistics and couple the periodic analysis with industry. This periodic analysis is for the period of this study, which is between 2005 and 2015.

### **Year 2005 – Hot period**

In 2005 in Hong Kong, there were 18 IPOs that registered total proceeds of \$931m, exhibiting an average underpricing of 4%. The IPO market was led by Industrial sector, which accumulated over \$670m in total IPO proceeds at an average underpricing of 3.6%.

Table 54 – 2005 IPOs, HK

<b>Industrial Sector</b>	<b>Total IPO proceeds (\$mil)</b>	<b>Total IPOs</b>	<b>Under (over) pricing %</b>
Consumer Products and Services	32	2	17.7
Energy and Power	33	2	0.7
Financials	6	1	5.3
Healthcare	22	1	0.7
High Technology	21	3	0.5
Industrials	675	5	3.6
Materials	111	2	2.3
Media and Entertainment	15	1	0.6
Retail	14	1	0.4
<b>Grand Total</b>	<b>931</b>	<b>18</b>	<b>3.8</b>

Materials sector was number two in IPO activity with only two IPOs raising \$111m at an underpricing of 2.3%. Lowest underpricing was found in the Retail sector at 0.4%, where only one IPO raised \$14m. Highest underpricing was found in Consumer Products and services, where two IPOs raised \$32m and were underpriced 18% on average. All sectors demonstrated underpricing, and no sector showed that securities were overpriced in Hong Kong in 2005.

Table 55 gives descriptive statistics for the year:

Table 55 – 2005 stats, HK

<b>Descriptive Statistics</b>	
Mean	3.78
Median	0.58
Standard Deviation	6.69
Sample Variance	0.45
Kurtosis	9.61
Skewness	2.93
Range	27.01
Minimum	0.39
Maximum	27.40
Count	18.00
Confidence Level(95.0%)	3.33
75th percentile	5.33

Table 55 shows that median underpricing 2005 was found out to be 0.58 %, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 2.93. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 5.33%.

### **Year 2006 – Hot period**

In 2006, in Hong Kong, a total of 21 IPOs raised \$3.96b in total proceeds at an average underpricing of 8.2%. Media and Entertainment sector led the IPO markets in Hong Kong with 2 IPOs raising over \$1.3b at an average underpricing of 17%. It was followed by Materials sector, where \$900m were raised in two IPO deals at an underpricing of 0.7%.

Real Estate sector followed with \$800m total proceeds in one IPO and exhibited an underpricing of 0.3%.

Table 56 – 2006 IPOs, HK

Industrial Sector	Total IPO proceeds (\$mil)	Total IPOs	Under (over) pricing %
Consumer Products and Services	26	2	12.6
Consumer Staples	75	3	2.9
Energy and Power	116	1	14.6
Financials	375	2	11.9
Healthcare	75	1	19.5
High Technology	21	3	13.3
Industrials	239	4	0.9
Materials	899	2	0.7
Media and Entertainment	1,321	2	17.4
Real Estate	812	1	0.3
<b>Grand Total</b>	<b>3,960</b>	<b>21</b>	<b>8.2</b>

Financial sector had raised \$375m during the period at an average of 20% underpricing. No sector exceeded 4 deals in the year, with highest deals occurring in Industrials sector, where four IPOs raised \$239m at an underpricing of just below 1%. No sector exhibited overpriced securities during the year.

Table 57 gives the descriptive statistics for the year:

Table 57 – 2006 stats, HK

Descriptive Statistics	
Mean	8.18
Median	1.03
Standard Deviation	9.39
Sample Variance	88.19
Kurtosis	-0.28
Skewness	0.95
Range	29.05
Minimum	0.31
Maximum	29.36
Count	21.00
Confidence Level(95.0%)	4.27
75th percentile	12.08

Table 57 shows that median underpricing 2006 was found out to be 1.03 %, indicating that more than 50% observations were underpriced. Some large observations are pulling the

distribution to the right, which can be corroborated by a positive skewness of 0.95. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 12%.

### **Year 2007 – Hot period**

In 2007, there were 19 IPOs that raised a little over \$2.5b at an average underpricing of 6%. Real Estate sector led the market with the highest proceeds totaling over \$1.3b at an average of 6% underpricing. It was followed by Financial sector which raised \$510m in five IPOs at an average of 7% underpricing.

Table 58 – 2007 IPOs, HK

<b>Industrial Sector</b>	<b>Total IPO proceeds (\$mil)</b>	<b>Total IPOs</b>	<b>Under (over) pricing %</b>
Financials	510	5	7.1
High Technology	92	3	3.2
Industrials	90	2	9.6
Materials	38	1	0.4
Real Estate	1,331	4	6.3
Retail	347	1	0.6
Telecommunications	170	3	6.9
<b>Grand Total</b>	<b>2,579</b>	<b>19</b>	<b>5.9</b>

No sector showed that securities were overpriced on average during the year. The highest underpricing occurred in the Industrials sector, where a cumulative of \$90m was raised from two IPOs at 10% underpricing. Lowest underpricing was found in Materials sector at 0.4%, and Retail sector at 0.6%

Following are the descriptive statistics for the year:

Table 59 – 2007 stats, HK

<b>Descriptive Statistics</b>	
Mean	5.87
Median	0.84
Standard Deviation	7.90
Sample Variance	62.41
Kurtosis	0.12
Skewness	1.24
Range	23.64
Minimum	0.41
Maximum	24.04
Count	19.00
Confidence Level(95.0%)	3.81
75th percentile	9.13

We can see from Table 59 that the median underpricing 2007 was found out to be 0.84 %, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.24. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 9.1%.

#### **Years 2008 – 2015 – Cold periods**

Due to extremely low volume of deals happening each year between the period, I have clubbed the years together to do a joint analysis on the period. I suggest that clubbing years together in this scenario will yield more meaningful results, relevant variances, and 75<sup>th</sup> percentile distribution of returns. Table 60 gives the details of IPOs as following:

Table 60 – Total IPOs (2008-'15), HK

Industrial Sector	Total IPO proceeds (\$mil)	Total IPOs	Under (over) pricing %
<b>Consumer Products and Services</b>	<b>94</b>	<b>11</b>	<b>3.3</b>
2009	7	1	3.7
2011	8	1	0.6
2012	42	3	3.8
2013	14	3	2.1
2014	24	3	4.8
<b>Consumer Staples</b>	<b>111</b>	<b>13</b>	<b>6.2</b>
2009	47	3	6.1
2010	10	2	1.8
2011	17	2	0.7
2012	10	2	11.1
2014	8	1	9.7
2015	12	2	11.9
<b>Energy and Power</b>	<b>10</b>	<b>1</b>	<b>7.5</b>
2015	10	1	7.5
<b>Financials</b>	<b>177</b>	<b>20</b>	<b>8.0</b>
2008	11	3	8.1
2009	4	2	11.7
2010	63	3	0.9
2011	44	4	3.5
2012	0	1	14.4
2013	33	3	8.8
2014	6	1	5.8
2015	15	3	16.7
<b>Healthcare</b>	<b>101</b>	<b>3</b>	<b>4.4</b>
2013	94	2	3.0
2014	8	1	7.0
<b>High Technology</b>	<b>104</b>	<b>10</b>	<b>9.0</b>
2010	11	1	1.0
2011	22	1	0.5
2012	5	1	-0.8
2013	10	2	5.2
2014	19	2	6.9
2015	37	3	21.9
<b>Industrials</b>	<b>209</b>	<b>22</b>	<b>9.6</b>
2008	3	1	25.1
2009	52	1	-1.0
2010	4	1	1.0
2012	20	2	1.1
2013	20	3	0.9
2014	22	3	6.3
2015	88	11	14.8
<b>Materials</b>	<b>82</b>	<b>9</b>	<b>6.9</b>
2008	8	1	0.7
2009	6	1	-1.0
2011	47	3	4.8
2014	8	2	13.2
2015	14	2	10.9
<b>Media and Entertainment</b>	<b>19</b>	<b>2</b>	<b>8.5</b>
2011	10	1	1.3
2015	9	1	15.6
<b>Real Estate</b>	<b>27</b>	<b>3</b>	<b>3.4</b>
2009	16	1	1.2
2012	6	1	0.5
2013	4	1	8.4
<b>Retail</b>	<b>75</b>	<b>8</b>	<b>3.3</b>
2009	5	1	1.5
2011	13	2	1.0
2013	13	1	2.7
2014	17	2	1.5
2015	26	2	8.5
<b>Telecommunications</b>	<b>17</b>	<b>1</b>	<b>0.6</b>
2011	17	1	0.6
<b>Grand Total</b>	<b>1,026</b>	<b>103</b>	<b>7.0</b>

A total of 103 IPOs happened during the year, raising a total of over \$1b in these years, with an average of underpricing of 7%. Now, I will discuss the underpricing phenomenon in the industries through these years.

**(i) Consumer Products and Services:**

A total of 11 IPOs happened in Consumer Products and Services between 2008 and 2015, which registered \$94m in total IPO proceeds, at an average underpricing of 3.3%. Highest underpricing occurred in 2012, when it was observed to be 4% through three IPO deals clocking in over \$40m in total proceeds. Lowest underpricing was found in 2011 at 0.6%, when one IPO raised \$8m.

**(ii) Consumer Staples**

During the “cold-issue” period of 2008-2015 in Hong Kong, a total of 13 IPOs raised over \$111m in total IPO proceeds, at an average underpricing of 6.2%. Highest IPO proceeds were raised in 2009, with total of \$47m across three IPOs at an average underpricing of 6%, while lowest proceeds during the period were raised in 2014, when just one IPO raised \$8m at 9.7% underpricing. Lowest underpricing was observed at 0.7% in 2011, when two IPOs raised \$17m.

**(iii) Energy and Power**

During 2008-2015, only one IPO deal happened in the Energy and Power sector, which raised \$10m in IPO proceeds, at an underpricing of 7.5%

**(iv) Financials**

A total of 20 IPOs raised \$177m during 2008-2015 in the Financial sector in Hong Kong, at an average underpricing of 8%. Largest proceeds were raised in 2010, amounting to \$63m at an average underpricing of 0.9%, while the lowest proceeds were raised in 2012, which amounted to \$0.2m at an underpricing of 14.4%. Highest underpricing was observed in 2015,

when three IPOs raised about \$15m in total proceeds at an average of 17% underpricing. Lowest underpricing was observed at 0.9%, when total proceeds were \$63m from three IPO deals.

**(v) Healthcare**

In the Healthcare sector, just three IPOs happened, which raised \$101m in total proceeds, with an average underpricing of 4.4%. Deals only happened in 2013 and 2014, with two deals happening in 2013 raising \$94m at an average underpricing of 3%. Only one deal happened in 2014 that raised \$7m at an underpricing of 7%.

**(vi) High Technology**

A total of 10 IPOs accumulated \$104m during 2008-2015 at an average underpricing of 9%. Highest IPO proceeds totaled \$37m in 2015, at an average underpricing of 22% in one IPO deal. 2011 had the second largest IPO proceeds in the sector totaling \$22m at an average underpricing of 0.5%. Highest underpricing was observed in 2015 with 22% securities underpriced on average, while the lowest underpricing was found in 2012, where one IPO raised \$5m and was overpriced by 0.8%.

**(vii) Industrials**

A total of 22 IPOs raised \$210m in total proceeds at an average of 9.6% underpricing during the period. Year 2015 had the highest number of deals totaling 11, which raised \$88m with an underpricing of 15% on average. Years 2012 and 2013 raised \$40m in five IPO deals with an average underpricing of 1%. Highest underpricing was found in 2008, when one IPO raised \$3m and was found to be underpriced by 25%. Lowest underpricing happened in 2009 when one IPO raised \$52m and was overpriced by 1%.

**(viii) Materials**

A total of 9 IPOs raised \$82m during the period at an average underpricing of 7%. Year 2011 had the highest number of deals, with three IPOs raising \$47m at an average underpricing of 5%. In 2015, a total of two IPOs raised \$14m and were found to be underpriced by 11%. Highest underpricing was found in 2014 when two IPOs raised a combined \$8m at an average underpricing of 13%. Lowest underpricing was in 2009, when one IPO, which raised \$6m was found to be overpriced by 1%.

**(ix) Media and Entertainment**

Only two IPOs happened during the period in Media and Entertainment, in 2011 and 2015, with combined proceeds of \$19m, at an average underpricing of 8.5%.

**(x) Real Estate**

Just three IPOs raised \$27m in the sector during the period at an average underpricing of 3.4%. Highest underpricing was in 2013 with 8.4%, with lowest underpricing in 2012 at 0.5%

**(xi) Retail**

A total of 8 IPOs raised a total of \$75m at an average underpricing of 3.3%. Year 2015 had the highest proceeds, with two IPOs raising \$26m at an average underpricing of 8.5%. Year 2011 had the lowest underpricing at 1%, with two IPOs raising \$13m in total proceeds.

**(xii) Telecommunications**

Only one IPO resulted in total proceeds of \$17m, at an underpricing of 0.6% in 2011.

Table 61 gives descriptive statistics for the period 2008-2015:

Table 61 – 2008-'15 stats, HK

<b>Descriptive Statistics</b>	
Mean	6.95
Median	2.97
Mode	0.68
Standard Deviation	8.54
Sample Variance	73.00
Kurtosis	1.31
Skewness	1.46
Range	36.26
Minimum	(0.99)
Maximum	35.27
Sum	716.20
Count	103.00
Confidence Level(95.0%)	1.67
75th percentile	10.4

Table 61 shows that the median underpricing during the period was found out to be 2.97 %, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.46. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 10.4%.

### **5.3.2 Regression results**

Regression results for Hong Kong are given in Table 62.

Table 62 gives the regression results for Japan. Based on these results, I conclude that IPOs were not fairly priced in the USA between 2005-2015 and reject Hypothesis 1. Results also show that underpricing was influenced by the periods, therefore, Hypothesis 2 is also rejected. IPO underpricing was not found to be independent of the firm's size (IPO proceeds), hence Hypothesis 3 is rejected. There was a strong effect of stock market on IPO underpricing, leading me to reject Hypothesis 4. Hypothesis 5 cannot be rejected because oversubscribed shares were not found to have higher underpricing with statistical significance.

Table 62

<b>Underpricing</b>	[1]	[2]	[3]	[4]
<b>Proceeds</b>	-183.35 (-4.26)*	-183.041 (-4.34)*	-203.9 (-4.63)*	-200.145 (-4.41)*
<b>Nikkei 500</b>	1035.065 (-4.73)*	1162.583 (5.03)*	1048.564 (4.66)*	1203.683 (4.74)*
<b>Oversubscription</b>	1.968 (0.87)	1.027 (0.48)	2.617 (1.04)	2.325 (0.94)
<b>Interest rates</b>	-22.12 (-0.30)			
<b>Inflation</b>	8.5688 -0.32			
<b>Constant</b>	-15.36 (-2.77)*	5.22 (1.81)	-17.934 (-2.65)*	3.854 -0.78
<b>Industry</b>	No	No	Yes	Yes
<b>Year</b>	No	Yes	No	Yes
<b>R<sup>2</sup></b>	0.2044	0.3175	0.2421	0.3571
<b>N</b>	161	161	161	161

\* Significant at 1% level of significance  
(t-stats) are given in parenthesis

## 5.4 Singapore

In Singapore, there was a total of 146 IPOs during 2005-2015, which raised a total of over \$5b in total IPO proceeds. Real Estate Sector led the IPO market in Singapore, amassing over \$1b in proceeds from 15 IPO deals, constituting 20% of the total proceeds (Table 63).

Table 63 – Cumulative IPOs, Singapore

Industrial Sector	Total IPO proceeds (\$ mil)	Total IPOs
Consumer Products and Services	104	13
Consumer Staples	361	12
Energy and Power	165	7
Financials	516	6
Healthcare	241	9
High Technology	331	10
Industrials	929	40
Materials	693	18
Media and Entertainment	389	7
Real Estate	1,021	15
Retail	248	8
Telecommunications	8	1
<b>Grand Total</b>	<b>5,006</b>	<b>146</b>

Industrials sector clocked in at second, with a total IPO proceeds of \$929m in 40 IPO deals. Materials sector came in at third, raising over \$690m from 18 IPO deals. Financials sector raised over \$500m in 6 IPO deals during the period. Lowest number of deals were in the Telecommunication sector, with only one deal raising \$8m.

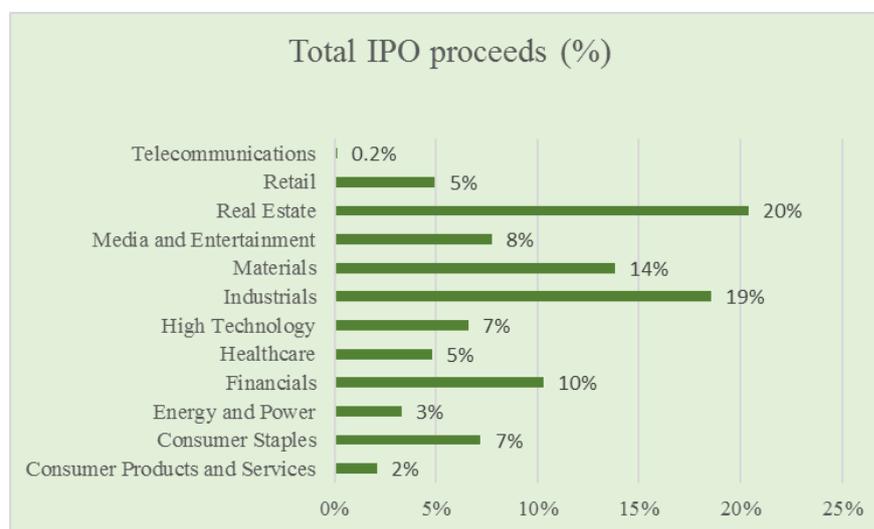


Figure 17 - Sector constitution in IPOs, Singapore

Figure 18 shows that Year 2007 had the highest proceeds exceeding \$1.4b, with a total of 22 IPOs. It followed a strong 2006, where total proceeds were \$801m. The market took a serious downturn in 2008, when the total proceeds from IPO went down to \$121m during the year.

Year 2009 also was disappointing in terms of IPO activity, and managed to raise a paltry sum of \$57m with 10 IPOs.

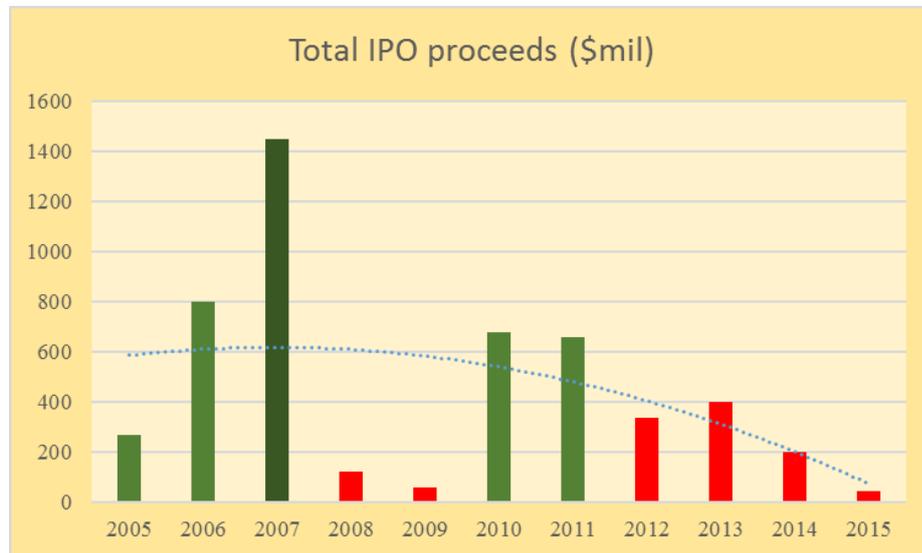


Figure 18 - Total IPO proceeds (yearly), Singapore

In Figure 18 we can see that IPO market recovered slightly hitting \$679m in total IPO proceeds from 10 deals in 2010. Year 2011 also witnessed relatively strong activity, when the total proceeds touched \$660m during the year with 16 IPOs. The market cooled down again in 2012, 2013, 2014, and 2015, where just \$975m were raised in four years with 45 IPOs.

For the purpose of this analysis, I have grouped 2005, 2006, 2007, 2010, and 2011, as “hot-periods”, and 2008, 2009, 2012, 2013, 2014, 2015 as “cold periods”. Due to low IPO activity in the country, it is useful to group years so as to come up with meaningful results and right conclusions, unlike the US and Japan, where each year merited its own analysis.

In the following sections, I have discussed the descriptive statistics.

#### 5.4.1 Underpricing results

Following table summarizes the results of descriptive statistics of IPO underpricing between 2005-2015 for Singapore.

Table 64 – Cumulative stats, Singapore

Descriptive statistics	
Mean	20.8
Median	10.0
Standard Deviation	38.6
Sample Variance	1493.4
Kurtosis	4.9
Skewness	2.1
Range	227.1
Minimum	-33.3
Maximum	193.7
Count	146.0
Confidence Level(95.0%)	6.3
75th percentile	26.4

These calculations are done using non-market adjusted pricing due to non-availability of data for Singapore. Table 64 shows that median underpricing in Singapore between 2005-2015 was found out to be 10%, indicating that more than 50% observations exhibited an initial return of 10%. Median, which is 10%, is lower than mean of 21%, means the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 2.1. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 26.4%.

I conclude that in Singapore IPO offerings were not fairly priced between 2005-2015.

### **Hot period: 2005, 2006, 2007, 2010, 2011**

During the “hot-period” issue, there were 88 IPOs that raised \$3.8b with an average underpricing of 21%. Real Estate sector led the overall IPO market during this period, where \$962m were raised through 10 IPO deals, with an average underpricing of 7%. It was followed by Industrials sector, which raised \$753m across 26 IPOs, at an average underpricing of 28.2%. Materials sector raised \$505m during the period through 13 IPOs, and was found to be underpriced by 58% on average. Financials sector raised \$460b at an average underpricing of 13%. Consumer Products and Services raised a paltry sum of \$15m at an average underpricing of 1.03%.

I have done the industry analysis for the period, which is as following:

**(i) Consumer Products and Services**

From Table 65, we can see that there was a total of 4 IPOs during the period, which raised a sum of \$15m showing average underpricing of 1%. Interestingly, in year 2005, the sector was overpriced by 26%, and in 2007, it was overpriced by 5%. In 2011, it showed underpricing of 17%.

Table 65 – IPOs ('05-'07 – '10-'11), Singapore

Industrial Sector	Total IPO proceeds (\$ mil)	Total IPOs	Under (over) pricing %
<b>Consumer Products and Services</b>	<b>15</b>	<b>4</b>	<b>1.03</b>
2005	3	1	(26)
2006	4	1	(5)
2011	9	2	17
<b>Consumer Staples</b>	<b>328</b>	<b>9</b>	<b>5.84</b>
2005	13	2	(21)
2007	48	3	44
2010	267	4	(9)
<b>Energy and Power</b>	<b>74</b>	<b>4</b>	<b>44.74</b>
2005	47	1	16
2006	21	2	71
2011	6	1	20
<b>Financials</b>	<b>459</b>	<b>5</b>	<b>12.67</b>
2005	15	1	(5)
2007	428	3	14
2011	15	1	27
<b>Healthcare</b>	<b>101</b>	<b>3</b>	<b>0.49</b>
2005	88	2	(10)
2006	13	1	21
<b>High Technology</b>	<b>188</b>	<b>8</b>	<b>(3.13)</b>
2005	27	4	(10)
2006	135	2	1
2010	25	1	2
2011	2	1	12
<b>Industrials</b>	<b>753</b>	<b>26</b>	<b>28.20</b>
2005	37	7	6
2006	3	1	5
2007	502	9	56
2010	23	3	37
2011	188	6	12
<b>Materials</b>	<b>505</b>	<b>13</b>	<b>58.79</b>
2005	21	3	5
2006	58	4	82
2007	215	4	93
2011	210	2	23
<b>Media and Entertainment</b>	<b>252</b>	<b>2</b>	<b>(5.44)</b>
2006	252	2	(5)
<b>Real Estate</b>	<b>962</b>	<b>10</b>	<b>6.69</b>
2005	14	2	(2)
2006	314	4	18
2007	244	1	(8)
2010	364	2	2
2011	26	1	4
<b>Retail</b>	<b>207</b>	<b>3</b>	<b>15.23</b>
2007	4	1	4
2011	203	2	21
<b>Telecommunications</b>	<b>8</b>	<b>1</b>	<b>(5.00)</b>
2007	8	1	(5)
<b>Grand Total</b>	<b>3,853</b>	<b>88</b>	<b>21</b>

**(ii) Consumer Staples**

A total of 9 IPOs raised \$328m at an average underpricing of 6%. The sector showed that securities were overpriced in 2005 at 21%, underpriced in 2007 at 44%, and overpriced in 2010 at 9%, on average.

**(iii) Energy and Power**

A total of 4 IPOs in the sector raised \$75m, and exhibited an underpricing of 45%. All the years demonstrated that securities were underpriced, with the highest underpricing occurring in 2006 at 71%.

**(iv) Financials**

Financial sector raised \$459m from 5 IPOs at an average underpricing of 13%. Year 2005 showed that securities were overpriced by 5%, while all other years demonstrated underpricing, with the highest underpricing occurring in 2011 at 27%.

**(v) Healthcare**

Healthcare sector raised a total of over \$100m in total proceeds from 3 IPOs, with an average underpricing of 0.5%. 2005 was overpriced by 10%, while 2006 exhibited underpricing over 21%.

**(vi) High Technology**

Eight IPOs raised \$188m during the period, and were found to be overpriced by 3%. Year 2005 witnessed overpricing of 10%, while highest underpricing was in the Year 2011, clocking in at 12%

**(vii) Industrials**

Industrials sector raised \$753m through 26 IPOs at an average underpricing of 28%. Highest proceeds emanated from 2007 totaling \$502m, while also the highest underpricing was in 2007 at 56%.

**(viii) Materials**

Materials sector raised \$505m through 13 IPOs, and was underpriced by 59% on average. Year 2007 showed highest proceeds totaling at \$215m, and also the highest underpricing at 93%.

**(ix) Media and Entertainment**

There were only 2 IPOs during the period in Media and Entertainment, which registered total proceeds of \$252m, at an overpricing of 6%.

**(x) Real Estate**

A total of 10 IPOs raised \$962m and exhibited an average underpricing of 6.6%. Highest underpricing occurred in 2006 at 18%, while data shows that in 2007, the securities were overpriced by 8%, and overpriced by 2% in 2005.

**(xi) Retail**

3 IPOs raised \$207m at an average underpricing of 15%. Both 2007, and 2011 were underpriced.

**(xii) Telecommunication**

Only one IPO deal happened in Telecommunication sector in the period and raised \$8m at an overpricing of 5%.

Table 66 descriptive statistics for the period:

Table 66 - stats ('05-'07 – '10 -'11), Singapore

Descriptive Statistics	
Mean	21.2
Median	7.1
Standard Deviation	44.2
Kurtosis	3.9
Skewness	2.0
Range	227.1
Minimum	-33.3
Maximum	193.7
Count	88.0
Confidence Level(95.0%)	9.4
75th percentile	25.54

IPO's were underpriced by an average of 21% in 2005, 2006, 2007, 2010, 2011. The median underpricing during the period was found out to be 7.1 %, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 2.0. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 25.54%.

#### **Cold period – 2008, 2009, 2012, 2013, 2014, 2015**

During the “cold period”, a total of 58 IPOs raised \$1.15b, with an average underpricing of 20%. The total proceeds were one-third of the proceeds in the hot-period.

##### **(i) Consumer Product and Services**

A total of 9 IPOs raised \$89m at an average underpricing of 13.55%. All the years showed that securities were underpriced, with 2014 showing the highest underpricing at 24%.

##### **(ii) Consumer Staples**

There were 3 IPOs that raised a cumulative of \$33m in total proceeds at an average of 11.77% underpricing. Both 2012 and 2014 showed underpricing, with 2012 clocking at 13% underpricing.

**(iii) Energy and Power**

A total of 3 IPOs raised over \$90m at an average underpricing of 4.44%. 2009 was overpriced by 7%, while 2013 and 2014 showed overpriced securities offered.

**(iv) Financial Sector**

There was just one IPO in the sector during the period, where total proceeds amounted to \$57m at an underpricing of 12%

**(v) Healthcare**

Healthcare sector had 6 IPOs that amassed \$140m in total proceeds at an average of 19% underpricing. Except for 2013, when securities were overpriced by 11%, all the years exhibited underpricing.

Table 67 - IPOs ('08,'09,'12-'15), Singapore

Industrial Sector	Total IPO proceeds (\$ mil)	Total IPOs	Under (over) pricing %
<b>Consumer Products and Services</b>	<b>89</b>	<b>9</b>	<b>13.55</b>
2009	13	2	11
2012	1	1	19
2013	56	3	4
2014	19	3	24
<b>Consumer Staples</b>	<b>33</b>	<b>3</b>	<b>11.77</b>
2012	24	1	13
2014	9	2	11
<b>Energy and Power</b>	<b>91</b>	<b>3</b>	<b>4.44</b>
2009	3	1	(7)
2013	68	1	19
2014	20	1	2
<b>Financials</b>	<b>57</b>	<b>1</b>	<b>11.76</b>
2013	57	1	12
<b>Healthcare</b>	<b>140</b>	<b>6</b>	<b>18.53</b>
2009	18	2	13
2012	23	1	46
2013	40	1	(11)
2014	59	2	25
<b>High Technology</b>	<b>142</b>	<b>2</b>	<b>10.07</b>
2012	6	1	(2)
2013	136	1	22
<b>Industrials</b>	<b>176</b>	<b>14</b>	<b>21.73</b>
2008	15	1	14
2009	4	1	7
2012	71	5	18
2013	35	4	26
2014	51	3	29
<b>Materials</b>	<b>188</b>	<b>5</b>	<b>12.80</b>
2008	78	1	(2)
2009	9	1	6
2012	82	2	33
2014	20	1	(7)
<b>Media and Entertainment</b>	<b>137</b>	<b>5</b>	<b>52.07</b>
2009	4	1	48
2012	105	1	4
2014	22	2	34
2015	6	1	140
<b>Real Estate</b>	<b>59</b>	<b>5</b>	<b>22.74</b>
2008	29	1	(20)
2009	4	1	22
2012	4	1	36
2013	10	1	91
2015	12	1	(16)
<b>Retail</b>	<b>41</b>	<b>5</b>	<b>21.32</b>
2009	2	1	(25)
2012	18	2	42
2015	21	2	23
<b>Grand Total</b>	<b>1,153</b>	<b>58</b>	<b>20</b>

**(vi) Media and Entertainment**

Securities were underpriced by 52%, a total of 5 IPOs raised over \$137m, and all years registered underpricing without exception in the sector. Highest underpricing was in 2015, when securities were underpriced by 140% in one IPO.

**(vii) Real Estate**

A total of 5 IPOs raised \$59m at an average underpricing of 23%. In 2008, in the sector, the securities were found to be overpriced by 20%, and in 2015 they were overpriced by 16%. All the years registered underpriced securities, with the highest underpricing at 91% in 2013.

I have now discussed the descriptive statistics with percentiles for all the industries discussed for the period.

Table 68 - stats ('08,'09,'12-'15), Singapore

Descriptive Statistics	
Mean	20.0
Median	16.3
Standard Deviation	28.6
Kurtosis	4.8
Skewness	1.7
Range	165.0
Minimum	-25.0
Maximum	140.0
Count	58.0
Confidence Level(95.0%)	7.5
75th percentile	30.9

Table 68 shows that IPO's were underpriced by an average of 20% in 2008, 2009, 2012, 2013, 2014, and 2015. The median underpricing during the period was found out to be 16.3 %, indicating that more than 50% observations were underpriced. Some large observations are pulling the distribution to the right, which can be corroborated by a positive skewness of 1.7. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 31%

### 5.4.2 Regression results

Regression results for Singapore are given in Table 69.

Table 69 – Regression results, Singapore

<b>Underpricing</b>	[1]	[2]	[3]	[4]
<b>Proceeds</b>	-0.778 (-0.28)	-3.787 (-1.35)	0.9767 (0.37)	-3.53 (-1.14)
<b>Nikkei 500</b>	33.77 (1.89)	38.62 (1.85)	10.311 (1.08)	18.266 (1.27)
<b>Oversubscription</b>	0.1295 (-1.09)	-0.06 (-0.52)	-0.2069 (-1.7)	-0.115 (-0.97)
<b>Interest rates</b>	230.917 (1.42)			
<b>Inflation</b>	5.588 (1.39)			
<b>Constant</b>	-13.05 (0.15)	0.1254 (0.55)	-0.051 (-0.17)	0.033 (0.13)
<b>Industry</b>	No	No	Yes	Yes
<b>Year</b>	No	Yes	No	Yes
<b>R<sup>2</sup></b>	0.2468	0.1931	0.1381	0.3322
<b>N</b>	146	146	146	146

(t-stats) are given in parenthesis

Table 69 gives the regression results for Singapore. Based on these results, I cannot conclude that IPOs were not fairly priced in the Singapore between 2005-2015 and cannot reject Hypothesis 1. Results also show that underpricing was not significantly influenced by the periods, therefore, Hypothesis 2 cannot be rejected. Hypothesis 3 cannot be rejected as the results were not statistically significant. It cannot be concluded that there was a strong effect

of stock market on IPO underpricing, and therefore I cannot reject Hypothesis 4. Hypothesis 5 is not rejected because oversubscribed shares were not found to have higher underpricing.

## 5.5 United Kingdom

In the UK, a total of 612 IPOs raised total proceeds of over \$120b across various sectors and industries. Descriptive statistics and detailed analysis is given in the following section.

Table 70 - Sector IPO proceeds (\$) - UK

Industrial Sector	Total IPO proceeds (\$mil)	Total IPOs
2005	9,401	108
2006	20,605	100
2007	16,297	81
2008	666	13
2009	823	7
2010	6,834	30
2011	3,519	23
2012	3,718	31
2013	16,566	53
2014	27,323	94
2015	14,858	56
<b>Grand Total</b>	<b>120,610</b>	<b>596</b>

From Table 70, we can see that Financial sector led the UK IPO market during 2005-2015 amassing over \$50b in total IPO proceeds from 159 IPOs, and constituted 41% of the total proceeds. It was followed very distantly by High Technology sector that raised a little over \$12.3b in total proceeds from 96 IPOs, constituting 10% of the total proceeds. It was followed by the Retail sector which accounted for just under 10% of the total proceeds, registered over \$11.5b in total IPO proceeds with 32 IPO deals. Lowest IPO proceeds were witnessed by Telecommunication sector where 17 IPOs raised a total of \$1.38b in total proceeds, accounting for just under 1% of the total proceeds.

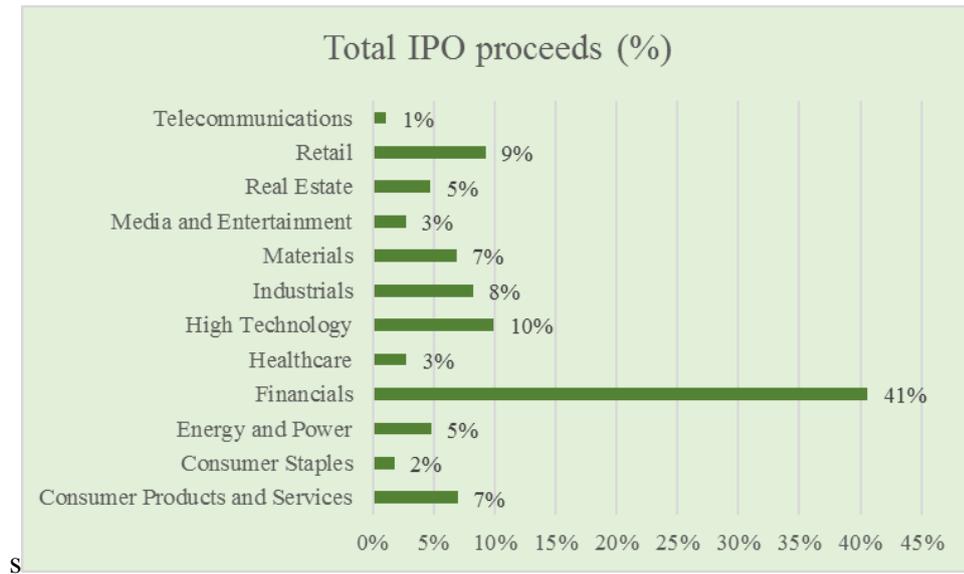


Figure 19 - Sector constitution in IPOs, UK

Figure 20 shows that in 2005, there were 108 IPOs that raised \$9.4b in total proceeds. This was followed by a strong 2006, where 100 IPOs raised over \$20b doubling total proceeds raised from the previous year. 2007 can also be characterized as a “hot year”, where 84 IPOs raised just a little under \$17b in total proceeds. The activity slowed down dramatically in 2008, when a meagre sum of \$666m was raised in total proceeds from just 14 IPOs. This trend continued into 2009, which had 7 IPOs but raised slightly over \$800m. 2011 was another relatively disappointing year for the markets in the UK, where only \$3.5b were raised in 24 IPOs. Recovery started in 2013 when a total of 54 IPOs crossed the ten-billion proceeds mark for the first time after crises, raising \$16.8b in total proceeds. Year 2014 doubled IPO proceeds from the preceding year and raised \$29.3b in 100 IPO deals. The markets again slowed down in 2015 due to political uncertainty raising only under \$16b in 60 IPOs.



Figure 20 - Total IPO proceeds (yearly)

The above analysis provides ample framework for further discussion. I will now share the descriptive statistics on a cumulative level (across all industries) and years.

### 5.5.1 Underpricing results

Following table summarizes the results of descriptive statistics of IPO underpricing between 2005-2015 for UK.

Table 71 – Cumulative stats, UK

Descriptive statistics	
Mean	15.5
Median	7.7
Standard Deviation	63.2
Kurtosis	187.7
Skewness	12.7
Range	1101.7
Minimum	-96.2
Maximum	1005.6
Count	596.0
Confidence Level(95.0%)	5.1
75th percentile	15.00

These calculations are done using simple initial return pricing. Table 71 shows that the median underpricing in UK between 2005-2015 was found out to be 7.7%, indicating that more than 50% observations exhibited an initial return of 7.7%. Median, which is 7.7%, is lower than mean of 15.5%, means the distribution is skewed to the right. Some large observations are pulling the distribution to the right, which can be corroborated by a very high skewness of 12.7. There is evidence of more data in the right tail than what is expected in a normal distribution. 75<sup>th</sup> percentile shows that 75% observations showed a return of approximately 15%. 25<sup>th</sup> percentile showed 2.2%, which means that some observations contribute heavily to the mean.

It can be concluded for UK that IPO offerings have not been fairly priced between 2005-2015.

### **5.5.2 Regression results**

Table 72 gives the regression results for the UK.

Based on the following regression results, Hypothesis 1 is rejected as IPO haven't been fairly priced in the UK between 2005-2015. Hypothesis 2 is also rejected as periodicity has impact on IPO underpricing. Firm size, in terms of total IPO proceeds has a relationship with IPO pricing, therefore, Hypothesis 3 is rejected. FTSE All Share Index showed significant results, so Hypothesis 4 is rejected. Hypothesis 5 cannot be rejected as oversubscribed shares did not show significant results.

Table 72 – Regression results, UK

<b>Underpricing</b>	[1]	[2]	[3]	[4]
<b>Proceeds</b>	-4.773 (-3.81)*	-4.851 (-3.87)*	-5.984 (-4.41)*	-5.224 (-4.07)*
<b>FTSE All Share</b>	9.755 (10.6)*	10.82 (6.26)*	-66.2 (-3.15)*	-50.74 (-3.19)*
<b>Oversubscription</b>	0.077 (1.42)	0.064 (0.25)	-0.014 (-0.25)	0.073 (1.29)
<b>Interest rates</b>	0.1006 (8.7)*			
<b>Inflation</b>	-2.287 (-0.94)			
<b>Constant</b>	-0.125 (0.957)	0.435 (2.07)**	6.857 (3.28)*	0.842 (3.00)**
<b>Industry</b>	No	No	Yes	Yes
<b>Year</b>	No	Yes	No	Yes
<b>R<sup>2</sup></b>	0.1591	0.1787	0.074	0.2015
<b>N</b>	596	596	596	596

\* Significant at 1% level of significance

\*\* Significant at 5% level of significance

(t-stats) are given in parenthesis

## 5.6 All Countries – Regression results

Regression results for USA, UK, Japan, Singapore, and Hong Kong are given in Table 73.

Table 73 – All countries regression

Underpricing	[1]	[2]	[3]	[4]
<b>Proceeds</b>	-10.22 (-11.17)*	-12.449 (-14.01)*	-12.14 (-13.02)*	-12.135 (-12.91)*
<b>Stock Indices</b>	8.879 (9.06)*	13.4033 (17.64)*	13.739 (-17.93)*	13.839 (17.68)*
<b>Oversubscription</b>	0.08 (2.59)*	0.0984 (3.16)*	0.093 (3.01)*	0.1094 (3.46)*
<b>Interest rates</b>	0.093 (7.25)*			
<b>Inflation</b>	-3.457 (-3.68)*			
<b>Constant</b>	0.314 (6.51)*	0.0644 (0.74)	0.392 (2.33)**	0.27 (1.45)
<b>Industry</b>	No	No	Yes	Yes
<b>Year</b>	No	Yes	No	Yes
<b>R<sup>2</sup></b>	0.1579	0.1452	0.1448	0.1519
<b>N</b>	2731	2731	2731	2731

\* Significant at 1% level of significance

\*\* Significant at 5% level of significance

(t-stats) are given in parenthesis

Based on the combined results of the countries given in Table 71, I have rejected Hypothesis 1 that shares were fairly priced between 2005-2015. Also, Hypothesis 2, is rejected as periodic effects can be seen from the results. Hypothesis 3 is rejected because we see that Total Proceeds impact IPO underpricing. Hypothesis 4 is rejected as Stock market is found to be correlated with IPO underpricing. Hypothesis 5 is rejected as oversubscribed shares were found to have higher underpricing.

## 6 CONCLUSION

Findings in this research have confirmed that IPO's were not fairly priced between 2005-2015 in the US, UK, Hong Kong, and Japan. Hypothesis 1 was, therefore, based on statistical significance, rejected for the aforementioned countries. IPO underpricing was not conclusively explained in Singapore by the model, as t-values were not significant in Singapore to reject null hypothesis that IPOs were fairly priced in Singapore between 2005-2015. R-squared in Singapore was 0.3322, with Industry and Years fixed effect, which means that underpricing could be explained by other factors, not analyzed in this research. When a combined regression was run for all countries, it was conclusively determined that IPO underpricing existed; Total IPO Proceeds, Stock Market returns, Oversubscription of the issues, Interest rates, and Inflation, were all statistically significant to show that IPOs were not fairly priced during the period.

Period of IPO offering, also impacted underpricing in all markets but Singapore. In the USA, all four models of regression (without year and industry effect, with year effect but not industry effect, with industry effect but not year effect, and with both industry and year effect) showed statistically significant values that period of issue was important and impacted IPO underpricing. No statistically significant values were found for Singapore market. Hypothesis 2 was rejected for all markets but Singapore, where it was not rejected.

Total Proceeds were also statistically significant in explaining IPO underpricing in all markets, standalone and combined, except for Singapore where they were not significant. Therefore, it was concluded that Total IPO proceeds were negatively correlated with the returns on the first trading day; or in other words, higher proceeds meant higher IPO underpricing and vice-versa. Hypothesis 3 was rejected for all markets except for Singapore where it couldn't be rejected due to the lack of statistical significance.

Stock market returns (gauge for stock market performance) and IPO underpricing were not found to be independent, leading me to reject Hypothesis 4 for all markets but Singapore, where results were not statistically significant. Stock market returns were found to be positively correlated with the IPO underpricing. Higher stock market returns meant that IPOs were underpriced more. One of the limitations of this research is that first trading day returns

were not market-adjusted returns, but instead they were simple returns. While data was available for UK, and the US, no such data could be found on that frequency for Japan, Hong Kong, and Singapore to calculate market adjusted returns. Therefore, for the sake of uniformity and consistency, simple returns were used across the countries. It can be inferred that the coefficient might not be very accurate in this case; for example if the market registered 10% growth, and the simple initial return showed 12%, then it cannot be inferred that the stock was underpriced by 12%, instead it was underpriced by 2%. However, as discussed previously, Hunger (2012b) did not find any statistical dissimilarities of proportional significance between simple returns and market adjusted returns.

Oversubscribed offerings exhibited IPO underpricing more than undersubscribed offerings in all markets but Singapore, leading me to reject Hypothesis 5 for all markets but Singapore. Oversubscribed shares were found to be positively correlated with the IPO underpricing.

**How did this research explain sectoral, country-wide, periodic, and size level characteristics influencing IPO underpricing in markets framework?**

Total proceeds, which were used as proxies for firms' size, had the highest negative coefficient in Hong Kong, followed by USA, Japan, and UK in that order. Singapore market did not exhibit any significant correlation with total proceeds.

Stock market indices, S&P 500 for the US, FTSE-All Share Index for the UK, and Nikkei 500 all impacted IPO underpricing in all markets but Singapore. Hong Kong had the highest positive coefficient, followed by Japan, the US, and the UK.

Oversubscription could not explain IPO underpricing in Hong Kong, UK, and Singapore. It had a small positive coefficient in the US and Japan.

Inflation rate had no impact on IPO underpricing in the sample I studied in any market. It did have impact when all the markets were combined and one regression model was run.

Interest rates were found to be statistically significant in Japan only in determining IPO underpricing. An inverse relationship was found between interest rates and IPO first trading day returns. Lower interest rates meant higher underpricing.

On the sector level, Financial sector, and Technology sectors were good proponents of IPO underpricing on industry level, while Government Sectors showed underpricing to a very little extent. R-squared values in regression modeling are consistent with previous findings, which approximately show that up to 15% of the variation in IPO underpricing can be explained by the model of size (proceeds), stock market (return index), and over (under) subscription of shares.

Although it was mostly a descriptive analysis of IPO performance across the markets, this research was an extension of existing academic literature on the puzzle of IPO underpricing mechanism. This original contribution extended the research beyond the USA and the UK, and included Asian countries – Japan, Singapore, and South Korea. While most existing literature primarily focused on the US and UK market, or studied Asian markets as stand-alone markets, no research had been done as comprehensively as this one in terms of descriptives. I believe this research will be useful for academics and prospective thesis writers to establish benchmarks and corroborate the findings.

## **6.1 Limitations**

Firstly, there can be limitations to the results based on the choice of proxy variables. For example, while some theories have purported the critical role of macroeconomic variables, such as interest rates and inflation in IPO underpricing, substantial academic literature does not exist to support this view.

Elimination of data from the analysis could mean that some companies will exhibit different results. Unfortunately, Thomson One did not prove to be a good tool for relevance and currency of information; many fields were omitted, which led me to completely remove those IPOs to prevent erroneous findings.

IPO data was tracked on a Country Level and not on Stock Exchange Level. If that data had been available, then Stock Markets could be included as prime independent variables.

Econometric issues can also limit the findings of this study. Omitted variable biases when running regressions for large datasets would cause endogeneity.

Finally, simple initial return pricing is not a good tool to track or measure IPO underpricing. Unfortunately, no reliable market level data on specific dates was available for independent markets and stock exchanges. For example, the decision was hard to choose among FTSE-100, FTSE-250, or FTSE All Shares Index, or industry specific indices. Similarly, the case for data was observed in Nikkei and S&P indices.

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