POST-GRADUATE STUDENT RESEARCH PROJECT

What Explains the IPO Cycle?

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Abstract

The paper explores the drivers of initial public offering (IPO) cycles. In this, it closely follows Lowry (2003). The primary contribution of the paper lies in analysing the U.K. IPO market using a longer period from 1960 to 2009. The U.K. has been the next most important IPO market after the U.S. over the last half century. We use quarterly time-series regressions of IPO volume to analyse the explanatory power of capital demands, information asymmetry, and investor sentiment hypotheses using proxies and controlling market variables. Subsequently, we use regressions of post-IPO returns to analyse the relationship between IPO volume and post-IPO stock and market returns. The paper finds that high future capital demand and recent information asymmetry are important explanatory variables of high IPO volumes in the U.K. market. Unlike Lowry (2003), we do not find evidence to support investor sentiment as a basis for fluctuations in IPO volume in the U.K.

What Explains the IPO Cycle?

1.   Introduction

Whether or not to go public is an important decision for a company during its life cycle. Companies obtain external equity financing through an initial public offering (IPO) of the shares when they go public. There are many reasons for listing a company on a stock exchange including easier access to additional capital, lower cost of funding with greater diversification and liquidity, as well as the potential to undertake some attractive investments. However, after the transformation from a private to a listed company, the company has to follow strict legal and regulatory requirements as well as disclose financial and business information. As a result, the shareholders bear the high costs of the IPO and suffer possible dissemination of business-relevant information to its peers and competitors.

There are three major academic issues related to IPOs. First, IPOs are typically underpriced—the share price rises substantially on the first trading day. Underpricing is often referred to as the initial return, defined as the percentage change of the closing price on the first day relative to the IPO offer price. Extensive empirical research has shown that underpricing occurs across countries and over time, suggesting that firms leave a considerable amount of money on the table. The level of underpricing tends to fluctuate substantially. For example, Chambers and Dimson (2009) presented innovative and comprehensive evidence of the significant changes in underpricing in the U.K. IPO market throughout the twentieth century.[1] The extant academic literature focuses on explaining why IPOs are usually underpriced. Previous studies mainly tested asymmetric information models and provided institutional explanations, ownership and control considerations, and behavioural explanations to explain IPO underpricing.[2]

Second, IPOs typically occur in cycles. These cycles in IPO volume and the fluctuations in the level of underpricing are observed because IPOs tend to come in waves characterised by hot/cold

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[1] Underpricing had an average of 3.8% from 1917 to 1945, 9.15% from 1846–1986, and 19% from 1986–2007 in the U.K (Chambers and Dimson, 2009).

[2] Asymmetric information models include: winner's curse (Rock, 1986), information revelation theory (Benveniste and Spindt, 1989), principal-agent model (Baron, 1982), and signalling model (Welch, 1989). Institutional explanations include: legal liability and price stabilisation. Control models were proposed by Brennan and Franks (1997). Behavioural models include: investor sentiment (Ljungqvist et al., 2006) and prospect theory (Loughran and Ritter, 2002).

market periods. "Hot issue" markets—usually denoting periods with high average initial returns—appear to be followed by periods of high IPO volume. Two commonly used measures of IPO volume are the number of IPOs and the total proceeds received in the offerings. The number of firms going public is far from random, showing a close relationship with underpricing. However, underpricing and IPO volume cycles are typically not perfectly synchronised. For instance, data from the U.S. market shows that the initial returns led IPO volume by 6–12 months.[3] Moreover, a set of particular industries can drive up the IPO volume, such as the oil and gas industry in the 1980s for the U.S. and the technology industry in the 1990s in both the U.S. as well as the U.K. Figure 1 illustrates the cycles in IPO volume and average underpricing in the U.K. during the period 1960–2007. The time series in Figure 1 includes 3914 IPOs issued on either the main market of the London Stock Exchange or its junior market, the Alternative Investment Market, during a 53-year period in the U.K. The plot of the real gross proceeds (RGP) of IPOs in Panel B supports prior findings based on data from other countries. The IPO volume and initial returns fluctuate substantially in cycles over time. For example, only 643 firms went public in the 1960s, while 1413 firms went public during the 10-year period from 1998–2007. Notably, the fluctuation in the proceeds from IPOs can be observed even with Gross Domestic Production (GDP) deflator adjustment, implying that factors other than the inflation over time affect the timing of IPOs. The IPOs were underpriced with positive initial returns during most periods in the U.K., as shown in Figure 1. Figure 1 also suggests that a high level of IPO underpricing subsequently drives a high level of IPO volume; two famous hot issue markets in the U.K. happened during the "Big Bang" in 1986 and the Internet boom in 2000.

Finally, although the U.S. and the U.K. capital markets are generally similar, the IPO selling process is significantly different in the two countries. The U.S. has a long history of selling IPOs via a book-building mechanism, which has also become increasingly popular in the U.K. starting in the 1990s. However, the book-building process is different in the two countries. In the U.S., book building starts with the setting of a price range; a revised price range might be filed after institutional investors express their demand; finally, the offer price could be set up to 20% above or below the latest price range. In contrast, the price range in the U.K. IPOs is set *after* the start

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[3] See Ibbotson et al. (1994) for evidence from the U.S. market; see Jenkinson and Ljungqvist (2001) for evidence from global markets.

of the book-building process, with the final offer price being adjusted in the direction given by the when-issued market price. In addition, the fees charged by underwriters for U.K. IPOs are lower than those in the U.S. The fees charged when using book-building methods are higher than those charged when using auctions or traditional fixed price offers. Many empirical studies have argued that the IPO issuing methods do have an impact on the degree of IPO underpricing as well as the efficiency of the IPO market. Biais et al. (2002) conclude that the book-building mechanism results in more severe underpricing and a less optimal outcome for issuers compared to the auction method.

Among these three major topics of IPO underpricing, IPO cycles, and selling mechanisms, this paper focuses on the less documented topic of IPO cycles in the context of the U.K. IPO market. The IPO cycle is closely associated with hot and cold markets. As documented by Ibbotson and Jaffe (1975) and Ritter (1984), a hot issue market is defined as a period in which IPOs have high initial daily or monthly returns (higher than the previous mean returns). They also found that each hot issue market period is followed by a significant increase in IPO volume. Loughran and Ritter (2002) explained the hot issue markets using behavioural explanations such as prospect theory. They argued that the positive initial returns imply that "money is left on the table" by the issuing companies. Thus, it is important for both companies as well as investors to understand the determinants of the IPO cycle in order to make decisions on the timing of IPOs.

Using Lowry (2003) as the basic theoretical framework, the current paper examines the U.K. IPO cycle by employing a time series of U.K. IPO data during the period 1960–2009. This is important because existing research on IPOs, especially IPO cycles, is very U.S.-centric. The analysis was begun from the year 1960 due to the availability of data and comparability to Lowry's (2003) dataset. The ending year was decided as 2009 instead of the most recent year in order to study the long-run performance of IPOs (3 years). The U.K. has had a vibrant primary equity market for a long time. Between 1960 and 2009, 3734 companies went public. The objective of this paper is to investigate how the IPO volume cycle fluctuates over time using large sets of U.K. data and to compare the results with Lowry's (2003) findings on the U.S. IPO market.

Figure 1: Time Series of IPO Volume—Number of IPOs and Real Gross Proceeds from IPOs in the U.K. (1960–2012)

Panel A: Number of IPOs in each quarter during 1960–2012
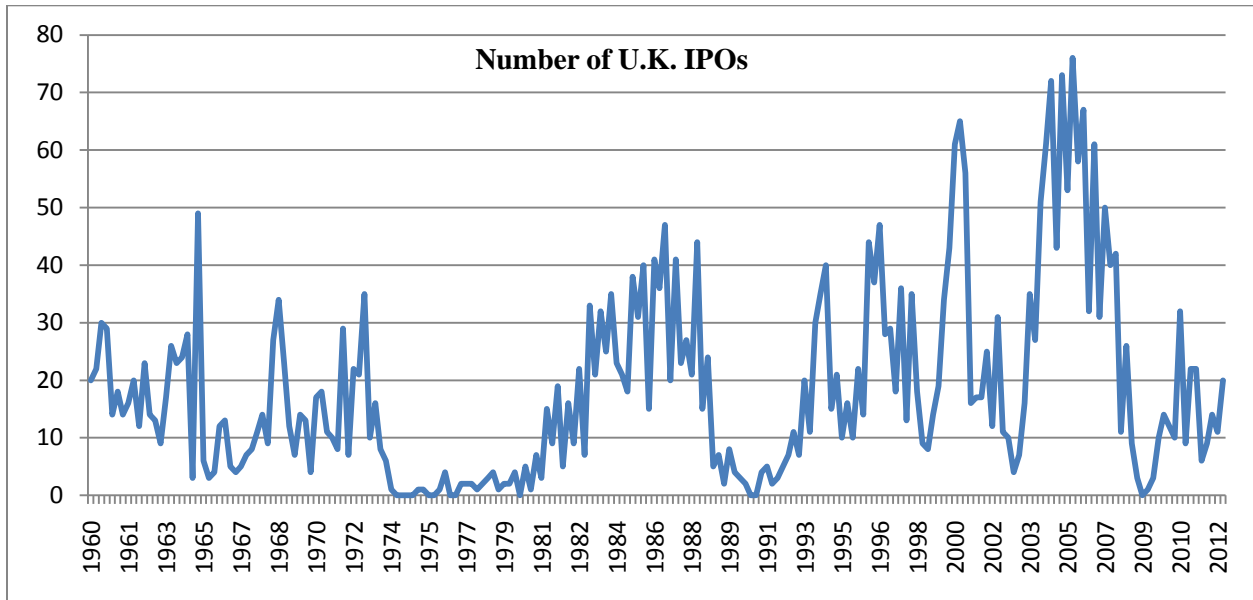
Panel B: Plot of the real gross proceeds of IPOs during 1960–2012 in millions each quarter deflated by the GDP in 2007
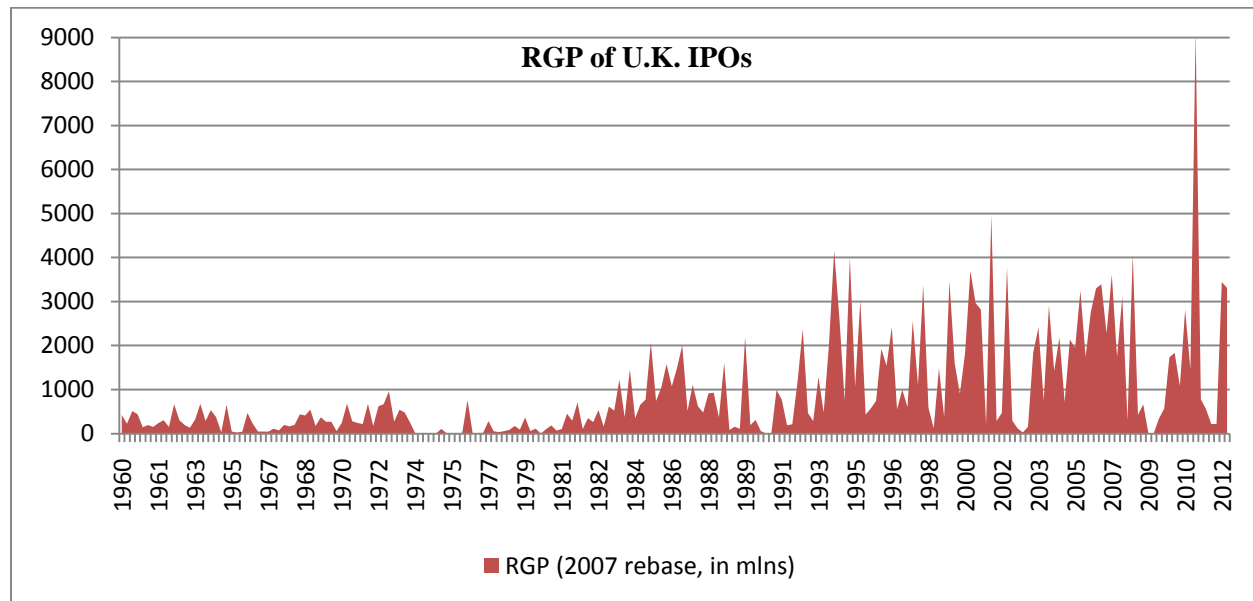
Following Lowry's (2003) model, the paper investigates how capital demand, information asymmetry, and investor sentiment can explain the variations in IPO volume in the U.K. and how post-IPO long-run performance is related to IPO volume. Lowry's (2003) model showed that capital demand and investor optimism explain a substantial portion of the variation in the U.S.

IPO volume. In contrast, the results of the current study show that the firms' aggregate capital demand and information asymmetry significantly explain the variation in IPO volume in the U.K. The investor sentiment hypothesis does not appear to affect IPO volume fluctuation after controlling for market condition variables. The results also show that the average post-IPO raw return is positive while the average post-IPO market-adjusted abnormal return is slightly negative. Both the post-IPO raw and abnormal returns are significantly and negatively correlated with IPO volume. Given the differences in the significant drivers of IPO volume variation in the U.S. and the U.K., for practical implications, the U.K. IPO volume appears to depend more on the underwriters' perceptions compared to those of the investors.

The remainder of this paper is organised as follows. Section 2 reviews the relevant literature and proposes the hypotheses for the IPO cycle. Section 3 describes the data including the proxies, control variables, and post-IPO data used in the empirical research. Section 4 presents the empirical results for the two main parts of the IPO volume research: one is the relationship between IPO volume variation and time-series variation in capital demand, the adverse-selection costs due to information asymmetry, and the extent of investor sentiment; the other one is the relationship between IPO volume and post-IPO returns. Section 5 summarises the main findings and concludes the paper.

2.   Literature Review and Hypotheses

While there is a considerable body of literature on IPOs, the extant research on variations in IPO volume is relatively limited. Ibbotson and Jaffe (1975) documented substantial fluctuations in IPO volume and attributed this phenomenon to hot issue markets. However, they did not empirically test the underlying factors that contribute to the variation. Lowry and Schwert (2002) focused on the interaction between IPO volume and IPO underpricing. They found that IPO volume tends to be higher following periods of high initial returns because more firms are willing to take advantage of hot markets and positive information. Thus, while some studies dealt with the substantial fluctuations in IPO volume and tried to give some explanations for such variation, very few studies comprehensively examined the underlying causes of IPO volume cycles. Lowry (2003) suggested three potential explanations for the variations in IPO volume

based on evidence from the U.S.: capital demand, information asymmetry, and investor sentiment.

2.1   Capital Demand Hypothesis

Under the capital demand hypothesis, firms issue equity due to their need for external capital. The variation in IPO volume is driven by changes in the aggregate financing demand of private firms. Such capital demand is then affected by the changes in the business cycle and economic conditions. If economic expansion results in better investment opportunities and lower cost of capital relative to the cost of debt, then firms tend to have greater capital demand to finance these projects. In general, IPO volume increases when aggregate capital demand increases. The variation in IPO volume is mainly caused by time-varying costs of equity and debt. Choe et al. (1993) pointed out that economic conditions do have effects on equity issuing, as indicated by empirical evidence that more companies make seasoned equity offerings when the economic conditions are better. Pastor and Veronesi (2005) also found that IPO waves occur as a response to market conditions rather than market misvaluations. Dittmar and Dittmar (2008) further confirmed that changes in economic conditions affect aggregate capital demand and drive waves of equity issuance. Specifically, economic expansion lowers the cost of equity, inducing more firms to conduct IPOs. The results indicate that an increase in equity issuance occurs early in the business cycle. Thus, the first hypothesis predicts that IPO volume is positively related to aggregate capital demand.

2.2   Information Asymmetry (Agency Costs) Hypothesis

Information asymmetry arises from the information gap between managers and the market about firm value. When information asymmetry is very high, companies suffer from high adverse selection costs in addition to the direct issue costs. If the total costs exceed the benefits of an IPO, firms will postpone the IPO until such time as the benefits can cover the costs, in order to maximise firm value. Thus, the information asymmetry hypothesis suggests that the IPO cycle is affected by the time-varying costs of adverse selection. Lucas and McDonald (1990) and Bayless and Chaplinsky (1996) found that changes in information asymmetries contribute to the variation in seasoned equity issue volume and that high information asymmetry is associated with a lower level of seasoned equity issue. They then speculated that the results could be applied to IPOs as

well. Choe et al. (1993) showed that adverse selection costs decrease during economic expansion, leading to an increased proportion of equity issues, given their relatively higher benefits than costs. Thus, the second hypothesis predicts that IPO volume is negatively correlated with information asymmetry.

2.3 Investor Sentiment (Misvaluation) Hypothesis

According to the investor sentiment hypothesis, fluctuations in IPO volume are due to the changes in the level of investor optimism, which lead to the varying costs of issuing equity. When investors are highly optimistic, they are willing to pay more for firms than they are actually worth. In such a scenario, the costs of equity issuance are very low, causing many firms to go public; thus, the IPO volume becomes relatively high. That is, firms want to issue overvalued IPOs during periods of high investor sentiment. Lee et al. (1991) found that the variations in investor sentiment significantly affect IPO volume. Loughran and Ritter (1995) pointed out that periods of high returns tended to be followed by high volumes of equity issuance. Baker and Wurgler (2000) found that new equity issuance has negative forecasting power for future returns, supporting the finding that managers decide the timing of IPOs to take advantage of overvaluation. Baker et al. (2012) explained investor sentiment using variables including IPO volume for six major stock markets and the overall global market.

2.4 Comparison of the Three Hypotheses

Although Lowry (2003) formalised capital demand and information asymmetry as two separate hypotheses, they are actually linked to each other because the costs of adverse selection are related to the costs of equity and debt. While capital demand focuses on the demand for equity and information asymmetry depends on the supply side, both hypotheses assume that the market is semi-strong form efficient, with rational expectations of investment opportunities. In contrast, the investor sentiment hypothesis—depending on the market supply of equity financing—asserts that the market is inefficient and that firms would like to launch an IPO during periods of overvaluation.

In addition to the above potential explanatory variables, IPO volume may be related to post-IPO stock returns and abnormal returns. Ritter (1991) as well as Loughran and Ritter (1995) concluded that IPO volume is negatively related to post-IPO stock returns. In their long-run

analysis, they found that the IPOs issued during periods of high volume had worse performance given the lower post-IPO returns. Although long-run IPO performance has been discussed a lot, empirical research on the interaction between IPO volume and long-run IPO performance has not yet received much attention, especially in the context of the U.K. stock market.

3.   Data and Methodology

The analysis in this paper uses a panel of 3734 companies that issued IPOs during the period 1960–2009 in the U.K. These firms are listed on either the main market of the London Stock Exchange or its junior market, the Alternative Investment Market. The analysis uses the IPO dataset taken from Chambers and Dimson (2009)[4] as well as data from London Stock Exchange website. The dataset excludes the IPOs of venture capitals, closed-end funds (known as investment trusts in the U.K.), penny-stock IPOs with an offer price of 10 pence or less,[5] and new listings by firms already listed on another stock exchange.

3.1   Descriptive Statistics on IPOs

Table 1 presents the descriptive statistics on the U.K. IPOs during the period 1960–2012 with prospectus data. The 4164 companies raised real gross proceeds (RGP) of GBP 874 billion with average real proceeds per IPO of GBP 210 million (in 2007 currency). Compared to the stock market in the U.S. (USD 12), the U.K. IPOs had relatively low offering prices whose average was GBP 1.1. On average, the IPOs were underpriced with a positive first-day return of 16.7%.

Table 1 includes the number of IPOs and the RGP for the IPOs during the period 2008–2012; however, this data is not included in the regression analyses. The firms that issued IPOs during 1960–2012 were classified into 10 industries, namely, basic materials, consumer goods, consumer services, financials, healthcare, industrials, oil and gas, technology, telecommunications, and utility; 19 firms did not fit into these industries. Among these 10 industries, the consumer goods industry includes the automobiles and parts, personal and household goods, and food and beverages sectors; the consumer services industry includes the

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[4] Chambers and Dimson's (2009) dataset is originally drawn from the Times Book of Prospectuses, the Singer and Friedlander New Equity Issue Statistics, the Extel Book of New Issues, KPMG New Issue Statistics, Stock Exchange Daily Official List, and *The Financial Times*.

[5] Penny-stock IPOs were excluded in order to make the dataset and results comparable to those of Lowry (2003). Moreover, there was only a small number of penny-stock IPOs compared to the large sample of 3734 IPOs.

media, retail, and travel and leisure sectors; the financial industry includes the financial services, banks, insurance, and real estate sectors; and the industrial industry includes the industrial goods and services as well as construction and materials sectors.

Table 1: Descriptive Statistics on U.K. IPO Volume (1960–2012)

IPOs: 1960–2012		
	No. of IPOs	**Real gross proceeds (GBP millions in 2007 currency)**
Total	4164	GBP 873, 949
1960s	643	367,996
1970s	268	170,490
1980s	811	138,947
1990s	686	89,291
2000s	1326	171,027
2010-2012	181	25,489

1960–2012	**Mean**	**Median**	**Standard deviation**
Total proceeds (millions)	32.63	4.02	171.32
Offer price	1.10	0.83	4.34
Initial returns (%)	16.71	8.51	0.10

	No. of IPOs	**No. of IPOs in each industry in each decade**				
Industry	**(1960–2012)**	**1960s**	**1970s**	**1980s**	**1990s**	**2000-12**
Basic Materials	254	31	8	21	27	174
Consumer Goods	465	158	64	129	48	26
Consumer Services	824	125	60	190	193	256
Financials	614	102	35	92	70	315
Healthcare	176	2	5	11	45	113
Industrials	1014	223	88	280	286	236
Oil & Gas	139	0	7	23	13	96

Technology	344	3	1	63	81	196
Telecommunications	43	0	0	1	15	27
Utilities	29	0	0	0	2	27

The last section of Table 1 presents the number of IPOs for each industry in each decade (1960s, 1970s, 1980s, 1990s, and 2000–2012), showing the popularity of the industries over time. For instance, the basic materials, oil and gas, and technology industries became active in recent decades; the consumer goods and financials industries fluctuated a lot over the long period. Unlike in the U.S. IPO markets, there is much stronger evidence of industry clustering in the U.K. hot IPO markets. For example, the recent hot markets mainly came from the technology and telecommunication industries during the dot-com boom in 2000 and from the oil and gas industry around 2005. Such key differences from the U.S. IPO market are consistent with the findings reported by Benveniste et al. (2002).

3.2   Time Series of Proxy Variables for Hypotheses Tests

The variables for capital demand, information asymmetry, and investor sentiment cannot be directly observed. Thus, three sets of proxies were employed for these hypotheses in order to investigate how they explain the IPO volume. Table 2 provides the descriptive statistics of the proxies and control variables used in the quarterly time-series regressions. Since the time series were different for capital demand (1985–2007), information asymmetry (1990–2007), and investor sentiment (1962–2007), multiple quarterly regressions were performed. The following sections discuss each proxy variable in detail. The definitions and time series of each variable are summarised in the Appendix.

Table 2 provides the descriptive statistics, the mean, median, and standard deviation of the explanatory variables (both proxies as well as control variables) used in Tables 3–5. The first group in Table 2 contains the capital demand proxies. Quarterly *industrial production growth* equals the log of real industrial production in quarter t minus the log of real industrial production in quarter t-1. Quarterly *GDP growth* and *investment growth* represent the percentage change in real GDP and investment each quarter. The second group contains the information asymmetry proxies, which are used only in the quarterly time-series regressions. The *dispersion of abnormal returns around earnings announcements* equals the standard deviation of the abnormal returns

with time window [-1, 1] across all firms that announce earnings in each quarter, where the abnormal return is defined as the firm return minus market return over the same period. The *dispersion of analysts' earnings forecasts* equals the average standard deviation of analysts' annual earnings forecasts across companies that are in the last quarter of their fiscal year and for which data is available on the IBES database during a given quarter. The third group contains the investor sentiment proxies. Quarterly *future value-weighted* (*VW*) *market returns* represent the compounded monthly returns on the value-weighted FTSE All-Share real market index over the following four quarters of the IPO. The last group in Table 2 contains the control variables. Real *value-weighted* (*VW*) *market returns* represent the compounded monthly returns on the value-weighted FTSE All-Share market index in real terms. *Dividend yield* equals the weighted average across the market index of each individual public firm's dividend paid divided by share price. The interaction term represents the market stock returns multiplied by a low dividend yield dummy variable, which equals one if the dividend yield is less than 0.03 and zero otherwise. The *initial returns* represent the average percentage return on the first trading day across all the firms that go public in each quarter. *Average firm age* represents the average age at the time of the IPOs of all the firms that went public in each quarter. All the real terms were adjusted by the quarterly consumer price index (CPI). The returns and growth terms presented in Table 2 are in decimal forms.

Table 2: Descriptive Statistics of Proxy Variables and Control Variables

	Time Series	Quarterly Interval		
		Mean	**Median**	**Std. dev.**
Capital demand proxies				
Industrial prod. growth	1968–2010	0.001	0.001	0.020
GDP growth	1960–2010	0.006	0.006	0.069
Investment growth	1985–2010	0.014	0.015	0.179
Information asymmetry proxies				
Δ in earn. AR dispersion	1999–2009	-0.001	-0.004	0.116

Δ in analyst dispersion	1990–2009	0.062	-0.033	5.378
Investor sentiment proxies				
Closed-end fund discount	1973–2009	-0.163	-0.140	0.079
Future VW market returns	1962–2010	0.020	0.026	0.092
Control variables				
VW market returns	1963–2009	0.005	0.006	0.160
Dividend yield	1960–2009	0.051	0.043	0.026
VW mkt returns × low DY	1963–2009	0.004	0	0.103
Initial returns	1960–2009	0.149	0.114	0.172
Average firm age	1960–2009	29.88	28.30	19.76

3.2.1 Capital demand proxies

The capital demand hypothesis suggests that the IPO volume cycle is affected by changes in the aggregate financing demand of private firms, which depends on the fluctuations of business cycles and economic conditions. One of the major reasons why firms go public is to raise capital for operations and good investment opportunities. Thus, changes in aggregate capital demand may affect the IPO volume over time.

Since the aggregate capital demand for private firms is not directly observable, three proxies were employed—future percentage growth in the real gross domestic product (GDP) since 1960; future percentage growth in industrial production since 1968; and future real investment growth since 1985. Future growth was used for the proxies because upcoming opportunities would affect the current decisions on capital demand. The demand for current working capital should be positively related to the macroeconomic conditions in a country, such as future GDP growth. The growing industrial production level imposes a higher capital requirement on the firms in order to generate increased production. Thus, future industrial production growth should also be positively correlated with the firms' capital demand. Due to the seasonal characteristic of production levels, the logarithm of industrial production was taken and the difference between

quarter (*t*+3) and quarter (*t*-1) was used for quarterly regressions. For investment opportunities, the aggregate capital demand should increase as new corporations and future investment projects grow.

3.2.2   Information asymmetry proxies

The information asymmetry hypothesis suggests that the IPO cycle is affected by the time-varying costs of adverse selection due to information asymmetry about firm value that exists between the market and the firm's managers. When information asymmetry is high, companies suffer from high adverse selection costs; thus, fewer of them would want to issue IPOs.

Since information asymmetry is totally unobservable, prior literature commonly employed two proxies related to earnings—the dispersion of abnormal returns around earnings announcements and the dispersion of analysts' annual earnings forecasts. These reflect the extent of private information held by a firm's managers and analysts. Thus, both these proxies should represent information asymmetry to a certain extent and have a negative relationship with IPO volume.

Stock market reactions do reflect the degree of information asymmetry. The stronger the abnormal reactions that are made by the market to earnings announcements, the higher the information asymmetry that exists at that time. Based on the models proposed by Dierkins (1991) and Lowry (2003), the abnormal return around earnings announcement with time window [-1, 1] was measured for each firm in each quarter, where "abnormal return" is defined as the 3-day firm return minus the value-weighted FTSE All-Share index return within the same time period. The earnings announcement data for the U.K. public companies could be obtained from Bloomberg since the second quarter in 1998 only. Then, the standard deviation of these abnormal returns was calculated for each quarter in order to get a quarterly time series of the change in the dispersion of abnormal returns around earnings announcement during the period 1999–2007.

The other proxy—the dispersion of analysts' earnings forecasts—can capture the information asymmetry between analysts and the market. The I/B/E/S database provides the earnings forecasts for public firms in the U.K. since 1989. Thus, the standard deviations of all the analysts' annual earnings forecasts for each company during the last quarter of its fiscal year were found. Subsequently, the average of these standard deviations was calculated for each quarter across companies to obtain a quarterly time series of the changes in the average dispersion from 1990 to 2007.

3.2.3 Investor sentiment proxies

The investor sentiment hypothesis suggests that the IPO volume cycle is caused by changes in the level of investor optimism, which leads to the varying costs of equity issuance. When investors are highly optimistic, the costs of issuing equity are relatively low, causing many firms to go public, leading to a relatively high IPO volume. Baker and Wurgler (2000), who focused on investor sentiment research, found that more firms choose to issue IPOs around hot market periods, which are then followed by periods of low market returns. Thus, IPO volume should have a negative relationship with future market returns.

According to Baker and Wurgler (2007), discounts on closed-end funds, the dividend premium, IPO volume and initial returns, and mutual funds flows could be reasonable proxies for investor sentiment. This paper employs discounts on closed-end funds and future value-weighted market returns as the two proxies for investor sentiment. The discount is measured by the difference between the net asset value and the fund market price. The discount for a given quarter starting 1973 is measured as the value-weighted discount across all domestic equity closed-end funds, where discounts are weighted by the fund's net asset value multiplied by the number of shares outstanding. As shown by Lee et al. (1991) and Neal and Wheatley (1998), closed-end funds are mostly held by retail investors, who are more likely to be affected by sentiment. When investor sentiment is high, these investors are willing to pay more for closed-end funds, leading to a relatively small discount. Therefore, past discounts—measured by lags of the discounts—are included in the regressions as potential explanatory variables. Compared to the discounts on closed-end funds, the future market return is a weaker proxy for favourable sentiment. If investors are paying too little today relative to the future stock market values, this could be an indication of unfavourable sentiment instead of a plausible proxy for favourable sentiment.

3.3   Control Variables

In order to capture the true effects of the explanatory proxies on the variation of IPO volume, some stock market variables were added to control their effects in the regression. As mentioned in Section 2.4, Loughran and Ritter (1995) found that periods of high market returns tended to be followed by high volumes of equity issuance. Such hot markets can be caused by an increase in capital demand (good investment opportunities and favourable economic conditions) and in investor sentiment (high investor optimism).

Unlike the previous three groups of hypotheses, the stock market control variables have the advantage of not using proxies. *The past value-weighted FTSE All-Share market returns* during the three quarters before IPO, the *average dividend yield* in the quarter before the IPO, and an interaction term of *market returns and low dividend yield* were included.[6] The time series of market returns since the second quarter in 1962 is available at Datastream; the time series was adjusted into real terms using quarterly CPI. Although Lowry (2003) used the index market-to-book ratio, such data in the U.K. context is not available in terms of a long time series. Thus, this paper uses/imitates the index dividend yield in the quarter prior to the IPO as another stock market control variable. A low index dividend yield implies the market is overvalued, similar to what the high market-to-book ratio suggests. The interaction term between market returns and low dividend yield is employed to measure whether the returns have a larger effect on IPO volume when the index dividend yield is relatively low.

In addition to these stock market variables, firm age at the time of the IPO was included as a control variable. The average age of the firms at the time of their respective IPOs was calculated, which forms a time series in the period 1960–2009.

4.   Empirical Results

This section explains the time-series analysis of IPO volume by the proxies for the hypotheses and the stock market control variables. Subsequently, the section explores how long-run performance—post-IPO stock returns as well as market returns—is related to variations in IPO volume.

4.1   Time-Series Regressions of IPO Volume

Table 3 presents the quarterly regressions of IPO volume on the proxy variables for the capital demand, information asymmetry, and investor sentiment hypotheses, as well as for the control variables including initial return and stock market return variables. Quarterly regressions were

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[6] We consider low dividend yield to be equal to one if the dividend yield is less than 3% and zero otherwise. This cut-off point of 3% was chosen because many analysts often compare stock dividend yield with the 10-year government bond yield, which is a little lower than 3% in average.

run because the time series may have quarterly seasonal effects, and quarterly regressions could cover more observations and include annual effects as well compared to annual regressions.

Table 3 presents the quarterly regressions of the number of IPOs in each quarter during the period 1960–2007. There are two panels in Table 3: one includes the regressions on each group of proxies (discussed in Section 4.1.1) and the other includes the regressions on a combination of these proxies and the control variables (see Section 4.1.2). *Future industrial production growth* equals the log of real industrial production in quarter t+3 minus the log of real industrial production in quarter t-1. *Future GDP growth* and *future investment growth* equal the growth of real GDP and real investments from quarter t to quarter t+3. The *dispersion of abnormal returns around earnings announcements* equals the standard deviation of the abnormal returns with time window [-1, 1] across all firms that announce earnings in each quarter, where abnormal return is defined as the firm's returns minus market returns over the same period. The *dispersion of analysts' earnings forecasts* equals the average standard deviation of analysts' annual earnings forecasts across the companies that are in the last quarter of their fiscal year and for which data is available on the IBES database during a given quarter. The change of these two dispersion terms equals the dispersion in quarter t-1 minus the dispersion in quarter t-4. *Future market returns* equal the compounded monthly returns for the FTSE All-Share value-weighted market index in real terms from quarter t+1 to quarter t+4. The *fund discount* equals the value-weighted (weighted by fund total market capitalisation) discounts across all domestic closed-end funds for two lagged quarters. The *real value-weighted market returns* represent the compounded monthly returns on the value-weighted FTSE All-Share market index in real terms from quarter t-3 to quarter t-1. The *dividend yield* equals the weighted average across the market index of each individual public firm's dividend paid divided by the share price, and the dividend yield in quarter t-1 is used for quarter t as the control variable. The interaction term represents the lagged market returns multiplied by a low dividend yield dummy variable, which equals one if the dividend yield is less than 0.03 and zero otherwise. The initial returns t-1 represents the average return on the first trading day across all the firms that went public in the previous quarter. *Firm age* represents the average firm age at the time of the IPO of the firms that went public in each quarter. A Quarter 1 dummy was included in each regression in order to control for seasonality. An autoregressive parameter AR(1) was included in order to consider the residual serial correlation. All the returns and growth terms presented in Table 3 are in decimal forms.

Table 3: Quarterly Time Series Analysis of IPO Volume

Panel A: Analysis of IPO volume on each group of variables individually

	(1) Mkt Var.	(2) Capital Demand	(3) No inv. from (2)	(4) Info. Aysm.	(5) Investor Sent.
Constant	5.38	28.88***	20.82***	38.48***	13.28***
	(1.97)	(6.15)	(7.03)	(4.10)	(5.14)
Capital demand proxies					
		362.93**	259.72***		
		(1.93)	(1.98)		
		59.54	2.396		
		(1.63)	(0.34)		
		-9.90			
		(-0.79)			
Information asymmetry proxies					
				-56.07**	
				(-5.52)	
				-0.57	
				(0.60)	
Investor sentiment proxies					
					21.03
					(1.07)
					-8,60
					(-0.44)
					-14.07*
					(-1.73)
Control variables					
	0.28				
	(0.79)				
	-165.27*				
	(2.25)				
	-20.72				
	(0.02)				
Quarter 1 dummy	-8.35***	-10.71***	-7.96***	-12.34***	-9.08***
	(-4.03)	(-5.54)	(-6.85)	(-5.16)	(-6.55)
AR(1)	0.70***	0.72***	0.76***	0.76***	0.73***
	(10.72)	(10.09)	(12.46)	(6.35)	(12.11)

Adjusted *R*-squared without AR(1)	0.08991	0.06725	0.1004	0.05165	0.1973
Adjusted *R*-squared with AR(1)	0.5352	0.574	0.6251	0.6251	0.6475
Number of observations	172	92	159	43	144

***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively, in two-sided significance tests.

Panel B: Analysis of IPO volume on groups of proxy and control variables

	(1) cap demand + investor sent.	(2) control var. +(1)	(3) all proxies + control var.
Constant	28.11***	9.29	-9.50
	(3.88)	(1.56)	(-0.21)
Capital demand proxies			
	51.63*	196.31*	76.9*
	(1.65)	(1.73)	(1.74)
	414.56**	96.15	330.92
	(1.87)	(0.25)	(0.64)
	4.40	5.04	193.61**
	(0.51)	(0.49)	(2.25)
Information asymmetry proxies			
			-23.07*
			(-1.75)
			-1.68
			(-1.57)
Investor sentiment proxies			
	72.78	76.47	147.99
	(1.20)	(0.99)	(0.55)
	-62.09	-68.41*	-659.94***
	(-1.10)	(-1.69)	(-4.56)
	-29.58*	-4.88	-0.89
	(1.66)	(0.42)	(-0.39)
Control variables			
		4.89	95.19***
		(0.51)	(2.96)
		-137.40	-311.23
		(-1.49)	(-1.16)
		0.62	-156.51***
		(0.03)	(-3.46)
Firm age at IPO issuance		-0.12*	-0.96*
		(-1.76)	(-1.93)
		20.82***	17.65**
		(4.37)	(3.21)

	(1) cap demand + investor sent.	(2) control var. +(1)	(3) all proxies + control var.
Quarter 1 dummy	-10.70***	-14.96***	-7.50
	(-5.60)	(-5.45)	(-1.51)
AR(1)	0.71***	0.63***	0.33**
	(9.63)	(6.11)	(2.08)
Adjusted *R*-squared without AR(1)	0.0987	0.3744	0.652
Adjusted *R*-squared with AR(1)	0.5837	0.6016	0.7288
Number of observations	100	84	40

***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively, in two-sided significance tests.

4.1.1 Regressions on each group of proxy variables

From the regressions of the capital demand proxies, future industrial production growth was found to be significantly and positively correlated with IPO volume, and future GDP growth was insignificantly and positively correlated with IPO volume. These findings are consistent with the capital demand hypothesis.

The information asymmetry hypothesis was found to provide some support for the variation in IPO volume in the U.K. over the period 1999–2009, which was slightly different from Lowry's (2003) results. The significantly negative coefficient for the change in the dispersion of abnormal returns around earnings announcements was at 1% significance level. Further, although its coefficient was insignificant, the change in the dispersion of analysts' earnings forecasts was found to have a negative relationship with IPO volume as well. These negative coefficients support the hypothesis that when analysts hold more private information of firms, the agency costs and information asymmetry will be greater, leading to lower IPO volume.

For the investor sentiment proxies with the data over the period 1962–2009, the significant negative coefficients of the first and second lags of discounts and future value-weighted market returns provided some support for the investor sentiment hypothesis as an explanation for variations in IPO volume. Diverging from Lowry's (2003) model, only two lags of fund discounts were kept in the current model due to the consistent insignificance of the third and fourth lags.

4.1.2 Regressions with control variables

After controlling for the stock market variables (stock market variables, average initial returns, and firm age), the capital demand hypothesis could still explain the IPO volume variation.

21

However, the future value-weighted market returns for the investor sentiment hypothesis became insignificantly negative in both columns (Table 3: Panel B), while the second lag of the closed-end fund discounts was still significantly negative. This could support the investor sentiment hypothesis; further, the discount on closed-end funds is probably a reasonable measure of sentiment. Notably, aside from the significant coefficients in the individual regressions, after these control variables were included, the change in the dispersion of abnormal returns around earnings announcements was still significantly negatively related to IPO volume, while the change in the dispersion of analysts' earnings forecasts became significant. This further supports the hypothesis that information asymmetry is significantly and negatively correlated with IPO volumes in the U.K. For the control variables, the significant positive coefficient of average initial returns supports the theory that hot issue markets with high initial returns are followed by periods of high IPO volume. The lesser information gap between the underwriters and issuers/investors during the selling process could also contribute to the significant effects of information asymmetry.

Further, an *F*-test was run as an alternative measure in order to find the joint explanatory power of each group of proxy variables—capital demand, information asymmetry, and investor sentiment. The results of the *F*-test supported the findings of the quarterly regressions that both capital demand as well as information asymmetry can explain the variations of primary IPOs. The investor sentiment proxy was found to be insignificant once again.

In summary, we compare the coefficient signs as well as the statistical and economic significance between our regression results and Lowry's (2003) results in Table 4. Table 4 is based on the quarterly regressions of IPO volume on the capital demand, information asymmetry, and investor sentiment proxies, as well as the control variables.

Table 4: Comparison of Regression Results with Lowry's Paper

	Coefficient sign		Statistical significance		Economic significance	
	This paper	Lowry's Paper	This paper	Lowry's Paper	This paper	Lowry's Paper
Capital demand proxies	+	+	Yes	Yes	Yes	Yes
Information asy. proxies	-	-	Yes	No	No	No

	Coefficient sign		Statistical significance		Economic significance	
	This paper	Lowry's Paper	This paper	Lowry's Paper	This paper	Lowry's Paper
Investor sentiment proxy	-	-	Yes/No	Yes	Yes/No	Yes
Initial returns	+	+	Yes	Yes		
Quarter 1 dummy	-	-	Yes	Yes		
AR(1)	+	+	Yes	Yes		

4.2 Relationship between Post-IPO Returns and IPO Volume

As mentioned in the literature review in Section 2, post-IPO returns have a potential relationship with IPO volume (Ritter, 1991; Loughran and Ritter, 1995). Therefore, empirical tests were run on the IPO volume and post-IPO returns to find out how they interact, with the advantage of not having to use proxies.

4.2.1 Descriptive evidence on post-IPO returns and IPO volume

Table 5 reports both equal-weighted and value-weighted (by the firms' market capitalisation at the time of the IPO) post-IPO returns for the quartiles classified based on the IPO volume during the quarter in which the firms went public. The equal-weighted returns represent the average of the sum of raw (abnormal) IPO returns across all firms in each quartile over the number of firms in the quartile. The value-weighted returns represent the average of the raw (abnormal) IPO returns in the quartile weighted by the firm's market capitalisation after the IPO.

Table 5 presents the post-IPO returns for those IPOs during the period 1992–2012 because the price data for the U.K. stocks is available on Bloomberg starting 1992. For the 3-year buy-and-hold stock returns, the monthly-compounded raw post-IPO returns was calculated over the 36 months after the IPO or over the period until the IPO delisting date (if the IPO firm delisted during the 36 months after the IPO). Abnormal post-IPO returns with market adjustment equal the raw stock returns minus the FTSE All-Share index return as a benchmark over the same period.

Table 5 targets those firms that went public between 1992 and 2007 and had both 3-year compounded post-IPO returns data on Bloomberg as well as the firms' market capitalisation data after the IPO. These firms were classified into four quartiles based on the IPO volume—the number of firms that went public in each quarter—during the quarter in which they issued their respective IPOs. During the period 1992–2007, there were a total of 64 quarters; each quartile covered 16 quarters, with quartile 1 representing the lowest IPO volume periods. The third column in Table 5 shows the total number of firms in each quartile.

Table 5: Descriptive Evidence on Post-IPO Stock Returns and IPO Volume

IPO volume Quartile	No. of quarters	No. of firms w/ data	*Equal-weighted returns*		*Value-weighted returns*	
			Raw IPO returns	Abnormal IPO returns	Raw IPO returns	Abnormal IPO returns
1 (low)	16	80	66.44%	23.03%	10.72%	-8.24%
2	16	190	35.78%	8.73%	10.09%	1.57%
3	16	346	35.91%	10.90%	30.08%	18.60%
4(high)	16	640	-11.04%	-24.97%	-17.34%	-23.72%

Raw IPO percentage compounded returns over the following 36-month after the IPO's first trading day = Abnormal IPO percentage returns = the difference between the raw IPO returns and the FTSE All-Share market return as the benchmark over the same period; that is,

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The average post-IPO raw return was 17.85% and the average abnormal return adjusted by the market benchmark was -1.92%, showing a long-run underperformance. We expect that such underperformance could be relieved if the characteristics-matched four-factor model were employed. As shown in Table 5, the 3-year equal-weighted raw returns and abnormal returns showed that there were roughly monotonic relationships across the quartiles, given that the middle quartiles were quite close to each other. The equal-weighted returns suggest that the highest IPO volume quartile has the lowest post-IPO returns. However, no clear trend could be identified from the value-weighted raw and abnormal returns. For the value-weighted returns, the lowest IPO volume quartile was far from having the highest raw and abnormal returns, which

opposed the investor sentiment hypothesis and was contrary to Ritter's (1991) findings. Since the descriptive evidence gave mixed results, we continued to conduct regression analyses to arrive at a more reliable conclusion of the relationship between post-IPO returns and IPO volume.

4.2.2 Regression of post-IPO stock returns on IPO volume

Following Ritter's (1991) model, as reported in Table 6, we ran a cross-sectional regression of 36 months of post-IPO stock (abnormal) returns on IPO volume during that year for each IPO, where the post-IPO stock returns were monthly compounded. In the regression, we also included the FTSE All-Share value-weighted market returns over the same period for each IPO, IPO initial returns, an oil and gas dummy, and a financial dummy. Consistent with Ritter's (1991) theory and Lowry's (2003) results based on the U.S. data, the long-term stock (abnormal) returns were found to be significantly and negatively related to IPO volume, implying that periods of high IPO volume (hot issue markets) lead to long-term underperformance of these stocks.

Table 6: Regression of Post-IPO Stock Returns against IPO Volume (1992–2007)

Panel A: Regression of post-IPO stock raw returns

Dependent variable	Intercept	Initial return	VW market return	IPO volume	Oil & gas dummy	Financial dummy	Obs	Adj R-sqr
36-month post-IPO returns	0.38**	-0.0076	1.41***	-0.0032***	0.81	-0.07	1239	0.085
	(0.16)	(0.0069)	(0.19)	(0.0007)	(0.22)	(0.36)		

Panel B: Regression of post-IPO stock abnormal returns

Dependent variable	Intercept	Initial return	IPO volume	Oil & gas dummy	Financial dummy	Obs	Adj R-sqrd
36-month post-IPO abnormal returns	0.58***	-0.013*	-0.0038***	0.83	-0.11	1239	0.02
	(0.15)	(0.0068)	(0.0007)	(0.67)	(0.08)		

***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively, in two-sided significance tests.

Panel A of Table 6 shows the cross-sectional regression of the post-IPO stock returns for the U.K. IPOs during the period 1992–2007 on IPO volume (because stock data is available on Bloomberg only from 1992). The post-IPO stock returns (as the dependent variable) were compounded monthly over the 36 months after the IPO, defined as
. The initial return represents the first trading day's returns, which equals the difference between the first-day closing price and the offer price divided by the offer price. The value-weighted market returns over the same period were included in the regression. The IPO volume equals the number of IPOs that went public during the same year with each firm. The oil and gas dummy equalled one if the firm operated in the oil and gas industry and zero otherwise. The financial dummy equalled one if the firm operated in the financial industry (such as banks, financial services, insurance, and real estate) and zero otherwise. Panel B of Table 6 presents a similar regression, but takes the difference between post-IPO stock returns and value-weighted market returns (as a proxy of expected returns) to obtain the 36-month post-IPO abnormal returns as the dependent variable. All the other independent variables were unchanged. All the return terms presented in Table 6 are in decimal forms.

5.   Conclusion

Although there is a considerable body of research on IPOs, studies on the variations in IPO volume over time are relatively few, especially in the context of the IPO market in the U.K. This paper aims to fill this gap by employing a large IPO sample in the U.K. over the period 1960–2007. IPO volume—in terms of both the number of IPOs as well as the gross proceeds from IPOs—fluctuates substantially over time. Based on Lowry's (2003) model, we developed proxies for the aggregate capital demand, the information asymmetry surrounding equity issuance, and the extent of investor sentiment. These proxies were included in the regressions to investigate how these groups of proxies could explain the variations in IPO volume over time. We then analysed the relationship between IPO volume and post-IPO stock returns and market returns, which are related to the relationship between IPO volume and hot/cold markets. We conclude that the firms' aggregate capital demand is significantly and positively correlated with IPO volume, while information asymmetry is slightly significantly and negatively correlated with

IPO volume in the U.K. For the investor sentiment hypothesis, the second lag of fund discount was found to be significantly and negatively correlated while the future market return was found to be insignificantly and negatively correlated.

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Appendix

Definition and Time Series of Variables

- *IPO volume: 1960–2009*
  Number of IPOs, gross proceeds from IPOs, and real gross proceeds from IPOs adjusted by 1990 currency.

- *Number of primary and secondary IPOs: 1960–2009*
  Primary IPOs are defined as those IPOs where at least three-quarters of the shares issued are new shares; secondary IPOs are those where new shares are less than three-quarters of the total shares issued.

- *IPO initial returns: 1960–2009*
  The difference between offer price and first-day closing price over the offer price of IPO.

- *Capital demand proxy: Industrial production growth—1968-2009*
  The industrial production index measures the volume of production of the manufacturing, mining and quarrying, and energy supply industries in the U.K. The growth equals the difference of the log of real industrial production adjusted by quarterly CPI during the period(s). (Source: Datastream, Office of National Statistics)

- *Capital demand proxy: GDP growth—1960–2009*
  The percentage change in real Gross Domestic Production adjusted by CPI in each period in the U.K. (Source: Datastream, Office of National Statistics)

- *Capital demand proxy: Investment growth—1985–2009*
  The percentage change in actual real investment growth in the U.K. provided by the investment survey. (Source: Datastream, Directorate General for Economic and Financial Affairs)

- *Information asymmetry proxy: Dispersion of abnormal returns around earnings announcements—1999–2009*
  Standard deviation of the abnormal returns with time window [-1, 1] across all firms that announced earnings in each quarter, where abnormal return is defined as the firm's returns minus market returns over the same period. (Source: Bloomberg for earnings announcements, stock returns, and market returns during each time window)

- *Information asymmetry proxy: Dispersion of analysts' earnings forecasts—1990–2009*
  Average standard deviation of analysts' annual earnings forecasts across companies that were in the last quarter of their fiscal year. (Source: IBES)

- *Investor sentiment proxy: Discounts in closed-end funds—1973–2009*
  Average of the discounts across all domestic equity closed-end funds at the end of each quarter. (Source: Morningstar. Thanks to Kirsty McLaren for providing the data given the limited access to the database.)

- *Investor sentiment proxy: Future value-weighted market returns—1962–2009*
  Compounded monthly returns on the value-weighted FTSE All-Share real market index over the following four quarters (one year). (Source: FTSE All-Share)

- *Dividend yield (index): 1960–2009*

Dividend yield equals the dividend paid divided by the IPO price. Before 1997, the market dividend yield was approximated by the average of the IPOs' dividend yield during each period. After 1997, the dividend yield data comes from Bloomberg, equalling the weighted average across the market index of each public firm's dividend paid divided by the share price.

- *Firm age: 1960–2009*
  Average age of all the firms that went public at the time of the IPO in each period.

- *Post-IPO stock (market) returns: 1992–2011*
  Compounded monthly returns over the 36 months after the IPO's first trading day.