UNDERPRICING ON THE STOCK EXCHANGE OF HONG KONG: A CROSS SECTIONAL ANALYSIS

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by

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1. Introduction
During the last twenty years the underpricing of initial public offerings (IPOs) has been widely documented in finance literature. Various studies have studied underpricing of IPOs on stock markets around the world for different time periods and IPO samples. The results of the various studies show significant average positive initial returns not consistent over time on the stock markets of various countries.


In this study we will analyse the underpricing of IPOs on the Stock Exchange of Hong Kong over the period 1990-1994. Compared to the studies of Dawson & Hiraki (1985), Dawson (1987) and McGuinness (1992) we cover a larger number of IPOs. Moreover, we perform an elaborated test to the factors that are able to explain the cross sectional differences in underpricing between the IPOs in our study. Most factors we deal with are closely related to the information asymmetry literature, namely the underwriter prestige, the sector a particular IPO belongs to, the subscription rate and the standard deviation of returns measured over the first five trading days.

The structure of this paper is as follows. In section 2 we will start with a brief overview of the IPO literature, followed by a discussion of the empirical literature in section 3. Section 4 is concerned with the data and methodology employed in this paper after which the results of our study will be discussed in section 5. This paper will be concluded in section 6 with the major conclusions.

2. Underpricing theory
A number of models has been offered to explain the underpricing of IPOs. In this section we will concentrate on the theories that are related to the information asymmetry literature.

Baron (1982) developed a model based on the information asymmetry between the underwriter and the issuing firm. Underpricing is the compensation which the issuing firm must pay to the underwriter for the use of their superior information. Underpricing reduces the risk that the underwriter must subscribe to the remaining shares offered in the case that the issue is not fully subscribed.

The signalling hypothesis which is based on an informational asymmetry between the issuing firm and the investors was introduced by Allen & Faulhaber (1989), Grinblatt & Hwang (1989) and Welch (1989). Signalling models suggest that issuing firms can signal their quality by underpricing. High quality issuers underprice and thereby forge issue proceeds of the initial public offering in order to compensate this loss in proceeds at the subsequent seasoned offering. Only high quality firms are expected to raise more capital and on better terms at the subsequent seasoned offering and therefore recoup the underpricing loss of the IPO. One

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1 Several authors, such as Bear & Cearley (1975), Dawson (1987), Bill (1991) and Hulbers (1994) offer a summary of the results of various studies.
implication of the signalling hypothesis is that IPOs with a subsequent seasoned offering are expected to have significantly higher level of underpricing than IPOs without a subsequent seasoned offering.

One of the most cited and examined models is the Rock (1986) model. This model is based on an informational asymmetry between the informed and the uninformed investors. Investors are uncertain about the value of the issuing firm. Informed investors are prepared to incur costs to learn the true value of the issuing firm and uninformed investors are reluctant to do so.

As a result informed investors only apply to initial public offerings which are underpriced. Uninformed investors however apply to IPOs indiscriminately. Thus, only uninformed investors will apply when an IPO is overpriced and for underpriced IPOs both informed and uninformed investors will apply. According to Rock (1986) uninformed investors end up with a winner’s curse problem: they receive a larger proportion of overpriced IPOs and a smaller proportion of underpriced IPOs then informed investors.

Due to this winner's curse uninformed investors would realize negative returns and therefore have no incentive to participate in the primary market. Rock assumes that the success of an IPO is dependent on the participation of uninformed investors because informed investors are assumed to be not numerous enough to fully subscribe an IPO. By underpricing IPOs, the uninformed investors can achieve a positive return on average, which is in fact equal to the risk-free return and do not withdraw from the primary market.

The model of Rock (1986) provides a number of propositions that can be empirically tested. The first proposition is that the uninformed investors earn an allocation-weighted return which is equal to the risk-free rate. Secondly, uninformed investors receive a smaller portion of the shares of underpriced offerings than informed investors.

Another proposition is the significant positive correlation between underpricing and oversubscription (a positive elasticity of demand of the investors with regard to underpricing). The chance that uninformed investors get shares allocated is greater when IPOs are undersubscribed then when they are oversubscribed.

Ritter (1984) and Beatty & Ritter (1986) developed a fourth proposition of the Rock model with regard to the initial return and ex-ante uncertainty. In the case of more uncertainty about the value of the issuing firm informed investors tend to have a bigger advantage than uninformed investors. The greater the (ex-ante) uncertainty about the value of new shares, the greater the underpricing needed to keep the uninformed investors interested in the primary market. A positive correlation between underpricing and (ex-ante) uncertainty is to be expected.

Ritter (1984) developed an extension of Rock's ex ante uncertainty proposition to explain hot issue periods which are periods with a high degree of underpricing. Hot issue periods could be explained by an unusually large fraction of IPOs with a high degree of ex ante uncertainty, the so-called high-risk companies. However, no empirical evidence for this extension of the ex ante proposition was found by Ritter (1984). Instead, the existence of the hot issue periods could be attributed almost entirely to just one sector, the natural resource industry. Ritter's results indicated that their could be a relation between the industrial sector from which the offering originates and underpricing. In his effort to explain the existence of 'hot' IPOs markets, Ritter (1984) reported that IPOs from some sectors have a larger level of underpricing than other sectors.
Rock's ex ante uncertainty proposition is extended by Carter & Manaster (1990) to illustrate a negative relation between underwriter prestige and underpricing. Informed investors will invest their scarce resources to gather information about offerings associated with high degree of uncertainty. Instead of bearing the cost of underpricing low risk firms reveal their low risk by selecting prestigious underwriters. McDonald & Fisher (1972), Logue (1973), Block & Stanley (1980), Neuberger & La Chapelle (1983), Beatty & Ritter (1986), Johnson & Miller (1988), and others also indicated a negative relation between underwriter or investment bank prestige and underpricing. Underwriter prestige is perceived as a quality signal, furthermore prestigious underwriters will be involved in IPOs with a low level of uncertainty given the risk of their reputation.

3. Empirical evidence

Various studies have generated empirical evidence on the Rock model. A general test of the implications of the Rock model is possible if the degree of rationing of the shares is known. Rock (1986) indicated that data with regard to the degree of rationing is hard to obtain. The studies of Koh & Walter (1989), Levis (1990) and Koliharju (1993) on respectively Singapore, United Kingdom and Finland stock exchange, had access to the degree of rationing of IPO shares and were able to provide more comprehensive empirical evidence of the Rock model. Their empirical evidence shows that the uninformed investors earn an allocation-weighted return which is equal to the risk-free rate, that uninformed investors receive a smaller portion of the underpriced shares and finally that there is a significant positive correlation between underpricing and oversubscription.

Most of the empirical studies however test the relation between underpricing and ex ante uncertainty of the Rock model. A number of proxy measures for ex ante uncertainty are used. The most widely used proxies are the standard deviation of the daily returns from the second through day i of trading, the age of the issuing firm, the gross proceeds of the IPO e.g. the number of shares offered times the offering price, the offering price and the number of uses for the funds raised.

There is considerable empirical support for the preposed positive relation between (ex ante) uncertainty and underpricing. For example Ritter (1984) reported a significant positive relation between underpricing and the standard deviation proxy and the age of the issuing firm proxy. Miller & Reilly (1987) found a significant positive correlation of 0.12 between the inverse of the gross proceeds proxy and underpricing and also a positive correlation of 0.32 between the standard deviation proxy and underpricing.

The results of various studies show the standard deviation and the issuing firm's age to be the best proxies for ex ante uncertainty. Using one or both these proxies Ritter (1984), Carter & Manaster (1990), Barry et al. (1991) Affleck-Graves et al. (1993), Miller & Reilly (1987),

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4. See Hübner (1994) for an overview of various studies.
McGuinness (1992) and others found empirical support for Rock's ex ante uncertainty proposition.

The McGuinness (1992) study of 80 IPOs on the Stock Exchange of Hong Kong during the years 1980 - 1990 reported an average underpricing of 17.6 percent. Various variables were tested to explain the underpricing on the Stock Exchange of Hong Kong. McGuinness (1992) used the standard deviation, the number of uses for the funds raised and the net assets adjusted for the net proceeds raised from issue variables as proxies for ex ante uncertainty and found a correlation with underpricing of respectively 0.41, -0.07 and 0.03. The regression results showed only a significant positive relation between the standard deviation and underpricing.

To test the relation between underwriter prestige and underpricing McGuinness (1992) used a dummy variable to indicate whether an underwriter is highly experienced, moderately experienced or neither, a dummy variable to indicate if an underwriter was one of the five big banks and a dummy variable to indicate that two or more underwriters are employed. The test results indicated no significant relationship between underwriters prestige and underpricing.

Furthermore McGuinness (1992) tested the impact of sector impacts on underpricing of IPOs on the Stock Exchange of Hong Kong by dividing the IPOs into six sectors. The t-test results showed no significant sector effects for underpricing.

4. Data and Methodology

4.1 The Primary Market of the Stock Exchange of Hong Kong

The unification of the four stock exchanges in Hong Kong in 1986 resulted in the Stock Exchange of Hong Kong as it is known today. Since the unification there has been an upsurge in the primary market. Table 1 illustrates the raise in the number of IPOs on the Stock Exchange of Hong Kong during the last eight years. The general bad performance of the Stock Exchange of Hong Kong in 1989, largely due to the event in Tiananman Square, are reflected by the relative low number of initial public offerings that year as illustrated in Table 1.

The last five years, 1990 to 1994, 262 firms went public for the first time, in the years 1980 to 1990 this number was 96. The high (market-)liquidity in Hong Kong, the perception of IPOs as being sure winners and revisions of the listing rule are factors which contributed to the upsurge of the primary market, especially in the years 1990 to 1994.

The primary market has been characterized by high level of oversubscription the last four years. Subscription rates of several hundred times were not uncommon. In 1993 a record oversubscription level of 658 times was reported for Denway Investments Ltd. The average levels of oversubscription for the years 1990 through 1994 with an overall average level of 59.55 times.

In March of 1994 the SEHK changed the listing rules to effect restrictions on multiple applications significantly reducing the subscription rates. The highest subscription rate recorded in 1994 after the listing rules were changed was 51.80 times (Golden Harvest Entertainment (Holdings) Ltd., November 1994).
Table 1: Statistics of the Primary Market of the SEHK

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of IPOs</th>
<th>Average level of subscription</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>15</td>
<td>52.72</td>
</tr>
<tr>
<td>1988</td>
<td>19</td>
<td>59.54</td>
</tr>
<tr>
<td>1989</td>
<td>5</td>
<td>16.52</td>
</tr>
<tr>
<td>1990</td>
<td>17</td>
<td>10.95</td>
</tr>
<tr>
<td>1991</td>
<td>60</td>
<td>21.39</td>
</tr>
<tr>
<td>1992</td>
<td>64</td>
<td>70.56</td>
</tr>
<tr>
<td>1993</td>
<td>68</td>
<td>132.20</td>
</tr>
<tr>
<td>1994</td>
<td>53</td>
<td>62.67</td>
</tr>
</tbody>
</table>

Source: Factbook 1990 - 1994, SEHK

Moreover, the Stock Exchange of Hong Kong employs a application procedure for IPO shares similar to those used in Singapore and the United Kingdom. Applications for shares of an IPO must be accompanied by payment for the full amount payable on application. After the closing of the applications they are processed, resulting in case of a oversubscription in the rationing of the shares. When an IPO is oversubscribed an application can be rejected or accepted in part only and the application money will be fully or partly refunded without interest. The period between the closing of the applications and the refund will take on average at least seven days. The interest on application money is for the benefit of the issuing firm. Therefore the application procedure used in Hong Kong creates interest costs for the applicants.5

This application procedure together with the reported high levels of oversubscription implicates that the application money is expected to be very large. In fact the average application money in the researched period 1990 to 1994 was 16,106.86 million HK$. As a result the interest on application money and therefore the interest costs are expected to be substantial for IPOs on the Stock Exchange of Hong Kong.

Investors need to be compensated for these interest costs to keep them interested in the IPO-market. The one way to compensate is underpricing. For investors just to break-even on their application the level of underpricing should at least be equal to the interest costs they have incurred. Therefore the application procedure applied in Hong Kong in combination with high levels of oversubscription generates underpricing. Thus implicating the existence of a significant positive relationship between subscription rates and levels of underpricing.

4.2 Data and method used in the empirical tests

Initial Public Offerings on the SEHK between January 1, 1990 and December 31, 1994 were collected from the factbooks of the SEHK, resulting in 262 IPOs.

The primary source of data is the SEHK factbooks which provides data regarding the companies, listing dates, sector-information, subscription rates, IPO size and All Ordinance Index daily closings. The announcement dates, offer prices and underwriter information were obtained from Internationale Nederlanden Capital Markets (Hong Kong) Ltd.

5 Empirical studies by Dawson (1987), Koh & Walter (1989), Sanders & Lim (1990) and Levin (1990) reported that the application procedure used in the United Kingdom, Singapore, Malaysia and Hong Kong creates interest costs for the applicant of shares of initial public offerings. Koh & Walter (1989) and Levin (1990) correct the calculated underpricing for these interest costs.
Information regarding the closing stock prices of the first five trading days were obtained from the daily quotations of the SEHK, Bloomberg and Reuter.

Due to incomplete information 52 IPOs were excluded from the initial sample, leading to a final sample of 210 IPOs covering 80.15 percent of all the IPOs on the SEHK during our sample period.

To investigate the relationship between uncertainty and underpricing implied by Ritter (1984) and Beatty & Ritter (1986) we make use of a proxy for ex-post uncertainty. The standard deviation of the stock returns of the first five trading days is used as a proxy for ex-post uncertainty.

Table 2 illustrates some characteristics of the final sample, namely the offer price (HK$), IPO-size (HK$Mil.), subscription-rate (times) and the proxy for ex-post uncertainty the standard deviation.

<table>
<thead>
<tr>
<th>Tabel 2 : Sample Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Offerprice</td>
</tr>
<tr>
<td>IPO-size</td>
</tr>
<tr>
<td>Subscription rate</td>
</tr>
<tr>
<td>Standard deviation</td>
</tr>
</tbody>
</table>

**Underpricing measurement/method**

For the purpose of measuring underpricing of the IPOs as well as to test hypotheses regarding underpricing, (raw) underpricing is defined as the first day return between the offer price and the first day closing price of the stock:

$$ UP_{t,t} = \left( P_{t,t} - OP_{t} \right) / OP_{t} $$

with:

- $UP_{t,t}$ = underpricing of IPO $i$ on time $t$
- $P_{t,t}$ = first day closing of IPO $i$ on time $t$
- $OP_{t}$ = offerprice of IPO $i$

Furthermore, the (raw) underpricing is adjusted for the return of the market index. The market-adjusted underpricing is defined as the (raw) underpricing adjusted for the first day return made on the market-index. For this adjustment the All-Ordinances Index was used because it is comprised of all the stocks of the SEHK.

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6 The market-adjusted underpricing implicitly assumes a Capital Asset Pricing Model beta of one, conform the market index. A risk-adjusted underpricing can be constructed by adjusting underpricing to reflect the specific beta factor of the IPO in question. Various studies have indicated that there is no significant difference between market-adjusted and risk-adjusted initial return, therefore we will confine to using the market-adjusted return. See for further information Huibers (1994), p 184.
\[ UP_{i,t} = UP_{i,t} - (I_t - I_0) / I_0 \]

with:

- \( I_t \) = All Ordinance Index closing of the announcement day of IPO \( i \)
- \( I_0 \) = All Ordinance Index closing on time \( t \)

Various researchers\(^7\) indicated that there is only minor difference between adjusted and not-adjusted initial returns. Our sample has an average not-adjusted and average adjusted underpricing of respectively 15.66 and 14.67 percent. The results of a paired \( t \)-test of these two means indicate that they are not significantly different.

### Table 3: Underpricing Statistics; raw and adjusted measure

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>( t )-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw underpricing</td>
<td>15.66</td>
<td>38.49</td>
<td>5.71</td>
</tr>
<tr>
<td>Adjusted underpricing</td>
<td>14.67</td>
<td>37.25</td>
<td>5.89</td>
</tr>
</tbody>
</table>

The results from table 3 indicate that the average underpricing is significantly greater than zero. Furthermore, based on the findings of earlier empirical studies on the SEHK of Dawson & Hiraki (1985), Dawson (1985) and McGuinnes (1992), who found average underpricing levels of respectively 10.9, 13.8 and 17.6 percent, we can conclude that the average amount of underpricing differs over time and is not stationary.

In the following analyses the (market-)adjusted underpricing will be used because prior research on the SEHK also made use of this methodology, consequently making comparison possible.

5. Results

In our study we analyse the cross sectional nature of underpricing over the period 1991 - 1994. As explanatory variables we use the underwriter prestige, the sector the IPO belongs to, the subscription rate and the standard deviation of the returns of the first five trading days. We will start with an univariate analysis of our explanatory variables by forming sub-groups of IPOs based on these variables. Inspection of the sub-groups formed revealed a severe departure from normality. Therefore, we used the non-parametric Kruskal-Wallis (K-W) test to assess the statistical significance of the differences.

A limitation of the univariate test is that it does not take into account possible correlations among the explanatory variables. Hence, we conclude our tests with a multivariate regression tests in which we analyse the cross sectional significance of all variables simultaneously. Since we do not split up our sample in the regression tests the departure of normality is less severe. Furthermore, we have used the standard \( t \)-tests to verify the significance of our explanatory variables. To control for heteroskedasticity in the residuals we have calculated the standard errors using White’s (1980) heteroskedastic-consistent estimator.

Underwriter prestige

As stated before the inverse relation between underwriter prestige and underpricing indicated by various scholars is empirically investigated. There appears to be considerable empirical evidence for the inverse relationship.

To capture underwriter prestige three major lead underwriters on the SEHK during the time period were singled out. Characteristic for the IPO-market of the SEHK is that IPOs are underwritten by more than one underwriter therefore the three most active and important lead underwriters, namely Peregrine, Standard Chartered (Asia) and Wardley were chosen to categorize underwriter prestige.

Table 4 shows the characteristics of the different underwriter subdivisions. Kruskal-Wallis test results indicate that there is no significant difference between the average underpricing levels per subdivisions. Therefore, the final sample seems not to offer empirical evidence for a significant (inverse) relationship between underwriter prestige and underpricing levels on the SEHK. This is in concordance with the empirical findings of McGuinness (1992) regarding the absence of a relation between investment bank quality levels and underpricing level on the stock markets of Hong Kong.

<table>
<thead>
<tr>
<th>Underwriter</th>
<th>Number of IPOs</th>
<th>Underpricing</th>
<th>Subscription</th>
<th>Size</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peregrine</td>
<td>37</td>
<td>25.62</td>
<td>108.27</td>
<td>368.51</td>
<td>3.82</td>
</tr>
<tr>
<td>Standard</td>
<td>52</td>
<td>11.91</td>
<td>78.35</td>
<td>195.30</td>
<td>3.29</td>
</tr>
<tr>
<td>Chartered</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wardley</td>
<td>30</td>
<td>17.96</td>
<td>69.70</td>
<td>298.20</td>
<td>3.86</td>
</tr>
<tr>
<td>Other IPOs</td>
<td>91</td>
<td>10.70</td>
<td>62.49</td>
<td>267.06</td>
<td>2.53</td>
</tr>
<tr>
<td>K-W test</td>
<td></td>
<td>0.1112</td>
<td>0.1583</td>
<td>0.1486</td>
<td>0.0050</td>
</tr>
</tbody>
</table>

In addition, no significant differences between the average subscription rate and neither between the average size per underwriter category were revealed. However, test results suggest that there is a significant difference between the ex-post uncertainty among the various underwriter groups. More specific the ex-post uncertainty does not differ significantly between the three lead underwriters groups, but it appears on the basis of Kurskak-Wallis test-results that IPOs with a lead underwriter not being Peregrine, Standard Charted and Wardley have a significantly lower ex-post uncertainty. This contradicts the results of Johnson and Miller (1988) for the IPO market in the US who found a negative correlation between investment bank prestige and the uncertainty of the IPOs these banks did underwrite.

Sector

As mentioned above Ritter (1984) investigated the 'hot issue market of 1980', a market characterized by high average underpricing levels. On the basis of his empirical research he concluded that the risk composition of firms going public could not explain the hot issue period but instead stated 'the high average initial returns can be attributed almost entirely to just one industry: natural resource issues.'

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In addition, Mauer & Senbet (1992) based on their segmentation hypothesis suspect that significant differences in underpricing levels across industry groups should be found. Consequently, our sample has been divided into seven different sectors conform the division provided by the factbook of the SEHK. These seven sectors are consolidated enterprises, finance, hotels, industrials, miscellaneous, properties and utilities.

It appears, as table 5 illustrates, that two sectors, consolidated enterprises and industrials, dominated the IPO market in our sample period. Therefore the statistical analysis will be confined to those two sectors. Kruskal-Wallis test results do not indicate a significant difference in underpricing levels between the two sectors. Thus suggesting no significant empirical evidence of sector dominance. No one sector can be held responsible for the average level of underpricing.

However the test results show a significant difference between the average size per sector. Table 5 indicates a significant greater size of IPOs in all other sectors than consolidated enterprises and industrials.

It has to be noted that the sample size of the category ‘Rest’ is significantly smaller than the other two sectors, making interpretations of test-results more difficult. Moreover, the size of the IPOs of the two sectors industrials and consolidated enterprises does not differ significantly.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Number of IPOs</th>
<th>Underpricing</th>
<th>Subscription</th>
<th>Size</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrials</td>
<td>79</td>
<td>16.52</td>
<td>100.13</td>
<td>168.88</td>
<td>3.39</td>
</tr>
<tr>
<td>Consolidated</td>
<td>110</td>
<td>12.64</td>
<td>60.07</td>
<td>251.26</td>
<td>3.06</td>
</tr>
<tr>
<td>Enterprises</td>
<td>21</td>
<td>18.32</td>
<td>63.78</td>
<td>764.73</td>
<td>2.57</td>
</tr>
<tr>
<td>K-W test</td>
<td></td>
<td>0.2564</td>
<td>0.1337</td>
<td>0.000</td>
<td>0.1742</td>
</tr>
</tbody>
</table>

Subscription

Given the application procedure and the abnormal levels of the subscription rate, a division of the final sample according to different subscription rate levels is in order. Table 6 shows the characteristics of the four sub-groups.

Kruskal-Wallis test results confirm that underpricing and subscription rate are positively related. Apparently, in line with the statements regarding the application procedure, there is a strong relationship between the subscription rates and the level of underpricing. However, it must be noted that the underpricing levels between the sub-groups 10<S≤50 and 50<S≤100 do not differ significantly.

<table>
<thead>
<tr>
<th>Subscription</th>
<th>Number of IPOs</th>
<th>Underpricing</th>
<th>Size</th>
<th>Uncertainty</th>
<th>Offer Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 10</td>
<td>76</td>
<td>-4.52</td>
<td>263.60</td>
<td>2.38</td>
<td>1.45</td>
</tr>
<tr>
<td>10 &lt; S ≤ 50</td>
<td>65</td>
<td>13.32</td>
<td>330.04</td>
<td>3.34</td>
<td>1.77</td>
</tr>
<tr>
<td>50 &lt; S ≤ 100</td>
<td>25</td>
<td>13.80</td>
<td>299.73</td>
<td>3.65</td>
<td>1.20</td>
</tr>
<tr>
<td>&gt; 100</td>
<td>44</td>
<td>50.30</td>
<td>183.17</td>
<td>3.85</td>
<td>2.11</td>
</tr>
<tr>
<td>K-W test</td>
<td></td>
<td>0.0000</td>
<td>0.6275</td>
<td>0.0011</td>
<td>0.1920</td>
</tr>
</tbody>
</table>
A significant difference is also reported for uncertainty averages (0.0011) per sub-group. Closer examination indicates that the ex-post uncertainty of the sub-group ≤10 is significantly lower (0.0168) than the uncertainty levels of all remaining sub-groups which do not differ significantly among each other.

Uncertainty

In the theory of Rock (1986) and the subsequent extension of Beatty and Ritter (1986) the ex-ante uncertainty of the return distribution plays a dominant role in explaining cross sectional differences in underpricing between IPOs. Most studies take the standard deviation of returns of the first to five trading days (e.g. Miller and Reilly, 1987) as a proxy for the ex-ante uncertainty. Table 7 shows the cross section of IPOs divided on basis of their standard deviation of return of the first five trading days.

<table>
<thead>
<tr>
<th>Standard deviation</th>
<th>Number of IPOs</th>
<th>Underpricing</th>
<th>Subscription</th>
<th>Size</th>
<th>Offer Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>74</td>
<td>4.84</td>
<td>39.65</td>
<td>307.26</td>
<td>1.95</td>
</tr>
<tr>
<td>2 ≤ SD &lt; 4</td>
<td>77</td>
<td>14.16</td>
<td>64.02</td>
<td>301.97</td>
<td>1.45</td>
</tr>
<tr>
<td>4 ≤</td>
<td>59</td>
<td>27.65</td>
<td>135.48</td>
<td>187.28</td>
<td>1.55</td>
</tr>
<tr>
<td>K-W test</td>
<td></td>
<td>0.0077</td>
<td>0.0028</td>
<td>0.9437</td>
<td>0.1028</td>
</tr>
</tbody>
</table>

A Kruskal-Wallis test for the differences in underpricing between standard deviation categories showed these differences to be statistically significant. It is also apparent from table 7 that the underpricing premium is closely and positively related to the size of the subscription level. Furthermore, the subscription rate levels are significantly higher for higher standard deviation categories.

In order to analyse the cross section contribution of our explanatory variables, while taking account of their within-group correlation, we conclude our tests with a multivariate cross section regression in which all explanatory variables are simultaneously regressed on the underpricing premium.
Regression test

In our regression test all explanatory variables are regressed on the underpricing premia of our sample. Therefore, the following cross section has been estimated:

\[ UP_i = \alpha_0 + \alpha_1 SD_i + \alpha_2 SUB_i + \alpha_3 SIZE_i + \alpha_4 PER_i + \alpha_5 WAR_i + \alpha_6 STAN_i + \alpha_7 SECC_i + \alpha_8 SECI_i + \varepsilon, \]

with:
- SD = standard deviation of return of the first five trading days;
- SIZE = proceeds of IPO i;
- PER = dummy variable that is 1 for Peregrine being the lead underwriter and 0 otherwise;
- WAR = dummy variable that is 1 for Wardley being the lead underwriter and 0 otherwise;
- STAN = dummy variable that is 1 for Standard Chartered being the lead underwriter and 0 otherwise;
- SECC = dummy variable that is 1 if an IPO belongs to the sector Consolidated Enterprises and 0 otherwise;
- SECI = dummy variable that is 1 if an IPO belongs to the sector Industry and 0 otherwise;
- \( \varepsilon \) = residual with \( \varepsilon \sim N(0,1) \).

Inspection of the residuals revealed a heteroskedasticity problem leading to inefficient estimation of our cross section regression. Therefore standard OLS procedures are no longer valid. To take into account heteroskedastic disturbances we estimated the cross section with OLS with the standard errors corrected for heteroskedasticity with the method of White (1980).

In the first run we estimated the cross section regression with all explanatory variables. This gives an impression of the contribution in the cross section explanatory power of each variable. As can be inferred from table 8 only the subscription variable is statistically significant at the 5%-level. One explanation for the fact that only one variable is significant may be multicollinearity in the cross section regression. To correct for possible multicollinearity we applied the backward elimination method to obtain a specification of the regression with only significant variables as regressors. The results of this procedure are shown in table 8 as Test-2.

Table 8: Cross section regression tests

<table>
<thead>
<tr>
<th></th>
<th>SD</th>
<th>SUB</th>
<th>SIZE</th>
<th>PER</th>
<th>WAR</th>
<th>STAN</th>
<th>SECC</th>
<th>SECI</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST-1</td>
<td>1.37</td>
<td>0.17</td>
<td>0.002</td>
<td>4.98</td>
<td>4.40</td>
<td>-2.35</td>
<td>-7.89</td>
<td>-4.39</td>
</tr>
<tr>
<td></td>
<td>(1.37)</td>
<td>(10.04)</td>
<td>(0.66)</td>
<td>(0.83)</td>
<td>(0.68)</td>
<td>(-0.45)</td>
<td>(-1.02)</td>
<td>(-0.59)</td>
</tr>
<tr>
<td>R² = 0.38</td>
<td>DW = 1.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEST-2</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(10.87)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R² = 0.36</td>
<td>DW = 1.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: t-statistics are between brackets and standard errors are calculated with White's (1980) method.
From Test-2 it becomes clear that cross sectional differences in subscription rates is the sole important factor for explaining cross sectional differences in underpricing. The increase in explanatory power by adding the other seven variables is only 2%.

This result is in line with prior observations. In section 4 it was mentioned that high subscription levels during the sample period led to high interest costs for applicants, implying that substantial underpricing premia were required to keep investors in the market. Also in section 5, table 4 it was shown that there was a close relation between the average underpricing and subscription level. The three largest investment banks, Peregrine, Standard Chartered and Wardley, had both the highest average subscription level and underpricing. From table 5 and 6 it can be inferred that this subscription effect dominated the ex-ante uncertainty effect. Of course, the validity of this conclusion depends on the strength of our proxy for ex ante uncertainty. In this study we have used the standard deviation of the returns in the first five trading days. This choice was motivated by the fact that most studies use this variable as a proxy for ex ante uncertainty. However, this leaves the possibility that there are variables which serve as better proxies.

**Conclusion**

In this paper we have studied the underpricing of IPOs on the Stock Exchange of Hong Kong over the period 1990 - 1994. Compared to the studies of Dawson & Hiraki (1985), Dawson (1987) and McGuinness (1992) our sample contains more IPOs making it possible to derive stronger conclusions.

The empirical tests we have employed are all aimed at testing the relationship between the level of underpricing and variables that are closely related to the information asymmetry literature on underpricing. This led to the following explanatory variables: underwriter prestige, the sector a particular IPO belongs to, the subscription rate and the standard deviation of returns of the first five trading days. All these variables have exhibited explanatory power for one or more countries and sample periods.

We started the empirical test with examining the univariate relation between our information variables and the level of underpricing. It appeared that there was only a statistical significant relationship with the level of underpricing for two variables: the subscription level and the standard deviation of the first five trading days. In order to take into account possible cross correlation between our information variables we have also estimated a cross section regression with all information variables as regressors. From that analysis it appeared that only the subscription level is significantly related to the level of underpricing. An univariate cross section regression with the subscription variable as the only regressor revealed that the subscription variable accounts for 95% of the total explanatory power. Adding the other information variables leads to a marginal improvement of the explanatory power with 2% point. Therefore, it was concluded that for the period 1990 - 1994 the subscription rate is the sole important factor for explaining cross sectional differences in underpricing.
References


