EXIT MARKET LIQUIDITY AND VENTURE CAPITALISTS' INVESTMENT BEHAVIOUR: EVIDENCE FROM AUSTRALIA, CANADA AND THE UNITED KINGDOM

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Abstract

This study investigates the effect of exit market liquidity on venture capitalists' (VCs') investment behaviour. The sample consists of 4,758 investment rounds disbursed by venture capital funds in three selected common law-based OECD countries (Australia, Canada and the United Kingdom) during 1990-2005. The results indicate that investments in early-stage projects by VCs are not related to exit market liquidity conditions after controlling for exogenous factors. Empirical results, however, show that exit market liquidity is positively associated with VCs' investments in new projects (as opposed to follow-on projects). Put differently, new firms (including start-ups) are more likely to obtain venture capital funding during times of liquid exit market conditions. Arguably, these findings highlight the importance of 'timing' of new project launch.

Keywords: Venture Capital Finance, Liquidity Risk, Exit Market Liquidity

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1. Introduction

The economic significance of well functioning venture capital markets is underlined by empirical studies, which show that venture capital backed companies play a significant role in innovation and the commercialisation of new industries (Kortum and Lerner, 2000). Specifically, by providing firms with equity capital as well as managerial expertise in their early development stages, venture capitalists (VCs) act as an important accelerator in the commercialisation of new technologies. Thus, many governments have been eager to engineer active venture capital markets and increase the share of investments directed to early stage companies in growth sectors.

Despite these developments, empirical evidence on the relationship between exit market conditions and VCs' investment behaviour has attracted very little empirical attention. In fact, as far as it could be ascertained, only one study in the US has addressed how exit market liquidity affects the venture capital project selection and thus the frequency of early stage investments (Cumming *et al*., 2005). Given the need to better understand exit market conditions and their impact on venture capital investment behaviour, it seems appropriate to conduct such an empirical study in an international setting. This study is an attempt to fill this gap.

We distinguish our study by investigating the effect of exit market liquidity on venture capitalists' investment decisions in three selected common law based Organisation of Economic Co-operation and Development (OECD) countries: Australia, Canada, and the United Kingdom.[1] It aims to determine whether exit market liquidity provides venture capitalists with incentives to undertake projects of different development stages. Furthermore, evidence is sought on the effect of exit market liquidity on venture capitalists' decision of investing in completely new projects as opposed to providing funds to on-going projects. Our sample consists of 4,758 investment rounds disbursed by venture capital funds in these three countries over the period 1990 - 2005. We employ a multivariate logit model to examine how venture capital investment rounds are influenced by liquidity risk

after controlling for investment climate as well as industry and country specific differences. The originality of this study emanates from the fact that the effect of exit market liquidity on VCs investment behaviour is examined from two dimensions: pooled and country-specific level. As far as it could be ascertained, this is the first such study.

The results indicate that investments in early-stage projects by VCs are not related to exit market liquidity conditions (except for the Canadian sample) after controlling for exogenous factors. These observations are robust to specification changes controlling for the internet boom period at the end of the 1990s. Our results, however, show that exit market liquidity is positively associated with VCs' investments in new projects (as opposed to follow-on projects). Put differently, during times of liquid exit market conditions, new firms (including start-ups) are more likely to obtain venture capital funding. These findings are consistent with the proposition that increased exit market liquidity leads to a larger pool of projects being worth funded, due to reduced required return on projects driven by lower market risk. Similar findings are reported in Gompers and Lerner (2000) and Cumming et al., (2005) for the US venture capital market.

In particular, these findings hold implications for entrepreneurs and regulators. For example, results indicate that entrepreneurs are more likely to obtain venture capital funding when exit market risk is low (i.e., when exit market liquidity is high). Arguably, these findings highlight the importance of "timing" of new project launch. Put differently, the danger for entrepreneurs of being turned down is high, when liquidity risk is high (i.e., when exit market liquidity is low), as VCs invest relatively more in follow-on projects. In contrast, times of low liquidity risk provide start-up entrepreneurs with increased opportunities. Also, findings highlight the importance of deepening and widening capital markets in order to create incentives for VCs to invest in new projects.

The plan of the paper is as follows. Section 2 reviews relevant and limited literature and derive testable hypotheses. Section 3 and 4 outline the data and method employed. Section 5 presents the results for the analyses of the effect of exit market liquidity on VCs investment behaviour, while Section 6 concludes with an overall discussion of results.

2. Literature Review

The VCs, a type of financial intermediary, typically provide capital to young and innovative firms which otherwise struggle to access funds due to their lack of tangible assets and sustainable cash flows. Seminal papers recognize that VCs are unique intermediaries which use their industry knowledge and monitoring skills to manage agency issues (Sahlman, 1990; Gompers, 1995). In fact, venture capital finance is a multi stage investment process that consists of three interrelated stages: fund raising, investing and exiting. While exiting is the final stage, it lies at the heart of the venture capital process. Finding a profitable opportunity to dispose of the investment is of paramount importance, as VCs derive their returns primarily through capital gains (Gompers and Lerner, 2004).

Exit performance and investment realisation not only impact on the VCs ability to raise funds, but also on the selection of future investments. Thus, the risk of not being able to sell the investment successfully is directly linked to the higher returns required by venture capitalists (Lerner and Schoar, 2004). Generally, favourable exit performance is positively correlated with favourable economic conditions which in turn are represented in liquid exit markets.

In their pioneering work on exit market liquidity and VCs investment behaviour, Cumming *et al*., (2005) model the effect of 'liquidity risk' on (1) new early-stage venture capital investments and (2) venture capital investments in general. They provide a theoretical framework (and empirical evidence) suggesting that venture capitalists rationally trade off liquidity risk against technological risk when making their investment decisions. 'Liquidity risk' in this context refers to the probability of being able to effectively exit the investment and thus not being forced to hold the investment or sell at a high discount. The liquidity risk thus resembles the dimension of immediacy - the time required to arrange large trades.[2] Technological risk, defined as a choice variable, refers to uncertainty with regard to product quality and entrepreneurial skills (technical and managerial). It primarily reflects the development stage of the entrepreneurial company in which the venture capitalist invests.

The Cumming *et al*., (2005) framework exploits the proposition that the payoff of a specific venture capital project is determined by (1) the market value of the investment at the exit, (2) the additional gain based on the technological risk of the venture, (3) the overall investment cost and (4) the cost of immediacy at the time of exit. In light of 'hot' and 'cold' issue markets, which impact on the ultimate investment payoff, venture capitalists face a trade-off between investing in early stage projects and later stage projects and thus are expected to make strategic investment decisions to optimize their returns.[3] Based on the rationale that VCs strategically adjust their exits depending on the market conditions in order to maximise investment returns, the model predicts that in times of expected illiquidity of exit markets, venture capitalists invest more into early stage projects in order to postpone

exit requirements. In contrast, at times of liquid market conditions VCs are expected to invest proportionally more in later stage projects in order to hold short term positions and thus be able to realize the investment returns.

At the same time, Cumming *et al*., (2005) rationalize that conditions of exit market liquidity effect the decision of VCs to invest in completely new projects as opposed to making follow-on investments in existing projects (pursuant to staged financing in the spirit of Gompers 1995).[4] Their argument is based on the risk and return principle of conventional finance theory. As exit markets are substantially affected by growth expectations of the overall economy, an increase in exit market liquidity should increase expected returns on investment. Similarly, an increase in the liquidity of exit markets, which reduces overall investment risk due to a decline in market risk, lowers the required return on investments and thus should increase the pool of projects being funded (Gompers and Lerner, 2000). The propensity of new investments should therefore increase regardless of the project stage.

Despite the growing body of venture capital research, apart from Cumming *et al*., (2005), no other study investigates this proposition. These authors empirically examine US venture capital funds (structured as limited partnerships (LP)) over the period 1985 - 2004. Their findings confirm the expected negative relationship between the exit market liquidity and the likelihood of venture capitalists investment in early stage projects. Furthermore, evidence suggests that liquid exit markets increase venture capital investments in new projects as opposed to existing projects.

Given the importance of this research issue and the lack of empirical evidence thereof, we are motivated to answer the following two research questions: (1) 'What is the effect of exit market liquidity conditions on early stage investments in selected OECD countries?' and (2) 'What is the effect of exit market liquidity conditions on new investments (irrespective of their development stage) in selected OECD countries?' According to Cumming *et al*., (2005), during times of liquid exit market conditions, venture capitalists opt for later stage projects, which require exits in the near future and entail less technological risk (trade-off between liquidity risk and technological risk). Thus, following hypothesis *(* H_1 *)* is specified to address research question 1:

(H_1): 'For new venture capital investments, the likelihood of investing in early stage projects decreases with the liquidity of exit markets'.

Research question 2 also relates to liquidity risk and venture capitalists portfolio composition, but does not focus on a particular investment stage. Based on the intuition of Gomerps and Lerner (2000), we hypothesize that an increase in liquidity of exit markets (which reduces overall investment risk due to a decline in market risk thereby lowering the required return on investments) increases the pool of new projects being funded. Thus, following hypothesis *(* H_2 *)* is specified to address research question 2:

i (H_2): 'The likelihood of investing in new projects (irrespective of their development stage) increases with the liquidity of exit markets'.

3. Data

This research covers venture capital markets of three common law based OECD countries (Australia, Canada and the United Kingdom) over the period 1990 - 2005. Ireland and New Zealand, the remaining common law based OECD countries are excluded due to data limitations. Likewise, the time period of 1990-2005 is restricted by data availability in SDC Platinum, the main database used.

Due to the focus of the study, emphasis is placed on venture capital funds that have limited lives and thus a need to exit their investments. The organisational form predominantly characterised by these attributes is known as limited partnership (LP).[5] Other types of venture capital structures such as corporate venture capital funds or government funds typically have much longer lives, as they are incorporated venture capital companies or publicly traded closed-end funds. Consequently, the need to exit the investment is not as prominent for these type of venture capital firms as for LPs (Gompers and Lerner, 2004). By restricting the sample to investment rounds by LPs, it is ensured that liquidity risk is of importance in the investment rounds studied.

The primary data source is the Securities Data Corporation (SDC) Platinum database, provided by Thomson Financial. Information on venture capital disbursements and IPOs are sourced from SDC Platinum VentureXpert and New Issue database respectively. Macroeconomic variables are obtained from World Development Indicator database (World Bank, 2009) while country specific stock index values are taken from Morgan Stanley Composite International (MSCI) Inc. (2009).

Throughout the study pooled cross-section and time series data are used. This helps to remove biases caused by aggregating heterogenous individual investment rounds so that the aggregates do not accurately represent behaviour at the micro level. Also, it minimizes the chances of a particular time/cross section series being atypical and provides increased precision of regression estimates due to larger sample size.

The unit of observation is an investment round in an entrepreneurial firm by a venture capital fund. Venture capital fund classifications provided by

SDC Platinum were used as the screening tool to ensure that at least one LP fund is recorded per investment round when collecting the data. By restricting the fund type to 'Independent Private Partnership' within VentureXpert, only LP investment rounds were obtained for the three sample countries.

With regard to general exit market liquidity (proxied by annual IPO volumes) the following selection procedures were applied: all first time public equity offerings (venture backed and non venture backed) were obtained for Australia, Canada and the United Kingdom from SDC Global New Issue database. In line with Cumming et al., (2005), equity offerings related to financial companies, spin-offs and firms already listed on other stock exchanges were then excluded using Global New Issue's company and IPO classifications. To ensure data completeness, investment rounds of years without IPO volume were removed, resulting in a slightly shorter time horizon for the country specific Canadian and Australian sample (1993 – 2005 and 1991 – 2005 respectively) as well as the pooled sample (1993 – 2005).

Specific attention was also given to the investment stages of disbursements. Investment stages mirror the development stage of entrepreneurial firms which in turn reveals information on the level of technological risk involved in the investment. For example, the more developed a firm is, the less technological risk is involved in the investment. To identify the stage of each sample investment round, investment stage classifications provided by VentureXpert were used. Within the database, investments are grouped into the following four stages:

Early stage: includes early stage, seed, start-up, first stage and other early.

Expansion stage: includes expansion, second stage and other expansion.

Later stage: includes third stage, bridge and other later stage.

Other stage (including buyout and acquisition): includes acquisition, acquisition for expansion, leverage buyout, turnaround, other acquisition, special situation, secondary purchase, open market, private investment in company, other special situation, bridge loan, VC partnership

As indicated above, technological risk and exit risk are least important for 'other stage' investments, as both risk factors are largely resolved. Therefore, 'other stage' investment rounds were excluded from the sample resulting in a total of 4,758 pooled investment rounds.

Further, for each of the 4,758 investment rounds, the following information was collected: investment amount, industry sector, and geographical fund origin. With regard to investment amount, the objective is to gain an insight into investment round differences on the basis of capital requirements. Disclosed investment round totals in US$ were obtained from VentureXpert and then adjusted for inflation using GDP deflator. The objective of applying industry classification is to capture potential differences across major industry sectors. All investment rounds in the sample are categorised according to VentureXpert's major industry group classifications, which group investment rounds into the following five categories: computer (includes semiconductors, other hardware, and software), internet (includes communication and media), biotechnology (includes biotechnology and pharmacology, medical and health (includes medical / health related and energy related services), and non-high-tech (includes all other industries). Further, fund origin codes provided by VentureXpert were used to identify national and international LP funds.

Table 1 shows the composition of venture capital investment rounds by country, project stage and industry. The overall pooled sample amounts to a total of 4,758 investment rounds. Of these, 17% (814) are from Australia, 20% (989) from Canada, and 63% (3051) from the United Kingdom. Thus, the sample is clearly dominated by investment rounds from the United Kingdom. This is largely due to the substantial size of the UK venture capital market compared to those in Australia and Canada.

(PLEASE INSERT TABLE 1 ABOUT HERE)

Table 1 also reveals that 46% (2191 out of 4758) of all investment rounds included in the pooled sample are new investments as opposed to follow-on investments. On a country level, the largest portion of 49% new investments is reported for Canada (485 out of 989) followed by 48% for the United Kingdom (1453 out of 3051). Collectively, this highlights the importance of new investments relative to follow-on investments in on-going projects. With regard to the industry distribution of venture capital investment rounds, the largest portion of investments in the pooled sample is devoted towards the computer sector (44%), followed by the non-high-tech sector (23%). Similar patterns are evidenced in the country specific samples. Most likely, this sectoral distribution is largely influenced by the high-tech boom during the late 1990s.

Although beyond the scope of this study, Table 1 also highlights that a significant portion of risk capital comes from international funds as opposed to local funds (see, row titled 'international investments'). This is true for the pooled sample as well as each individual country. This confirms the global nature of the venture capital industry. The observed interdependence of venture capital funds across countries helps to justify the pooled analysis.

4. Methodology

4.1 Multivariate Logit Model

We extend the Cumming *et al*., (2005) model to accommodate cross-country data. Our multivariate logit model is expressed as:

$$L = \ln\left(\frac{P}{1-P}\right) = \alpha + \beta_1 IPO + \beta_2 IC + \beta_3 \ln AMT + \sum_{i=1}^{I} \gamma I + \sum_{c=1}^{C} \delta C + \varepsilon \quad (1)$$

where, subscript *ln* denotes natural logarithm and

L = binary dependent variable. When testing hypothesis 1, L = takes on values of one if the investment is in the early stage and zero otherwise. When testing hypothesis 2, L = taking on values of one if the investment is a first round investment and zero otherwise;

P = conditional expected probability that Y=1 $\mid$ X;

α = constant;

IPO = exit market condition;

IC = investment climate;

AMT = investment amount total in US$ adjusted for inflation;

I = a vector of industry dummy variables to account for unobserved industry specific factors;

C = a vector of country dummy variables to account for unobserved country specific factors;

ε = stochastic error term; and

$\beta_1, \beta_2, \beta_3, \gamma, \delta$ = parameters to be estimated.

The estimation of the Equation 1 is done at two levels: (1) for the pooled venture capital market by combining investments from Australia, Canada, and the United Kingdom and then incorporating dummy variables to account for country specific influences, and (2) for country-specific domestic venture capital markets of Australia, Canada, and the United Kingdom separately.

The country specific version of Equation 1 is obtained by removing the vector of country dummy variables (*C*) used to control for unobserved country specific factors. Equation 1 is kept in a generic form, as the lack of a regular time pattern of the data does not allow for any time or country specific subscripts. It is estimated using LIMDEP version 7.0 econometric software (LIMDEP, 1998). This software provides logit coefficient estimates along with marginal effect estimates, which is beneficial with regard to economic interpretation.

The selection of dependent and independent variables is complicated by the fact that theory does not offer much guidance for some variables. Therefore, previous research is used as a yardstick. Table 2 provides a detailed summary of the variables employed in the regression models.

(PLEASE INSERT TABLE 2 ABOUT HERE)

Following Cumming *et al*., (2005), the dependent variable *L* used in Equation 1 is a dummy variable. For hypothesis 1 this variable takes on values of one, if the investment is categorized as an early stage investment and zero otherwise. For hypothesis 2 it takes on values of one, if an investment is a first round investment and zero otherwise and thus distinguishes new investments from follow-on investments.

To date, no formal theoretical guidance exist defining appropriate proxies for exit market liquidity. Prior venture capital research has used proxies such as market value of IPOs (Jeng and Welch, 2000), stock market capitalisation (Schertler, 2004) and number of IPOs (Ritter and Welch, 2002; Cumming *et al*., 2005). In line with the majority, we use the number of IPOs to proxy exit market liquidity.[6] Based on existing evidence, the following *a priori* expectations are formed: a negative coefficient is expected for *IPO* when testing hypothesis 1 and a positive coefficient is anticipated when testing hypothesis 2.

In order to account for changes in investment conditions, variable *(IC)* is used. In particular, *IC* controls for stock market returns by means of Morgan Stanely Capital Index (MSCI). Specifically, country specific MSCI indices, measuring stock market performance in real US$ terms are included.[7] Gompers and Lerner (2004) show that the supply of funds to venture capital markets is positively correlated with stock market returns and thus a positive coefficient is expected for MSCI with regard to both testable hypotheses. To limit data variability, the natural logarithm of MSCI is used.

The inclusion of investment amount *(AMT)* variable, which measures capital investment size in real US$ terms, is based on the argument that

capital requirements differ across investment stages. Due to large dispersions in investment amount values (ranging from 1million to 7million) the natural logarithm (ln) is used. Generally, capital requirements are lowest for early stage projects, and increase proportionally to the advancement of a project. Consequently, a negative coefficient for *AMT* variable is expected.

To capture industry specific technological risk, industry dummy variables are included in Equation 1. Based on VentureXpert's major industry group classification for portfolio companies receiving venture capital financing, investment rounds are grouped into the following categories: *computer, internet, biotech* and *medical*. No *a priori* expectation is formed for the various industry coefficients. Similarly, due to lack of prior evidence no *a priori* expectations are made regarding the sign of the country dummy coefficients.

5. Results and discussion

5.1 Univariate Comparison Tests

Table 3 shows test results for differences in proportions for the pooled sample. In particular, comparison of proportion tests is presented for (1) new early stage investments and (2) new investments, at low and high IPO volumes. With regard to the proportion of new early stage investments relative to total new investments, univariate comparison tests show that the fraction of new early stage investments is lower when the number of IPOs is high. This is evidenced by statistically significant difference test static values. The difference in proportions is statistically significant at the 1% level for test (1) which shows the proportion of new early stage projects above and below the median, and at the 5% level for test (2) which depicts the same proportion for IPO volumes above the 1st quartile and below the 3rd quartile. Stated differently, the choice of financing new early stage investments against new expansion and later stage investments seems to decrease when exit market liquidity increases. These findings provide preliminary support for hypothesis 1.

(PLEASE INSERT TABLE 3 ABOUT HERE)

With regard to the proportion of new investments relative to total investments (Table 3, last row), both univariate comparison tests show that the proportion of new investments significantly increases when IPO volumes rise. The test statistics for differences in proportions are statistically significant at the 1% level and thus provide strong preliminary support for hypothesis 2.

5.2 Effects of Liquidity Risk on New Early Stage Investments

Table 4 presents Maximum Likelihood estimates of the multivariate logit model given in Equation 1 for both pooled and country specific venture capital markets. For each regression variable, apart from the logit coefficient, marginal effect and odds ratio are reported to highlight effect size and economic significance. The corresponding Z-statistics were calculated after White (1980) adjustment.

With regard to diagnostics, the likelihood ratio (LR) test statistic in the lower panel of Table 4 indicates overall model significance. The Chi-square statistics are statistically significant at 1% level and thus uniformly reject the null hypothesis of the LR test that all explanatory variable coefficients are jointly equal to zero in the respective specifications. The reported Pseudo R-square, measuring overall 'goodness of fit' of the specification, is 0.0702 for the pooled model and highest for the Australian model with a value of 0.1668. These values are quite low. However, when benchmarked against other models analysing similar phenomena in venture capital literature, they are quite consistent (Chrochane, 2005). Further, it needs to be noted that in binary regressand models, goodness of fit is of secondary importance (Gujarati, 2003).

Estimates for *IPO* variable provide key results with regard to hypothesis 1. Unfortunately, the estimated logit coefficients for this variable in the pooled and country specific models (except in the Canadian sample) are statistically insignificant. Thus, there is insufficient statistical support of a negative association between exit market conditions and early stage investments for the pooled as well as individual venture capital markets in Australia and the United Kingdom.

Although these coefficients are statistically insignificant, they may well have important implications from an economic point of view. For example, the reported marginal effect for *IPO* at mean figure of -0.0002 indicates that an increase in liquidity by 100 IPOs in one year reduces the probability that VCs invest in new early stage projects by 2% after controlling for exogenous factors. This value is relatively small, but nevertheless economically important, as IPO markets themselves experience large swings as highlighted by Bradley *et al*., (2003). The reported odds ratio of 0.9991 suggests that the odds of the binary dependent variable taking one in the pooled venture capital market decreases by a factor of 0.9991 given a one unit increase in *IPO*.

(PLEASE INSERT TABLE 4 ABOUT HERE)

Unfortunately, benchmarking these findings is substantially hampered by the absence of similar

previous studies. The observed negative relationship between early stage investments and exit market liquidity in the Canadian venture capital market, however, is consistent with Cumming *et al*., (2005) study on the US venture capital market. A possible reason for the similarity in investment behaviour could be the geographical proximity and integration of the two venture capital markets.

Overall, empirical findings presented in Table 4 do not provide convincing support for the hypothesized negative association between exit market liquidity and new early stage investments. Results suggest that there are other factors dominating venture capitalists investment decision with regard to early stage investments and the frequency of investments in that stage. For example, venture capitalists might be more willing to invest in early stage investment when associated tax incentives make the investment return promising. Alternatively, regulations with respect to foreign venture capital funds may distort the VCs' investment behaviour.

As expected, it was found that favourable stock market conditions correspond to high levels of early stage investments. This is evidenced by positive and statistically significant coefficients for *IC* for the pooled and Canadian samples. For the Australian sample the *IC* coefficient is also positive, but marginally insignificant. Economic significance of this variable (as shown by marginal effect) is largest for the Canadian model (0.2388), closely followed by the pooled model (0.1521). Put differently, the probability of a new early stage investment in the pooled venture capital market increases by 0.1521 given a one unit increase in MSCI. This highlights that investment climate has a significant economic impact on new early stage investments. Similar findings are reported by Cumming *et al*., (2005) for the American venture capital market.

Moreover, as anticipated the investment amount *(AMT)* has a negative and statistically significant coefficient at 1% level across all specifications. This indicates that the likelihood of a new investment being an early stage project decreases, if capital requirements are high. In other words, projects with low capital requirements are more likely to be early stage projects, since capital needs increase with the advancement of a project. Further, this may also suggest that new early stage projects are less likely in industry sectors, where early stage projects require high capital investment levels.

Coefficients of the binary industry dummy variables used to detect differences between market segments are positive and statistically significant at 10% level for the pooled and country samples. Broadly, results indicate that investments in the biotechnology, computer, medical and internet sector are different from investments in the non-high-tech sector.[8] In particular, the four models suggest a greater economic significance in the probability of early stage financing in the biotech and medical industry compared to the internet and computer sector. This is evidenced by size of the marginal effect estimates. In the pooled model for example, economic impact is largest in the biotech (0.3115) and medical (0.1616) industry respectively. Collectively, this may reflect differences across sectors with regard to venture capitalist' success rates (Gompers and Lerner, 2004). An alternative explanation may be that the need for venture capital financing in the biotech and medical sector, where projects generally require larger capital levels, is higher (Cumming *et al*., 2005).

With regard to the two binary country dummy variables, introduced to capture exogenous country specific differences in the pooled model, the estimated coefficients are both negative and statistically significant. Thus, the likelihood of new early stage investments is lower in Australia and the United Kingdom compared to Canada.[9] These observations reveal that systemic factors influence venture capitalist behaviour. Arguably, these country level differences across the three venture capital markets may reflect differences in government policies promoting early stage investments.

Further, the results are robust to other tests, not explicitly presented, but available upon request. Specifically, regression results were stress-tested with respect to years surrounding the internet boom, as they represent a remarkable portion of the overall investments considered. To capture possible influences of the internet bubble on venture capital markets during 1999-2000, two dummy variables taking values of one for the years 1999 and 2000 were included in the Equation 1. As expected, the coefficients of these binary dummies were statistically significant.

5.3 Effects of Liquidity Risk on New Investments

The empirical results for hypothesis 2 are presented in Table 5. For the pooled and country specific samples, it is tested whether there is a positive association between exit market liquidity and new investment projects. To test the proposed positive relationship, the full sample of early stage, expansion stage, and later stage investments is used in all regressions.[10]

Maximum Likelihood estimates for pooled and country specific venture samples using Equation 1 are presented in Table 5. For each variable, apart from the logit coefficient, marginal effect and odds ratio are also reported to highlight effect size and economic significance. The corresponding Z-statistics (not shown in Table 5 due to space

limitations) were calculated using White (1980) adjustment.

With regard to diagnostics, the likelihood ratio (LR) test statistics in the lower panel are all statistically different from zero at 1% as indicated by the corresponding Chi-square values, and thus highlight overall model significance. Even though Pseudo R-square values are lower than in the previous models, they are still broadly in line with other similar research (Cochrane, 2005; Cumming *et al*., 2005).

(PLEASE INSERT TABLE 5 ABOUT HERE)

The logit coefficients for *IPO* variable are positive and statistically significant in all four models. These results provide strong support for hypothesis 2. In other words, the likelihood of investing in new venture capital investments increases when exit markets become more liquid. These findings are consistent with results on the US venture capital market by Cumming *et al*., (2005). Economic impact of the variable *IPO*, as indicated by the marginal effect at mean value is highest for the Australian and Canadian samples (0.0013 each) closely followed by the pooled sample (0.0010). This shows that an increase in liquidity by 100 IPOs a year increases the probability of a new venture capital investment between 13% (in Australian and Canadian venture capital markets) and 10% (in the pooled venture capital market). The odds ratio of 1.0042 for the pooled model reveals that the odds in favour of new investments increase by a factor of 1.0042, should the exit markets are liquid.

The results for *IC* variable, however, are not uniform across the different samples. Specifically, the expected positive sign is not evidenced for the Australian and Canadian samples. While the negative coefficient for *IC* is insignificant for Australia, it is statistically significant for Canada. Furthermore, coefficients for investment amount *(AMT)* are not uniformly negative as well. While the coefficient is negative for Canada and the United Kingdom, and thus in line with findings by Cumming *et al*., (2005), the same is positive in the pooled (0.0004) and Australian model (0.2338). A possible explanation for this anomaly may be that the supply of funds in these venture capital markets is primarily influenced by policy incentives as opposed to the general investment climate.

The four binary dummy variables, used to detect differences between market segments, have largely negative and statistically significant coefficients at 1% level across specifications. In the context of the pooled venture capital market, the economic effect is largest for the medical industry (-0.1088) followed by the internet industry (-0.0895). Overall, this means that medical and internet projects are more often new investments as opposed to follow on investments. Stated differently, investment staging is less frequent for medical and internet projects. These findings are consistent with prior findings by Cumming *et al*., (2005) for the US venture capital market.

6. Conclusion

This study investigated the effect of liquidity risk on the investment behaviour of venture capitalists in three selected common law based OECD countries (Australia, Canada and United Kingdom). To that end, two research questions driven by existing information gaps were considered: (1) how does liquidity risk effect the choice of new early stage venture capital projects? And (2) how does liquidity risk effect venture capitalists willingness to invest in new projects as opposed to ongoing projects?

To answer these two research questions, two hypotheses were tested respectively. H_1: 'for new investments the likelihood of investing in early stage projects decreases with the liquidity of exit markets' and H_2 : 'the likelihood of investing in new projects (irrespective of development stage) increases with the liquidity of exit markets'. Both hypotheses were evaluated for pooled and country specific venture capital markets using Maximum Likelihood estimates of a multivariate logit model.

With regard to hypothesis 1, the expected negative association between exit market liquidity and new early stage investments proved to be statistically insignificant except for the Canadian venture capital market. Overall, empirical evidence in favour of hypothesis 1 was obtained only for the Canadian venture capital market. While the Canadian observation is in line with findings for the US venture capital market, benchmarking of the other results is largely hampered due to lacking previous studies. One possible reason for the similarity between Canadian and U.S. venture capital environments may be the geographical proximity and the integrations of these markets.
Results suggest that liquidity risk *per se* does not seem to effect early stage investments in Australia and the United Kingdom. Arguably, the results suggest that there are other factors dominating venture capitalists investment decision with regard to early stage investments and the frequency of investments in that stage. Potential reasons for this behaviour might be as follows. (i) Government led tax incentive schemes, intended to stimulate capital flow into early stage venture capital projects, may have contributed to changes in limited partnership (LP) investment behaviour. (ii) Moreover, government led equity venture capital programmes, introduced to reduce imbalances of venture capital allocation, might have caused competition with existing private finance sources. Differences with

respect to rates of return of private and government led funds may have led to this unexpected investment behaviour.

With regard to hypothesis 2, maximum likelihood estimates uniformly show a positive and statistically significant association between exit market liquidity and the probability of new investments (irrespective of development stage). Thus, these results provide empirical support for hypothesis 2. Overall, results suggests that during times of favourable exit market conditions, new firms (including start-ups) are more likely to obtain venture capital funding. Identical findings are reported for the US venture capital market by Cumming, Fleming and Schwienbacher (2005).

In particular, the reported results hold implications for entrepreneurs. For example, findings indicate that entrepreneurs are more likely to obtain venture capital funding when exit market risk is low. Understanding the impact of liquidity risk on venture capitalists investment behaviour should be beneficial for entrepreneurs, as it indicates their chances (or lack of it) of obtaining funds. The danger for entrepreneurs of being turned down is high, when liquidity risk is high, as venture capitalists invest relatively more in follow-on projects. In contrast, times of low liquidity risk provide start-up entrepreneurs with increased opportunities. Finally, this study proves beneficial for investor as it provides better understanding of factors driving venture capitalists' investment decisions.

This study advances knowledge of venture capital finance by focusing on the effect of liquidity risk on venture capital investment behaviour. It extends the empirical literature by providing the first ever analysis on this issue for venture capital markets in Australia, Canada and the United Kingdom. As far as it could be ascertained, this is the first study to investigate this issue at both pooled and country-specific level. It explores the robustness of the findings presented by Cumming, Fleming and Schwienbacher (2005) in an international context.

This study, however, suffers from three main limitations. First, the sample used is limited to early stage investment by venture capitalists, the so-called organised source of venture capital finance, due to data availability. Second, the concept of liquidity has been analysed from one perspective only, the angle of immediacy cost, which seems to be the most appropriate for the venture capital market. Third, liquidity is defined in terms of IPO market liquidity, although in some countries merger and acquisition (M&A) markets are actually more frequently used. Nevertheless, there should be no reason to believe that liquidity is not captured appropriately. Stock market conditions are crucial for acquisitions and thus M&A markets are expected to closely follow the IPO cycle.

With regard to possible extensions to this research, we suggest three avenues. First, there is scope for expanding the breadth of data with respect to sample size and period by using more extensive databases or proprietary data. Specifically, the analysis can be extended by including the whole spectrum of investors which play a role in venture capital financing. Second, one can analyse the issue of liquidity risk by distinguishing between national and international venture capital funds. Allowing for comparison between foreign and domestic venture capital funds can provide insights with regard to potential differences of the effect of liquidity risk on venture capitalists investment behaviour.

Third, one can investigate and compare the effect of liquidity risk across different legal backgrounds, such as civil law countries compared to common law countries. The issue might be worthwhile exploring in a behavioural finance setting as results suggest importance of behavioural factors with regards to venture capitalist decisions.

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End notes

1 [This restriction facilitates cross country comparisons given the common legal structure governing these venture capital markets.]

2 [This is consistent with the aspect of non-tradability discount in the context of venture capital valuation (Das *et al*., 2003). These authors also find that non-tradability discounts are highest for early stage capital projects, as a result of the higher exit risk borne.]

3 ['Hot' issue markets refer to a period where the number of IPOs increases significantly and average first month performance of a new stock issue is abnormally high and thus provide venture capitalists with favourable exit conditions. In contrast, 'cold' issue markets show less IPO activity and generally reveal no substantial deviations from initial issue prices (Ibbotson and Jaffe, 1975).]

4 Venture capitalists generally do not commit all the capital required by firms to accomplish their business plan at once. Instead they invest capital in distinct stages, based on the firm development. This mechanism allows the VCs to monitor and control the firm and preserves their right to abandon unsuccessful projects (Sahlman, 1990).

5 [The economic life of LPs is on average set at 10 years and after that all cash and securities are distributed amongst the investors (Sahlman, 1990).]

6 [To capture the fact that future liquidity might matter, it was considered to use predicted IPO values using a forecasting model, but proved infeasible due to data limitations. *IPO* lead values are not included in the regression as this would implicitly assume perfect foresight concerning future liquidity, which is a very strong restriction.]

7 [Country specific MSCI Indices are used to ensure methodological consistency and thus increase comparability of results across countries.]

8 [In order to avoid perfect colinearity in econometric estimation, the dummy variable *non-high-tech* was suppressed in Equation 2 and thus coefficients of the presented industry dummy variables are interpreted in relation to this benchmark category. The choice of benchmark category is not influencing the overall conclusion of the regression results and was made to highlight the differences in industry sectors only.]

9 To avoid perfect colinearity the dummy variable for Canada was suppressed.

10 As a robustness check, hypothesis 2 was also tested by excluding later stage investments, but did not result in any significant differences.

Table 1. Investment Round Distributions 1990 – 2005

	Pooled Sample		**Australia**		**Canada**		**United Kingdom**	
Investments by Stage and Industry								
Stages of Investment (%)	**New**	**All**	**New**	**All**	**New**	**All**	**New**	**All**
Early Stage	52	40	48	45	66	47	48	37
Expansion Stage	45	55	50	53	31	45	49	58
Later Stage	3	5	2	2	3	8	3	5
Industry Sector (%)								
Biotech	8	8	9	8	11	11	7	8
Computer	45	44	36	39	49	48	45	44
Internet	13	15	8	11	20	23	12	13
Medical	8	10	9	11	8	8	8	11
Non-high-tech	26	23	37	30	12	10	29	25
International investments (fund origin) (%)	-	43	-	31	-	65	-	40
Number of observations	2191	4758	299	814	485	989	1453	3051

This Table shows the composition of venture capital investment rounds by country, project stage and industry. Data are sourced from SDC Platinum VentureXpert Database for the period of 1990 – 2005. The unit of observation is an investment round. The data are disaggregated into two groups: 'new' refers to new first round investments and 'all' to new and follow-on investments.

Table 2. Variable Definitions

Variable		Definition
Dependant variable		
L	Early Stage Investments	A dummy variable that takes on the value 1 if the investment round is an early stage investment (otherwise equal to zero)
L	New Investments	A dummy variable that takes on the value 1 if the investment round is a first round (otherwise equal to zero)
Investment specific variables		
IPO	Numbers of IPO	Total number of IPOs per annum during which the investment round was made (national stock exchanges)
IC	MSCI Country Index	Country specific Morgan Stanley Capital International (MSCI) Stock Index annual end of period figures (real value in US$ calculated using GDP deflator)
AMT	Investment Amount	Total estimated amount of funds invested per round (in millions of US$ calculated using GDP deflator)
Industry specific dummy variables		
(I_1)	Industry dummy for Biotechnology sector	A dummy variable that takes on the value 1 if the investment round is received by an entrepreneurial firm in the biotechnology sector (otherwise equal to zero)
(I_2)	Industry dummy for Computer sector	A dummy variable that takes on the value 1 if the investment round is received by an entrepreneurial firm in the hardware and software sector (otherwise equal to zero)
(I_3)	Industry dummy for Internet sector	A dummy variable that takes on the value 1 if the investment round is received by an entrepreneurial firm in the ecommerce sector (otherwise equal to zero)
(I_4)	Industry dummy for Medical and Health sector	A dummy variable that takes on the value 1 if the investment round is received by an entrepreneurial firm in the medical and health sector (otherwise equal to zero)
(I_5)	Industry dummy for Non-high-tech sector	A dummy variable that takes on the value 1 if the investment round is received by an entrepreneurial firm in the non-high-tech sector (otherwise equal to zero)
Country specific dummy variables		
C_1	Country dummy for Australia	A dummy variable that takes on the value 1 if the investment round is from Australia (otherwise equal to zero)
C_2	Country dummy for the United Kingdom	A dummy variable that takes on the value 1 if the investment round is from the United Kingdom (otherwise equal to zero)

This table presents the definitions of variables used to estimate the logit model given in Equation 1. The definitions used are consistent with previous studies as explained in the text. Following common academic practices all dollar values are inflation adjusted. Data sources include SDC Platinum VentureXpert and New Issue Database (2009), MSCI Web site (2009) and WDI Online.

Table 3. Tests for Differences in Proportions for Pooled Sample

	Test (1)			Test (2)		
	IPOs < 81 (Median)	IPOs > 81 (Median)	Difference Test Statistic	IPOs < 50 (1st quartile)	IPOs > 138 (3rd quartile)	Difference Test Statistic
Total No. of New Inv.	862	1112		522	618	
Total No. of New Early Stage Inv.	467	512		298	307	
Proportion of new Early Stage Inv.	0.54	0.46	3.58***	0.57	0.50	2.50**
Total No. of Inv.	2040	2238		1141	1106	
Total No. of New Inv.	862	1112		522	614	
Proportion of New Inv.	0.42	0.50	-4.87***	0.46	0.56	-4.63***

This table presents tesr results for differences in proportions for the pooled sample. Test statistics are provided for (1) the proportion of new early stage investments to the total number of new investments, and (2) the proportion of new investments to the total number of investments in the pooled sample. ***, ** and * indicate statistical significances at the 1%, 5% and 10% level respectively.

Table 4. Logit Estimates for Early Stage Investments

	Pooled (Model 1)			Australia (Model 2)			Canada (Model 3)			United Kingdom (Model 4)		
	Logit estimate	*Marginal effect*	*Odds ratio*	*Logit estimate*	*Marginal effect*	*Odds ratio*	*Logit estimate*	*Marginal effect*	*Odds ratio*	*Logit estimate*	*Marginal effect*	*Odds ratio*
Constant	-1.3541	-0.3353	0.2582	1.7296	0.4324	5.6385	-2.0495	-0.4139	0.1288	1.7852	0.4463	5.9610
Number of IPOs *(IPO)*	-0.0009	-0.0002	0.9991	-0.0014	-0.0003	0.9986	-0.0087***	-0.0018	0.9913	0.0016	0.0004	1.0016
Investment climate *(IC)*	0.6142***	0.1521	1.8483	0.0844	0.0211	1.0881	1.1823**	0.2388	3.2619	-0.1162	-0.0290	0.8903
Investment amount *(AMT)*	-0.2796***	-0.0692	0.7561	-0.4254***	-0.1063	0.6535	-0.6440***	-0.1300	0.5252	-0.1750***	-0.0438	0.8394
Biotechnology industry dummy *(I_1)*	1.2579***	0.3115	3.5180	2.7308***	0.6827	15.3447	1.3553***	0.2737	3.8781	1.2752***	0.3188	3.5794
Computer industry dummy *(I_2)*	0.2656**	0.0658	1.3042	0.8688***	0.2172	2.3840	0.9477**	0.1914	2.5797	0.0917	0.0229	1.0960
Internet industry dummy *(I_3)*	0.5754***	0.1425	1.7778	2.0426***	0.5106	7.7106	1.4746***	0.2978	4.3692	0.2838	0.0709	1.3282
Medical industry dummy *(I_4)*	0.6525***	0.1616	1.9203	1.4283***	0.3571	4.1716	1.3236**	0.2673	3.7568	0.5617*	0.1404	1.7536
Australia country dummy *(C_1)*	-0.5688**	-0.1408	0.5662									
UK country dummy *(C_2)*	-0.9574***	-0.2370	0.3839									
Log likelihood	-1161.6730			-163.4182			-235.1916			-745.1486		
Chi-square statistics (9, 7, 7, 7 df)	175.5154***			65.4531***			79.2728***			49.8533***		
Pseudo *R*-square	0.0702			0.1668			0.1442			0.0324		
Number of observations	1812			283			441			1111		
Time period	1993 - 2005			1991 - 2005			1993 - 2005			1990 - 2005		

This table presents the maximum likelihood estimates for the pooled and country specific sample respectively using the multivariate logit model given in Equation 1. Regressions use the sub-sample of new first round investments only as rationalised in Section 3. The country specific models do not include the country dummy component of Equation 1. Each model reports logit estimates, marginal effect estimates and odds ratio. ***, ** and * indicate statistical significances at 1, 5 and 10% levels, respectively.

Table 5. Logit Estimates for New Investments

	Pooled (Model 1)			Australia (Model 2)			Canada (Model 3)			United Kingdom (Model 4)		
	Logit estimates	*Marginal effects*	*Odds ratio*	*Logit estimates*	*Marginal effects*	*Odds ratio*	*Logit estimate*	*Marginal effects*	*Odds ratio*	*Logit estimates*	*Marginal effects*	*Odds ratio*
Constant	-4.6517***	-1.1605	0.0095	-1.5946	-0.3647	0.2030	3.4206*	0.8533	30.5873	-16.7780***	-4.1876	0.0000
Number of IPOs *(IPO)*	0.0042***	0.0010	1.0042	0.0055**	0.0013	1.0055	0.0054**	0.0013	1.0054	0.0015*	0.0004	1.0015
Investment climate *(IC)*	0.6858***	0.1711	1.9853	-0.1277	-0.0292	0.8802	-0.5263*	-0.1313	0.5908	2.4984***	0.6236	12.163
Investment amount *(AMT)*	0.0004	0.0001	1.0004	0.2338***	0.0535	1.2634	-0.0318	-0.0079	0.9687	-0.0562**	-0.0140	0.9453
Biotechnology industry dummy (I_1)	-0.2757**	-0.0688	0.7591	-0.0446	-0.0102	0.9563	0.0004	0.0001	1.0004	-0.4087**	-0.1020	0.6645
Computer industry dummy (I_2)	-0.2233***	-0.0557	0.7999	-0.3650**	-0.0835	0.6942	-0.1717	-0.0428	0.8423	-0.1894**	-0.0473	0.8274
Internet industry dummy (I_3)	-0.3586***	-0.0895	0.6987	-0.6861**	-0.1569	0.5036	-0.3737	-0.0932	0.6882	-0.1858	-0.0464	0.8304
Medical industry dummy (I_4)	-0.4362***	-0.1088	0.6465	-0.4901**	-0.1121	0.6126	0.0597	0.0149	1.0616	-0.5969***	-0.1490	0.5505
Australia country dummy (C_1)	-0.1357	-0.0338	0.8731									
UK country dummy (C_2)	-0.2844***	-0.0710	0.7524									
Log likelihood	-2547.2230			-493.1417			-626.9456			-1409.8720		
Chi-square statistics (9, 7, 7, 7 df)	152.3359***			39.1477***			26.4314***			133.5067***		
Pseudo *R*-square	0.0290			0.0382			0.0206			0.0452		
Number of observations	3790			784			925			2133		
Time period	1993 - 2005			1991 - 2005			1993 - 2005			1990 - 2005		

This table presents the maximum likelihood estimates for the pooled and country specific sample respectively using the multivariate logit model given in Equation 1. Regressions use the sub-samples of new-early, expansion and later stage investments as rationalised in Section 3. The country specific models do not include the country dummy component of Equation 1. Each model reports logit estimates, marginal effect estimates and odds ratio. ***, ** and * indicate statistical significances at 1, 5 and 10% levels, respectively.