APPENDICES

Appendix A1: Control Variables

Our control variables reflect VC/PE attributes and general firm-level variables, ownership and governance structure. We include whether the founder remains the CEO (*Founder is CEO)* The impact of founder-CEOs is unclear. While they may be innovative thought-leaders (and thus increase innovation), they sometimes lack management skill (which may reduce innovation) and explain why VCs often remove founder-CEOs (Heger and Tykvova, 2009). We control for the presence of a 'substantial shareholder' in the firm at the time of the IPO (*Blockholder)* to capture the role of blockholders in improving governance; and thus, in improving innovation (Edmans and Manso, 2011). We control for the CEO's stake in the firm (*CEO % Owned)*. VC/PEs often require entrepreneurial managers to retain some stake or management role in the firm in order to incentivize them to continue R&D. Empirical evidence suggests that CEO ownership and R&D expenditure are either positively related (Barker and Mueller, 2002) or that R&D expenditures increase (decrease) with increasing CEO stock ownership at low (high) levels of ownership (Cho, 1998; Ghosh et al., 2007). Finally, we control for concentration of share ownership as which is likely to positively influence innovation because it reduces agency costs and disciplines managers' behavior (Hill and Snell, 1988; Baysinger et al., 1991). The definition of the control variables is in Table A1 below.

Table A1: Variable Definitions

Variable	Definition
VC/PE attributes	
Overseas Location	An indicator that equals one if the IPO was backed by a VC/PE that is based outside of Australia.
Syndicate	An indicator that equals one if more than one VC/PE invests in the firm
VC/PE size Top 25%	An indicator that equals one if at least one of the VC/PE firm's size (capital under management) is in the top 25% of the sample
Portfolio spread	The ratio of the VC/PEs number of portfolio companies scaled by its size
Firm level characteristics	
Firm size	The natural log of total assets
Return on equity	Net income /book value of equity
Leverage	Total debt/total assets.
Firm age	The natural log of one plus the number of years between IPO and the founding year in the prospectus
High tech	An indicator that equals one if the firm is a high tech firm as defined in Loughran and Ritter (2004) to include computer hardware, communications equipment, electronics, navigation equipment, measuring and controlling devices, telephone equipment, communications services and software industries.
Founder is CEO	An indicator that equals one if the firm founder is the CEO at IPO
Blockholder	An indicator that equals one if there is a substantial shareholder' at IPO who owns more than 5% of the firm
CEO % Owned	The percentage ownership of the CEO.
Top 20 - % Owned	The proportion of the firm that the top 20 shareholders own at the time of the IPO (following Birt et al., 2006; Heaney et al., 2011; Azim, 2012).

Appendix A2: R&D Start scheme

The majority of the grants awarded to our sample firms were from the R&D start program. The program ran from 1996 to 2005 and provided Australian companies with grants to undertake research and development (R&D) and for commercialisation of technical innovations. The program supported projects that aim to develop new or improved products, processes, or services. Grants of up to $15 million were available, though typically they ranged between $100 000 and $5 million.

The objectives of R&D Start were to:

- increase the number of projects involving R&D activities with a high commercial potential that are undertaken by companies;
- foster greater commercialisation of the outcomes of those projects;
- foster collaborative R&D activities in industry and between industry and research institutions;
- encourage successful innovation in small companies by supporting commercialisation of internationally competitive products, processes and services;
- increase the level of R&D activity in Australia that is commercialised in a manner that will benefit the Australian economy; and
- increase the level of R&D activities conducted that provides national benefit.

The selection criteria for the program included management capability; commercial potential of the projects; technical strengths of the projects; 'need for funding'; and national benefits. *(*Administration of the R&D Start Program: Department of Industry, Tourism and Resources, Industry Research and Development Board / the Auditor-General, Audit Report No.15 2005–06)

The Industry Research and Development Board (the Board) was responsible for the administration of R&D Start under provisions of the *Industry Research and Development Act 1986* (the Act), and directions issued by the Minister for Industry, Tourism and Resources. Three sectoral committees, appointed by the Minister, assisted the Board to administer the program. The Board and its committees comprised over 50 private sector and academic members with expertise and experience in R&D and commercialisation. Members were appointed by the Governor-General for a period up to three years.

The committees undertook technical and financial assessments of applications and recommended to the Board whether applications should receive financial assistance. The Board delegated its authority to approve financial assistance to a Financial Delegate in AusIndustry. AusIndustry, a division of the Department of Industry, Tourism and Resources (DITR), assisted the Board to deliver the program. It provided secretariat support to the Board and the committees, processed applications, calculated and approved grant payments, and managed the program's annual budget allocation of funds.

This arrangement assisted in providing a clear delineation between the high levels of technical skills required to assess applications versus management of large public-sector organisations. The Uhrig Review (2003) notes that statutory bodies established to perform both of these functions can result in the loss of truly independent technical advice.

The decision to approve or reject an R&D Start application was made in four stages. Firstly, AusIndustry confirmed that the application met the program's eligibility requirements. Where eligibility could not be established clearly by AusIndustry, the application was sent to the relevant committee to determine eligibility. At the second stage, AusIndustry assessed the strengths and weaknesses of each eligible application, and provided the relevant committee with its assessment, as well as a recommendation on whether the application should be supported.

In the third stage, having regard to AusIndustry's ratings, a committee assessed the project, and recommended to the Financial Delegate whether the project was sufficiently competitive to justify financial assistance. The final stage in the processing of applications was the approval or rejection of the application by the Financial Delegate. Prior to approval, the Financial Delegate confirmed that the recommendation was consistent with the program's objectives and there were sufficient uncommitted funds to meet the new financial obligations.

Recipient details are not publicly available for 1996 to 2001, although around 1000 companies received support through the program. (Industry Research and Development Board Annual Report 2001-2002). For 2001-2005 where grant details (R&D Start) can be publicly obtained from annual reports, 609 firms obtained total funding of $452M. From data we compiled on VC funding of Australian firms[1], 88 (14%) of the grant recipients went on to obtain VC funding.

[1] From VentureExpert, Preqin and CapitalIQ. Deal data is available that identifies the VC firm, VC fund and investee firm. However, data on the investee firm is not available beyond the name and industry of the firm.

Appendix A3: Robustness tests

It is possible that VC/PE firms might 'cherry pick' innovative companies, in which case the firm's latent innovation causes VC/PE funding, rather than VC/PE funding causing innovation. We note that while the decision to go public is often non-random, and can be motivated by the desire to fund innovation (Wu, 2012), our sample contains only newly public firms, meaning that we are controlling for this by comparing 'like with like' (by contrast, it would be a concern if we were to compare non-public firms with public firms). We undertake several tests to mitigate endogeneity concerns and/or sample-selection-effects. This appendix provides details for two of these tests, two-stage least squares analyses and propensity score approach.

We run two sets of two-stage least squares analyses (Wooldridge, 2002; Greene, 2008). The first 2SLS method focuses on investment-specific instruments and uses the logit models from Table 7. We run the logit models to obtain predicted values for whether the firm receives VC funding or PE funding. We then replace the VC and PE indicators with these predicted values. When running these models, we omit the grant dummy in order to avoid collinearity with the grant dummy in the second stage model. The second 2SLS method uses a model that is similar in spirit to that in Samila and Sorenson (2011) with some limitations due to data availability.

Samila and Sorenson (2011) examined the relationship between VC/PE funding and entrepreneurship. They use as instrumental variables the average lagged returns of VC/PE firms as an instrument for whether a company receives VC/PE funding. They argue that this variable should satisfy both the relevance requirement and the exclusion restriction. The relevance requirement is satisfied because VC/PE returns determine how much capital VC/PEs can invest, so higher VC/PE returns should increase the likelihood of VC/PE funding. The exclusion restriction is satisfied because it is unlikely that the innovative potential from one investment will influence the overall level of VC/PE activity in the whole industry. We cannot use the exact instrumental variables of Samila and Sorenson (2011) as we lack the data on the returns for most VC/PEs in a given year. However, we do have data on the IRRs of funds raised in a particular vintage (in the US, but not in Australia[2]). For the set of VC/PEs in our sample, we also have data on VC/PE firm size, investment size, syndication, and location. Thus, we create the following instruments for our 2SLS analysis in Table 7.

[2] We can obtain IRRs for 67 Australian VC/PEs (from Preqin). However, we focus on IRRs for U.S. firms because (a) the small sample size might lead to inaccurate results that are not representative of the VC/PE environment; and (b) there is evidence of increasing internationalization in the VC/PE environment.

We use the average IRR that accrues to all VC/PEs whose vintage is between 5 years and 10 years before the date of the IPO. These VC/PEs are from the US (we do not have IRR data for Australia). We focus on returns from VC/PEs raised between 5 and 10 years ago in order to give the VC/PEs some time to invest capital and realize returns. This variable should satisfy the exclusion restriction because it is based on global data (not Australian data), so the innovativeness of a company in Australia is unlikely to influence the IRRs of VC/PEs in other countries. It should satisfy the relevance restriction because many VC/PEs in Australia rely on international connections, so the performance of global VC/PE would influence capital availability in Australia.

We use as an instrument the proportion of IPOs that are high-tech. This variable captures the presence of a high-tech environment, which might attract VC/PE activity (so should satisfy the relevance requirement). It should satisfy the exclusion restriction because the level of high-tech IPOs should not per se influence the innovativeness of any individual company.

We also construct instruments from various aggregate VC/PE attributes, including the proportion of IPOs that have overseas funding in the prior year, the proportion of IPOs that have syndicated investment in the prior year, the average ratio of investment size to VC/PE size for IPOs in the prior year, and the average VC/PE size for the prior year. The nature of the VC/PE environment might influence the likelihood that a VC or PE decides to back a company in Australia, but these aggregate characteristics are unlikely to drive the level of R&D, patenting or patent quality in any individual company.

We take steps to address sample selection issues by using the propensity score approach. This approach matches the VC/PE backed IPOs with a sub-sample of non-VC/PE backed IPOs that have similar characteristics to the VC/PE backed IPOs. We use the predicted values from Equation (4) and for the sub-sample of VC/PE backed IPOs, we construct a distribution of predicted values (the 'prediction interval'). For the sub-sample of IPOs that are not VC/PE backed, we then exclude any observation whose predicted value lies in the bottom 5% of the previously constructed prediction distribution. Thus, the remaining sample comprises only VC/PE backed IPOs and non-VC/PE backed IPOs whose predicted value lies in the prediction interval.