Business Partners: Complementary Assets, Financing, and Invention Commercialization

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Abstract

This paper assesses the relative importance of the complementary assets and financial capital that business partners may add to the original inventor-entrepreneur. Projects run by partnerships were five times as likely to reach commercialization as those without business partners, and they had mean revenues approximately ten times as great as projects run by solo entrepreneurs. These gross differences may be due both to partners impacting business success that is, who the particular partners were, and to selection of the type of project or of whom to select as a partner. After controlling for selection effects and observed/unobserved heterogeneity, the smallest estimate of partners’ complementary assets approximately doubles the probability of commercialization and increases expected revenues by 29% at the sample mean. Our findings suggest that a critical policy option to increase commercialization rates and revenues for early-stage businesses is to support the market for finding skilled partners.
1 Introduction

The individual entrepreneur has traditionally been an important force for technological change, job creation, and economic growth. Several studies and popular accounts, however, have reported a recent shift from the individual-based model of entrepreneurship to a team model, especially for invention-based ventures (e.g. Klotz et al., 2014). Indeed, the number of U.S. businesses that are partnerships has increased by 75% over the period 1995-2005 (U.S. Small Business Administration [USSBA], 2009).

A major question in the study of entrepreneurship is whether entrepreneurs can compete successfully with incumbents. Incumbents may have competitive advantages over entrants due to access to complementary assets. Teece (1986, 2006) identifies various complementary assets of incumbents including competitive manufacturing, complementary technology, marketing, and distribution. However, Spulber (2014) suggests that entrepreneurs may prefer to establish firms to develop their own inventions because of the transaction costs of transferring technology to incumbents. In this article, we suggest that independent inventors may overcome some of the competitive advantages of incumbents by obtaining business partners who provide some of the necessary complementary assets in the form of skills and contacts. Business partners thus provide complementary assets that help inventors commercialize inventions.

Founding the firm together with business partners may be important for the entrepreneur for several reasons. The partners may provide complementary assets in the form of skills that are often associated with deep knowledge of the target industry held by specific individuals with prior experience in the industry (see e.g. Shane, 2000; Sleeper and Klepper, 2005). Partners may also have crucial contacts with suppliers of complementary assets and with distributors and customers (Audia and Rider, 2005; Beckman, 2006; Spulber, 2014.) A third reason to find a partner is
to finance the cost of starting up. Bank lending may be difficult to obtain if the inventor does not have any hard assets, and VC financing is only available for a small number of ventures. Individual inventors may therefore, for various reasons, and to an increasing degree, team up with other individuals to add appropriate complementary assets as well as financing in order to more strongly compete as start-ups.¹

But the drive of entrepreneurs to form partnerships may come at the expense of limited improvements in the venture’s performance, and it might not compensate enough for the potential loss of aggregate invention commercialization following a reduction in the number of projects undertaken as proportionally more teams are formed. Improvements may be limited for teams because it is costly to find partners with the appropriate complementary assets (Harrison et al., 2010; Mason 2009; Shimer and Smith, 2000), and seeking partners can increase the risk of idea expropriation (Arrow, 1962; Gans and Stern, 2003). Moreover, teamwork can suffer from moral hazard (Alchian and Demsetz, 1972; Holmstrom, 1982) and coordination losses (Argote and McGrath, 1993). The key to assessing the economic implications of the shift in the entrepreneurial model is to quantify the overall impact of team formation on economic activity, in terms of the impact on both the distribution of project productivity and number of projects conducted.

In this paper, we assess one of these two aspects: we document and estimate the economic benefits of having partners with complementary assets join an inventor and the specific economic drivers of these benefits. In particular, we inquire whether it is the addition of complementary assets in the form of skills and contacts, or the addition of financial capital that drives the benefits of forming a team. If these benefits are significant, they might offset concerns that the reduction in number of projects conducted reduces aggregate innovation.

¹Complementary assets are important also for other firm decisions than the one we study. For example, a firm’s R&D investments (Helfat, 1997), the proclivity to enter new markets (Scott-Morton, 1999), the licensing and trading of patent rights (Arora, Fosfuri, and Gambardella, 2001; Serrano, 2010; Galasso, Schankerman, and Serrano, 2013), the make-or-buy decision in R&D (Ceccagnoli, Higgins, and Palermo, 2014).
Despite the importance of the issue, there is little empirical work substantiating the link between entrepreneurial teams and venture performance. First, the size of the founding team in the past has been found to be of only marginal significance and not robustly related to start-ups’ sales growth and general firm performance (e.g., Eisenhardt and Schoonhoven, 1990; Halebian and Finkelstein, 1993). Second, a review of the literature reveals no documentation of the causal effect of how team formation impacts venture performance. In previous work, the size and formation of the entrepreneurial team, as well as the type of inventions ultimately commercialized by teams, have been presumed to be exogenous to business outcomes. Our paper, to our knowledge, is the first attempt to quantify the marginal economic benefit of having business partners with complementary assets join a venture, while accounting for selection into partnership formation. This paper is also the first to identify the economic value of providing entrepreneurs with more external capital, versus helping entrepreneurs to obtain complementary assets through partnering with other people. Further research is needed to document the potential effect on aggregate innovation.

Studying the economic impact of entrepreneurial team formation is challenging for three reasons. The first challenge is that team formation may be endogenous. This endogeneity can arise in a number of ways. For instance, business partners with complementary assets may be more likely to join inventors with high-quality inventions or inventions with better prospects, and these inventions are more likely to be commercialized, inducing a positive correlation between business partnership and revenues. Another source of possible endogeneity is that inventors with high-quality inventions – who may be more likely to experience constraints on liquidity – are more likely to seek partners to obtain financing. Both sources of endogeneity indicate that not accounting for selection into partnership would consequently overestimate the economic benefits of teamwork. A second challenge is that the complete contributions of partners’ investments, skills,
and contacts are typically hard to discern. Third, it is also hard to determine who the original inventor-entrepreneur was and who joined him/her later. In this paper we address endogeneity issues and are fortunate to know who in the team had the original idea for the invention and indicators of all three of these kinds of potential contributions from business partners.

We rely on a survey, which documents the human, social, and financial capital contributions of business partners to Canadian independent inventors. The survey reveals that in approximately 21 percent of the projects the inventor was joined by business partners. The primary reasons for the inventor to create a partnership were to obtain skills (65%), to obtain financing (51%), and to acquire contacts (42%)—these three comprise a broad array of assets provided by business partners. The raw data suggest that obtaining financing may not be the primary reason for the formation of teams. Nevertheless, these partners take on substantial financial risk. In our sample, average pre-revenue external commercialization investments are approximately $24,800 (in 2003 Canadian dollars), when the average probability of commercialization is 0.11. The survey further indicates a very important role for business partners in commercialization success; the rate of commercialization of projects run by partnerships (0.30) is five times that of those run by solo entrepreneurs (0.06), and the revenues of projects undertaken by partnerships are almost ten times those run by solo-entrepreneurs. These raw data, however, are likely to overestimate the value of forming entrepreneurial teams.

We use several strategies to control for the endogeneity of subsequent partnering decision. First, we control for the quality of the invention and the observed commercialization investments by the inventor and external investors. Including realized investment levels will control for selection on the pre-investment prospects of ventures, which are unobserved to the econometrician but visible to both the inventor and investors. Second, we control for selection into partnerships on measurable inventor and invention characteristics using a propensity score-weighted model. In a
third approach, we explicitly control for unobserved heterogeneity.

The bulk of our empirical analysis quantifies how much of the above-noted gross effects represents the returns to obtaining complementary assets versus obtaining additional financing, while controlling for selection of projects into partnerships. Our smallest partnership estimate approximately doubles the probability of commercialization and increases expected revenues by 29% at the sample mean. The marginal impact of partners’ complementary assets on entrepreneurial returns is 10% larger than the one of financial capital and 128% larger than a proxy of the quality of the venture. While these estimates represent a first attempt at analyzing marginal impacts, our methodological approach could be further improved by identifying an instrument that logically and statistically significantly affects the probability of partnership but not the outcome variables except through its effect on partnership formation.

Taken together, these results indicate that the decision to form a business partnership is an important determinant of the existing large heterogeneity in entrepreneurial success and that obtaining complementary assets accounts for a large portion of this effect. Our empirical results do not document equally strong marginal effects for the provision of financing by business partners. Our findings suggest instead that a major policy option that can increase commercialization rates and revenues for early-stage businesses is to support the market for finding skilled partners. This takes forms that differ from the typical policy levers to stimulate the provision of venture financing and is likely to be less costly.

Our paper relates to other work on partnerships. Many previous studies concern alliances between large existing firms and new entrants (e.g., Baum et al., 2000), university-industry collaboration (e.g., Banal-Estañol et al., 2012), venture capital syndication (e.g., Brander et al., 2002), teamwork production (e.g. Hamilton et al., 2003), or the value added of venture capital (e.g., Hellmann and Puri, 2002). Our paper is most closely related to recent work studying the
effects of informal venture capital on start-up success. For example, Kerr et al. (2013) empirically demonstrate an overall positive effect of obtaining financing from two specific angel investor groups on business survival, launching an initial public offering (IPO), and access to follow-on funding for high-growth start-up firms.

2 A primer on business partners

Business partnerships are formally defined in the U.S. tax code as relationships between two or more persons who join to carry on a trade or business, with each person contributing money, property, labor or skill, and each expecting to share in the profits and losses of the business. In 2007, 61% of small U.S. firms were run by solo entrepreneur owners, 30% were run by two partners who own the firm, and the rest by three or more partners.2 The number of U.S. businesses that are partnerships increased by 75% for the period 1995-2005 (USSBA, 2009). The approximately 3.1 million U.S. partnerships in 2007 had 18.5 million partners.3

We use a narrower definition in this study, examining business partners who join an independent inventor and contribute either complementary skills, contacts, or financial capital to early-stage commercialization efforts. Relatedly, Burton et al. (2009, p. 116) report that 27% of start-ups were business partnerships (excluding spouses). Most early-stage partnerships are started by two people (Burton et al. 2009; Ruef et al. 2003).

The link between entrepreneurial team formation and venture performance is currently not clear. First, the size of the founding team has been found to be only marginally significant and not robustly related to start-ups’ sales growth (Cooper and Bruno, 1977; Eisenhardt and Schoonhoven, 1990; Kor, 2003), general firm performance (Haleblian and Finkelstein, 1993), and new business

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survival (Astebro and Bernhardt, 2003). Second, Beckman et al. (2007) and Beckman and Burton (2008) find limited effects from adding managerial expertise to the founding team on launching an IPO. However, Cressy (1996) found team size to be a significant predictor of new business survival, while Astebro and Bernhardt (2003) and Beckman et al., (2007) found it to be significantly related to start-ups ability to raise bank and venture financing, respectively. In these articles the size and formation of the entrepreneurial team was presumed exogenous to business outcomes, making it hard to infer from these correlations how the shift from individual to team entrepreneurship will affect venture performance and the overall economy.

As discussed, early-stage business partners may provide complementary assets in the form of skills, contacts, and also financing. While we have not found much literature on the performance impacts of the provisions of complementary assets by partners, the provision of early-stage financing by business partners is somewhat documented, as reported below.

Obtaining financing is thought by many to be important. But most start-ups still require relatively modest capital initially. Only 1.5% of firms operating in 2007 required more than $1 million at first, a level usually reserved for venture capital (VC) and other more complex financing schemes. Most start-up capital comes from personal savings or family.4 Reflecting this, as much as 5% of U.S. households may be informal venture investors (Bygrave and Reynolds, 2006). More than 50% of these informal investments go to a relative, and 28.5% to a friend or neighbor (Bygrave and Reynolds, 2006). These informal investors typically make only a few investments at a time, tend to invest substantially smaller amounts than VCs, invest their savings on their own or in syndication with other private persons, and invest more often in early-stage deals. They are widely distributed geographically and make most investments locally. They rely on very primitive informal networking arrangements among friends, family, business angels and business associates.

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4 Economic Census, U.S. Census Bureau, 2007 Survey of Business Owners, as reported by http://factfinder2.census.gov/ (accessed October 22, 2013)
for finding deals (Prowse, 1998). The primary criterion used to screen investment proposals is whether the entrepreneur is previously known to them or to an associate whom they trust (Prowse, 1998). Compared to other investors they, generally, rely less on traditional control mechanisms, such as board control, staging, or contractual provisions. Instead, they typically spend time "hands-on" in the business or exercise control through other mechanisms, such as trust or social influence. Many are active investors who seek to contribute their experience, knowledge, and contacts to the investee; they often invest in sectors where they have had previous experience, sometimes as an entrepreneur, while others are passive investors. Because individual investors invest much smaller amounts, and generally differ significantly in their investment preferences and screening and monitoring behavior from formal VC, individual investors represent a complement rather than substitute for VC financing (Goldfarb et al. 2007.)

3 Brief summary of a model of selection into business partnerships

A full model is provided in the on-line Appendix. Here we briefly summarize it verbally. The key components of the model are that inventors have varying and limited wealth, their inventions have varying pre-partnership quality, inventors meet partners with a positive probability of having varying complementary assets, and varying financial capital. Partners can release an inventor’s liquidity constraint by providing financing. Partners’ complementary assets can contribute towards both higher commercialization success and higher productivity of commercialization capital for any given level of invention quality and commercialization capital. The probability of meeting a partner represents friction in the market. The cost of forming a partnership is fixed.

5 For more details see Harrison, Mason, and Robson (2010); Mason (2009); Van Osnabrugge and Robinson (2000); Wiltbank (2009); Wiltbank and Boeker (2007); Wong, Bathia, and Freeman (2009) and the web site http://www.angelresourceinstitute.org.
A key model prediction is that the probability of forming a partnership is higher when invention quality is higher. The model further shows that the probability of partnership is higher when the complementary assets (i.e., skills and contacts) of the partner that the inventor meets is higher. Finally, we demonstrate that the probability of financing from partners increases with invention quality. The model thus clarifies three endogenous selection mechanisms that must be econometrically controlled for when estimating the economic impact of partnerships. The model further predicts three distinct types of partnerships: those where partners bring only financing, those where partners provide both complementary assets and financing, and those where partners provide only complementary assets. In addition, some projects are run more profitably by solo entrepreneurs than as partnerships, when the cost of partnering exceeds their marginal value added.

Our model is related to Lazear (2005), who develops a theory of entrepreneurs as jacks-of-all-trades where he assumes that the entrepreneur must invest in his/her worst skill to increase business performance. We instead analyze the value for entrepreneurs of adding business partners who provide complementary assets. Furthermore, our model is distinct from that of Holmes and Schmitz (1990), who develop a theory of entrepreneurship with specialization and business transfers. We abstract from the possibility that the inventor will transfer her invention to others.6 Finally, our work relates to the literature on liquidity constraints for start-ups. Evans and Jovanovic (1989) studied the degree to which personal wealth provides a binding liquidity constraint on a single individual’s choice between entrepreneurship and wage work. We focus instead on individuals who may find partners to relax liquidity constraints for commercialization success.

6Our data contains only five inventions where ownership was transferred and these are deleted from analysis.
4 Sampling method and data

We focus our empirical analysis on a sample of independent inventors; that is, individuals who
decide to develop inventions outside their regular employment duties. Many inventors may not
have great entrepreneurial or business skills and may lack the network and financial capital neces-
sary to commercialize their inventions. Further, they may lack the benefits of working in a large
incumbent organization in terms of access to a multitude of key resources such as a lab, funding,
skilled colleagues, and an established marketing and distribution network (Teece, 1986). They
may thus find it particularly useful to have others join them in their commercialization efforts to
provide these complementary assets. Studying independent inventors should thus likely provide
an excellent opportunity for examining the role of partnership mechanisms and their outcomes.

However, finding independent inventors among the general population is costly because of
their scarcity. To economize on search costs, we therefore use a list of independent inventors,
self-identified through their use of the Canadian Innovation Centre (CIC) in Waterloo, Canada.
(For further information on the CIC see the on-line Appendix.) Our sample frame consists of
inventors who had asked the CIC to evaluate their inventions between 1994 and 2001. A survey
resulted in a response rate of 61% and 772 analysis observations. Survey methodology details are
available in the on-line Appendix.

As in most surveys we expected sampling and response biases. We estimate sampling bias by
using a probit model of the probability of being able to trace the private address/phone number
of the inventor and a probit of responses from the traceable sample (Holt, Smith, and Winter,
1980). Results with the sample selection corrections were qualitatively similar to those reported
in the text (see online Appendix). There is also the potential for missing item (question) response
bias. We therefore imputed missing items five times assuming that data were Missing at Random
(MAR) using a switching regression approach and report estimation results averaged across the
five complete samples.

To understand the composition of the inventor sample better, we further drew a comparison
sample from the general Canadian population. We queried a sample of 300 Canadians from the
general population based on sampling quotas for province, work experience, and gender, to reflect
similarities in the aggregate with the inventors on these three variables. Comparisons were made
on background characteristics and are reported in the on-line Appendix.

A key variable in our survey was whether the inventor formed a business partnership for the
commercialization of the invention. To obtain this information we asked the inventor in the phone
interview: "Did you ever team up with other people trying to commercialize the invention?" To
obtain information on the provision of complementary assets, we inquired about the reasons for
the formation of the partnership: "Why did you team up with other people?" with the following
options read aloud: "You needed to have your skills complemented by their skills," "They had
contacts that were useful," "You needed the capital they provided," "They had resources that
were useful (land, equipment, plant)," and "Other." Each option required a "Yes" or a "No" reply
before continuing. The category "Other" also required the respondent to detail the particular
reason and all words in the reply were coded and analyzed. In the analysis the two categories
prior to "other" are collapsed into one. The questions imply that there is some form of matching
in which the partner provides something complementary that the inventor could benefit from
having. Follow-up interviews with a few inventors indicated that the questions accurately reflect
the decision to form a business partnership, not the decision to hire an employee or to engage a
consultant or other service provider (e.g., a lawyer or a banker) for cash payment.

However, we were concerned that the inventor may have formed a business partnership to
develop the invention and that this may be correlated with business partnership formation at
the commercialization stage. We therefore also asked: "I am now going to read you several alternatives regarding the circumstances of your invention’s genesis. Did you..." with one option being: "You belonged to a team that together came up with the idea." We coded whether the respondent belonged to a team that together came up with the idea as a binary dummy variable and control for this event in the analysis.

Another key variable in our analysis is an assessment of the inventions’ quality. This variable was obtained not from the phone survey of the inventors but from the administrative records of the CIC. The program helps inventors, before significant R&D expenditures are made, to evaluate an invention. The average time between the evaluation and eventual market launch was approximately two years (Åstebro, 2003). Further, total commercialization investments for inventions that later reached the market averaged C$276,350, but R&D expenses for all inventions up to the date of evaluation had averaged only C$22,518 (in 2003 dollars). Both statistics confirm that the evaluations were made at an early stage.

Our key dependent variable is the log of all future business revenues (appropriately discounted). The details of the method to compute the discounted present value is reported in the on-line Appendix. Other studies have used business survival, raising of venture capital, or time to IPO or time to commercialization as proxies for business success. For this sample, we believe that commercialization revenues is an appropriate measure of business success as most of these businesses have a limited opportunity to raise formal venture capital or be listed on major stock exchanges, and business survival may be capturing the subjective value of remaining an entrepreneur.

It is likely that the entrepreneurs were not able to respond particularly accurately when answering our phone calls. Indeed, some of these inventions were developed up to ten years before the phone conversation. We are thus likely to experience measurement error, which will bias any regression estimates towards zero. Had we chosen to obtain more contemporary data we would
likely reduce such noise, but would have had to deal with a greater degree of truncation of data on commercialization revenues. We chose to avoid as much as possible truncation of the dependent variable at the cost of noisier data.

Another concern is that entrepreneurs will embellish on their roles and downplay the roles of others if the business is successful (this bias is generally known as "attribution bias"). This particular bias, likely to exist also in this survey, will then reduce the proportion of entrepreneurs who respond that they obtained the assistance of business partners if the invention was successful and also reduce the reported investments made by those others than the entrepreneurs in the case that the invention was successful. This will bias downward the estimated impact of business partners on success.

4.1 Summary statistics

Although the identification of inventors relies on a specific, focal, invention submitted to the CIC it does not imply that the individuals are predominantly one time inventors. To the contrary, the sample is dominated by long-term serial inventors. Fifty-three percent of them had spent six or more years developing inventions, and 75% had worked on more than one invention. Eleven percent developed the invention as part of their normal duties at work. Twenty-six percent were stimulated by something at work, a majority of whom (73%) were not required to innovate at work.

With regard to the inventions, 21% were rated by the CIC as being of high quality and given a positive recommendation, suitable to further development at least as a part-time effort. The other 79% were deemed of low quality, and inventors were recommended to cease further development. Most numerous were sports/leisure products (28%), followed by security or safety applications (16%), automotive (14%), medical or health (14%), and items with environmental or energy
applications (13%). Inventions involving high technology (9%) and industrial equipment (14%) were also relatively frequent. Descriptions of some inventions reveal most to be “user-driven.” Successful consumer-oriented inventions included a new milk container design, a washable sanitary pad, and a home security light timer that emulates typical use. Other inventions had business applications. These inventions included an aligner and printer for photographic proofs, a tractor-trailer fairing that enhances fuel efficiency, a reusable plug to insert in wooden hydroelectric poles after testing for rot, and a computerized and mechanically integrated tree harvester. Thus, the inventions varied substantially in technological complexity and market potential. The median invention development effort was performed in 1997, and 95% of respondents had attempted to develop their focal invention before 2003.

The pre-commercialization investments in the inventions appear to be substantial. The average R&D investment for the inventors is approximately Cdn. $22,500, and the additional commercialization investment is another C$24,800 (in 2003 dollars).

5 Partnerships and the commercialization of inventions

Table 1 reports some descriptive statistics on partnerships and solo-entrepreneurs. In Panel A, we show that in approximately 21% of the projects, the inventor was joined by someone in commercializing the invention. The primary reason for the inventor to create a partnership was to obtain skills (65%), followed by obtaining financing (51%), and contacts (42%). Stated differently, 79% lack a partnership; and among the partnerships, in 16% of the cases only financing was provided, in 37% financing, skills, and contacts were provided by partners, and in 47% of the partnerships only skills and contacts were provided.

That several inventors are joined by partners to commercialize their invention suggests that there may be benefits to partnership. Indeed, we find that working with partners is positively cor-
related with the probability that inventions are commercialized. Table 1B shows that partnerships have a probability of commercialization of 0.30, which is five times that of projects run by solo entrepreneurs (0.06). The presence of partners is also positively correlated with revenues. Projects run by solo entrepreneurs had a mean present value of revenues of $24,196; mean revenues from projects run by partnerships were nearly ten times higher, $232,397.

5.1 Selection into business partnerships

Selection on invention quality  Partners may choose to join projects with higher quality. To investigate selection on invention quality, we use two proxies for invention quality: the CIC assessment and the inventor’s own R&D expenditures prior to partnership formation.\(^7\) We first classify inventions into two categories: high-quality inventions are those with a CIC positive assessment, and the rest of the inventions are deemed of low quality. It is immediately apparent that partners are more likely to join inventors with high-quality inventions, as shown in Table 1B. Partnerships are twice as likely as solo entrepreneurs to have high-quality inventions, 35% versus 18%. Stated differently, 34% of inventor with inventions rated as high quality were eventually joined by a partner, while only 17% of inventors with inventions of low quality were joined by a partner. Similar results were obtained when the inventions were categorized using the inventor’s own R&D expenditures. Partners were more likely to join inventors with higher R&D expenditures. The average R&D expenditures by the inventors that were eventually joined by partners was $90,364; solo entrepreneurs spent on average $4,725. To control for varying capital requirements by technology and for varying costs of capital we include industry and year dummies in a regression of the probability of partnership formation on invention quality. Estimates survive the inclusion of these industry and year controls (see Table 2). Table 2 also reveals that the two

\(^7\)We make a distinction between the idea creation and commercialization phase by the date of the CIC assessment.
quality measures are positively correlated with each other.

**Selection on demand for financing** An additional reason that partners join inventors is to provide external financing. To study selection on demand for financing, we test whether the probability of forming a partnership to obtain financing increases with invention quality. Using the same quality indicators and controls as before as predictors, Table 3 presents probit regressions with a dummy =1 if a partnership with financing was formed, and zero otherwise. The table shows support for this prediction. However, it appears that most of the invention quality variation that determines partnership financing is best captured with pre-partnership R&D expenditures.

Both tests for selection indicate that partnerships are formed because high-quality ideas attract business partners and because high-quality ideas have greater demands for financing, even after controlling for industry and year effects. Examining the impact of partners will then need to control for project quality.

6 The economic impact of partners’ complementary assets

6.1 Baseline econometric model

To study the contribution of partners in the commercialization of inventions we adopt the following econometric specification:

\[
y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases}
\]

with \(y_i^*\) as a latent variable indicating commercialization success, and

\[
y_i^* = \alpha q_i + \beta d_i + \delta X_i + \mu_j + \tau_t + \epsilon_i
\]
where $y_i$ is the log of commercialization revenues; $q_i$ is unobserved (to the econometrician) invention quality, $d_i$ is a dummy that equals one if a partnership was formed to commercialize invention $i$; $X_i$ represents regressors that vary across inventions and specifically includes investment levels by all parties, and $e_i$ is a normally distributed zero mean, independently distributed residual component. The terms $\mu_j$ and $\tau_t$ correspond to industry and CIC application year effects as implemented by a set of dummy variables, and $\beta$ captures the effect of partner’s complementary assets on the commercialization revenues conditional on a partnership being formed. We use the log form to allow for multiplicative effects of inputs.

Table 4 reports the effects of forming a partnership and control variables on the latent variable $y^*_i$. We use a Tobit model as a large number of inventions are never commercialized and have zero revenues. To provide intuition, we use a standard decomposition technique of the coefficient $\beta$ into the marginal effect on the probability of commercialization, and the marginal effect on expected log revenues, both estimated at sample means (see e.g. McDonald and Moffitt, 1980). The first column (Model 1) shows the estimated coefficient for the partnership dummy controlling for industry and year effect. Joint t-tests indicate that industry dummies ($t=1.74$) and year dummies ($t=1.70$) are only marginally significant. After controlling for industry and year dummies the size of $\beta$ is 15.25. Taking this value and evaluating the marginal effects of partnership at the mean of the sample imply that an invention project run as a partnership has approximately a 0.22 greater probability of commercialization than one run by a solo-entrepreneur, and its expected

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8 We also experimented with a Heckman selection specification, but we could not find a variable that could be reasonably assumed to affect the probability to commercialize but not revenues conditional on commercialization. Without an exclusion restriction estimations were unstable or did not converge.

9 Consider the following Tobit model. Let the dependent variable be $y = y^*$ (if $y^* > 0$) and $y = 0$ (if $y^* \leq 0$), and the latent variable $y^* = \beta X + e_i$. The marginal effect on the observed log of expected revenues $y$ is $\frac{\partial E(y|X)}{\partial x_k} \beta_{x_k} \Phi \left( \frac{X\beta}{\sigma} \right)$, where $x_k$ is a regressor of interest, $\overline{X}$ is a matrix of the sample means of the regressors, $\beta_{x_k}$ is the corresponding Tobit estimated coefficient of the regressor $x_k$, and $\Phi$ is the cdf of the standard normal distribution. If $x_k$ is a dummy, the marginal effect is the difference between the difference of the predicted values of the dummy evaluated at the sample mean of the rest of the regressors. Because our dependent variable is the log of revenues, the marginal effect of partnership in revenues can be approximated by exponentiating the marginal effect of partnership on the log of revenues.
revenues are eight times higher than that of a solo-entrepreneur project. (Because the controls are only marginally significant the gross differences in Table 1B are quite similar; 0.24 and 9.6, respectively.)

The positive correlation between commercialization success and partnership formation has to be interpreted with caution as there is selection on invention quality. We therefore add two proxies for invention quality: the CIC assessment and the log of R&D expenditures. The second column in Table 4 (Model 2) shows that the effect of partnership formation on expected commercialization success then decreases from 15.25 to 11.68, a 23 percent reduction. The drop in the coefficient estimate indicates that there is clear selection on measurable project quality into partnerships. However, the partnership coefficient still remains significant and large. At the sample means, partnerships are associated with an increase in the probability of commercialization of sixteen percentage points, and an increase in the expected revenues by a factor of 3.5.

The remaining partnership effect may be due in part to selection on unobservable invention quality. To control for this possibility we include a measure of total commercialization investment. Rational investors will invest as a function of qualities of the project that drives commercialization performance. Including realized investment levels will therefore control for selection on the pre-investment prospects of ventures which are unobserved to the econometrician but observed by investors (Olley and Pakes, 1996). In addition, the amount of external financing provided by partners should capture the partnership effect on revenues from relaxing liquidity constraints.

In Model 3 of Table 4 we analyze the effect of total commercialization investments. The third column adds the natural logarithm of post-partnership commercialization investments; the sum of all cash provided both by the inventor and external financiers to commercialize the invention after the formation of a partnership. The results show that the commercialization investment is positively correlated with partnership formation (and that unobservables determine this decision) because the partnership coefficient declines significantly (35.5%) when the commercialization
investment is added. As observed, the investments are also strongly correlated with the two observable measures of project quality. Including investments reduces one quality measure (CIC assessment) to insignificance and the other (R&D expenditures) to marginal significance. This suggests that investors clearly consider invention quality. But while the introduction of commercialization investment reduces the partnership coefficient considerably, the partnership effect remains positive and statistically significant. For instance, if the effects of partnerships are evaluated at the mean of the sample, partnerships increase the probability of commercialization by eight percentage points, and increase expected revenues by 65%.

To examine whether inventors are liquidity constrained and the degree to which partners relax these liquidity constraints, in Table 5 we distinguish between the natural logarithm of the inventor’s cash contribution and the natural logarithm of the sum of all cash contributions by all external financiers.\footnote{Unfortunately, due to the survey’s structure we cannot simultaneously identify inventor and external commercialization investments from inventor and others R&D expenditures. R&D expenditures are therefore included in the measures of financing. The survey inquired: 1. First, we would like to know how much money was spent on developing XX. Include all costs for product development, marketing research, making of prototypes, etc. How much did you spend before you contacted the CIC for an evaluation? 2. How much did you spend after you contacted the CIC for an evaluation? 3. I will now read a list of sources of funds that you may have used to pay for the costs of developing your invention. Please tell me for each source whether you have actually used it or not. 4. Consider the total amount of money you have spent on this invention so far. How large a proportion of this amount was your own money? These data allow us to identify either the effect of commercialization investment (using question 2) or external financing (using question 4).} External financiers, for example, may be banks, friends and family, or business partners. A first result from this analysis is that the size of the coefficient for external financing is almost four times smaller than the coefficient for inventor financing in Model 3. This result is consistent with the idea that inventors are capital constrained. If they were not constrained the coefficients for inventor and external financing would be equal.\footnote{This result is consistent with the finding that smaller and younger firms have higher growth-cash flow sensitivities than larger and more mature firms (see, e.g., Fazzari, Hubbard, and Peterson, 2000).} Thus, selection into partnerships to relax liquidity constraints is likely to occur. External financing is also positively correlated with the partnership effect, but only slightly. Quantitatively, the partnership coefficient declines by 10 percent, from 10.28 (in Model 2) to 9.26 (in Model 3). The results indicate that
partners often may not be the main external financier.

Our previous analysis did not include the labor supply for the inventor and the partner. But it is possible that labor input may depend on the quality and prospects of the venture. For example, the inventor may be splitting time in the venture with working part-time as an employee, and the partner may be investing in several ventures at the same time. We therefore add labor supply as a control. In particular, we inquired about the sum of the number of hours provided by the inventor and all partners post-CIC evaluation to commercialize the invention. Including the log of this number (with log of zero hours set to zero) will allow us to approximately isolate the quality of the partners’ complementary assets from hours of input by the partner. Results are reported in Model 4 in Tables 4 and 5. Controlling for labor inputs, the partnership coefficient drops by 0% in Table 4 and 5% in Table 5. The low conditional correlation between the partnership dummy and total hours indicate that it is the inventor who performs the majority of commercialization efforts, and that the main contribution by partners is complementary assets, rather than hours. That is, we find little evidence that business partners simply join to provide more labor hours to the venture. However, the magnitudes of the other parameters generally falls, indicating that labor efforts, unsurprisingly, are positively correlated with invention quality, total commercialization investments, and the amount of external financing. These correlations likely reflect incentive effects. Nevertheless, the partnership coefficient remains significant and large.

Whatever is left of the partnership coefficient after accounting for selection on quality, commercialization investment, labor supply, and external financing can be attributed to the effects of the partner’s complementary assets but also to omitted variable bias. In the next section we therefore attempt to further control for selection on inventor-invention observed characteristics and on unobservables.
6.2 Accounting for selection on observables and unobservables

6.2.1 Selection on observables

We exploit a large number of detailed inventor and invention characteristics\(^{12}\) to estimate a propensity-score-weighted model described by Hirano, Imbens, and Ridder (2003).\(^{13}\) By matching partnership observations to non-partnership observations with similar propensity scores, we can act as if there were random assignment to partnerships on inventor and invention characteristics, under the condition that there is ample partnership and non-partnership observations for each score. We examined this requirement and deleted observations where there was no common support, leaving between 712 and 752 observations, depending on the model specification. The

\(^{12}\)We included inventor gender, marital status, age, education, work experience, managerial experience, business experience, family business experience, years experience inventing, number of inventions developed, invention developed at work, invention stimulated at work, invention developed together with someone else, full-time, part-time, and un- or self-employed when inventing. Burton, Anderson, and Aldrich (2009) show that many of these demographics are related to partnership formation. We also included the following invention characteristics: positive, pre-team R&D expenditures, pre-team number of hours of effort, industry dummies, year dummies, and whether the fee paid to the CIC for the review was partly subsidized by a third party.

\(^{13}\)In an attempt to endogenize partnership formation we estimated an IV model with "the invention was stimulated at work" as an exogenous predictor of partnership. It seems reasonable to assume that if the stimulus for the invention was at work it may make it easier for the inventor to find partners, but should not necessarily directly affect returns. The variable was indeed a significant predictor of partnership \((t = 2.14, p < 0.01)\), but results were not stable. This is a situation in which the instrument simply is identified too weakly. We report the result in column 1 in Table A4 in the on-line appendix.

In another attempt to tackle the endogeneity issue, we also used both whether the invention was "stimulated at work" and Census data variation in the "proportion of self-employed", the "proportion of employees in the finance industry" and the "proportion of individuals being business owners" as exogenous predictors of partnership, all as proportions of residents in the respective census division (CD) of the inventor. There are around 300 CDs in Canada, and these represent large cities, county, regions, or divisions. We used a Postal Code Conversion Table (Statistics Canada, Geography Division, 2001) to relate the residential address of inventors to the above Canadian census unit according to the postal code provided by each inventor. Our assumption is that conditional on whether the inventor is located in a city or rural, the higher the proportion of self-employed, business owners, and finance people in the vicinity of the inventor the easier is to find business partners, but that these variables should not directly affect the invention future returns. We tried various IV models, such as ivtobit, ivprobit and ivreg2. The new instruments using data at the CD level were found to be jointly weak predictors of partnership formation (joint F values of around 4.5 were typically obtained, when seeking values of 10 or above). The Hansen J-statistic was sometimes not significant, and sometimes marginally significant (at around \(p = 0.09\)), indicating some potentially troubling aspects of using these variables as presumed exogenous. In addition, the point estimates of the IV coefficients differed substantially across specifications, largely due to their weakness in predicting team formation in the first stage. Unfortunately, estimations sometimes did not converge when running analysis at more detailed geographical level, such as a census subdivision (CSD) or dissemination area (DA). We report a summary of the regression results in Table A4 in the on-line appendix. More detailed results are available on request from the corresponding author.

We also experimented with including all the inventor and invention characteristics in the production function. This produced results qualitatively similar to the ones reported in Tables 4 and 5 and were deemed to be of no major interest. Results are available on request from the corresponding author.
area of common support for the score is [0.02, 0.91], capturing the 1st to the 99th percentile. Because there is considerable overlap in the score distributions between partnership and non-partnership observations, the so-called balance property is satisfied between the 1st to the 99th percentile, and we can safely rely on the scores to provide reasonable matching.

Results of the inverse propensity-score-weighted Tobit are provided in Model 5 of Tables 4 and 5. As seen, the estimate of the partnership coefficient is again reduced, indicating that there is also selection on observable inventor and invention characteristics. However, the coefficient does not decrease much; it falls by an additional 6.3% and 9.7%, in Tables 4 and 5, respectively. Therefore, after controlling for these selection effects, the partnership coefficient remains large. The size of the effect is either 46% or 52% of the gross partnership coefficient in Model 1, respectively. The estimate from Table 4 implies that expected revenues of commercialized inventions increase by 29% by going from solo entrepreneurship to partnership and that the probability of commercialization increases by 0.06 percentage points, which is a 97% percent increase over the commercialization rate of solo entrepreneurs, both non-trivial impacts. The estimates of the impact of partnerships in Table 5 are somewhat higher. Partnerships increase the probability of commercialization by 0.09 percentage points and increase expected revenues by 49%.

Another result to note is that after we control for inventor and invention characteristics prior to collaboration, the coefficient for own financing becomes negative. This may be the case because our propensity score method uses observables that are correlated with the borrowing capacity of the inventor; Astebro and Bernhardt (2003) indicate such correlations. If the borrowing increases, then equity financing may be reduced.
6.2.2 Selection on unobservables

To address the possibility that there is unobserved heterogeneity and measurement error in our identified selection effects, we utilize the fact that some partners provide only financial capital. We decompose the partnership effect as follows: Partnership = partner with complementary assets \([P(ca)]\) + partner without complementary assets but with financing \([P(not\_ca\_fin)]\). The identifying restriction we consider is that the financial contribution of partners exclusively affects commercialization investments by relaxing liquidity constraints. Under this assumption, after we control for invention quality and commercialization investment, a partner who provides exclusively financing should not affect revenues in any other way, that is, the coefficient for \(P(not\_ca\_fin)\) should be zero \((\gamma = 0)\). If the estimated coefficient for \(P(not\_ca\_fin)\) is zero, \(\hat{\gamma} = 0\), then the coefficient for \(P(ca)\) (label this \(\hat{\beta}\)) should represent the economic value of the partner’s complementary assets. Alternatively, if \(\hat{\gamma}\) is positive, then there will likely be selection on unobservables and therefore \(\hat{\beta}\) may have an upward bias.

Model 6 in Table 4 (5) replaces Partnership with dummies for \(P(ca)\) and \(P(not\_ca\_fin)\). In Table 4 we find that \(\hat{\beta} = 7.09\) \((p < 0.01)\), and \(\hat{\gamma} = 6.52\) \((p = 0.08)\). Results in Table 5 are similar. Therefore, it appears that \(\hat{\beta}\) is upward biased due to selection on unobservables.

We proceed to separately identify the contribution of the partner’s complementary assets from selection on unobservables. Rather than imposing further parametric restrictions to obtain point identification, we construct a lower bound for \(\hat{\beta}\). The effect of selection on unobservables may differ between partners who provide complementary assets and partners who provide only financing. We consider that, conditional on inventor’s assets the partnerships that receive only financing on average are of higher quality than the rest of the partnerships. In the on-line appendix we formally derive this result. The result is fairly general: partners who on average provide lower contributions can compensate for the opportunity cost of forming a partnership only in
projects of high quality. This implies that the ventures in which partners did not contribute complementary assets but provided financing are more likely than the rest of the ventures to involve high-quality inventions. In our econometric setting, this result is equivalent to having $\text{cov}(P(ca), q) < \text{cov}(P(not\_ca\_fin), q)$. The sign of this inequality allows us to calculate a lower bound for the partner’s complementary assets: $\beta^L = \beta - 0.224\gamma$. Evaluating the right-hand side of the boundary at the estimated $\beta$ and $\gamma$, we obtain $\beta^L = 5.63$ (std. err. 1.99, $p < 0.00$) and $\beta^L = 6.95$ (std. err. 2.06, $p < 0.00$) for the estimations presented in Table 4 and Table 5, respectively. Because we can safely assume that an upper bound for $\beta^L$ is $\beta^U$, the best estimate of partner’s complementary assets must lie in the range $\beta \in (5.63, 7.09)$. The lower bound represents a partnership coefficient that decreases from 7.54 in Model 4 to 5.63 in Model 6 of Table 4, a 25% reduction. The lower bound is 37% of the gross partnership coefficient in Model 1. The lower bound remains economically meaningful. For example, the mean probability of commercialization increases from 0.06 to 0.12 at the estimated lower bound effect, and the impact on expected revenues is a 38% increase. As the lower bound estimate is higher for results in Table 5 we refrain from reporting those details. Note that this method returns estimates quite similar to those from the method that controls for observed heterogeneity.

To test for robustness, all models estimated were re-run with the outcome variable limited to $=1$ if the project was commercialized and zero otherwise. These estimates indeed replicate results

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14 The result depends on positive complementarity among invention quality, commercialization investment, and competence in skills and contacts. This is satisfied by most production functions.

15 Define $\text{bias}(\beta) = \frac{\text{cov}(P(sc), Q)}{\text{var}(P(sc))}$ and $\text{bias}(\gamma) = \frac{\text{cov}(P(not\_sc\_fin), Q)}{\text{var}(P(not\_sc\_fin))}$. $\text{bias}(\gamma) = \gamma$ since our theoretical model implies that the true value of $\gamma$ is 0, while $\text{bias}(\beta) = \beta - \beta$. Rearranging and using that $\text{Cov}(P(hc), Q) < \text{Cov}(P(not\_sc\_fin), Q)$, the lower bound $\beta^L$ for $\beta$ is $\beta^L = \beta - \frac{\text{var}(P(not\_sc\_fin))}{\text{var}(P(sc))}\gamma = \beta - 0.224\gamma$. We have replaced $\text{var}(P(sc))$ and $\text{var}(P(a\_not\_sc\_fin))$ with their sample counterparts.

16 As stated in the sampling methods and data section there is the potential for selection bias due to address traceability and non-response. We therefore estimate a model for the probability of address traceability and a model for the probability of response from the traceable sample. We multiply the probabilities of tracing and response and invert the product for use as selection weight in the analysis (see Holt, Smith, and Winter, 1980). Results of regressions when applying these weights are reported in the on-line appendix, Tables D1 and D2. These results are qualitatively similar to those reported in the text where weights are not applied (Tables 4 and 5). This indicates that while there were trace and response sampling biases, these did not covary strongly with the correlations in the model.
derived from the Tobit model where the probabilities of commercialization for team formation were generated using McDonald and Moffitt’s (1980) formulae. Results are reported in the on-line Appendix (see Tables A2 and A3).

7 Conclusion

We investigate the value of forming a partnership with regard to commercializing an invention. We further analyze the impact on commercialization revenues of obtaining complementary assets, or financing from a partner. Since the data reveal strong selection into partnerships, we use several approaches to control for selection into partnership. We find that the smallest effect of partners’ complementary assets represents a large increase in the probability of commercialization – between 0.06 and 0.09 points. These are economically meaningful values as the probability of commercialization for solo-entrepreneurs is 0.06. The smallest estimated effect of partner complementary assets on revenues is also large, representing approximately either a 29% or a 38% increase in expected revenues, depending on the specification. Our findings also indicate that inventors are capital constrained, and that external financing is positively correlated with the partnership effect, but only slightly, suggesting that partners often may not be the main external financier. Although these estimates represents a first attempt at analyzing marginal impacts, our methodological approach could be further improved by identifying an instrument that logically and statistically significantly affects the probability of partnership but not the outcome variables, except through its effect on partnership formation.

Our paper relates most closely to recent work trying to estimate the real effects of obtaining business angel financing. Kerr et al. (2013) compare the impact of obtaining versus not obtaining informal VC for entrepreneurs who opt to apply to two angel financing networks that are just above and below a funding cut-off, thereby eliminating most of the explanations based on selection
on unobservables. The authors estimate the joint effects of these networks that relax liquidity constraints and provide complementary assets, conditional on entrepreneurs applying to these networks. We take a different approach from that of Kerr et al. (2013) in that we try to separately estimate the selection and complementary assets effects. We also try to untangle the effect of partners relaxing liquidity constraints from the effects of bringing complementary assets.

Our setting is admittedly unique. A comparison sample drawn from the Canadian population shows that the analysis sample represents seasoned inventors with significantly higher invention and prior business experience and with a broader number of occupations and industries worked in than the general population. We likely examine a domain where good business partners’ complementary assets may be considerably more useful than in the usual start-ups, such as a mom-and-pop shop. In this respect, our sample is probably similar to that of projects that attract and receive angel financing (Goldfarb et al, 2007). At the same time, our sample does not contain many projects that eventually receive formal VC funding, and our results may reflect this fact.\textsuperscript{17} This sample should not be compared to those generated by databases exclusively covering venture capital investments or directly with surveys of business partnerships in general. The first sample represents significantly larger investment amounts, risk, and upside opportunities, while the second is tilted toward non-invention-oriented businesses dominated by the trade, service and restaurant industries with lower investments by owners and partners. This sample represents a middle ground between these extremes.

Although there appear to be large benefits to forming partnerships, a natural question is then why all projects are not run as partnerships – the proportion observed in this dataset was 21\%. Our model and data reveal three main reasons. The first reason is the difficulty that inventors have in finding potential partners because of various frictions in the market (Harrison

\textsuperscript{17}The fraction which received VC financing was 0.8\%, too small to be analyzable in our study.
et al. 2010; Mason 2009; and Shimer and Smith, 2000). Furthermore, as evidenced in the paper, many projects are not of sufficient quality to warrant investment by partners but are still possible for solo entrepreneurs to pursue profitably. Finally, even after finding a potential partner, a partnership is formed only if the potential partner has complementary assets which justify the cost of doing so. The impacts of these mechanisms, which are central to our model, are described formally in the on-line Appendix. In addition, a partnership may not be formed because of a lack of "chemistry", coordination problems, moral hazard, or for various other behavioral reasons that lies outside the scope of this paper.

In this paper we have identified that a modest fraction of inventors form partnerships and that the returns to these partnerships are extremely large. This suggests market failures. These failures are frictions in the market for finding partners created by information asymmetries regarding whom among all known and unknown partners possess the right assets, the inalienability of these assets coupled with geographical distances to potential partners and search costs, to name a few. The good news is that the market failures are apparently not strongly associated with financing, and so there is less need for expensive direct capital subsidies. (Such subsidies often create incentive problems of moral hazard and crowding out of private investors.) Our results suggest instead that if the policy goal is to increase early-stage business rates and success, the most effective policies should make it easier for inventors to meet potential business partners. Such policies would take different forms than those meant to stimulate the provision of VC financing and is likely to be less costly. Popularly supported mechanisms which intend to match inventors with potential partners are, to name a few, breakfast networking meetings and speed dating events, entrepreneurship clubs, and the setting up and operations of business angel networks. Whenever the government funds inventors, researchers at universities or early stage businesses, it may therefore be appropriate to also facilitate potential collaborations with
experienced business people. A Canadian example is the NRC Industrial Research Assistance Program (IRAP) program where experts maintain extensive networks to extend and complement the capabilities of the Program. Access to these networks provides an opportunity for inventors and new businesses to connect with individuals and organizations knowledgeable about financing, research and development institutions, technology brokers and technology transfer centres. Another example is the U.S. Small Business Technology Transfer Program (STTR), which uses an approach to expand public/private sector partnerships between small businesses and nonprofit U.S. research institutions. The STTR program requires a funded company to have a partnering research institution which must be awarded a minimum of 30% of the total grant funds. None of these mechanisms, to our knowledge, have been evaluated for their social rate of return. This would be useful to know of course, and an interesting direction for future research.

References


Haleblian, J., and S. Finkelstein (1993): “Top Management Team Size, CEO Dominance,


Table 1: Commercialization, Invention Quality, R and D Expenditures and Revenues by Solo Entrepreneurs and Teams.

All data are in Canadian 2003 dollars. Each missing item response has been imputed five times. Means are computed using the formulae in Little and Rubin (1987).

### A. Percentage of projects with partnerships and contributions by partners

- Percentage partnerships (%) 21.0
- Contributions among partnerships (%)
  - Only financing 16.1
  - With both financing and complementary assets 36.8
  - Without financing and with complementary assets 47.1

### B. Characteristics of projects unconditional on commercialization

<table>
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<tr>
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<th>All</th>
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<th>Solo-entrepreneur</th>
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<tr>
<td>Percentage with positive CIC review (%)</td>
<td>21.5</td>
<td>35.5</td>
<td>17.8</td>
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<td>Mean R&amp;D expenditures ($) by inventor prior to the CIC review</td>
<td>22,518</td>
<td>90,364</td>
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<td>Mean commercialization investment ($)</td>
<td>24,823</td>
<td>70,690</td>
<td>12,792</td>
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<td>Mean commercialization revenues ($)</td>
<td>67,432</td>
<td>232,397</td>
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<td>Probability of commercialization (%)</td>
<td>10.9</td>
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### C. Characteristics of projects conditional on commercialization

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<td>Mean commercialization investment ($)</td>
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<td>Mean commercialization revenues ($)</td>
<td>619,739</td>
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Table 2: Probit Regression Analysis of Selection into Partnership

Dependent variable is partnership, a dummy variable taking the value 1 if an innovation was commercialized as a partnership, 0 otherwise. All data are in Cdn 2003 dollars. Regressions include dummy variables controlling for industry and year. Standard errors in parenthesis. ***, ** or * mean the coefficient is significant at the 1 percent, 5 percent, or 10 percent level, respectively. Missing item data are multiple imputed. Coefficients and standard errors are computed using the formulae in Little and Rubin (1987).

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<th>Pseudo $R^2$(%)</th>
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<td>0.397***</td>
<td>0.080***</td>
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<td>(0.130)</td>
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<td>2</td>
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<td>3</td>
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Table 3: Probit Regression Analysis of Selection into Partnership with Financing

Dependent variable is partnership with financing; a dummy variable taking the value 1 if an innovation was commercialized by a partnership with financing, 0 otherwise. All data are in Cdn 2003 dollars. Regressions include dummy variables controlling for industry and year. Standard errors in parenthesis. ***, ** or * mean the coefficient is significant at the 1 percent, 5 percent, or 10 percent level, respectively. Missing item data are multiple imputed. Coefficients and standard errors are computed using the formulae in Little and Rubin (1987).

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<tr>
<th>Model</th>
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35
Table 4: Tobit Regression Analysis of Commercialization Revenues

Dependent variable = log(commercialization revenues). Regressions include dummy variables controlling for industry and year. Standard errors in parenthesis. ***, ** or * mean the coefficient is significant at the 1 percent, 5 percent or 10 percent level, respectively. Missing item data are multiple imputed. Coefficient estimates and standard errors are constructed using the formulae in Little and Rubin (1987).

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Table 5: Tobit Regression Analysis of Commercialization Revenues with Inventor’s and Other’s Capital

Dependent variable = log(commercialization revenues). Regressions include dummy variables controlling for industry and year. Standard errors in parenthesis. ***, ** or * mean the coefficient is significant at the 1 percent, 5 percent or 10 percent level, respectively. Missing item data are multiple imputed. Coefficient estimates and standard errors are constructed using the formulae in Little and Rubin (1987).

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