Why Form Business Partnerships?*

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Abstract

I empirically investigate why some people find a business partner when they first start a business. To this end, I structually estimate a matching model of partnership formation by using a nationally representative household-based survey. First, I find that most aggregate gains from partnerships are generated by gains in productivity. However, for partners with a net worth that is less than the 20th percentile of wealth distribution, 80% of gains are generated by financing. Second, the transition into business ownership hindered by financial friction is not much alleviated by allowing the option to form business partnerships. Financial friction generates additional inefficiency due to mismatch among partners. A loan program for startups can substantially improve match quality among partners. Finally, moral hazard, the problem of inducing optimal effort by partners when effort is not observable, can be costly. For the observed partners, the cost corresponds to 39% of the entire gain from partnerships. Moreover, 57% of partners are discouraged from partnerships due to moral hazard.

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1 Introduction

The decision to find a partner is one of the most important decisions for potential startup owners. Successful business owners often argue that finding the right partner is the key for a successful business.[1] Indeed, many successful companies started as partnerships. Examples include Hewlett-Packard, Procter & Gamble, and Ben & Jerry's. Yet, despite successful examples, only 15% of non-family owned businesses began with partnerships.[2] Who forms business partnerships, and why? Answering this question can be valuable not only for potential startup owners but also for policy makers who try to boost entrepreneurship via partnerships.

Theoretical studies identify moral hazard, the problem of inducing optimal effort by partners when effort is not observable, as a primary concern for working with a co-owner.[3] Despite moral hazard, the presence of financial friction[4] can drive the formation of a partnership: a financially constrained agent may give up some portion of equity in exchange for his partner's wealth. Finally, there can be gains and losses in productivity when working together: knowledge transfer between partners can increase productivity,[5] but at the same time working with a co-owner can be costly due to difficulties in coordination and communication.[6]

Despite extensive theoretical studies,[7] relatively little is known about how different factors come into play during the formation of business partnerships. To examine this issue, I first document the pattern of partnership choice of startup owners by using the Survey of Income and Program Participation (SIPP). I show that this pattern is consistent with some of the

[1] See, for example, Cohen and Eisner, 2010; Kawasaki, 2004.

[2] See Section 2 in this paper.

[3] See Holmstrom, 1982, and many papers that followed.

[4] Many studies indicate that financial friction is an important factor for starting a business (e.g., Evans and Jovanovic, 1989; Evans and Leighon, 1989; Holtz-Eakin, Joulfaian and Rosen, 1994; Paulson, Townsend and Karaivanov, 2006; Cagetti and DeNardi, 2006).

[5] If two agents can increase productivity by transacting a subject such as knowledge (e.g., Lazear, 1998; Argote and Ingram, 2000), and the subject is not observable or not contractible, then the partnership can be chosen over single ownership (Teece, 1980; Garicano and Santos, 2004; Morrison and Wilhelm, 2004; Bar-Isaac, 2007).

[6] See, for example, Jensen and Meckling, 1992; Becker and Murphy, 1992.

[7] Another line of literature on partnerships focuses on established professional service partnerships as an alternative to corporations (e.g., Levin and Tadelis, 2005; Kaya and Vereshchagina, 2014).

theories' predictions. First, business earnings of partners are significantly greater than those of measurably similar single owners, which may suggest gains in productivity from partnerships. Second, the proportion of partners among startup owners is significantly greater in the lowest quintile than in the middle of wealth distribution. This may support the view that partnerships are driven by a financing motive. Finally, despite the high earnings among the observed partners, only a small portion of startup owners form partnerships, suggesting high potential costs, such as moral hazard, associated with business partnerships.

To disentangle the effect of financing and productivity motives in partnership formation and to quantify the cost of moral hazard, I develop and estimate a simple model of partnership formation. The model is an extension of Evans and Jovanovic (1989), an occupational choice model between a worker and an entrepreneur with collateral constraint. I incorporate an option of forming a partnership into their model. By forming a partnership, financially constrained agents can increase borrowing capacity. I also allow the possibility that working with a partner requires additional ability such as collaborative skills. A partnership can be formed if there exist mutual gains in productivity or one partner's gain in productivity and the other partner's gain in financing despite the efficiency loss due to moral hazard. Who is matched with whom is determined in a stable matching in which no partner would prefer a single owner or worker, and one cannot find two partners who would both rather form a partnership with each other than remain with their current partners. The estimated model implies three sets of results.

First, the increase in productivity accounts for the major gains for the observed partnerships: 85% of the aggregate gains for all partners is attributed to the productivity gains. However, although small in total, the gains from financing are important for low-wealth individuals. For the partners in the lowest quintile of wealth distribution, financing accounts for 80% of the entire gain from partnerships.[8]

[8]The previous studies estimating the productivity gain from having a partner include Astebro and Serrano (2014). In line with the result in this paper, Astebro and Serrano show that having a partner leads to substantial productivity gains for inventors. However, this paper differs from Astebro and Serrano in several dimensions. Astebro and Serrano treat the financing motive as primarily a statistical issue that causes a selection bias for the estimate of interest. In contrast, I explicitly quantify the gains in financing from business partnerships. In addition, I investigate partnership choice with a much larger sample from the general population. I also allow heterogenous productivity gains across agents while Astebro and Serrano assume homogenous productivity

Second, the transition into business ownership hindered by financial friction is not much alleviated by allowing the option to form business partnerships. Financial friction instead imposes an additional distortion on a matching market by inducing "mismatch" among startup owners. Aggregate net welfare loss associated with mismatch is about 1% of the entire welfare change due to financial friction. However, when I calculate welfare loss for those who actually incur a loss, the amount increases up to about 4%. This means that there exists a group of people – mostly agents with enough wealth – who gain from financial friction. With policy experiments, I show that a simple government loan policy can not only be effective for facilitating the transition of constrained potential business owners into business ownership, but also be effective for increasing match quality among business partners.

Lastly, the cost of moral hazard can be large. For the observed partners, the cost corresponds to 39% of the entire gain from partnerships. Moreover, the number of partners decreases 57% due to moral hazard.

This is the first study, to my knowledge, to quantify the role of partnerships on the transition into business ownership and to quantify welfare loss associated with mismatch among business partners induced by financial friction. This study also contributes to the debate on whether small business subsidies create value. For example, Hurst and Pugsely (2011) point out that a size-dependent small business subsidy can be distortionary. Hamilton, Papageorge and Pande (2014) argue that small business grants may fund individuals with low-quality ideas, but a preference for self-employment, and can be largely ineffective. On the other hand, Brown and Earle (2013) show that small business loans have a positive impact on job creation. My analyses suggest that small business loans can create additional value by improving efficiency in partnership formation along with helping potential business owners to enter business ownership.

The results in this paper extend the existing empirical findings regarding the effect of moral hazard in business partnerships. For example, Gaynor and Gertler (1995) and Lang and Gordon (1995) find evidence that moral hazard indeed plays a role in business partnerships. These studies examine already established partnerships in professional industries. However, I examine the formation of business partnerships among potential startup owners in general

gain from adding a partner across the inventors.

industries. Moreover, while past studies test theoretical hypotheses from models with moral hazard, I rather quantify the importance of moral hazard both at the intensive and at the extensive margins.

This paper is also related to the literature on estimating one-sided matching model (e.g., Gordon and Knight, 2009; Weese, 2014). In attempting to overcome a challenge − we do not observe who is matched with whom in the data, especially with respect to net worth − I exploit the aggregate moments, notably the outcome from the matching, for identification and use the method of simulated moments for estimation. This is a different approach from previous studies.

The paper is organized as follows. Section 2 describes the data. The baseline model is discussed in Section 3, and its extension into a matching model is presented in Section 4. Section 5 discusses the identification and the estimation of the matching model. The main results are presented in Section 6. Section 7 presents a welfare analysis and policy experiments are discussed in Section 8. Section 9 concludes.

2 Data

Before discussing the model, I will briefly describe the data and show its distinctive features. The Survey of Income and Program Participation (SIPP) is used for this study. The SIPP was chosen for a couple of reasons. First, the sample size is large and the survey is nationally representative. The sample size and the time periods of each panel range from approximately 14,000 to 36,000 households and from 3 to 4 years respectively. I use panels including the years 1996, 2001, 2004 and 2008 and hence the time periods spans more than 10 years. Thanks to a large number of respondents, I can observe a relatively large number of individuals at the time they become business owners. Second, the SIPP contains information on the respondent's equity share of the business. Using this information, I can define partners versus single owners. Finally, the SIPP provides information on the net worth in household level, one of the most important variables for this study.

Using the SIPP data, I construct a two-year panel. To limit the influence of the labor market participation, I focus on males from ages 18 to 65 who are employed before they start their businesses. I drop family businesses since forming a partnership among household members does not increase the total value of household net worth, an important mechanism this paper investigates. In the first year, all agents are workers. In the second year, some of the workers in the first year choose to be a business owner. I call the first year the base year and the second year the subsequent year. A detailed sample construction procedure is found in Appendix A.

2.1 Descriptive Analysis

A business partnership is characterized as a group that divides its profit among its members (equity holders).[9] A partner is defined as a business owner whose share of business equity is greater than or equal to 25% and less than or equal to 75%. Similarly, a business owner whose equity share is greater than 75% is defined as a single owner.[10]

Table 1 reports the summary statistics for characteristics of workers, single owners, and partners. Excluding family businesses, about 15% of startup owners chose to form partnerships. The years of education and the years of experience are similar to both types of owners. Partners are more likely to be white and married than single owners.

Figure 1 depicts the density of equity shares for those who have positive but less than 100% equity shares. Most of the equity shares are around 50%. This may suggest that two-owner partnerships with the same equity share are the most common ownership structure among startup partnerships.[11] The same observation is reported in Bitler, Moskowitz, and Vissing-Jorgensen (2005).

Table 2 reports the summary statistics for incomes of workers, single owners, and partners. Figure 2 depicts the density of log incomes for each group. The median income of startup owners is less than that of workers as is well-documented in the literature (e.g., Hamilton,

[9]A similar definition is found in the literature (e.g., Holmstrom, 1982; Farrell and Scotchmer, 1988; Levin and Tadelis, 2005).

[10]Given that most business owners have either 50% or 100% equity share, the results in this paper are not sensitive to this particular definition of partners versus single owners.

[11]Consistent with Figure 1, in Kauffman Firm Survey (KFS), a panel study of 4,928 businesses founded in 2004, 70% of multi-owner firms are two-owner firms, and 84% of two-owner firms that reported equity share have either 49% to 51% or 50% to 50% equity share.

2000; Pugsley, 2013). Among business owners, median income and mean income of partners are greater than those of single owners. To determine whether the same pattern is observed after controlling for other observables, I conduct a regression analysis for log incomes among startup owners. Table 3 reports the estimates for the regression of log incomes on partnership dummy and other covariates. I first start with the typical Mincer regression in the regression equation (1) and add various controls for other regressions. For all cases, the partnership dummy is significant and indicates that partners earn about 1.5 times more than the single owners.

Table 4 shows the summary statistics for net worth of workers, single owners, and partners. Figure 3 depicts the density of net worth for each group. The wealth distribution of partners is more dispersed than that of single owners. Figure 4 plots the proportion of partners among startup owners with respect to net worth. The lower and upper percentile of wealth distribution is where the partnerships are relatively more observed. Among both tails, more partners are observed at the upper percentile of wealth distribution. To control for other observables, I conduct a Probit regression of partnership choice among startup owners including wealth dummies and other covariates. Table 5 reports the estimates from the Probit analysis. Consistent with Figure 4, the predicted probability to form a partnership is higher in the lower and upper percentile of wealth distribution than in the middle.

Based on the survey of small business firms (NSSBF) in 1987, Hurst and Lusardi (2004) categorize construction and services as low-starting capital industries. They categorize mining; manufacturing; transportation and public utilities; wholesale and retail trade; and finance, insurance and real estate as high-starting capital industries. The proportion of partnerships for high and low starting capital industries is shown in Figure 5. The partnership proportion for high-starting capital industries is significantly greater than for low-starting capital industries.[12] Table 6 reports the number and the proportion of partners for different industries. Partnerships are observed in all industries.[13]

[12] p-value of difference is 0.028.

[13] The number of startup owners in the Mining industry is one, and the owner is a single owner.

Discussion

The pattern of data is consistent with some of the theories' predictions. First, partnerships can increase the total factor productivity. The fact that the partners earn 1.5 times more than single owners even after controlling for other observables may support this hypothesis. Second, partnerships can be particularly attractive for a financially constrained agent since the agent can increase investments by using his partner's wealth. The fact that relatively more partners are observed in the lowest quintile than in the middle of wealth distribution may support the finance-based hypothesis. The fact that relatively more partners are observed in the high-starting capital industries may also support this hypothesis. The observation that only 15% of startup owners choose partnerships, despite the high earnings among the observed partners, may indicate a high potential cost, such as moral hazard, associated with partnerships.

Risk sharing is considered the main motive for joining a partnership among lawyers or physicians (Gaynor and Gertler, 1995; Lang and Gordon, 1995). However, it does not seem to be the main motive for partnerships in the final sample.[14] For example, a major risk for lawyers may be characterized by the number of clients in the future. Such a risk can be shared by forming a partnership. In contrast, partners in other industries, say co-owners of a restaurant, cannot share such a risk since they face the same number of customers in the future in their single restaurant. A major risk for these co-owners may be the possibility that their restaurant goes out of business. However, if that was their main concern, one of the partners could have incorporated his business instead of finding a partner.

Moreover, certain features of the data are not consistent with what the risk sharing hypothesis predicts. As shown in Figure 4, the proportion of partners increases as wealth level increases. The opposite or no relation is predicted if risk sharing is the main motive for forming partnerships and a standard preference is assumed. Another feature is that most partnerships are formed by two partners. If the reason behind finding a partner is to share a risk, the number of partners within a firm would vary depending on the partners' risk preference. For example, if an agent is highly risk-averse, he would find not just one but many partners who

[14] The final sample includes only a handful of lawyers and physicians: 166 out of 48,405 were lawyers or physicians in the base year. Among them, 17 became single owners and 3 became partners. Lawyers and physicians are identified by the industry code as a worker.

have a similar risk preference.

Although the data pattern is consistent with several hypotheses regarding partnerships, it is difficult to quantify each one without further assumptions about the data generating process. In the next section, I present a simple model of partnership formation. I use this model as a measurement tool to quantify the gains from productivity and from financing as well as the cost of moral hazard. The model is also used for welfare and policy analyses.

3 Baseline Model

I first present a baseline model in which the distribution of partnership productivity and the distribution of potential partner's net worth are fixed. Most intuitions are clearly addressed by using the baseline model. In Section 4, I extend the baseline model into a matching model in which the partnership productivity and the partner's net worth are endogenously determined as an equilibrium outcome.

3.1 Environment

The model is an extension of Evans and Jovanovic (1989). I incorporate effort and heterogeneous partnership productivity into their model.

Preference

The utility is linear in consumption. The effort is incorporated to capture moral hazard between business partners. Under the quadratic form, I can derive an analytic value function, which significantly reduces the computational burden in the estimation while the marginal rate of substitution between consumption and effort is still captured by κ.

$$u(c, z) = c - \kappa \frac{z^2}{2}, \quad c\text{: consumption, } z\text{: effort}$$

Technology

Income as a worker is determined by worker productivity (θ_w). Income as a single owner is determined by capital investment (k), efforts, solo productivity (θ_s).

$$w = \theta_w z^{1-\alpha} \quad \text{if} \quad d = 1 \quad \text{(worker)}$$

$$y = \begin{cases} \theta_s k^\alpha z^{1-\alpha} & \text{if} \quad d = 2 \quad \text{(single owner)} \quad \alpha \in (0,1) \\ \\ \theta_p k^\alpha (z + z')^{1-\alpha} & \text{if} \quad d = 3 \quad \text{(partner)} \end{cases}$$

The partnership output is determined by partnership productivity (θ_p), the joint capital investment, and the efforts from both partners. Under this partnership production function, the efficient outcome from two identical partners is the same as the sum of each partner's outcome if the solo and partnership productivity are the same (Corollary 1 in Section 3.3). Moreover, the value from single ownership is the same as the value from hiring the potential partner as an employee if we interpret hiring an agent as a situation in which (1) the productivity does not change from the solo productivity, (2) the wage contract is set to eliminate moral hazard of the worker, and (3) the wage is equal to the marginal benefit of hiring the agent.

Financial Market

Without financial friction, agents can borrow any amount of money for the risk-free gross interest rate r. A financial friction is modelled as limited commitment between borrowers and lenders. The fact that lenders cannot force borrowers to repay a loan limits the maximum amount of borrowing. I assume that the maximum borrowing amount depends on the borrowers' net worth. More specifically, a single owner can borrow up to λA. If he forms a partnership with another agent with net worth A', then the partnership can borrow up to $\lambda(A + A')$. This type of financial friction is widely used in the literature, and has empirical support (see, e.g., Adelino, Schoar and Severino, 2014; Schmalz, Sraer and Thesmar, 2013).

3.2 Value Functions and Earned Incomes

I first consider the value function and earned incomes for partners. Equal sharing is a defining feature of partnerships. For example, Farrell and Scotchmer (1988) define a partnership as "a group that divides its output equally among its members." Indeed, many data sources, including the final sample, indicate that two-owner with equal shares are the most common partnership structure. Supported by this fact, I assume that a partnership is formed by two agents and the equity shares are distributed equally among partners.[15]

Effort in an entrepreneurial team is spent on activities such as generating an idea, validating the business idea and developing a business model. Effort in these types of activities is hard to observe or monitor. For this reason, I assume that effort is not observable.

Suppose agent i and agent j are matched and their partnership productivity is given as θ_p. The partners choose $\{z_i, z_j, k\}$, their effort levels and the joint investment. Given $\{z_j, k\}$, the best response function for z_i solves

$$\max_{z_i} \left[\frac{1}{2}\left\{\theta_p k^{\alpha}(z_i + z_j)^{1-\alpha}\right\} - \kappa\frac{z_i^2}{2}\right]$$

Likewise, given $\{z_i, k\}$, the best response of z_j solves

$$\max_{z_j} \left[\frac{1}{2}\left\{\theta_p k^{\alpha}(z_i + z_j)^{1-\alpha}\right\} - \kappa\frac{z_j^2}{2}\right]$$

Finally, given $\{z_i, z_j\}$, k solves

$$\max_{k} \left[\theta_p k^{\alpha}(z_i + z_j)^{1-\alpha} - rk\right] \quad \text{subject to} \quad k \leq \lambda(A_i + A_j)$$

The earned incomes and value function *per* partner are given as

$$\begin{aligned}\pi_p(\theta_p, A_p) &= \frac{1}{2}\left[\theta_p k^{*\alpha}(2z^*)^{1-\alpha} - rk^*\right]\epsilon_p \\ &= \begin{cases} a_1\theta_p^{\frac{2}{1-\alpha}}\epsilon_p & \text{if} \quad \lambda A_p \geq \hat{a}\theta_p^{\frac{2}{1-\alpha}} \\ \\ \left\{a_8\left(\frac{\lambda A_p}{2}\right)^{\frac{2\alpha}{1+\alpha}}\theta_p^{\frac{2}{1+\alpha}} - \frac{r\lambda A_p}{2}\right\}\epsilon_p & \text{if} \quad \lambda A_p < \hat{a}\theta_p^{\frac{2}{1-\alpha}} \end{cases}\end{aligned}$$

[15] Many studies investigate theoretical implications of equal sharing in partnerships (e.g., Farrell and Scotchmer, 1988; Sherstyuk, 1998; Levin and Tadelis, 2005). Others provide rationale for equal sharing among partners (e.g., Bartling and Simens, 2010; Espino, Kozlowski, and Sanchez, 2014).

$$
\begin{aligned}
V_p(\theta_p, A_p) &= \mathbb{E}[\pi_p(\theta_p, A_p)] - \kappa\frac{z^{*2}}{2} \\
&= \begin{cases} a_3\theta_p^{\frac{2}{1-\alpha}} & \text{if} \quad \lambda A_p \geq \hat{a}\theta_p^{\frac{2}{1-\alpha}} \\ \\ a_4\left(\frac{\lambda A_p}{2}\right)^{\frac{2\alpha}{1+\alpha}}\theta_p^{\frac{2}{1+\alpha}} - \frac{r\lambda A_p}{2} & \text{if} \quad \lambda A_p < \hat{a}\theta_p^{\frac{2}{1-\alpha}} \end{cases}
\end{aligned}
$$

where

$$
\begin{aligned}
&A_p = A_i + A_j, \quad \hat{a} = \left(\frac{1-\alpha}{\kappa}\right)\left(\frac{\alpha}{r}\right)^{\frac{1+\alpha}{1-\alpha}}, \quad a_3 = \hat{a}r\left(\frac{1-\alpha}{\alpha}\right)\left(\frac{3}{8}\right), \\
&a_4 = \left(\frac{1-\alpha}{2\kappa}\right)^{\frac{1-\alpha}{1+\alpha}}\left(\frac{3+\alpha}{4}\right), \quad a_1 = \hat{a}r\left(\frac{1-\alpha}{2\alpha}\right), \quad a_8 = \left(\frac{1-\alpha}{2\kappa}\right)^{\frac{1-\alpha}{1+\alpha}}
\end{aligned}
$$

Note that I allow the earning shocks to partners (ϵ_p), to workers (ϵ_w), and to single owners (ϵ_s) with the assumption that the expectation of the shocks are equal to one.

Given the worker productivity θ_w, workers choose effort to maximize their utility. The earned incomes and value function as a worker is given as

$$
\pi_w(\theta_w) = a_6\theta_w^{\frac{2}{1+\alpha}}\epsilon_w
$$

$$
V_w(\theta_w) = a_2\theta_w^{\frac{2}{1+\alpha}}
$$

where

$$
a_2 = \left(\frac{1-\alpha}{\kappa}\right)^{\frac{1-\alpha}{1+\alpha}}\left(\frac{1+\alpha}{2}\right), \quad a_6 = \left(\frac{1-\alpha}{\kappa}\right)^{\frac{1-\alpha}{1+\alpha}}
$$

Single owners optimally choose the amount of investment and efforts, and the earned incomes and value function are given as

$$
\pi_s(\theta_s, A) = \begin{cases} 2a_1\theta_s^{\frac{2}{1-\alpha}}\epsilon_s & \text{if} \quad \lambda A \geq \hat{a}\theta_s^{\frac{2}{1-\alpha}} \\ \\ \left\{a_6(\lambda A)^{\frac{2\alpha}{1+\alpha}}\theta_s^{\frac{2}{1+\alpha}} - r\lambda A\right\}\epsilon_s & \text{if} \quad \lambda A < \hat{a}\theta_s^{\frac{2}{1-\alpha}} \end{cases}
$$

$$
V_s(\theta_s, A) = \begin{cases} a_1\theta_s^{\frac{2}{1-\alpha}} & \text{if} \quad \lambda A \geq \hat{a}\theta_s^{\frac{2}{1-\alpha}} \\ \\ a_2(\lambda A)^{\frac{2\alpha}{1+\alpha}}\theta_s^{\frac{2}{1+\alpha}} - r\lambda A & \text{if} \quad \lambda A < \hat{a}\theta_s^{\frac{2}{1-\alpha}} \end{cases}
$$

To summarize, the individual choice (d) and the corresponding conditional income (π) are

$$d = \arg\max \left\{V_w(\theta_w), V_s(\theta_s, A), V_p(\theta_p, A_p)\right\}$$

$$\pi = \begin{cases} \pi_w(\theta_w) & \text{if} \quad d = 1 \quad \text{(worker)} \\ \\ \pi_s(\theta_s, A) & \text{if} \quad d = 2 \quad \text{(single owner)} \\ \\ \pi_p(\theta_p, A_p) & \text{if} \quad d = 3 \quad \text{(partner)} \end{cases}$$

3.3 Decomposing Benefits and Costs of Partnerships

Before further discussions, I derive the value for each partner from the first best allocation. In doing so, I assume that the planner treats each partner equally: the aggregate production from the efficient allocation is distributed equally among partners.

Proposition 1. *The value function for each partner from the efficient allocation under financial friction is given as (1)*

$$V_p^E(\theta_p, A_p) = \begin{cases} a_1 \theta_p^{\frac{2}{1-\alpha}} & \text{if} \quad \frac{\lambda A_p}{2} \geq \hat{a}\theta_p^{\frac{2}{1-\alpha}} \\ \\ a_2 \left(\frac{\lambda A_p}{2}\right)^{\frac{2\alpha}{1+\alpha}} \theta_p^{\frac{2}{1+\alpha}} - \frac{r\lambda A_p}{2} & \text{if} \quad \frac{\lambda A_p}{2} < \hat{a}\theta_p^{\frac{2}{1-\alpha}} \end{cases} \tag{1}$$

Proof See Appendix C.1.

With Proposition 1 in hand, it is straightforward to prove the following Corollaries:

Corollary 1. $V_p^E(\theta_s, 2A) = V_s(\theta_s, A)$

Suppose two identical agents form a partnership and the solo and partnership productivity are the same. Corollary 1 says that the sum of each partner's value as a single owner is equal to the aggregate value of the partnership. Three channels make the value from partnerships different from the value from single ownership.

Corollary 2. $V_p^E(\theta_p, 2A) = V_s(\theta_p, A) > V_s(\theta_s, A)$ *if and only if* $\theta_p > \theta_s$

Suppose $A = A'$. The first best value from partnerships is greater than the value from single ownership if and only if the partnership productivity is greater than the solo productivity. The value difference in Corollary 2 captures the value generated by the partnership productivity.

Corollary 3. $V_p^E(\theta_s, A_p) > V_s(\theta_s, A)$ *if and only if* $A' > A$ *and* $\lambda A < \hat{a}\theta_s^{\frac{2}{1-\alpha}}$

Although the partnership productivity and the solo productivity are the same, if an agent is financially constrained as a single owner and his partner's net worth is greater than his net worth, the value from the partnership is strictly greater than the value from single ownership if there were no moral hazard. The value difference in Corollary 3 captures the value generated by financing. Notice that if there were no financial friction, the value difference induced by financing would be zero.

Corollary 4. $V_p(\theta_s, 2A) < V_p^E(\theta_s, 2A) = V_s(\theta_s, A)$

Finally, the cost of moral hazard captured by the value difference in Corollary 4.

To summarize,

$$V_p(\theta_p, A_p) - V_s(\theta, A) = \underbrace{V_p^E(\theta_p, 2A) - V_s(\theta_s, A)}_{\Omega_1} + \underbrace{V_p^E(\theta_p, A_p) - V_s(\theta_p, A)}_{\Omega_2} + \underbrace{V_p(\theta_p, A_p) - V_p^E(\theta_p, A_p)}_{\Omega_3} \tag{2}$$

where Ω_1 represents gains from productivity, Ω_2 represents gains from financing, and Ω_3 captures losses from moral hazard.

4 Matching Model

The baseline model does not provide any prediction on how the partnership productivity and the partner's net worth are determined. In this section, I extend the baseline model into a matching model in which the partnership productivity and the partner's net worth are generated as an equilibrium outcome. The model environment is identical to the baseline model. Two additional structures are imposed.

4.1 Matching Function and Complementarities

First, instead of treating partnership productivity as fixed, I model it as a function of solo productivity of each partner. More specifically,

$$\theta_p(i,j) = \sqrt{\tilde{\theta}_i \tilde{\theta}_j} \quad \text{where} \quad \tilde{\theta}_i = g_i \theta_{si}, \quad \tilde{\theta}_j = g_j \theta_{sj}, \quad g_i, g_j > 0 \tag{3}$$

Knowledge transfer has been considered the key mechanism through which teamwork increases productivity (Lazear, 1998; Argote and Ingram, 2000). However, knowledge transfer is hard and it can be costly due to difficulties in coordination and communication (Arrow, 1969; Teece, 1977; Becker and Murphy, 1992; Jensen and Meckling, 1992; Haas and Hansen, 2005; Jones, 2009). "Collaborative skill" (Hamilton, Nickerson, and Owan, 2003) and "willingness to cooperate" (Kosfeld and Siemens, 2011) are necessary to facilitate the knowledge transfer. More importantly, such characteristics are heterogenous across individuals independent of the quality of their business idea. g captures this additional element for teamwork. I call this additional element collaborative skill. Depending on individual skills for collaborating, it can enhance ($g > 1$) or reduce ($g < 1$) the solo productivity when partners work together. As a result, the productivity as a partner ($\tilde{\theta}$) can be different from the solo productivity (θ_s).

To model the partnership productivity in a tractable way, I impose a couple of assumptions in (3). First, the collaborative skill (g) interacts with the solo productivity (θ_s). Second, the contribution to partnership productivity by each partner is the same. Moreover, if two identical partners are matched, the partnership productivity is the same as their individual productivity as a partner. In particular, if we shut down the additional productivity channel by making g equal to one, the partnership productivity is the same as the solo productivity when two identical agents are matched.

To explain how a partnership can be formed, I introduce the following two definitions.

Definition 1. *There exists complementarity between two partners' solo productivities in a partnership by Agent i and Agent j if $\theta_p(i,j) \geq \max\{\theta_{si}, \theta_{sj}\}$.*

Definition 2. *There exists complementarity between one partner's solo productivity and the other partner's wealth in a partnership by Agent i and Agent j if (1) one partner, say Agent i, is financially constrained as a single owner, and (2) the other partner, Agent j, has more net worth than the financially constrained partner and $\theta_p(i,j) > \theta_{sj}$.*

Suppose there is no borrowing constraint. Then $V_p^E(\theta_p(i,j), A_p) \geq \max\{V_s(\theta_{si}, A_i), V_s(\theta_{sj}, A_j)\}$ if and only if $\theta_p(i,j) \geq \max\{\theta_{si}, \theta_{sj}\}$ by Corollary 2 in Section 3.3. This means that without financial friction a partnership is formed only if there exists complementarity between two partners' solo productivities.

If there is borrowing constraint, a partnership is formed even without the complementarity between two partners' solo productivities. The intuition is found in Corollary 3. If a partner is financially constrained as a single owner, he may be willing to sacrifice his productivity for financing. Definition 2 captures this situation.

Note that the complementarity between two partners' solo productivities and the complementarity between one partner's solo productivity and the other partner's wealth are not mutually exclusive. For example, a financially constrained agent may be matched with a more productive and wealthier agent if his productivity as a partner is large enough. To determine an equilibrium, who is matched with whom, I impose another structure on the matching market.

4.2 Matching Market

I model the matching market as a one-sided, non-transferable utility, frictionless market. Unlike the marriage matching market, I cannot separate market participants into two groups. The assumption that the equity share is fixed as 50% to 50% rules out the possibility that two partners can transfer the outcome. Finally, I assume there is no search friction in the market.

There are N number of agents. Let I denote the set of agents. An agent $i \in I$ is characterized by $\{g_i, \theta_{si}, A_i\}$. I assume that θ_{si} is drawn from a continuous distribution and therefore every agent has a different value of θ_s. A *matching* Γ is a one-to-one mapping from I onto itself such that for all $\{i,j\} \subset I$, $\Gamma(i) = j$ if and only if $\Gamma(j) = i$. A matching is *stable* if (i) no partner would rather prefer single owner or worker, and (ii) one cannot find two partners who would both rather form a partnership with each other than remain with their current partners.

Proposition 2. *There exists a unique stable matching.*

Proof With 50% to 50% equity share, the value per partner from any partnership is symmetric. Moreover, for any agent $i \in I$, the value from partnership with $k \in I$ − including to remain as single − is different for all k since every agent has a different value of θ_s. In other words, every agent has a strict preference over I. Under these two conditions, there exists a unique stable matching by Gordon and Knight (2009). ■

Without borrowing constraint, characterizing a stable matching is straightforward by the matching function in (3). For expositional purpose, assume that g is so large that every agent wants to form a partnership rather than remain as either worker or single owner. Sort agents in I with respect to $\tilde{\theta}$ and denote the agent with the highest $\tilde{\theta}$ be one and so on. With (3), every agent wants to be matched with Agent 1. Then it is Agent 1's decision to choose his partner. Again, under (3), Agent 1 wants to form a partnership with Agent 2. By iterating this procedure, we can find a stable matching. The stable matching exhibits an assortative matching with respect to $\tilde{\theta}$.

With borrowing constraint, however, the stable matching under no borrowing constraint can alter because of the financing motive for financially constrained agents. For example, consider a partnership formed by Agent 1 and Agent 2 in the above example. If financial friction is introduced, Agent 1 and Agent 2 may not be able to finance the optimal amount of capital, and the value from their partnership may decrease. Suppose Agent 3 has a marginally lower productivity but has a much higher net worth than Agent 2. With financial friction, Agent 1 may prefer to be matched with Agent 3 since he can increase financing capacity with Agent 3 without sacrificing productivity that much. To illustrate this intuition more clearly, I present a simple example.

Example

Suppose there are four agents in the market. The outside option value for workers is assumed to be zero and hence the relevant characteristics for matching is $\{g_i, \theta_{si}, A_i\}$. Let's assume g_i is 1.2 so that we can focuss on $\{\theta_{si}, A_i\}$. Assume that

$$\{\theta_{s1}, A_1\} = \{2.1, 0\}, \quad \{\theta_{s2}, A_2\} = \{2, 0\}, \quad \{\theta_{s3}, A_3\} = \{1.1, \infty\}, \quad \{\theta_{s4}, A_4\} = \{1, \infty\}$$

For convenience, let $a_1 = 1$, $\alpha = 0.5$.

First, I consider a situation where there is no borrowing constraint. The outside option value as a single owner for each agent is the following.

$$V_{s1} = \theta_{s1}^4 = 19.45, \quad V_{s2} = \theta_{s2}^4 = 16, \quad V_{s3} = \theta_{s3}^4 = 1.46, \quad V_{s4} = \theta_{s4}^4 = 1$$

It is easy to check that Agent 1 is matched with Agent 2 and Agent 3 is matched with Agent 4 in the stable matching. The value from the matching is

$$V_p(1,2) = \frac{3}{4}\left(\theta_p(1,2)^4\right) = 27.43, \quad V_p(3,4) = \frac{3}{4}\left(\theta_p(3,4)^4\right) = 1.88$$

Note that $\theta_p(1,2) \geq \max\{\theta_{s1}, \theta_{s2}\}$ and $\theta_p(3,4) \geq \max\{\theta_{s3}, \theta_{s4}\}$ and hence both partnerships are driven by the complementarity between two partners' solo productivities.

Suppose now that there is a borrowing constraint. The outside option value as a single owner changes.

$$V_{s1} = 0, \quad V_{s2} = 0, \quad V_{s3} = \theta_{s3}^4 = 1.46, \quad V_{s4} = \theta_{s4}^4 = 1$$

In this situation, it is easy to check that Agent 1 is matched with Agent 3 and Agent 2 is matched with Agent 4 in the stable matching. The value from the matching is

$$V_p(1,3) = \frac{3}{4}\left(\theta_p(1,3)^4\right) = 8.3, \quad V_p(2,4) = \frac{3}{4}\left(\theta_p(3,4)^4\right) = 6.22$$

Note that $\theta_p(1,3) < \max\{\theta_{s1}, \theta_{s2}\}$ and $\theta_p(2,4) < \max\{\theta_{s3}, \theta_{s4}\}$ and hence both partnerships are driven by the complementarity between one partner's solo productivity and the other partner's wealth, not by the complementarity between two partners' solo productivities.

5 Estimation

5.1 Specification

Before estimation, I specify worker productivity (θ_w), solo productivity (θ_s), and the collaborative skill (g). The specification is similar to the one in Evans and Jovanovic (1989), Xu (1998), Paulson, Townsend, and Karaivanov (2006).

Worker Productivity

The worker productivity is determined by education (x_1) and experience (x_2).

$$\log \theta_w = \gamma_1 \log x_1 + \gamma_2 \log x_2$$

To identify α and κ, I normalize the constant term in worker productivity as zero. A stochastic component in θ_w, in θ_s, or in g cannot be identified. As in Evans and Jovanovic (1989), I assume no unobserved heterogeneity in the worker productivity.

Solo Productivity

The solo productivity is assumed to be a function of education, experience, net worth and an unobserved component.

$$\log \theta_s = \beta_0 + \beta_1 \log A + \beta_2 \log x_1 + \beta_3 \log x_2 + \eta, \quad \text{where} \quad \eta \sim N(0, \sigma_\eta^2)$$

There could be a positive relationship between an agent's net worth and his value as a single owner even without financial friction. Consider an agent whose value from working is the same as his value from starting a business. Cressy (2000) shows that an increase in the agent's net worth makes his value from starting the business strictly greater than his value from working if his preference exhibits a decreasing absolute risk aversion. Pugsley (2013) points out that the same conclusion can be derived by modelling being a business owner as a normal good. Instead of explicitly modeling such cases, I incorporate such possibilities by allowing θ_s to be a function of net worth.

Collaborative Skill

I specify g as a function of observable and unobservable component as below.

$$\log g = g_0 + g_1 \log x_1 + g_2 \log x_2 + u, \quad u \sim N(0, \sigma_u^2) \tag{4}$$

As explained in Section 4.1, g represents an additional ability as a partner such as collaborative skill. Education and work experience are inevitably involved with social interaction, and therefore they may help to develop the collaborative skill.

A critical assumption is that g is not a function of net worth. As explained in Section 5.2, this assumption is required for identification of λ. Note that even if g is not a function of net worth, the partnership productivity is a function of net worth because it is also affected by θ_s which is a function of net worth.

With the specification in (4), the matching function − log value of the partnership productivity − can be written as

$$\log \theta_p(i,j) = g_0 + \tilde{g}_1 \log(x_{1i}x_{1j}) + \tilde{g}_2 \log(x_{2i}x_{2j}) + \epsilon_{<i,j>}$$

where $\tilde{g}_1 = \frac{g_1}{2}$, $\tilde{g}_2 = \frac{g_2}{2}$ and $\epsilon_{<i,j>} = \frac{1}{2}(u_i + u_j + \log \theta_{si} + \log \theta_{sj})$. x_{1i} and x_{1j} indicate the year of education for agent i and j respectively. Similarly, x_{2i} and x_{2j} indicate the year of experience for agent i and j respectively. $\epsilon_{<i,j>}$ represents an unobserved match specific component. This functional form specification is similar to other papers on matching estimation (e.g., Gondon and Knight, 2009; Akkus, Cookson, and Hortacsu, 2014).

Earning Shocks

The expected value of the stochastic components $(\epsilon_w, \epsilon_s, \epsilon_p)$ is equal to one, allowing zero income for business owners. As shown in Figure 2, the distribution of conditional income for business owners looks similar to a log-normal distribution with a possible realization of a zero or a negative income. The current specification captures this stylized feature of the data.

$$\log \epsilon_w \sim N(\mu_w, \sigma_w^2), \quad \mathbb{E}[\epsilon_w] = 1$$

$$\epsilon_s = \tilde{\epsilon}_s - P_s, \quad \log \tilde{\epsilon}_s \sim N(\mu_s, \sigma_s^2), \quad \mathbb{E}[\epsilon_s] = 1, \quad P_s \text{ is a positive constant.}$$

$$\epsilon_p = \tilde{\epsilon}_p - P_p, \quad \log \tilde{\epsilon}_p \sim N(\mu_p, \sigma_p^2), \quad \mathbb{E}[\epsilon_p] = 1, \quad P_p \text{ is a positive constant.}$$

5.2 Identification

The matching model is fully characterized by a set of parameters: $\{\kappa, \gamma_1, \gamma_2, \alpha, \beta_0, \beta_1, \beta_2, \beta_3, \sigma_\eta, g_0, g_1, g_2, \sigma_u, \sigma_w, \sigma_s, \sigma_p, P_s, P_p, \lambda\}$. A formal identification argument for the baseline model is shown in Appendix B. I use the intuition developed in the identification of the baseline model, and exploit the aggregate moments, notably the outcome from a matching, to identify the matching model.

The proportion of single owners among those who are not partners identifies β_0. Given λ, the proportion of single owners conditional on net worth among those who are not partners identifies β_1. Likewise, the proportion of single owners conditional on education and on experience identify β_2 and β_3 respectively. Among business owners, the proportion of partners identifies g_0. Likewise, the proportion of partners among business owners conditional on education and on experience identify g_1 and g_2 respectively.

The average income for workers conditional on education and on experience identify γ_1 and γ_2 respectively. The average income for workers, for single owners, and for partners identify κ and α. The average income for single owners conditional on education (or experience) identify σ_η. The average income for partners conditional on education (or experience) identify σ_u.

A couple of data moments identify λ. First, the proportion of partners among business owners conditional on net worth is only affected by λ given β_1. Consider, for example, business owners with a small net worth in which the measure of constrained single owners is positive. As λ becomes smaller, the value of those constrained single owners also decrease. As a result, those whose value as a single owner is marginally higher than the value as a worker or as a partner will change their choice either to workers or to partners. In either case, the proportion of partners among business owners conditional on the small net worth will increase. Second, λ also affects the average income both for single owners and for partners conditional on net worth by affecting the income for financially constrained business owners.

The variance of log incomes for workers identifies σ_w. The variance of log incomes for single owners identifies σ_s given P_s. Given σ_s, the proportion of zero or a negative income single owners identifies P_s. Likewise, the variance of log incomes for partners and the proportion of zero or a negative income partners identify σ_p and P_p.

5.3 Defining a Market

In existing empirical work on matching markets, a market is defined differently depending on the purpose of the work and the availability of the data. As in Choo and Siow (2006), I define the entire united states in a particular year as the market for estimation. I choose a particular year because there is no way that an agent in a year could have been matched with an agent in another year. I choose the 2004 panel since it has the most observations for both single owners and partners. Location may be a relevant factor for a matching. However, I cannot rule out the possibility that an agent in California may form a partnership with a friend in New York. Therefore, I consider the entire united states as one market. Industry may seem to be a relevant factor as well. However, in the data, the industry as a business owner does not always correspond to the industry as a worker. For example, one partner in the Agricultural sector used to be in the Construction sector as a worker. Similarly, one partner in the Construction sector used to be in the Vocational rehabilitation service sector as a worker. Therefore, I did not put a restriction on the matching market based on agents' industry as a worker. To summarize, I use the entire 2004 panel for estimation.

5.4 Method of Simulated Moments

The analytic derivation of likelihood function is not feasible. I use the method of simulated moments to estimate the model parameters. The criterion function is given in (5).

$$M(\psi) = \Big[\sum_{i=1}^{n} Z_i\big(K_i - \tilde{K}_i(\psi)\big)\Big]' \hat{\Sigma}^{-1} \Big[\sum_{i=1}^{n} Z_i\big(K_i - \tilde{K}_i(\psi)\big)\Big] \tag{5}$$

$$\text{where} \quad \tilde{K}_i(\psi) = \frac{1}{ns}\sum_{s=1}^{ns} k_i^s(\psi)$$

Z_i represents a vector of instruments and K_i represents a vector of data moments. $\tilde{K}_i(\psi)$ represents a vector of moments simulated by the model given a set of parameters ψ. ns is the number of simulation.[16] $k_i^s(\psi)$ represents a vector of moments given ψ derived per simulation.

The moments choice is guided by the identification argument in Section 5.2. In particular, I choose the ownership choice and the first moment of the conditional income. Net worth, education and experience are used as instruments.[17] I also include the conditional variance and the proportion of zero or a negative income single owners and that of zero or a negative income partners. I choose $\hat{\Sigma}$ to be a diagonal matrix which contains variances of the data moments. The number of parameters and the number of moments are 19 and 32 respectively.

Log value of net worth is required for estimation and I replace negative net worth as \$1. Before estimation, I normalize one unit of net worth and income as \$10,000 in 2011. Since the current model is an extension of Evans and Jovanovic (1989), I refer to their normalization \$1,000 in 1976 which is similar to \$10,000 in 2011. The gross risk-free interest rate, r, is

[16] I set $ns = 3$ for estimation.

[17] Since net worth is an important state variable in the model, I use an interaction between net worth and the other covariates as additional instruments.

also assumed to be 1.1 following the literature (e.g., Evans and Jovanonvic, 1989; Xu, 1998; Paulson, Townsend, and Karaivanov, 2006). The standard errors are calculated following Gourieroux and Monfort (1996).

5.5 Model Fit

Figure 6 compares the proportion of single owners and partners to the simulated proportion of single owners and partners. The density of data and simulated incomes are shown in Figures 7, 8 and 9. The model predicts both ownership choice and the distribution of conditional income, especially the former, quite well.

The full set of simulated and targeted moments are shown in Tables 14 and 15 in the Appendix. All moments are matched quite well. Some predicted moments related to single owner income are a little bit higher than actual moments. First investigated by Hamilton (2000), a low earning for business owners has been explained by a non-pecuniary benefit (Hamilton, 2000; Pugsley, 2013). Abstracting from such a benefit makes it difficult for the current model to perfectly match the earning differential, especially for single owners.

6 Results

6.1 Estimates

Table 7 shows the estimates for log worker productivity ($\log \theta_w$) and log solo productivity ($\log \theta_s$). It shows that a 10% increase in the years of education leads to approximately a 4% increase in worker productivity and 3.3% increase in solo productivity. Likewise, 10% increase in the years of experience leads to approximately a 1% increase in worker productivity and 0.3% increase in solo productivity. The education and experience affect both worker productivity and solo productivity significantly, but their impacts are greater for worker productivity. Table 7 also shows that the relationship between net worth and solo productivity is estimated insignificant.

Table 8 shows the estimates for log value of the collaborative skill. It indicates that a 10% increase in the years of education leads to roughly an additional 2.5% increase in productivity as a partner in addition to solo productivity. The coefficient for the years of experience is estimated insignificant. This implies that the individual skill for collaborating with co-owners is fostered more in schools than in workplaces. The constant term is estimated -1.3923, suggesting there is a large efficiency loss from working together with co-owners comparing to working alone.

Table 9 reports the estimates for $\{\lambda, \alpha, \kappa\}$ and the outcome shocks. The collateral constraint parameter (λ) is estimated as 2.1761, suggesting agents can borrow up to about twice their net worth. α is estimated as 0.1958, implying that a 10% increase in investments leads to approximately a 2% increase in outputs for a given effort-level.

To understand the relationship between the solo and partnership productivity, I project the simulated $\log\theta$ on the simulated $\log\tilde{\theta}$. The regression coefficient for $\log\theta$ is 1.22 and its p-value is 0.000, suggesting that agents with better solo productivity tend to have better productivity as a partner. However, the collaborative skill, g, is estimated so low on average that only a small portion (less than 4%) of the agents have the productivity as a partner greater than their solo productivity. This is shown in Figure 10.

Note that I explicitly control for the cost of moral hazard in business partnerships. The cost of moral hazard is not enough to explain the fact that only about 15% of agents choose partnerships conditional on business ownership. This supports the view that the cost of knowledge transfer outweighs the benefit from it for most individuals. The finding also supports the view that there is additional efficiency loss from "collective decision making" other than the loss from moral hazard in business partnerships. Hansmann (1996) points out that the partnerships are involved with the process through which an important decision is made by owners, and this process can be costly due to heterogenous interests among the owners. Merges between firms are similar to forming business partnerships in that the mergers are often thought to be driven by the gains in productivity. The low estimated g is also in line with the fact that most mergers − even *conditional on being merged* − are not successful, and often being divested. (see e.g., Banal-Estanol and Seldeslachts, 2011 and references therein.)

6.2 Decomposing Aggregate Gains

With the estimates of structural parameters, I can use Equation (2) to measure the benefits and the costs of the partnerships. More specifically, I use the following metric:

$$\begin{aligned}&\mathbb{E}_{(\eta,u)}\Big[\sum_{i=1}^{n}\big\{V_{pi}(\theta_{pi},A_{pi})-V_{si}(\theta_i,A_i)\big\}\mathbb{I}_i(d=3)\Big]\\ =&\mathbb{E}_{(\eta,u)}\Big[\sum_{i=1}^{n}\Omega_{1i}\mathbb{I}_i(d=3)\Big]+\mathbb{E}_{(\eta,u)}\Big[\sum_{i=1}^{n}\Omega_{2i}\mathbb{I}_i(d=3)\Big]+\mathbb{E}_{(\eta,u)}\Big[\sum_{i=1}^{n}\Omega_{3i}\mathbb{I}_i(d=3)\Big]\end{aligned} \tag{6}$$

Equation (6) decomposes the benefits and the costs of business partnerships for those who actually choose the partnerships. For each simulation, I can calculate Ω_1 (gains from productivity), Ω_2 (gains from financing) and Ω_3 (losses from moral hazard) in Equation (2) for every partner and then sum them up. After N simulation, I average the aggregate value of Ω_1, Ω_2 and Ω_3 for partners.

A graphical representation is shown in Figure 11. Most aggregate gains − before subtracting the losses from moral hazard − is explained by gains from the partnership productivity: 85% of the aggregate gains are explained by the partnership productivity. The remaining 15% is explained by the gains from financing.[18]

To investigate the variation between gains from two sources across wealth distribution, I conduct the same exercise for those whose net wealth is below and above the 20th percentile of wealth distribution. The result is reported in Figure 12. Most gains from financing are generated by the low wealth group and it is the major benefit for them: 80% of the aggregate gains for the low wealth group is explained by financing. In contrast, most gains from partnership productivity are generated by the high wealth group. For them, almost all of the gains are generated by the partnership productivity.

[18] The gains from financing were calculated conditional on partnership productivity. I could have instead calculated it conditional on solo productivity. The difference between two decompositions matters in the following situation. Suppose an agent is not financially constrained as a single owner with his solo productivity but financially constrained as a single owner with the partnership productivity. Moreover, his partner's net worth is greater than his. With the current decomposition, the gains of the agent from the partnership is captured both by the productivity gains and the financing gains. In contrast, all the gains from the partnership is attributed to the productivity gains with the alternative decomposition. As a result, the gains from financing with the alternative decomposition is smaller than the current one.

Note that a partnership is formed only if there exist the complementarity between two partners' solo productivities, the complementarity between one partner's solo productivity and the other partner's wealth or both. Looking at Figure 11, we cannot tell whether the large gains in productivity are driven by a pure productivity motive between partners or by the case in which wealthy but unproductive partners are matched with poor but productive partners due to a financing motive.

Figure 13 depicts the decomposition in Equation (6) with respect to two complementarities. The gains generated by partnerships solely driven by the complementarity between two partners' solo productivities explain 73% of the gains from productivity and 60% of the entire gain from partnerships. This is mainly because 63% of partnerships are solely driven by the complementarity between two partners' solo productivities. The remaining 37% of partnerships are involved with the complementarity between one partner's productivity and the other partner's wealth, and only a small portion (less than 1%) choose a partnership solely due to the complementarity between one partner's solo productivity and the other partner's wealth.

The key feature in the data driving this result is the following: relatively more partners are observed in the upper percentile than in the lower percentile of wealth distribution. For example, 62% of partners are located above the median of wealth distribution and 40% of partners are located above the 70th percentile of wealth distribution. Remember that the relationship between solo productivity and wealth is estimated insignificant, and therefore, most of the financially constrained agents are concentrated in the lower percentile of wealth distribution. The fact that we observe more partners in the upper part of wealth distribution implies that there must be partnerships formed by two relatively wealthy agents. In fact, 63% of partnerships are such cases as shown above. Gains generated by them explain major aggregate gains from business partnerships. However small in aggregate, financing generates major gains for low-wealth partners.

6.3 Financial Friction vs. Partnership Friction

Evans and Jovanovic (1989) do not allow an option to form business partnerships. This may over-emphasize the negative impact of financial friction, especially on the transition into business ownership. To examine this issue, I simulate four economies and compare the number of workers who would have become business owners without financial friction. I call these workers "constrained workers." I first start with an economy without financial friction and without the choice to form partnerships (Economy A). This economy corresponds to Evans and Jovanovic (1989) without financial friction. I then impose financial friction as in Evans and Jovanovic (1989) (Economy B). In Economy C, I allow agents to form partnerships but with their productivity as a partner being the same as their solo productivity. I also assume no moral hazard. Any partnership in this economy is solely driven by the complementarity between one partner's solo productivity and the other partner's wealth. Finally, I allow the productivity as a partner to be different from the solo productivity and also impose the cost of moral hazard in benchmark economy. Note that the benchmark economy corresponds to the estimated economy.

The result is summarized in Figure 14. About 12% of potential business owners are constrained to become a business owner due to financial friction (Economy B). If I allow the constrained workers to find a business partner without collaborative skill and moral hazard, most constrained workers enter entrepreneurship via partnerships (Economy C). The result indicates that there exists a large potential gain in financing through partnerships. However, if I allow the heterogeneous collaborative skill and moral hazard, most constrained workers who entered business ownership in Economy B once again become discouraged from starting a business (Benchmark). This is because only a small portion of the agents is assigned the productivity as a partner greater than their solo productivity as shown in Figure 10. The cost of moral hazard is also high as shown in the next section. Overall, despite the potential gains in financing, the constrained workers do not choose to form partnerships due to the cost of moral hazard and the potential productivity loss associated with working with a co-owner.

6.4 Assessing the Cost of Moral Hazard

In this section, I assess the cost of moral hazard in the formation of business partnerships. I first quantify the cost of moral hazard among partners by using Equation (2). Its graphical representation is shown in Figure 11 and 12. The cost of moral hazard among partners is substantial: it is estimated at 39% of the aggregate gains from partnerships (Figure 11). As shown in Figure 12, the cost is smaller for the low wealth group (29%) than for the high wealth group (41%).[19]

The current framework allows me not only to evaluate the cost of moral hazard for those who actually choose partnerships, but also to examine how many potential partners are discouraged from partnerships due to moral hazard. Figure 15 plots the number of single owners and partners before and after the moral hazard is introduced. The cost of moral hazard is large even at the extensive margin: 57% of partners are discouraged from partnerships due to moral hazard.

7 Welfare Analysis

This section analyzes the welfare cost from financial friction. Unlike most of the previous models with financial friction, the current model features an additional distortion due to financial friction: the efficiency loss from mismatch. An intuition is addressed in Section 4.2. Because of financial friction, a productive agent with low-wealth can be matched with a less productive agent than his partner with whom he would have been matched if there were no financial friction.

Introducing financial friction into an economy changes the ownership choice of agents. Table 10 decomposes the welfare change for each transition group.[20] Most of the welfare losses are coming from the single owners who are constrained to become business owners. This accounts for 87% of the aggregate welfare change due to financial friction. The second biggest source of welfare loss is from single owners who remain as single owners but with constrained borrowing. The welfare loss from this group accounts for 12% of the aggregate welfare change due to financial friction.

Before further discussion, let me clarify what I mean by mismatch in my model. I call the following three situations as mismatch driven by financial friction: (1) a partner changes

[19] Note that the cost of moral hazard increases as the partnership productivity increases. Some of the low wealth partners sacrifice the gains from productivity for the gains from financing. As a result, the cost of moral hazard is smaller for the low wealth group than for the high wealth group.

[20] I first normalize the aggregate welfare change due to financial friction as minus 100, $\sum_{i=1}^{N}(V_i^f - V_i) = -100$, and focus on how financial friction influence across individuals differently. V_i^f and V_i represent the value of agent i with and without financial friction respectively.

his ownership either to a worker or a single owner due to financial friction, (2) a worker or a single owner become a partner due to financial friction, and (3) a partner changes his partner in response to financial friction.

Some partners are discouraged from partnerships due to financial friction. The cost for them corresponds to 0.3% of the aggregate welfare change due to financial friction. More importantly, there are newly-made partners as well as partners who remain as partners but with a different partner. In the second column of Table 10, I further decompose the welfare change by these agents. First of all, there exist a group of agents who incur a loss due to mismatch. Some single owners change their ownership to partnerships for financing. Likewise, some partners remain as partners even though they are matched with a less-productive agent than a partner with whom he would have been matched if there were no financial friction. The welfare losses from these two groups explain 3.06% of the aggregate welfare change due to financial friction.

However, there exist a group of people who *gain* from financial friction. For example, workers who become partners because of financial friction benefit from financial friction. The magnitude of gains for them corresponds to 0.23% of the aggregate welfare change due to financial friction. There also exist partners and a small portion of single owners who benefit from financial friction and the magnitude of welfare gain for these business owners correspond to 2.11% of the aggregate welfare change due to financial friction. Again, an intuition can be found in Section 4.2. Some partners, workers, and single owners with high-wealth can have an opportunity to meet with a more productive agent than a partner with whom he would have been matched if there were no financial friction. The gains from these wealthy agents offset the losses incurred by other agents due to mismatch.

To summarize, the welfare losses from mismatch are 3.36% of the aggregate welfare change due to financial friction and the magnitude of gains from mismatch are 2.34% of the aggregate welfare change due to financial friction. Overall, *net* losses from mismatch are about 1.02% of the aggregate welfare change due to financial friction.

In Table 11, I further investigate welfare change due to mismatch with respect to wealth level. In fact, most welfare losses due to mismatch are generated by individuals whose net worth is less than the 20th percentile of wealth distribution. It accounts for 80% of the entire welfare loss from mismatch. This is a sharp contrast to the fact that only 3% of the gains from mismatch are generated by the low-wealth individuals. Overall, financial friction induces mismatch among partners. Most individuals who incur a loss due to mismatch are those who have a low net worth. However, some individuals, those with high wealth, benefit from mismatch.

8 Policy Experiments

Financial friction is often a concern for policy makers who try to boost entrepreneurships. In attempting to help financially constrained business owners, the U.S. government offers a variety of loan programs.[21] The model developed here can be used to evaluate the impact of such programs not only on startup owners in general but also on the formation of business partnerships.

8.1 Policy 1: Small Business Loans

I evaluate a policy that lends a certain amount of money to startup owners at the market interest rate. The policy resembles the core feature of small business loans by the U.S. Small Business Administration. Given that the interest rate is the same as the market interest rate, no financially unconstrained startup owners will apply to the loan program as long as there exists an epsilon amount of cost associated with the application. The marginal benefit of additional investment is strictly greater than the market interest rate for financially constrained agents, and it is only those agents who actually apply to the loan program. I experiment with a policy that lends $25,000 to startup businesses.[22]

The left column of Table 12 shows the welfare gain by Policy 1 for each transition group. The result is quite striking: almost 99% of the aggregate welfare change due to financial friction disappear. First of all, workers who could have become single owners without financial friction enter business ownership as a single owner thanks to the small business loans. Most single

[21] For detailed information, refer to the U.S. Small Business Administration website.

[22] I assign $25,000 per business regardless of the number of owners. I simulated the economy with this policy 1000 times and averaged the results from all simulations.

owners who are constrained to borrow also apply to and benefit from the loan program. The number of single owners also increase more than 10% after the loan program is applied as shown in Table 13.

There is additional gain by Policy 1: gains from alleviating mismatch by partners. In doing so, some partners − who can be matched with a more productive partner due to financial friction − are worse off by the loan policy. The value of their wealth in the presence of financial friction reduces once other partners can access the loans provided by the government. Despite the gains from alleviating mismatch, the aggregate number of partners is almost identical before and after the loan program is applied (Table 13).

8.2 Policy 2: Business Loans Targeted for Business Partnerships

Given that partnerships firms are more successful than single owner firms on average, we may consider a policy that encourages the creation of more business partnerships. To this end, I experiment with a loan policy that lends $25,000 only to business partnerships.

The effect of this policy on increasing the number of partners is negligible (Table 13). The number of partners remains almost identical before and after the policy is implemented. Moreover, although the program specifically targets business partnerships, the welfare gains generated by improving match quality is smaller than Policy 1: the gains by alleviating mismatch by Policy 2 are about 43% of the gains by alleviating mismatch by Policy 1. The key difference is that under Policy 2, partners who would have become single owners without financial friction still remain as partners. In contrast under Policy 1, these partners switch their ownership choice to single ownership and generate welfare gains.

Overall, the loan program targeted for general businesses is more effective since it not only increases welfare for workers who would have been single owners without financial friction and for single owners who are constrained to borrow, but also improves the match quality more than the loan program specifically targeted for business partnerships.

One caveat of the policy analyses in this section is that I did not take into account applicant's default decision. Endogenizing agents' default decision can be valuable for analyzing small business loan programs, but is outside the scope of this paper.

9 Conclusion

I study the formation of partnerships among startup owners. I first document that partners earn significantly more than single owners, and relatively more partners are observed in the lowest quintile, than in the middle, of wealth distribution. Despite the high earnings among observed partners, the proportion of partners among startups is much smaller than single owners. To further investigate the decision to form a partnership, I develop and estimate a model based on Evans and Jovanovic (1989).

Using the estimated model, I first show that the gains from the increase in productivity explain most gains from the observed partnerships. Though relatively small in aggregate, the gains from the increase in financing capacity are the major benefit to individuals with a low net worth. I also examine how much the option to form a business partnership can encourage constrained workers, who could have become business owners without financial friction, to start a business. Despite potential gains in financing, most of the constrained workers do not choose to form a partnership. First of all, the cost of moral hazard between partners is high both at the intensive and at the extensive margin. Moreover, most individuals are estimated less productive when working with co-owners than working alone. Financial friction instead imposes additional distortion among potential startup owners by generating mismatch among partners. A simple loan policy by the government can not only be effective for facilitating the transition of the constrained potential business owners into business ownership, but also be effective for increasing match quality among business partners.

This study focuses on the role of partnerships on the business formations. A limitation of this study is that I only use the first year business earnings as a measure of outcome of the business. Although the first year earning is highly predictive for future earnings from the business (e.g., Hamilton, 2000), it cannot fully capture the dynamics of businesses, especially their failure rate. Many new businesses fail within a few years. A further investigation into whether and how partnerships are related to business dissolution would shed light not only on business partnerships, but also on business failures.

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Tables and Figures

Table 1: Summary Statistics

	Workers	Single owners	Partners	
Obs.	47,304	941	162	
Experience (Year)	19.89	19.86	19.15	
Education (Year)	13.73	14.05	14.13	
Race (White)	85.26	85.62	90.74	%
Married	62.76	62.35	78.98	%

NOTE: This table reports the summary statistics for characteristics of workers, single owners, and partners. Mean is reported unless otherwise indicated. The survey weight is applied.

Table 2: Income

	Workers	Single owners	Partners
Obs.	47,304	862	150
Mean	51,858	37,120	55,466
10%	15,032	2,017	3,149
50%	40,883	18,561	33,631
90%	95,612	84,078	114,315

NOTE: Dollar in 2011. This table shows the summary statistics for incomes of workers, single owners, and partners given that they reported a positive income.

Table 3: Income Regression for Business Owners

	(1)	(2)	(3)	(4)
VARIABLES	log Income	log Income	log Income	log Income
Partnership	0.584***	0.553***	0.540***	0.513***
	(0.139)	(0.137)	(0.138)	(0.140)
Education	0.0527***	0.00200	-0.000945	0.00336
	(0.0188)	(0.0204)	(0.0220)	(0.0218)
Experience	0.0267	0.0124	0.0136	0.0104
	(0.0165)	(0.0165)	(0.0164)	(0.0167)
Experience^2	-0.000577	-0.000336	-0.000372	-0.000314
	(0.000377)	(0.000376)	(0.000376)	(0.000378)
Previous income		0.0529***	0.0503***	0.0495***
		(0.00995)	(0.0101)	(0.0101)
Net worth		0.00269*	0.00270*	0.00308**
		(0.00141)	(0.00141)	(0.00141)
Industry dummy	No	No	Yes	Yes
Other dummies	No	No	No	Yes
Observations	1,012	1,012	1,012	1,012
R-squared	0.027	0.060	0.086	0.104

NOTE: Ten thousand dollars in 2011. This table shows the estimates for regression of log incomes on partnership dummy, the years of education, the years of experience and its square, previous income, net worth and industry and other dummies. Partnership means the partnership dummy. Previous income indicates the wage income in the base year. Other dummies include race, marital status and year dummies. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Net Worth

	Workers	Single owners	Partners
Obs.	47,304	941	162
Mean	180,582	208,958	273,226
10%	-5,501	-7,815	-5,626
50%	74,954	78,056	123,865
90%	493,217	598,411	692,040

NOTE: Dollar in 2011. This table shows the summary statistics for net worth of workers, single owners, and partners.

Table 5: Probit Analysis of Partnership Choice

VARIABLES	Partnerships
Q0-20	0.356***
	(0.149)
Q50-100	0.471***
	(0.128)
Education	-0.0265
	(0.0205)
Experience	-0.0118**
	(0.0048)
Previous income	-0.0085
	(0.0105)
Observations	1,103
Pseudo R-squared	0.061

NOTE: Ten thousand dollars in 2011. This tables reports the estimates for Probit regression of the partnership dummy on wealth dummies, the years of education, the years of experience, and previous incomes among business owners. Q"x" represents "x"th percentile of wealth distribution of the entire population. Q20: $ 3,998, Q50: $ 75,162. Other dummies include race, marital status and year dummies. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Industry Decomposition

Industry	Single owners	Partners	Partners (%)
Agriculture, forestry, fishing, and hunting	53	16	23
Mining	1	0	0
Construction	252	40	14
Manufacturing	33	6	15
Wholesale trade	19	6	24
Retail trade	78	21	21
Transportation, warehousing, and utilities	51	3	6
Information	11	1	8
Finance, insurance, real estate, and rental and leasing	39	14	26
Professional, scientific, management, administrative, and waste management	213	27	11
Services	191	28	13
Total	941	162	15

NOTE: This table reports the number and the proportion of partners for different industries. Services include Business and repair services; Personal services; Educational, health and social service; Arts, entertainment, recreation, accommodations, and food service; Public administration; and other services.

Table 7: Estimates for log Worker Productivity and log Solo Productivity

Parameters	Variables	Estimates	Standard Errors
γ_1	log(Education)	0.3947	(0.0195)
γ_2	log(Experience)	0.0947	(0.0045)
β_0	Constant	0.3104	(0.0620)
β_1	log(Net worth)	0.0024	(0.0109)
β_2	log(Education)	0.3245	(0.0887)
β_3	log(Experience)	0.0359	(0.0188)
σ_η	Std. of η	0.1068	(0.0027)

NOTE: This table presents the estimates for the equation: $\log\theta_w = \gamma_1\log x_1 + \gamma_2\log x_2$ and $\log\theta = \beta_0 + \beta_1\log A + \beta_2\log x_1 + \beta_3\log x_2 + \eta$, where $\eta \sim N(0,\sigma_\eta^2)$. A is net worth (ten thousands dollars in 2011). x_1 is the years of education. x_2 is the years of experience. Asymptotic standard errors are in parentheses.

Table 8: Estimates for Matching Function

Parameters	Variables	Estimates	Standard Errors
g_0	Constant	-1.3923	(0.0867)
g_1	log(Education)	0.2487	(0.1171)
g_2	log(Experience)	0.0191	(0.0341)
σ_u	Std. of u	0.3735	(0.0098)

NOTE: This table presents the estimates for the equation: $\log g = g_0 + g_1\log x_1 + g_2\log x_2 + u$, $u \sim N(0,\sigma_u^2)$. g represents the additional ability as a partner. x_1 is the years of education. x_2 is the years of experience. Asymptotic standard errors are in parentheses.

Table 9: Estimates for Other Parameters

Parameters	Variables	Estimates	Standard Errors
λ	Collateral constraint	2.1761	(0.9423)
α	Technology	0.1958	(0.0297)
κ	Preference	1.7673	(0.0220)
σ_w	Std. of $\log \epsilon_w$	0.7289	(0.0072)
σ_s	Std. of $\log \tilde{\epsilon}_s$	1.6143	(0.0240)
P_s	–	0.0386	(0.0072)
σ_p	Std. of $\log \tilde{\epsilon}_p$	1.0245	(0.1111)
P_p	–	0.1505	(0.0387)

NOTE: This table presents the estimates for $\{\lambda, \alpha, \kappa\}$ and the outcome shocks. λ captures the extent of collateral constraint. α governs the marginal productivity of capital. κ captures the marginal rate of substitution between consumption and effort. The outcome shock to workers (ϵ_w) is modelled as $\log \epsilon_w \sim N(\mu_w, \sigma_w^2), \quad \mathbb{E}[\epsilon_w] = 1$. The outcome shock to single owners (ϵ_s) is modelled as $\epsilon_s = \tilde{\epsilon}_s - P_s, \quad \log \tilde{\epsilon}_s \sim N(\mu_s, \sigma_s^2), \quad \mathbb{E}[\epsilon_s] = 1$. The outcome shock to partners (ϵ_p) is modelled as $\epsilon_p = \tilde{\epsilon}_p - P_p, \quad \log \tilde{\epsilon}_p \sim N(\mu_p, \sigma_p^2), \quad \mathbb{E}[\epsilon_p] = 1$. P_s and P_p are some positive constants. Asymptotic standard errors are in parentheses.

Table 10: Decomposing Welfare Change due to Financial Friction by Transition Group (normalized by the aggregate welfare change due to financial friction as minus 100)

	(1) After Financial Friction			(2) Partners	
	Workers	Single owners	Partners (A+B)	Group (A)	Group (B)
Workers	0	0	0.23	0.23	0
Single owners	-87.23	-11.75	-0.55	0.02	-0.57
Partners	-0.31	-0.003	-0.39	2.09	-2.48

NOTE: The first column of this table presents welfare change with respect to each transition group after financial friction is introduced. The second column of this table further decomposes welfare change for agents who become or remain as partners after financial friction is introduced. Group (A) indicates partners who benefit from financial friction. Group (B) indicates partners who incur a loss due to financial friction. The summation of the figures in blue is **-3.36**, which represents the aggregate welfare losses due to mismatch. The summation of the figures in red is **2.34**, which represents the aggregate welfare gains due to mismatch. The aggregate *net* losses due to mismatch is the summation of these two numbers, which is about **1.02**% of the aggregate welfare change due to financial friction. The aggregate welfare change due to financial friction is normalized as -100: $\sum_{i=1}^{N}(V_i^f - V_i) = -100$. V_i^f and V_i represent the value of agent i with and without financial friction respectively.

Table 11: Welfare Loss/Gain due to Mismatch by Low-wealth Individuals (normalized by the aggregate welfare change due to financial friction as minus 100)

	Welfare loss	Welfare gain
All agents (a)	-3.36	2.34
Agents < 20th (b)	-2.69	0.07
(b/a)×100	(80%)	(3%)

NOTE: This table presents losses and gains due to mismatch especially by low-wealth individuals. Agents < 20th indicate individuals whose net worth is less then 20th percentile of wealth distribution. The aggregate welfare change due to financial friction is normalized as -100: $\sum_{i=1}^{N}(V_i^f - V_i) = -100$. V_i^f and V_i represent the value of agent i with and without financial friction respectively.

Table 12: Decomposing Welfare Change for Policy 1 & Policy 2 by Transition Group (normalized by the absolute value of the aggregate welfare change due to financial friction as 100)

	After Policy 1			After Policy 2		
	Workers	Single owners	Partners	Workers	Single owners	Partners
Workers	0	87.23	0.30	0	0	0.29
Single owners	0	11.74	0.002	0	0	0.003
Partners (C+D)	-0.23	0.55	0.27	-0.19	-0.014	0.30
Group (C)	-0.23	-0.02	-1.60	-0.19	-0.014	-1.48
Group (D)	0	0.57	1.87	0	0	1.78

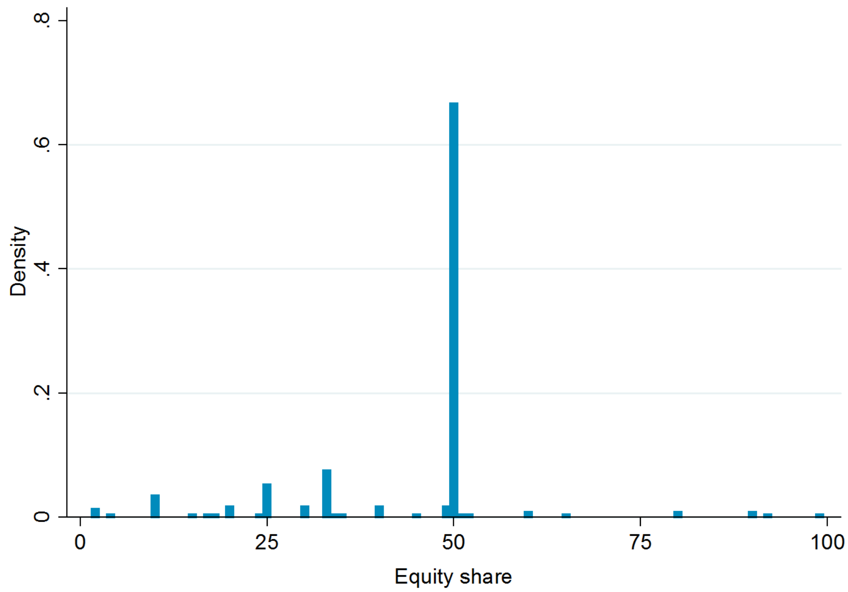
NOTE: The table presents welfare gains generated by Policy 1 and Policy 2 respectively. Policy 1 is a loan program for all businesses by the government with the market interest rate and the maximum lending amount of $25,000. Policy 2 is a loan program targeted for partnership firms by government with the market interest rate and the maximum lending amount of $25,000. Group (C) indicates ex-partners who incur a loss due to each policy. Group (D) indicates ex-partners who benefit from each policy. A minus figure indicates the welfare *losses* from each policy. To highlight the extent of welfare improvement by policies, I normalize the gains in both polices with respect to the absolute value of aggregate welfare change due to financial friction, which is normalized as 100: $\left|\sum_{i=1}^{N}(V_i^f - V_i)\right| = 100$. V_i^f and V_i represent the value of agent i with and without financial friction respectively.

Table 13: Number of Business Owners After Policy 1 & Policy 2

	Single owners (a)	Partners (b)	Business owners (a+b)
Benchmark	82.04	17.96	100
Policy 1	93.71	17.92	111.63
Policy 2	82.04	17.98	100.02

NOTE: This table compares the number of business owners after Policy 1 and Policy 2. Policy 1 is a loan program for all businesses by the government with the market interest rate and the maximum lending amount of $25,000. Policy 2 is a loan program targeted for partnership firms by the government with the market interest rate and the maximum lending amount of $25,000. The benchmark economy is the estimated economy. The number of business owners in the benchmark economy is normalized as 100.

Figure 1: Equity Share for Startup Owners



NOTE: This figure shows the histogram of equity shares for those whose equity share is greater than 1% and less than 100%.

Figure 2: Kernel Density of Log Income

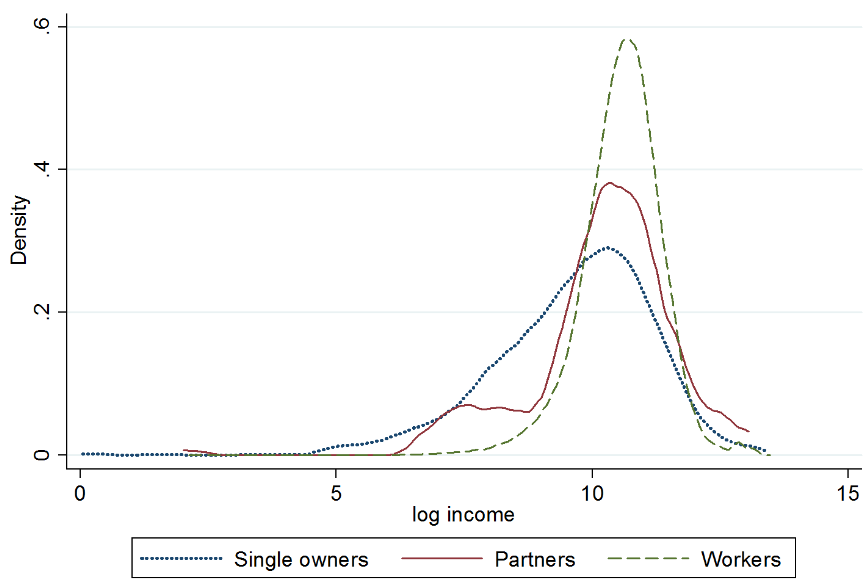


Figure 3: Kernel Density of Net Worth

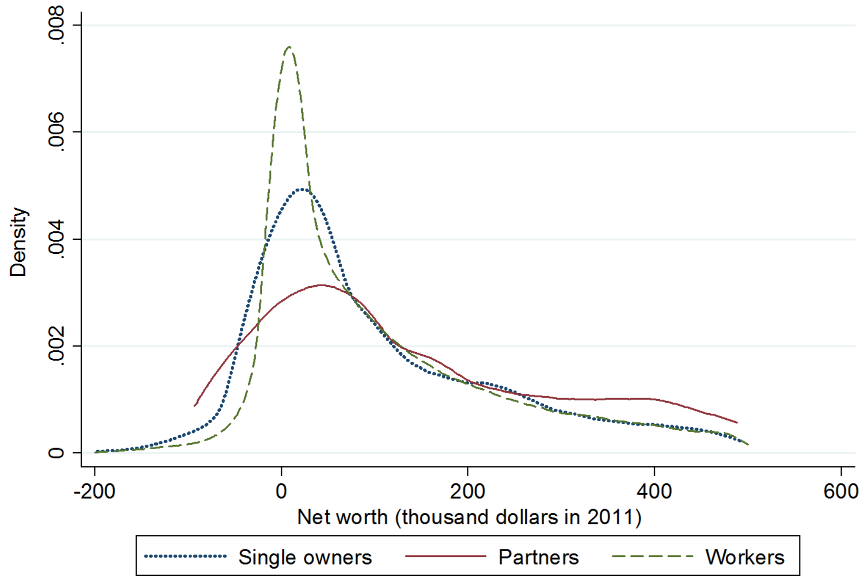
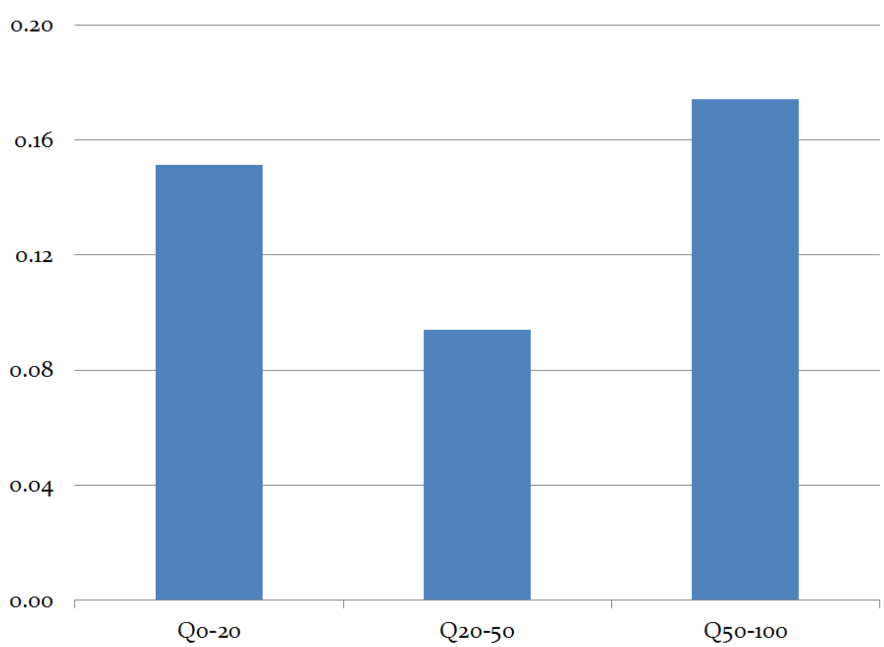
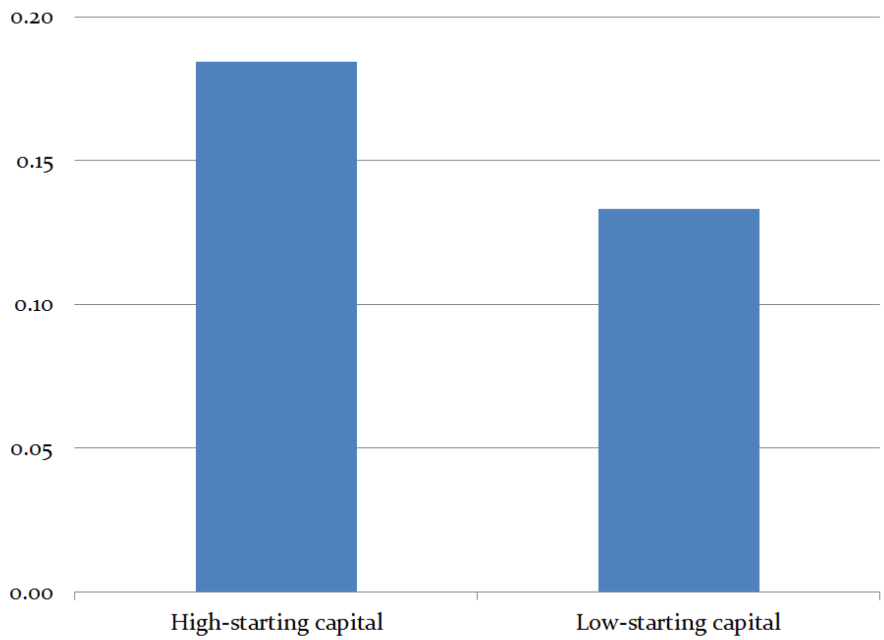


Figure 4: Proportion of Partners among Business Owners with respect to Net Worth



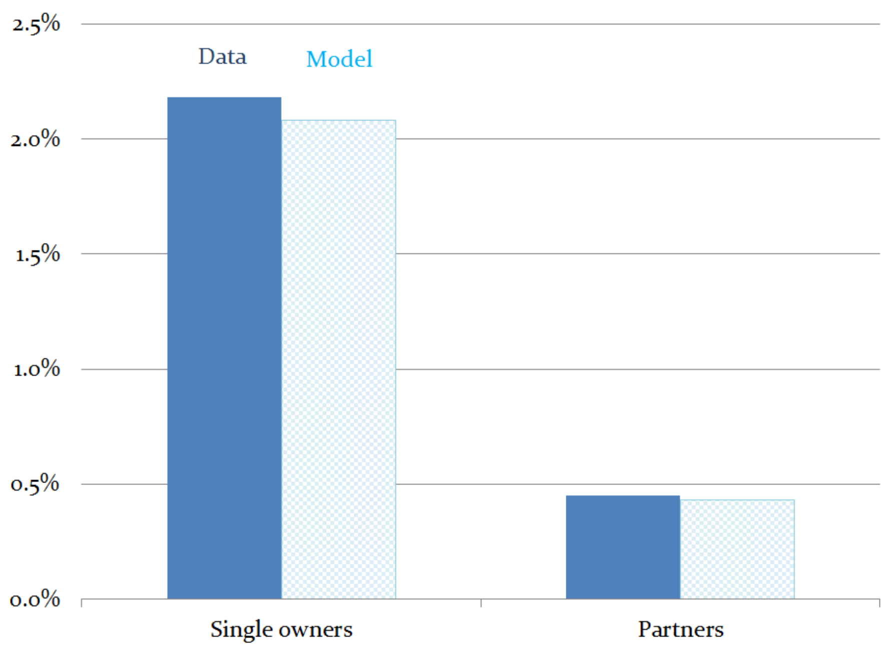
NOTE: This figure depicts the proportion of partners among startup owners with respect to net worth. Q“x” represents “x”th percentile of wealth distribution of the entire population. Q20: $3,998, Q50: $75,162

Figure 5: Proportion of Partnerships across Industries



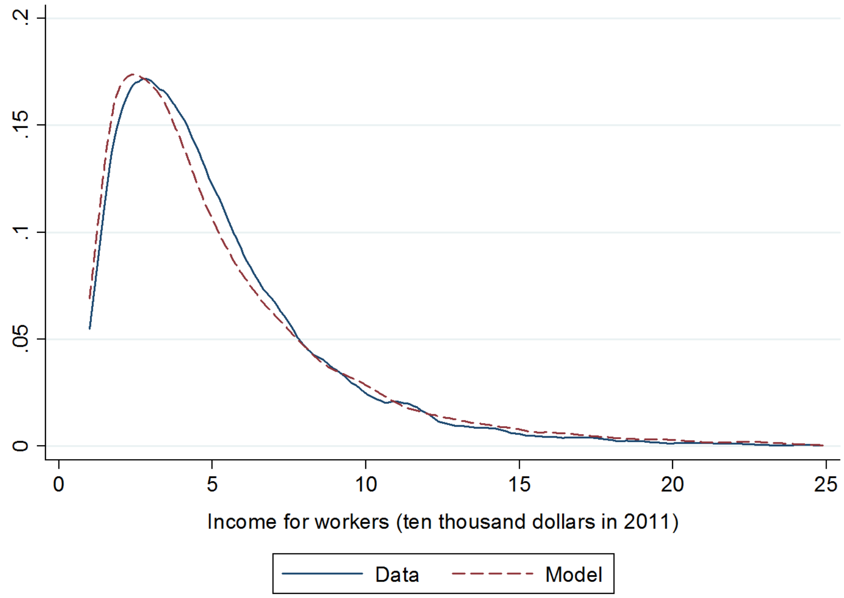
NOTE: This figure shows the proportion of partnerships for high and low starting capital industries. High-starting capital industry includes Mining; Manufacturing; Wholesale and Retail trade; Transportation, warehousing, and utilities; and Finance, insurance, real estate, and rental and leasing. Low-starting capital industry includes Construction and Services. p-value of difference is 0.028.

Figure 6: Proportion of Business Owners (Data vs. Model)



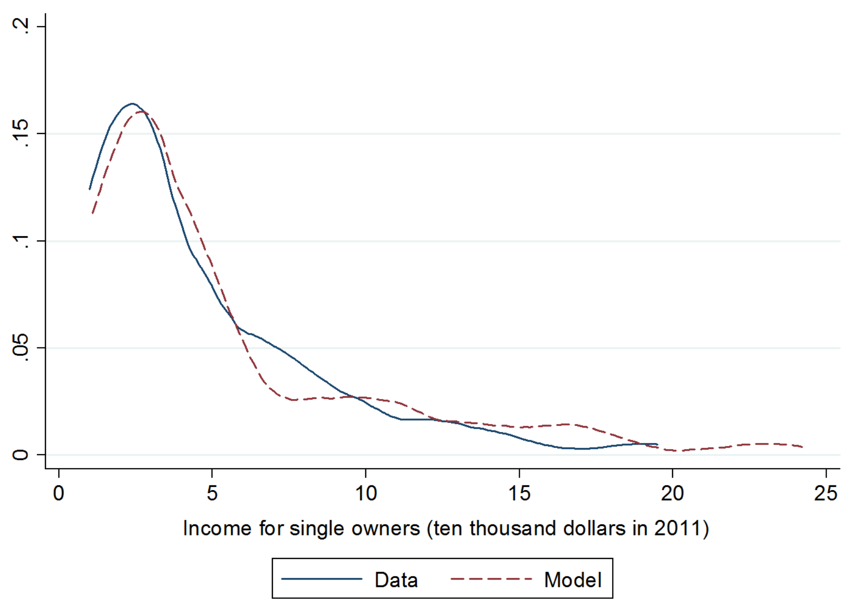
NOTE: This figure compares the proportion of single owners and partners to the simulated proportion of single owners and partners.

Figure 7: Kernel Density of Income for Workers (Data vs. Model)



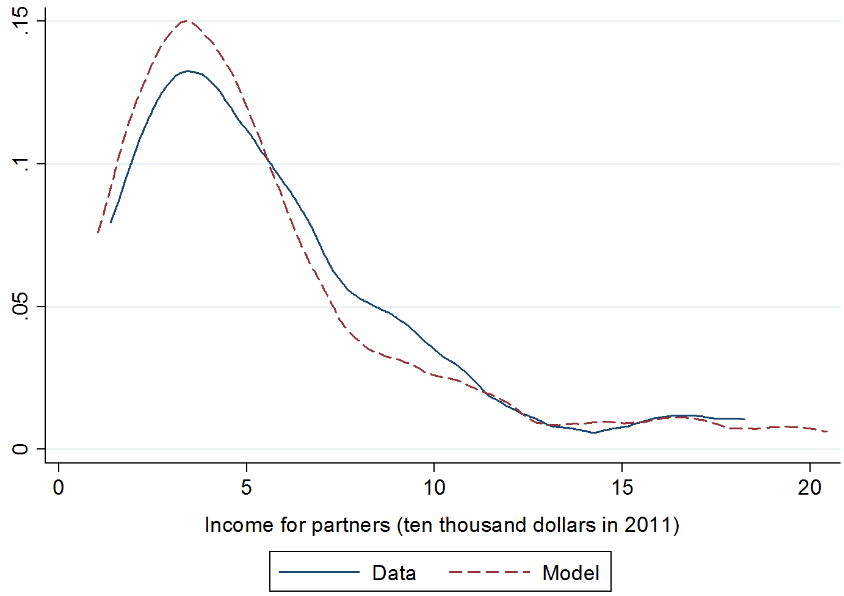
NOTE: This figure compares Kernel density of income for workers and a simulated income for workers given covariates and estimates.

Figure 8: Kernel Density of Income for Single Owners (Data vs. Model)



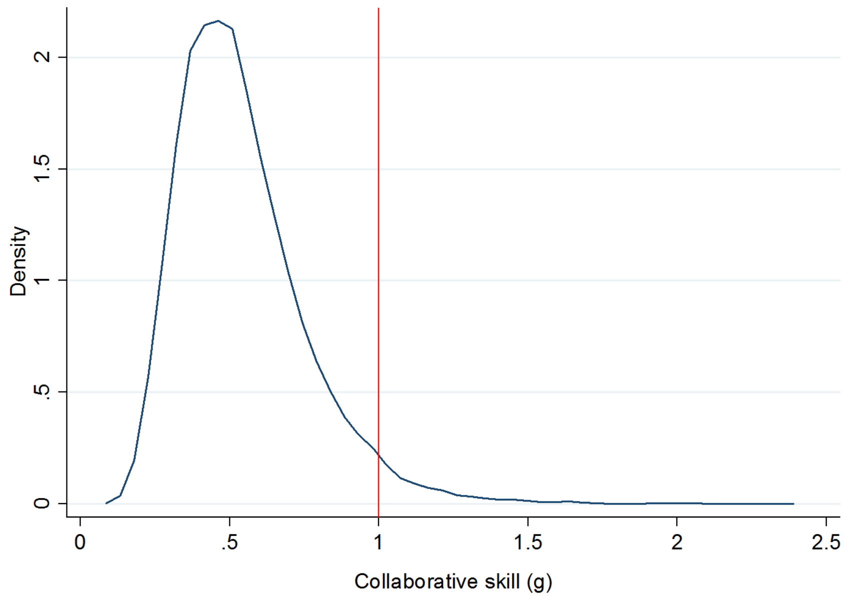
NOTE: This figure compares Kernel density of income for single owners and a simulated income for single owners given covariates and estimates.

Figure 9: Kernel Density of Income for Partners (Data vs. Model)



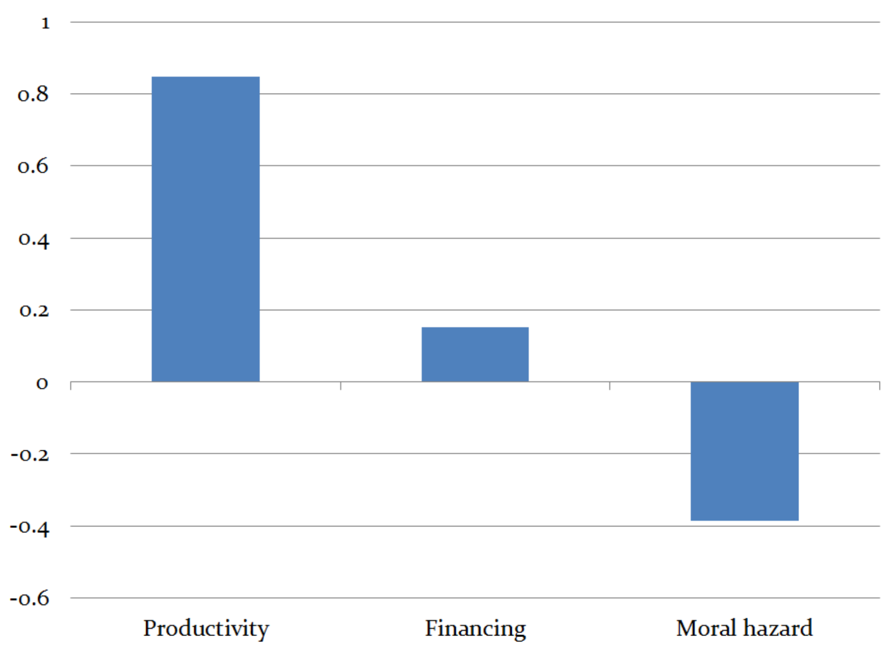
NOTE: This figure compares Kernel density of income for partners and a simulated income for partners given covariates and estimates.

Figure 10: Kernel Density of Collaborative Skill



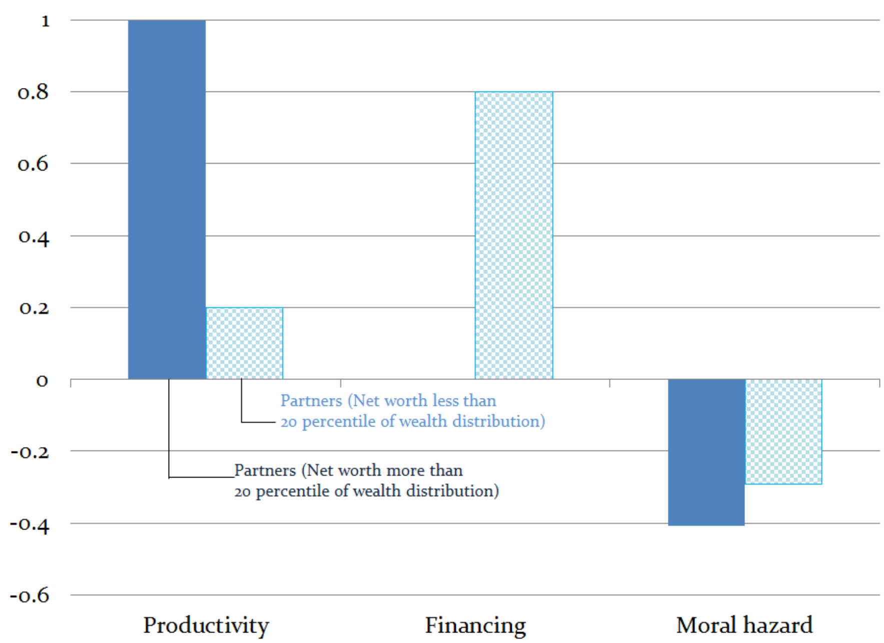
NOTE: This figure shows Kernel density of a simulated value for g given covariates and estimates.

Figure 11: Decomposing Benefits and Costs of Partnerships 1



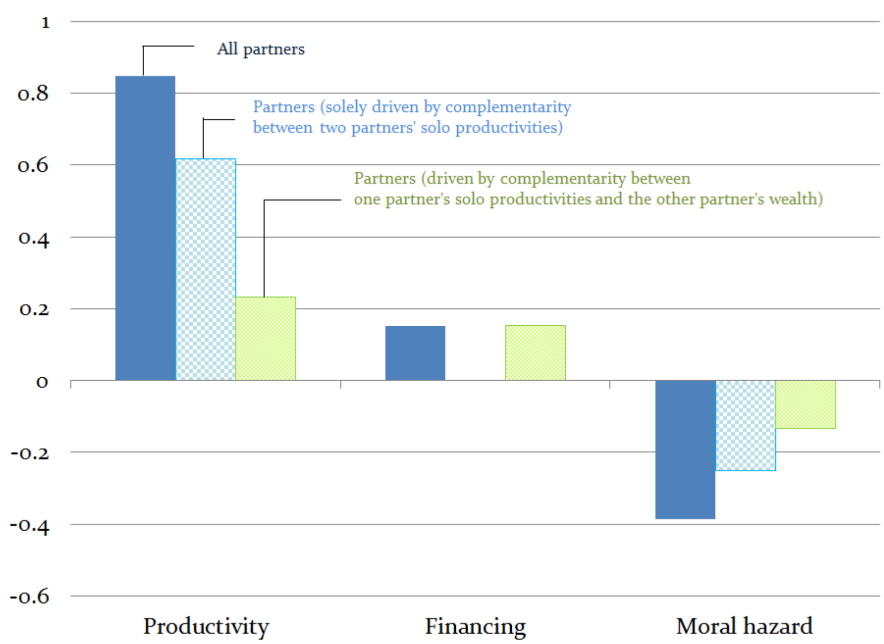
NOTE: This figure depicts the decomposition of benefits and costs from partnerships for all partners. The aggregate gains for all partners are normalized as one.

Figure 12: Decomposing Benefits and Costs of Partnerships 2



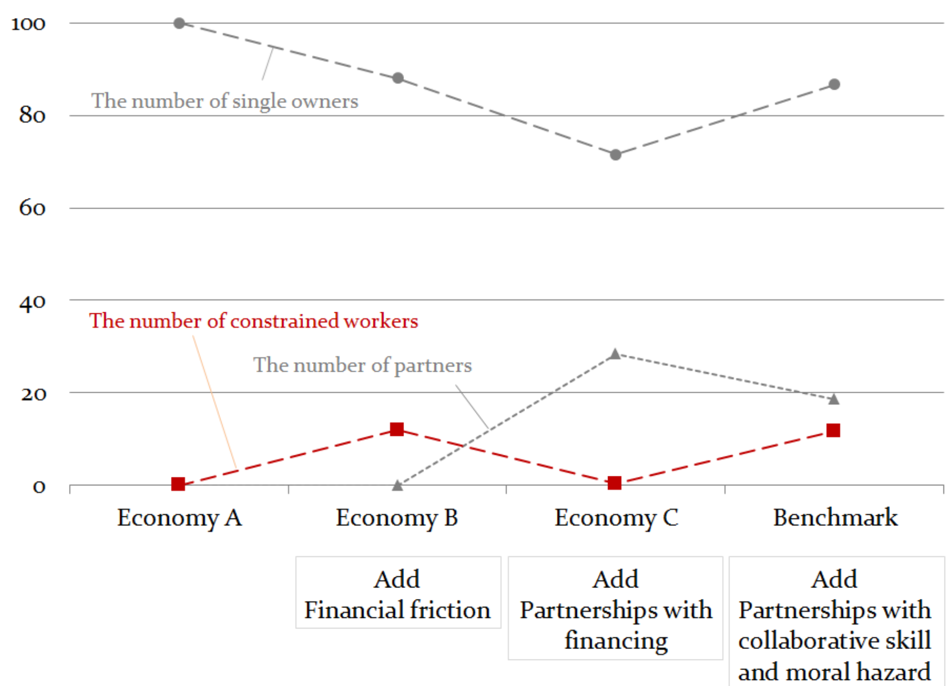
NOTE: This figure depicts the decomposition of benefits and costs from partnerships below and above 20th percentile of wealth distribution (Blue: Partners Below 20th percentile of wealth distribution, Sky-blue: Partners above 20th percentile of wealth distribution). The aggregate gains for each group are normalized as one.

Figure 13: Decomposing Benefits and Costs of Partnerships 3



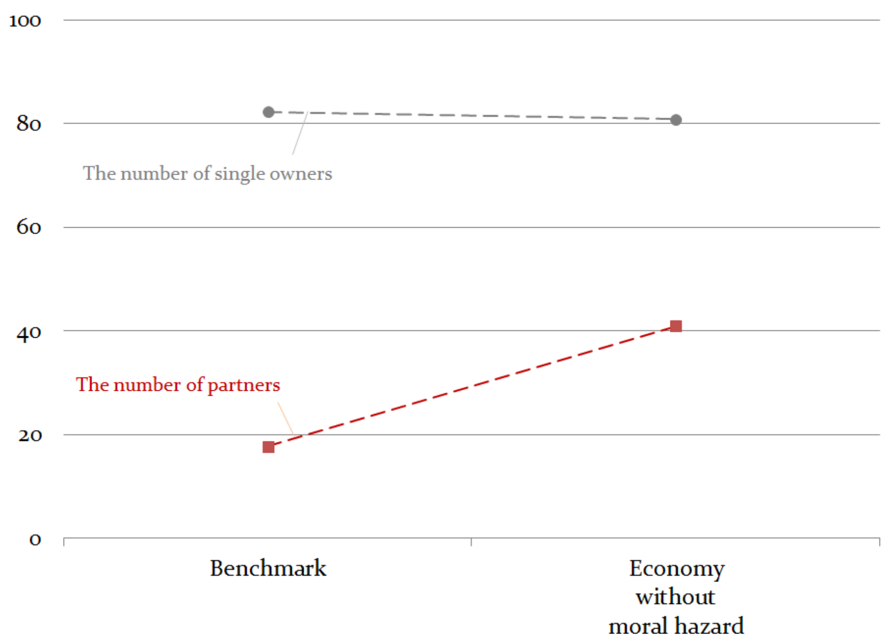
NOTE: This figure depicts the decomposition of benefits and costs from partnerships with respect to complementarities (Blue: All partners, Sky-blue: partnerships solely driven by complementarity between two partners' solo productivities, Green: partnerships driven by complementarity between one partner's solo productivities and the other partner's wealth). The aggregate gains for all partners are normalized as one.

Figure 14: Counterfactual Exercise 1



NOTE: This figure illustrates the number of single owners, of partners, and of constrained workers in each counterfactual simulation. The constrained worker is a worker who would have become a business owner if there were no financial friction. The **Economy A** is the economy without financial friction and without an option to form business partnerships. The **Economy B** is the economy with financial friction but without an option to form business partnerships. The **Economy C** is the economy in which an option to form business partnerships is introduced from Economy B with the productivity as a partner being the same as the solo productivity and without moral hazard. In this economy, a partnership is formed only if there exists the complementarity between one partner's solo productivity and the other partner's wealth. The **Benchmark** economy is identical to the Economy C except that the collaborative skill and moral hazard are allowed. Note that the benchmark economy corresponds with the estimated economy. The number of single owners in Economy A is normalized as 100.

Figure 15: Counterfactual Exercise 2



NOTE: This figure illustrates the number of single owners and partners before and after moral hazard is introduced into the benchmark economy. The number of business owners in the benchmark economy is normalized as 100.

Appendix

A Sample Construction

In this section, I describe the sample construction in more details. The SIPP was redesigned in 1996, and as a result the variable names, as well as the data editing and imputing procedures, are not consistent between panels before and after the 1996 panel. For this reason, I use panels after 1996 including 1996, 2001, 2004 and 2008. The samples between panels are not overlapping.

In SIPP, the respondents were interviewed every 4 month with questions such as income level and working hours for each month (These questions are labeled as "core modules"). In addition, broader questions ranging from household net worth to child support were asked annually (These questions are labeled as "topical modules"). In particular, for every third wave of interviewing, SIPP provides the household level net worth (THHTNW) and the share of business equity for business owners (EVBOW). Since the household net worth is one of the most important variables for this study and it is recorded annually, I construct a panel where the time unit is a year.

Type of Business Owners A respondent is defined as a business owner if he answered yes to the question "Did you own a business?" (EBIZNOW) during at least one of three previous waves (representing one year) when the household net worth is recorded[23]. The equity share for those who have more than 1% and less than 100% equity is concentrated around 50% (Figure 1). I define a partner as a business owner whose share of business equity is greater than or equal to 25% and less than or equal to 75%.[24] Business owners whose equity share is greater than 75% are called single owners.

Income SIPP explicitly asks how much each respondent earned for each month in every wave (TBMSUM/TPRFTB for business owners, TPMSUM for workers). In principle, one wave covers four months. I use the monthly income only for the survey month since it is

[23]Some respondents in the third wave of 2004 panel were wrongly recorded as business owners (APDJBTHN=5). I drop these respondents. For more information, see SIPP user note for Business Feed-Back Problem.

[24]According to this definition, an incorporated firm with multiple owners is considered a business partnership.

well documented that there is little variation in monthly incomes within the same wave. Thus, I use the term "wave" and "month" interchangeably. For example, suppose a respondent reported earned income for only two months and the total amount of earned income for the two months was \$5,000. Then his annual earned income is calculated as $\$5,000 \times \frac{12}{2}$.

One issue regarding business income is that negative income is reported only for the panel after 2004 but not for the panel before 2004. This is due to a change in interview questions for business earnings starting in 2004. For example, some portion of earned income from a business is recorded in TPRFTB after 2004 but not before 2004.[25] The way I handle zero or negative business income is found in the Final Sample construction.

Other Characteristics Other questions regarding characteristics such as age (TAGE), sex (ESEX), race (ERACE), marital status (EMS) and education (EEDUCATE) were asked in the wave after the household net worth is recorded. I use this information as the annual characteristics of each respondent. Industry information is found in the core modules both for workers (EJBIND) and for business owners (TBSIND). Typical hours worked per week is also reported in the core modules (EJBHRS: wage work hours, EHRSBS: business work hours). The potential experience is calculated as $\max\{\text{age - years of education - } 6, 1\}$.

The Final Sample The final sample is constructed in a similar way to the literature (e.g, Evans and Jovanovic, 1989; Hamilton, 2000; Hurst and Lusardi, 2004). It is a two year panel for males from ages 18 to 65. This sample is chosen to limit the influence of the labor market participation. I call the first year the base year and the second year the subsequent year. I first drop business owners in the base year. Some respondents started their business from the last wave in the base year and I re-categorized these respondents as new business owners in the subsequent year.[26] I also drop unemployed respondents in the base and the subsequent year.[27] Those who did not report the household wealth are also dropped. 13 outliers whose net worth is greater than \$10 billion are also dropped. Among startup owners in the subsequent

[25] For more detailed information, see SIPP user note for Business Income and Profit/Loss.

[26] A handful of respondents reported as business owners only in the last wave in the base year but not in the subsequent year. I dropped these respondents.

[27] The unemployed is defined as non-business owners who reported "no job" (RMESR $\in \{6, 7, 8\}$) at least two waves during a given year. To limit measurement error, I also drop respondents who were employed but did not report the wage earnings in the subsequent year.

year, I drop respondents who answered yes to the question "Was this business owned entirely by members of this household?" (IHHOWN[28]). These individuals are dropped for two reasons. First, the motivation to form a family business may be different from the motivation to start a business with non-household members. Second, forming a partnership among household members does not increase the total value of household net worth, an important mechanism this paper investigates. I also drop 1 active duty military personnel who are categorized as business owners. Business owners who did not report the equity share or reported equity share which is less than 25% are also dropped. To remove casual business owners, I drop an individual if his business work hours are less than 30 hours and less than wage work hours. I did not exclude business owners who reported their working hours as "Time varies". The sample consists of 48,407 individuals. 1,103 out of 48,407 became business owners in the subsequent year and among them 162 are categorized as partners. The number of observations at each stage of sample construction is summarized in Table 16.

Out of 1,103 startup owners, 161 reported zero income and 30 reported a negative income. Note that a negative income is reported in panels after 2004. During the same period, zero income is also reported (70 observations). Some business owners who reported zero income before the 2004 panel may realize a negative income. To make variables consistent across survey years, I first replace negative income to zero. Then, for startup owners with zero income, I impute business incomes to the one reported one year after the subsequent year if it is available (89 observations imputed). If not, and if the business owners started their business from the last wave in the base year, I impute business incomes to the one reported in the base year (11 observations imputed). The resulting number of business owners with zero income is 79 for single owners and 12 for partners. Finally, I impute the years of education for those who did not respond wit 13, the average years of education for the whole population conditional on reporting.[29]

SIPP Oversampling For SIPP sample design, the Census Bureau assigned the universe of addresses into two strata, one with a higher proportion of poverty than the other. The Census Bureau select more samples in the high-poverty stratum. Most of the high-poverty

[28]This variable is found in the same topical module containing the individual characteristics.

[29]The years of education for 234 workers, 9 single owners and one partner were imputed.

regions coincide with areas in which more African-American, Hispanic, and female headed family are populated. As a result, most over-sampled low income individuals or families are African-American, Hispanic, or female headed family (Huggins and King, 1997). To assess whether the final sample contains relatively more of these low-income individuals, I compare racial composition of the final sample to that of Consumer Expenditure Survey (CEX) in 2011.

Table 17 compares the proportion of African-Americans with respect to income both for the final sample and for CEX. The proportion of low-income African-Americans in the final sample is smaller than that of CEX. This suggests that most of the over-sampled low income individuals are more likely to be dropped in the process of sample construction.

B Identification of the Baseline Model

The estimation of the baseline model requires a specification of the partnership productivity and the potential partner's net worth. Theories predict that the partnership productivity can be different from the solo productivity. I assume that the *proportional* difference in productivity is determined by each agent's observable and unobservable characteristics. More specifically,

$$\log \theta_p - \log \theta = \hat{g}_0 + \hat{g}_1 \log A + \hat{g}_2 \log x_1 + \hat{g}_3 \log x_2 + \hat{u}, \quad \text{where} \quad \hat{u} \sim N(0, \sigma_{\hat{u}^2})$$

Education and experience may have an additional value on a team's work. Having more wealth may increase the opportunity to meet with a partner with a higher solo productivity. u captures other unobserved components affecting partnerships productivity. I assume that the partner's net worth to be *randomly* assigned from the whole population.

With the specification above, the model is fully characterized by a set of parameters: $\{\kappa$, γ_1, γ_2, α, β_0, β_1, β_2, β_3, σ_η, $\hat{g}_0$, $\hat{g}_1$, $\hat{g}_2$, $\hat{g}_3$, $\sigma_{\hat{u}}$, σ_w, σ_s, σ_p, $\lambda\}$.[30] ψ denotes the set of all parameters. X denotes $\{A, x_1, x_2\}$, the set of all covariates. Y denotes $\{d, \pi \cdot d\}$, the ownership choice and income conditional on each choice.

For identification of the baseline model, I exploit the following idea. The effect of financial friction can be different across wealth distribution: agents in the lower percentile are more affected than agents in the upper percentile by the financial friction. If an agent's net worth is

[30] For expositional convenience, I normalize P_s and P_p as zero.

large enough, he may not be financially constrained, and thus the primary reason for him to choose a partnership is because of the productivity gains. Therefore, the ownership choice and the conditional income for those wealthy agents can be informative on the joint distribution of solo and partnership productivity. Given the joint distribution of solo and partnership productivity, the probability to become a partner for financially constrained agents is only affected by the collateral constraint λ. Thus, the ownership choice of agents in the lowest quintile of wealth distribution can be informative on λ.

To formally address the above argument, I first clarify what I mean by identification in this context. The notations and definitions are similar to Cameron and Trivedi (2005) and Dufour and Hsiao (2008). A *structure*, indexed by ψ, is defined as the joint probability distribution $\Pr(Y, X; \psi)$ where $\psi \in \Psi$ and $(Y, X) \in W = \{1, 2, 3\} \times [0, \infty) \times [0, \infty) \times [0, \infty) \times [0, \infty)$. Two structures are *observational equivalent* if $\Pr(Y, X; \psi^1) = \Pr(Y, X; \psi^2)$ for all $(Y, X) \in W$. ψ is *identified* if there is no other observational equivalent structure in Ψ.

To identify ψ, I impose the following assumption.

Assumption 1.

$$\frac{1-\alpha}{2} > \max\{\beta_1, \beta_1 + \hat{g}_1\}$$

The solo and partnership productivity can be allowed to increase positively with respect to net worth, but the rate must not be so large to identify the model. Under Assumption 1,

$$\lim_{A \to \infty} F\big(\eta \leq G_s \bar{X}, \eta + \hat{u} \leq G_p \bar{X}\big) = 1 \tag{7}$$

where

$$\begin{bmatrix} G_s \\ \\ G_p \end{bmatrix} = \begin{bmatrix} -\frac{(1-\alpha)}{2} \log\left(\frac{\hat{a}}{\lambda}\right) - \beta_0 & \frac{1-\alpha}{2} - \beta_1 & -\beta_2 & -\beta_3 \\ \\ -\frac{(1-\alpha)}{2} \log\left(\frac{\hat{a}}{\lambda}\right) - \beta_0 - \hat{g}_0 & \frac{1-\alpha}{2} - \beta_1 - \hat{g}_1 & -\beta_2 - \hat{g}_2 & -\beta_3 - \hat{g}_3 \end{bmatrix}$$

and $\bar{X} = [1 \quad \log X]'$. F is a bivariate normal distribution. Equation (7) says that, for any (x_1, x_2), one can find a value of A^* such that the probability for agents whose net worth is greater than A^* not to be financially constrained both as a single owner and as a partner is arbitrarily close to one. In other words, the measure of financially unconstrained agents both as a single owner and as a partner is one at the infinity of wealth distribution. The first part of the identification argument is to show the ownership choice and the first moment of conditional income of these unconstrained agents identify $\{\gamma_1,\ \gamma_2,\ \alpha,\ \beta_0,\ \beta_1,\ \beta_2,\ \beta_3,\ \sigma_\eta,\ \hat{g}_0,\ \hat{g}_1,\ \hat{g}_2,\ \hat{g}_3,\ \sigma_{\hat{u}},\ \kappa\}$ for a given $\{\lambda,\ \sigma_w,\ \sigma_s,\ \sigma_p\}$.

The ownership choice for unconstrained agents is:

$$\begin{aligned} u_1^* &= G_1\bar{X}, & d &= 1 \quad \text{if } u_1^* = \max\{u_1^*, u_2^*, u_3^*\},\ 0 \text{ otherwise} \\ u_2^* &= G_2\bar{X} + e_2, & d &= 2 \quad \text{if } u_2^* = \max\{u_1^*, u_2^*, u_3^*\},\ 0 \text{ otherwise} \\ u_3^* &= G_3\bar{X} + e_3, & d &= 3 \quad \text{if } u_3^* = \max\{u_1^*, u_2^*, u_3^*\},\ 0 \text{ otherwise} \end{aligned} \tag{8}$$

$$\begin{pmatrix} e_2 \\ e_3 \end{pmatrix} \sim N(0, \Sigma), \quad \Sigma = \begin{bmatrix} 1 & 1 \\ 1 & 1+\rho^2 \end{bmatrix}$$

where

$$\begin{bmatrix} G_1 \\ G_2 \\ G_3 \end{bmatrix} = \begin{bmatrix} \frac{(1-\alpha)\log a_2}{2\sigma_\eta} & 0 & \frac{\hat{\gamma}_1}{\sigma_\eta} & \frac{\hat{\gamma}_2}{\sigma_\eta} \\ \frac{(1-\alpha)\log a_1}{2\sigma_\eta} + \frac{\beta_0}{\sigma_\eta} & \frac{\beta_1}{\sigma_\eta} & \frac{\beta_2}{\sigma_\eta} & \frac{\beta_3}{\sigma_\eta} \\ \frac{(1-\alpha)\log a_3}{2\sigma_\eta} + \frac{\beta_0+\hat{g}_0}{\sigma_\eta} & \frac{\beta_1+\hat{g}_1}{\sigma_\eta} & \frac{\beta_2+\hat{g}_2}{\sigma_\eta} & \frac{\beta_3+\hat{g}_3}{\sigma_\eta} \end{bmatrix},$$

$\rho = \frac{\sigma_{\hat{u}}}{\sigma_\eta}$, $\hat{\gamma}_1 = \frac{(1-\alpha)\gamma_1}{1+\alpha}$, and $\hat{\gamma}_2 = \frac{(1-\alpha)\gamma_2}{1+\alpha}$. Notice that (8) is equivalent to the Multinomial probit model and hence $\tilde{G}_2 := G_2 - G_1$, $\tilde{G}_3 := G_3 - G_1$ and ρ are identified with the same argument by which parameters in the Multinomial probit model are identified (Bunch, 1991).

The first moment of the conditional log income in each ownership is:

$$\begin{aligned} \mathbb{E}\big[\log \pi_w | d = 1, \bar{X}\big] &= G_4\bar{X} \\ \mathbb{E}\big[\log \pi_s | d = 2, \bar{X}\big] &= G_5\bar{X} + \frac{2\sigma_\eta}{1-\alpha}\mathbb{E}\big[e_2 | -e_2 < \tilde{G}_2^*\bar{X}, e_3 - e_2 < (\tilde{G}_2^* - \tilde{G}_3^*)\bar{X}\big] \\ \mathbb{E}\big[\log \pi_p | d = 3, \bar{X}\big] &= G_6\bar{X} + \frac{2\sigma_\eta}{1-\alpha}\mathbb{E}\big[e_3 | -e_3 < \tilde{G}_3^*\bar{X}, e_2 - e_3 < (\tilde{G}_3^* - \tilde{G}_2^*)\bar{X}\big] \end{aligned} \tag{9}$$

where

$$\begin{bmatrix} G_4 \\ \\ G_5 \\ \\ G_6 \end{bmatrix} = \begin{bmatrix} \log a_6 & 0 & \frac{2\gamma_1}{1+\alpha} & \frac{2\gamma_2}{1+\alpha} \\ \\ \log(2a_1) + \frac{2\beta_0}{1-\alpha} & \frac{2\beta_1}{1-\alpha} & \frac{2\beta_2}{1-\alpha} & \frac{2\beta_3}{1-\alpha} \\ \\ \log a_1 + \frac{2(\beta_0+\hat{g}_0)}{1-\alpha} & \frac{2(\beta_1+\hat{g}_1)}{1-\alpha} & \frac{2(\beta_2+\hat{g}_2)}{1-\alpha} & \frac{2(\beta_3+\hat{g}_3)}{1-\alpha} \end{bmatrix}$$

The expectation terms in (9) can be calculated by using the estimates from (8). Once the selection effect is controlled, G_4, G_5 are G_6 are identified by a regression. Finally, I can recover the structural parameters by using the estimates $\tilde{G}_2^*$, $\tilde{G}_3^*$, G_4^*, G_5^*, G_6^*, and ρ^*.[31]

Given the parameters identified above, λ is identified by the ownership choice of agents whose net worth is near zero where the measure of financially constrained agents is positive. For example, consider $\Pr(d = 3|X, A \leq 0)$.

$$\begin{aligned} \Pr(d = 3|X, A \leq 0) = \int_0^\infty & \Big\{ \Pr(d = 3, \hat{a}\theta_p^{\frac{2}{1-\alpha}} \leq \lambda A'|X, A \leq 0, A') \\ & + \Pr(d = 3, \hat{a}\theta_p^{\frac{2}{1-\alpha}} > \lambda A'|X, A \leq 0, A') \Big\} f(A')dA' \end{aligned} \tag{10}$$

where $f(A')$ is the population distribution of net worth. Given that $A \leq 0$, the probability to become a partner for those who are assigned a negative A' is zero. The equation (10) is a function of λ. I show that it is strictly increasing with respect to λ and hence one to one mapping with λ.

Proposition 3. *Given* $\{\gamma_1, \gamma_2, \alpha, \beta_0, \beta_1, \beta_2, \beta_3, \sigma_\eta, \hat{g}_0, \hat{g}_1, \hat{g}_2, \hat{g}_3, \sigma_{\hat{u}}, \kappa\}$, $\Pr(d = 3|X, A \leq 0)$ *is strictly increasing with respect to* λ.

Proof See Appendix C.2.

[31] Some parameters are over-identified. See Appendix C.3.

Finally, $\{\sigma_w,\, \sigma_s,\, \sigma_p\}$ are identified by the following moments.

$$\begin{aligned}
var(\log y_w|X, d=1) &= \mathbb{E}\Big[\big(\log y_w - \mathbb{E}(\log y_w|X, d=1)\big)^2|X, d=1\Big] = \sigma_w^2 \\
var(\log y_s|X, d=2) &= \mathbb{E}\Big[\big(\log y_s - \mathbb{E}(\log y_s|X, d=2)\big)^2|X, d=2\Big] \\
&= \mathbb{E}\Big[\big(\eta - \mathbb{E}(\eta|X, d=2)\big)^2|X, d=2\Big] + \sigma_s^2 \\
var(\log y_p|X, d=3) &= \mathbb{E}\Big[\big(\log y_p - \mathbb{E}(\log y_p|X, d=3)\big)^2|X, d=3\Big] \\
&= \mathbb{E}\Big[\big(\eta + \hat{u} - \mathbb{E}(\eta + \hat{u}|X, d=3)\big)^2|X, d=3\Big] + \sigma_p^2
\end{aligned}$$

Therefore, ψ is identified.

C Proofs

C.1 Proof of Proposition 1

The planner solves the following problem:

$$\max_{\{z_i, z_j, k\}} F(z_i, z_j, k) = \Big[\underbrace{\theta_p k^\alpha (z_i + z_j)^{1-\alpha}}_{\text{Aggregate production}} - \underbrace{\Big(rk + \frac{\kappa}{2}\big(z_i^2 + z_j^2\big)\Big)}_{\text{Aggregate cost}}\Big]$$

$$\text{subject to} \quad (z_i, z_j, k) > 0, \quad \alpha \in (0,1), \quad \kappa > 0, \quad A_p \geq 0, \quad k \leq \lambda A_p$$

(Case 1) $\lambda A_p \geq 2\hat{a}\theta_p^{\frac{2}{1-\alpha}}$

I first consider the case in which $k \leq \lambda A_p$ is not binding. I first show that $F(z_i, z_j, k)$ is a concave function on $U = \{x \in \mathbb{R}^3 | (z_i, z_j, k) > 0\}$. Since $F : U \to \mathbb{R}^1$ is C^2 function and U is a convex open subset of $\mathbb{R}^3$, F is a concave function on U if and only if $D^2F(x)$ is negative semidefinite for all $x \in U$. By deriving leading principal minors, one can easily show that $D^2F(x)$ is negative definite for all $x \in U$ and hence negative semidefinite for all $x \in U$. Given that $F(z_i, z_j, k)$ is a concave function on U, it is sufficient to show that there exists the unique $x^* \in U$ satisfying $DF(x^*) = 0$ to guarantee that x^* is the unique global max of F on U.

The first order conditions are:

$$(1-\alpha)\theta_p\Big(\frac{k}{z_i+z_j}\Big)^{\alpha} = \kappa z_i \tag{11}$$

$$(1-\alpha)\theta_p\Big(\frac{k}{z_i+z_j}\Big)^{\alpha} = \kappa z_j \tag{12}$$

$$\alpha\theta_p\Big(\frac{k}{z_i+z_j}\Big)^{\alpha-1} = r \tag{13}$$

(11) and (12) imply $z^* = z_i = z_j$ for any given k. The first order conditions reduce

$$(1-\alpha)\theta_p\Big(\frac{k}{2z^*}\Big)^{\alpha} = \kappa z^* \tag{14}$$

$$\alpha\theta_p\Big(\frac{k}{2z^*}\Big)^{\alpha-1} = r \tag{15}$$

By putting (15) into (14), I get

$$z^* = \Big(\frac{1-\alpha}{\kappa}\Big)\theta_p^{\frac{1}{1-\alpha}}\Big(\frac{\alpha}{r}\Big)^{\frac{\alpha}{1-\alpha}} \quad \text{and hence} \quad k^* = 2\Big(\frac{1-\alpha}{\kappa}\Big)\Big(\frac{\alpha}{r}\Big)^{\frac{1+\alpha}{1-\alpha}}\theta_p^{\frac{2}{1-\alpha}} = 2\hat{a}\theta_p^{\frac{2}{1-\alpha}}$$

Therefore, I derived the unique $x^* = (z^*, z^*, k^*)$ such that $DF(x^*) = 0$.

Given that the aggregate production is distributed equally, the value function per parter is given

$$V_p^E(\theta_p, A_p) = \frac{1}{2}\Big[\theta_p k^{*\alpha}(2z^*)^{1-\alpha} - rk^*\Big] - \frac{\kappa}{2}z^{*2} = a_1\theta_p^{\frac{2}{1-\alpha}}$$

(Case 2) $\lambda A_p < 2\hat{a}\theta_p^{\frac{2}{1-\alpha}}$

In this case, $k \leq \lambda A_p$ is binding and $k^* = \lambda A_p$. The problem reduces

$$\max_{\{z_i,z_j\}} F(z_i,z_j) = \Big[\underbrace{\theta_p k^{\alpha}(z_i+z_j)^{1-\alpha}}_{\text{Aggregate production}} - \underbrace{\Big(rk + \frac{\kappa}{2}\big(z_i^2+z_j^2\big)\Big)}_{\text{Aggregate cost}}\Big]$$

$$\text{subject to} \quad (z_i,z_j) > 0, \quad \alpha\in(0,1), \quad \kappa>0, \quad A_p \geq 0, \quad k = \lambda A_p$$

Following the same argument as in (Case 1), there exists the unique maximum and

$$z_i = z_j = z^* = \Big(\frac{1-\alpha}{\kappa}\Big)^{\frac{1}{1+\alpha}}\Big(\frac{\lambda A_p}{2}\Big)^{\frac{\alpha}{1+\alpha}}\theta_p^{\frac{1}{1+\alpha}}$$

Therefore,

$$V_p^E(\theta_p, A_p) = \frac{1}{2}\Big[\theta_p k^{*\alpha}(2z^*)^{1-\alpha} - rk^*\Big] - \frac{\kappa}{2}z^{*2} = a_2\Big(\frac{\lambda A_p}{2}\Big)^{\frac{2\alpha}{1+\alpha}}\theta_p^{\frac{2}{1+\alpha}} - \frac{r\lambda A_p}{2} \quad \blacksquare$$

C.2 Proof of Proposition 3

If $\{\gamma_1,\ \gamma_2,\ \alpha,\ \beta_0,\ \beta_1,\ \beta_2,\ \beta_3,\ \sigma_\eta,\ \hat{g}_0,\ \hat{g}_1,\ \hat{g}_2,\ \hat{g}_3,\ \sigma_{\hat{u}},\ \kappa\}$ is given, λ is the only variable which governs $\Pr(d = 3|X, A \leq 0)$. The equation (10) is rewritten as $\Pr(d = 3|X, A \leq 0) = \int_0^\infty \{\Gamma_1 + \Gamma_2\} f(A')dA'$ where

$$\Gamma_1 = \Pr\Big[\Big(\frac{W(X)}{a_3}\Big)^{\frac{1-\alpha}{2}} < \theta_p \leq \Big(\frac{\lambda A'}{\hat{a}}\Big)^{\frac{1-\alpha}{2}}\Big]$$
$$\Gamma_2 = \Pr\Big[\max\Big\{\Big(\frac{\lambda A'}{\hat{a}}\Big)^{\frac{1-\alpha}{2}}, \Big(\frac{W(X)}{a_4} + \frac{r\lambda A'}{2a_4}\Big)^{\frac{1+\alpha}{2}}\Big(\frac{\lambda A'}{2}\Big)^{-\alpha}\Big\} \leq \theta_p\Big]$$

$W(X)$ is the wage earnings given X.

$$\frac{\partial \Pr(d = 3|X, A \leq 0)}{\partial \lambda} = \int_0^\infty \Big(\frac{\partial \Gamma_1}{\partial \lambda} + \frac{\partial \Gamma_2}{\partial \lambda}\Big) f(A')dA'$$

Fix A'.

(Case 1) $\left(\frac{\lambda A'}{\hat{a}}\right)^{\frac{1-\alpha}{2}} \geq \left(\frac{W(X)}{a_4} + \frac{r\lambda A'}{2a_4}\right)^{\frac{1+\alpha}{2}} \left(\frac{\lambda A'}{2}\right)^{-\alpha}$

Under Case 1, $\Gamma_1 + \Gamma_2 = \Pr\left[\left(\frac{W(X)}{a_3}\right)^{\frac{1-\alpha}{2}} < \theta_p\right]$ and hence $\left(\frac{\partial \Gamma_1}{\partial \lambda} + \frac{\partial \Gamma_2}{\partial \lambda}\right) = 0$.

(Case 2) $\left(\frac{\lambda A'}{\hat{a}}\right)^{\frac{1-\alpha}{2}} < \left(\frac{W(X)}{a_4} + \frac{r\lambda A'}{2a_4}\right)^{\frac{1+\alpha}{2}} \left(\frac{\lambda A'}{2}\right)^{-\alpha}$

It is obvious that $\frac{\partial \Gamma_1}{\partial \lambda} > 0$. It is also easy to show that $\frac{\partial \Gamma_2}{\partial \lambda} > 0$. Therefore, $\left(\frac{\partial \Gamma_1}{\partial \lambda} + \frac{\partial \Gamma_2}{\partial \lambda}\right) > 0$.

It is now sufficient to show that the measure of A' satisfying Case 2 is positive for a given λ. Case 2 is equivalent to $\left(\frac{2W(X)}{a_4 \lambda A'} + \frac{r}{a_4}\right)\left(\frac{\hat{a}}{2}\right)^{\frac{1-\alpha}{1+\alpha}} > 1$. For any λ, one can always find $A'_\lambda > 0$ below which Case 2 is satisfied. Therefore, the measure of A' satisfying Case 2 is positive for any given λ. This completes the proof. ■

C.3 Recovering Structural Parameters

There are many ways to recover structural parameters from $\tilde{G}_2$, $\tilde{G}_3$, G_4, G_5, G_6 and ρ. I present one example. I start with recovering α by using the following two equations.

$$G_6(1) = \log a_1 + \frac{2(\beta_0 + \hat{g}_0)}{1 - \alpha}$$
$$\tilde{G}_3(1) = \frac{1 - \alpha}{2\sigma_\eta}\big(\log a_3 - \log a_2\big) + \frac{\beta_0 + \hat{g}_0}{\sigma_\eta}$$

Combining two equations, I get

$$\begin{aligned} G_6(1) &= \frac{2\sigma_\eta}{1-\alpha}\tilde{G}_3(1) + \log a_2 - \log\frac{3}{4} \\ &= \frac{2\sigma_\eta}{1-\alpha}\tilde{G}_3(1) + \log a_6 + \log\left(\frac{1+\alpha}{2}\right) - \log\frac{3}{4} \end{aligned}$$

Since $\frac{2\sigma_\eta}{1-\alpha}$ and $\log a_6$ can be recovered by $\frac{G_6(2)}{\tilde{G}_3(2)}$ and $G_4(1)$ respectively, α can be recovered. Once α is known, κ can be recovered by the equation $G_4(1) = \log a_6$. The remaining parameters can be recovered as follows.

$$\begin{array}{lll} \gamma_1 = \frac{(1+\alpha)G_4(3)}{2} & \gamma_2 = \frac{(1+\alpha)G_4(4)}{2} & \sigma_\eta = \frac{1-\alpha}{2}\left(\frac{G_6(2)}{\tilde{G}_3(2)}\right) \\ \sigma_{\hat{u}} = \rho\sigma_\eta & \beta_0 = \frac{1-\alpha}{2}\big(G_5(1) - \log(2a_1)\big) & \beta_1 = \frac{(1-\alpha)G_5(2)}{2} \\ \beta_2 = \frac{(1-\alpha)G_5(3)}{2} & \beta_3 = \frac{(1-\alpha)G_5(4)}{2} & \hat{g}_0 = \frac{1-\alpha}{2}\big(G_6(1) - \log a_1\big) - \beta_0 \\ \hat{g}_1 = \frac{1-\alpha}{2}\big(G_6(2) - G_5(2)\big) & \hat{g}_2 = \frac{1-\alpha}{2}\big(G_6(3) - G_5(3)\big) & \hat{g}_3 = \frac{1-\alpha}{2}\big(G_6(4) - G_5(4)\big) \end{array}$$

D Additional Tables

Table 14: Moments for Ownership Choice

		Observed	Simulated
K_i	Z_i	$\frac{1}{n}\sum_{i=1}^{n} K_i Z_i$	$\frac{1}{n}\sum_{i=1}^{n} \tilde{K}_i(\psi) Z_i$
$\mathbb{I}_{si}$	1	0.0218	0.0208
	A_i	0.5231	0.5442
	x_{1i}	0.3042	0.2992
	x_{2i}	0.4644	0.3560
	$A_i x_{1i}$	7.9762	8.2319
	$A_i x_{2i}$	12.8884	10.1497
$\mathbb{I}_{pi}$	1	0.0045	0.0043
	A_i	0.1320	0.1216
	x_{1i}	0.0638	0.0639
	x_{2i}	0.0876	0.0838
	$A_i x_{1i}$	1.9135	1.8931
	$A_i x_{2i}$	3.0964	2.9320

NOTE: This table compares the actual and the simulated moments for ownership choice. $\mathbb{I}_{si}$ is the indicator function for single owners. $\mathbb{I}_{pi}$ is the indicator functions for partners. A is net worth (ten thousands dollars in 2011). x_1 is the years of education. x_2 is the years of experience.

Table 15: Moments for log Conditional Incomes

K_i	Z_i	Observed $\frac{1}{n}\sum_{i=1}^{n} K_i Z_i$	Simulated $\frac{1}{n}\sum_{i=1}^{n} \tilde{K}_i(\psi) Z_i$
$\pi_{wi}\ \mathbb{I}_{wi}$	1	1.3339	1.3495
	x_{1i}	19.2330	18.9771
	x_{2i}	30.6172	30.3514
$\left(\pi_{wi} - \frac{1}{\sum \mathbb{I}_{wi}} \sum \pi_{wi}\mathbb{I}_{wi}\right)^2 \mathbb{I}_{wi}$	1	0.6153	0.5505
$\pi_{si}\ \mathbb{I}_{si}^{s}$	1	0.0037	0.0113
	A_i	0.2576	0.2876
	x_{1i}	0.0583	0.1679
	x_{2i}	0.1042	0.2537
	$A_i x_{1i}$	3.7701	4.4577
	$A_i x_{2i}$	7.4794	7.2806
$\left(\pi_{si} - \frac{1}{\sum \mathbb{I}_{si}^{s}} \sum \pi_{si}\mathbb{I}_{si}^{s}\right)^2 \mathbb{I}_{si}^{s}$	1	0.0583	0.0657
$\mathbb{I}_{si}^{f}$	1	0.0019	0.0021
$\pi_{pi}\ \mathbb{I}_{pi}^{s}$	1	0.0044	0.0044
	A_i	0.1623	0.1463
	x_{1i}	0.0671	0.0668
	x_{2i}	0.0865	0.0938
	$A_i x_{1i}$	2.4830	2.2951
	$A_i x_{2i}$	3.7125	3.3380
$\left(\pi_{pi} - \frac{1}{\sum \mathbb{I}_{pi}^{s}} \sum \pi_{pi}\mathbb{I}_{pi}^{s}\right)^2 \mathbb{I}_{pi}^{s}$	1	0.0069	0.0076
$\mathbb{I}_{pi}^{f}$	1	0.0004	0.0004

NOTE: This table compares the actual and the simulated moments for log conditional incomes. π_{wi} is log income conditional on i is a worker. π_{si} is log income conditional on i is a single owner and i reports a positive income. $\mathbb{I}_{si}^{s}$ is the indicator function for single owners who report a positive income. $\mathbb{I}_{si}^{f}$ is the indicator function for single owners who report a negative or zero income. π_{pi} is log income conditional on i is a partner and i reports a positive income. $\mathbb{I}_{pi}^{s}$ is the indicator function for partners who report a positive income. $\mathbb{I}_{pi}^{f}$ is the indicator function for partners who report a negative or zero income. A is net worth (ten thousands dollars in 2011). x_1 is the years of education. x_2 is the years of experience.

Table 16: Number of Observations at Each Stage of Sample Construction

Drop if	Workers	Single owners	Partners
	247,828	16,078	3,580
Female	114,745	9,888	2,385
Age $<$ 18 or $>$ 65	65,777	8,856	2,189
Unemployed in either one of periods	49,224	8,519	2,154
Business owners in the base year	48,182	1,564	288
No info. on net worth	47,466	1,541	285
Family business	47,317	1,491	199
Net worth $>$ \$10 billion	47,304	1,491	199
Active duty military	47,304	1,490	199
No info. on equity share or equity share $<$ 25%	47,304	1,135	199
Wage work hours $>$ business work hours & business work hours $<$ 30	47,304	941	162

NOTE: Business owners who did not report equity share or whose equity share is less than 25% were categorized as single owners before being deleted.

Table 17: Proportion of African-American with respect to Income Before Tax

	~ \$18,559	\$18,559 ~ \$35,645	\$35,645 ~ \$58,272	\$58,272 ~ \$93,837	\$93,837 ~
CEX 2011 (%)	20	14	11	11	6
Final sample (%)	12	12	8	6	3

NOTE: Dollar in 2011. This table compares the proportion of African-American in terms of income levels both for the final sample and for CEX 2011. For the final sample, incomes in the base year are used.