Entrepreneurial Teams
in Financially Constrained Economies

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Abstract

Borrowing constraints are known to limit households’ ability to undertake entrepreneurial projects, significantly reducing the level of aggregate economic activity. This paper shows that such problem is considerably mitigated as these households choose to search for partners, with whom they share the ownership and control of their firms.

Within the population of US privately held businesses, I document that entrepreneurial teams are bigger and more profitable than firms owned by single households, but require a four times larger initial investment. Their owners are three times wealthier, have more income, and devote a larger proportion of their net worth to the business.

These differences are quantitatively explained by developing and calibrating a model with imperfect enforceability of lending contracts in which households are allowed to run firms individually or with a partner. This model, contrary to others about teams in the literature, endogenizes participation in the search market for partners, a crucial feature to understand the dynamics of this market and its dependence with the wealth distribution. It is also a first step in bridging the gap existing in the macro literature between the single-owned entrepreneurial firm and the publicly traded firm.

In the model, sharing control of a business is supposed to be undesirable, and searching for a partner is assumed to be costly. Therefore, only households with high entrepreneurial ability or significant wealth search for a match. This complementarity between partners is key to explaining the properties of the teams found in the data. The calibrated model shows that having partners in the economy reduces the output gap introduced by financial constraints by 26%.

Keywords: Entrepreneurship, Partnerships, Teams, Wealth Distribution, Borrowing Constraints, Incomplete Markets, Limited enforceability.

JEL codes: M13, D21,D23,D31,E21

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1 Introduction

Borrowing constraints are known to limit households’ ability to undertake entrepreneurial projects\(^1\), significantly reducing the level of aggregate economic activity, as well as amplifying and delaying the effects of productivity shocks during the business cycle\(^2\). To give an idea of their importance, Fernández-Villaverde and Galdon-Sanchez (2003) find that removing financial constraints from the US economy would imply an increase of 30% in the level of GDP. For this reason, the literature has made a significant progress in understanding the nature of financial frictions and the design of optimal contractual arrangements between outside investors and entrepreneurs, in environments subject to moral hazard and asymmetric information\(^3\).

However, this line of research has not addressed the possibility for households to share the ownership of a business, pool resources and constitute a production team. The purpose of this paper is to explore the macroeconomic implications of this type of arrangement among households in the presence of borrowing constraints, by answering the following key questions: a) do we observe in the data entrepreneurs organized in teams, and do they show relevant empirical differences from those who are not in teams? , b) if so, can these differences be explained by a standard model of entrepreneurship with financial frictions and allowing for the formation of teams? and c) how important are the aggregate consequences of having teams being formed in an economy with financial frictions?

The analysis begins by documenting some stylized facts characterizing entrepreneurial teams, using data from the Panel Study of Entrepreneurial Dynamics (PSED), the Survey of Consumer Finances and the Survey of Small Business Finances (SSBF). In the first place, partnerships are found to be macroeconomically relevant. Despite being only a quarter of all entrepreneurs, their firms account for half of total output, assets and employment within privately held businesses; a sector that accounts for half of non-farm private GDP and employment. In the second place, teams are different from firms managed individually. They yield higher returns, and require larger initial investment. Due to the higher profits accrued, partners have also higher incomes and significantly more wealth. Finally, despite being richer, they also keep a higher fraction of their wealth in their businesses.

These findings are consistent with financial frictions playing a key role in the formation of teams. From the work of Evans and Jovanovic (1989), we know that only those households with very profitable ideas and little wealth are really affected by borrowing constraints. For the rest of the entrepreneurs, the optimal scale of their businesses is relatively small, so financial constraints are not a big problem. Our results suggest that precisely those highly skilled households overcome borrowing constraints by forming partnerships. The fact that partners have a lower degree of portfolio diversification despite being wealthier is also consistent with this hypothesis. As Gentry and Hubbard (2000) pointed out, the notion of being financially constrained is relative, and depends on how wealthy the entrepreneur is with regard to the optimal production scale of his business.

To analyze the channels that might explain this data, we construct a model of entrepreneurial choice in which households have the ability to manage their firms individually or in pairs. The general features of the economy are similar to those in Quadrini (2000): the production side of the economy is comprised by a small business sector, run by entrepreneurs facing financial frictions, and by a corporate sector that has full access to capital markets\(^4\). There is a financial intermediary that borrows money from households and lends money to firms every period. The financial friction appears endogenously as in Albuquerque and Hopenhayn (2002), by assuming that there is limited liability on the part of the financial intermediary – which, in

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\(^1\) An extensive literature examines the link between household wealth and entry into entrepreneurship, finding in general that there is a strong positive relation between net worth and the likelihood to start a business. See for example Evans and Jovanovic (1989), Evans and Leighton (1989) and Holtz Eakin, Joulfaian and Rosen (1994a) (1994b). An exception to this literature is Hurst and Lusardi (2004), who report that such likelihood increases only at the very top of the wealth distribution. Another strand of the literature studies the effect of borrowing constraints on the dynamics and size distribution of firms, as Cooley and Quadrini (2001) and Clementi and Hopenhayn (2002).

\(^2\) As in Fernández-Villaverde and Galdon-Sanchez (2003) and Cooley, Marimon and Quadrini (2003).

\(^3\) See Albuquerque and Hopenhayn (2004) for an example with asymmetric information.

\(^4\) The need for a corporate sector is to properly capture the size of the small business sector in terms of total capital. The reason for assuming that the corporate sector has full access to capital markets – contrary to empirical evidence shown in Fazzari, Hubbard, and Petersen (1988) – is to stylize the fact that the asymmetry of information problem is much larger in the entrepreneurial sector.
turn, is assumed to have full commitment on the money it borrows –. In this environment, households are allowed to randomly search for prospective partners with whom to constitute a production team. Once two agents meet, they have to decide if they want to engage in a team and how to split the ownership of the firm, by solving a symmetric Nash bargaining problem. The next period profits are assumed to be distributed according to these pre established ownership shares. Search is assumed to be costly in terms of resources – it takes time to search –, and the operation of a joint team is assumed to generate some disutility to its members. This disutility can be interpreted as proxying the loss of nonpecuniary benefits that team members derive from control, access and other noncontractible aspects of the venture, as in Grossman and Hart (1986) and Aghion and Bolton (1992). In the model, only households with high entrepreneurial ability or significant wealth search for a match. This complementarity between partners is the central feature that explains the properties of teams we found in the data.

The model is calibrated to match in steady state some statistical moments from US data not directly related to the performance of teams. Then, its quantitative performance is tested by comparing other moments, obtained from the simulated economy and the data, directly related to teams and solo entrepreneurs. The model is successful in reproducing the main characteristics of partnerships, both from a macro and microeconomic perspective. Firstly, the model explains the shares of small business output, assets and employment for team-owned firms. Secondly, it is also capable of accounting for 44% of the wealth gap and 68% of the income gap between teams and solo entrepreneurs.

Cagetti and De Nardi (2003) find that loosening financial frictions causes an increase wealth inequality. In this paper, introducing teams in the economy has a similar effect. Four reasons account for this: 1) wealth is more persistent for rich households, as some of them engage in teams with partners having business ideas, 2) borrowing constraints are still binding; but since team owners have more collateral, they borrow more, make more profits and accumulate relatively more wealth, 3) team partners without business skills increase their savings, in order to be more attractive to a partner, and 4) every searching agent increases his savings, in order to raise his expected share of profits when bargaining with a prospective partner.

Finally, we find from the model that partnerships reduce the output gap due to financial constraints by 26%, underscoring their importance for aggregate economic activity.

Beyond the literature on entrepreneurial behavior and borrowing constraints already mentioned, the mechanism for team formation also links our paper to some quantitative research on marriage markets. This literature studies the interplay between the formation and dissolution of families, the saving decision of households and the degree of wealth inequality in the economy. Despite similarities, our model departs from such research in important ways by assuming utility to be transferable among team members and by completely endogenizing the decision to search for a partner. Finally, our research can also be framed within the class of decentralized search models with ex-ante heterogeneity and transferable utility, as Shimer and Smith (2000). Although our approach is purely quantitative, we believe that our model provides an interesting case study in this literature. First of all, the complementarity function between partners is endogenous, being determined by the primitives of the model – preferences and technology –. This makes the assortative properties of the model nontrivial to determine. In our case, the assumption that the productivity of teams is given by the maximum ability of the two partners, that the entrepreneurial production function has decreasing returns to scale, and the fact that teams are formed to surmount borrowing constraints leads us to the conclusion that matching is negatively assortative in entrepreneurial abilities and wealth. Secondly, in an environment with endogenous dissolution – not ours – the complementarity function would also become a dynamic relation, depending on the individual saving rates of each partner. In this paper, we limit ourselves to studying how the matching sets and the decision to search for a partner change after modifying the search costs and the disutility of entering a team.

The rest of the paper is organized as follows. Section 2 describes the main empirical differences between single entrepreneurs and partners in the US economy. Section 3 introduces the model of entrepreneurs with partnerships and defines the steady state equilibrium for the economy. Section 4

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5Moskowitz, Jørgensen and Bitler(2003) find this disutility to be responsible for the highly concentrated ownership shares observed in the data on privately held businesses.

discusses the calibration procedure, and section 5 presents and discusses the results. Finally, section 6 concludes.

2 Empirical Characteristics of team entrepreneurs

2.1 Characteristics of entrants

To study the characteristics of households planning to undertake entrepreneurial ventures, we used data from the Panel Study of Entrepreneurial Dynamics (PSED). The PSED is a national longitudinal sample of 64,622 U.S. households that were contacted to find individuals actively engaged in starting a new business. If so, they were classified as nascent entrepreneurs. The survey identified a set of 830 nascent entrepreneurs willing to provide information about their business start-up activities and their efforts were then followed over a two-year period\(^7\). From the panel, we defined as entrepreneurs the subsample of nascent entrepreneurs whose startups were reported as not being sponsored by the entrepreneur’s current employer \(^8\). We considered data only from the first wave of the panel, in order to keep the sample size as large as possible \(^9\). The resulting subsample contained a total of 693 entrepreneurs, interviewed in 1998.

In the survey, individuals were asked about the number of people that shared the ownership of the startup, about the personal linkages between them (whether they were spouses, relatives, friends etc.), and about whether they lived or not in the same household. Taking the household as the economic decision unit for this paper, we classified a business as a team venture if it had at least two owners living in different households. Entrepreneurs sharing a business were called team entrepreneurs, and those producing alone were called solo entrepreneurs, according to the terminology used by the Small Business Administration (2003). Using this classification, the proportion of entrepreneurs organized in teams was found to be 0.26.

Tables A.1 and A.2 (see appendix), show the descriptive statistics of the respondents and the distribution of businesses across industries, sorted by the type of venture. The observed patterns for solo and team entrepreneurs turned out to be similar, indicating that the reasons for constituting a partnership are not related to demographic characteristics or to features specific to a particular industry.

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<tbody>
<tr>
<td>All entrep.</td>
<td>2,800</td>
<td>20,000</td>
<td>55,000</td>
<td>200,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Teams</td>
<td>5,000</td>
<td>20,000</td>
<td>60,000</td>
<td>200,000</td>
<td>1,100,000</td>
</tr>
<tr>
<td>Solo</td>
<td>2,300</td>
<td>20,000</td>
<td>54,000</td>
<td>194,300</td>
<td>450,000</td>
</tr>
</tbody>
</table>

Table 1: Wealth distribution of nascent entrepreneurs in 1998 US$ (PSED)

Sorting business owners by reported net worth, in table 1 we show the levels of wealth corresponding to the 10\(^{th}\), 25\(^{th}\), 50\(^{th}\), 75\(^{th}\) and 90\(^{th}\) percentiles; both for the total entrepreneurial population as well as when divided by entrepreneurial type. The median net worth for the entire population was $55,000, $50,000 for teams, and $23,000 for solo entrepreneurs.

\(^7\)The PSED is being administered by the Institute for Social Research at the University of Michigan and can be found at http://projects.isr.umich.edu/psed. For more details on the data collection process, see Reynolds (2000).

\(^8\)This is a somewhat different criterion from what has been used in the past to define an entrepreneur. Gentry and Hubbard (2000) and Cagetti and De Nardi (2003), for example, use data from the Survey of Consumer Finances and require the agent to have an active management role in the business and to have more than $5,000 invested in it. Since firms in the PSED were in the startup phase, we decided not to impose any investment requirement. Also, the exclusion of individuals sponsored by their employers was made to capture the set of people who better fitted into the notion of what is commonly believed to be an entrepreneur: someone that bears all the risks and benefits of the new venture. In fact, the literature calls this excluded group intrapreneurs, instead of entrepreneurs (Gromb and Scharfstein 2002 ).

\(^9\)Including the first two waves of the panel for which we had the necessary data implied reducing the sample size from 693 to 501 entrepreneurs.
being that of entrepreneurs in teams 10% higher than that of solo entrepreneurs. Using the wealth levels found in the first row of table 1, we constructed a set of bins and computed the proportion of entrepreneurs of each type falling in each bin. We added three additional categories to explicitly account for those agents with negative wealth, those in the top wealth decile whose net worth had not reached the top code value ($3M), and those whose wealth had been top coded at $3M. The resulting distribution of entrepreneurs is presented in figure 1, showing that business owners organized in teams are not wealthier than those alone. Only the poorest 10% and richest 10% of team entrepreneurs hold twice more assets than their solo counterparts.

![Figure 1: Wealth distribution for nascent entrepreneurs. (PSED)](image)

We followed the same procedure to compare the distributions of reported household income, the results being shown in table 2 and figure 2. The distributions for single entrepreneurs and those in teams were also found to be very similar, the median income of entrants with partners being only 10% higher.

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<tbody>
<tr>
<td>All entrep.</td>
<td>20,000</td>
<td>30,000</td>
<td>45,000</td>
<td>70,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Teams</td>
<td>25,000</td>
<td>34,000</td>
<td>50,000</td>
<td>75,000</td>
<td>130,000</td>
</tr>
<tr>
<td>Solo</td>
<td>18,000</td>
<td>30,000</td>
<td>45,000</td>
<td>68,300</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Table 2: Income distribution of nascent entrepreneurs in 1998 US$ (PSED)

Finally, entrepreneurs were also asked in the survey about the capital needed by the firm in order to become self sustaining, a magnitude that we chose as a proxy for the capital requirement of the business. In table 3 we show that the median initial investment required to start a business is $12,000, an estimate very close to those reported by Townsend (1999) and Hurst and Lusardi (2004) from other surveys. We find that the capital requirements for teams are substantially larger than those of solo entrepreneurs, ranging from a factor three for the bottom decile to a factor 6 for the top decile. Evaluated in per capita terms, the median capital requirement per capita for teams was found to be $10,000, the first quartile $3,333, the third quartile $50,000 and the top decile $166,667. Assuming that all team members make equal contributions to the firm, this implies that teams build not only larger projects, but also that a large number of partners make up-front investments that in per capita terms exceed those made by solo entrepreneurs.

Computing the capital requirement per capita as a proportion of household net worth leads to the same conclusion – see table 4 –. Team partners make initial investments that represent a larger share of their wealth, leaving them more exposed to entrepreneurial risk.
2.2 Characteristics of ongoing entrepreneurs

To study the characteristics of entrepreneurs already running businesses, we pooled the cross sections of households in the 1989, 1992, 1995 and 1998 Federal Reserve Board Survey of Consumer Finances (SCF). These surveys are nationally representative samples of about 4,000 households per survey year, with household weights designed to allow aggregation to population levels\textsuperscript{10}. To deal with non-responses to some questions, the SCF data have imputations for missing values and provide 5 replications for each household\textsuperscript{11}.

To identify those households engaged in entrepreneurial activities, we followed Gentry and Hubbard (2000) and Cagetti and De Nardi (2003)\textsuperscript{12}. They defined as entrepreneurial those households who reported owning and having an active management role in at least one non-publicly traded business with a total market value of at least $5,000 (in 1989US$). Entrepreneurs were further subdivided into solo entrepreneurs if they owned 100% of the business in which they had the largest investment, and team entrepreneurs otherwise. In the sample, 8.9% of households were classified as entrepreneurs and 30% of these were found to be team entrepreneurs, similarly as what was previously reported from PSED.

Summary statistics for solo and team entrepreneurs are provided in table A.3 (see appendix). In general, both groups had similar characteristics, with the exception of the proportion of entrepreneurs receiving their businesses as a bequest. While 20% of team entrepreneurs inherited their firms, only 4% of solo entrepreneurs did. Although inheriting a business is undoubtedly an important way to generate teams and through which households become entrepreneurs\textsuperscript{13}, it is also clear that the constitution of such partnerships is completely independent from the business characteristics or from those of

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\textsuperscript{10} In what follows, all figures have been computed using sample weights, and all money values are expressed in 1998 dollars, using CPI as deflator.

\textsuperscript{11} For more information on the SCF, see Kennickell and Shack-Marquez (1992).

\textsuperscript{12} These authors were also interested in the links between savings and investment of business owners, thinking of an entrepreneur as “someone who combines upfront investments with entrepreneurial skill to obtain the chance of earning economic profit” (Gentry and Hubbard (2000)).

\textsuperscript{13} There is a vast literature about the influence of bequests in the likelihood that a person becomes an entrepreneur. See for example Cagetti and De Nardi (2003)
Table 4: Capital requirement per capita, as a proportion of the entrepreneurs’ net worth (PSED)

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<tbody>
<tr>
<td>Team entrep.</td>
<td>0.025</td>
<td>0.046</td>
<td>0.250</td>
<td>1.0</td>
<td>3.84</td>
</tr>
<tr>
<td>Solo entrep.</td>
<td>0.018</td>
<td>0.040</td>
<td>0.175</td>
<td>0.78</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Table 4: Capital requirement per capita, as a proportion of the entrepreneurs’ net worth (PSED)

Figure 3: Distribution of capital requirement by entrepreneurial type. (PSED)

its current owners. Therefore, we decided to exclude them from the sample (both teams and solo entrepreneurs). In the remaining subsample, the share of entrepreneurs in teams was 0.27. The descriptive statistics of these entrepreneurs are similar to those of table A.3, and are therefore omitted. One last finding worth mentioning from table A.3 is the high concentration of ownership in teams. Approximately 52% of partners reported owning between 40% and 60% of their actively managed businesses, indicating the importance of retaining the nonpecuniary benefits that entrepreneurs derive from control, access and other noncontractible aspects of the venture.

Table A.4 (see appendix) provides the share of teams and solo entrepreneurs belonging to each sector of production. As with the PSED sample, teams and solo entrepreneurs are roughly equally distributed across industries; the former being slightly more concentrated in manufacturing, and less concentrated in retail/wholesale and agriculture.

Table 5: Wealth distribution of ongoing entrepreneurs in 1998 US$ (SCF)

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<tr>
<td>All entrep.</td>
<td>51,267</td>
<td>121,462</td>
<td>285,825</td>
<td>809,340</td>
<td>1,991,120</td>
</tr>
<tr>
<td>Team entrep.</td>
<td>76,570</td>
<td>179,370</td>
<td>420,113</td>
<td>1,310,050</td>
<td>3,717,400</td>
</tr>
<tr>
<td>Solo entrep.</td>
<td>44,087</td>
<td>110,646</td>
<td>252,986</td>
<td>668,101</td>
<td>1,543,340</td>
</tr>
</tbody>
</table>

Table 5: Wealth distribution of ongoing entrepreneurs in 1998 US$ (SCF)

Table 5 reports the wealth levels corresponding to the top and bottom deciles, and all quartiles of the entrepreneurial sample. Business owners in the SCF were found to be much wealthier than


15Household wealth is measured as the difference between total assets and total debt. Assets include financial assets, the net market value of active and passive business holdings, the value of residential and investment real estate, vehicles, and other miscellaneous financial and nonfinancial assets. Assets include the value in quasi-liquid retirement accounts – e.g. 401(k) plans – but not the value of defined benefit plans or Social Security wealth. "Net worth" subtracts mortgage and other personal debt from the value of assets.
those in the PSED sample, the median entrepreneur holding $285,825. This was non-surprising for
two reasons: on the one hand, the SCF oversamples high income households to better represent the
upper tail of the wealth distribution; on the other, the average entrepreneur in the SCF has already
been managing a business and experiencing upward social mobility for about ten years.\(^{16}\)

In the sample, partners are found to be significantly wealthier than single entrepreneurs. This is
shown in the last two rows of table 5 and figure 4, where we observe that partners’ median net worth
– $420,000 – is 67% larger than that of solo entrepreneurs – $253,000 – . In aggregate terms, partners
are only 27% of business owners, but hold 57% of all entrepreneurial wealth.

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<tbody>
<tr>
<td>All entrep.</td>
<td>18,536</td>
<td>34,541</td>
<td>58,881</td>
<td>105,273</td>
<td>210,546</td>
</tr>
<tr>
<td>Team entrep.</td>
<td>21,808</td>
<td>41,184</td>
<td>74,999</td>
<td>156,740</td>
<td>290,085</td>
</tr>
<tr>
<td>Solo entrep.</td>
<td>17,446</td>
<td>31,582</td>
<td>54,468</td>
<td>93,242</td>
<td>176,645</td>
</tr>
</tbody>
</table>

Table 6: Income Distribution of ongoing Entrepreneurs SCF.

This difference in wealth holdings can be partially explained by the higher incomes received by
households in partnerships. In table 6 and figure 5, we show the empirical distributions for household
income\(^{17}\), for both types of entrepreneurs. Team owners receive 51% of all entrepreneurial income,
and have a median income 36% larger than solo entrepreneurs.

So far, we know that entrepreneurs with partners are similar to those alone during the startup
phase of their firms; and that they are also income and wealth richer once they are already running
a business. However, we cannot infer from here that entrepreneurs in teams get wealthier from the
exploitation of their businesses, as we do not know which of the startup firms actually succeed into
becoming ongoing concerns. Since there is no longitudinal dataset with sufficient sample size to follow
solo and team entrepreneurs over time; we sorted business owners in the SFC according to their type
– team or solo – and the age of their firms, and considered each group as representative of the average
entrepreneur along the life cycle of his firm.

\(^{16}\)This upward social mobility of entrepreneurs in economies with borrowing constraints has been described and
explained, among others, by Gentry and Hubbard (2000) and Quadrini (2000)

\(^{17}\)Income includes wages, salaries, business income, distributions from pensions plans, interest and dividend income,
gains on the sale of stock or other assets, rents and royalties, unemployment insurance, workers’ compensation, gifts and
transfer payments.
Figure 5: Income distribution for ongoing entrepreneurs. (SCF)

We constructed three age categories: firms ranging from 0 to 4 years, from 5 to 11 years and with more than 11 years\(^{18}\). Each group had one third of entrepreneurs, the share of teams being roughly uniform across them\(^{19}\). In each age group we computed the first, second and third wealth quartiles for both team and solo entrepreneurs. In table 7, we report the ratios between the wealth of team entrepreneurs and solo entrepreneurs, for each age group and wealth quartile.

\[
\begin{array}{|c|c|c|c|}
\hline
\text{Age group} & \text{1}\text{st} \text{quartile} & \text{median} & \text{3}\text{rd} \text{quartile} \\
\hline
0 - 4 yrs & 1.59 & 1.46 & 1.24 \\
5 - 11 yrs & 1.80 & 2.22 & 2.80 \\
11 + yrs & 1.10 & 1.70 & 2.05 \\
\hline
\end{array}
\]

Table 7: Ratio of net worth quartiles between team and solo entrep. (SCF)

Within the group of young firms (0 - 4 yrs) the median wealth of entrepreneurs in teams was found to be 46% larger, this result being robust across wealth quartiles. Within the group of older firms (5 -11 yrs), the ratios got bigger for all quartiles, with the median wealth of team entrepreneurs being 1.22 times larger. For the group of mature firms (11+ yrs) the ratios remained bigger than those of young firms (except for the first quartile), but smaller than those of older firms. While the ratios found for young firms suggest that some of the wealth differential found in table 5 has to be attributed to the fact that only those teams with a sufficiently large amount of assets were actually capable of entering into business, their evolution over time constitutes evidence that team entrepreneurs get wealthier than solo entrepreneurs, and that initially they do it even at a faster rate.

\[
\begin{array}{|c|c|c|c|}
\hline
\text{Age group} & \text{1}\text{st} \text{quartile} & \text{median} & \text{3}\text{rd} \text{quartile} \\
\hline
0 - 4 yrs & 0.89 & 1.08 & 1.03 \\
5 - 11 yrs & 1.29 & 1.60 & 1.80 \\
11 + yrs & 1.22 & 1.41 & 1.70 \\
\hline
\end{array}
\]

Table 8: Ratio of income quartiles between team and solo entrep. (SCF)

When comparing the ratio of incomes using this methodology (see table 8), a similar conclusion emerges. Incomes grow initially faster for team entrepreneurs and become relatively larger in the long run.

\(^{18}\)Although this division is arbitrary, the results that follow are robust to using two and four categories.

\(^{19}\)The shares were 0.267, 0.273 and 0.259 respectively.
Taking the market value of the business as a proxy for firm size, table 9 compares team and solo owned firms. As with the PSED sample, team firms are much larger than those owned by single households, the median business being 5 times larger.

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<tbody>
<tr>
<td>Team entrep.</td>
<td>39,855</td>
<td>105,283</td>
<td>292,425</td>
<td>1,069,020</td>
<td>4,678,800</td>
</tr>
<tr>
<td>Solo entrep.</td>
<td>10,904</td>
<td>22,297</td>
<td>58,485</td>
<td>187,152</td>
<td>506,750</td>
</tr>
</tbody>
</table>

Table 9: Total business value in 1998 US$

In order to compare the relative degree of portfolio diversification – see Gentry and Hubbard (2000) and Cagetti and De Nardi (2003) –, we computed the ratio of business wealth to total wealth for each entrepreneurial household. On the one hand, a financially constrained entrepreneur would have to hold a large fraction of his wealth in the business. On the other, an unconstrained entrepreneur would try to diversify the idiosyncratic risk associated with the entrepreneurial activity; keeping the net business value as low as possible relative to his total wealth. In our case, diversification of idiosyncratic risk could also be one important reason for team formation. Two entrepreneurs may find beneficial to diversify their entrepreneurial risk by sharing the ownership of their businesses.

<table>
<thead>
<tr>
<th></th>
<th>bottom decile</th>
<th>first quartile</th>
<th>median</th>
<th>third quartile</th>
<th>top decile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team entrep.</td>
<td>0.051</td>
<td>0.150</td>
<td>0.330</td>
<td>0.577</td>
<td>0.800</td>
</tr>
<tr>
<td>Solo entrep.</td>
<td>0.058</td>
<td>0.125</td>
<td>0.286</td>
<td>0.516</td>
<td>0.744</td>
</tr>
</tbody>
</table>

Table 10: Business wealth to total wealth ratio (SCF)

In table 10, we report the bottom and top deciles, as well as the first, second and third quartiles of the business wealth to total wealth ratio for team and solo entrepreneurs. We find that the median ratio for partners was $33\%^{20}$, 17\% higher than that of single entrepreneurs. This observation, coupled with the fact that the average number of active businesses owned by team and solo entrepreneurs are very similar – see table 4.a in the appendix – indicates that portfolio diversification does not appear to be among the main reasons for team formation.

Finally, in light of the higher incomes found for partners, we are interested in comparing the relative profitability of businesses managed by teams and solo entrepreneurs. We use data from the 1998 Federal Reserve Board Survey of Small Business Finances, that collects financial information on a nationally representative cross section of non-farm, non-financial firms with less than 500 employees$^{21}$. The public dataset contains a total of 3651 firms, from which we selected those that were managed by an owner or a partner, the resulting sample consisting of 3186 businesses. Firms were classified as solo entrepreneurial if they had only one owner, or if they had more than one owner but 100\% of the firm was owned by a single family$^{22}$. Team firms were identified as those that did not fall in the above category, and whose number of owners did not exceed 4$^{23}$. In the sample, the share of teams was found to be 27.92\%, accounting for 55\% of total reported sales, 50\% of total assets and 44\% of total employment. As with both the SCF and PSED, the distribution across sectors of solo and team owned firms did not show significant differences.

Respondents in the SSBF are asked to report on their after tax profits $^{24}$, as well as on the business net equity. Missing values are computed from detailed information on sales and costs, assets

$^{20}$These estimates are similar to those reported by Gentry and Hubbard (2000), but smaller than those indicated by Cagetti and DeNardi (2003), the reason being that in this paper the value of collateral is not incorporated as part of the business wealth.

$^{21}$For more information on the SSBF, see Haggerty (2001)

$^{22}$This is typically the case of married entrepreneurs.

$^{23}$The reason for this being to capture the type of small firms that we have in the model presented below, who can have two owners only. In any case, this restriction is not very strong, since 90\% of all firms with more than one owner fall in this category.

$^{24}$There is one caveat with the measure of profits, and has to do with the fact that it is not reported in which cases the entrepreneur considers his own wage as part of the total costs or not. Moreover, if wages were not considered as part of total costs, it would be very difficult to deduct imputed wages coming from a mincerian regression to the subsample
and liabilities; information that is also used for consistency check with reported values. Sorting the population of firms by net equity and dividing it in quintiles, we report in table 11 the ratio of median profits, controlling by net equity quintile. Table 12 shows the same ratios for some selected profit percentiles in each net equity quintile. From the tables, profits are in general larger for team owned firms for any given equity category. Only when we consider those team owned firms with the worst performance (25th percentile), do we observe that solo entrepreneurs have higher profits.

<table>
<thead>
<tr>
<th>Net Equity quintile</th>
<th>Median profits</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teams</td>
<td>Solo</td>
</tr>
<tr>
<td>1</td>
<td>14,182</td>
<td>20,655</td>
</tr>
<tr>
<td>2</td>
<td>12,214</td>
<td>5,281</td>
</tr>
<tr>
<td>3</td>
<td>22,557</td>
<td>18,000</td>
</tr>
<tr>
<td>4</td>
<td>36,792</td>
<td>30,000</td>
</tr>
<tr>
<td>5</td>
<td>109,000</td>
<td>59,290</td>
</tr>
</tbody>
</table>

Table 11: Median profits ratio by net equity (SSBF)

<table>
<thead>
<tr>
<th>Net Equity quintile</th>
<th>Profit percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>2.0</td>
</tr>
<tr>
<td>3</td>
<td>0.50</td>
</tr>
<tr>
<td>4</td>
<td>0.57</td>
</tr>
<tr>
<td>5</td>
<td>2.15</td>
</tr>
</tbody>
</table>

Table 12: Profits ratio by net equity and profit percentile (SSBF)

To conclude, our results show that partners need an initially larger amount of capital, but run more profitable businesses than solo entrepreneurs. Consequently, they have bigger businesses, receive higher incomes and hold more wealth. These findings are consistent with financial frictions playing an important role in the formation of teams. Since the work of Evans and Jovanovic (1989), we know that only households with very high entrepreneurial ability and low wealth are affected by borrowing constraints. The vast majority of entrepreneurs are not that skilled, and therefore the optimal scale of their businesses is relatively small. Our results suggest that these highly skilled households overcome borrowing constraints by forming partnerships. The fact that partners have a lower degree of portfolio diversification despite being wealthier is also consistent with financial frictions being the reason behind the formation of teams. As Gentry and Hubbard (2000) pointed out, the notion of being financially constrained is relative, and depends on how wealthy the entrepreneur is with regard to the optimal production scale of the business. Teams are more profitable, and therefore their optimal production scale is larger, implying that partners are borrowing constrained despite being wealthier.

In order to assess the effectiveness of partnerships in surmounting the output gap introduced by financial constraints, in the next section we present a model of entrepreneurial choice with financial frictions in which we allow for the explicit formation of teams.

3 A model of entrepreneurs with team formation

The economy is inhabited by a continuum of infinitely lived households (agents) of total measure one. There is a single good, the numeraire, used for both consumption and investment. There are two of teams, since the characteristics of the remaining business owners are not known. To get an idea of how large the problem may be, in the Survey of Consumer Finances 60% of team entrepreneurs reported receiving a wage from their firms, whereas only 33% of solo entrepreneurs reported receiving wages from their own business. This implies that, if anything, it is the profits of solo entrepreneurs more likely to be overestimated, which lets us take a conservative stand in our comparability of profits.
production technologies. One is managed by households – “entrepreneurs” –, has decreasing returns to scale in capital and labor and can be operated either individually or in pairs. Firms managed by two households are called “a team”. The other technology is used by a representative firm – “the corporate sector” – with constant returns to scale. In both cases, working capital is assumed to depreciate after production at rate \( \delta \). Such characterization of the production sector is standard in the entrepreneurship literature\(^2\), and serves a dual purpose. In the first place, it eliminates from the problem having to take into consideration the size distribution of large firms. The assumption of constant returns to scale allows to aggregate them into a single representative firm. In the second place, it makes possible to incorporate into the model some distinctive features between small and large firms. In this paper, to be able to determine the importance of teams in surmounting liquidity constraints it is necessary to introduce the limited availability of working capital faced in general by small firms. It is a well documented fact that said restricted access to capital markets makes the production possibility plans of small firms to depend on the net worth of their owners and their consumption/saving decisions. In the model, the financial friction is introduced by assuming limited commitment on the part of households to repay their loans, coupled with limited enforceability on the part of the legal system to fully recover the lenders’ funds.

The timing of the economy is as follows. All agents enter every period with an occupation. They can be either workers, single entrepreneurs, or entrepreneurs in teams – constituted at the end of the previous period –. At that moment, uncertainty about entrepreneurial and working abilities is revealed. With that information, firms access capital and labor markets to produce the final good. Capital markets work in the model through a representative financial intermediary, with zero marginal costs, who collects the savings from households and makes short term loans to firms. After production has taken place, the financial intermediary collects the proceeds from the loans and in turn pays back the returns on deposits. Households then decide how much to consume, how much to save, and whether they are willing to search for a partner – search is assumed to be costly, and sharing the control of a firm to be undesirable – at the end of the period, while all markets clear. Teams are assumed to last only one period\(^2\), but its members are allowed to search for a new partner at no cost.

Finally, before entering a new period, those households who have paid the search cost – or those already in teams during the current period – enter a matching stage. They are randomly coupled with another searcher. Once in a match, both households have to decide whether to constitute a joint firm for the following period or to break apart into single agents. In the first case, both partners have to determine a non-contingent sharing rule for the future expected profits. In the second, they have to decide their occupation for the following period (either a worker or an entrepreneur), together with all the remaining households that decided not to search.

### 3.1 The Household sector

#### 3.1.1 Preferences

Households are assumed to have identical preferences over consumption streams \( \{c_t\}_{t=0}^{\infty} \), with per period utility function \( u(c_t), u(.) : \mathbb{R}^+ \rightarrow \mathbb{R}, u(.) \in C^2, u'(.) > 0, u''(.) < 0 \), and satisfying Inada conditions \( \lim_{c \to 0} u'(c) = \infty \) and \( \lim_{c \to \infty} u'(c) = 0 \).

Preferences are assumed to admit a time separable, von Newmann - Morgenstern expected utility representation.


\(^2\)This seems a strong assumption, as a partnership is generally believed to be a long term relationship. However, in this paper the advantage of partnerships is rooted in the complementarity existing between households with high entrepreneurial abilities and households with abundant wealth. Having search costs and assuming that sharing a business is undesirable induces households to self select into searching; with only these two types of agents looking for a match. Once the search market is segmented, the costs of loosing one match are significantly reduced, as all searchers of each type are very similar. The reason for this assumption was to simplify considerably the numerical computation of the problem, and to make the maximization of profits a natural objective for a partnership, avoiding the hold up problem that arises within teams if dissolution is endogenous.

\(^2\)We assume this to avoid imposing an excessive search cost on households that would benefit from establishing long term teams.
\[ E_0 \left[ \sum_{t=0}^{\infty} u(c_t) \beta^t \right], \]

where the future is discounted at rate \( \beta \in (0, 1) \) and the expectation is taken conditional on current information.

### 3.1.2 Characteristics

Households are endowed with two individual characteristics: an entrepreneurial idea or ability \( \varepsilon \in E = \{ \varepsilon_1, \varepsilon_2, \ldots, \varepsilon_N \} \) and a working ability \( \eta \in H = \{ \eta_1, \eta_2, \ldots, \eta_M \} \), being \( E \) and \( H \) finite sets, \( \varepsilon_1 < \varepsilon_2 < \ldots < \varepsilon_N \) and \( \eta_1 < \eta_2 < \ldots < \eta_M \). \( \varepsilon_1 \) is assumed to be 0, implying the lack of entrepreneurial ability.

Both \( \varepsilon \) and \( \eta \) follow first order Markov processes with transition probabilities \( \Gamma(\eta_{t+1}|\eta_t) \) and \( \Theta(\varepsilon_{t+1}|\varepsilon_t, d_{t+1}) \) respectively, where \( d_{t+1} \) is the occupation chosen by the household for period \( t+1 \) (1 if an entrepreneur and 0 if a worker). Conditioning \( \Theta(\cdot) \) on the occupational choice attempts to capture the learning-by-doing process related to entrepreneurial activities, as described in Jovanovic (1982) or Quadrini (2000).

### 3.2 Production Sector

#### 3.2.1 Entrepreneurial Technology

Households can operate small firms either individually or in pairs. In the first case, the entrepreneur uses her abilities \( (\varepsilon, \eta) \), working capital \( k \) and possibly additional labor \( n \) to produce the final good with technology

\[ \varepsilon \cdot f(k, l) \]

where \( l = n + \eta \), since it is assumed that once the agent decides to become an entrepreneur, she can only use her labor time into her own firm.

The production function \( f: \mathbb{R}^{+2} \to \mathbb{R} \) is assumed to have decreasing returns to scale, to be increasing in both arguments and concave in each of them, with \( f(0, \cdot) = f(\cdot, 0) = 0 \), to be twice continuously differentiable, strictly increasing and strictly concave in \( \mathbb{R}^{+2} \). \( f(k, l) \) is also assumed to satisfy Inada conditions \( \lim_{k \to 0} f_1(k, l) = \lim_{l \to 0} f_2(k, l) = \infty \) and \( \lim_{k \to \infty} f_1(k, l) = \lim_{l \to \infty} f_2(k, l) = 0 \) in \( \mathbb{R}^{+2} \).

For a given interest rate \( i \), wage rate \( w \), working capital \( k \) and total labor \( l \), the profits for the firm are given by

\[ \pi = \varepsilon \cdot f(k, l) - wl - (i + \delta)k, \]

where it is implicitly assumed that the compensation to the entrepreneur’s efficiency units of labor is not taken as part of the profits. This accounting assumption makes entrepreneurial earnings a fixed cost for the firm, which for the low realization of the entrepreneurial ability forces the business to have negative profits – it hires no capital nor labor, but still has to pay the entrepreneur’s wage –. This assumption is very important when considering the problem of teams, because it eliminates the possibility of households establishing firms to smooth idiosyncratic labor risk. However, for individual entrepreneurs it is transparent, the budget constraint looks exactly the same as if they considered such earnings as part of total profits.

When two agents (labelled \( j \) and \( -j \)) produce in a team, they are assumed to combine their abilities, \( (\varepsilon_j, \eta_j) \) and \( (\varepsilon_{-j}, \eta_{-j}) \), and jointly decide how much capital \( k \) and additional labor \( n \) to hire in order to produce the final good with technology

\[ g^z_{j,-j} \cdot f(k, n + \eta_j + \eta_{-j}). \]

for \( g^z_{j,-j} = g^z(\varepsilon_j, \varepsilon_{-j}) \) an aggregator of the partners’ abilities. This aggregator plays an important role in describing the properties of joint firms. On the one hand it controls the degree of idiosyncratic risk faced by the team and on the other it describes the relative productivity of teams relative to individual management. Since we are interested in determining to what extent can the observed higher productivity of joint firms and the higher income and wealth of team entrepreneurs be explained
by the role of financial frictions, we restrict the choice of \( g_{j,-j}^e \) so that \( g_{j,-j}^e \leq \max(\varepsilon_j, \varepsilon_{-j}) \). This restriction makes the relative productivity of teams no better than that of single managed firms. Without empirical evidence available to support a particular functional form, we set \( g^e(\varepsilon_j, \varepsilon_{-j}) = \max(\varepsilon_j, \varepsilon_{-j}) \), under the assumption that team members always make the best decisions at their reach. Profits for an entrepreneurial team are computed as

\[
g_{j,-j}^e f(k, n + \eta_j + \eta_{-j}) - w(n + \eta_j + \eta_{-j}) - (i + \delta) k,
\]

and are distributed between partners according to a pre-established sharing rule \((\theta_j, \theta_{-j})\), with \( \theta_j + \theta_{-j} = 1 \).

### 3.2.2 Corporate sector technology

The representative firm in this sector has a typical neoclassical production function \( F(K,L) \) with constant returns to scale, satisfying Inada conditions.

### 3.3 Financial intermediary and borrowing constraints

In the economy there is a financial intermediary that collects deposits from households and makes loans to entrepreneurs asking for funds and to the corporate sector. The borrowing and lending rates are equal to \( i^{28} \) for both sectors of production. Households make deposits \( a \) at the end of every period and collect the proceeds of those savings \((1 + i) a\) after production has taken place the following period. Once uncertainty about \((\varepsilon, \eta)\) is revealed at the beginning of every period, households that the previous period chose to become entrepreneurs (either individually or in pairs) can go to the financial intermediary to borrow funds for production. Loans are assumed to be short term and expected to be repaid once production has taken place, productive capital has depreciated, and wages have been paid\(^{29} \).

As in Albuquerque and Hopenhayn (2004), the financial friction of the model comes from the assumption that in the economy there is limited commitment on the part of entrepreneurs to repay loans and limited enforceability of the legal system to recover the funds. To capture the easier access that the corporate sector has to capital markets relative to the entrepreneurial sector, we will assume that it always honors its debt and therefore is not subject to financial frictions.

When households choose to repudiate a loan, the intermediary is allowed to resort to an existing legal system to recover the money. We set the maximum amount that an entrepreneur can be forced to return to be the sum between the entire proceeds on his savings \((1 + i) a\) – which acts as a collateral – , plus a fraction \( \gamma \) of the business gross sales net of labor costs – excluding the entrepreneur’s compensation – \( \gamma(f(k, n + \eta) - wn) \). We will further assume that the consequences of the default decision do not go beyond the current period, which in turn implies that households will not be able to borrow for consumption purposes \(- a \geq 0^{30} \).

A single entrepreneur with abilities \((\varepsilon, \eta)\) and assets \(a\), who borrows \(k\) from the financial intermediary and hires \(n\) additional units of labor would prefer to pay back the loan if the following incentive compatibility condition is met:

\[
(1 - \gamma)[\varepsilon f(k, n + \eta) - wn] + k(1 - \delta) \leq \varepsilon f(k, n + \eta) - wn - (i + \delta) k + (1 + i) a.
\]

The financial intermediary will therefore set a borrowing constraint \(b = b(\varepsilon, \eta, a)\) on loans so that there is no default in equilibrium. From the incentive compatibility constraint, the function \(b(\varepsilon, \eta, a)\)

---

28 Some authors impose a gap between the borrowing and lending rate in order to stimulate asset accumulation from entrepreneurs (Quadrini 2000). Since \(a\) this feature affects equally the behavior of single entrepreneurs and entrepreneurs in partnerships and 2) we want to isolate the effect of borrowing constraints, we choose to eliminate this margin from the model.

29 In this model there is no uncertainty at the time of investment, eliminating the possibility of bankruptcy for the entrepreneur. The purpose of this assumption is to eliminate the possibility of bankruptcy as a potential formation of partnerships. This feature will be considered in future research.

30 It is clear that different types of financial frictions may have an effect on the importance of teams. For this paper, we choose this specific type of friction to keep in line with some of the existing literature on the field (Fernández-Villaverde and Galdon Sanchez (2003), Cagetti and De Nardi (2003)).
will be a solution of the equation

\[ b = a + \frac{\gamma}{(1+i)} \left[ \varepsilon f(b,n(\varepsilon,\eta,b) + \eta) - w n(\varepsilon,\eta,b) \right] \]

where \( n(\varepsilon,\eta,b) \) is the optimal amount of labor that the entrepreneur hires if she has abilities \((\varepsilon,\eta)\) and capital \(b\).

For entrepreneurs in teams, we need to establish a criterion by which the firm decides to default on its debt. We will assume that this will be the case whenever the surplus from defaulting exceeds the sum of the surpluses that both partners could get by meeting the firm’s obligation. In other words, the decision to default must be unanimous, after a possible renegotiation of the proceedings by the entrepreneurs. Under this assumption, it is easy to show that the borrowing constraint \(b\) set by the financial intermediary to joint firms will depend on the sum of entrepreneurs’ assets (see appendix). That is,

\[ b = (a_j + a_{-j}) + \frac{\gamma}{(1+i)} \left( g_{j,-j} f(b,n_j,-j + \eta_j + \eta_{-j}) - w n_{j,-j} \right) \]

with \( n_{j,-j} = n(\varepsilon_j,\eta_j,\varepsilon_{-j},\eta_{-j},b) \) the optimal amount of labor hired by the joint firm.

### 3.4 The households’ problem

Given the timing of the economy, subdividing every period into three subperiods simplifies the characterization of the households’ problem. The first subperiod begins once idiosyncratic uncertainty is revealed. The second starts after consumption and savings decisions have been made, just before the matching round among agents. Finally, the third subperiod commences once the matching round is finished, before agents make their occupational choices for the following period. In what follows, value functions, state variables and measures contain a superindex \(i \in \{1,2,3\}\) indicating the corresponding subperiod. In addition to that, they have a subindex \(m \in \{s,p\}\) indicating if they correspond to a single household or to a household in a pair. As is customary, variables with a prime indicate that they correspond to the following period.

All agents begin every period either as a single household or with a partner. At this point, single households are characterized by a state variable \(z^s = (\varepsilon,\eta,d,a)\) in \(Z_s = E \times H \times \{0,1\} \times \mathbb{R}^+\) containing his current entrepreneurial and working abilities \((\varepsilon,\eta)\); current occupational status \(d\), and amount of net assets \(a\). The individual state of household \(j\) in a partnership is given by \(z^p_{1,j} = (z^1_j, z^1_{-j}, \theta_j) \in Z_p\), with \(Z_p = Z_s \times Z_s \times [0,1]\). Components \(z^1_j\) and \(z^1_{-j}\) contain the partners’ \(j\) and \(-j\) individual characteristics, as for single households \(-\), while \(\theta_j \in [0,1]\) indicates agent \(j\)’s share of the current period production profits, agreed with her partner at the end of the previous period.

In a steady state of this economy, the aggregate state is fully described by a pair of invariant measures \((\mu^1_s,\mu^1_p)\) where \(\mu^1_s\) is the distribution of single households and \(\mu^1_p\) is the distribution of partners at the beginning of a period. They are respectively defined on spaces \((Z_s,Z_s)\) and \((Z_p,Z_p)\), with \(Z_s\) and \(Z_p\) being appropriate \(\sigma\) algebras of \(Z_s\) and \(Z_p\).

#### 3.4.1 The problem of single agents in recursive form

At the end of a generic period \(t\), every single agent has to decide her occupational choice \(d'\) for the following period, based on her current abilities \((\varepsilon,\eta)\) and the level of assets \(a'\) she has already decided to save for the next period. Letting \(v^3_s(z^3_s)\) and \(v^3_s(z^3_s')\) be her value functions at the end of period \(t\) and at the beginning of period \(t+1\) respectively, with \(z^3_s = (\varepsilon,\eta,d,a')\) and \(z^3_s' = (\varepsilon',\eta',d',a')\) the agent occupational choice problem can be written as\(^{31}\)

\[ v^3_s(z^3_s) = \beta \max_{d' \in [0,1]} \sum_{\varepsilon'} \sum_{\eta'} v^3_s(z^3_s') \Gamma(\eta'|\eta) \Phi(\varepsilon'|\varepsilon, d'), \tag{1} \]

and its solution is given by a function \(d_s(z^3_s)\).

\(^{31}\)The value functions also depend on the aggregate state of the economy, characterized by the invariant measures \(\mu^1_s\) and \(\mu^1_p\). Since in steady state they are taken by the agents as constants in their programming problems, we omit writing them explicitly as arguments to economize notation.
Once a new period begins, uncertainty about $(\varepsilon, \eta)$ is revealed, every single agent is characterized by her current individual state $z_s^1 = (\varepsilon, \eta, d, a)$. At that point, the agent collects her income $y (z_s^1) + (1 + i) a$ and decides how much to consume ($c$), how much to save for the following period ($a'$) and whether he wants search for a prospective partner for the following period. To enter the matching round, the household has to pay a search cost that is assumed to be a proportion $\rho > 0$ of the wage rate $w$. The agent programming problem is

$$v_s^1 (z_s^1) = \max_{c, a', q \geq 0 \atop q \in \{0, 1\}} u (c) + v_s^2 (z_s^2, q)$$

subject to

$$a' + c \leq y (z_s^1) + w \eta + (1 + i) a - qw \rho$$

$$z_s^2 = (\varepsilon, \eta, d, a')$$

with

$$y (z_s^1) = \begin{cases} 0 & \text{if } d = 0 \\ \pi (\varepsilon, \eta, a) & \text{if } d = 1 \end{cases}$$

and

$$\pi (\varepsilon, \eta, a) = \max_{0 \leq k \leq b (\varepsilon, \eta, a)} \varepsilon f (k, n + \eta) - w (n + \eta) - (\delta + i) k$$

where prices $(w, i)$ are taken as given and $v_s^2 (z_s^2, q)$ is the value function of a single agent before the matching stage. The solution to this problem is given by policy functions $a_s (z_s^1), c_s (z_s^1), q (z_s^1), k_s (z_s^1)$ and $n_s (z_s^1)$.

### 3.4.2 The Matching stage

Once production, consumption and savings decisions were made, those agents that paid the cost to search for a partner and those who were in a team during the current period enter a matching round. Agents are distributed according to measures $\mu_{s, q}$ defined over $(Z_s, Z_s)$, for $q = 0, 1$, and those who search are randomly matched with another agent in $\mu_{s, 1}^1$. In steady state, $\mu_{s, q}$ is related to $\mu_{s, 1}^1$ and $\mu_{s, 1}^1$ by

$$\mu_{s, 1}^1 (B) = \int_{z_s} \chi (z_s^2 \in B \wedge q = 1) \mu_{s, 1}^1 (dz_s^1) + \int_{z_p} \chi (z_{s, p}^2 \in B) \mu_{s, 1}^1 (dz_{s, p}^1)$$

$$\mu_{s, 0}^1 (A) = \int_{z_s} \chi (z_s^2 \in A \wedge q = 0) \mu_{s, 1}^1 (dz_s^1)$$

with $z_s^2 = (\varepsilon, \eta, d, a_s (z_s^1))$, for every $A, B \in Z_s$, $\chi (x)$ being the indicator function

$$\chi (x) = \begin{cases} 1 & \text{if } x \text{ is true} \\ 0 & \text{otherwise} \end{cases}$$

Letting $v^m (z_s^2, z_{s, -j}^2)$ be the value function of a single agent with state $z_s^2$ when matched with another with state $z_{s, -j}^2 = (\varepsilon, \eta, d, a)_{-j}$, the value function $v_s^2 (z_s^2, q)$ for a single agent before the matching stage is

$$v_s^2 (z_s^2, q) = \frac{q}{\mu_{s, 1}^1 (Z_s)} \int_{z_s} v^m (z_s^2, z_{s, -j}^2) \mu_{s, 1}^1 (dz_{s, -j}^2) + (1 - q) v^3_s (z_s^3)$$

with $z_s^2 = z_s^3$. The last unknown in the single households’ problem is the value of a match $v^m (z_s^2, z_{s, -j}^2)$, which is obtained from the solution to the problem of partners.
3.4.3 The problem of partners

As previously mentioned, when an agent is in a team at the beginning of a period, her individual state is given by \( z_{p,j}^{1} = (z_{s,j}^{1}, z_{s,-j}^{1}) \) \( \in Z_p \). Defining her value function as \( v_p^1 (z_{p,j}^{1}) \), and letting \( z_{s,j}^{2} = (\varepsilon, \eta, 1, a') \), her problem can be written as

\[
v_p^1 (z_{p,j}^{1}) = \max_{c,a' \geq 0} u(c) + v_s^2 (z_{s,j}^{2}) - \psi
\]

subject to

\[
c + a' \leq (1 + i) a + w\eta_j + \theta_j \pi (z_{s,j}^{1}, z_{s,-j}^{1})
\]

where \( \psi \geq 0 \) is assumed to capture the loss of nonpecuniary benefits that team members derive from control, access and other noncontractable aspects of the venture, as in Grossman and Hart (1986) and Aghion and Bolton (1992); and \( \pi (z_{s,j}^{1}, z_{s,-j}^{1}) \) are the profits obtained from the joint production technology,

\[
\pi (z_{s,j}^{1}, z_{s,-j}^{1}) = \max_{0 \leq k \leq b(z_{s,j}^{1}, z_{s,-j}^{1})} g_{s,j}^{2} f (k, n + \eta_j + \eta_{-j}) - w (n + \eta_j + \eta_{-j}) - (\delta + i) k,
\]

with \( b(z_{s,j}^{1}, z_{s,-j}^{1}) \) the borrowing constraint for the joint firm. The solution to this problem is a consumption function \( c_p (z_{p,j}^{1}) \), a saving function \( a_p (z_{p,j}^{1}) \), and factor demand functions \( k_p (z_{p,j}^{1}) \) and \( n_p (z_{p,j}^{1}) \).

3.4.4 The constitution decision

After the matching round, every pair of prospective partners has to decide whether to constitute a team for the next period or to remain as single households. Given \( z_{s,j}^{2} \) and \( z_{s,-j}^{2} \), the possibility to establish a team depends on the existence of a sharing rule \( (\theta_j, \theta_{-j}) \) such that the expected value of staying together exceeds the expected value that both households could get independently.

In our setup, there are two conditions that must be met for a team to be feasible. One of them has to do with the fact that profits can be eventually negative, implying that some households face the risk of not having enough wealth to cover the losses. To avoid entering into bankruptcy considerations, we restrict the set of feasible sharing arrangements by imposing that households cannot go bankrupt in the worst case scenario. This implies that for two prospective partners with abilities \((\varepsilon_j, \eta_j)\) and \((\varepsilon_{-j}, \eta_{-j})\), and assets \(a_j\) and \(a_{-j}\), the share of future profits going to agent \(j, \theta_j\), cannot exceed \(\overline{\theta} = \overline{\theta} (z_{s,j}^{2}, z_{s,-j}^{2})\), defined by

\[
\overline{\theta} = \{ \max \theta \in [0, 1] : \pi (\varepsilon_{j-1}, \eta_{j}, a_j, \varepsilon_{j-1}, \eta_{M_j}, a_{-j}) + (1 + i) a_j + w\eta_1 \geq 0 \}
\]

where \( \pi (\varepsilon_{j-1}, \eta_{j}, a_j, \varepsilon_{j-1}, \eta_{M_j}, a_{-j}) \) are the profits attainable in the worst case scenario for partner \(j\), where she gets the minimum labor income, has to pay her partner the maximum labor compensation, and the firm productivity is the lowest possible – given current entrepreneurial abilities \(\varepsilon_j\) and \(\varepsilon_{-j}\). A similar condition for partner \(-j\) sets a lower bound on \(\theta_j\), labelled \(\underline{\theta} = \underline{\theta} (z_{s,j}^{2}, z_{s,-j}^{2})\), given by

\[
\underline{\theta} = \{ \min \theta \in [0, 1] : (1 - \theta) \pi (\varepsilon_{j-1}, \eta_{M_j}, a_j, \varepsilon_{j-1}, \eta_{M_{-j}}, a_{-j}) + (1 + i) a_{-j} + w\eta_1 \geq 0 \}
\]

The second condition establishes that forming a team must be mutually beneficial. Putting these two conditions together, given a pair \((z_{s,j}^{2}, z_{s,-j}^{2})\) a team is said to be feasible if there exists a pair \((\theta_j, \theta_{-j})\) in \([0, 1]^2\), \(\theta_j + \theta_{-j} = 1\) \(\theta \leq \theta_j \leq \overline{\theta}\) such that

\[
EV_{p,j}^1 (z_{s,j}^{2}, z_{s,-j}^{2}, \theta_j) \geq v_s^3 (z_{s,j}^{2}) \quad \text{and} \quad EV_{p,-j}^1 (z_{s,j}^{2}, z_{s,-j}^{2}, \theta_{-j}) \geq v_s^3 (z_{s,-j}^{2})
\]

for

\[
EV_{p,j}^1 (z_{s,j}^{2}, z_{s,-j}^{2}, \theta_j) = \beta \sum_{\varepsilon_j, \eta_j, \varepsilon_{-j}, \eta_{-j}} v_p^1 (z_{p,j}^{1}) \Gamma (\eta_j' | \eta_j) \Gamma (\eta_{-j}' | \eta_{-j}) \Phi (\varepsilon_j' | \varepsilon_j, 1) \Phi (\varepsilon_{-j}' | \varepsilon_{-j}, 1).
\]
In what follows, the set
\[ F = \left\{ (z_{s,j}, z_{s,j-1}) \in Z_s^2 : \exists (\theta, \theta_j) \in [0, 1]^2, \theta_j + \theta - 1 \leq 1, \theta \left( z_{s,j}, z_{s,j-1} \right) \leq \theta_j \leq \theta \left( z_{s,j}, z_{s,j-1} \right) \right\} \]
\[ \text{s.t. } EV_{p,j}^1 \left( z_{s,j}, z_{s,j-1}, \theta_j \right) \geq v_3^3 \left( z_{s,j} \right) \land EV_{p,j}^1 \left( z_{s,j}, z_{s,j-1}, \theta_j \right) \geq v_3^3 \left( z_{s,j} \right) \}
of matches for which a team is feasible is called the \textit{feasibility region}.

Given \( F \), the value of a match \( v_m \left( z_{s,j}, z_{s,j-1} \right) \) can be computed as
\[ v_m \left( z_{s,j}, z_{s,j-1} \right) = \left[ EV_{p,j}^1 \left( z_{s,j}, z_{s,j-1}, \theta \right) - v_3^3 \left( z_{s,j} \right) \right]^{1/2} \left[ EV_{p,j}^1 \left( z_{s,j}, z_{s,j-1}, 1 - \theta \right) - v_3^3 \left( z_{s,j} \right) \right]^{1/2} \]
where the share of next period profits that corresponds to agent \( j \), \( \theta^* \left( z_{s,j}, z_{s,j-1} \right) \), is assumed to be determined by solving a symmetric Nash bargaining problem
\[ \theta^* \left( z_{s,j}, z_{s,j-1} \right) = \arg \max_{\theta \in [0,1]} \left[ EV_{p,j}^1 \left( z_{s,j}, z_{s,j-1}, \theta \right) - v_3^3 \left( z_{s,j} \right) \right]^{1/2} \left[ EV_{p,j}^1 \left( z_{s,j}, z_{s,j-1}, 1 - \theta \right) - v_3^3 \left( z_{s,j} \right) \right]^{1/2} \]
with \( z_2^2 = z_3^2 \) for both agents.

### 3.5 Equilibrium

A steady state recursive competitive equilibrium is characterized by a set of value functions \{ \( v_1^1(.) \), \( v_2^1(.) \), \( v_3^1(.) \), \( v_m^1(.) \), \( v_3^3(.) \) \}, policy functions \{ \( c_a(.) \), \( a_a(.) \), \( k_a(.) \), \( n_a(.) \), \( d_s(.) \), \( q(.) \), \( c_p(.) \), \( a_p(.) \), \( k_p(.) \), \( n_p(.) \) \}, a sharing rule \( \theta^*(.) \), a set of prices \{ \( i, w \) \}, a pair of input demand functions from the corporate sector \{ \( L_c(w,i), K_c(w,i) \) \} and measures \( \mu_s^1 \) and \( \mu_p^1 \) such that:

1. Decision rules \{ \( d_s(.) \), \( c_a(.) \), \( a_a(.) \), \( k_a(.) \), \( n_a(.) \), \( q(.) \) \} solve the problems of single agents, as described in (1),(2) and (3), with \( v_3^3(.) \), \( v_2^2(.) \), \( v_1^1(.) \) the associated value functions.
2. Policies \{ \( c_p(.) \), \( a_p(.) \), \( k_p(.) \), \( n_p(.) \) \} solve the problems of partners as described in (7) and (8), with \( v_3^3(.) \) the associated value function.
3. The sharing rule \( \theta^*(.) \) solves the bargaining problem (11) and allows to compute the value function of a matched pair of agents according to (10).
4. Factor demands \{ \( L_c(w,i), K_c(w,i) \) \}, maximize profits for the corporate sector.
5. Prices \{ \( i, w \) \} are competitive.
6. Capital and labor markets clear
\[ \int_{Z^c} k_s \left( z_1^1 \right) \mu_s^1 \left( dz_1^1 \right) + \frac{1}{2} \int_{Z_p} k_p \left( z_1^1 \right) \mu_p^1 \left( dz_1^1 \right) + K_c = \int_{Z_s} a \mu_s^1 \left( dz_1^1 \right) + \int_{Z_p} a_j \mu_p^1 \left( dz_1^1 \right) \]
\[ \int_{Z^c} \left( n_s \left( z_1^1 \right) + \eta \right) \mu_s^1 \left( dz_1^1 \right) + \frac{1}{2} \int_{Z_p} n_p \left( z_1^1 \right) \mu_p^1 \left( dz_1^1 \right) + L_c = \int_{Z_s} \eta \mu_s^1 \left( dz_1^1 \right) \]
with \( Z^c = \{ \varepsilon \in Z_s : d = 1 \} \).
7. Measures \( \mu^1_s \) and \( \mu^1_p \) are stationary and their transitional operator \( T(.) \) so that \( \mu' = T(\mu) \) is consistent with individual behavior \(^{32}\).

\(^{32}\)See the Appendix for a more detailed description of this condition.
4 Parametrization

In this section, we specify the functional forms used and the procedure performed to pin down the different parameters in the model. The duration of each time period is assumed to be one year. Given that the general structure of the model is similar to that used in the past to model entrepreneurial behavior – Quadrini (2000), Fernández-Villaverde and Galdon-Sanchez (2003) and Cagetti and De Nardi (2003) – many parameters are calibrated or determined using similar criteria. The only two that have not been considered so far are the ones related directly to teams, the search cost \( \rho \) and the disutility of sharing control \( \psi \). They are determined in equilibrium, together with other three parameters\(^{33}\) that are not directly pinned down from existing data or previous studies. This process requires solving a nonlinear system of 5 equations and 5 unknowns, which involves matching five calibration targets computed from the data and their corresponding statistics computed from the model in steady state. As in Regalia and Rios-Rull (1998) and Fernández-Villaverde and Galdon-Sanchez (2003), there is one problem in solving this system due to the discontinuities in the policy functions for the occupational choice, the decision to search for a partner and the acceptance of an agent as a team partner. This discreteness in agents’ choices makes the mapping from the model parameters to the model statistics to be discontinuous, turning usual nonlinear solvers useless. One possibility to overcome this problem is to proceed as in Regalia and Rios-Rull (1998), convexifying the choices of agents by introducing effort functions that affect the probabilities of the desired outcomes and imposing some additional calibrating conditions so that few agent end up with undesired outcomes in equilibrium. Since these efforts introduce distortions in the agents’ preferences that are exogenous to the economics of the model\(^{34}\), we decided not to take this approach. Given that the existing literature on entrepreneurs had very good guesses for the three parameters not related to teams, the calibration strategy consisted in a two step process. In the first place, we performed a grid search over a two dimensional lattice, looking for a guess of \( \rho \) and \( \psi \) that gave the closest match to the target moments in the data, having fixed the remaining three parameters at those values reported by previous calibration exercises. In the second stage, we allowed all five parameter to change and searched\(^{35}\) for the parameter vector that gave the closest match to the moments in the data, within a neighborhood of the guess parameters determined in the first stage.

Finally, there is also a remark that has to be made about the computation of equilibria in this model. Given that the decision to search for a partner \( q(z_{11}) \) depends, among other things, on the measure of other agents searching, there will always be in the model a no-team equilibrium, one in which nobody searches. Even though this is not an interesting equilibrium, its existence guarantees that in general there will be multiplicity of equilibria. This feature is particularly important to be taken into account during the computation of the model, because the possibility of finding an equilibrium with teams depends on choosing an appropriate initial guess of the measures \( \mu_{1}^{c} \) and \( \mu_{1}^{p} \). Otherwise, we may end up with the wrong conclusion that for some parameter values there are no teams in equilibrium, simply because we started with the wrong guess of the aggregate state.

4.1 Preferences

In the model, agents maximize their expected lifetime utility

\[
E_{0} \left[ \sum_{\tau=0}^{\infty} u(c_{\tau}) \beta^{\tau} \right],
\]

where the per-period utility is assumed to be of the relative risk aversion form

\[
u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}\]

\(^{33}\)These are the discount factor \( \beta \), the total factor productivity of the corporate sector \( A_{c} \) and the degree of returns to scale for entrepreneurs \( a_{sb} + b_{sb} \). They are presented in the following subsections.

\(^{34}\)The fact that agents make the right choices almost surely does not guarantee that they would make the same choices if these distortive efforts were not present.

\(^{35}\)The search was carried out using Goffe et. al (1994) simulated annealing algorithm.
The risk aversion coefficient $\sigma$ is assumed to be 2.0. This is a standard choice in the literature – see for example Quadrini (2000) and Fernández-Villaverde and Galdon-Sanchez (2003) –. The discount factor $\beta$ is calibrated so that in equilibrium, the annual interest rate on deposits $i$ equals 4.0% . This return is reported by McGrattan and Prescott (2000) to be close to the average values of the risk-free rate on inflation-protected bonds issued by the U.S. Treasury. In the first quarter of 2000, the average return on 5-year inflation protected bonds was 3.99 percent, and the average return on 30-year inflation-protected bonds was 4.19 percent.\footnote{A similar return (3.5%) is used by Quadrini (2000) in his calibration exercise, obtained by averaging Mehra and Prescott (1985) reported returns on government bonds (0.5%) and risky financial assets (6.5%) during the postwar period.}

### 4.2 Technology

The corporate sector is assumed to have a standard neoclassical production function

$$F(K, L) = A c K^{\alpha_K} L^{1-\alpha_K},$$

where $\alpha_K$ is set to $1/3$ in order to match the distribution of income between capital and labor according to the shares measured by NIPA of 0.33 and 0.67 respectively. The productivity coefficient $A_c$ is calibrated in order to match the fraction of capital allocated in the corporate sector, reported by Quadrini (2000) to be approximately 60%.

The entrepreneurial sector is assumed to possess a Cobb Douglas production function of the form

$$\varepsilon f(k, l) = \varepsilon k^{a_k} l^{b_k},$$

where it is assumed that $2a_k = b_k$. This assumption again distributes income across capital and labor according to the shares measured by NIPA. The degree of returns to scale $a_k + b_k < 1$ is calibrated to match the percentage of income earned by entrepreneurs. Quadrini (2000) reports that, according to PSID data, such percentage is 22%. The depreciation rate is set at 0.06, a standard choice in the literature that results from solving the steady state condition

$$\delta = \frac{I/Y}{K/Y}$$

where $K/Y = 2.63^{37}$ and $I/Y = 0.16$ for the average period 1957-1990.

### 4.3 Financial Intermediation Sector

The only parameter relevant for this sector is the appropriability factor $\gamma$. As in Fernández-Villaverde (2003), we set $\gamma = 0.6$, based on evidence reported by Moody’s Investor Service – Carty and Lieberman (2000) –. In such report, the average recovery rate from defaulted bank loans is approximately 60%, ranging from 34% to 71%, depending on whether the default is on multiple loans or not.

### 4.4 Labor abilities

We parameterize the stochastic idiosyncratic labor abilities as in Cagetti and De Nardi (2003) and Fernández-Villaverde and Galdon-Sanchez (2003). They first use the results of Storesletten et al. (1999), who build a rotating panel from the Panel Study of Income Dynamics (PSID) and estimate the stochastic part $u_{it} = \ln(\nu_{it})$ of the labor income process, after eliminating the component of the data accounted by a mincerian regression. The process for household $i$ at time $t$ is modelled as

$$u_{it} = z_{it} + \varepsilon_{it}$$

$$z_{it} = \rho z_{i(t-1)} + \zeta_{it}$$

\footnote{This paper does not have a government sector, so a consistent definition of aggregate capital should exclude public capital and consider only private tangible assets. This makes the $K/Y$ ratio to be somewhat smaller than 3, the number generally reported in other studies.}
where \( \varepsilon_{it} \sim N(0, \sigma^2_{\varepsilon}) \) and \( \zeta_{it} \sim N(0, \sigma^2_\zeta) \) are innovation processes, with point estimates \( \rho = 0.935, \sigma^2_{\varepsilon} = 0.017 \) and \( \sigma^2_\zeta = 0.061. \) Finally, they approximate this AR (1) process with a discrete Markov chain, using the method proposed by Tauchen and Hussey (1991). In this paper, we use a two point Markov chain, leading to the corresponding normalized state vector \( H \) and transition matrix \( \Gamma \):

\[
H = \{0.76, 1.24\}
\]

\[
\Gamma = \begin{pmatrix}
0.83 & 0.17 \\
0.17 & 0.83 \\
\end{pmatrix}
\]

As usual, the stationary distribution of labor abilities \( H^* \) is obtained as the eigenvector of \( \Gamma \) with eigenvalue 1, giving \( H^* = [0.5, 0.5] \).

### 4.5 Entrepreneurial abilities

With respect to the entrepreneurial abilities vector \( E \), we follow the procedure described in Quadrini (2000), who uses data on the household distribution of businesses from the 1989 and 1992 waves of the SCF\(^{38}\). From the decile distribution of business wealth among families reporting a net value of the business greater than zero, he classifies businesses in three categories: small, medium and large projects. Consequently, \( E \) is defined as a four element vector \( \{\varepsilon_1, \varepsilon_2, \varepsilon_3, \varepsilon_4\} \), with \( \varepsilon_1 = 0 \) as already mentioned. In order to approximate the skewness in the distribution of business capital, Quadriini assigns 60 percent of all entrepreneurial ideas to the small, 30 percent to medium size and 10 percent to the large projects.

Computing the ratios among the average values of business wealth \( K_i \) for each group \( i \), he finds that medium size projects are 10 times bigger than small ones \( (K_3/K_1 = 10) \), and that large projects are also an order of magnitude larger than medium ones \( (K_4/K_1 = 10) \). Given our description of the entrepreneurial sector, we interpret \( K_i \) to be the unconstrained level of capital for each type of project

\[
K_i = \left( \varepsilon_i a_i b_i (w) \right)^{1/(1-(a_i+b_i))}
\]

and normalize \( \varepsilon_2 = 1 \), finding that \( \varepsilon_3 = 1.26 \) and \( \varepsilon_4 = 1.68 \). With respect to the transition matrices \( \Phi_{i,j} = \Phi(\varepsilon_i, \varepsilon_j, d = 0) \) and \( \Phi_{i,j} = \Phi(\varepsilon_i, \varepsilon_j, d = 1) \), the lack of good micro data makes their calibration somewhat problematic. In principle, we have two 4x4 matrices to calibrate, a total of 24 parameters when we take into account that each of their rows have to add up to one. With respect to \( \Phi_{i,j} \), we will assume that entrepreneurs learn from current ongoing projects and evolve according to a “ladder of opportunities”, as in Quadrini (2000). This ladder only allows entrepreneurs to move from one idea \( \varepsilon_j \) to another immediately adjacent to it: \( \varepsilon_{j-1} \) or \( \varepsilon_{j+1} \). As a result \( \Phi^i \) becomes a band matrix, with \( \Phi^i_{i,j} = 0 \) if \( |i-j| > 1 \) and 6 undetermined elements.

Parameter \( \Phi_{1,2} \) is set at 0.03, to match the unconditional probability of entry into entrepreneurship holding over the first nine deciles of the wealth distribution, as reported by Hurst and Lusardi (2004) from PSID. \( \Phi_{2,1} \) is set at 0.30, to match the average exit rate of entrepreneurs with less than three years of experience as reported by Quadrini (2000) using PSID data\(^{39}\). Imposing the restriction that \( \Phi_{3,2} = \Phi_{3,4} \), we set the remaining diagonal elements of \( \Phi^1 = \Phi^2 = \Phi^3 = \Phi^4 \) so that the stationary distribution of entrepreneurial ideas other from \( \varepsilon_1 \) is \( E^* = [0.6, 0.3, 0.1] \), as previously mentioned. The resulting transition matrix is

\[
\Phi^1 = \begin{pmatrix}
0.97 & 0.03 & 0.00 & 0.00 \\
0.30 & 0.63 & 0.07 & 0.00 \\
0.00 & 0.15 & 0.70 & 0.15 \\
0.00 & 0.00 & 0.41 & 0.59 \\
\end{pmatrix}
\]

\(^{38}\)Results are identical using SSBF data on net equity or the entire pooled cross section of the SCF.

\(^{39}\)Similar estimates are found from CPS by Evans and Leighton (1989), with entry and exit rates being 2.5% and 21% respectively.
With respect to $\Phi_{i,j}$, we will assume that $\Phi_{i,j}^0 = \Phi_{i,j}^1 \forall i,j$; implying that an agent that has been a worker in the current period, has to go to the bottom of the “ladder of opportunities” to draw a new idea for the subsequent period. In other words, previous ideas not implemented are lost forever.

### 4.6 Search and matching parameters

The last two parameters to pin down are the frictional cost of finding a partner $\rho$, and the disutility $\psi$ that agents incur from the loss of control when operating a firm in a team. The former is calibrated to match the percentage of households managing businesses in the SCF – 8.9% –. Note that this moment is not directly determined from the properties of the matrix $\Phi_{i,j}^1$, since the final number of entrepreneurial households depends on the characteristics of the distribution of agents looking for partners. The latter is calibrated so that in the steady state the proportion of entrepreneurs organized in teams is 0.27.

### 5 Results

In this section we present and discuss the results obtained from the calibrated model. In section 5.1, we focus on its quantitative performance, in particular on its ability to reproduce the relative differences observed in the data between solo and team entrepreneurs. Section 5.2 uses the calibrated model to study the contribution of teams to aggregate economic activity. Finally, section 5.3 deals with the workouts of the model, analyzing why teams emerge in this economy and why they increase the inequality in the distribution of wealth; as well as it explains the roles played by the search and disutility parameters, $\rho$ and $\psi$, in shaping the feasibility region and the distribution of households searching for partners.

#### 5.1 Quantitative analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target variable</th>
<th>Target value</th>
<th>Value obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.93</td>
<td>$i$</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>$A_c$</td>
<td>0.775</td>
<td>$K$</td>
<td>0.60</td>
<td>0.54</td>
</tr>
<tr>
<td>$a_{sb} + b_{ab}$</td>
<td>0.9</td>
<td>inc. entrep inc: entrep</td>
<td>0.22</td>
<td>0.20</td>
</tr>
<tr>
<td>$\rho$</td>
<td>0.70</td>
<td>share of entrep</td>
<td>0.089</td>
<td>0.087</td>
</tr>
<tr>
<td>$\psi$</td>
<td>0.041</td>
<td>share entrep in teams</td>
<td>0.27</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Table 13: Calibration targets and results

Table 13 shows the calibration results, with all targets being matched within 10% precision. Calibration values for the discount factor $\beta$ and the degree of homogeneity in the entrepreneurial technology were found to be consistent with those reported in earlier studies by Quadrini (2000) and De Nardi (2003). With respect to the calibrated value of $\rho$, it is worth noting that the search cost being 70% of the wage rate implies that no household is directly prevented from participating in the matching round. Even non-entrepreneurial agents with the lowest working ability – $\eta_1 = 0.76$ – have enough resources to search for a partner, if they wanted to.

To assess the quantitative performance of the model, we proceed to compare other statistics that can be computed from both our simulated economy and the data, and that are not related to the calibration targets. In the first place, table 14 provides some measures of aggregate economic activity computed from the model, showing that the macroeconomic representation of the small business sector is accurate. In the simulated economy, the entrepreneurial sector hires 40% of total capital – as we calibrated –, and 56% of total labor; producing 57% of total output. Similar estimates are documented by the Small Business Administration (2003) from the SSBF, with small businesses accounting for 50% of total non-farm private employment and 52% of non-farm private GDP.

Secondly, table 15 shows statistics computed from the simulated economy related to the concentration of wealth in the population. In the model, business families are 8.7% of the population and
<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>interest rate</td>
<td>0.040</td>
</tr>
<tr>
<td>wage rate</td>
<td>0.825</td>
</tr>
<tr>
<td>Total GDP</td>
<td>1.29</td>
</tr>
<tr>
<td>GDP_ssb</td>
<td>0.74</td>
</tr>
<tr>
<td>Labor Supply</td>
<td>1.00</td>
</tr>
<tr>
<td>Labor Demand_ssb</td>
<td>0.56</td>
</tr>
<tr>
<td>Capital-output ratio</td>
<td>2.56</td>
</tr>
</tbody>
</table>

Table 14: Aggregates in the Model Economy

<table>
<thead>
<tr>
<th></th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of Entrepreneurs</td>
<td>0.087</td>
</tr>
<tr>
<td>Entr. wealth to Total wealth ratio</td>
<td>0.49</td>
</tr>
<tr>
<td>Wealth Gini index</td>
<td>0.876</td>
</tr>
<tr>
<td>Share of wealth owned by richest 1%</td>
<td>0.38</td>
</tr>
<tr>
<td>Mean assets holdings (workers)</td>
<td>1.79</td>
</tr>
<tr>
<td>Mean assets holdings (entrep)</td>
<td>18.5</td>
</tr>
</tbody>
</table>

Table 15: Measures of wealth concentration

hold 49% of total net worth, while Gentry and Hubbard (2000) find this percentage to be 40% for the SCF. Also, the proportion of total net worth in the hands of the wealthiest 1% of the population in the model is 0.38, close to what Quadrini (2000) documents for the SCF – 0.33 –. In line with this, the Gini index for family wealth in the model economy is found to be 0.876, on the higher end of the values reported by Quadrini (2000) for the SCF – 0.78 and 0.86 –. We conclude that, in general, the model captures well the net worth concentration in the hands of entrepreneurs and the skewness in the distribution of wealth, although for the given value of $\gamma$ it tends to slightly exceed the degree of inequality observed in the data.\(^\text{40}\) This may be an important consideration if trying to estimate the tightness of borrowing constraints using a model of entrepreneurship without teams; adjusting $\gamma$ to match some degree of wealth inequality makes borrowing constraints look less tight than what they really are.

<table>
<thead>
<tr>
<th></th>
<th>Model Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrep. in teams</td>
<td>0.29</td>
</tr>
<tr>
<td>$GDP_{teams}/GDP_{entrep}$</td>
<td>0.46</td>
</tr>
<tr>
<td>$K_{teams}/K_{entrep}$</td>
<td>0.44</td>
</tr>
<tr>
<td>$L_{teams}/L_{entrep}$</td>
<td>0.44</td>
</tr>
<tr>
<td>Wealth_{teams}/Wealth_{entrep}</td>
<td>0.39</td>
</tr>
<tr>
<td>Income_{teams}/Income_{entrep}</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Table 16: Comparison between team and solo entrepreneurs

In the third place, table 16 shows the allocation of entrepreneurial factors of production, wealth and income between the two types of entrepreneurs. The model captures well the contribution of teams to the entrepreneurial sector. While in the baseline economy team firms are responsible for 46% of output, 44% of capital and 44% of labor among small businesses, in the SSBF these estimates are found to be 54%, 50% and 44% respectively. With regards to the wealth and income concentration within the entrepreneurial population, in the simulated economy team owners receive 44% of all entrepreneurial income and hold 39% of entrepreneurial wealth. While the income concentration is similar to that

\(^{40}\) Having calibrated $\gamma$ to match the proportion of total net worth in the hands of entrepreneurs as in Cagetti and DeNardi (2003) would have eliminated this problem, but it would have rendered useless any wealth comparison between entrepreneurs and workers.
observed in the SCF sample –51% –, the wealth concentration is lower than the one found in the data –57% –. Our model with financial frictions can therefore account for 44% of the wealth gap and 68% of the income gap between team and solo entrepreneurs. One reason for this discrepancy can be found in the assumption that teams are destroyed every period, something that we will cover in more detail in the discussion.

<table>
<thead>
<tr>
<th>Ownership range</th>
<th>team entrep. (SCF)</th>
<th>team entrep. (Model)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40% - 60%</td>
<td>0.52</td>
<td>0.38</td>
</tr>
<tr>
<td>33% - 67%</td>
<td>0.62</td>
<td>0.65</td>
</tr>
<tr>
<td>25% - 75%</td>
<td>0.69</td>
<td>0.72</td>
</tr>
<tr>
<td>20% - 80%</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>10% - 90%</td>
<td>0.89</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Table 17: Distribution of team entrepreneurs by ownership range.

Finally, table 17 shows the proportion of team entrepreneurs grouped by ownership share, for both the SCF and the baseline economy. As in the data, our model generates an important concentration of entrepreneurs having close to 50% ownership –38% –, but not as high as the one observed for the SCF–52% –. This is due to the discontinuity in the loss of control existing at 50%, the only sharing agreement where both owners have equal decision power over the firm. Our uniform $\psi$, although it generates some concentration, cannot account for such discontinuity. All the above suggests that while the current model with financial frictions can account for an important fraction of the differences between team and solo entrepreneurs, more structure may be necessary to match the details.

5.2 Aggregate consequences of teams

In this section, we use our calibrated model to assess the importance of teams for aggregate economic activity. As we said in the introduction, Fernández-Villaverde and Galdon-Sanchez (2003) find that an economy with financial frictions and a storage technology would experience a 30% increase in output if borrowing constraints were eliminated. Also, Cagetti and De Nardi (2003) show that relaxing borrowing constraints in an economy similar to ours –but without teams – increases wealth inequality and aggregate capital, with higher wage rates and lower interest rates.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline</th>
<th>$\gamma = 0.6$</th>
<th>$\gamma = 1.0$</th>
<th>$\gamma = 1.3$</th>
<th>$\gamma = 2.0$</th>
<th>$\gamma = 3.5$</th>
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</thead>
<tbody>
<tr>
<td>$\psi$</td>
<td>0.041</td>
<td>0.825</td>
<td>0.80</td>
<td>0.815</td>
<td>0.825</td>
<td>0.86</td>
</tr>
<tr>
<td>$\psi = 0$</td>
<td>0.04</td>
<td>0.045</td>
<td>0.0425</td>
<td>0.04</td>
<td>0.032</td>
<td>0.0225</td>
</tr>
<tr>
<td>$K^{supply}$</td>
<td>3.30</td>
<td>3.08</td>
<td>3.17</td>
<td>3.24</td>
<td>3.47</td>
<td>3.89</td>
</tr>
<tr>
<td>$K^{ab}$</td>
<td>1.52</td>
<td>1.02</td>
<td>1.28</td>
<td>1.47</td>
<td>2.17</td>
<td>3.70</td>
</tr>
<tr>
<td>$K^c$</td>
<td>1.78</td>
<td>2.06</td>
<td>1.89</td>
<td>1.77</td>
<td>1.36</td>
<td>0.19</td>
</tr>
<tr>
<td>$L^{supply}$</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>$L^{ab}$</td>
<td>0.56</td>
<td>0.44</td>
<td>0.52</td>
<td>0.56</td>
<td>0.72</td>
<td>0.92</td>
</tr>
<tr>
<td>GDP</td>
<td>1.29</td>
<td>1.22</td>
<td>1.26</td>
<td>1.29</td>
<td>1.36</td>
<td>1.48</td>
</tr>
<tr>
<td>GDP$^{ab}$</td>
<td>0.74</td>
<td>0.56</td>
<td>0.67</td>
<td>0.74</td>
<td>0.99</td>
<td>1.43</td>
</tr>
<tr>
<td>Mean Wealth workers</td>
<td>1.80</td>
<td>2.08</td>
<td>2.04</td>
<td>1.97</td>
<td>1.99</td>
<td>2.02</td>
</tr>
<tr>
<td>Mean Wealth entrep</td>
<td>16.93</td>
<td>14.09</td>
<td>14.7</td>
<td>15.03</td>
<td>15.88</td>
<td>20.21</td>
</tr>
<tr>
<td>Mean Wealth teams</td>
<td>22.95</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Wealth Gini index</td>
<td>0.876</td>
<td>0.85</td>
<td>0.86</td>
<td>0.861</td>
<td>0.87</td>
<td>0.894</td>
</tr>
</tbody>
</table>

Table 18: Aggregate consequences of teams and financial frictions.

Qualitatively speaking, we expect teams to have a similar impact in a financially constrained economy, the question being how large these effects are. To this end, table 18 shows some measures of
aggregate economic activity computed for the baseline model and for alternative economies in which teams are suppressed – setting $\psi = 100$ –, for different degrees in the tightness of financial frictions.

Since we are interested in considering values of $\gamma > 1$, we need to redefine the punishment in the event of default, in order to rule out the possibility for the entrepreneur to incur in infinite losses and being paid for that. For that reason, the punishment is going to be set in such a way that the payment to the entrepreneur under default is

$$\max \left\{ [\varepsilon f (k, n + \eta) - wn] - \gamma [\varepsilon f (k, n + \eta) - wn]^* + k (1 - \delta), 0 \right\}$$  \hspace{1cm} (12)$$

where $[\varepsilon f (k, n + \eta) - wn]$ are the actual profits collected by the entrepreneur during the period and $[\varepsilon f (k, n + \eta) - wn]^*$ are the maximum possible profits attainable, which are known since all information is public. Under this payoff scheme the entrepreneur always finds optimal to maximize profits, so the expressions found in section 3 remain unchanged.

From table 18, we observe that introducing teams into an otherwise financially constrained economy changes in a substantial way the importance of the small business sector: the shares of total output, assets and employment accounted by small firms increase 21% once teams are allowed. On top of that, total capital increases by 7% and total output by 5.6%. Finally, the degree of net worth inequality also increases, the wealth Gini index going from 0.85 to 0.876. Comparing across columns in table 18, we note that teams exert the same influence on aggregate activity as relaxing $\gamma$ by a factor 2.17 \(41\). The economy with $\gamma = 1.3$ and no teams has similar aggregate characteristics that the economy with $\gamma = 0.6$ and teams.

Finally, the last column of table 18 shows that for $\gamma = 3.5$ almost all factors of production are utilized in the entrepreneurial sector, with total output reaching 1.48. If we take the 21% output gap existing between this extreme case and the baseline economy without teams as a reference for the potential output gains of surmounting financial frictions, we come to the conclusion that teams are also very important for aggregate economic activity, allowing to surmount 26% of such output gap.

5.3 Discussion

Having assessed the quantitative performance of the model and the importance of teams for aggregate activity, in this section we comment on four issues. First, we study why teams appear in this economy, and what proportion of them are formed to surmount financial frictions and not due to other reasons. Secondly, we explain the economics behind the increase in wealth inequality observed after introducing teams. In the third place, we analyze the effects of the search cost, $\rho$, and the disutility of forming teams, $\psi$, on households’ decisions to participate in the search market and form teams. Finally, we assess in what ways the assumption that teams are destroyed every period is affecting our results.

5.3.1 The nature of teams in the model

<table>
<thead>
<tr>
<th>$\varepsilon_1$</th>
<th>$\varepsilon_2$</th>
<th>$\varepsilon_3$</th>
<th>$\varepsilon_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\varepsilon_1$</td>
<td>0.00</td>
<td>0.00</td>
<td>0.070</td>
</tr>
<tr>
<td>$\varepsilon_2$</td>
<td>0.00</td>
<td>0.05</td>
<td>0.075</td>
</tr>
<tr>
<td>$\varepsilon_3$</td>
<td>0.07</td>
<td>0.075</td>
<td>0.06</td>
</tr>
<tr>
<td>$\varepsilon_4$</td>
<td>0.09</td>
<td>0.10</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Table 19: Composition of team businesses, grouped by owners’ entrepreneurial abilities $\varepsilon$

In the model, matched households decide to constitute teams for three reasons: to share the additional profits arising from the expansion of the firm’s collateral, to smooth idiosyncratic risk in entrepreneurial abilities and to save future search costs. Insurance of idiosyncratic labor risk has already been excluded from consideration, because of the assumption that entrepreneurs in teams collect their labor earnings according to their labor abilities and not as part of the firm’s profits.

\(41\) This should come at no surprise, since our model admits only two member teams
Given that the entrepreneurial ability for a team-owned business is given by the maximum ability of the two partners, an agent with an idea in the current period and willing to run a business can lower the idiosyncratic entrepreneurial risk the following period by engaging in a team with an appropriate partner. In this respect, among all possible combinations, only those between agents with the same entrepreneurial ability provide significant risk sharing. This is so because the probability \( \Phi_{k,k-1}^1 \) of transiting to a lower ability is at least two times larger than the probability \( \Phi_{j,j+1}^1 \) of transiting to a higher ability level, for every \( k \) and \( j \), implying that the idiosyncratic risk of an asymmetric team will not differ much from that of the agent with the initially larger entrepreneurial ability\(^{42}\). Therefore, the proportion of symmetric teams provides an upper bound to the share of team businesses formed due to entrepreneurial risk smoothing in the model. Table 19 shows the distribution of teams for the baseline economy, grouped by owners’ entrepreneurial abilities. Only 19% of all team firms are symmetric, indicating that smoothing entrepreneurial abilities is not the main mechanism at work.

A closer estimate can be found by eliminating financial frictions from the firms’ problem in the baseline economy, while keeping the matching stage available to households. Relaxing the borrowing constraint increases the incentives of households willing to smooth out entrepreneurial risk to search for a partner, as the volatility of next period profits increases. On the other hand, it reduces the willingness of otherwise financially constrained entrepreneurs to search for a partner, since they now can borrow more. We therefore raised the appropriability factor \( \gamma \) from 0.6 to 3.5, maintaining factor prices at the baseline economy equilibrium levels\(^{43}\), and computed the measure of households searching for partners. We find that in this case nobody searches for a partner, indicating the only reason why households look for a teammate in the model is to surmount financial frictions.

This leaves us with the question of why are symmetric teams formed, if not for insurance purposes. Being matched to a household with the same \( \varepsilon \) should be in principle an undesirable event, as the entrepreneurial production function has decreasing returns to scale and the associated profit function is strictly concave in the owner’s assets (see figure in appendix). Therefore, both agents should be better off running their firms separately rather than together. The only case when this is not true is when both households are so poor that they prefer to loose some profits instead of having to pay the search cost the following period. We therefore conclude that while all searching households engage in the search of a partner to surmount financial frictions, there is approximately a 20% of teams that are formed only to avoid paying the search cost the following round. The remaining 80% of our teams are intended to overcome borrowing constraints.

5.3.2 On the increase in wealth inequality

There are four reasons why introducing teams concentrates more wealth in the hands of entrepreneurs. The first one can be inferred from figure 6. It shows households’ decision to search for a business partner as a function of net worth and entrepreneurial ability, holding fixed \( \eta = \eta_1 \). Agents with low productivity ideas – either \( \varepsilon_1 \) or \( \varepsilon_2 \) – can now search for a partner, and they do so if they have enough wealth to be accepted in a team with high probability. This does not happen in models of entrepreneurship without teams, as every rich household who looses his business ability has to wait until a new idea arrives – something that happens exogenously with very low probability \( \cdot \). In the meantime, such household is being counted as a worker and eats up his wealth. As a result, the share of net worth in the hands of entrepreneurs is artiﬁcially reduced. In our model, wealthy households with \( \varepsilon_1 \) or \( \varepsilon_2 \) start immediately searching for partners, and those who find the appropriate match make a team, maintaining higher income and wealth levels while at the same time still being counted as entrepreneurs.

This same mechanism explains, qualitatively, why is the likelihood of starting a new business for a

\(^{42}\)The joint probability of maintaining the same productivity for a team between households of types \( \varepsilon_4 \) and \( \varepsilon_3 \) is 0.66, versus 0.6 if the type \( \varepsilon_4 \) is considered alone. For a match between a type \( \varepsilon_3 \) and a type \( \varepsilon_2 \) agents, the chances of not ending up with joint ability \( \varepsilon_2 \) is 0.86, against 0.85 of the type \( \varepsilon_3 \) alone. Similarly, the chances for such team of ending up with productivity \( \varepsilon_4 \) is 0.15, the same that the partner with \( \varepsilon_3 \) could get by herself. Finally, matches between non adjacent types (say, \( \varepsilon_4 \) and \( \varepsilon_2 \)) cannot provide any insurance.

\(^{43}\)This is a comparative static exercise, where we are not concerned with general equilibrium. The new equilibrium without financial frictions would lead to a change in factor prices and the volatility of profits; with households having different incentives to form teams.
current worker nonlinearly increasing in her current net worth, as documented by Hurst and Lusardi (2004). On the other hand, working households without sufficient wealth do not search, their likelihood to open a new business being uniform and dependent on the exogenous shock given by $\Phi_{1,2}$. On the other, working households with wealth search for partners, increasing their chances of being back in business.

The second reason why wealth inequality rises is that having teams in the model increases the collateral available for firms with high $\varepsilon$, whose owners are now able to borrow more capital and make more profits. Despite their increase in collateral, business owners are still borrowing constrained, and so they keep accumulating assets at high rates. This increases aggregate capital and reduces interest rates, which in turn lowers workers’ incentives to save – but not those of borrowing constrained entrepreneurs, as their returns on savings are still given by the higher marginal return on their business capital –. Hence, the wealth gap between entrepreneurs and workers goes up. This expansion in the production possibility sets of high productivity firms is also responsible for the increase in the contribution of the small business sector to total output observed in section 5.2, with productive factors being shifted away from the corporate sector towards highly productive small firms.

The last two reasons for the increase in inequality are related to the higher saving rates of households searching for partners. On the one hand, searching households have an incentive to save marginally more to improve their bargaining positions when negotiating the distribution of future profits. On the other, searching households with $\varepsilon_1$ or $\varepsilon_2$ save more on the margin to increase their chances to be accepted into a team by a household with high $\varepsilon$, for reasons that we will see in the next section.

### 5.3.3 Understanding the roles of $\rho$ and $\psi$

In order to understand the roles that the search cost $\rho$ and the disutility of forming teams $\psi$ play in the model, it is useful first to fix a pair of agents’ abilities and have a look at the feasibility regions determined by the asset holdings of potential partners. Figure 7 displays the share of profits $\theta_j^i$ corresponding to agent $j$ as a function of the asset holdings of both agents – $j$ and $-j$ –, for the particular case when the two households have the same entrepreneurial skill, $\varepsilon_3$, and labor ability, $\eta_2$. The set of asset combinations for which $\theta_j^i > 0$ determines the portion of the feasibility region corresponding to this particular type of match. From the figure, we see that the only case when two identical households engage in a team is when at least one of them is sufficiently poor. In this situation, both agents are better off together, making less profits but saving the future cost of searching. While the relatively wealthier agent gets the majority of the profits, the other simply gets something more than her wage rate. This is almost the same outcome that they could make independently if they
decided to split apart, but by forming a team they avoid to incur in the search cost the following period. Their existence in the model economy – 19% of teams are of this type – reduces the wealth in the hands of team entrepreneurs. However, it also indicates that the 44% of the wealth gap being explained by our model should be considered as a lower bound of what financial frictions can really account for team formation.

With regards to asymmetric abilities, see figure 8, matches of this kind have a much bigger chance of ending in a team, as the feasibility region extends further into the assets domain. This is so because the asymmetry in agents’ productivities increases the gains from trade that both households get in a team, especially if the household with the smallest entrepreneurial ability is rich enough. In figure 9, we show a typical feasibility region for households with different entrepreneurial abilities; the horizontal axis indicating the wealth holdings of the partner with the lower ability \( \varepsilon \). The feasibility region turns out to be hump shaped, being limited by the lower envelope of two curves, labelled \( A_1 \) and \( A_2 \), also shown in figure 9. Each point on \( A_1 \) indicates, for given asset holdings of agent \( j \), the minimum wealth that a prospective partner with the abilities of agent \( -j \) needs to have; so that the team can create enough surplus to compensate agent \( j \) for the disutility \( \psi \) of entering into a team. As the value functions are concave and \( \psi > 0 \) is a constant, such minimum wealth must be an increasing and convex function of the wealth of agent \( j \). On the other hand, each point on \( A_2 \) indicates the maximum net worth that a prospective partner \( -j \) can have in order for the solution of the bargaining problem to be acceptable by agent \( j \). As can be seen in figure 8, as the wealth of household \( -j \) increases, the share of profits going to agent \( j \) becomes progressively smaller; up to a point where it is no longer acceptable since it does not compensate her disutility \( \psi \).

It is easy to see from the above that an increase in \( \psi \) shifts both the \( A_1 \) and the \( A_2 \) curves downwards, reducing the feasibility region and the share of teams. This is shown in figure 10, where we plot the proportion of team entrepreneurs as a function of \( \psi \), holding fixed all parameters and prices at their baseline economy levels – to avoid general equilibrium effects and concentrate on the role of \( \psi \)\(^{44}\). Table 20 shows, at the same time, that the contraction in the feasibility region deters some households from searching and reduces the proportion of searchers that end in a match, making the matching technology more inefficient. Such increase in inefficiency is justified by the fact that an increase in \( \psi \) deters primarily the richest households from searching. Since their value functions are strictly concave, a larger \( \psi \) implies that they need to receive a much bigger share of profits in order

\(^{44}\)In figure 10, we can also observe one example of the discontinuous behavior of agents previously mentioned in section 4. For some \( 0.042 < \psi^* < 0.046 \), a significant fraction of households stop searching, and hence the number of team entrepreneurs becomes discontinuous.
to accept participating into a team. Finding a household willing to concede such a large $\theta$ is a much more unlikely event, and unworthy of paying the search cost $\rho$. As a result of this, the proportion of matches between agents with the same entrepreneurial idea is more likely to occur, and since this type of symmetric matches have a lower chance of ending in a team the efficiency of the matching technology decreases.

With respect to the search cost, an increase in $\rho$ has three effects. First it makes searching for a partner less profitable, reducing the number of searchers and matches. Second, at low values of $\rho$, an increase in the search cost induces those agents adding little value to teams to self select and stop searching, reducing the congestion in the market and increasing the number of teams as a proportion of entrepreneurs. Finally, given that agents in matches do not pay the search cost the following period, an increase in $\rho$ also expands marginally the feasibility region, as we already discussed. The composition of all effects is shown in figure 11.

To conclude, the influence of $\rho$ and $\psi$ on households’ decision to search can also be seen in figure 6. Households with $\varepsilon_1$ and $\varepsilon_2$ self-select into searching for a match and paying the search cost $\rho > 0$, only if they have sufficient wealth to create the necessary surplus to be accepted in expectation by a prospective partner of type $\varepsilon_3$ or $\varepsilon_4$ – for a given disutility level $\psi > 0$ –. On the other hand, households with $\varepsilon_3$ and $\varepsilon_4$ only search if they are sufficiently borrowing constrained – i.e. there are enough remaining profits to be made by the business to accommodate a partner and still surmount the disutility $\psi$. Finally, since type $\varepsilon_2$ projects generate too little profits, borrowing constrained entrepreneurs with $\varepsilon_2$ do not have enough surplus left to offer to a teammate, for given $\rho > 0$ and $\psi > 0$, and therefore they do not search.

5.3.4 Consequences of destructing teams every period

Finally, in this section we want to determine the ways in which the results of the model economy may be affected by the assumption that teams are destroyed every period.

First of all, there are two reasons why this assumption lowers the wealth concentration in the hands
of team entrepreneurs. One of them has already been mentioned in the previous section, and has to
do with the formation of symmetric teams in order to save future search costs. Approximately 20% of
teams in our economy are of this type, and they necessarily need at least one entrepreneur with low
wealth to be feasible. This type of partnerships would certainly not emerge in a setup with endogenous
dissolution, or in which the search cost is paid every period.

The other reason for observing a lower concentration of wealth is related to the high turnover rate
from team entrepreneurship, which in turn is due to the low efficiency of the matching technology. In
our economy, each agent currently engaged in a partnership faces only a 47 percent chance – see table
20 – of finding an appropriate match for the following period. This high turnover rate introduces a
mixing effect in the population, reducing the ability of the model to fully separate entrepreneurs in
teams from solo entrepreneur, and therefore lowering the concentration of wealth in the hands of team
owners. Endowing teams with endogenous dissolution would help avoiding this mixing effect.

In the second place, having teams destroyed every period prevents from seeing any strategic savings
between partners, something that should take place in an endogenous dissolution setting. In the
current model, every team member expects to meet the average searcher at the end of a period and

\[ \text{Figure 9: The hump shaped portion of the feasibility region for asymmetric partners} \]

\[ \text{Figure 10: Effect of increasing } \psi \text{ on the share of entrepreneurs in teams.} \]

\[ \text{\footnotesize{\textsuperscript{45}If we assume that team members are allowed to renegotiate the ownership shares every period.}} \]
not her current teammate, so her saving rate becomes independent of whom she is coupled to. However, these effects are expected to be of second order, given the self selection existing in the search market. The main incentives that make searching households to save are maintained, these being the desire to increase their expected share of profits in a future team, their willingness to enhance their chances of being accepted when matched with a prospective partner, and their high returns to saving from the exploitation of larger businesses.

Finally, there are some outcomes of the model that should remain relatively invariant even after introducing endogenous dissolution. One of them is the shape of the feasibility region for asymmetric teams, given that the curves $A_1$ and $A_2$ depend on $\psi$ and not on the continuation probability of a team. Another result that would remain unchanged is the decision rule to search for a partner. As long as $\rho$ and $\psi$ are nonzero, households without wealth and entrepreneurial ideas would still prefer not to search for a partner, even if continuation is endogenous. This is so because, unless they meet a sufficiently poor type $\varepsilon_3$ or $\varepsilon_4$ household – which are hard to find given the properties of the transition probability matrix $\Phi^1$ – they are not going to be accepted into a team by anybody. Moreover, their chances to find such a partner are reduced even more when considering the congestion effect that they themselves introduce by entering into the search market. These observations suggest that given a search cost $\rho > 0$ and a disutility parameter $\psi > 0$, we should expect to observe almost the same type of agents self selecting and looking for partners.

6 Conclusions

In this paper we asked ourselves to what extent could households engage in production teams to surmount financial frictions. By looking at US data, we found evidence consistent with the idea that agents participate in partnerships when the business requires a substantial amount of investment, but at the same time is very profitable. This is precisely the type of scenario portrayed by Evans and Jovanovic (1989): agents suffering the most from borrowing constraints are the ones with the most valuable business ideas but insufficient capital. Forming partnerships has proven in this paper to be one way by which entrepreneurial households partially overcome this problem, being capable of expanding the production possibility sets of their firms, making more profits and accumulating more wealth. This was done by constructing and calibrating a simple model of entrepreneurial choice and
financial frictions, to which we added a matching technology and a bargaining mechanism for sharing the proceedings of joint ventures. The ability of the model to quantitatively reproduce the relative differences between team and solo ventures, both at the macro and micro levels, is an indication that borrowing constraints do play an important role in the formation of teams.

These results suggest some directions for further research. Firstly, having found that teams are capable of surmounting 26% of the output gap even in an environment where the matching technology is costly and inefficient, suggests that the potential benefits of having a matching agency dedicated to maximize the expected surplus from matching entrepreneurs and investors can be quite large. In fact, the surge of internet companies offering angel investing services seems to point in this direction, turning our model into a useful tool to assess the value of this growing market. Finally, from a policy analysis perspective, our framework also seems suitable to study how alternative tax systems may affect the formation of teams, the size of the entrepreneurial sector and, consequently, the aggregate state of the economy.

References


7 Appendix

7.1 Characteristics of Team and Solo Entrepreneurs

7.1.1 Descriptive statistics of respondents and distribution of businesses by sector

Panel Study of Entrepreneurial Dynamics

Table A.1 Summary Statistics

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<thead>
<tr>
<th></th>
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<tr>
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</tr>
<tr>
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<td>43</td>
</tr>
<tr>
<td>Age (yrs) (Mean)</td>
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</tr>
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<td>59</td>
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<td>Post College</td>
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<td>14</td>
</tr>
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<td>Wkr. full time</td>
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</tr>
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<td>Retired/Not Wkr</td>
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</tr>
</tbody>
</table>

Figures are in percentages (Except Age)

Table A.2 Dist. by sector

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<thead>
<tr>
<th></th>
<th>Teams</th>
<th>Solo</th>
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</thead>
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<td>agr,forest, fish</td>
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<td>3.83</td>
</tr>
<tr>
<td>construction</td>
<td>4.81</td>
<td>4.90</td>
</tr>
<tr>
<td>manufacturing</td>
<td>6.06</td>
<td>5.31</td>
</tr>
<tr>
<td>trans, comm, util</td>
<td>2.83</td>
<td>2.79</td>
</tr>
<tr>
<td>wholesale</td>
<td>3.07</td>
<td>3.22</td>
</tr>
<tr>
<td>retail</td>
<td>23.65</td>
<td>25.97</td>
</tr>
<tr>
<td>fin, ins, real est</td>
<td>7.77</td>
<td>4.72</td>
</tr>
<tr>
<td>services</td>
<td>47.44</td>
<td>48.52</td>
</tr>
<tr>
<td>other</td>
<td>0.00</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Figures are in percentages

Survey of Consumer Finances

Table A.3 Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>Teams</th>
<th>Solo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of Entrepreneurs</td>
<td>0.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Age of hh. head (yrs.) (mean)</td>
<td>45.5</td>
<td>47.2</td>
</tr>
<tr>
<td>Firm age (yrs.) (mean)</td>
<td>9.9</td>
<td>10.9</td>
</tr>
<tr>
<td>% High School degree</td>
<td>92</td>
<td>89</td>
</tr>
<tr>
<td>% Some College</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>% College degree</td>
<td>52</td>
<td>41</td>
</tr>
<tr>
<td>% Retired</td>
<td>4.7</td>
<td>7.6</td>
</tr>
<tr>
<td>% Ownership in 40% - 60%</td>
<td>52</td>
<td>0</td>
</tr>
<tr>
<td>Num. act. mngd bus (mean)</td>
<td>1.38</td>
<td>1.25</td>
</tr>
<tr>
<td>% Started the bus.</td>
<td>50</td>
<td>69</td>
</tr>
<tr>
<td>% Inh. / Given</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>% Bought/Inv.</td>
<td>30</td>
<td>27</td>
</tr>
</tbody>
</table>

Source: SCF (2854 households)

Table A.4 Dist. by Sector

<table>
<thead>
<tr>
<th></th>
<th>Teams</th>
<th>Solo</th>
</tr>
</thead>
<tbody>
<tr>
<td>agriculture</td>
<td>10%</td>
<td>16%</td>
</tr>
<tr>
<td>construction</td>
<td>18%</td>
<td>15%</td>
</tr>
<tr>
<td>manufacturing</td>
<td>6%</td>
<td>2%</td>
</tr>
<tr>
<td>retail &amp; wholesale</td>
<td>24%</td>
<td>27%</td>
</tr>
<tr>
<td>real estate, insur.</td>
<td>17%</td>
<td>17%</td>
</tr>
<tr>
<td>prof. practice</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>fin. &amp; bus. serv.</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>other services</td>
<td>11%</td>
<td>11%</td>
</tr>
</tbody>
</table>

7.2 Borrowing constraint for entrepreneurs in teams

If the joint firm defaults on its debt, the proceedings for the team are

$$\gamma \left[ g_{j-j}^* f \left(k, n + \eta_j + \eta_{-j} \right) - wn \right] + (1 - \delta) k;$$

(13)

whereas if the debt is repaid, each partner gets a fraction $\theta_j$ and $1 - \theta_j$ of the profits. The total resources that both partners would have if debt $k$ is honored is

$$g_{j-j}^* f \left(k, n_{j-j} + \eta_j + \eta_{-j} \right) - w n_{j-j} - (i + \delta) k + (1 + i) (a_j + a_{-j})$$

(14)

with $n_{j-j} = n(\varepsilon_j, \eta_j, \varepsilon_{-j}, \eta_{-j}, k)$. Once we allow for potential ex post redistribution of proceeds under default, we have that a necessary and sufficient condition for both partners not to be willing to repay the debt is that the total proceedings in (13) exceeds the joint resources available in (14). So, given the observable states $(\varepsilon_i, \eta_i, a_i), i = \{j, -j\}$, for both team members, the financial intermediary will set a borrowing constraint $b$ so that default is never optimal. Setting $k = b$ in (13) and (14), we find after some manipulation that $b$ is the solution to

$$b = (a_j + a_{-j}) + \frac{\gamma}{(1 + i)} \left[ g_{j-j}^* f \left(b, n_{j-j} + \eta_j + \eta_{-j} \right) - w n_{j-j} \right]$$
7.3 Stationary measures in equilibrium

In a steady state recursive competitive equilibrium, measures $\mu^1_s$ and $\mu^1_p$ must be a fixed point of

$$
\mu^1_s (A) = \int_{Z_s} Q^s (z^1_s, A) \mu^1_s (dz^1_s) + \int_{Z_p} P^p (z^1_{p,j}, A) \mu^1_p (dz^1_{p,j})
$$

$$
\mu^1_p (B) = \int_{Z_s} P^s (z^1_s, B) \mu^1_s (dz^1_s) + \int_{Z_p} Q^p (z^1_{p,j}, B) \mu^1_p (dz^1_{p,j})
$$

for transition functions $Q^s : \mathbb{Z}_s \times \mathbb{Z}_s \to [0, 1]$, $Q^p : \mathbb{Z}_p \times \mathbb{Z}_p \to [0, 1]$ and stochastic kernels $P^s : \mathbb{Z}_s \times \mathbb{Z}_s \to [0, 1]$, $P^p : \mathbb{Z}_p \times \mathbb{Z}_p \to [0, 1]$, which in turn must be consistent with households’ individual behavior, for any given sets $A \in \mathbb{Z}_s$, $B \in \mathbb{Z}_p$.

The transition functions $Q^s$ and $Q^p$, and the stochastic kernels $P^s$ and $P^p$ are given by

- 
  $$
  Q^s (z^1_s, A) = \sum_{\epsilon' \in E} \sum_{\eta' \in H} \Gamma (\eta' | \eta) \Phi (\epsilon' | \epsilon, d_s (z^3_s)) \chi (z^{1'}_s \in A)
  $$

  $$
  \left\{ \chi [q (z^1_s) = 0] + \chi [q (z^1_s) = 1] \int_{Z_s} \chi \left[ (z^2_s, \tilde{z}) \notin F \right] \mu^2_s,1 (d\tilde{z}) \right\}
  $$

  with $z^2_s = z^3_s = (\epsilon, \eta, d, a_s (z^1_s))$, $z^{1'}_s = (\epsilon', \eta', d_s (z^3_s), a_s (z^1_s))$, and $\mu^2_s,1$ given by equation (4);

- 
  $$
  P^p (z^1_{p,j}, A) = \sum_{\epsilon' \in E} \sum_{\eta' \in H} \Gamma (\eta' | \eta) \Phi (\epsilon' | \epsilon, d_p (z^3_{p,j})) \chi (z^{1'}_{p,j} \in A)
  $$

  $$
  \left\{ \int_{Z_s} \chi \left[ (z^2_{s,j}, \tilde{z}) \notin F \right] \mu^2_s,1 (d\tilde{z}) \right\}
  $$

  with $z^2_{s,j} = (\epsilon', \eta', d_p (z^3_{s,j}), a_p (z^1_{p,j}))$, $z^{1'}_{s,j} = z^3_{s,j} = (\epsilon_j, \eta_j, 1, a_p (z^1_{p,j}))$;

- 
  $$
  Q^p (z^1_{p,j}, B) = \sum_{(\epsilon', \eta') \in E \times H} \Gamma (\eta' | \eta) \Gamma (\tilde{\eta}' | \tilde{\eta}) \Phi (\epsilon' | \epsilon, 1) \Phi (\tilde{\epsilon}' | \tilde{\epsilon}, 1) \chi \left[ z^{1'}_{p,j} \in B \right]
  $$

  $$
  \left\{ \int_{Z_s} \chi \left[ (z^2_{s,j}, \tilde{z}) \in F \right] \mu^2_s,1 (d\tilde{z}) \right\}
  $$

  with $z^2_{p,j} = (z^{1'}_{s,j}, z^{1'}_{s,-j}, \theta^* (z^2_{s,j}, z^2_{s,-j}), \theta^* (z^2_{s,j}, \tilde{z}))$, $z^{1''}_{p,j} = (z^{1'}_{s,j}, (\tilde{\epsilon}', \tilde{\eta}', 1, \tilde{a}), \theta^* (z^2_{s,j}, \tilde{z}))$;

- 
  $$
  P^s (z^1_s, B) = \sum_{(\epsilon', \eta') \in E \times H} \Gamma (\eta' | \eta) \Phi (\epsilon' | \epsilon, 1) \Gamma (\tilde{\eta}' | \tilde{\eta}) \Phi (\tilde{\epsilon}' | \tilde{\epsilon}, 1) \chi \left[ z^{1''}_{p,j} \in B \right]
  $$

  $$
  \left\{ \int_{Z_s} \chi \left[ (z^2_s, \tilde{z}) \in F \right] \mu^2_s,1 (d\tilde{z}) \right\}
  $$

with $\chi ()$ denoting the indicator function as before.
7.4 Computational Appendix

7.4.1 Discretization of the Asset Space

We first restrict the set of possible asset holdings with a closed interval $I = [0 \ 200]$. The upper bound is set at 200 so that, in the stationary equilibrium, the measure of households with assets at or beyond that level is zero. We then divide the interval $I$ into a mesh of 64 adjacent elements, its density being a decreasing function of wealth. The numerical method solves the households’ programming problem at the endpoints of each element. In a first pass it uses a basic grid search method, and in a second pass it refines the solution taking the two elements sharing the best node from the first pass and using linear interpolation within elements. To compute the stationary measure of households in equilibrium a finer mesh is used, increasing the mesh density between 0 and 1, 1 and 50, and above 50 by factors 2, 3, and 4 respectively. The resulting final number of asset nodes was 185.

7.4.2 Computational Algorithm

The algorithm to find an equilibrium is as follows:

1. For given parameter values, we start with a guess of the interest rate $i$. We compute $w$ from the zero profit condition for the corporate sector.

2. Given prices, we solve the households’ problem by iteration on the value function. We start by guessing a measure of agents $\mu_{s,q}^2$, $q = 0, 1$, and candidates for $v_s^3$, $v_s^2$ and $v_s^1$. These are found by solving the problem of entrepreneurs when teams are not allowed, making $p = 1000$. Trivially, in this case $v_s^2 = v_s^3$. This is a problem similar to Quadrini (2000), and hence omitted.

3. We then proceed in the following way:

   (a) Holding fixed $\mu_{s,q}^2 = \mu_{old}$, we take the initial guesses of $v_s^3$, $v_s^2$ and $v_s^1$ and solve the problem backwards for each subperiod.
      
      i. With $v_s^2$, we first solve the problem of partners, finding $v_p^3$, $a_p$, and $c_p$.
      
      ii. Using $v_p^3$ and $v_s^2$, we solve for $v_{m}^{3}()$, $\theta^*(())$ and the feasibility region $F$. The bargaining solution $\theta^*(())$ is computed using a grid search procedure. The grid ranges from 0 to 1 at intervals of 0.01.
      
      iii. With $v_{m}^{3}()$ and $\mu_{s,1}^{2}$, we compute $v_{s}^{2}(, q) = E(v_{m}^{3}() | \mu_{s,1}^{2}) q + (1 - q) v_{s}^{3}(())$.
      
      iv. Using $v_{s}^{2}(, q)$, we solve for $v_{s}^{1}(())$ and $v_{s}^{3}(())$, finding in the process $a_p$, $c_p$ and $q(.)$.

   (b) Once convergence of the value functions is attained, or the number of iterations is a multiple of 10, we update the measure $\mu_{s,q}^2$. Holding fixed the policies and value functions, we assume $\mu_{s,q}^2 = \mu_{k}^2$ and construct the transitional operators $T_k^{q0}$, $q, q' \in \{0, 1\}$ for the measure of households before the matching. We then look for a fix point $\mu_{k+1}^2$ of

   $\mu_{s,1N+1}^2 = T_{k}^{11} \mu_{s,1N}^2 + T_{k}^{10} \mu_{s,0N}^2$

   $\mu_{s,0N+1}^2 = T_{k}^{01} \mu_{s,1N}^2 + T_{k}^{00} \mu_{s,0N}^2$

   If $\mu_{k+1}^2 = \mu_{k}^2$, we exit this stage, if not we recompute $T^{q0}$ and iterate until $\mu_{k+j-1}^2 = \mu_{k+j-1}^2 = \mu_{new}$. If the value functions had not converged yet, we make $\mu_{old} = \mu_{new}$ and go back to a. Otherwise, we go to point c. The reason why we do not update the measure in every iteration is because its computational cost increases with the number of individual states raised to the fourth power.

   (c) If $\mu_{old} = \mu_{new}$ we go to step 4. If not, we make $\mu_{old} = \mu_{new}$ and go back to a.

4. Once convergence is attained, market clearing conditions are tested. We compute from the resulting measure of households, the supply of capital and labor, as well as the amount of both inputs used by the entrepreneurial and corporate sector.

5. If factor markets clear, the algorithm ends. If not, the interest rate $i$ is updated and the procedure starts over until market clearing is achieved.
7.5 Some Results from the baseline Economy

Capital demand by single entrepreneurs, \( \eta = \eta_2 \).

Profit functions of single entrepreneurs, for different values of \( \varepsilon \), and for \( \eta = \eta_2 \).

Value function \( v^1_{ss} \).