Entrepreneurship, Labor Market Mobility and the Role of Entrepreneurial Insurance*

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Abstract

This paper introduces a quantitative general equilibrium model with risky entrepreneurship and search frictions designed to endogenously match the magnitude of the occupational flows between entrepreneurship, paid-employment and unemployment. The model also accounts for the general shape of these flows as well as key entrepreneurial and labor market features in the US, based mostly on micro CPS and SCF data. We use this model to examine the mitigation of the bias created by most current unemployment insurance programs in favor of paid-employment and at the expense of self-employment. We show that an entrepreneurial insurance program can significantly reduce this bias and we decompose the elements that most contribute to this reduction. Comparing this policy to an entrepreneurial subsidy, we find that entrepreneurial insurance selects more talented, wealthier, faster growing and longer lasting entrepreneurs from the unemployment pool. Finally, we find that UI system attributes have a significant impact on entrepreneurship, which might be an important additional concern for optimal UI design.

Keywords: entrepreneurship, labor market mobility, unemployment, insurance.

JEL classification: E24, J68, E61

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1 Introduction

If we were to look at the vast number of programs promoting entrepreneurship across many countries, it would be fair to conclude that policymakers have acknowledged the potential virtues of having a sizable amount of entrepreneurs in the economy. This subject has found a large echo in the academic literature, but, among the many questions addressed by the substantial body of papers on entrepreneurs, two important issues have so far drawn relative little attention: (i) the existence of a distortion arising from the current unemployment insurance (UI) system that favors the search for paid-employment rather than self-employment and, (ii) the related question of insuring the downside risk inherent to any entrepreneurial activity as a means to reduce the above distortion. By enforcing the requirements that unemployed individuals are available for work and actively searching for a job in order to obtain regular benefits, most UI programs implicitly disfavor the pursuit of an entrepreneurial project. At the same time, for those becoming entrepreneurs, the downside risk, defined as the risk supported by the entrepreneur on her income stream because of potential business failure or bad performance, is a stark reality. The main trade-off appearing with the opportunity of insuring downside risk can be stated as follows: on the one hand, the existence of downside risk could be an important selection mechanism of the ablest entrepreneurs. On the other hand, downside risk could prevent many potentially successful individuals from engaging in an entrepreneurial activity. The papers by Hombert et al. (2017), Ejrnæs and Hochguertel (2014) and Caliendo and Künn (2011) have paved the way for empirically addressing this trade-off. The policy discussed in Hombert et al. (2017) maintains the UI rights of unemployed individuals when they start a small business in order to alleviate the effects of adverse business shocks. Implementing such a reform is a step towards reducing the distortion arising from current UI systems. However, before addressing these issues, remains the important task of representing the endogenous occupational choices and the associated occupational flows between activities, crucial for understanding the above and related policies. The main contribution of this paper is thus to build a rich theoretical framework encompassing entrepreneurs and detailed occupational flows. To support this objective, we start by documenting a number of empirical facts about entrepreneurship and the labor market focusing on these flows. Our second contribution is to use this framework to assess the interaction between UI and entrepreneurship, with a special focus on the introduction of an entrepreneurial insurance in the US. To the best of our knowledge, this paper is the first to tackle this agenda.

The basic building block of our economy is an incomplete markets general equilibrium model with heterogeneous agents, occupational choice, risky entrepreneurship and search frictions, as it will let us naturally deal with questions such as the composition of the entrepreneurial pool, mobility across activities and potentially redistributive policies. In our economy, agents can either be employed in a corporate sector, self-employed in an entrepreneurial activity or unemployed. Employed agents face an unemployment risk and they can also exert some effort towards becoming self-employed *on-the-job*. Self-employed agents, that we will commonly call entrepreneurs, can exert some effort towards finding a corporate job *on-the-business*. They might experience an adverse shock on their firm's productivity, leading them to potentially default on a previously contracted debt. Importantly, they have to decide how much to invest in their business before knowing this shock. Finally, unemployed agents can exert some effort to find a corporate job and can also exert some effort towards becoming an entrepreneur. The government runs a tax-financed UI program that partly covers the income loss of short-term unemployed individuals. In our baseline economy, as in the US, entrepreneurs that fall out of business cannot claim such UI rights.

We use Current Population Survey (CPS) micro data to characterize occupational flows between paid-employment, unemployment and entrepreneurship in our baseline economy. Using education, earnings and wages in the data and ability in the model and with only a very parsimonious and basic set of assumptions, we capture most of the shapes of these flows, namely the hump-shape of the flow from unemployment to employment, the decreasing shapes from employment to unemployment and entrepreneurship to unemployment, the increasing shape between unemployment and entrepreneurship and the increasing part of the flow from entrepreneurship to employment[1]. We show that wealth and ability are crucial for matching these flows. Importantly, we match the magnitude of a number of flows: we capture the high entrepreneurial exit rate into paid-employment or show that unemployed individuals are four times as likely to start a business as employed individuals. In contrast to the previous literature on the subject, we obtain most of these flows endogenously: for instance, we do not impose an exogenous entrepreneurial exit mechanism. The model is also able to match a large number of other entrepreneurial or individual characteristics found in CPS and Survey of Consumer Finances (SCF) data such as the relative wealth between occupations, entrepreneurial earnings including the zero or negative earnings fraction and the fraction of people starting a business out of necessity. Our resulting entrepreneurial survival rate is consistent with the data, both in terms of magnitude, but also in replicating the large exit rate of young entrepreneurs and the low exit rate of older entrepreneurs. We thus find that the model is well suited to address our main concern regarding occupational choices and flows and relevant to study our policy experiments.

As stressed by Kihlstrom and Laffont (1979), a crucial attribute of an entrepreneur is the associated idiosyncratic (and possibly fundamental) risk of starting and continuing her business activity. To address this issue, a number of countries have recently implemented policies in

[1]We target the flow from employment to entrepreneurship by earnings quantiles and impose a decreasing job destruction rate with respect to ability.

order to foster entrepreneurship by helping turn unemployment into self-employment. A first type of policy provides start-up subsidies to unemployed individuals in the form of monetary grants, loan guarantees or training. A second set of policies extends the UI system to cover part of the entrepreneurial risk. Hombert et al. (2017) describe a French reform of 2002 called *Plan d'Aide au Retour à l'Emploi (PARE)*, that introduced a form of downside risk insurance (DRI): in the first three years from starting their businesses, previously unemployed entrepreneurs could still claim their UI rights in case of business failure. Furthermore, they could use their UI benefits to bridge the gap between the original amount of UI benefits and their business income, subject to a specific rule. These authors estimate a significative increase of 12% of the number of newly created firms after the reform while the pool of entrepreneurs and their relative performances are unchanged. In the US, a policy called the Self-Employment Assistance Program[2] waives regular UI beneficiaries from active job search and provides a weekly allowance of the same amount and duration as regular benefits, as long as they engage in the establishment of their own small businesses. However, this policy is only active in ten states and is constrained by quotas such that a relatively low number of individuals are concerned[3]. We extend our baseline economy to evaluate the two types of policies above. The DRI policy implements two important mechanisms. First, a formerly unemployed individual with an entrepreneurial activity can return to the pool of unemployed with UI claims in case of business failure. Second, the government partially insures such entrepreneurs by providing a supplementary income in case of low business outcomes using a specific rule that depends on their previous UI benefits[4]. These privileges are all temporary. In the alternative experiment, the government provides a once-and-for-all start-up subsidy (SUS) to new entrepreneurs, designed to generate the same share of entrepreneurs as under the DRI.

Our implementation of the DRI with a specific replacement rate[5] and a duration matching the US unemployment duration leads to a 1.8% increase in the share of entrepreneurs, a 11% increase of the fraction of unemployed individuals starting businesses while newly created firms per year rise by 3%. The insurance has thus a large impact on the propensity to become an en-

[2]The SEAP was introduced in 1993 and permanently authorised in 1998.

[3]Other examples of such policies include: Ejrnæs and Hochguertel (2014) use a Danish retirement reform incorporating entrepreneurial UI to study the effects of a DRI and finds that entry into entrepreneurship increases by 1.2 - 1.8% and that entrepreneurs are not any different in terms of performance. Caliendo and Künn (2011) estimate the effects of two different German programs helping unemployed individuals to start businesses. In the first program, individuals are given a lump-sum startup subsidy each month for three years, with the amount declining every year. Under the alternative *bridging allowance* (BA) program, individuals received their unemployment benefits for six months. The authors find that under the two experiments, new entrepreneurs tend to be less qualified, but are more qualified under the BA than the start-up subsidy.

[4]A third auxiliary mechanism can be activated to provide an extra income even in case of better outcomes.

[5]We comment this technical DRI parameter in detail and perform various robustness tests on it.

trepreneur, especially for the unemployed. In contrast to the previous literature that focuses on partial equilibrium, we argue that the unemployment rate is slightly lower and that this policy reduces employment in the corporate sector. We also show that while the SUS can have effects of greater magnitude, the DRI and the SUS have very different implications on the characteristics of newly selected entrepreneurs. Insuring (resp. subsidizing) entrepreneurs tends to favor the entry of high-skilled (resp. low-skilled) and richer (resp. poorer) entrepreneurs. Comparing the performance of new entrepreneurs before and after the reform reveals that insurance allows entrepreneurs to grow faster and to survive longer. We also argue that the single mechanism of allowing business-starting unemployed individuals to return to the unemployment pool at some point and keep claiming their outstanding UI rights would significantly reduce the bias towards paid-employment at virtually no extra cost for the economy. Finally, we show that the characteristic of the UI system itself has a large impact on the fraction of entrepreneurs in the economy since a more generous system implies a lower incentive for unemployed to start a business, due to the rising opportunity costs of abandoning their status. Therefore, the effectiveness of the DRI depends on the UI system and we show that controlling the duration of insurance can have a beneficial impact with respect to controlling the replacement rate.

1.1 Related literature

There is a substantial literature on entrepreneurship and many papers are concerned about the impact of existing barriers to entrepreneurship on the share of entrepreneurs in the economy. A number of contributions such as Holtz-Eakin et al. (1994), Nanda (2008), Landier and Thesmar (2008), Schoar (2010) or Hurst and Pugsley (2011) show that only focusing on this share might prevent us from understanding the vast amount of heterogeneity in the entrepreneurial pool and the rich composition or selection effects underneath. Our specification is able to capture a number of those effects: we, for instance, highlight a high quarterly flow from entrepreneurship to paid-employment. While this latter finding is not new (see for instance Cagetti and De Nardi (2006) or Rissman (2007) at yearly frequency), our model is able to endogenously generate this transition. The recent literature introduces a distinction between entrepreneurs starting a business out-of-necessity and out-of-opportunity to study the transition rates in the business cycle (Visschers et al. (2014)) and assesses the choice of becoming entrepreneurs with respect to the working ability (Poschke (2013)). Our model theoretically characterizes the related notion of necessity share, and show how insurance mechanisms affect its magnitude. This paper is also related to the quantitative literature on entrepreneurship in relation with mobility and wealth inequality issues pioneered for instance by Quadrini (2000) or Cagetti and De Nardi (2006) and to the many policy questions that have been addressed using this framework (Kitao (2008), Cagetti and De Nardi (2009) and Buera and Shin (2013) among others). Similarly to our contribution, some recent papers have begun addressing the question of insurance mechanisms in models with entrepreneurship. This literature has mainly focused on the effects of introducing health insurance (Fairlie et al. (2011)) or alternative bankruptcy laws (Mankart and Rodano (2015)) on the fraction of entrepreneurs and their performances.

This article is also related to a very large literature on the effects of unemployment insurance, although we focus on a specific reform[6]. While many papers often argue that improving entrepreneurial conditions could be a way to reduce unemployment (for instance, Caliendo and Künn (2011) or Thurik et al. (2008)), our results mitigate this argument based on entrepreneurial insurance. Some authors (Evans and Leighton (1989), Thurik et al. (2008), Røed and Skogstrøm (2013) and Glocker and Steiner (2007) among others) have studied the relationship between unemployment and UI benefits and the probability to start a business. In this respect our paper is closest to Hombert et al. (2017) and Ejrnæs and Hochguertel (2014), although their contributions are mostly empirical and use partial equilibrium models. To the best of our knowledge, none of the above contributions have raised the question of entrepreneurial insurance or that of the distortive effect of the UI system in a general equilibrium model, especially one matching occupational flows.

The remaining of the paper is organized as follows. Section 2 presents empirical facts concerning entrepreneurship and occupational flows. Our baseline general equilibrium model is developed in section 3 and our parameterization in section 4. In section 5, we discuss the properties of our baseline economy while our policy experiments are conducted in section 6. Section 7 concludes.

2 Risk, financial frictions and occupational flows: some facts about entrepreneurship

In this section, we first clarify our notion of entrepreneurship and then highlight the relationship between entrepreneurial risk and the business start-up rate, and hint at how insurance provision could foster entrepreneurship, most notably for unemployed individuals. Second, we document a number of empirical facts about occupational flows in the US that motivate our modeling choices.

2.1 Entrepreneurship and risk

Definitions. The definitions of an entrepreneur in the literature take into account three main dimensions: the self-employment status, the business ownership, and the management activities in the business. Depending on the definition of an entrepreneur and the survey used, the

[6] Broadly speaking, the role of UI policy in an incomplete markets setting has been first investigated in Hansen and İmrohoroğlu (1992). A substantial number of papers, among which Costain (1997), Acemoglu and Shimer (2000) or Wang and Williamson (2002) have followed.

fraction of entrepreneurs in the US varies from 7% to 11% in the literature. Surveys such as the SCF or CPS contain questions that let an individual define himself as self-employed according to her own perception. In this paper, we use the CPS in order to compute both the masses in each occupation and the corresponding flows between occupations[7]. We define an entrepreneur as a self-employed individual owning her business[8]. According to this definition, from 2001 to 2008, we find an average fraction of entrepreneurs of 9.4%. In the SCF, we find an average fraction of entrepreneurs equal to 8.8% over the 2001, 2004 and 2007 waves[9].

Entrepreneurship and risk perception. As documented by Herranz et al. (2015) using the Survey of Small Business Finances (SSBF), small firm returns are very risky. According to these authors, in a year, about 12% of SSBF firms lose more than 20% of assets invested in the firm (debt plus equity), 7.4% lose more than 40%, and 3.8% lose more than 100%. We use the 2007 SCF to study entrepreneurial income and also find substantial risk. Considering only income filed as business income, about 20% of the entrepreneurs report having zero or negative income. This number falls to 3% when we account for entrepreneurial income filed as wages plus business income[10]. Similarly, using the Survey of Income and Program Participation (SIPP), Hamilton (2000) finds that 10% of self-employed reports zero or negative earnings. Figure 1 shows that entrepreneurial income is not distributed normally but is rather extremely right-skewed. Most entrepreneurs are concentrated below and around the median income (normalized to unity here) but some of them perform extremely well while others have negative incomes. Whether we consider business or total income, the main idea is that there are potentially important risks associated with an entrepreneurial occupation. In particular, entrepreneurial earnings distribution displays much higher variance than the distribution for employees; the standard deviation is typically 2 to 4 times greater according to Hamilton (2000) (table. 3).

[7]We restrict our sample to the period from 2001 to 2008 and consider only the 20-65 old population. Ratios are computed with respect to the total number of entrepreneurs, unemployed individuals and workers. Appendix A details our sample section approach and section B of the online appendix offers additional details on data.

[8]Cagetti and De Nardi (2006) define an entrepreneur as a self-employed individual owning her business and actively managing it in the PSID. Unfortunately, we cannot control for active management because this information is absent in the CPS.

[9]Appendix A.2 summarises our reference SCF moments. We define an entrepreneur as self-employed individuals holding a positive value of their businesses in order to be consistent with our definition in the CPS.

[10]We distinguish between *business income* and *wage* plus *business income* because as discussed in Hamilton (2000), a number of entrepreneurs file their earnings either as *wage* or as *business income*. We also normalize incomes by the median entrepreneurial income. There are two main problems arising in most of the survey. First, entrepreneurial earnings are bottom-coded. Second, as argued by Astebro and Chen (2014), entrepreneurial earnings can be underreported. In the end, SCF data concerning negative (due to loan repayment and interests, salary to employees and per-period variable and fixed costs) and zero income have to be taken with caution.

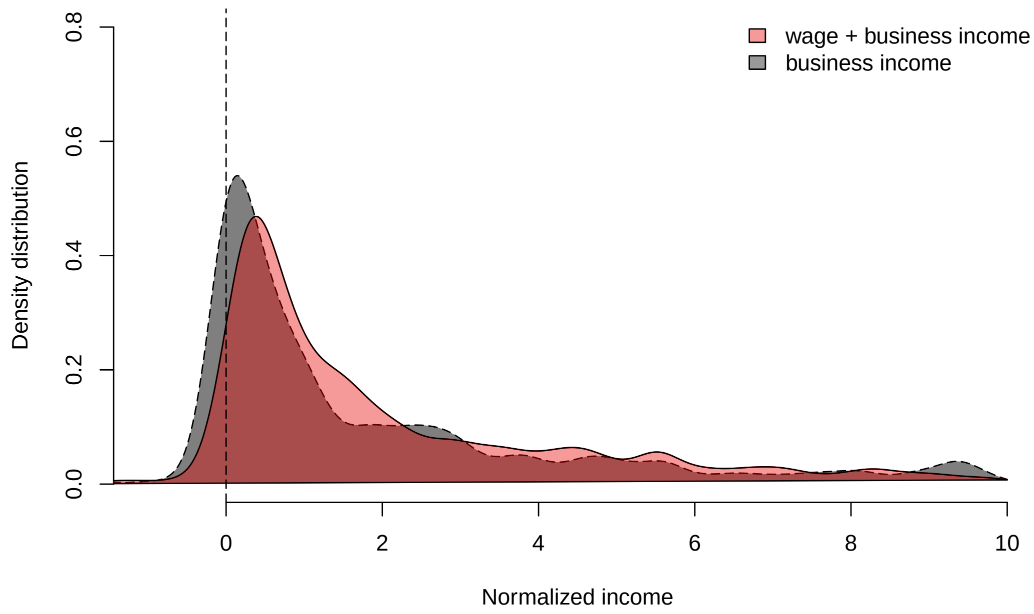

Figure 1. Entrepreneurial income normalized with respect to the median. *Legend:* dashed line refers to only business income and solid line to all entrepreneurial income. *Source:* SCF 2007.

The literature on entrepreneurial risk states that fundamental risk associated with any business constitutes an important barrier to entry. Using data from the Global Entrepreneurship Monitor (GEM) project for 28 countries, Arenius and Minniti (2005) find that perceptual variables, such as alertness to opportunities, fear of failure, and confidence in one's own skills are significantly correlated with new business creation across all countries[11]. The above evidence on perceived risk as a barrier to entry into entrepreneurship is an argument for the fact that insurance provision could foster entrepreneurship by lowering entrepreneurial risk.

Unemployment insurance (UI) and entrepreneurship. In almost every states in the US, unemployed individuals lose their unemployment benefits when starting a business. For instance, in Pennsylvania, section 402(h) of the Pennsylvania Unemployment Compensation Law states that "*a claimant is ineligible for any week in which he/she is engaged in self-employment. When a claimant is starting a new business, the claimant becomes self-employed with the first positive step toward starting the business*".

Hombert et al. (2017) argue that insurance provision could lead to substantial entrepreneurial entries without deteriorating the quality of new businesses. They document a form of DRI implemented in France through the PARE program between 2002 and 2003 aiming to extend UI to previously unemployed new entrepreneurs and report that the number of newly created firms in France between 2000 and 2006 increased by 25%. Using a difference-in-difference strategy

[11]We report in section A of the online appendix a figure that shows that the decline in the self-employment rate in the US since the 2000s is associated with an increase in the fear of failure index.

with the fraction of sole-proprietorship in different sectors as treatment intensity variable, these authors estimate that insurance provision led to a 12% increase in business creations. The empirical validity of their instrument is built on the assumption that insurance provision may mainly favor entrepreneurial entry in sectors where it is easier to start businesses, and that the share of sole-proprietorship is a good measure of that element[12].

Financial frictions. In the incomplete markets literature with entrepreneurship, the presence of borrowing constraints is documented (see for instance by Holtz-Eakin et al. (1994) and Quadrini (2000)) and is used to generate heterogeneous firm sizes. Poorer entrepreneurs run on average smaller firms whereas richer entrepreneurs start larger firms. The ability to borrow is essential for a business venture and can be damaged by the past history of defaults[13]. Bankruptcy filing remains public information for ten years: this can exclude a potential entrepreneur from borrowing for a significant amount of time. How personal and business assets are considered is an important question for our modeling approach. In the case of sole-proprietorship, personal and business assets cannot be separated when filing for bankruptcy and, according to Mankart and Rodano (2015), of the total credit backed by some real collateral, about 80% is backed by some business assets[14]. According to the US Census Bureau, sole-proprietorship businesses account for more than 70% of total business structures. From 1993 to 2007, the number of Limited Liabilities Company (LLC) and more generally the number of Pass-through Entities rose sharply. However, in 2007, the share of LLC accounted for only 3.5% of the number of sole-proprietorship businesses according to the Internal Revenue Service (IRS). Finally, entrepreneurs can also be distinguished according to the incorporated and unincorporated nature of their businesses. As a significant fraction of incorporated entrepreneurs have to use private assets as collateral to obtain credit, this distinction is thin for some businesses and we abstract from this interesting aspect[15].

[12]Sectors with a high fraction of sole-proprietorship are mainly those where the need for capital is low. Therefore, insurance provision lead individuals to start their own business in these sectors more often as compared to activities where a high initial investment level is needed (for instance in the manufacturing sector). In the latter activities, individuals are borrowing constrained and unable to start businesses.

[13]In the U.S., entrepreneurs have access to both secured and unsecured debt, and a default is only possible on the latter. Secured debt is debt backed by collateral whereas there are no such constraints on unsecured debt. For instance, personal bankruptcy can be made under Chapter 7 (liquidation bankruptcy) and Chapter 13 (repayment reorganisation bankruptcy), with the former accounting for 70% of total bankruptcy cases. According to Mankart and Rodano (2015), in the bottom quintile of firm sizes, the share of secured debt is 67%, whereas it is 55% in the middle quintile and 92% in the top quintile.

[14]This includes inventory, account receivables, vehicles or other business equipment, business securities or deposits and business real estate.

[15]Moreover, Mankart and Rodano (2015) report that incorporating dampens the access to credit markets, since private assets are shielded after the incorporation. Only richer entrepreneurs can actually choose this option. How-

2.2 Occupational flows

In this section we document a number of empirical features of quarterly flows between occupations based on CPS data, as many of these flows have not been detailed in the literature and because they are important factual elements for our modeling choices and calibration. Cagetti and De Nardi (2006) target a high annual entrepreneurship exit rate of about 23% in the US. With a different but related measure of entrepreneurship, we find a consistent quarterly entrepreneurship exit rate of 6%, with roughly 1% toward unemployment. As shown in table 1, if we consider the whole population of self-employed individuals[16], the corresponding number is close to 7.5%. This exit rate is much higher than the 1% to 3% of entrepreneurs filing for bankruptcy each year, corresponding to 0.25% to 0.75% each quarter. This suggests that many entrepreneurs voluntary quit their businesses for a job, for instance because it constitutes a better opportunity or because entrepreneurship is too risky.

	Transition (%)			Mass (%)
	Employment	*Entrepreneurship*	*Unemployment*	
A. Self-employed business owner				
Employment	97.35	0.50	2.15	85.2
Entrepreneurship	4.80	94.22	0.99	9.4
Unemployment	47.36	2.40	50.25	5.4
B. All self-employed				
Employment	97.20	0.69	2.11	84.3
Entrepreneurship	6.15	92.45	1.40	10.3
Unemployment	46.04	3.72	50.25	5.4

Table. 1. Flows between occupations for different definitions of entrepreneurship per quarter. *Data sources:* authors' own computations using CPS data from 2001 to 2008.

On the entry side, roughly 2.4% of the unemployed individuals and 0.5% of the workers start a business each quarter. Again, if we consider the whole population of self-employed, these numbers rise respectively to 3.7% and 0.7%. We find that unemployed individuals are 4 to 5 times more likely to enter entrepreneurship than workers. Concerning the flow from employment to entrepreneurship, we document a U-shaped relation with respect to earning quintiles in table 2. We find that high earning (and potentially high skill) and low earning (and potentially low skill) workers tend to start their own businesses more often than the average worker. It is arguable that high earners tend to be more talented for running valuable businesses, making self-employment a better alternative than employment for those individuals. Similarly, low

ever, DRI and entrepreneurial subsidy mostly concern relatively poor entrepreneurs.

[16]This grouping comes from individual replies to the CPS survey questions across people clearly mentioning being self-employed and a business owner and people generally declaring being self-employed.

earning workers can view entrepreneurship as a way to improve their standards of living. Contrastingly, for average (and potentially mid-skill) earners, entrepreneurship seems to be a less solid alternative when compared to paid employment.

% of workers switching to	**Quintile**					**Mean**
	[0:20]	[20:40]	[40:60]	[60:80]	[80:100]	
A. Self-employment & business owner	0.67	0.39	0.46	0.42	0.62	0.50
B. Self-employment	1.03	0.62	0.62	0.54	0.76	0.69

Table. 2. Flows from employment to entrepreneurship by earning quintiles. *Data sources:* authors' own computations using CPS data from 2001 to 2008.

Figure 2 gives a general picture of the shape of the flows between occupations with respect to educational attainment[17] (and for flows out of employment with respect to wage quintile). One striking feature is that the $> C$: *higher college and associated degree* group can have a substantially different behavior with respect to other college graduates. This finding is quite recurrent and one explanation is the fact that this group has a less uniform definition in the data when compared to all the other groups (with the exception of maybe $< HS$: *less than a high school degree* group at the other extreme). The U-shape described above for the employment to entrepreneurship flow by earnings persists with respect to educational attainment when taking into account only self-employment[18]. We also find that other flow profiles are non-linear, such as the entrepreneurship to worker flow that displays a *S shape*. Specifically, less educated entrepreneurs have a high flow out of entrepreneurship, reflecting potentially their higher risk of failure. Then as more educated groups can find high income and less risky paid jobs, the profile becomes increasing again. The *S-shape* is created by the $> C$ group that displays a very low disposition to quit entrepreneurship that mirrors the very high disposition of the same group to leave paid employment for entrepreneurship. We surmise that on top of education, other characteristics might explain this behavior, making this group specially prone to becoming and remaining entrepreneurs. We point out that the patterns above are robust to others time frames. We also obtain similar shapes when we exclude mobility toward and from part-time jobs (less than 20 hours of work per week)[19] and if we control for individual characteristics[20]. In the end,

[17]Educational attainment is divided between: $< HS$: less than a high school degree, H: high school degree, $< C$: some college but no degree, B: bachelor's degree, M: master's degree, $> C$: higher college and associated degree.

[18]In section A of the online appendix, we show that this flow with respect to education for any definition of entrepreneurship is *U-shaped* at the longer 2001-2015 horizon.

[19]These alternative flows are reported in the online appendix section A. In detail, we compute quarterly flows for the alternative period 2008-2015, quarterly flows for 2001-2008 selecting only full-time occupation and yearly flows for 2001-2008. We find that the patterns of the flows shown above are robust.

[20]Results of a linear probability model on the probability to exit a given occupation reveal similar shapes relative to educational attainment.

what these flows show is that observing only aggregate occupational mobility might not be enough. The skill or ability of an individual, that we can not directly measure in the CPS data, could be an important determinant of mobility. Flows by education or income show significant non-linearities that should be captured in a model. On this subject, Poschke (2013) shows theoretically that a correlation between working ability and the opportunity of setting-up a valuable business can replicate the observed masses of self-employed workers among different ability groups (measured in terms of education). We stress that financial frictions are also an important requirement to generate heterogeneous entrepreneurship decisions within ability groups. We therefore build our model on the two minimal dimensions of individual capital and skill levels.

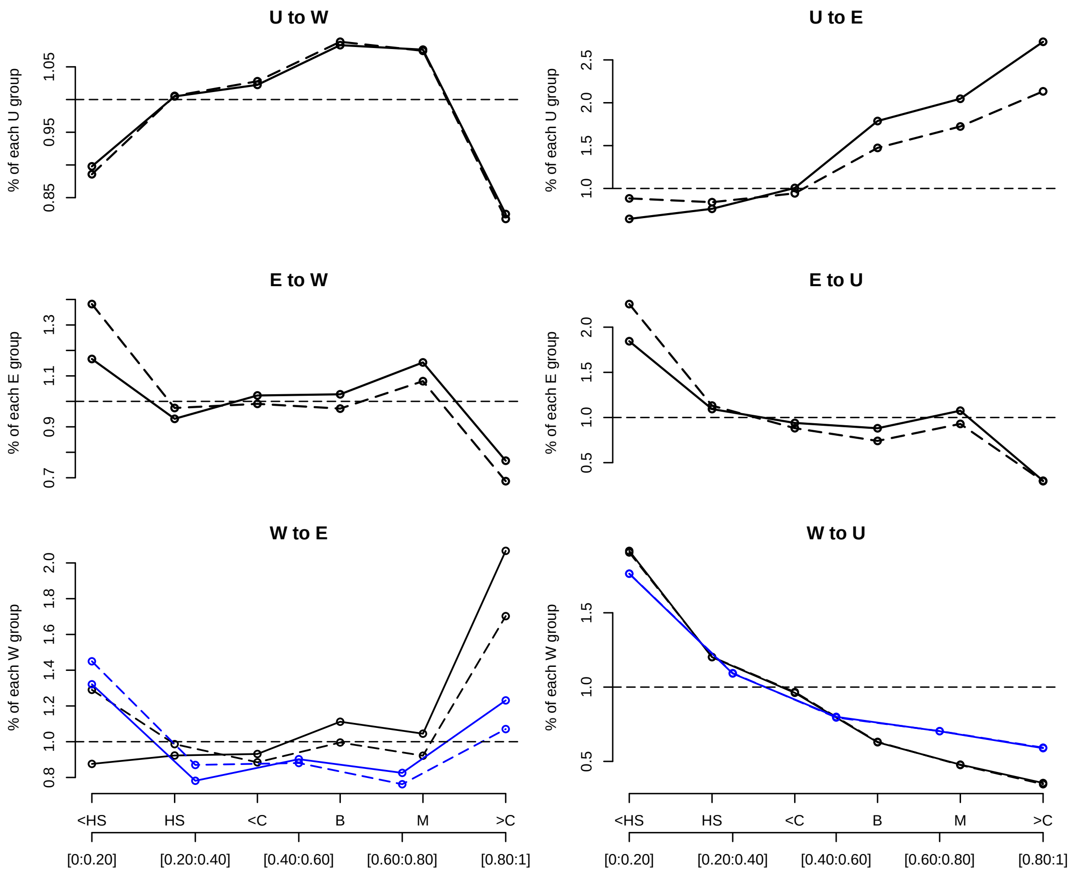

Figure 2. Flows from a given occupation to another by educational attainment (black) and wage earnings (blue). The dashed lines refer to self-employment only while the solid line to self-employed business owners. The bottom horizontal axis displays earning quintiles whereas the top horizontal axis displays educational attainment groups. Legend: *U*: unemployment, *W*: paid-employment, *E*: entrepreneurship. *Data sources:* authors' own computations using CPS data from 2001 to 2008.

In Table 3, we detail flows from employment to entrepreneurship and from entrepreneurship to employment by origin CPS main occupation and educational attainment. The majority of the lowly educated individuals leaving paid employment for entrepreneurship were occupied in the production sector or the services sector. We find the same type of flows from entrepreneurship to paid employment. However, the picture is quite different for highly educated individuals: a majority of the movers originate in the professional and related sector with management activities coming in second[21]. Mid education groups such as individuals with a bachelor's degree or less than a college degree seem to bridge the gap with more diverse origin sectors. This seems to suggest that individuals with different educational attainments are selected in different activity sectors associated with different performances and growth expectations.

Employment to entrepreneurship flow (%)	<HS	HS	<C	B	M	>C
Professional and related	1	6	15	29	51	77
Management, business, and financial occupations	6	9	16	29	29	16
Sales and related	9	11	15	18	10	4
Service	25	19	16	6	4	2
Production, maintenance, and repair	40	31	17	6	2	0
Transportation and material moving	10	8	6	2	0	0
Others	9	16	15	10	6	1
Entrepreneurship to employment flow (%)	<HS	HS	<C	B	M	>C
Professional and related	1	4	11	19	35	72
Management, business, and financial occupations	16	22	24	33	35	17
Sales and related	10	15	19	24	16	5
Service	24	16	17	7	4	1
Production, maintenance, and repair	31	25	16	8	5	3
Transportation and material moving	11	7	3	2	2	1
Others	7	11	10	6	5	2

Table. 3. Flows from employment to entrepreneurship and from entrepreneurship to employment by origin sector educational attainment. *Data sources:* authors' own computations using CPS data from 2001 to 2008, defining entrepreneurs as self-employed business owners. Category "others" refers to individuals meeting no other condition and office and administrative support.

3 Model

In this section, we describe a Bewley (1983) - Huggett (1993) - Aiyagari (1994) type general equilibrium model in incomplete markets, with occupational choices in the spirit of Cagetti and De Nardi (2006). We extend the latter paper's framework by introducing risky entrepreneurial investment choice and search frictions generating unemployment. Individuals have to search for an occupation before switching to a new one. We also explicitly model the possibility to de-

[21]Professional and related occupations refer to engineers, architects, surveyors, mathematical and computer scientists, teachers, lawyers, judges etc. A complete definition is available in the BLS documentation.

fault in equilibrium in order to generate realistic spreads. In particular, bankrupt entrepreneurs have to reimburse a given fraction of their debt in case of default.

Our model accounts for all economies that we consider: the baseline economy and two alternative economies: (i) with a specific DRI, which is our main policy concern and (ii) with a start-up subsidy, that we use to compare with the insurance mechanism. In the two alternative economies, only entrepreneurs entering into the program can benefit from the extended unemployment insurance reforms. That is, only those who have started their business as a former unemployed individual covered by UI.

3.1 Corporate sector

As it is standard in this literature, our economy has two production sectors: a corporate sector with a representative firm presented here and an entrepreneurial sector discussed later. There is no aggregate uncertainty. As in Quadrini (2000) and Cagetti and De Nardi (2006), the output Y in the corporate sector is produced by a single competitive representative firm with Cobb-Douglas technology with total factor productivity A, capital level K and employed labor L, such that: $Y(K, L) = AK^{\alpha}L^{1-\alpha}$, where $\alpha \in (0, 1)$ is the capital share in the economy. Profit maximization in this sector produces the following competitive prices:

$$r = \alpha\left(\frac{L}{K}\right)^{1-\alpha} - \delta, \qquad w = (1-\alpha)\left(\frac{K}{L}\right)^{\alpha}$$

with w the wage level and r the interest rate, which by no arbitrage condition, are identical in the entrepreneurial sector.

3.2 Households

The economy is populated by a continuum of infinitely-lived households of unit mass that we describe interchangeably as individuals or agents. Every period, a household falls in one of the following three occupations (o): entrepreneurship (o_e), unemployment (o_u) or employment (o_w) (worker in the corporate sector), such that $o \in \mathcal{O} \equiv \{o_e, o_w, o_u\}$. An agents' occupation can change between the three occupations either exogenously because of random events or endogenously. Specifically, individuals search a business idea with effort s_e and a job opportunity with effort s_w[22]. Workers can search for an entrepreneurial idea *on-the-job*, entrepreneurs can search for a job opportunity *on-the-business* and unemployed individuals can do both.

Agents derive utility from consumption and disutility from searching. Thus, the life-time

[22]Business search effort can describe market research on the feasibility of an idea, competition assessment, business education, agency costs or the time needed to fill administrative forms, validate product norms, etc. Job search effort can represent the time needed to submit résumés, answer job advertisements, take job interviews, etc.

utility of a household is given by:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c, s_e, s_w)$$

with β the discount factor. We assume that labor is supplied inelastically and abstract from labor-leisure choice considerations. We note $a \in \mathcal{A}$ the agent's wealth. Any wealth saved in the model pays the deposit rate r^d, with $r^d = r - \upsilon$. The competitive interest rate r can thus be interpreted as a lending rate and υ as a wedge between the lending rate and the deposit rate.

Insurance status Depending on their previous occupation, agents can either be insured ($j = i$) or uninsured ($j = n$). In the baseline economy, only a worker falling in involuntary unemployment (i.e. when laid off) can claim any insurance in the form of a standard unemployment insurance. In the alternative economies subject to specific economic policies discussed below, entrepreneurs previously unemployed with outstanding unemployment insurance claims are also insured or subsidized during their entrepreneurial endeavor. Section 3.6 describes these policies in details.

Exclusion status Entrepreneurs can borrow from an external creditor and use the borrowed sums in their entrepreneurial venture. However, an agent who has defaulted in the past is excluded temporarily from the credit market. In such a case, an agent can still start a business, but cannot borrow. Such an agent is called constrained and we denote her credit status as C. Following Chatterjee et al. (2007) and Mankart and Rodano (2015), we model exclusion in a probabilistic way. A constrained agent with occupation o can recover access to the credit market with probability ϕ at the end of each period. Alternatively, we denote an individual with normal access to the credit market by A. Therefore, from the credit market point of view, all agents in the economy are described by the state $e \in \{A, C\}$ summarizing their credit status.

Individuals start the period with the knowledge of exogenous shocks (θ, y, z_{-1}). We assume that all shocks are orthogonal to each other and that each follows a first-order Markov process. All individuals are endowed with an idiosyncratic innate ability $\theta \in \Theta$. This ability is determined early in life according to the invariant distribution Π_θ, but evolves over time at a very slow rate[23]. We stress that both a working household's labor income and an entrepreneurial household's business income depend on this innate ability. Workers are subject to an idiosyncratic transitory shock $y \in \mathcal{Y}$ on labor income, and entrepreneurs face a within-period idiosyncratic business shock $z \in \mathcal{Z}$ correlated with its past realization z_{-1}. Both the

[23]We allow the innate ability to evolve in order to generate additional saving motives. Indeed, our model does not take into account life-cycle aspects, human accumulation at work, technological progress or health risks. Those elements can explain a large productivity dispersion along the life-cycle, but are not included in our framework.

innate ability shock θ and the transitory labor market shock y are realized at the beginning of the period before agents take any decision. In that respect, the business shock z is different as only its previous value z_{-1} is known at the beginning of the period, and the current shock is realized within the period after entrepreneurs have decided on their business investment. Because the business shock z occurs within the period and depends on its previous realization z_{-1}, we assume that an individual not currently running a business but willing to start one infers her future shock z according to the invariant distribution Π_z associated with the first-order Markov process for z[24]. Contrastingly, a non-working individual does not know her future transitory shock before receiving a job offer but decides to work after observing the shock. It is thus drawn from the invariant distribution Π_y associated with the first-order Markov process for y. We note $\mathbf{x} = (a, y, \theta, z, j, e)$ the full state of households over all occupations. We will sometimes use a subset $\mathbf{x}_o$ of the previous states for the states of an individual in occupation o.

We can now note W the value function associated with a worker, U with an unemployed individual and E an entrepreneur. For convenience, we use the subscript j to indicate the insurance status, with the exception of the worker who is by definition always insured. The future values of those value functions are respectively noted:

$$W' = W(a', \theta', y', e'), \qquad U'_{j'} = U(a', \theta', e', j'), \qquad E'_{j'} = E(a', \theta', z, e', j')$$

Finally, only unemployed individuals with UI rights can benefit from an implemented policy during the policy experiments i.e. either the entrepreneurial insurance (DRI) or the entry subsidy. The value of being a new entrepreneur while uninsured is given by $\mathcal{E}'_n = \mathbb{E}_z[E(a', \theta', z, e', j = n)]$. The value $\mathcal{E}'_i$ of being a new insured entrepreneur depends on the economy considered[25]. We specify this value in section 3.6. Note that in section C of the online appendix, we write a more detailed version of model equations, explicitly including transition probabilities that we omit below for readability.

3.3 Workers

By working in the corporate sector, a worker receives the labor income $h(\theta)yw$, where the function $h : \theta \mapsto \mathcal{R}$ transforms the innate ability into working ability. She has a probability $\eta(\theta)$ of getting laid off, depending on her innate ability. In such a case, she falls in insured unemployment and can expect to get value U'_i[26]. To finance UI benefits, a worker pays a proportional tax τ_w on their labor income.

[24]We assume that z is observed only after experimenting the business idea. In our model as in the reality, an important fraction of new entrepreneurs experiments a business and exit if the project is not profitable enough.

[25]We denote this value with the subscript i even if no insurance policy is currently in place in the baseline model. The subscript can thus be interpreted as access to insurance in the alternative economies.

[26]Notice that in our model, value functions associated with unemployment are always lower than those associated to a worker. Therefore, we exclude any voluntary switch to unemployment.

By providing the effort s_e, a worker can start a business in the next period with probability $\pi_e(s_e)$. By becoming an entrepreneur at the end of the period the worker voluntary exits her current occupation and cannot claim UI benefits (i.e., $j = n$). She can then expect to get value $\mathcal{E}'_n$. If she gets laid off at the same time as getting a business idea, she can claim UI rights and start a business with value $\mathcal{E}'_i$, which depends on the policy currently in place: no insurance/subsidy in the baseline case or either insurance or subsidy in the other cases.

To simplify the notations, let us denote $\eta \equiv \eta(\theta)$, $\pi_e \equiv \pi_e(s_e)$ and $\pi_w \equiv \pi_w(s_w)$ in the remaining of the paper. An excluded worker ($e = C$) recovers credit market access with probability ϕ, whereas a non-excluded worker ($e = A$) always accesses the credit market. The recursive formulation of a worker is given by:

$$W(a, \theta, y, e) = \max_{c, a', s_e} u(c, 0, s_e) + \beta \mathbb{E}_{e', y', \theta' | e, y, \theta} \Big\{ (1 - \eta) \big[(1 - \pi_e) W' + \pi_e \max\{\mathcal{E}'_n, W'\} \big] \\ + \eta \big[(1 - \pi_e) U'_i + \pi_e \max\{\mathcal{E}'_i, U'_i\} \big] \Big\} \quad (1)$$

$$\text{s.t.} \quad c = (1 - \tau_w) h(\theta) w y + (1 + r^d) a - a' \quad (2)$$

$$c > 0, \quad a' \geq 0 \quad (3)$$

$$s_e \geq 0 \quad (4)$$

where equation (2) is the worker's budget constraint[27]. Equation (3) and (4) states that consumption and search effort have to be positive and that a worker cannot borrow.

3.4 Unemployed individual

An unemployed individual can either claim unemployment insurance ($j = i$) or not ($j = n$). Nevertheless, we assume that all unemployed individuals are endowed each period with a fixed amount m, that can be interpreted as domestic production. In addition, insured unemployed agents receive UI benefits proportional to the average labor income over the transitory component, $(1-\tau_w)h(\theta)w$, with replacement rate μ. We assume that an insured unemployed individual loses her UI rights with probability ρ[28]. An uninsured unemployed individual cannot claim any UI benefits and remains uninsured until finding a job.

When unemployed, agents can search for a business idea and a job opportunity with respective efforts s_e and s_w and the corresponding success probabilities π_e and π_w. If a job is found, such an agent can switch to a worker occupation with corresponding value W'[29]. Sim-

[27]For simplicity, we assume that w already internalizes other taxes not related to the UI financing. Relaxing this assumption would need to account for a more realistic set of taxes.

[28]This is a common assumption in the literature. In addition, this lowers computational time.

[29]Since the value associated with a job is always greater than the value associated to unemployment in our model (i.e. $W(a, \theta, y, e) > U(a, \theta, e, j)$), for any a, θ, y, j, e), an unemployed individual getting a job opportunity is always assumed to exit.

ilarly, when getting an idea, a business can be started. As for a laid-off worker, a next period insured unemployed agent ($j' = i$) can start a new business venture with value $\mathcal{E}'_i$, which includes the expectation with respect to the business shock z and features the appropriate implemented policy. For instance, under DRI, such an individual can keep her claims to UI even as an entrepreneur. If uninsured next period ($j' = n$), the value associated to an entrepreneurial situation is $\mathcal{E}'_n$. The decision to start a business or to take a job is made after shocks (j', e', θ', y') are realized, where y' is drawn with respect to the invariant distribution Π_y. Finally, exclusion from credit market evolves similarly to a worker. The recursive program of an unemployed individual is:

$$U(a,\theta,e,j) = \max_{c,a',s_w,s_e} u(c,s_w,s_e) + \beta\mathbb{E}_{\theta',y',j',e'|e,j,\theta}\Big\{\pi_w\big[(1-\pi_e)W' + \pi_e \max\{\mathcal{E}'_{j'}, W'\}\big] \tag{5}$$

$$+ (1-\pi_w)\big[(1-\pi_e)U'_{j'} + \pi_e \max\{\mathcal{E}'_{j'}, U'_{j'}\}\big]\Big\}$$

$$\text{s.t.} \quad c = m + \mathbb{1}_{\{j=i\}}(1-\tau_w)h(\theta)w\mu + (1+r^d)a - a' \tag{6}$$

$$s_w \geq 0 \tag{7}$$

$$(3), \quad (4)$$

where equation (6) is the budget constraint and equation (7) imposes that job search has to be positive.

3.5 Entrepreneurs

An entrepreneur raises revenues from her self-employed business venture. She decides to invest an amount of resources k, that can be either her own or borrowed, in a decreasing returns to scale technology governed by the parameter $\nu \in (0,1)$, before knowing the current realization of the business shock $z \in \mathcal{Z}$. All entrepreneurs are subject to this within-period idiosyncratic shock affecting the firm's productivity. Entrepreneurial activity also depend on $g(\theta)$ where the function $g : \theta \mapsto \mathcal{R}$ transforms the individual's innate ability into entrepreneurial talent[30]. The entrepreneurial technology is thus:

$$f(k,\theta,z) = zg(\theta)(k)^{\nu}$$

We define entrepreneurial income as the entrepreneurial production net of capital depreciation and any interest repayment on borrowed entrepreneurial capital. The sequence of choices an entrepreneur is facing is summarized in Figure 3. We now detail this sequence.

[30]This $g(\theta)$ could reflect the fact that individuals with different abilities (i.e educational attainment for instance) runs very different businesses, as observed previously in section 2.2.

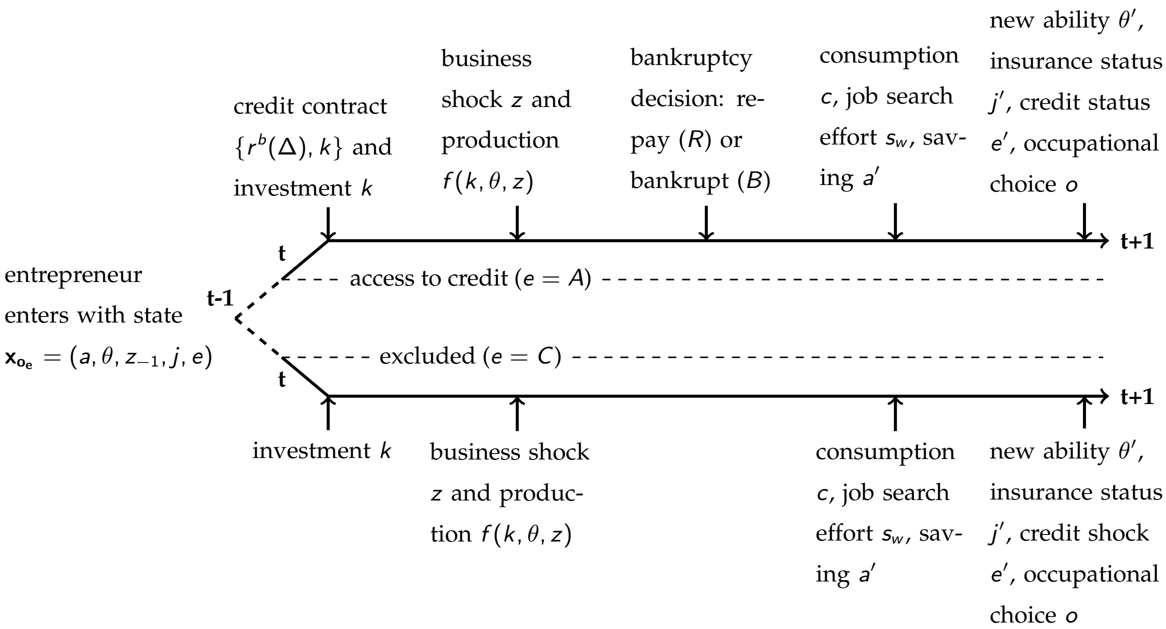

Figure 3. Timing for an entrepreneur

3.5.1 Non-excluded entrepreneur

When an entrepreneur has access to the credit market, she is allowed to borrow from a financial intermediary an amount that can only be invested in her business. Recalling that a is the agent's current wealth, an entrepreneur chooses whether to borrow ($k > a$) or save ($k < a$). As in Buera and Shin (2013) and Kitao (2008), if she borrows from an external creditor the amount $(k - a)$, we assume that such an entrepreneur can only borrow up to a fixed fraction λ of their total assets[31]. The entrepreneur decides the amount k invested in her firm in order to maximize her expected value with respect to the shock z, as expressed below:

$$E(a, \theta, z_{-1}, e = A, j) = \max_k \left\{ \sum_{z \in \mathcal{Z}} \pi_z(z|z_{-1}) \max\{B(a, k, \theta, z, j), R(a, k, \theta, z, j)\} \right\} \tag{8}$$

$$\text{s.t.} \quad (k - a) \leq \lambda a \tag{9}$$

The interior max operator in expression (8) corresponds to the choice the entrepreneur has to make between bankruptcy or repayment once the realization of the shock z is known. Only after this whole sequence, will she decide how much to consume, save and how much effort to exert in search of a job opportunity. At the end of the period, she receives a new credit,

[31] In principle, an entrepreneur could borrow an amount and then decide to invest none or only a part of it in her business. Such a behavior is excluded in this model. In that sense, the entrepreneur pledges the totality of her business collateral amount a invested in her firm before borrowing any amount. Alternatively, we could introduce an endogenous borrowing constraint as in Cagetti and De Nardi (2006). However, this considerably increases the computational time.

insurance and innate ability status given her previous states. The transitory shock y' is realized with respect to the invariant distribution Π_y. Given this and the opportunities available to her, an entrepreneur chooses the most valuable future occupation. In the absence of a job opportunity and if the entrepreneur faces low returns, unemployment can be a better option and the entrepreneur can optimally choose to exit after repaying any contracted debt.

Repayment The standard behavior of a borrowing entrepreneur is to repay her loan after entrepreneurial production. In case of a bad shock, the entrepreneur will receive a low (and possibly negative) entrepreneurial income but can still decide to repay and thus not be excluded from the credit market in future periods. If she repays, the entrepreneur also has to pay the interest on her loan according to the interest rate $r^b(\Delta)$. Following the literature on entrepreneurial option to default, this interest rate is chosen endogenously by the financial intermediary based on the *observable* characteristics $\Delta = (a, \theta, z_{-1}, j)$ of an entrepreneur[32]. By a no-arbitrage condition, an entrepreneur with a zero probability of default will pay the competitive rate r. The recursive formulation of the problem of such an entrepreneur is:

$$R(a, k, \theta, z, j) = \max_{c, a', s_w} u(c, s_w, 0) + \beta \mathbb{E}_{\theta', y', j' | \theta, j} \Big\{ \pi_w \max\{W', E'_{j'}\} + (1 - \pi_w) \max\{U'_{j'}, E'_{j'}\} \Big\} \tag{10}$$

$$\text{s.t.} \quad \pi_r^A = zg(\theta)(k)^\nu - \delta k - r^b(\Delta)(k - a)\mathbb{1}_{\{k \geq a\}} \tag{11}$$

$$c + a' = \pi_r^A + \mathbb{1}_{\{j=i\}} b_e(\theta, \pi_r^A) + a + r^d(a - k)\mathbb{1}_{\{k \leq a\}} \tag{12}$$

$$(3), \quad (7)$$

where equation (11) is the profit function defined as total production minus depreciation and interest paid on debt. Equation (12) is the budget constraint. Note this program is written under the assumption that the entrepreneur will have access to the credit market next period. We emphasize that the baseline economy (and the alternative one with entry subsidy) is only populated with uninsured entrepreneurs. Contrastingly, there are two groups of entrepreneurs in the alternative economy with DRI: the insured group ($j = i$) and the uninsured group ($j = n$). Although we discuss the specific characteristics of the DRI policy in section 3.6, we stress here for clarity that insured entrepreneurs can receive an additional income $b_e(\theta, \pi_r)$ on top of their current entrepreneurial income π_r, in case the latter is too low. Such an entrepreneurial insurance right expire with probability q. Thus the consumption and saving decision of the entrepreneur depend on her total income and assets composed of her entrepreneurial income,

[32]Concerning the literature see, among others, Herranz et al. (2015), Mankart and Rodano (2015) or D'Erasmo and Boedo (2012). We assume here that there is a sufficient relation between the financial intermediary (bank) and the entrepreneur. In particular, concerning the innate ability θ, we argue for instance that the bank is able to observe enough elements (past entrepreneurial income, wage income, etc.) about the entrepreneur to infer this value.

possible DRI benefits, interests on savings not invested in her company for an amount $(1 + r^d)(a - k)\mathbb{1}_{\{k \leq a\}}$ and personal assets a[33].

Bankruptcy. When an entrepreneur chooses not to repay the borrowed amount or the interests, she defaults and goes bankrupts. Her firm is liquidated and her business idea is lost[34]. We model default in the spirit of the specification adopted by D'Erasmo and Boedo (2012). Specifically, we assume that after producing and observing her shock z , an entrepreneur can choose to renegotiate what is due through a judicial action in a court. Bankruptcy is characterized by two components: a cost component and a recovery rate. The cost of the bankruptcy procedure (χ), reported as a percentage of the business capital, includes court fees and the cost of insolvency practitioners. The recovery rate (ξ) refers to the portion of the original loan that the external creditor can recover, conditional on the entrepreneur defaulting[35]. This portion captures what can be recovered using different channels, including liquidation and reorganization. After defaulting, the entrepreneur is excluded temporarily from the credit market in subsequent periods and the recursive formulation of a bankrupting entrepreneur is written under this assumption:

$$B(a, k, \theta, z, j) = \max_{c, a', s_w} u(c, s_w, 0) + \beta \mathbb{E}_{\theta', y', j' | \theta, j} \Big\{ \pi_w W' + (1 - \pi_w) U'_{j'} \Big\} \tag{13}$$

$$\text{s.t.} \quad \pi_r = zg(\theta)(k)^\nu - \delta k \tag{14}$$

$$c + a' = \max\{(1 - \chi)k + \min\{\pi_r, 0\} - \xi(k - a), 0\} + \mathbb{1}_{\{j=i\}} b_e(\theta, 0) \tag{15}$$

$$(3), \quad (7)$$

where we assume that banks recover all the positive profit. In our alternative economy with DRI, an insured but bankrupt entrepreneur can claim any outstanding UI rights $b_e(\theta, 0)$. This is consistent with the current bankruptcy law. Public benefits, including unemployment compensation, are fully exempted from any debt recovery. Such an entrepreneur then fall in insured unemployment next period with associated value $U(a', \theta', e = C, j')$, conditional on not losing her rights and/or not finding a job at the same time.

[33] To see this, recall that the cash on hand of such an entrepreneur in the baseline economy can be written: $zg(\theta)(k)^\nu + (1 - \delta)k - (1 + r^b(\Delta))(k - a)\mathbb{1}_{\{k \geq a\}} + (1 + r^d)(a - k)\mathbb{1}_{\{k \leq a\}}$. Rearranging terms yield the profit and household's budget constraint equations.

[34] In that case, the entrepreneur has to exit entrepreneurship for at least one period: she can start searching for a new business idea in the next period and create a new business the period after that.

[35] Unlike Mankart and Rodano (2015), we abstract from exemption level as specified under Chapter 7 of the US bankruptcy law, since we do not distinguish between secured and unsecured debt. In their model, default is generated with an *iid* investment specific shock, that generates large capital losses. In our model, we focus on productivity shocks that impact directly the current profit. We therefore need a bankruptcy specification that implies a higher default incentive. Despite this potential limitation, our specification is able to capture the entrepreneur's income distribution as shown in section 5, which is our major concern for our policy experiment to be meaningful.

Credit contract We modeled bankruptcy as a judicial procedure in which entrepreneurs renegotiate their debts while having potentially the ability to reimburse them[36]. We assumed that the external creditor had perfect information about the entrepreneur's state, and thus about her default probability. Thus, the lender and the borrowing entrepreneur agree on the terms of the credit contract $\{k - a, r^b(\Delta, k)\}$, which include the amount loaned and its cost. The interest rate applied to the loan is set such that the external creditor makes zero profit in expectation given the entrepreneur's decision to default on a specific loan. When the entrepreneur chooses not to repay the debt, the creditor can recover only a fraction ξ of the original loan (plus the positive profit). The zero profit condition includes three elements: (i) the expected return in case of bankruptcy (V_B), (ii) the expected return in case of repayment (V_R) and (iii) the amount that the creditor would get by investing the loaned amount in a safe project paying the safe interest rate of the economy plus operating costs υ (right hand side) such that:

$$V_B + V_R \geq (1 + r^d + \upsilon)(k - a) \tag{16}$$

where V_B and V_R are given by:

$$V_B = \sum_{z \in \mathcal{B}(\Delta)} \pi(z|z_{-1}) \Big[\min \big\{ \xi(k-a), (1-\chi)k + \min\{\pi_r, 0\} \big\} + \max\{\pi_r, 0\} \Big] \tag{17}$$

$$V_R = \sum_{z \in \mathcal{B}^c(\Delta)} \pi(z|z_{-1})(1 + r^b(\Delta))(k - a) \tag{18}$$

where $\mathcal{B}(\Delta)$ is the set of values z for a given state vector Δ for which the entrepreneur bankrupts and $\mathcal{B}^c(\Delta)$ is the complement for which she repays. Note that if the entrepreneur's cash on hand is too low and that $\pi_r < 0$, the external creditor can only recover what the entrepreneur actually has, that is, only the amount $(1 - \chi)k + \pi_r$.

Bankruptcy has two roles in this model. First, it prevents poor entrepreneurs from entering a credit contract because the charged interest rate would be too high for them to borrow. Second, while the entrepreneur's upper borrowing limit is identical between agents ($k \leq (1 + \lambda)a$), the option to default generates different behavior among different ability group of entrepreneurs. Finally, bankruptcy may interact with our policy experiments. In particular, the reforms could modify the default incentive. In section 6.6, we show that bankruptcy, as we model it, does not alter our qualitative results, but slightly impact their magnitude.

3.5.2 Excluded entrepreneur

An entrepreneur excluded from the credit market can only run a firm using her own wealth. She has a probability ϕ to reenter the credit market next period with her earlier default forgot-

[36]This is common in many models. For instance, while using an exemption level, Mankart and Rodano (2015) have an important fraction of bankrupt but solvent entrepreneurs. Similarly, D'Erasmo and Boedo (2012) also generates this type of individuals. The main difference here is that because productivity shocks generate small losses relative to the entrepreneur's wealth, most bankrupt entrepreneurs would be able to actually repay.

ten. Her recursive program after the realization of the shock z is thus:

$$\hat{E}(a,k,\theta,z,j) = \max_{c,a',s_w} u(c,s_w,0) + \beta\mathbb{E}_{\theta',y',j',e'|\theta,j,e=C}\Big\{\pi_w \max\{W', E'_{j'}\} \\ + (1-\pi_w)\max\{U'_{j'}, E'_{j'}\}\Big\} \tag{19}$$

$$\text{Subject to:} \quad \pi_r^C = zg(\theta)(k)^\nu - \delta k \tag{20}$$

$$c + a' = \pi_r^C + \mathbb{1}_{\{j=i\}} b_e(\theta, \pi_r^C) + a + r^d(a-k)\mathbb{1}_{\{k\leq a\}} \tag{21}$$

$$(3), \quad (7)$$

Therefore, the excluded entrepreneur decides the amount k invested in her firm in order to maximize her expected value with respect to the shock z, as expressed below:

$$E(a,\theta,z_{-1},e=C,j) = \max_{k\in[0,a]} \Big\{ \sum_{z\in\mathcal{Z}} \pi(z|z_{-1})\hat{E}(a,k,\theta,z,j) \Big\} \tag{22}$$

3.6 Policy reforms: insurance and entry subsidy

We now detail the two alternatives policy reforms that extend the baseline economy: entrepreneur downside risk insurance and entry subsidy. In both cases, we open these options only to formerly unemployed individuals with outstanding UI rights. We recall that an entrepreneur entering one of these programs after a period of unemployment is expected to have a future value $\mathcal{E}'_i$ as an entrepreneur. Depending on which reform is currently in place, we define this value using the indicators Ψ_1, Ψ_2 and Ψ_3 and combine the considered policies into a single specification:

$$\mathcal{E}'_i = \mathbb{E}_z\big[\underbrace{\Psi_1 E(a',\theta',z,e',j=n)}_{\text{baseline}} + \underbrace{\Psi_2 E(a',\theta',z,e',j=i)}_{\text{insurance reform}} + \underbrace{\Psi_3 E(a'+S,\theta',z,e',j=n)}_{\text{entry subsidy reform}}\big] \tag{23}$$

with S the entry subsidy. The baseline economy is characterized by $\{\Psi_1 = 1, \Psi_2 = \Psi_3 = 0\}$, the downside risk insurance reform by $\{\Psi_1 = \Psi_3 = 0, \Psi_2 = 1\}$ and the alternative economy with entry subsidy by $\{\Psi_1 = \Psi_2 = 0, \Psi_3 = 1\}$.

Insurance reform The major policy reform we introduce is an entrepreneurial insurance in the spirit of the French PARE program and its evaluation on the US economy. An entrepreneur entering this program as a formerly unemployed individual will continue to benefit from her UI rights, even after starting a business activity. The UI provision will depend on the realized entrepreneurial income. Specifically, the additional amount $b_e(\theta, \pi_r)$ is given to the entrepreneur, depending on her current entrepreneurial income π_r and the UI benefits she could have claimed as an unemployed individual. When the entrepreneurial income is negative (i.e., $\pi_r < 0$), an entrepreneur can fully claim her unemployment benefits. Otherwise, the UI supplement diminishes proportionally with the realized entrepreneurial income. The policy is characterized with the couple of parameters (f, q), where $f \in [0, 1]$ is a replacement parameter[37] and q the insurance duration. The rule governing $b_e(\theta, \pi_r)$ is given by:

$$b_e(\theta, \pi_r) = \begin{cases} b(\theta) & \text{if} \quad \pi_r < 0 \\ b(\theta) - (1-f)\pi_r & \text{if} \quad 0 \leq \pi_r \leq \frac{b(\theta)}{1-f} \\ 0 & \text{if} \quad \pi_r > \frac{b(\theta)}{1-f} \end{cases} \tag{24}$$

where $b(\theta) = (1-\tau_w)h(\theta)w\mu$ is the full UI benefit that the entrepreneur could have claimed if she was only unemployed. Figure 4 illustrates this policy with an example. The higher is f, the higher is the amount of insurance provided in case of a positive but low profit. Moreover, the higher is f, the higher is the fraction of entrepreneurs insured. Indeed, the maximum level of entrepreneurial income π_r for which some UI benefits are provided is equal to $\frac{b(\theta)}{1-f}$. By increasing the parameter f, entrepreneurial incomes are covered up to a higher threshold value. Therefore the insurance mechanism displays three regions: (i) a supplement that guarantees at least the UI benefits if the entrepreneurial income is positive but low, (ii) an insurance-subsidy which provides an additional supplement even if the entrepreneurial income is greater than the UI benefits and (iii) in case of a negative entrepreneurial income the full extent of the UI benefit to compensate.

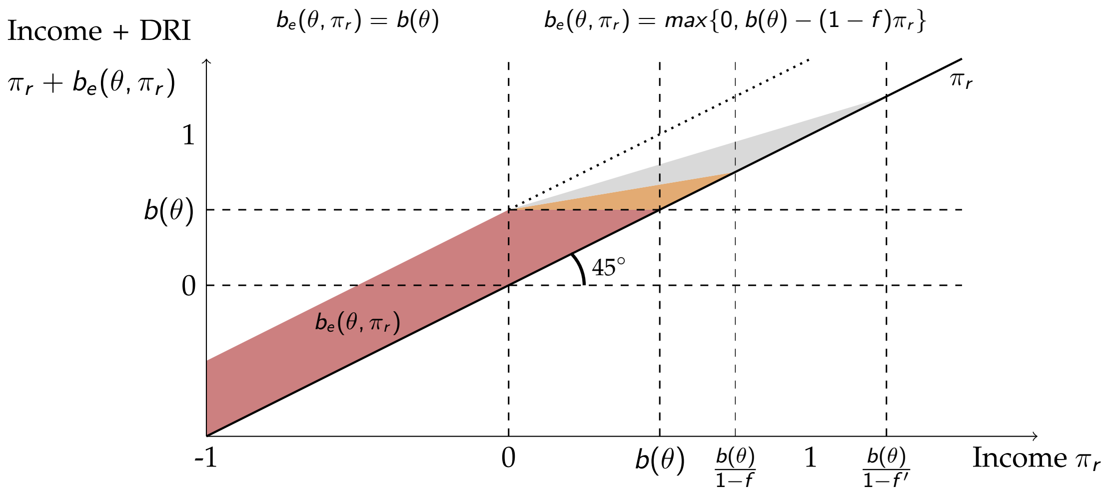

Figure 4. DRI reform. The red (most dark) region corresponds to a minimal case where $f = 0$ (entrepreneur gets at least $b(\theta)$ when $b(\theta) > \pi_r > 0$). Note that if current entrepreneurial income $\pi_r < 0$, this zone will be the same whatever the value of f. The orange (lighter) zone refers to a case where $f = 0.3$: entrepreneurs will get at least the red zone and the extra orange zone depending on their income. The grey (lightest) zone is a case where $f = 0.45$. Finally the white zone between the grey zone and the round dotted line is the case where $f \to 1$ (entrepreneur always gets $b(\theta)$). In all cases $b(\theta) = 0.5$.

[37] f lets the entrepreneur's income be larger than her UI payment in case of low profits, but the compensation $b_e(\theta, \pi_r)$ cannot exceed the UI rights. As a robustness check, we show that even if $f = 0$, the insurance is effective.

Finally, there is another important element to the DRI policy also present in the French PARE program: in case of a stream of low income (or because of default), an entrepreneur can decide (or be forced) to stop their business activity and return to the unemployment pool. If they have any outstanding UI rights, they can keep claiming their UI benefits as normal insured unemployed individuals. An unemployed individual starting a business and who does not use all her outstanding unemployment insurance in the form of DRI payments must keep her UI rights as long as they are unused. To model this feature, we let the probabilistic DRI duration $q(\pi_r)$ vary endogenously with the realized profit, such that:

$$q(\pi_r) = \bar{q}\,\frac{b_e(\theta,\pi_r)}{b(\theta)} \tag{25}$$

In particular, in the case where $\pi_r > \frac{b(\theta)}{1-f}$, the government does not provide any compensation, $b_e(\theta,\pi_r) = 0$, and the probability $q(\pi_r)$ equals zero, a lower bound: the entrepreneur keeps all her remaining UI rights. In contrast, an entrepreneur with negative income will receive all her period DRI payment and lose her rights with the upper bound probability $\bar{q}$. In case of only low profits, this probability lies in between the bounds such that $0 < q(\pi_r) < \bar{q}$, depending on the amount of compensation provided.

Entry subsidy The entry subsidy constitutes one of the most important instruments used to boost entrepreneurship. Many countries have a full or limited entrepreneurship subsidy program[38]. We introduce the entry subsidy in the most basic way as an additional amount S added to the wealth of a new entrepreneur entering the program[39]. Note that in the model, a loan is provided proportionally to the entrepreneur's wealth. Therefore, the entrepreneur can access a larger loan at the beginning of her activity by pledging a higher amount of assets.

3.7 Government

In all considered economies, the government runs an unemployment insurance system that covers the pool of short-term unemployed individuals. In the two alternative economies, the government extends the UI program to unemployed individuals starting a business activity. In France, the PARE entrepreneurial insurance program is an extension of the current UI system. Indeed, this insurance is only available after contributing enough as a former worker. Therefore, we assume that the government finances the reforms using labor income taxes τ_w. Total

[38] For instance, the EXIT grant or the *Einstiegsgeld* from the unemployment insurance system in Germany or the ARCE program in France. Moreover, many countries provide various assistance services that are not labeled as subsidies but that will clearly reduce start-up costs by measurable monetary amounts. In the US, the Small Business Administration program provides free entrepreneurial training, loan guarantees, and grants to new start-up small businesses.

[39] An alternative specification that might better replicate the US Small Business Administration program would be to subsidise the interest rate or to facilitate the access to credit by relaxing the parameter λ.

government revenues (T) are (with a slight abuse of notations):

$$T = \int_{\mathbf{x}_{o_{w,u}}} \Big(\tau_w h(\theta) wy \; d\Gamma(\mathbf{x}_{o_w}) + \tau_w h(\theta) w\mu \; d\Gamma(\mathbf{x}_{o_u}) \Big) \tag{26}$$

where $\mathbf{x}_o$ is the state vector summarizing all the individual's state by occupation and $\Gamma(\mathbf{x}_o)$ is the measure of individual in occupation o. Total government expenditures G are equal to distributed UI benefits plus the reforms' cost:

$$G = \int_{\mathbf{x}_{o_{u,e,eu_i}}} \Big(h(\theta)\mu w \; d\Gamma(\mathbf{x}_{o_u}) + \Psi_2 b_e(\theta, \pi_r) \; d\Gamma(\mathbf{x}_{o_e}) + \Psi_3 S \; d\Gamma(\mathbf{x}_{o_{eu_i}}) \Big) \tag{27}$$

where $\Gamma(\mathbf{x}_{o_{eu_i}})$ is the measure of new entrepreneurs coming from the pool of unemployed individuals with outstanding UI rights.

3.8 Equilibrium

Definition 3.1 (Stationary recursive equilibrium)**.** *Given the state vector $\boldsymbol{x} = (a, y, \theta, z, j, e)$ with $a \in A$, $y \in \mathcal{Y}$, $z \in \mathcal{Z}$, $\theta \in \Theta$, $j \in \{i, n\}$ and $e \in \{A, C\}$; a stationary recursive equilibrium in this economy consists of a set of value functions $W(\boldsymbol{x})$, $U(\boldsymbol{x})$, $E(\boldsymbol{x})$, policy rules with asset holding $a'(\boldsymbol{x})$, consumption $c(\boldsymbol{x})$, job search effort $s_w(\boldsymbol{x})$, business search effort $s_e(\boldsymbol{x})$, business investment $k(\boldsymbol{x})$, bankruptcy decision, occupational choice, prices ($r, w \in \mathbb{R}$), tax parameters ($\tau_w \in \mathbb{R}$) and a stationary measure over individuals $\Gamma(\boldsymbol{x})$ such that*

- *the allocation choices maximize the agent problem and $\Gamma(\boldsymbol{x})$ is the stationary probability measure induced by decision rules, the probabilities ϕ, ρ, q, Π_y and Π_z.*
- *the capital and labor markets clear. The wage w and the interest rate r in the corporate sector are equal to the marginal products of the respective production factor.*
- *the government budget is balanced $T = G$.*

This model has no analytical solution and must be solved numerically. We detail our numerical implementation for this problem in section F of the online appendix.

4 Parameterization

We parameterize the model to be consistent with key features on occupational mobility, entrepreneurship and the wealth distribution in the US. We compute moments related to mobility using the basic Current Population Survey (CPS) from 2001 to 2008. For moments related to the wealth distribution, we use information from the Survey of Consumer Finance (SCF) in 2001, 2004 and 2007. The model period is the quarter. A subset of model parameters are normalized or taken from their estimates in the literature to restrict the number of estimated parameters. The other parameters are pinned down by minimizing the distance between a number of equilibrium moments from the stationary distribution, and their data counterparts.

4.1 Fixed parameters

Demography Each period, a fraction ζ of individuals retires and is replaced by ζ unemployed individuals without UI rights. Demography is therefore stable. The value of ζ is set to 0.5%, which corresponds to the average entry rate of young individuals into the working population each quarter in the CPS.

Preferences We use the following CRRA and power functions to describe utility of consumption and disutility of search:

$$u(c, s_w, s_e) = \frac{c^{1-\sigma}}{1-\sigma} - s_w^{\psi_w} - s_e^{\psi_e},$$

The coefficient of relative risk aversion σ is set to 1.5 and ψ_w and ψ_e are calibrated. Notice that both search efforts enter separately in our utility function. This specification is computationally easier to solve, but these two efforts might also be very different.

Transition probabilities The probabilities of getting a business idea or a job opportunity arrive at a poisson rate that depends on each search effort. We define the exit probabilities as:

$$\pi_e(s_e) = 1 - e^{-\kappa_e s_e} \qquad \pi_w(s_w) = 1 - e^{-\kappa_w s_w}$$

where κ_w and κ_e are pinned down to match the unemployment rate and the share of entrepreneurs.

We document a linear relationship for the transition from employment to unemployment with respect to earnings using the CPS. We therefore specify the layoff probability η as a linear function of the working ability $h(\theta)$, such that $\eta(\theta) = \alpha_\eta + \beta_\eta wh(\theta)$, where α_η and β_η are estimated using ordinary least square. Earning quantiles are used as a proxy for $wh(\theta)$.

Labor income processes We model the labor income process with a permanent component $h(\theta)$ and a transitory component y. Each component is assumed to follow an AR(1) process in logs with respective persistence ρ_θ and ρ_y and respective variance σ_θ^2 and σ_y^2. This leaves us with four parameters. We discretize innate ability using a 3-states process and the transitory component with a 5-states process. We set workers' permanent component such that $h(\theta) = \theta$. The two processes y and θ are assumed to be orthogonal. We set the persistence of the transitory part to about a year, corresponding to a value of 0.75 for ρ_y and the variance to 0.0225[40]. For the innate ability, we set the persistence to 0.975, corresponding to 10 years in the model. The variance of the innovation of the innate ability process is chosen to match the Gini

[40]This is in the range of the literature (see for instance Storesletten et al. (2004) or Conesa et al. (2009)). Adding the transitory process brings our earning distribution closer to reality but our results are not sensitive to this assumption.

index for labor income, as observed in the PSID, which is 0.38 (Cagetti and De Nardi (2006)). The processes are discretized using the method in Rouwenhorst (1995).

Entrepreneurial abilities In the literature, there are no clear indications of how entrepreneurial abilities could evolve over time. The estimation procedure for such abilities is challenging since: (i) the contribution of the entrepreneur's skills to the business returns is generally unobservable, and (ii) entrepreneur's income could be the sum of different income sources (business income, wage, and capital income). Some authors, for instance, Kitao (2008), parameterize this ability using the entrepreneur's income Gini. However, this assumes that entrepreneurial and working abilities are uncorrelated. In this paper, instead, we stress that working and entrepreneurial abilities are correlated and can generate the observed U-shaped relationship in the transition from paid-employment to entrepreneurship by earning quantiles. We use this relation to indirectly infer the mapping between working and entrepreneurial innate abilities. To do so, we divide the labor income distribution in three quantiles and we compute the ratio of worker starting a business in each quantile over the average transition rate from employment to entrepreneurship taking into account all the workers. This measure tells us how likely is a worker in a given quantile to start a business as compared to the average worker.

Depending on the period and the definition considered, we find that workers in the bottom and the top quantiles (with 3 quantiles) are 0% to 15% more likely to start a business than the average worker. Contrastingly, workers in the middle quantile are 10% - 20% less likely to set up an activity than the average worker. Therefore, we estimate entrepreneurial abilities $g(\theta) = \{g_1, g_2, g_3\}$ such that the resulting transition ratios by earning quantiles in the model are close to their data counterparts[41].

Firm's productivity Unlike preceding papers who assumes *iid* shocks (for instance Mankart and Rodano (2015) and Herranz et al. (2015)) the idiosyncratic business shock we use is characterized by an AR(1) process with mean μ_z, variance σ_z and persistence parameter ρ_z. In the model, a persistent business shock generates an incentive to exit entrepreneurship when an individual fall into a bad state. Therefore, we do not impose any probability of losing the business idea in order to fit the entrepreneurial exit rate as in Cagetti and De Nardi (2006). We normalize the mean to 1.0 and (σ_z, ρ_z) are pinned down endogenously. These parameters help to generate the high entrepreneurial exit rate and the fraction of entrepreneurs with zero or negative earnings. We discretize the process using 7 states.

[41]Notice that we could also take the ratio by educational attainment, however, in the model, there is no state variable summarizing education exactly as θ reflects education, but also experience, professional training, etc..

Other parameters In the US, the joint federal-state Unemployment Compensation program established under the Social Security Act of 1935 provides regular UI benefits for 26 weeks. Additionally, since 1993, the Federal-State Extended Benefits program extend the duration up to 20 weeks in states with especially high unemployment rates. In the model, we choose the least generous UI duration and set the probability ρ of falling in uninsured unemployment to 0.5, which corresponds approximately to 26 weeks of unemployment insurance benefits as in the US. The replacement rate μ is set to 0.4 according to Shimer (2005)[42].

The probability ϕ of reentering the credit market after an exclusion is set to 4.2%, which corresponds to a period of 6 years. The share of capital in the Cobb-Douglas technology for the corporate sector α is set to 0.33. The depreciation rate δ is set to 0.015. The wedge v that translates the transaction cost that banks face when lending is set to 0.4% per quarter, which is in the range of the literature[43]. We fix the home production m to 0.04[44]. Concerning the recovery rate of a bankrupt entrepreneur, we use data from the Word Bank 2009 *Doing Business* report and set this value to 77% of capital invested in the firm. The bankruptcy cost, however, is calibrated endogenously to generate a realistic default rate. Finally, we set the maximum leverage ratio λ to 50% following Kitao (2008).

4.2 Estimated parameters

After setting the previously discussed parameters, other structural parameters need to be pinned down. The return to scale parameter in the entrepreneurial sector ν lets us fit the ratio of median net worth between workers and entrepreneurs. The discount factor β helps to generate a realistic annual capital-output ratio of 2.65[45]. We pin down the three values of the mapping $g(\theta)$ in order to generate realistic flows from employment to entrepreneurship by earning quantiles. Finally, the matching parameters (κ_w, κ_e), the persistence of the process z and the search cost parameters, ψ_w and ψ_e (with the restriction $\psi_w = \psi_e$), are used to obtain consistent masses and transitions of occupations in the model. We choose a fraction of entrepreneurs in the model of 8.8%, which is close to the CPS estimate of entrepreneurship rate and equal to the average observed rate in the SCF. We target an unemployment rate of 5%, which is roughly the US average between 2001 and 2008. We set an entrepreneurship exit rate of about 6% and a

[42] In section 6.5, we study policy effects under various UI systems with longer durations and higher benefits.

[43] For instance, Mankart and Rodano (2015) set a cost of 1% for secured debt and 4% for unsecured debt. Bassetto et al. (2015) report a spread between the interest rate paid by borrowers and that received by lenders of about 1.5% annually, corresponding to 0.37% quarterly.

[44] This value helps to generate a realistic unemployment rate, by lowering the incentive to search for either a job or a business idea by increasing the agent's current income.

[45] As Kitao (2008), we follow Quadrini (2000) and choose a capital-output ratio without taking into account public capital. Capital in the model refers to equipment and structures, inventories, land and residential structures, which is 2.65 of total output annually.

fraction of new entrepreneurs previously unemployed of 20%, which is approximately what is observed in the CPS. Finally, the variance of the innovation of the process z lets us match a fraction of entrepreneurs with zero or negative earnings of about 10%, following Hamilton (2000), who uses his own entrepreneurial earnings measure and controls for under-reporting using the SIPP[46]. Finally, we let the bankruptcy cost ϕ to adjust in order to generate a realistic default rate of 0.57% following Mankart and Rodano (2015)[47]. We note that while some parameters mainly affect some moments, changing one parameter affects the whole set of generated moments. In order to estimate those parameters, we use a simulated method of moments (SMM)[48]. Let $\mathbf{p}$ represents the vector of parameters to be endogenously estimated. The parameter vector is chosen to minimize the squared difference between simulated and empirical moments,

$$\hat{\mathbf{p}} = \arg\min_{\mathbf{p}} \sum_{k=1}^{10} \Big(m_k - m_k(\mathbf{p}) \Big)^2 \tag{28}$$

where $m_k(\mathbf{p})$ represents the k-th simulated moment and m_k its data counterpart. Minimizing this function is computationally intensive, since it requires solving policy functions and the whole equilibrium outcomes for each set of parameters. The resulting estimated parameter set and targeted moments are summarized in Table 4[49].

We find a low value for the discount factor of 0.974. As in other entrepreneurial models (for instance Cagetti and De Nardi (2006) who find 0.86 to 0.88 at a yearly frequency) the existence of wealthy entrepreneurs reduce the need to give extra incentives to save through a higher discount factor to match the capital-output ratio. The implied quarterly lending interest rate, $r^d + \nu$, is of 2%[50].

For the idiosyncratic firm shock process z, the persistence is 0.87, which is close to the estimated profit persistency reported in Gschwandtner (2012) (at an annual frequency) and corresponds approximately to a shock every 2 years.

[46]Table 6 in Astebro and Chen (2014) reports a fraction of self-employed households with zero and negative earnings of 7%. However, they do not distinguish household and individual earnings. Because this number is subject to a debate, in section 6.6 as a robustness check we recalibrate the model with the arbitrary much lower fraction of zero or negative earnings of 3%. The qualitative results of the paper remain unchanged.

[47]Some papers assume a bankruptcy cost close to 7% according to existing estimation. However, this does not generate enough bankruptcy in our setting. As shown in section 6.6, alternative bankruptcy specifications do not alter the qualitative results of the paper, since they account for only a small fraction of the entrepreneurs.

[48]To be more precise, we use a version of the Control Random Search (CRS) algorithm introduced by Kaelo and Ali (2006) with a set of starting points generated via sobol sequences along a dimension of 11 parameters.

[49]We also present the resulting policy functions and distributions in the section D of the online appendix.

[50]This corresponds to an annual interest rate of 8.2%, which is a bit higher than the average lending rate from 1993 to 2008 of 7.44%, as computed by the IMF.

A. Parameter	Symbol	Value
Discount factor	β	0.9742
z process (autocorrelation, variance)	ρ_z, σ_z^2	0.869, 0.185
Businesses' return to scale	ν	0.79
Search utility parameter	$\psi_e = \psi_w$	2.41
Matching parameter	κ_e,κ_w	0.267,0.855
Bankruptcy cost	ϕ	0.0238
Entrepreneur's innate ability	$[g_1, g_2, g_3]$	[0.0679, 0.0775, 0.1026]
B. Targeted moments	**Target**	**Model**
Unemployment rate (in %)	5.0	5.0
Share of entrepreneurs (in %)	8.8	8.8
Entrepreneurs' exit rate (in %)	6.0	5.9
Fraction of new entrepreneurs prev. unemployed (in %)	20	18.9
Capital-output ratio (annual)	2.65	2.6
Ratio of net worth E/pop	8.0	8.07
Bankruptcy rate (as fraction of entrepreneurs) (in %)	0.57	0.57
Fraction of entrepreneur with earnings ≤ 0 (in %)	10	10.8
Flows W to E by quantiles / avg rate (%)	$\begin{bmatrix} Q1 & Q2 & Q3 \\ 1.075 & 0.85 & 1.075 \end{bmatrix}$	$\begin{bmatrix} Q1 & Q2 & Q3 \\ 1.075 & 0.85 & 1.075 \end{bmatrix}$

Table. 4. Estimated parameters and targeted moments.

5 Properties of the calibrated model

We now detail the properties displayed by the calibrated model for occupational mobility and other moments related to entrepreneurship. On the mobility between occupations, by construction, the transition from worker to unemployment is pinned down and close to the data. All other transitions are generated endogenously by the model. Table 5 displays the flows in the model and in the CPS. Transitions are quite close to their empirical counterparts in and out of each occupation. Notice that theoretically there is a link between the model flow values and the model generated masses: model flow values correspond to a transition matrix and its invariant distribution generates the model masses[51]. However, this will never be the case in the data between observed masses and observed flows for various reasons. Thus depending on whether we target the masses or the flows, there will always be some amount of mismatch. Therefore, the flow values in the model and in the data are somewhat different, however, the overall magnitude of the flows is realistic[52]. In particular, our model captures the fact that unemployed individuals are 4 to 5 times more likely than workers to run a business. Furthermore, while we target the overall entrepreneurial exit rate, we also capture the high entrepreneurial exit rate

[51] We abstract here from the demography assumption used in the model that disturb this computation.

[52] Moreover, a substantial fraction of unemployed in the data transition to a Not in the Labor Force (NLF) state but continues to actually search for a job. We do not take this into account in the model.

into paid-employment. Two forces lead to this high exit rate. First, a bad business shock z generates low future expected profits and encourage entrepreneurs to search a job *on-the-business*. Second, a sizable fraction of unemployed individuals started their business out-of-necessity. Since the option to work in the corporate sector is better for those individuals, they continue to search for a job *on-the-business* and exit as soon as a job is found.

	Mass (%)		**Transition: Model (Data)** (%)		
	Target	Model	W	E	U
W	86.2	86.2	97.36 (97.35)	0.53 (0.50)	2.11 (2.15)
E	8.8	8.8	5.19 (4.80)	94.07 (94.22)	0.74 (0.99)
U	5.0	5.0	45.07 (47.36)	2.14 (2.40)	52.79 (50.25)

Table. 5. Transition between occupations during a quarter (data counterpart between braces). *Data sources:* authors' computations using CPS data from 2001 to 2008. We restrict our sample to individuals aged between 20 to 65 years old.

In figure 5, we report how the model matches the shapes of the flows from a given occupation to another as compared to the CPS data. The flows in the model are computed with respect to ability levels and educational attainment is taken as a proxy in the data[53]. In order to compare the alternative definitions of entrepreneurship, we simultaneously display the flows for self-employed individuals and self-employed business owners. Among those flow patterns, only the decreasing shape of the paid-employment to unemployment flow is somewhat more explicitly imposed in the model as we set the layoff probability with a decreasing dependence to the ability level θ. We also recall that we imposed in the calibration step that the model match the *U-shape* of the flow between paid-employment and entrepreneurship by earnings quantiles. The shape of this flow by educational attainment is similarly *U-shaped* in the data for self-employed individuals and flatter on the left for self-employed business owners. All the other patterns are endogenously generated by the model. A number of flow shapes are well reproduced under our parsimonious assumptions concerning search frictions and business shocks across ability groups: we capture the decreasing pattern of the entrepreneurship to unemployment flow as well as the increasing shape of the reverse flow. We also capture the *hump-shape* of the flow from unemployment to paid-employment despite the fact the model is unable to match the exact magnitude of this flow. This *hump-shape* is explained in the following

[53]Matching ability groups with education groups might not be the most obvious way to compare data and model simulations. However the CPS data does not allow many options on the subject. Although they are probably the best to recover the flow dynamics at high frequency, CPS data does not provide any information about wealth or accurate earnings. The included family income variable is rather imprecise and its range is too small. Education is the best directly available element comparable to the model. However, we still tried to match by indirect means: in Appendix B, we report flows by *reconstructed wages* using a fitted wage that takes age, education, etc. to predict an individual's ability.

way in the model: low-skilled unemployed individuals search for a job with a lower incentive than other groups since the difference of value between employment and unemployment for this category is smaller. This is not true for unemployed individuals in the high skilled group although they tend to also switch toward paid-employment less often. But, this group of individuals has a large incentive to switch toward self-employment, consistently with the data, lowering the transition to paid-employment. Finally, the flow shape the model captures the least is the *S-shaped* from entrepreneurship to paid-employment. We still capture the increasing part of this flow for HS to M groups but not the highly non-linear extremes[54]. In the model, high-skilled entrepreneurs tend to exit more often since they have access to high paying jobs without the risk of the entrepreneurial venture. Therefore, the incentive to search for a job tends to be higher for this category[55].

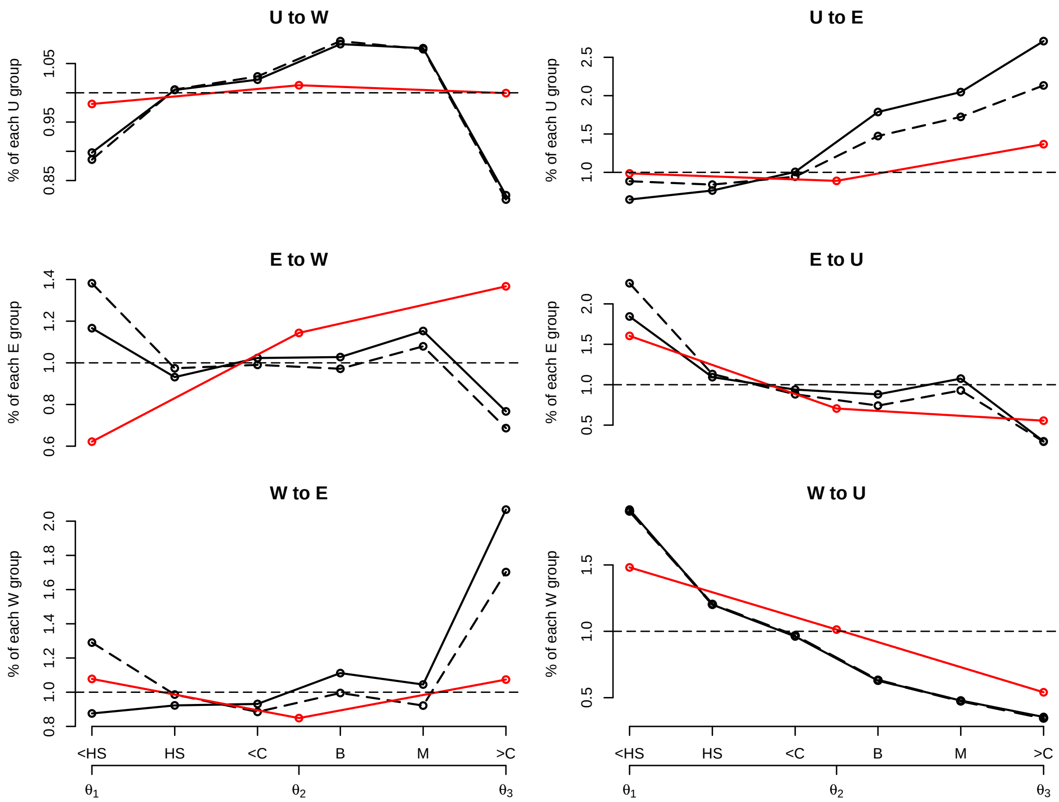

Figure 5. Flows from a given occupation to another by CPS educational attainment (black) and model ability level θ (red). Dashed lines refer to self-employed only while solid lines to self-employed business owners. The bottom horizontal axis displays model ability level whereas the top horizontal axis displays educational attainment groups. Legend: U: unemployment, W: paid-employment, E: entrepreneurship. *Data sources:* authors' own computations using CPS data from 2001 to 2008.

[54] According to the BLS, groups $> C$ and $< HS$ together represent less than 15% of the working population.

[55] In the online appendix section A, we show that this *S-shape* is a hump-shaped curve at a yearly frequency for self-employed business owners. This may be due to the fact that at a higher frequency, we also capture self-employment movements that may mainly concern the lowest educated group potentially running more unstable businesses in the short-run.

As argued above, the model is based on the two minimal dimensions of ability and wealth and individual search efforts play an important role in shaping the flows between occupations. Figure 6 depicts the insured unemployed search efforts with respect to wealth. Job search efforts are decreasing with wealth, but also with respect to the ability level[56]. Concerning the business search efforts, the policy functions are hump-shaped. Wealth poor individuals do not find it interesting to run very small firms and thus provide very small effort. As wealth increases, individuals are willing to invest larger amounts in their businesses and the effort increases. At some point, search costs become larger than the benefit of additional capital in the business and search efforts decrease.

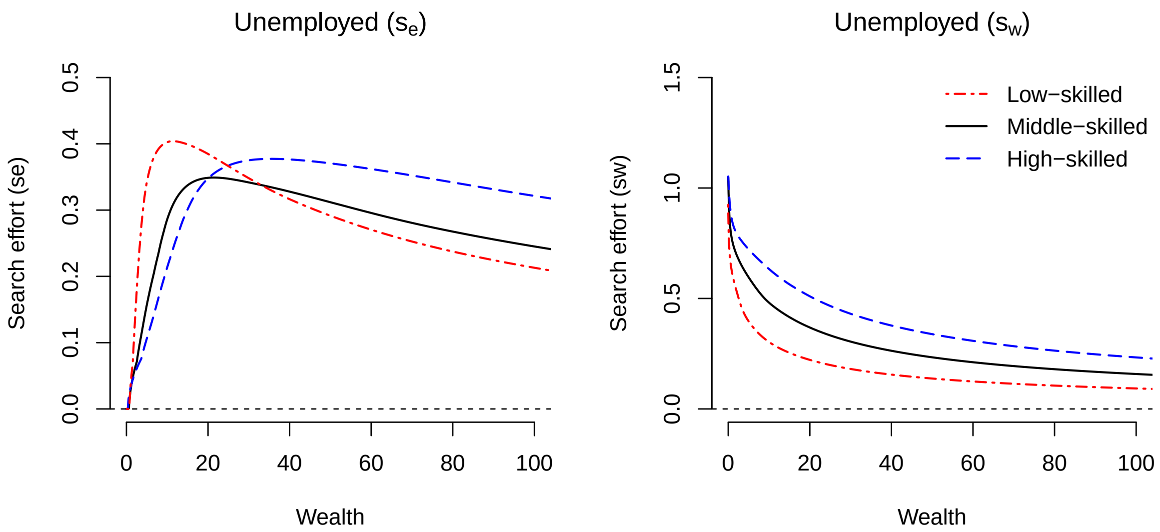

Figure 6. Business (left) and job (right) optimal search efforts for insured unemployed individuals.

We also capture a number of other moments related to the labor market and entrepreneurship that are not explicitly targeted in the parameterization procedure but that are still reasonably matched and comparable to the US economy. The necessity share, which is the fraction of entrepreneurs who started businesses because of a lack of job opportunities is equal to 7.4% in our model and is evaluated by Ali et al. (2008) in 2008 to be 4.7% of early-stage entrepreneurs for men and 21.4% for women, representing 10% in total. Therefore, in line with Caliendo and Kritikos (2009), among the 20% new entrepreneurs who were previously unemployed, a substantial fraction enters entrepreneurship *out-of-necessity*.

Concerning entrepreneurial earnings, we obtain a fraction of 10.8% of the entrepreneurs with zero or negative earnings (profits in the model). If we consider only those who do not exit entrepreneurship at the end of the period, this fraction falls to 9.5%. This means that despite the realization of bad shocks, a substantial number of entrepreneurs persist in their activity. As argued by Hamilton (2000), a substantial fraction of entrepreneurs create and keep running a

[56]For convenience, the search policy functions of workers and entrepreneurs in the baseline model are plotted in section D of the online appendix.

business despite the fact that they would earn more with paid-employment. In the model, expectations of a better business shock z and frictions induce some entrepreneurs to keep running a bad business. Such entrepreneurs search for a job opportunity and exit as soon as they find one. Finally, the model generates heterogeneity in entrepreneurial earnings through different firm sizes, ability and business shock. The implied Gini coefficient for entrepreneurial earnings in the model is 0.58 against 0.65 in the SCF.

Considering all forms of income (including capital gains plus realized profit), the fraction with zero or negative income fall to 2.7% in the model. Table 6 compares the fraction of entrepreneurs with an income lower than a given level of normalized income (including wage, business income, and capital gains) in the model and in the data. The model exhibits a slightly higher concentration of total income on the left side with respect to data.

Normalized income level	**0.1**	**0.3**	**0.5**	**0.7**	**1.0**	**1.5**	**2.0**	**2.5**
Model (% entrepreneurs)	4.6	12.7	25	36	50	66.2	77	83.9
Data (% entrepreneurs)	3.7	9.9	20.9	33	50	63.2	73	79

Table. 6. Fraction of entrepreneurs with an income lower than a given level of normalized income.

The model does also match well the crucial relative wealth between occupations. First, it is worth noting that the median ratio of entrepreneurial net worth relative to the one held by the whole population is equal to 6.2 in the model against an average of 6.6 in the SCF. Second, the median ratio of workers' income over entrepreneurial income is equal to 1.6 in the model, against 1.62 in the SCF. Concerning the cross-sectional variance between occupations, Hamilton (2000) reports that the standard deviation of entrepreneurial earnings is 2 to 4 times that of wage-earners in the SIPP depending on the adopted definition. We find a value equal to 3.5 in the model. Additionally, in the data, the ratio of median debt to income ranges from 0.95 to 1.6 between SCF waves, whereas it is 0.93 in our model. Finally, the fraction of zero (or negative) net worth (i.e. total assets minus debt) in the data is roughly 10%, whereas in our model we obtain 4%, and the fraction of total wealth held by entrepreneurs is 30% in the data, against 29.4% in the model. The model however underestimates the wealth Gini, which is 0.63 in the model against 0.82 in the SCF. Indeed, as compared to Cagetti and De Nardi (2006), we do not target this statistic and our model abstract from voluntary bequests, which has been shown to play an important role in order to obtain the right tail of the wealth distribution.

Finally, we compare the entrepreneurial survival rate with records available for surviving establishments. The fraction of entrepreneurs surviving after 2 years and 4 years are respectively 59% and 43% in the model, whereas the average establishment rates are respectively 66% and 44% in the data according to Knaup and Piazza (2007). However, this data excludes two-thirds of the observations, as it does not account for sole-proprietorship who might survive less. Moreover, it is worth noting that establishment dynamics might be somewhat different from the actual firm and entrepreneurial dynamics[57]. Overall, we potentially underestimate the true survival rate, however, we capture well the usual shape of the survival rate as shown in figure 7. That is, the largest exit occurs during the first and second years and, after the fourth year, the probability of exit is considerably reduced.

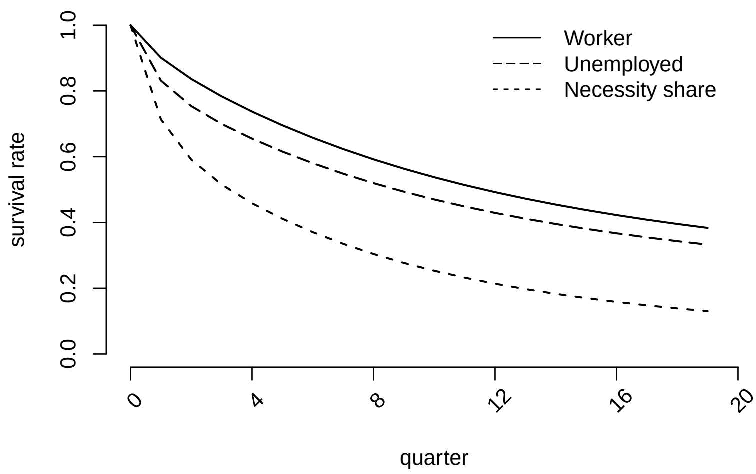

Figure 7. Survival rate for workers, unemployed and individuals in the necessity share becoming entrepreneurs.

Overall, despite the few limitations that we underlined, the model is well suited to capture occupational flow dynamics as well as other properties expected from a rich entrepreneurial framework. In the next section, we use this model in two policy experiments.

6 Entrepreneurial insurance and start-up subsidy

This section studies the impact of introducing an entrepreneurial downside risk insurance as an extension to the existing UI program in the spirit of a number of European insurance policies. Following the explanations in section 3.6, we implement the DRI with replacement and duration parameters $(f, \bar{q}) = (0.3, 0.5)$. The insurance duration $\bar{q}$ is set to equate the US unemployment insurance duration and, as mentioned before, depends on the realized profit. We compare our main policy experiment with another frequently used instrument to foster entrepreneurship in the unemployment pool: a start-up subsidy (SUS). To make the two experiments comparable, we adjust the subsidy amount S provided to new entrepreneurs entering the program in order to generate the same share of entrepreneurs in the two alternative economies. We also show that UI design (replacement rate and duration) has a significant impact on occupational

[57] As another comparison, using the Panel Study of Entrepreneurial Dynamics (PSED), Reynolds (2017) finds that 48% of firms survive after 4 years, taking the first transaction as a measure for firm birth.

choices and that the effectiveness of the DRI depends on the UI specification.

6.1 Aggregate effect

We start our analysis by exploring the aggregate effects of the two reforms at the steady state equilibrium. As mentioned before, only new entrepreneurs previously insured unemployed can benefit from the programs. In table 7, we compare the impact of the reforms on main indicators from the baseline economy. Under the two experiments, the share of entrepreneurs increases by 1.8% and approximatively 3% of the entrepreneurs are insured under the DRI. This table clearly shows that for an identical increase of the fraction of unemployed individuals starting a business, there are specific advantages and disadvantages to the DRI policy when compared to the SUS policy. They can roughly be separated along these lines: the DRI policy is slightly more expensive and overall has a smaller impact on unemployment than the SUS policy. However, the DRI policy has a lasting qualitative effect on the entrepreneurial pool and the economy as discussed below. In more details, implementing the DRI increases the unemployed individuals' incentive to start businesses by 11% and implies important changes in mobility between occupations. The number of newly created firms per year[58] goes up by 3% under the DRI and 14% under the SUS. Surprisingly, the unemployment rate is only slightly lower. Instead, less corporate jobs are filled. Under the SUS mobility effects are stronger. Relative to the DRI, the fraction of unemployed individuals starting businesses is much larger. However, the entrepreneurship exit rate is also substantially larger, suggesting that many new entrepreneurs entering the SUS program prematurely stop their activity in the quarters following the reception of the subsidy. Insured entrepreneurs tend to survive longer than subsidized entrepreneurs, we will further develop this point in subsection 6.3.

As stressed earlier, the SUS policy is slightly less costly tax-wise. However, overemphasizing this cost advantage of the SUS is somewhat unfair to the DRI policy. First, the tax cost advantage almost disappears when computing the cost of the policy over total production. Second, the reason for the extra cost comes for the intrinsic nature of the two policies which is quite different: even though the DRI is paid in actually a small number of cases, an entrepreneur might have to be insured and compensated (e.g. when entrepreneurial incomes are slightly higher than UI benefits) during several periods. Moreover, an insured entrepreneur can choose to return to the unemployment pool and continue to receive her UI benefits. There is no equivalent mechanism under the start-up subsidy. Nevertheless, the unemployment rate decreases more under the SUS, which reduces government expenditure for the UI system.

We find that the effects of the DRI on major macroeconomic indicators such as production,

[58] We normalize this number in the baseline model to 500.000 new business creation as in the US. A firm in the model corresponds to an entrepreneur.

	Baseline	DRI ($f = 0.3, \bar{q} = 0.5$)	SUS ($S = 0.07$)
Fraction of entrepreneurs	8.8	8.96	8.96
Fraction unemployed starting businesses (in %)	2.14	2.38	3.58
Entrepreneurship exit rate (in %)	5.93	6.0	6.72
Unemployment rate (in %)	5.0	4.991	4.958
Corporate jobs (in %)	86.2	86.05	86.08
New firm per year (th.)	500	514.15	571.24
Necessity share (in %)	7.4	5.9	12.1
Entrepreneurial sector production	0.333	0.339	0.335
Corporate sector capital	3.585	3.581	3.583
Entrepreneurial sector capital	1.495	1.520	1.501
Tax rate τ_w (in %)	0.902	0.992	0.972
Cost of the policy over total production (in %)	-	0.013	0.011

Table. 7. Downside risk insurance (DRI) and start-up subsidy (SUS) effects on aggregates.

unemployment, capital accumulation or prices are small[59]. One reason is that unemployed individuals account for only a small share of the whole population. In the case of the unemployment rate, there are two effects in the model that might lower it. First, there is a change in the relative values between entrepreneurship and paid-employment that leads to a shift of the cut-off point, along the two-dimensions of assets and abilities, at which unemployed individuals start businesses since entrepreneurship becomes a more valuable option. Second, unemployed individuals react to the policies by changing their search efforts toward finding a job or finding a business idea. When the policies are implemented, the value of starting a business mechanically increases. On the one hand, this effect encourages unemployed individuals to search for a business idea and start their own business, which reduces unemployment. On the other hand, the policy also improves the value of being unemployed. It becomes relatively more valuable to stay unemployed and wait for a business idea, lowering the incentive to search for a job and increasing unemployment. Our results suggest that the first effect dominates the second and that unemployment is lowered under the two experiments.

6.2 Impact on the pool of entrepreneurs

In this section, we assess the impact of the above policy experiments on the composition of the pool of entrepreneurs. Since regular UI benefits are proportional to the working ability, highly productive workers receive higher UI compensation when laid off than workers

[59]This result is in contrast with the empirical literature on this type of policies on the unemployment pool (see among other Baumgartner and Caliendo (2008), Caliendo and Künn (2011), or Ejrnæs and Hochguertel (2014)). All those papers are partial equilibrium studies and do not endogenise occupational choice.

with low productivity. Therefore, the insurance mechanism generated by the compensation $b_e(\theta, \pi_r)$ is naturally type-dependent. Contrastingly, the start-up subsidy provides an additional amount of wealth, independently of the agent's productivity. Additionally, the SUS does not let entrepreneurs keep their UI rights in case of failure. These two policies are thus likely to have very different implications on the composition of the new entrants into entrepreneurship.

Selection by ability Table 8 displays the increase in the share of entrepreneurs by productivity groups, defined in terms of their innate ability θ, under three reform programs: standard DRI, start-up subsidy, and a lump-sum DRI. The latter experiment is the same as the standard DRI, except that we restrict the low income compensation to be a lump-sum amount given to the entrepreneurs, with no regard to the agent's ability (i.e., $b_e(\theta, \pi_r) = \tilde{b}_e(\pi_r)$). This lump-sum amount is set such that the resulting share of entrepreneurs is the same as under the DRI reform, and the resulting tax rate increases to 0.985%.

% of entrepreneurs	θ_1	θ_2	θ_3
Baseline	12.73	7.68	7.10
DRI	+1.32	+2.01	+2.30
SUS	+2.71	+1.61	+0.71
Lump-sum DRI	+2.31	+1.61	+1.36

Table. 8. Percent increase (relative to the baseline economy) in the share of entrepreneurs by ability groups under different reforms.

It is worth noting that the DRI leads highly skilled unemployed individuals to start their own business more often as compared to the low-skilled group. For the SUS, we find the opposite: the policy benefits mostly low-skilled entrepreneurs. There are two forces that explain this result. First, under a type-dependent insurance mechanism, highly skilled individuals have a very high opportunity cost when entering entrepreneurship, because they have to give up their relatively higher UI benefits. This opportunity cost is lower for low to middle-skilled groups, with lower UI benefits. Second, low-skilled individuals are on average poorer. However, entrepreneurship is accessible mainly for individuals with sufficient capital levels, who can start a sizable business that is profitable. Therefore, under the DRI, low-skilled unemployed individuals are still too constrained to set a sufficiently large business venture.

The DRI has the effect of resorbing the distortion arising from losing UI benefits when the individual enters entrepreneurship, as discussed earlier. Therefore, highly skilled unemployed individuals are willing to start their business, without running the risk of losing their UI rights. For this type of individuals, this effect is strong, much more than for other groups, because they are also richer, and thus more likely to start valuable business ventures. When a start-up subsidy is implemented however, it mainly benefits poorer individuals, who were previously

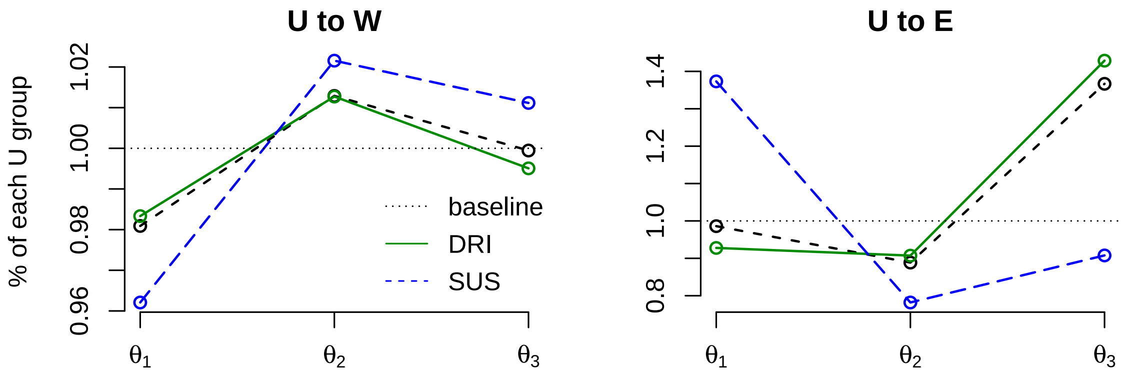

Figure 8. Transitions (relative to the average transition rate) from unemployment toward paid-employment and entrepreneurship by ability group for the baseline model, under DRI and SUS.

borrowing constrained and unable to start a business in the baseline economy. Those individuals are mainly lower-skilled with a low opportunity cost of setting a business, since their UI benefits are small[60].

Finally, under the lump-sum DRI, the increase in the share of entrepreneurs seems to be more homogenous across groups as compared to the SUS because part of the insurance is included in this policy. Indeed, under this policy, unemployed individuals can experiment in starting their own business, without the risk of losing their UI rights. Nevertheless, when compared to the standard type-dependent DRI policy, the insurance provided in such a case is small for the highly skilled group, which explains why the fraction of new entrepreneurs shifts to the left of the ability distribution. For the low-skilled group, the lump-sum insurance is closer to their UI benefits (and even slightly higher), such that setting a business is a valuable option.

In Figure 8, we plot the model flows (relative to the average transition rate) from unemployment to paid-employment and entrepreneurship by ability group for the baseline economy and both reforms. The flow from unemployment to entrepreneurship (right panel) clearly shows the opposing selection mechanism by ability under SUS and DRI. In the case of SUS, the low ability group switches much more to entrepreneurship than both in the DRI and the baseline case.

Effect on entrepreneurial wealth We further investigate the fact that DRI does not favor the entry of poorer (lower-skilled) entrepreneurs whereas a SUS does in Figure 9: we display in the top panel the difference in the mass of entrepreneurs following the two reforms relative to the baseline economy. The DRI policy produces a fatter right tail and at the same time

[60]Our findings corroborate two results in the empirical literature relative to the DRI and the SUS. First, in Germany, a start-up subsidy implemented in 2003 has been shown to significantly increase the entry of unemployed individuals into entrepreneurship, especially for lowly educated individuals (see Caliendo and Künn (2011)). Second, Hombert et al. (2017) show that the DRI introduced in France in 2002 - 2003 did not lower the quality of new entrepreneurs, especially in terms of education.

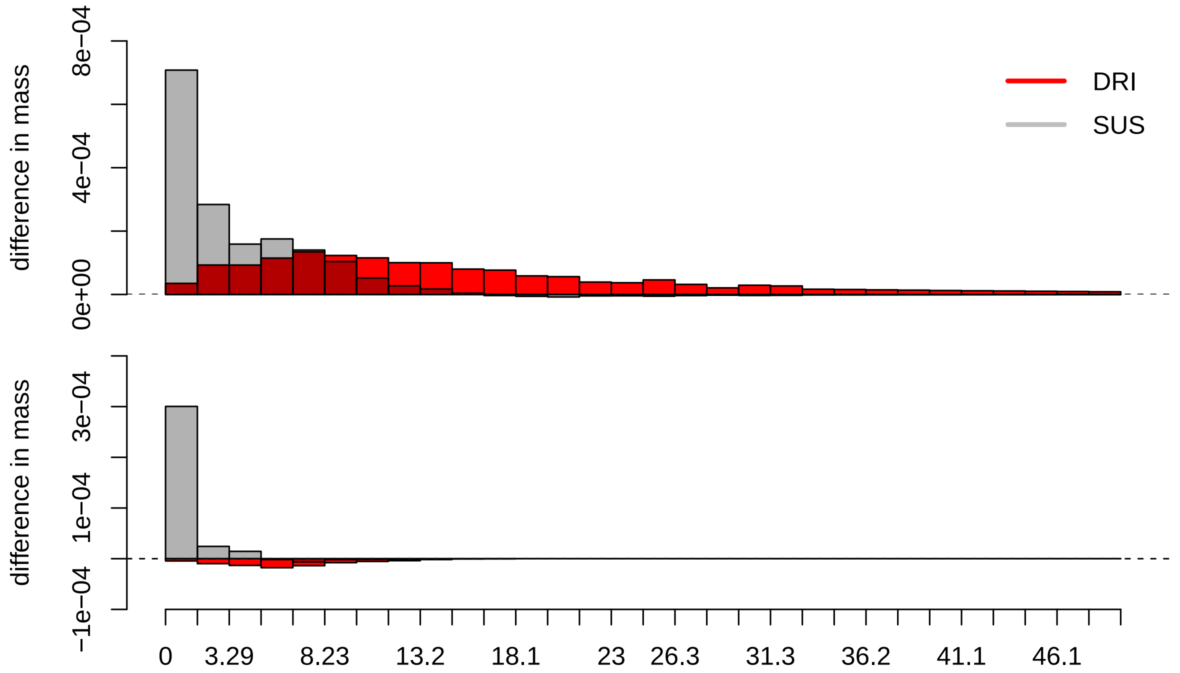

Figure 9. Difference in the mass of entrepreneurs (top panel) and the necessity share (bottom panel) relative to the baseline economy for the DRI and SUS policies.

the DRI policy increases the mass of entrepreneurs more than the SUS policy for any level of wealth except left most bins. Most of the increase of the mass produced by the SUS policy is concentrated on those left most bins and thus increases mainly the low wealth population of entrepreneurs. This is explained by the fact that very poor unemployed individuals are borrowing constrained and are therefore unable to start businesses. Contrastingly, under the SUS, the additional wealth coming from the subsidy allows the entry of poor entrepreneurs.

Interestingly, the bottom panel of Figure 9 shows the change in the necessity share under the two policies. We define the necessity share as the fraction of unemployed individuals who start a business because of a lack of job opportunities[61]. Under the DRI, the fraction of unemployed individuals starting businesses do so because it becomes comparatively more valuable than taking a job opportunity, lowering the necessity share. This supports the previous intuition that the DRI implies a shift in the occupational choice of unemployed individuals who already have the possibility of setting-up sufficiently large firms. On the contrary, we show that the SUS increases this necessity share, by providing a better option to the poorest unemployed individuals, despite the fact that this opportunity to start a business is still less valuable than employment.

[61] We formally defined this in section 5 as an unemployed individual with state space $\mathbf{x}$ who started her business while $\mathbb{E}[W(\mathbf{x})] > \mathbb{E}[E(\mathbf{x})] > U(\mathbf{x})$.

6.3 Entrepreneur's selection and performance

In this section, we are interested in the performance of new entrepreneurs entering the programs over a time period of 5 years. A natural question when we implement a program fostering entrepreneurship is how the newly selected entrepreneurs perform. For instance, we showed in previous sections that new entrepreneurs tend to be more qualified under the DRI, but we still miss important elements about how the new entrepreneurs survive, produce and grow in the quarters and years after their entry under the two reforms.

To address to this preoccupation, we compute the performances, measured in terms of production, capital and skills, of (previously unemployed) new entrepreneurs, and we compare the differences with respect to the baseline economy. We also measure the survival rate of entrepreneurs, which is the fraction of entrepreneurs who did not exit entrepreneurship.

In contrast to previous empirical studies, using the model we can perfectly identify the fraction of unemployed who specifically entered entrepreneurship due to the policies. We therefore separate new entrepreneurs into two groups: (i) those who would have entered entrepreneurship even without the reforms, (ii) those who started a business essentially because the program was available[62]. The first group is a counterfactual one that lets us compare the performance implied by the DRI and the SUS relative to the baseline economy, without selection effects: we mark individuals becoming entrepreneurs in the baseline economy even without DRI, then we provide DRI to those people and measure their average performance during 5 years. The second group sheds light on the performance of selected new entrepreneurs that entered due to the reforms. Then, we simulate the behavior of entrepreneurs in all possible states during 5 years[63]. Along the simulation, we compute a number of indicators, including production and capital levels, survival rate or the average innate ability. Table 9 summarizes the average effect of the reforms relative to the baseline economy for the first group, as well as the characteristics of the selected groups under the two reforms.

When unemployed individuals start a business under the insurance reform in the counterfactual group, they tend to grow faster and survive longer when compared with the baseline and the SUS cases. The selected fraction of new entrepreneurs is behaving very differently under the downside risk insurance with respect to the start-up subsidy. Under the DRI (resp. the SUS), selected entrepreneurs are on average more (resp. less) skilled, and this persists along the five years. They are also richer, produce and survive more and grow faster than those selected under the SUS. Even if they are on average poorer compared to those who would have entered entrepreneurship even in the absence of the policy, they produce slightly more than the

[62]This fraction is simply the residual between the distribution of new entrepreneurs previously insured unemployed in the new economy, relative to the baseline economy.

[63]This computation is demanding because it implies tracking specific entrepreneurs over a long period for each pair of the entrepreneur's state vector.

5 years average	Baseline	Counterfactual		Selected	
		DRI	SUS	DRI	SUS
$g(\theta)$ (skill)	0.0789	0.0790	0.0788	0.0831	0.0757
Wealth	12.06	12.05	12.13	10.10	7.57
Production	0.825	0.812	0.828	0.823	0.598
Production growth (in %)	2.45	2.6	2.47	2.22	1.68
Survival rate (in %)	48.15	50.44	48.29	35.66	34.74
Marginal productivity of labor (MPL)	0.298	0.302	0.298	0.371	0.244

Table. 9. Performance and quality of entrepreneurs. *Notes:* all values are an average over 5 years.

counterfactual group because they tend to be more qualified[64].

We also compute the (virtual) average marginal productivity of labor (MPL) that translates the marginal production that an additional worker in each considered group would have generated if she was employed in the corporate sector[65]. We find that for all groups, the production that comes from the entrepreneurial business venture is higher than what this individual could have produced in the corporate sector. For instance, the selected fraction under the SUS produces on average 0.598 in 5 years, and would have contributed to only 0.244 if she were employed in the corporate production sector.

Finally, in figure 10, we display the average survival rate of the previously unemployed new entrepreneurs for the two (counterfactual and policy) groups. First, under the SUS, the survival rate of the counterfactual group is very close to the one under the baseline model. This is because for such entrepreneurs, the risk of being hit by a bad business shock is still present and the additional wealth does not prevent the entrepreneur from exiting. On the contrary, under the DRI they tend to survive longer, contributing to the aggregate increase in the entrepreneurship rate. Second, despite the fact that the two groups are different in terms of their composition, the survival rate of the selected group under the two reforms are lower than the baseline rate at all horizon and reach an average of 20% after 5 years, suggesting that only a few successful entrepreneurs are selected with the policies.

[64] Our findings are consistent with the empirical results in Hombert et al. (2017). Most notably, we find that the counterfactual group under DRI does not produce more than this same group without the policy. This suggests that the two groups invest broadly the same amount in their business. In our model, this happens endogenously since most of the entrepreneurs are already binding their borrowing constraint. Additionally, in our model, the selected fraction of entrepreneurs behave somewhat similarly to the counterfactual group. However, we find that they tend to be more skilled whereas Hombert et al. (2017) do not identify a significant difference in the educational levels in their estimation.

[65] We abstract from the additional production coming from the entrepreneur's wealth that would have been also invested in the corporate sector. Nonetheless, it represents a very small amount.

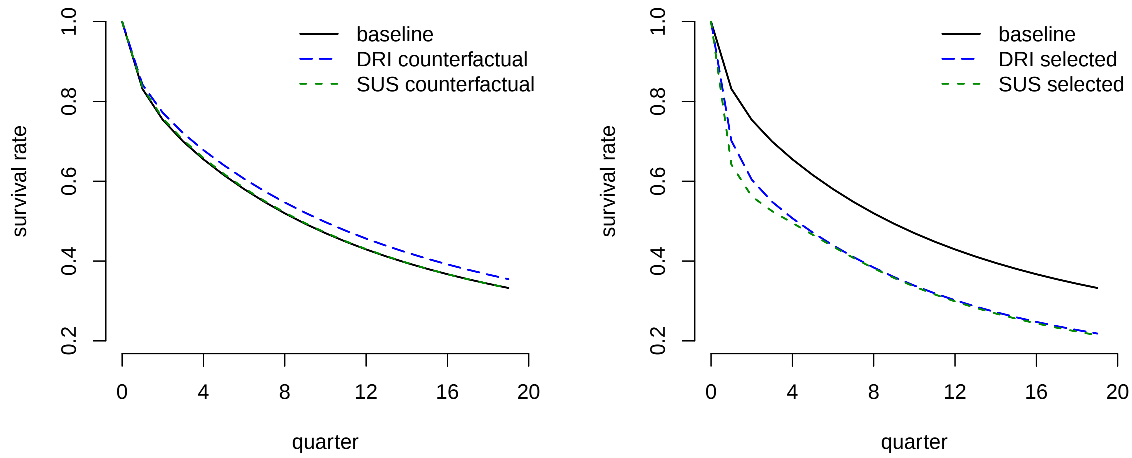

Figure 10. Survival rate for the counterfactual group (left panel) and the selected group (right panel). *Note:* black line refers to the unemployed individuals starting businesses in the baseline economy.

6.4 Decomposing the downside risk insurance effects

Broadly speaking, insured unemployed individuals can be divided into two groups. Those who can actually start businesses and those who cannot. There are three reasons why insured unemployed individuals would not start a business: (i) it requires some effort (it is costly in utility terms because it implies searching for a business idea), (ii) it is risky and (iii) it implies losing UI benefits. The last point is crucial. It means that because unemployed individuals are no longer eligible for UI benefits when starting their own business, they are not willing to start businesses and face potentially very low returns. When the DRI is implemented, insured unemployed individuals can still benefit from their regular UI benefits *on-the-business*. In this section, we explore the effect of resorbing the above distortion from the current UI system. Under our specification, the effect of the downside risk insurance combines three insurance components. First, the right to claim any outstanding UI rights in case of failure after returning to the unemployment pool. Second, a compensation that guarantees at least UI benefits in case of low but positive entrepreneurial income (if income is negative, the entrepreneur gets her UI but has to bear the cost of the bad shock). Third, a part that provides a supplement to entrepreneurs when their income is low and depending on f that can let her earn more than her initial UI rights.

In table 10, we disentangle the various components of the DRI by inspecting the effects of two partial entrepreneurial insurances. The first insurance that we name *No compensation* does not pay any compensation to an entrepreneur in case of a bad income stream as in the full DRI policy. However, entrepreneurs under this partial insurance can return to the unemployment pool if necessary and keep claiming any outstanding UI rights (provided they were insured unemployed before becoming an entrepreneur). The second partial insurance is a case of DRI

	Baseline	DRI	No compensation	$f = 0$
(Δ%) % of entrepreneur	8.8	1.8	0.59	1.69
(Δ%) % of U → business (in %)	2.144	11.2	8.3	10.0
(Δ%) Tax rate τ_w (in %)	0.902	9.89	0.5	9.26
(Δ%) Ratio cost / total production (in %)	-	0.0125	-	0.0117

Table. 10. Effect of the entrepreneurial insurance policy under three different assumptions. *Note:* (Δ%) means % deviation from the baseline model.

with $f = 0$: there is no supplementary part and entrepreneurs are never compensated above their initial unemployment benefit. As a reminder, we also report in Table 10 the baseline case and the full DRI case.

Under both partial insurance experiments, the fraction of unemployed individuals starting a business as well as the fraction of entrepreneurs in the economy significantly increase. Obviously, these effects of the policy are smaller in the absence of a compensation over potential bad shocks. In the latter case, the fraction of unemployed individuals starting businesses increases by 8.3% relative to the baseline, against 11.2% with the compensation. More importantly, this policy is realized with almost no cost with an increase in the tax rate by only 0.5% (against 9.89% for the DRI policy). When the government does not provide any supplement when entrepreneurial incomes are greater than initial UI benefits (i.e. when $f = 0$), this same fraction goes up by 10%. Therefore, the subsidy part does not play a crucial role in the total effect. It is rather the insurance compensation component and the right to claim UI benefits after a business failure and returning to the unemployment pool that make the DRI effective. In particular, we stress that allowing (previously insured unemployed) entrepreneurs to return to the unemployment pool and keep claiming UI rights is a substantially beneficial policy with virtually no cost that can be a major element in resorbing the distortion created by the current UI system that favor paid-employment relative to self-employment: this single component of the DRI policy leads to significant movements in occupational decisions, that may boost entrepreneurship.

6.5 The role of the unemployment insurance system

In the last decades, the US experienced several UI reforms, in particular during recession periods. For instance, in late 2009, UI duration has been extended several times beyond the normal 26 weeks up to a maximum of 99 weeks. In this section, we study the impact of alternative unemployment insurance systems on the generated masses of occupation and how it changes the effects of insuring entrepreneurs through the DRI.

In the model, both the duration of UI and the level of benefits directly affect the decision to start a business. First, the more generous the UI system (i.e. longer duration or larger benefits) is and the more the incentives to search for either a job or a business idea are reduced, since unemployment becomes a relatively more valuable option. Second, the more generous the UI system, the higher the opportunity cost of starting a business is, since new entrepreneurs previously unemployed have to give up larger UI rights. Third, a more generous UI system allows unemployed individuals to accumulate more wealth in order to potentially start their own business later[66]. The last effect goes in opposite direction of the two others. In the end, as we will show, incentive effects dominate.

Table 11 displays the impact of alternative UI systems on the occupational decisions. We analyze the steady-state effects of providing DRI when the UI duration (ρ) and the DRI duration (q) increases from 26 weeks to a year and to 99 weeks (e.g. such parameters are set to 0.25 and 0.132 instead of 0.5), and when the replacement rate (μ) is increased from 40% to 60% and 80%[67]

$(\rho, \mu/\bar{q})$	Baseline $(0.5, 0.4)$	$(0.25, 0.4)$		$(0.132, 0.4)$		$(0.5, 0.6)$		$(0.5, 0.8)$	
		Ini.	DRI	Ini.	DRI	Ini.	DRI	Ini.	DRI
Frac. of entrepreneurs (%)	8.8	8.63	8.91	8.49	8.96	8.6	8.84	8.41	8.75
Frac. of unemployed (%)	5.0	5.19	5.17	5.38	5.35	5.09	5.07	5.18	5.15
Frac. of workers (%)	86.2	86.18	85.92	85.68	86.28	86.31	86.09	86.41	86.1
Frac. of U $\rightarrow$ E (%)	2.14	1.98	2.25	1.84	2.17	2.08	2.39	2.03	2.44
Frac. of U $\rightarrow$ W (%)	45.07	43.49	43.31	41.91	41.71	44.36	44.11	43.63	43.38
New ent. per year (in %)	500	489	506	480	501	489	509	480	507
Total production	1.957	1.949	1.955	1.943	1.953	1.949	1.954	1.942	1.950
Labor income tax (%)	0.902	1.133	1.299	1.311	1.566	1.362	1.491	1.827	1.998

Table. 11. Effects of alternative unemployment insurance systems on occupational choices with and without DRI. *Ini.* is the baseline economy without DRI but with the considered change to the UI system.

First, as expected, extending UI duration increases unemployment rate and lowers the number of entrepreneurs. Interestingly, the number of workers is also slightly reduced due to the increased disincentive to search for a job. UI rights are available longer which reduces the need to exit unemployment. Moreover, starting a business becomes riskier as the UI duration increases since those individuals have to give up larger remaining UI benefits, while they are still uncertain about potential future profits. Overall, the number of newly created firms and

[66]There are also general equilibrium effects, such as increased taxes and wages, but our quantitative investigations suggest that those effects are small because unemployed agents account for a small share of the population.

[67]More generous UI systems sometimes lead to $W(a, \theta, y, e) < U(a, \theta, e, i)$ for low values of y. We still assume that an insured unemployed individual receiving a job offer switch to paid-employment. This could reflect the fact that they can not refuse a job offer, otherwise they lose their UI rights and get $U(a, \theta, e, n) < W(a, \theta, y, e)$. Notice also that $\mathbb{E}_y[W(a, \theta, y, e)] > U(a, \theta, e, i)$, therefore, they still search a job with high intensity. Alternatively, we could let agents refuse some offers, and the unemployment rate would be even larger under a very generous UI system. For simple comparison with the benchmark results, we do not explore this issue.

the production is reduced. Second, with higher UI benefits, surprisingly, only the number of entrepreneurs is reduced and both the unemployment rate and the share of corporate jobs increase. Indeed, better insuring workers against unemployment risk through more UI benefits considerably improves the value of taking a job relative to creating a business. As a result, some entrepreneurs, the poorest ones, find it now better to stop their activity and search for a job. Moreover, since UI ends after 26 weeks, there is still a high incentive to exit unemployment. Therefore, in total, the fraction of workers in the economy increases. However, because the number of firms is lower, production diminishes. Finally, the cost of the new UI system considerably increases in such experiments.

Figure 11 plots the entrepreneurship rate with respect to either an increase in the replacement rate or an increase in the UI duration. Implementing the DRI under a more generous UI system has a larger impact than in the baseline economy, since the opportunity cost implied by the UI system that favors employment relative to self-employment is larger. Mobility effects are stronger and production increases. One might argue that the increase in the entrepreneurship rate comes from the fact that the higher tax imposed on workers to pay for the UI system might reduce the value of paid-employment with respect to entrepreneurship. However, as shown in the figure, even when we neutralize the tax adjustment, we obtain similar results. Another interesting result is that the evolution of the entrepreneurship rate forms a U-shape with respect to duration. Increasing the UI duration under the DRI should increase both the value of unemployment and entrepreneurship because of the effect of longer insurance. However, starting from 20 weeks, increasing the UI duration reduces the entrepreneurship rate: it means that the value of unemployment (and indirectly the value of employment) is increased more than the value of entrepreneurship at this stage. However, if we keep increasing the UI duration, the entrepreneurship rate increase after some weeks. This means that the insurance effect provided by the DRI over this longer period of time did increase the value of entrepreneurship enough to compensate the increase in the value of unemployment and make entrepreneurship more interesting again. We can see from the figure that this U-shape with respect to duration does not appear without the DRI. UI (and DRI) duration is thus an important aspect of what makes the DRI interesting. We can confirm this by noting that the entrepreneurship rate with respect to an increase in the replacement rate is decreasing monotonically. This means that it is not the amount of provided insurance that matter most for entry into entrepreneurship with the DRI but the fact that some amount can be obtained regularly over a longer duration. The generosity of the UI design significantly impacts the decision to enter entrepreneurship, and to a larger extent, occupational decisions[68]. The DRI mechanism dampens the negative ef-

[68]For instance, taking the case of France with a specially more generous UI duration of 3 years (around 156 weeks), the DRI implies an increase of 7.3% of the share of entrepreneurs and around 11% of the entrepreneurs are insured (against 1.8% and 3% in the baseline). This corroborates the finding of Hombert et al. (2017) on the large

fect on entrepreneurship of reforming the UI by resorbing the distortion that arises when new entrepreneurs lose their UI rights.

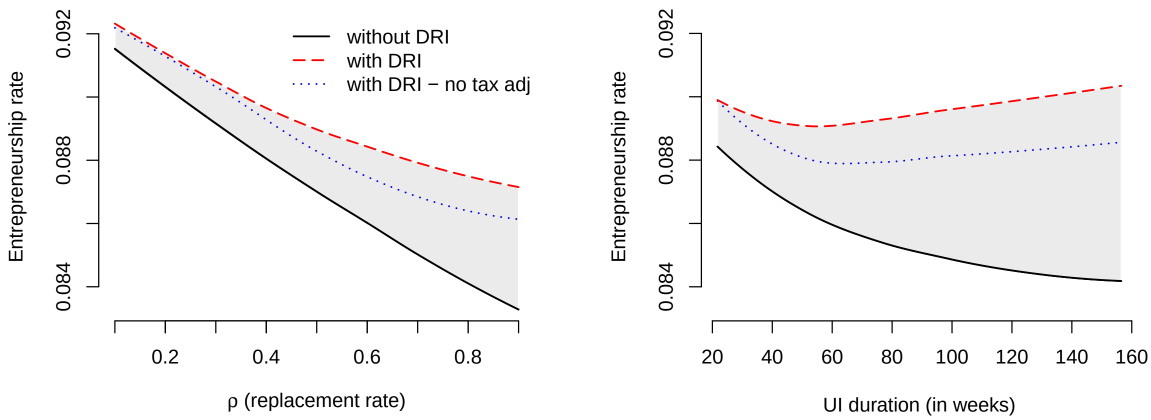

Figure 11. Effect of UI reforms with and without DRI on the entrepreneurship rate.

6.6 Transitional dynamics, welfare and robustness

As it is standard in the literature with policy experiments, we compute the transition path of the economy between steady states, and measure the welfare outcomes both at the steady-state and including the transition. For the sake of brevity, the detail of our results on this subject is presented in section *E* of the online appendix. We just underline here that welfare-wise, both the SUS and the DRI policy are implementable at the steady-state but also when taking the transition into account. In the remaining of this section, we discuss some assumptions of our model and show that our results are not affected by our modeling choices.

On the definition of an entrepreneur, we calibrate an alternative version of the model where we define an entrepreneur as a self-employed individual in the CPS. In such a setting, the impact of the DRI is slightly larger, however, our qualitative results are unchanged. We present the parameterization and the results of this experiment in section G of the online appendix. Therefore, the model and the results are applicable to a broader definition of entrepreneurship.

Other alternatives, such as implementing a fixed start-up cost had no significant impact on our numerical results, but of course, the parameterization is different. Notice also that we implicitly already incorporate a start-up cost since an individual has to search an idea before creating his business. Results with an entry cost suggest that the DRI leads to a larger increase in the share of entrepreneurs while unemployed individuals are less likely to create a business as compared to the no-entry cost case. Indeed, imposing an entry cost reduces the temptation to exit entrepreneurship in case of a bad shock, since individuals would have to repay the entry

magnitude of the policy in France, with an increase of about 12% of the number of newly created firms.

cost if they want to recreate a firm.

In the baseline economy, we have assumed that entrepreneurs could default in equilibrium but are subject to a cost component and a recovery rate. We also explore the case where no bankruptcy is allowed here. Under this assumption, we obtain a lower flow from entrepreneurship to unemployment of about 0.39% against 0.74% in the benchmark case and 0.99% in the data. Policy results are qualitatively unchanged but the magnitude of the DRI is larger. The policy leads to a 2.2% increase in the share of entrepreneurs against 1.86% in the benchmark. Indeed, the ability to bankrupt can be viewed as an extra insurance mechanism on top of the DRI. Removing the option to default implies a larger entrepreneurial risk, which increases the effectiveness of the DRI.

We also conduct some robustness on the business shock z. We have reduced artificially the variance of the shock to 0.12. The fraction of entrepreneurs with zero or negative earnings falls to 2.7%. Under this experiment, the effect of the insurance policy is slightly lowered. This is because even with low shock z variance, the insurance induces the entry of some unemployed individuals who run small firms that generate low profits. Under the DRI, such new entrepreneurs are compensated and receive part of their UI rights in addition to their starting low profit.

Finally, we explore in figure 12 the effects of alternative values for the DRI replacement rate parameter f. For all considered values of the parameter, the most talented entrepreneurs are those who benefit the most. When $f \to 1$ (i.e. all entrepreneurs receive their UI benefits independently of their entrepreneurial income), the insurance mechanism leads to a lower fraction of entrepreneurs than when $f = 0.8$. This is because when f is very high, entrepreneurs receive almost always part of their benefit, and therefore use their remaining UI rights very quickly. The tax rate also falls in that case, since the policy leads to a lower fraction of insured entrepreneurs with remaining UI rights. Finally, in general, a larger f leads to a lower fraction of unemployed individuals, since they find it better to start a business.

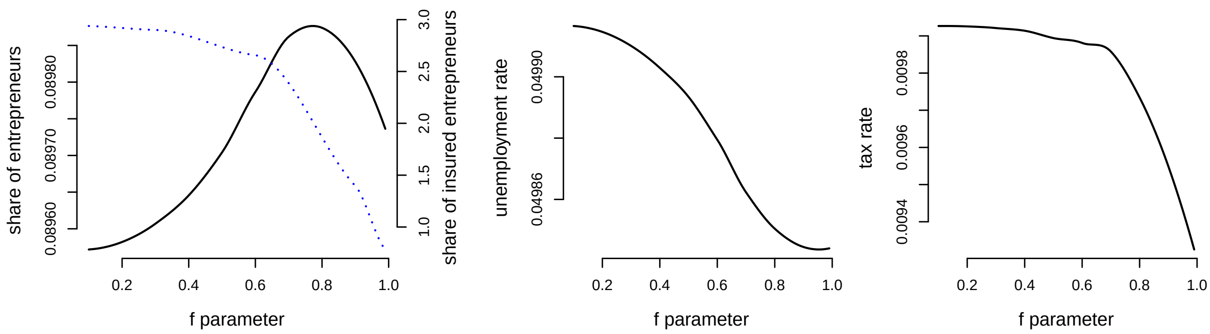

Figure 12. Effect of f on various indicators relative to the baseline economy.

7 Conclusion

In this paper, we develop an incomplete markets heterogeneous agents general equilibrium model with risky entrepreneurship and search frictions to characterize occupational choices and occupational flows between entrepreneurship, paid-employment, and unemployment. Importantly, this model accounts for the main empirical features about occupational flows, macroeconomic aggregates and key entrepreneurial features in the US. We show that both wealth and ability are major determinants of occupational choices and that the model is able to endogenously match the magnitude of exits and entries in and out of occupations. We then extend our baseline economy to incorporate two major entrepreneurship fostering policies: entrepreneurial insurance and subsidy. Insurance is shown to help reduce the current bias towards paid-employment of most UI programs while producing important shifts in occupational choices. Insurance and subsidy also generate very different selection effects, with the former generating higher-skilled, richer and longer lasting entrepreneurs.

We point out that this model could be used to tackle a number of related questions. Simple experiments suggest that shocks affecting both the job destruction rates and the job finding rates in our model can account for the observed change in occupational flows during the Great Recession and the observed increase in the fraction of *out-of-necessity* entrepreneurs. We also showed that within our framework, UI design significantly impacts entrepreneurship. A careful analysis of optimal UI design accounting for these effects seems promising. Finally, it is worth noting that we abstracted from entrepreneurial hiring frictions: accounting for them could lead to additional policy implications of the pool of entrepreneurs on employment and unemployment dynamics.

Appendix

A Data

In this section, we report the main elements concerning our sample selection. Additional elements can be found in section B of the online appendix.

A.1 Current Population Survey: sample details

We use the CPS from 2001 to 2008 to compute masses and transitions between occupations. We restrict our sample to the population aged between 20 and 65 years old. Quarterly probability to exit a given occupation to another one is computed using all months from 2001 to 2008 in order to boost sample sizes. We end up with a panel of around 7 millions of matched individuals. In order to control for false matches, we construct a specific individual identifier that controls for age, sex and US state. Probabilities are multiplied by the first-month respondent weight (PWCMPWG) to generate a numeric value for the fraction of individuals in a specific occupation leaving to another occupation.

Worker We classify as a worker an individual who currently work in a job or who declares being temporarily absent from a job (PEMLR = 1 or 2, and PEIO1COW = 1:5 or 8).

Unemployed individual Individuals classified as unemployed are those who do not have a job, but have actively looked for one in the preceding 4 weeks (except for temporary illness), and are currently available for work. According to the Bureau of Labor Statistics (BLS), actively looking for work may consist in contacting an employer, a university or an employment center (job interviews, submitting resumes, answering job advertisements, checking unions or professional registers, etc.). Workers expecting to be recalled from temporary layoffs are counted as unemployed whether or not they have engaged in a specific job seeking activity (PEMLR = 3 or 4). We also count as unemployed *all individuals marginally attached to the labor force*. Those individuals declare wanting a job (PRWNTJOB = 1), are currently available for work (PEDWAVL = 1), have looked for a job in the last 12 months (even if they did not actively search in the 4 weeks preceding the interview for various reasons) (PRJOBSEA = 1, 2 or 3). Such individuals are likely to be represented in our model, since we account for individuals that could search a relatively small amount of time, which may classify them as not in the labor force following the BLS definition.

Entrepreneur In the case of an entrepreneur, we use a definition similar to Cagetti and De Nardi (2006). Using the CPS, we define an entrepreneur as a self-employed (incorporated or unincorporated) worker (PEIO1COW = 6 or 7), who currently work (PEMLR = 1 or 2) and own his business (HUBUS = 1). We control business ownership by creating a specific variable that indicates whether or not the individual was owning his firm from 2001 to 2008, allowing us to control for measurement errors arising in the survey[69]. The share of entrepreneurs varies between 8.5% to 11% (relative to the population of workers, entrepreneurs and unemployed) depending of the assumption considered and the period.

[69] If we do not construct this additional variable, the flow from entrepreneurship to paid-employment during a quarter jump to 16%, which is inconsistent with yearly flows (see Cagetti and De Nardi (2006)). Therefore, our definition captures a part of self-employment that is not business ownership, but this is more consistent with resulting flows.

A.2 Survey of Consumer Finance

We use the SCF 2001, 2004 and 2007 waves in order to compute various moments relative to entrepreneurship. To be consistent with our CPS sample, we restrict the definition of an entrepreneur to individuals declaring being self-employed and owning a business (that they actively work in) with at least 5000$ invested in it[70]. In table 12, we report those SCF moments that can be compared to those obtained with the model.

X / SCF	2001	2004	2007	Average	Model
Share of entrepreneurs (in %)	8.8	8.5	9.1	8.8	8.8
Fraction of unemployed (in %)	4.2	5.2	5.2	4.9	5.0
Ratio of median net worth (entrepreneur to worker)	7.3	8.7	7.5	7.8	8.1
Ratio of median net worth (entrepreneur to all population)	6.2	7.2	6.6	6.7	6.2
Ratio of median earnings (entrepreneur to worker)	1.75	1.62	1.5	1.62	1.6
Fraction of pop. with net worth < 1/10 of median (in %)	21.1	22.2	23.43	22.2	15.2
Gini coefficient - wealth	0.81	0.82	0.82	0.82	0.63
Fraction of capital hold by entrepreneurs (in %)	28.5	30	31.5	30	29.4
Ratio of median entrepreneurs' debt to entrepreneurs' earnings	0.95	1.37	1.59	1.3	0.93
Ratio of median ent. income to ent. net worth (in %)	0.166	0.128	0.11	0.134	0.106
Ratio of median worker income to worker net worth (in %)	0.72	0.73	0.60	0.68	0.63

Table. 12. Various moments using different SCF waves as compared to the baseline model.

B Occupational flows by wage quintiles, data and model

Figure 13 displays how the baseline model matches the shapes of the flows from a given occupation to another as compared to CPS data for fitted wages (except for the transition W to U and W to E where we use exact wages). In the data, information is available for the wages of employed workers but not for entrepreneurs or unemployed for obvious reasons. Thus we use a specific methodology to recover this information. We estimate a potential wage that an individual (i.e. unemployed or entrepreneurs) could have if she would have taken a job. We use age, age^2, age^3, sex, $education$, $occupation$ and $industry\ sector$ as covariates to fit the observed $log(wage)$ of a worker in the data. We obtain an R^2 of about 0.37 using simple OLS. We then assign to all the individuals the potential wage using the coefficient estimates. It appears that educational attainment, that we use as the main proxy for ability in the baseline model, produce almost the same transitions except for the E to W transition which is now decreasing, a feature that we do not capture in the model.

[70]The magnitude of the moments are quite similar under different assumptions for this value. We impose a restriction of 5000$ to reduce misreporting effects and to be more consistent with our CPS sample.

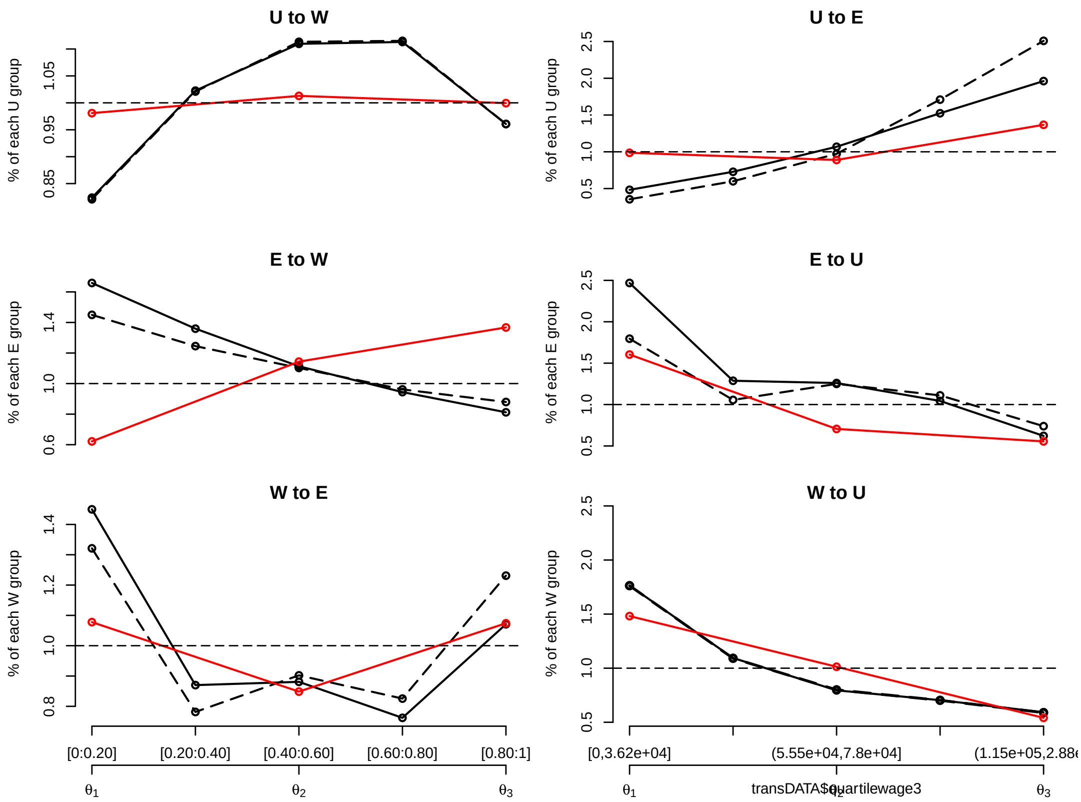

Figure 13. Quarterly flows from a given occupation to another by CPS fitted wage quintile (black) and model (red). The dashed lines refer to self-employment only while the solid line to only self-employed business owners. Wages are estimated for entrepreneurs and unemployed. *Data sources:* authors' own computations using CPS data from 2001 to 2008.

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