Entrepreneurship, Unemployment and Insurance Effect*

Alexandre Gaillard
Toulouse School of Economics

Sumudu Kankanamge
Toulouse School of Economics

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Abstract

In the spirit of recent programs implemented in the US and France, this paper evaluates the effects of a specific policy providing insurance to unemployed individuals entering entrepreneurship by extending their current unemployment insurance rights to their new activity. We use a general equilibrium model with occupational choices, labor market frictions and risky entrepreneurship to study the implications of such a reform for the US economy. We discipline our model to the data using the CPS and SCF and indirectly infer entrepreneurial abilities using the non-linear transitions from worker to entrepreneur by earning quantiles. The reform is shown to resorb the distortion generated by the current unemployment insurance system that favours the search for employment rather than self-employment. This leads to a 10% increase in the fraction of unemployed individuals starting businesses, however, we also find that the unemployment rate is roughly unchanged. When compared to a start-up subsidy, which is the most commonly used instrument to foster entrepreneurship, new entrepreneurs under the entrepreneurial insurance policy are shown to be more talented, surviving longer and growing faster.

Keywords: entrepreneurship, insurance, occupational choice, mobility, unemployment.
JEL classification: E24, J65, J68, D52

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1 Introduction

Either because of rising unemployment rates, especially in Europe, or due to the benefits in terms of wealth and innovations production attributed to them, policy makers have recently rediscovered the virtues of having a sizeable amount of entrepreneurs in the economy. This interest 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 question of insuring the downside risk inherent to any entrepreneurial activity, (ii) the distortion arising from the current unemployment insurance (UI) system that favours the search for paid-employment rather than self-employment. The downside risk can be defined as the risk supported by the entrepreneur on its income stream because of potential business failure or bad performances. 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 most able 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. (2014), Ejrnæs and Hochguertel (2014) and Caliendo and Künn (2011) have paved the way for empirically addressing this trade-off. To the best of our knowledge, our contribution is the first to offer a rich theoretical framework to assess the effects of insuring new entrepreneurs. In the spirit of the French insurance program discussed in Hombert et al. (2014), such a policy insures unemployed individuals starting an entrepreneurial venture by extending their current UI rights to their new activity in order to resorb the effects of adverse business shocks. Implementing such a reform is a step towards resorbing the distortion arising from the current UI system that requires availability for work and active job search to remain a beneficiary, which significantly reduce the incentives to start a self-employed activity.

The basic building block of our economy is an incomplete markets general equilibrium model with heterogenous agents, occupational choice, risky entrepreneurship and labor market 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 also face the risk of experiencing an adverse shock on firm's productivity leading them to potentially bankrupt and default on previously contracted debt. 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 unemployment insurance (UI) program that partly covers the income loss of short-term unemployed individuals. Importantly, as in the US, entrepreneurs that fall out of business cannot claim such UI rights in our baseline economy.

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 his business activity. To address this issue, a number of countries have recently implemented policies in order to foster entrepreneurship by turning unemployment into self-employment. A first type of policy provides start-up subsidies to unemployed individuals in the form of loan guarantees, training or a monetary grants. A second set of policies extends the UI system to cover part of the entrepreneurial risk. In their paper, Hombert et al. (2014) describe the large-scale French reform of 2002 called *Plan d'Aide au Retour à l'Emploi (PARE)*, that introduced a form of downside risk insurance (DRI) through the ACCRE[1] program: in the first three years from starting their businesses, entrepreneurs that started a business after being unemployed could still claim their UI rights in case of business failure. Furthermore, during the same period, they could use their UI benefits to bridge the gap between the original amount of UI benefits and their business income up to a specific rule. Using French data and the fraction of sole proprietorships among newly created firms as treatment intensity variable[2], they find a significative increases of 12% of the number of newly created firms following the reform, while the pool (age and education groups) of entrepreneurs and their relative performance are not different. Using administrative data in Denmark, Ejrnæs and Hochguertel (2014) use a retirement reform incorporating entrepreneurial insurance to study the effects of a DRI[3]. This study finds that entry into entrepreneurship increases by 1.2 - 1.8% and that entrepreneurs are not any different in terms of performance. In the US, a related policy called the Self-Employment Assistance Program (SEAP) introduced in 1993 and permanently authorised in 1998, currently active in 10 states, waives regular UI beneficiaries from active job search and provides a weekly allowance of the same amount and for the same duration as regular benefits, as long as they engage in the establishment of their own small businesses. However, this policy is constrained by quotas and a relatively low number of unemployed individuals are concerned. Finally, Caliendo and Künn (2011) estimate the effects of two different programs in Germany that help unemployed individuals to start businesses. In the first program, individuals are given a lump-sum startup

[1] Aide aux Chômeurs Créateurs Repreneurs d'une Entreprise.

[2] The underlying assumption is that the PARE reform was aimed at unemployed individuals who have limited start-up capital and are more likely to start low-scale firms, measured as sole proprietorships.

[3] The policy provided higher retirement rights and at the same time provided unemployment insurance to self-employed. The underlining assumption for their instrument to be valid is that the policies did not directly target the provision of unemployment insurance for self-employed. Because of a set of rules, self-employed who wanted to benefit from retirement insurance should have entered the program immediately if they were too old. This vertical jump created a mean to study the effect of the unemployment insurance for entrepreneurs.

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. Authors show that under the BA program, new entrepreneurs were relatively more qualified and created larger businesses.

We extend our baseline economy to evaluate two of these policies. 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 a business failure. Second, in the spirit of the French PARE reform, the government partially insures such entrepreneurs by providing an income complement in case of low business incomes using a specific rule that depends on their previous UI benefits. A third mechanism can also be activated in order to subsidise the insured entrepreneurial activity. Identically to regular UI benefits, these special privileges given to formerly insured unemployed individuals are temporary. In a comparative experiment, we evaluate an alternative policy where the government provides a once and for all start-up subsidy to new entrepreneurs, designed to generate the same share of entrepreneurs as under the DRI. For our policy experiments to be meaningful, it is decisive that our baseline calibration matches fundamental empirical data on unemployment, entrepreneurship and mobility. We discipline our model using the Current Population Survey (CPS) and the Survey of Consumer Finances (SCF). On mobility, we stress here our novel contribution: in the US, transition rates between self-employed, corporate workers and unemployed individuals display important non-linearities. We show that the transition from worker to entrepreneur with respect to earnings is described by a U-shaped curve. We use this transition to indirectly infer the mapping between working and entrepreneurial ability. As a result of market incompleteness and financial constraints, wealth is also an important determinant of mobility between occupations in our model. For instance, low-skilled entrepreneurs run smaller firms in general. To the best of our knowledge, our baseline economy is the first to match those relevant empirical observations on the transitions between these occupations.

Our policy experiments show that implementing a DRI policy, while instrumental in resorbing the distortion from the current UI system, increases the share of entrepreneurs by 1% and the fraction of unemployed individuals starting business by 10%. Contrastingly to the previous literature that focus on partial equilibrium, we argue that the unemployment rate is slightly lower, and that self-employment crowd-out employment in the corporate sector. We also show that the DRI and the start-up subsidy, two of the most frequent policies used to foster entrepreneurship in the unemployment pool, have very different implications on the characteristics of newly selected entrepreneurs. Insuring (resp. subsidising) entrepreneurs tends to favour the entry of high-skilled (resp. low-skilled) and richer (resp. poorer) entrepreneurs. Comparing the performances of new entrepreneurs before and after the reform reveals that insurance allows entrepreneurs to grow faster and to survive longer.

1.1 Related literature

The literature on entrepreneurship is wide and has mainly been concerned with the impact of existing barriers to entrepreneurship on its level. Many papers such as Holtz-Eakin et al. (1994), Nanda (2008), Landier and Thesmar (2008), Schoar (2010) or Hombert et al. (2014) have stressed that only focusing on the level 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 those rich effects: we for instance highlight a high quarterly flow from entrepreneurship to paid-employment. While the 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 transition rates during the business cycle (Visschers et al. (2014)) and assess the choice of becoming entrepreneur with respect to working ability (Poschke (2013)). Our model allows to theoretically characterise the necessity share in many dimensions, and how insurance mechanism affects its magnitude. Our contribution is also related to a 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). As we do, some recent papers begin to address the question of insurance mechanisms in model with entrepreneurship. This literature mainly focus on the effect of introducing health insurance (Fairlie et al. (2011)) or alternative bankruptcy laws (Mankart and Rodano (2015)) on the fraction of entrepreneurs and performance.

To the best of our knowledge, none of these contributions have specifically raised the question of the downside risk insurance, neither the distortive effect of the unemployment insurance program that favours paid-employment relative to entrepreneurship, in a general equilibrium model of occupational choice. This paper is also related to a very large literature on the effects of unemployment insurance although we focus on a specific reform. While papers often argue that improving entrepreneurship could be a way to reduce unemployment (for instance, Caliendo and Künn (2011) and Thurik et al. (2008)), our results mitigate the impact of DRI on unemployment. More generally, 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. Some other paper (Evans and Leighton (1989), Thurik et al. (2008), Røed and Skogstrøm (2013) and Glocker and Steiner (2007) among other) studied the relationship between unemployment and unemployment benefits offered to workers and the probability to start a business. In this respect our paper is closest to Hombert et al. (2014) and Ejrnæs and

Hochguertel (2014), although their contribution is mostly empirical and use partial equilibrium models.

The remaining of the paper is organised as follows. Section 2 presents facts concerning entrepreneurship and DRI. Our baseline general equilibrium model is developed in section 3 and our calibration in section 4. In section 5, we conduct our main policy experiments and section 6 discusses our modelling choices and additional results. Finally, section 7 concludes.

2 Risk, labor market characteristics and financial frictions: some facts about entrepreneurship

In this section, we first highlight the relationship between entrepreneurial risk and the business start-up rate, and hint to how insurance provision could foster entrepreneurship, most notably for unemployed individuals. Second, we document facts about labor market transitions and financial frictions in the US, that motivate our modelling choices.

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 loose more than 20% of assets invested in the firm (debt plus equity), 7.4% loose more than 40%, and 3.8% loose more than 100%. We use the SCF to study entrepreneurial income and also find substantial risk[4]. Considering only income filed as business income[5] , about 20% of the entrepreneurs have negative income. This number falls to 3% when we account for entrepreneurial income filed as wages, capital gains and business income. Figure 1 shows that income is not distributed normally but is rather extremely right skewed. While most entrepreneurs are concentrated below the median income (normalised to unity here), some of them perform extremely well and others have a negative income[6]. The main message here is that, for any type of income considered, there are potentially important risk associated to an entrepreneurship situation.

The literature on entrepreneurial risk states that fundamental risk associated with any business constitutes an important barrier to entry. As non-entrepreneurs, perceived business risk can prevent individuals from starting their own business venture. Using data from the Global Entrepreneurship Monitor (GEM) project for 28 countries, Arenius and Minniti (2005) find that

[4]In order to be consistent with our definition of an entrepreneur in the CPS, we define an entrepreneur in the SCF as self-employed workers who hold part of their business.

[5]We distinguish between business income and total income depending on how entrepreneurs file their income in the survey. A number of entrepreneurs file their income as *wage* whereas others file it as *business income*. We also normalize incomes by the median entrepreneurial income.

[6]Negative income happens because entrepreneurs have to repay their loan with interests, as well as paying salary to employees and per-period variable and fixed costs (for instance rent or energy).

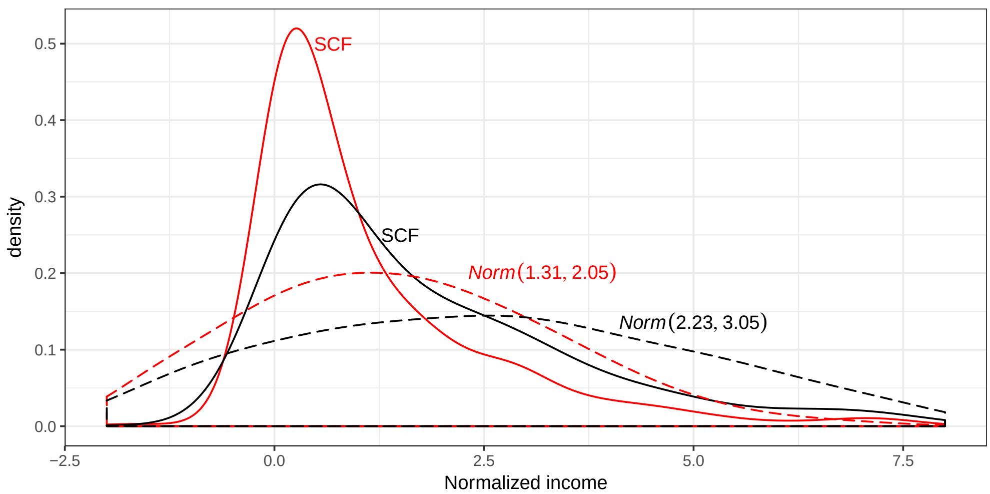

Figure 1. Normalized income with respect to the median value. *Legend:* black line refers to only business income and red line to all entrepreneur's income.

perceptual variables, such as alertness to opportunities, fear of failure, and confidence about one's own skills are significantly correlated with new business creation across all countries. As shown in Figure 2, the decline in the self-employment rate in the US since the 2000s is associated with an increase in the fear of failure. 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*[7]*.*".

In their paper, Hombert et al. (2014) 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. Figure 3 displays the number of newly created firms in France between 2000 and 2006: the number of such firms increased by 25%. Using a difference-in-difference strategy with the fraction of sole-proprietorship in different sectors as treatment intensity variable, Hombert et al. (2014) estimate that insurance provision led to a 12% increase in business creations. The empirical validity of their instrument

[7]For example, the claimant would become self-employed when he/she begans advertising for a business, rent an office or purchase equipment/property, etc.

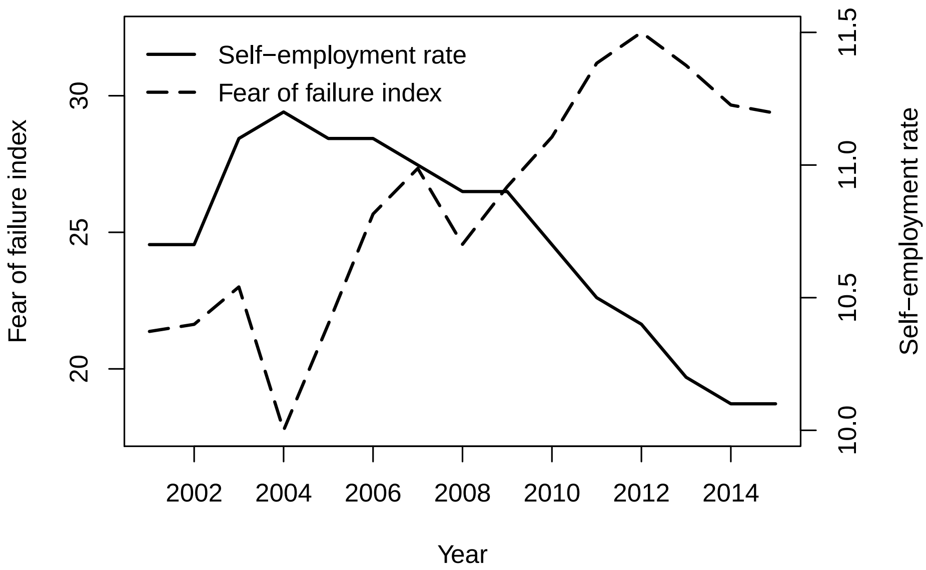

Figure 2. Fear of failure index and self-employment rate in the US. *Source:* Global Entrepreneurship Monitor and The Bureau of Labor Statistics (BLS). The Fear of Failure index measures the 18-64 old population perceiving good opportunities to start a business while indicating that the fear of failure would prevent them from doing so. The self-employment rate is the fraction of the 20-65 old population declaring themselves as self-employed (incorporated or not).

is build on the assumption that insurance provision may mainly favour 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[8].

Labor market characteristics. The definitions of an entrepreneur in the literature take into account three main dimensions: the self-employment status, the business ownership and management activities in the business. Surveys such as the SCF or CPS contain questions that let an individual define himself as an entrepreneur according to his own perception. One challenge comes from the fact that this perception can sometimes not be in line with the administrative or fiscal status of an individual. Depending on the definition of an entrepreneur and the survey used, the fraction of entrepreneurs in the US varies from 7.5% to 11% in the literature. In this paper, we use the CPS[9] in order to compute both the masses in each occupation (entrepreneurs, workers and unemployed individuals) and the corresponding transition matrix between occu-

[8]Sectors with a high fraction of sole-proprietorship are mainly those where the need for capital is low. Therefore, insurance provision led 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 those activities, individuals are borrowing constrained and unable to start businesses.

[9]We restrict our sample to the period from 2001 to 2008 and consider only the 20-65 old population working at least 20 hours. The shares are computed with respect to the total number of entrepreneurs, unemployed individuals and workers. See the online appendix for a sensitivity analysis on that subject.

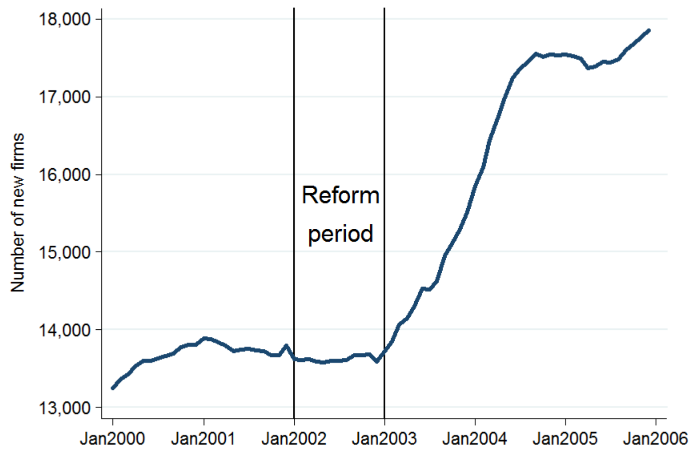

Figure 3. Firm creation in France between 2000 and 2006. *Source:* Hombert et al. (2014).

pations. We define an entrepreneur as a self-employed worker owning his business[10]. According to this definition, from 2001 to 2008, we find an average fraction of entrepreneurs in the US of 8.5% and an average unemployment rate of 5.1% in the CPS. Concerning transitions between occupations, Cagetti and De Nardi (2006) find that the yearly entrepreneurship exit rate is high in the US at 22%. With a different but related measure of entrepreneurship, we find a similar number with a 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[11], the corresponding number is close to 8%. This exit rate is much higher than the 1% to 2.3% of entrepreneurs filing for bankruptcy each year, corresponding to 0.25% to 0.57% each quarter. This suggests that most entrepreneurs voluntary quit their businesses for standard employment, for instance because it constitutes a better opportunity or because entrepreneurship is not profitable enough.

On the entry side, roughly 2.2 - 2.5% 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 4% and 0.75%. We find that unemployed individuals are 5 times more likely to enter entrepreneurship than workers. We document a U-shaped transition from employment to entrepreneurship 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. As argued by Poschke (2013), high earners tend to be more talented for running valuable businesses, mak-

[10]Unfortunately, we cannot control for people managing their businesses, as it is the case in Cagetti and De Nardi (2006), because this information is not contained in the CPS. Cagetti and De Nardi (2006) define an entrepreneur as a self-employed worker that owns his business and actively manages it.

[11]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.

	Transition (%)			Mass (%)
	Employment	*Entrepreneurship*	*Unemployment*	
A. Self-employed business owner				
Employment	97.56	0.52	1.92	86.4
Entrepreneurship	5.18	93.98	0.84	8.5
Unemployment	43.05	2.39	54.56	5.1
B. All self-employed				
Employment	97.36	0.75	1.89	83.9
Entrepreneurship	6.76	92.05	1.18	11
Unemployment	43.05	3.96	52.99	5.1

Table. 1. Transition between occupations during a quarter for different definitions of entrepreneurship. *Data sources:* authors' own computations using the monthly basic CPS from 2001 to 2008.

ing self-employment a better alternative than employment. Similarly, low earning workers can view entrepreneurship as a way to improve their standards of living. Contrastingly, for average (and potentially mid-skill) earners, staying employed turns out to be a better option than entrepreneurship. While Poschke (2013) shows theoretically that a correlation between working and entrepreneurship can replicate the observed masses of self-employed workers among different ability groups (measured in terms of education), we stress that financial frictions are an important requirement to generate heterogenous entrepreneurship decisions within ability groups. We therefore build our model on the two minimal dimensions of individual capital and skill levels.

% of workers switching to	Quintile					**Mean**
	[0:20]	[20:40]	[40:60]	[60:80]	[80:100]	
A. Self-employment & business owner	0.67	0.456	0.45	0.463	0.68	0.52
B. Self-employment	1.11	0.74	0.67	0.60	0.77	0.75

Table. 2. Transition from employment to entrepreneurship. *Data sources:* authors' own computations using the monthly basic CPS from 2001 to 2008.

Financial frictions. In the incomplete markets literature with entrepreneurship, the presence of borrowing constraints is documented (for instance by Quadrini (2000)) and is used to generate heterogenous firm sizes. Poorer entrepreneurs run on average small 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. In the U.S., entrepreneurs have access to both secured and unsecured debt[12], and default is only possible on the latter. For instance, personal

[12] Secured debt is debt backed by collateral whereas there is no collateral contraints on unsecured debt.

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. Therefore, a sizeable fraction of entrepreneurs can actually default on their debt and the higher is the capitalisation of the firms the more they prefer secured debt, as it is cheaper. 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 modelling choice. 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[13]. According to the US Census Bureau, sole-proprietorship businesses account for 72% of total business structures. From 1993 to 2007, the number of Limited Liabilities Company (LLC) and more generally the number of Pass-through Entities[14] 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. However, as stressed by Mankart and Rodano (2015), 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 issue[15].

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, bankruptcy and labor market frictions generating unemployment. We explicitly model the possibility to default in equilibrium as in Mankart and Rodano (2015), but we abstract from the distinction between secured and unsecured debt and entrepreneurs. Instead, bankrupt entrepreneurs have to reimburse a given fraction of their debt in case of default.

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

[14]Pass-through entities do not pay income taxes at the corporate level. Instead the owners individually pay income taxes over the distributed corporate income.

[15]Moreover, as stressed by Mankart and Rodano (2015), incorporating dampens the access to credit markets, since private assets are shielded after the incorporation. Only richer entrepreneurs can actually choose this option. However, DRI and entrepreneurial subsidy mostly affect relatively poor entrepreneurs.

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 an entry 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 maximisation in this sector produces the following competitive prices:

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

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[16]. 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 at the same time.

Agents derive utility from consumption and disutility from searching. Thus, the life-time utility of a household is given by:

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

[16]Business search effort can describes market research on the feasibility of an idea, competition assessement, 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.

with β the discount factor. For simplicity, 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 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 subsidised during their entrepreneurial endeavour[17].

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 his credit status as C. Following Chatterjee et al. (2007) and Mankart and Rodano (2015), we model exclusion in a probabilistic way. A constrained agents 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 $e \in \{A, C\}$ summarising their credit status.

Individuals start the period with the knowledge of exogenous shocks (θ, y, z_{-1}). 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[18]. 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 realisation z_{-1}. Both the innate ability shock θ and the transitory labor market shock y are realised in 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 realised within

[17]Section 3.6 describes these policies in details.

[18]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.

the period, after entrepreneurs have decided on their business investment. We assume that all shocks are orthogonal to each other and that each follows a first-order Markov process. Because the business shock z occurs within the period and depends on its previous realisation z_{-1}, we assume that an individual not currently running a business but willing to start one infers his future shock z according to the invariant distribution Π_z associated with the first-order Markov process for z[19]. Contrastingly, a non-working individual does not know his 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 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, recall that non-entrepreneurs deciding to start their own business infer the future shock z with respect to the invariant probability Π_z. Moreover, only unemployed individuals with UI rights can benefit from the policy experiments: 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 which economy we consider. We specify this value in section 3.6.

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. He has a probability $\eta(\theta)$ of getting laid off, depending on his innate ability. In such a case, he falls in insured unemployment and can expect to get value U'_i[20]. To finance UI benefits, a worker pays a proportional tax τ_w on their labor income.

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 his current occupation and cannot claim UI benefits (i.e., $j = n$). However, he can expect to get

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

[20]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.

value $\mathcal{E}'_n$. If he gets laid off at the same time as getting a business idea, the worker 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[21].

To simplify the notations, let us denote $\eta \equiv \eta(\theta)$, $\pi_e \equiv \pi_e(s_e)$ and $\pi_w \equiv \pi_w(s_w)$ for 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:

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

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

$$c > 0, \quad a' \geq 0 \tag{3}$$

$$s_e \geq 0 \tag{4}$$

where equation (2) is the worker's budget constraint. 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 his UI rights with probability ρ[22]. An uninsured unemployed individual can not 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 respectively effort 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'[23]. Similarly, 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

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

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

[23] Since the value associated to 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.

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 his 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 realised, where y' is realised 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:

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

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

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

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

where equation (6) is the budget constraint and equation (7) imposes that job search has to be positive. In the online appendix, we characterise the optimal search efforts under different cases relative to the opportunities available to the unemployed individual.

3.5 Entrepreneurs

An entrepreneur raises revenues from his self-employed business venture. He decides to invest an amount of resources k, that can be either his own or borrowed, in a decreasing returns to scale technology governed by the parameter $\nu \in (0,1)$[24], before knowing the current realisation 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. 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 summarised in Figure 4. We now detail this sequence.

[24] We adopt the common Lucas (1978) specification.

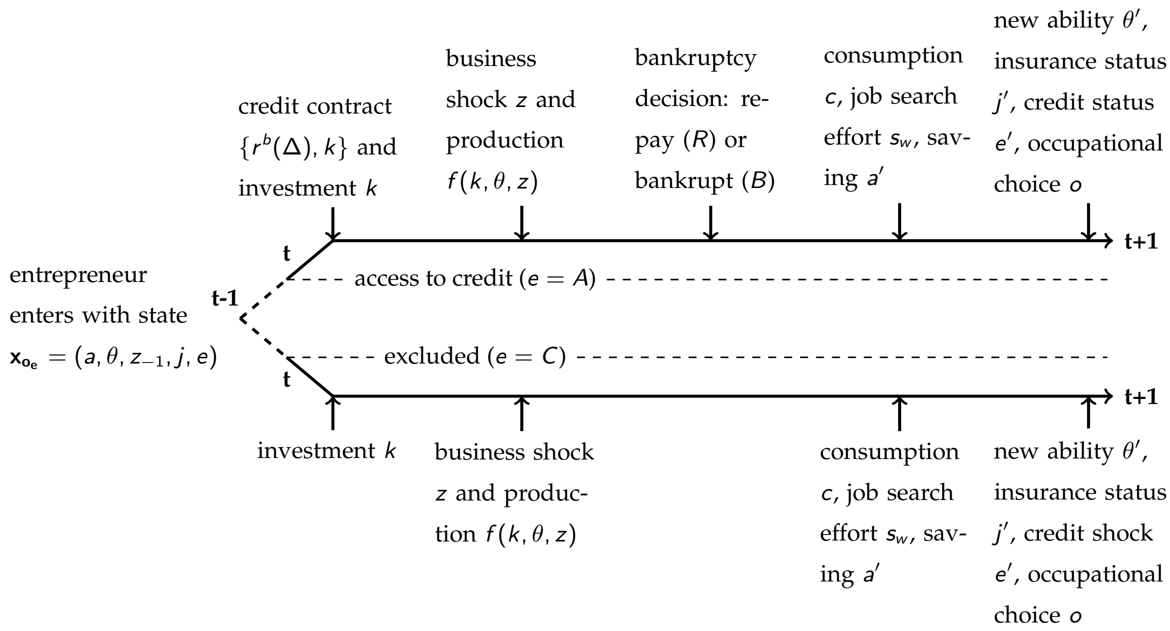

Figure 4. Timing of an entrepreneur

3.5.1 Non-excluded entrepreneur

When an entrepreneur has access to the credit market, he is allowed to borrow from a financial intermediary an amount that can only be invested in his business[25]. Recalling that a is the agent's current wealth, an entrepreneur chooses whether to borrow ($k > a$) or save ($k < a$). If he borrows from an external creditor the amount ($k - a$), as in Buera and Shin (2013) and Kitao (2008), we assume that entrepreneurs can only borrow up to a fixed fraction λ of their total assets[26]. The entrepreneur decides the amount k invested in his firm in order to maximise his 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 realisation of the shock z is known. Only after this whole sequence, will he decide how much to consume, save and how much effort to exert in search of a job opportunity. At the end of the period, he receives a new credit, insurance and innate ability status given his previous states. The transitory shock y' is realized with respect to the invariant distribution Π_y. Given this and the opportunities available to

[25] In principle, an entrepreneur could borrow an amount and then decide to invest none or only a part of it in his business. Such a behavior is excluded in this model.

[26] Alternatively, we could introduce an endogenous borrowing constraint as in Cagetti and De Nardi (2006). However, this considerably increases the computational time.

him, 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 behaviour of a borrowing entrepreneur is to repay its 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[27]. If he repays, the entrepreneur also has to pay the interest on his loan according to the interest rate $r^b(\Delta)$. Following the literature on entrepreneur's option to default[28], this interest rate is chosen endogenously by the financial intermediary based on the *observable* characteristics $\Delta = (a, \theta, z_{-1}, j)$ of an entrepreneur[29]. 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:

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

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

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

$$e' = A \tag{13}$$

(3), (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 and (13) specifies the next period access to credit market, which is A when the entrepreneur repays. We emphasise 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 rights expire with probability q. Thus the consumption and saving decision of the entrepreneur depend on his

[27]In the SCF and in the model, we find that 3% of entrepreneurs have negative income.

[28]See, among others, Herranz et al. (2015), Mankart and Rodano (2015) or D'Erasmo and Boedo (2012).

[29]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.

total income and assets composed of his entrepreneurial income, possible DRI benefits, interests on savings not invested in his company for an amount $(1+r^d)(a-k)\mathbb{1}_{\{k\leq a\}}$ and personal assets a[30].

Bankruptcy When an entrepreneur chooses not to repay the borrowed amount or the interests, he defaults and goes bankrupts. His firm is liquidated and his business idea is lost[31]. We model default in the spirit of the specification adopted by D'Erasmo and Boedo (2012). Specifically, we assume that after producing and observing his shock z , an entrepreneur can choose to renegotiate what is due through a judicial action in a court. Bankruptcy is characterised 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[32]. This portion captures what can be recovered using different channels, including liquidation and reorganisation. After defaulting, the entrepreneur is excluded temporarily from the credit market in subsequent periods.

In our alternative economy with DRI, an insured but bankrupt entrepreneur can claim any outstanding UI rights $b_e(\theta,\pi_r)$. 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_i^C, conditional on not losing his rights and/or not finding a job at the same time. The recursive formulation of a bankrupting entrepreneur is:

$$B(a,k,\theta,z,j)=\max_{c,a',s_w} u(c,s_w,0)+\beta\mathbb{E}_{\theta',y',j'}\left\{\pi_w W'+(1-\pi_w)U'_{j'}\ \middle|\ \theta,j\right\} \tag{14}$$

[30]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.

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

[32]Unlike Mankart and Rodano (2015), we abstract from exemption level as specified under Chapter 7 of the US bankruptcy law for two reasons. First, we do not distinguish between secured and unsecured debt. Second, default in their model is generated with an investment specific shock, that generates large capital losses and strong default incentive in case of a bad shock. In our model, however, we focus on productivity shocks that impact directly the current profit as defined above. We therefore need a bankruptcy specification that implies a higher incentive to default. Despite this potential limitation, our shock specification is able to capture the entrepreneur's income distribution as shown in section 4.3, which is our major concern for our policy experiment to be meaningful.

$$\text{s.t.} \quad \pi_r = zg(\theta)(k)^{\nu} - \delta k \tag{15}$$

$$c + a' = \max\{(1-\chi)k + \pi_r - \xi(k-a), 0\} + \mathbb{1}_{\{j=i\}} b_e(\theta, \pi_r) \tag{16}$$

$$e' = C \tag{17}$$

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

Credit contract We modelled bankruptcy as a judicial procedure in which entrepreneurs renegotiate their debts, while having potentially the ability to reimburse them[33]. We assumed that the external creditor had perfect information about the entrepreneur's state, and thus about his 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 realises 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. 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 such that:

$$V_B + V_R \geq (1 + r^d + \upsilon)(k - a) \tag{18}$$

where V_B and V_R are given by:

$$V_B = \sum_{z \in \mathcal{B}(\Delta)} \pi(z|z_{-1}) \big[\min\{\xi(k-a), (1-\chi)k + \pi_r\} \big] \tag{19}$$

$$V_R = \sum_{z \in \mathcal{B}^c(\Delta)} \pi(z|z_{-1})(1 + r^b(\Delta))(k - a) \tag{20}$$

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 he repays. Note that if the entrepreneur's cash on hand is too low, 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 upper entrepreneur's borrowing limit is identical between agents ($k \leq \lambda a$), the option to default generates different behaviour among different ability group of entrepreneurs.

[33]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 their debt.

Finally, bankruptcy may interact with our policy experiments. In particular, the reforms could modify the default incentive. In section 5.6, 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 his own wealth. He has a probability ϕ to reenter the credit market next period with his earlier default forgotten. The recursive program of such an entrepreneur after the realisation of the shock z is thus:

$$\hat{E}(a,k,\theta,z,j) = \max_{c,a',s_w} u(c,s_w,0) + \beta \mathbb{E}_{\theta',y',j',e'} \Big\{ \pi_w \max\{W', E'_{j'}\} + (1-\pi_w)\max\{U'_{j'}, E'_{j'}\} \;\Big|\; \theta, j, e = C \Big\} \tag{21}$$

$$\text{Subject to:} \quad \pi_r^C = zg(\theta)(k)^\nu - \delta k \tag{22}$$

$$c + a' = \pi_r^C + \mathbb{1}_{\{j=i\}} b_e(\theta, \pi_r^C) + a + r^d(a-k)\mathbb{1}_{\{k\le a\}} \tag{23}$$

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

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

$$E(a,\theta,z_{-1},e=C,j) = \max_{k\in[0,a]} \Big\{ \sum_{z\in\mathcal{Z}} \pi(z|z_{-1})\hat{E}(a,k,\theta,z,j) \Big\} \tag{24}$$

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:

$$\mathcal{E}'_i = \mathbb{E}_z\big[\underbrace{\Psi_1 E(a',\theta',z,e',j=n)}_{\text{baseline}} + \underbrace{\Psi_2 E(a',\theta',z,e',j=i)}_{\text{insurance reform}} + \underbrace{\Psi_3 E(a'+S,\theta',z,e',j=n)}_{\text{entry subsidy reform}}\big] \tag{25}$$

with S is the entry subsidy. The baseline economy is characterised 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 his UI rights, even after starting a business activity. The UI provision will depend on the realised entrepreneurial income. Specifically, the additional amount $b_e(\theta, \pi_r)$ is given to the entrepreneur, depending on his current entrepreneurial income π_r and the UI benefits he could have claimed as an unemployed individual. When the entrepreneurial income is negative (i.e., $\pi_r < 0$), an entrepreneur can fully claim his unemployment benefits. Otherwise, the UI complement diminishes proportionally with the realised entrepreneurial income. The policy is characterised with the couple of parameters (f, q), where $f \in [0, 1]$ is a replacement parameter[34] and q the insurance duration. The rule governing $b_e(\theta, \pi_r)$ is given by:

$$b_e(\theta, \pi_r) = \begin{cases} b(\theta) & \text{if} \quad \pi_r < 0 \\ b(\theta) - (1-f)\pi_r & \text{if} \quad 0 \le \pi_r \le \frac{b(\theta)}{1-f} \\ 0 & \text{if} \quad \pi_r > \frac{b(\theta)}{1-f} \end{cases} \tag{26}$$

where $b(\theta) = (1 - \tau_w)h(\theta)w\mu$ is the full UI benefit that the entrepreneur could have claimed if he was only unemployed. Figure 5 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 complement that guarantees at least the UI benefits if the entrepreneurial income is positive but low, (ii) an insurance-subsidy which provides an additional complement 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.

[34] f can also be viewed as a subsidy parameter since it increases the amount received by an entrepreneur with bad realizations above his UI. As a robustness check, we show that even if $f = 0$, the insurance is effective.

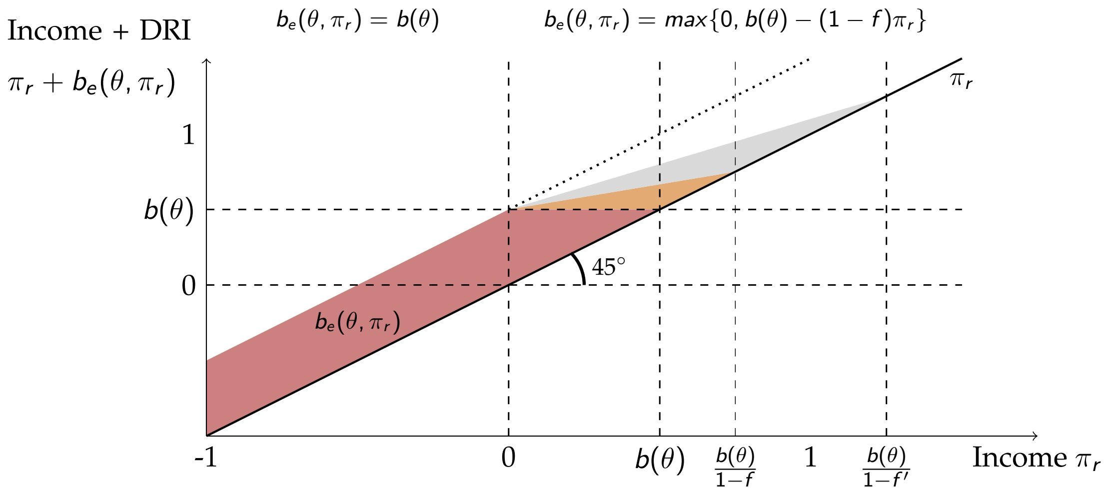

Figure 5. DRI reform.
The red (most dark) region corresponds to a minimal case where $f = 0$ (entrepreneur gets at least $b(\theta)$ when $b(\theta) > \pi_r > 0$). Note that if current entrepreneurial income π_r is negative, this zone will be the same whatever the value of f. The orange (lighter) zone 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 $b(\theta) = 0.5$.

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 entrepreneurs 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.

Entry subsidy Entry subsidy constitutes one of the most important instruments used to boost entrepreneurship. In the spirit of the current US Small Business Administration program, which provides free entrepreneurial training, loan guarantees and grants to new start-up small businesses, we introduce the entry subsidy in the most basic way. It is simply an additional amount S added to the wealth of a new entrepreneur entering the program. Note that in the model, a loan is provided proportionally to the entrepreneur's wealth. Therefore, increasing wealth with an entry subsidy generates an effect similar to a loan guarantee: the entrepreneur can access a larger loan at the beginning of his 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 government revenues (T) are (with a slight abuse of notations):

$$T = \int_{\mathbf{x}_{o_{w,u}}} \Big(\tau_w h(\theta) wy \; d\Gamma(\mathbf{x}_{o_w}) + \tau_w h(\theta) w\mu \; d\Gamma(\mathbf{x}_{o_u})\Big) \tag{27}$$

where $\mathbf{x}_o$ is the state vector summarising 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:

$$G = \int_{\mathbf{x}_{o_{u,e,eu_i}}} \Big(h(\theta)\mu w \; d\Gamma(\mathbf{x}_{o_u}) + \Psi_2 b_e(\theta, \pi_r) \; d\Gamma(\mathbf{x}_{o_e}) + \Psi_3 S \; d\Gamma(\mathbf{x}_{o_{eu_i}})\Big) \tag{28}$$

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 maximise the agent problem and $\Gamma(\boldsymbol{x})$ is the stationary probability measure induced by decision rules, the probabilities 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 the online appendix.

4 Parametrisation

We parametrise 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 monthly 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[35]. The model period is the quarter.

A subset of model parameters are normalised or taken from their estimates in the literature to restrict the number of estimated parameters. The other parameters are pinned down by minimising the distance between a number of equilibrium moments from the stationary distribution, and their data counterparts.

4.1 Fixed parameters

Demographics 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 to 2.5.

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 estimated 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 $\eta(\theta) = \alpha_\eta + \beta_\eta w h(\theta)$, 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 discretise 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

[35]The online appendix provides details on assumptions used to restrict our samples.

0.0225[36]. 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 index for labor income, as observed in the PSID, which is 0.38 (Cagetti and De Nardi (2006)). The processes are discretised using the method in Rouwenhorst (1995).

Entrepreneurial abilities In the literature, there is 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), parametrise 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 explain 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 considered, we find that workers in the bottom and the top quantiles are respectively 7% to 13% and 6% to 19% more likely to start a business than the average worker. Contrastingly, workers in the middle quantile are 11% - 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 in the model are close to their data counterparts.

Firm's productivity In contrast to Mankart and Rodano (2015) who assume i.i.d. shocks, we estimate the idiosyncratic business shock process using an AR(1) characterised by mean μ_z, variance σ_z and persistence parameter ρ_z. We normalise the mean to 1.0 and (σ_z, ρ_z) are estimated endogenously. These parameters help to generate the high entrepreneurial exit rate and the fraction of entrepreneur with negative income. We discretise the process using 7 states.

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.

[36]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.

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)[37].

The probability ϕ of reentering the credit market after an exclusion is set to 4.2%, which corresponds approximatively to a period of 6 years as in Mankart and Rodano (2015). 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 υ between the lending rate and the deposit rate is set to 0.3% per quarter and the minimum subsistence level m is set to 0.04[38]. Finally, concerning the bankruptcy parameters, we follow D'Erasmo and Boedo (2012), who use data from the 2009 *Doing Business* . We set the bankruptcy cost to 7% of the business capital and the fraction that the entrepreneur has to repay in case of default to 77%.

4.2 Estimated parameters

After setting the previously discussed parameters, 10 structural parameters need to be pinned down. The return to scale parameter in the entrepreneurial sector, ν, and the borrowing constraint parameter λ fits the ratio of median net worth between workers and entrepreneurs, and the fraction of capital used in the entrepreneurial sector[39]. The discount factor β helps to generate a realistic quarterly capital-output ratio of 10.6[40]. Finally, for the remaining six parameters i.e. the mapping $g(\theta)$ (3 parameters), the matching parameters (κ_w, κ_e) and the variance and the persistency of the process z, we note that while some parameters mainly affect some moments, changing one parameter affects the whole set of generated moments. In order to es-

[37] As a robustness check, we also consider in section 5.6 various UI program with longer duration and higher unemployment benefits. For example, we consider two periods characterized with historically high unemployment rates: early 2000s recession and the Great Recession. As shown in the online appendix, the availability of UI benefits in the US has been extended several times beyond the normal 26 weeks during these periods, reaching a maximum of 72 weeks in a small number of states between 2002 and 2004 and a maximum of 99 weeks in late 2009 (Valletta (2014)).

[38] 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 wealth level. The value of m is small enough to guarantee that $U_i^e(\mathbf{x}) < W^e(\mathbf{x})$ in equilibrium.

[39] Quadrini (2000) targets a fraction of capital used by entrepreneurs of 40% and Kitao (2008) of 35%. However, in contrast to them, we have a more restrictive definition of an entrepreneur (our share of entrepreneurs is 8.5% against 12% in their paper). Therefore, we target a slightly lower fraction of capital used by entrepreneurs.

[40] As Kitao (2008), we follow Quadrini (2000) and choose a capital-ouput 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).

timate those parameters, we use a simulated method of moments[41]. Let $\mathbf{p}$ represents the vector of parameters to be endogenously estimated. The parameter vector is chosen to minimise the squared difference between simulated and empirical moments,

$$\hat{\mathbf{p}} = \arg\min_{\mathbf{p}} \sum_{k=1}^{10} \Big(m_k - m_k(\mathbf{p}) \Big)^2 \tag{29}$$

where $m_k(\mathbf{p})$ represents the k-th simulated moment and m_k its data counterpart. Minimising 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 summarised in Table 3.

Parameter	Symbol	Value
Discount factor	β	0.97
z process (autocorrelation, variance)	ρ_z, σ_z^2	0.85, 0.256
Businesses' return to scale	ν	0.806
Borrowing parameter	λ	0.552
Matching parameter	κ_e,κ_w	0.28,0.83
Entrepreneur's innate ability	$[g_1, g_2, g_3]$	[0.0645, 0.0774, 0.1017]
Targeted moments	**Data**	**Model**
Capital-output ratio	10.6	10.57
Share of entrepreneurs (in %)	8.5	8.52
Entrepreneurs' exit rate (in %)	6	5.8
Ratio of net worth E/pop	8.0	8.04
Capital used by entrepreneurs (in %)	30	29.7
Fraction of entrepreneur with neg. income (in %)	3	3.34
Unemployment rate (in %)	5.1	5.05
Worker to ent. flows by quantiles	[1.07, 0.87, 1.07]	[1.069, 0.85, 1.082]

Table. 3. Estimated parameters and targeted moments.

4.3 Properties of the calibrated model

We find a low value for the discount factor of 0.97. 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.

For the idiosyncratic firm shock process z, the persistence is 0.85, which correspond approximately to 1.7 year, and the variance is equal to 0.256, which is surprisingly close to the variance of the *iid* shock in Mankart and Rodano (2015).

[41] To be more precise, we use a Control Random Search (CRS) algorithm introduced by Price (1977) with a set of starting points generated via sobol sequences along a dimension of 10 parameters.

Concerning the aggregate macroeconomic behaviour, the model implies a quarterly lending interest rate of 2.12% (corresponding to an annual interest rate of 8.7%), which is a bit higher than the average lending rate from 1993 to 2008 of 7.44%, as computed by the IMF. The fraction of entrepreneurs who bankrupt each quarter ranges between an average of 0.25% according to the Administrative Office of the Courts for the period 1990–2005 to 0.57% following Mankart and Rodano (2015). In our model, we get a lower number of 0.13%, however, as in the data, bankruptcy in our model constitutes a small fraction of exiting entrepreneurs.

The model also captures a number of moments related to mobility and entrepreneurship that are not explicitly targeted in the parametrisation procedure but that can still be compared 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 10% in our model and evaluated to be 12-13% by Amorós and Bosma (2014)[42]. In the data, unemployed individuals represent 20% of new entrepreneurs, whereas in our model, we get a number quite close at 21%. The insured unemployment rate (IUR), which measures the number of recipients of regular benefits (i.e. insured unemployed in the model) divided by the total number of jobs covered by the unemployment insurance system (i.e. all workers in the model), is equal to 2.8 in the model against an average of 2.3 between 2001 and 2008 according to the US Employment and Training Administration[43]. As argued by Anderson and Meyer (1997), it is likely that some unemployed individuals do not claim their UI rights, while they are eligible. In our model, instead, all unemployed individuals are automatically enrolled in the unemployment insurance program.

On the mobility between occupations, by construction, the transition from worker to unemployment is fixed and close to the data and the entrepreneur's exit rate is targeted using our SMM strategy, and is therefore close to its data counterpart. All other transitions are generated endogenously with the model. Table 4 displays the flows in the model and in the CPS. Transitions are quite close to their empirical counterparts in and out of each occupation. Importantly for our policy experiments, the fraction of unemployed individuals starting a business is well reproduced. Furthermore, while we target entrepreneurial exit rate, we also capture the high entrepreneurial entry rate into 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 sizeable fraction of unemployed individuals started their business out-of-necessity. Since the option to work in the corporate sector is a better option for those in-

[42]In our model, we define necessity entrepreneurs as an unemployed individual who start a business while he would have been better off in a corporate job. Formally, this happens when an entrepreneur started his business in the region of the state space where $\mathbb{E}_y[W^e(a,\theta,y)] > \mathbb{E}_{z-1}[E^e_j(a,\theta,z_{-1})] > U^e_j(a,\theta)$.

[43]Compared to the unemployment rate that accounts for unemployed who report searching actively for a job (an action which cannot be verified), the IUR is a useful measure which associates an observed action (filing for UI) with being among the insured unemployed group. Insured unemployment also leaves out the long-term unemployed, who are no longer eligible for UI and therefore abstract from people not in labor force.

dividuals, they continue to search a job *on-the-business* and exit toward employment when a job is found. Finally, as detailed in the online appendix, we also capture well the observed pattern of the transitions between occupations by ability level, taking educational attainment as proxy in the CPS.

	Mass (%)		**Transition: Model (Data)** (%)		
	Data	Model	W	E	U
W	86.4	86.44	97.45 (97.56)	0.48 (0.52)	2.07 (1.92)
E	8.5	8.5	5.23 (5.18)	94.22 (93.98)	0.49 (0.84)
U	5.1	5.06	43.23 (43.05)	2.25 (2.39)	54.32 (54.56)

Table. 4. Transition between occupations during a quarter (data counterpart between braces). *Data sources:* authors' computations using the monthly basic CPS from 2001 to 2008. We restrict our sample to individuals declaring working at least 20 hours, aged between 20 to 65 years old.

Our model underestimates the wealth Gini, which is 0.64 in the model against 0.82 in the SCF. Indeed, as compared to Cagetti and De Nardi (2006), we do not target wealth Gini and our model abstract from voluntary bequest, which has been shown to play an important role in order to obtain the right tail of the wealth distribution[44]. Instead, it is crucial to capture the 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 6.42 in the model against 6.57 in the SCF. Second, the median ratio of workers' income over entrepreneurial income is equal to 1.61 in the model, against 1.65 in the SCF. In the data, the ratio of median debt to income ratio is 0.5, whereas it is 0.75 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 32.6% in the model.

Concerning entrepreneurial income, we targeted a fraction of 3% of the entrepreneurs with negative income, including all forms of income (wage, capital and business income). However, in the data, this fraction goes up to 20% when considering business income as the only source of income. In the model, the fraction of entrepreneurs with negative entrepreneurial income excluding capital gains is 13%.

Figure 6 displays the total income distribution of entrepreneurs normalised by its median. Our model reproduces quite well this distribution with respect to SCF data, especially the left tail important for our DRI experiment. Additionally, table 5 compares the share of entrepreneurs earning less total income (including business and capital gains) than various levels of normalised income in the model and in the data. Our model exhibits a slightly higher con-

[44]Moreover, as our model is at a quarterly frequency, our implied discount factor is large. The consequence is that agents tend to accumulate more wealth, which depresses the concentration of wealth.

centration of total income at the left side in comparison with the data. Finally, we compare the entrepreneurial survival rate with records available for surviving establishments. The fraction of entrepreneurs surviving after 2 years and 5 years are respectively 58.2% and 37.7% in the model, against 67% and 47% in the data. We note that establishment dynamics might be somewhat different from the actual entrepreneurial dynamics. However, it is conceivable that a fraction of exiting entrepreneurs sell their businesses, contributing to a surviving establishment in the data. Thus, the establishment survival rate might overestimate the actual number of individuals that actually remain entrepreneur. This argument is in line with Caliendo and Kritikos (2009) who finds a relatively low monthly entrepreneurial survival rates.

Overall, despite the few limitations that we underlined, the model properties indicate that we can appropriately conduct a careful analysis of the effects of entrepreneurial insurance, a policy that might mainly be relevant for entrepreneurs with low income.

Normalized income level	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**
Model (% entrepreneurs)	23.2	50	67.2	78	85.3
Data (% entrepreneurs)	22	49	62.7	70.4	77.5

Table. 5. Share of entrepreneurs earning less than a given level of normalized income.

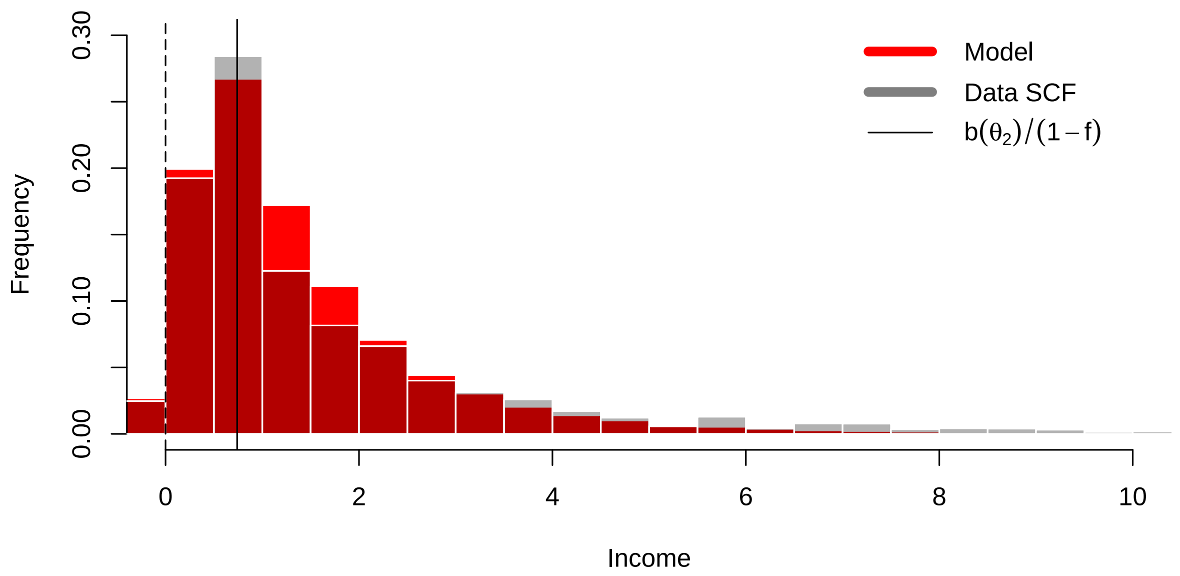

Figure 6. Distribution of entrepreneur's total income (including wage, business income and capital gains). *Notes:* we normalize entrepreneurial total income using the median in the model and in the data. The entrepreneur's total income is the model defined as the sum of π_r and interests on capital.

5 Policy experiments: insurance effect and start-up subsidy

This section studies the impact of introducing an entrepreneurial downside risk insurance as an extension to the existing UI program. As stressed earlier, we implement this DRI by replicating the policy implemented in France with the PARE program in the US economy, with replacement and duration parameters $(f, q) = (0.3, 0.5)$. The insurance duration q is set to equate the US unemployment insurance duration[45]. We compare our main policy experiment with the most used instrument to foster entrepreneurship in the unemployment pool[46]: 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.

Our policy experiment results are organised in the following way: in subsection 5.1, we compare the baseline economy to the new alternative economies with a special interest for the impact on occupational choices. Subsection 5.2 studies relative entrepreneur performances and dynamics by comparing those who would have started businesses even in absence of a reform with the selected fraction that entered entrepreneurship because of the reform. The next subsection discusses how the policies contribute to resorbing the wedge created by the current UI system, discouraging unemployed individuals to start businesses. Subsection 5.4 shows the distributional effects of the reforms on different ability groups and subsection 5.5 shows the transitional dynamics toward the new steady states. Finally, subsection 5.6 reviews alternative policy assumptions and conduct robustness exercices.

5.1 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 6, we compare the impact of the reforms on main indicators in percent deviations from the baseline economy. 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 theses lines: the DRI policy is slightly more expensive and overall has a smaller quantitative impact than the SUS policy. However, the DRI policy has a lasting qualitative effect on the entrepreneurial pool and the economy. In more details,

[45] We restrict q to this value in order to avoid any moral hazard effect. For instance, an unemployed individual with UI rights could enter entrepreneurship in order to extend his UI duration.

[46] For instance in the US with loan guarantee or training programs, or in Germany with the start-up subsidy program that provides lump-sum amounts to new entrepreneurs who were previously insured unemployed during 3 years.

implementing the DRI increases the unemployed individuals' incentive to start businesses by 9.7% and implies important changes in mobility between occupations. Most notably, the number of new entrepreneurs per year increases by 2.5%. Surprisingly, the unemployment rate is almost unchanged. Instead, less corporate jobs are filled. Under the SUS mobility effects are stronger. Relative to the DRI, the fraction of unemployed individuals who start businesses is almost twice as high. However, the entrepreneurship exit rate is also more than two times higher, 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 subsidised entrepreneurs, we will further develop this point in subsection 5.2. On average, in comparison to the DRI, the SUS favours the entry of poorer entrepreneurs setting up smaller businesses and reducing the average firm size. As stressed earlier, the SUS policy is slightly less costly tax wise. However overemphasising 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 during several periods. Moreover, a bankrupting entrepreneur can return to the unemployment pool and continue to receive his 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.

	Baseline	**DRI (% deviation)**	**SUS (% deviation)**
		$(f = 0.3, q = 0.5)$	$(S = 0.0693)$
Fraction of entrepreneurs	8.448	1.01	1.01
Fraction of unemployed starting businesses (in %)	2.26	9.73	18.14
Entrepreneurship exit rate (in %)	5.79	1.64	3.76
Unemployment rate (in %)	5.054	-0.07	-0.43
Corporate jobs (in %)	86.457	-0.1	-0.07
New entrepreneur per year	0.0054	2.46	4.42
Bankruptcy rate (in %)	0.1305	1.79	1.97
Necessity share (in %)	10.18	-21.53	19.87
Average firm size	26.068	-0.18	-0.42
Entrepreneurial sector production	0.376	0.87	0.61
Capital-output ratio K/Y	10.557	0.14	0.12
Tax rate τ_w (in %)	0.911	2.5	1.8
Ratio cost of the policy over total production	-	0.0032	0.0026

Table. 6. Downside risk insurance and start-up subsidy effects on aggregates. Values are expressed as pourcentage deviation relative to the baseline economy, except for the cost of the policy which is expressed as pourcentage of GDP.

We find that the effects of the DRI on major macroeconomic indicators such as production, unemployment, capital accumulation or prices are small. For capital, production and prices, we see two main reasons: (i) unemployed individuals are a small share of the whole population accumulating small amounts of capital, and (ii) there are opposing forces on the capital market. On the one hand, a higher share of entrepreneurs, who tend to accumulate more capital, boosts investment and increases the interest rate. On the other hand, a lower fraction of workers (and hence corporate jobs). Therefore, capital invested in the entrepreneurial sector crowd out capital invested in the corporate sector. On the unemployment side, notice that implementing a DRI draws not only unemployed individuals but also a significative fraction of employed individuals to the entrepreneurial pool, especially when compared to the SUS policy. This type of individuals can eventually fail in their entrepreneurial venture, increasing the unemployment rate in equilibrium.

5.2 Entrepreneur's selection and performance

In this section, we are interested in the performance of new entrepreneurs entering in 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 the short-run versus the long-run. Indeed, it is possible that such a policy encourages the entry of many low-qualified entrepreneurs with a lower survival probability in the short-run relative to highly skilled entrepreneurs. This is important since it could mean that a policy that in fact favours the entry of low-skilled unemployed individuals is not evaluated correctly because mostly the highly skilled tend to survive: we would only observe in the final steady-state that the fraction of highly skilled entrepreneurs has increased relative to the low-skilled group.

To respond 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, taking into account what could lead to an exit from entrepreneurship, caused by either an outside opportunity to work in a corporate job or a forced decision due to bad business outcomes[47].

In the details, we 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[48]. The first group is a counterfactual group that lets us com-

[47]This measure is different from the firm survival rate that is commonly found in the data: since a firm can be sold the survival rate of firms if often larger relative to the entrepreneurial survival rate.

[48]This fraction is simply the residual between the distribution of new entrepreneurs previously insured unem-

pare the performance implied by the DRI 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. We do this comparison only for the DRI, since the SUS only increase the entrepreneur's wealth level. The second group sheds light on the performance of selected new entrepreneurs that entered due to the reforms. Then, we simulate the behaviour of entrepreneurs in all possible states during 5 years[49]. Along the simulation, we compute a number of indicators, including production and capital levels, survival rate or the average innate ability. Table 7 summarises the average effect of the DRI relative to the baseline economy for the first group, as well as the characteristics of the selected groups under the two reforms.

5 years average	**Baseline**	**Counterfactual**	**Selected**	
		DRI	DRI	SUS
$g(\theta)$	0.079	0.0791	0.0835	0.0754
Wealth	12.64	12.71	9.94	8.11
Production	0.952	0.954	0.944	0.691
Production growth (in %)	2.83	3.02	2.41	2.1
Survival rate at 5 years (in %)	32.09	32.21	15.20	20.81

Table. 7. Performance and quality of entrepreneurs. *Notes:* all values are an average over 5 years, except for the survival rate at 5 years.

When unemployed individuals start a business under the insurance reform, they tends to become richer, grow faster and survive longer when compared with the baseline case. The selected fraction of new entrepreneurs are 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 more and grow faster than those selected under the SUS. Because they are on average poorer compared to those who would have entered entrepreneurship even in the absence of the policy, they produce slightly less than the counterfactual group[50].

ployed in the new economy, relative to the baseline economy.

[49]This computation is specially demanding because it implies tracking specific entrepreneurs over a long period. A complete description of the algorithm is provided in the online appendix.

[50]Our findings are consistent with the empirical results in Hombert et al. (2014). 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. (2014) cannot identify a significant difference in the educational levels in their estimation. This could be due to the fact that educational attainment might be biased in the estimation of entrepreneurial abilities.

Interestingly, the insurance implies a lower survival rate of the selected entrepreneurs at five years than the SUS. In fact, resorbing the distortion implied by the current UI system in the US has the effect of increasing the entry of more skilled entrepreneurs. Those new entrepreneurs start their business as an experiment. However, as they have a potentially good opportunity (high wage) in the corporate sector, they are more willing to give up their firm than those entering thank to the SUS, who have on average a lower ability level[51].

5.3 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 is costly in utility terms because it implies searching for a business idea, (ii) it is risky and (iii) it implies losing UI benefits[52]. 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 his UI but has to bear the cost of the bad shock). Third, a subsidy part that provides a complement to entrepreneurs when returns are low, that can be greater than just their UI rights depending on f.

In table 8, 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 entrepreneur). The second partial insurance is a case of DRI with $f = 0$: there is no subsidy part and entrepreneurs are never compensated above their initial unemployment benefit. As a reminder, we also report in Table 8 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.

[51] In the model, the survival rate after at one year of the selected high-skilled group is 79%, against 81% for the low-skilled group.

[52] For instance, in the US, only 10 states apply the Self-Employment Assistance (SEA) program, which provides guarantees in terms of keeping their UI rights to unemployed individuals looking to start a business.

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 7.08% relative to the baseline, against 9.73% with the compensation.. More importantly, this policy is realised with almost no cost with an increase of the tax rate by only 0.11% (against 2.5% for the DRI policy). When the government does not provide any complement when entrepreneurial incomes are greater than initial UI benefits (i.e. when $f = 0$), this same fraction goes up by 9.29%.

Therefore, the subsidy part does not play a crucial role in the total effect. It is rather the income compensation component and the right to claim UI benefits after 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 favour paid-employment relative to self-employment: this single component of the DRI policy leads to significant movements in occupational decisions, that may boost entrepreneurship.

	Baseline	**DRI (% dev.)**	**No compensation (% dev.)**	**$f = 0$ (% dev.)**
Share of entrepreneur (in %)	8.488	1.013	0.424	0.966
Fraction of unemp. starting business (in %)	2.26	9.734	7.080	9.292
Tax rate τ_w (in %)	0.911	2.525	0.110	2.525
Ratio cost over total production (in %)	-	0.01697	-	0.0172

Table. 8. Effect of the entrepreneurial insurance policy under three different assumptions.

5.4 Distributional impacts

In this section, we assess the distributional impact of the above policy experiments on the composition of the pool of entrepreneurs. The model describes unemployed individuals as heterogeneous in terms of wealth and innate ability. Since regular UI benefits are proportional to the working ability, highly productive workers receive higher UI compensation when laid off than workers with low productivity. Therefore, the insurance mechanism generated by the compensation $b_e(\theta, \pi_r)$ is 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.

New entrepreneur's ability Table 9 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 by 2.3%.

% of entrepreneurs	θ_1	θ_2	θ_3
Baseline	11.60	7.55	7.24
DRI	+0.66	+1.11	+1.38
SUS	+1.30	+0.98	+0.66
Lump-sum DRI	+1.10	+0.95	+0.99

Table. 9. 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 sizeable business that are 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 borrowing constrained and unable to start a business in the baseline economy. Those individuals are mainly lower-skilled ones with a low opportunity cost of setting a business, since their UI benefits are small[53].

[53]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. (2014) show that the DRI introduced in France in 2002 - 2003 did not lower the quality of new

Finally, under the lump-sum DRI, the increase in the share of entrepreneur seems to be more homogenous across groups because part of the insurance is included in this policy. Indeed, under this policy, unemployed individuals can experiment 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.

Effect on the entrepreneur's wealth level To validate our prediction that the DRI does not favour the entry of poorer (lower-skilled) entrepreneurs whereas a SUS does, we display in Figure 7 (top panel) the difference in the mass of entrepreneurs following the two reforms relative to the baseline economy. Under the DRI, the mass of entrepreneurs increases for any level of wealth up to a given threshold. 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 7 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. We formally defined this in section 4.3 as an unemployed individual with state space $\mathbf{x}$ who started his business while $\mathbb{E}[W(\mathbf{x})] > \mathbb{E}[E(\mathbf{x})] > U(\mathbf{x})$. 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.

5.5 Transitional dynamics and welfare considerations

Transitional dynamics and convergence to a new steady-state Our results have so far focused on the comparison of steady-state economies. However, evaluating this policy using this type of analysis leaves interesting questions unanswered. In this section, we study what are the dynamic effects of suddenly, and unexpectedly, introducing these policies. Along the perfect foresight transitional path that ends at the new steady-state, all agents correctly forecast the sequence of prices, and markets clear in each period. We assume that at $t = 0$, the economy is at

entrepreneurs, especially in terms of education.

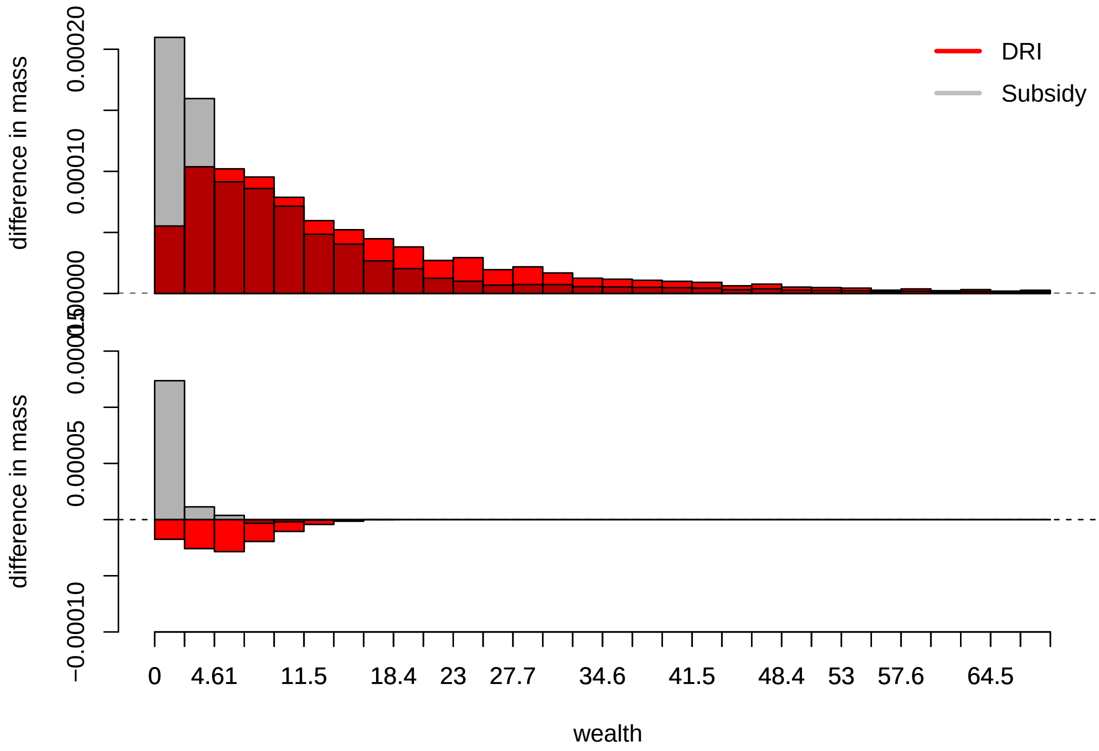

Figure 7. Difference in the mass of entrepreneurs (top panel) and the necessity share (bottom panel) relative to the baseline economy for the DRI and SUS policies.

the initial steady-state characterised by the absence any policy. At $t = 1$ the reform (either the DRI or the SUS) is implemented and is unanticipated by agents. The economy then converges to the new steady-state[54].

In Figure 16, we depicts the transitional dynamics of the economy after an unexpected introduction of either the DRI or the SUS[55]. Under the two reforms, the share of entrepreneurs sharply increases by 0.2% under the DRI and 0.37% under the SUS and then smoothly converges to the new steady-state level. The convergence is slower under the DRI, since the fraction of unemployed individuals starting businesses is smaller. After 5 years, 60% of the occupational adjustment has taken place under the SUS and 52% under the DRI.

Regarding other occupations, the adjustment is similar for corporate jobs. Under the DRI, self-employment crowd out corporate jobs slowly after a sharp decline at the first period, due to the shift of the occupation choice of unemployed individuals after the policy implementation. This crowding out effect is smaller under the SUS. Instead, unemployment rate sharply

[54]To solve the transition, we compute the solutions of the household problem backwards, starting at the new steady-state. We then find prices that are consistent with the implied policies and we iterate until convergence. Details of the full algorithm is provided in the online appendix.

[55]This assumption of unexpected introduction of the policies is standard in the incomplete markets literature. Of course, the policies could be in practice announced before their implementation and therefore anticipated by agents.

declines by 0.4% and then stays fairly stable along the transition. Consequently, under the DRI, the first increase in the share of entrepreneurs is driven by a shift of the occupational choice (extensive margin) of unemployed individuals, that have the opportunity to either open a business or work in a corporate jobs. Contrastingly, the increase under the SUS is due to a fraction of unemployed individuals that find it now more interesting to start business than staying unemployed. Those individuals increase their search effort to find a business idea. Taken together, the results show that much of the response of household occupational shift occurs on the extensive margin under the DRI while it comes from an intensive margin under the SUS.

Concerning the financing of the policies along the transition, the tax rate sharply increases directly after their implementation to its steady-state level under the SUS, while it is slightly smoothed with the DRI as the number of entrepreneurs within the program increases.

On the aggregate capital stock, corporate investment decreases under the two policies after implementation because there are less corporate jobs filled. This lower capital invested in the corporate sector is in fact compensated by a higher level of capital invested in the entrepreneurial sector. Under the SUS, the corporate capital adjustment changes and increases after 2.5 years. Since the failing and exit rate under this policy are higher: entrepreneurs that entered the program tend to stop their businesses and invest their wealth in the corporate sector either voluntarily or involuntarily. Production is only slightly impacted by the reforms. There is a relatively small decline in total production under the DRI during the first two years because of the decline in corporate production. After that period, production of the entrepreneurial sector increases and overcomes the decline of the corporate sector.

Welfare analysis Following Flodén (2001), we compute the welfare change between steady-states in consumption equivalent variations. Our results suggest that resorbing the distortion in favour of paid employment of the current UI system increases welfare by 0.57% with the SUS policy and by 0.2% for the DRI policy, and respectively by 0.055% and by 0.035% when taking into account the transitional dynamics. Both policies are thus implementable even when taking into account the transition costs that arise in the short run. Those who benefits the most from the policy are individuals with sufficient wealth to start their business. The reported welfare gains are small, but we note that the policies concern only a very small fraction of the economy while its cost is supported by the majority. Indeed, the gains that the policies produce are partially reduced because of the way the policies are financed. As we considered the policies as an UI extension plan, the source of financing is a labor income tax on every worker. We surmise that had the financing been different, for instance by taxing the current pool of entrepreneurs, the welfare results might have been different. In the online appendix, we provide details on how we compute the welfare change as well as more information about our welfare results.

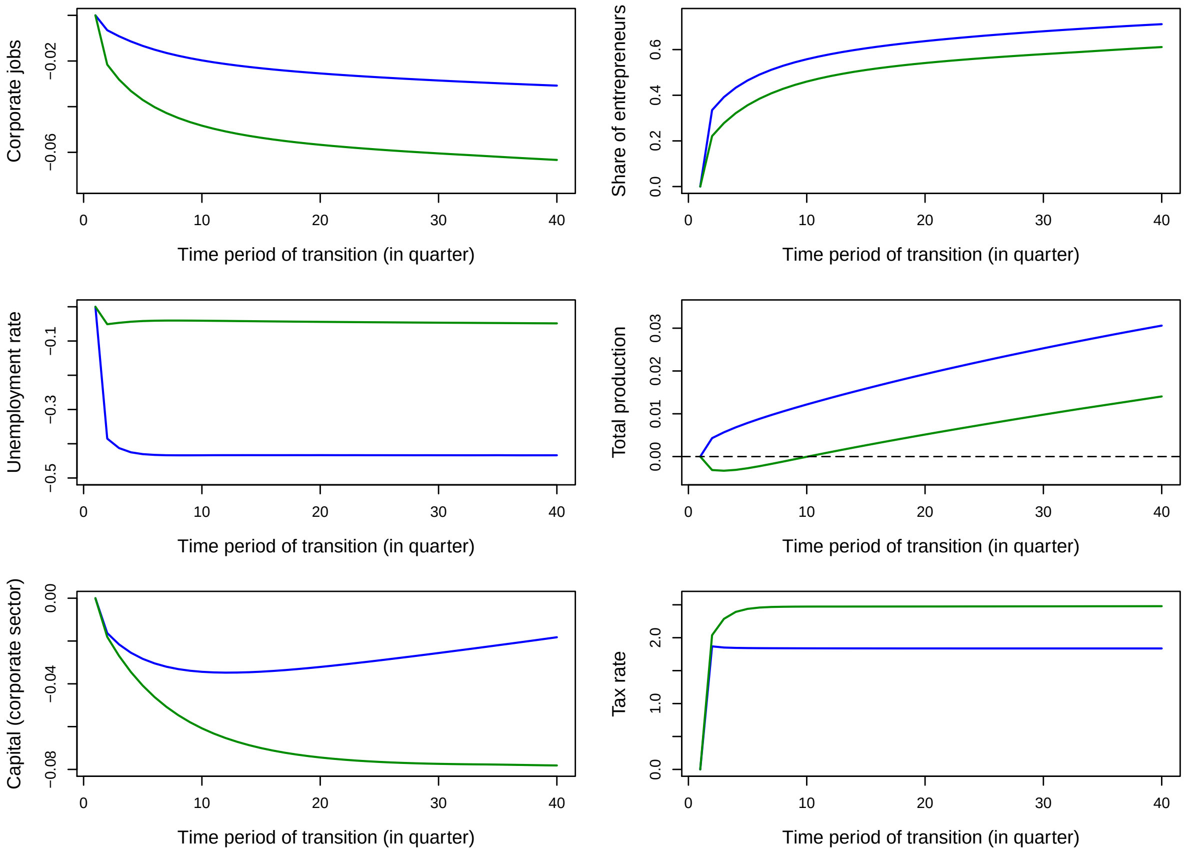

Figure 8. Transitional dynamics of the Economy after an unexpected introduction of the policies at t = 1. *Note:* the solid green line refers to the DRI policy and the solid blue line to the SUS experiment.

5.6 Robustness and discussion

In this section, we discuss some assumptions of our model and show that our results are not affected by our modelling choices.

Bankruptcy In the baseline economy, we have assumed that entrepreneurs could default in equilibrium but are subject to a cost component and a recovery rate. Here we explore an alternative specification where entrepreneurs can bankrupt but are subject to a given exemption level, as in Mankart and Rodano (2015). With this assumption, the effect of the insurance mechanism is slightly lower, with an increase of the fraction of unemployed individuals starting a business equal to 7%. The bankruptcy rate, however, falls to 0.005%, which is explained by the fact that we consider firm's productivity shock instead of an investment shock that lowers mechanically the amount of wealth and makes the default more likely. Moreover, poor individuals enter entrepreneurship less often in such an economy, since the incentive to default is very high and thus the perspective of borrowing much lower.

We also experiment with an economy without any possibility to bankrupt: an entrepreneur who faces a bad shock has to support the loss incurred. In such an environment, the relative effects of DRI and the start-up subsidy are similar. The fraction of unemployed individuals starting a business falls to 8.75%. Indeed, the ability to bankrupt can be viewed as an extra insurance mechanism on top of the DRI giving more incentives to unemployed individuals to start a business. Removing the default possibility reduces the incentive, even under the DRI.

Alternative DRI parameter In the online appendix, we discuss in details the effects of changing the policy parameters of our insurance mechanism. For any parameter set considered, the most talented entrepreneurs are those who benefit the most from the policy. When $f \to 1$ (i.e. all entrepreneurs receive their UI benefits independently of their entrepreneurial income), the insurance mechanism leads to an increase of 2% of the share of entrepreneurs and lower unemployment rate by 0.1%. However, the cost goes up and the tax rate increase by 1.2%. When $f = 0$ (i.e. only entrepreneur with income lower than their UI benefit receive insurance), we already showed in section 5.3 that the insurance is still effective. Interestingly, the tax rate is lower when $f = 0.1$ than when $f = 0$ since in the former case the benefit from the diminution of the unemployment rate is higher than the cost of providing more entrepreneurial insurance.

6 Conclusion

In this paper, we developed a general equilibrium model with heterogenous agents in incomplete markets with risky entrepreneurship and labor market frictions. Our model accounts for the main empirical facts about occupational mobilities, wealth levels, entrepreneurship key features and macroeconomic aggregates in the US Specifically, our empirical contribution is to infer entrepreneurial abilities using the non-linear relationship of the transition from paid-employment to entrepreneurship by earning quantiles. Additionally, our quantitative results suggest that both ability and wealth are determinant for occupational choice.

The main contribution of this paper is to study two major policies promoting entrepreneurship in the unemployment pool: insuring versus subsidising new entrepreneurs. The former is shown to resorb the actual distortion that arise with the current UI system, that favour paid-employment relative to entrepreneurship. Simply resorbing this wedge implies important shifts in occupational choices. In addition, we find very different effects between the two instruments on the profile of new entrepreneurs. Keeping the same share of entrepreneurs across the two policies shows that insuring tends to favour the entry of high-educated entrepreneurs, who are also richer than those entering under the subsidy. We also show that, in the long-run, initially insured entrepreneurs tend to survive longer, run larger firms and grow faster. Importantly, these two policies do not suggest strong effects on the unemployment rate, but instead that self-employment crowd out corporate jobs.

The results we underline could be very different considering aggregate shocks, since insurance plays the role of a potential economic stabiliser. Also, it is worth noting that we abstract from several interesting aspects. First, entrepreneurs in our model cannot hire any workers. By doing so, we probably lose part of the insurance aggregate effects which could lead to more job creations, with a larger impact on the unemployment rate. Our result therefore consists of a lower bound in the effect of those policy on the aggregate outcomes that comes from the pure occupational choice decision. Second, we abstract from the distinction between secured versus unsecured debt. Introducing this distinction could be interesting to evaluate the interaction between bankruptcy laws and insurance mechanisms. Third, we assess the effect of a specific policy. We could use a version of our framework to study more general entrepreneurial insurance that are debated in some countries like France or Denmark, or implemented in other, like in Ireland. We leave these issues and questions for future research.

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Appendix

A Data

A.1 Current Population Survey (CPS)

We use the CPS from 2001 to 2008 to compute the masses of occupations and the transitions between occupations. We restrict our sample to 20-65 population working at least 20 hours.

Unemployed individuals Individuals classified as unemployed are those who do not have a job, but have actively looked for work in the prior 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 of contacting an employer, an university or an employment center (job interview, submitting resumes, answering job advertisements, checking union or professional registers, etc.). Workers expecting to be recalled from temporary layoff are counted as unemployed whether or not they have engaged in a specific job seeking activity.

Entrepreneur Using the CPS, we define an entrepreneur as a self-employed worker (unincorporated or incorporated) who own his business. We control business ownership by creating a variable *holdhubus* which indicates whether or not the individual was owning his firm from 2001 to 2008, allowing us to control for measurement error arising in the survey[56]. Table. 10 displays alternative definitions and alternative sample selection. The share of entrepreneurs varies between 7.1% to 10.3% depending of the assumption considered.

Not in the labor force (NLF) In the model, we are computing the transitions between three occupations: entrepreneurship, paid-employment and unemployment. We therefore abstract from non-participation. This assumption can substantially biased the transitions between occupations. Table 11 shows the transition between occupations and out of the labor force. There are two mains findings. First, when augmented with not in labor force exit and entry, entrepreneur's and worker's flows to the other two occupations are almost unchanged. The flows from NLF to an occupation is mainly toward paid-employment. This could comprise young people entering the labor market and long-run and discouraged unemployed individuals who finally find a job. Second, adding NLF changes considerably the transitions out of unemployment. Precisely, accounting for NLF reduces substantially the switch toward paid-employment. However, this also reduces the fraction of unemployed individuals remaining in

[56]Specifically, if we do not construct this additional variable, flows of entrepreneurs to paid-employment during a quarter jump to 16%, which is inconsistent with the average yearly flow of 22%. Therefore, our definition may count as entrepreneur part of self-employed workers that are not actually business owners at the time of the survey, but the resulting flows are consistent.

Entrepreneur's definition	Sample selection	*W*	*E*	*U*
Self-employed, business owner (1)	20-65 population, >20h	86.5	8.5	5.1
Self-employed, business owner (2)	20-65 population, >20h	87.6	7.4	5.1
Self-employed	20-65 population, >20h	85.4	9.6	5.0
Self-employed, business owner (1)	20-60 population, >20h	86.6	8.2	5.2
Self-employed, business owner (2)	20-60 population, >20h	87.7	7.1	5.2
Self-employed	20-60 population, >20h	85	10	5.0
Self-employed, business owner (1)	whole population	85.6	9.3	5.1
Self-employed, business owner (2)	whole population	86.8	8.1	5.1
Self-employed	whole population	84.6	10.3	5.1

Table. 10. Mass of individuals (in %) falling in each occupation for different sample selection and entrepreneur's definition. *Notes:* (1) benchmark definition with constructed business owner variable, (2) use of CPS variable *hubus* to control business ownership.

unemployment. As compared to the transitions without accounting for NLF, the relative movements are very similar between the three occupations. Therefore, we think that not accounting for NLF is a reasonable assumption.

	Transition (without NLF)			Transition (with NLF)			
	W	*E*	*U*	*W*	*E*	*U*	*NLF*
W	97.56	0.52	1.92	97.39	0.52	2.02	3.37
E	5.23	93.98	0.84	5.5	93.27	1.11	3.84
U	43.05	2.39	54.56	32.69	1.66	41.8	23.85
NLF	-	-	-	8.02	0.95	3.82	87.2

Table. 11. Transition in % between occupations during a quarter, taking into account not in the labor force (NLF) individuals. *Data sources:* flows computed using the monthly basic CPS from 2001 to 2008. We restrict our sample to individuals declaring working at least 20 hours aged between 20 to 65.

A.2 Survey of Consumer Finance

We use the SCF 2007 in order to compute various moments relative to entrepreneurship. We restrict our entrepreneur's sample to individuals declaring being self-employed, actively managing their firm and owning at least 5% of their firm[57].

[57]We use this to control for business ownership, despite it is not a perfect measure. However, this insures some comparability with our CPS sample.

B Model specification and inspection

B.1 Paid-employment is prefered to unemployment

In the model, we assumed that paid-employment was prefered to voluntary unemployment. To insure this, a necessary condition is that home production is lower than labor income for any transitory shock y (i.e. $m < (1 - \tau_w)h(\theta)wy$). However, this is not sufficient. Indeed, recall that a non-worker can search for a job and find it with probability drawn by the invariant distribution Π_y. Therefore, it might be possible that a worker with low state y with a low probability of switching to a high state y' (with first-order markov chain $F(y'|y)$) is worse off than an unemployment worker who can switch with an higher probability to this high state. Therefore, a sufficient condition is that for any y, the value of a worker is greater than the value of an uninsured unemployed individual. We need $W^e(a, \theta, y) > U_n^e(a, \theta)$. In the model, this condition is always true and we also have $W^e(a, \theta, y) > U_i^e(a, \theta)$.

C Inspecting the model mechanism

Search effort behaviors Fig. 9 shows the optimal search effort policies s_w and s_e for the three occupations of our model with different individual's characteristics. On the top left panel, the figure shows that high-skilled unemployed agents search a job-opportunity with more intensity than middle and low-skilled individuals, for any level of wealth. The same is true for entrepreneurs searching for a job, up to a given wealth threshold at which entrepreneurship becomes valuable.

The business search policy function s_e is a hump-shape curve (top right panel). Indeed, poor entrepreneur runs, in average, small firms which are less profitable than working in a job. As wealth increases, entrepreneurship becomes more valuable and agents increase their business search. Up to a given wealth level, s_e decreases because the disutility associated to an increase of the search effort becomes stronger than the associated benefit (i.e. find a business).

Entrepreneur's investment and default incentive In the model, an entrepreneur will default only when the business shock z is too small. This is because, in such a case, an entrepreneur generates a small loss and expected future profits are small. Because the external creditor perfectly anticipates this behavior, it charges a higher price to risky entrepreneurs, with a higher incentive to default. The resulting interest rate depends on the entrepreneur's states. In particular, entrepreneurs with sufficient levels of wealth would never default. Indeed, for those entrepreneurs, bankruptcy costs (fees and expected losses from credit market exclusion) are high as compared to the benefits of renegotiating their debt. The incentive to default is also strongly related to the business shock z_{-1} realized during the previous period. Entrepreneurs

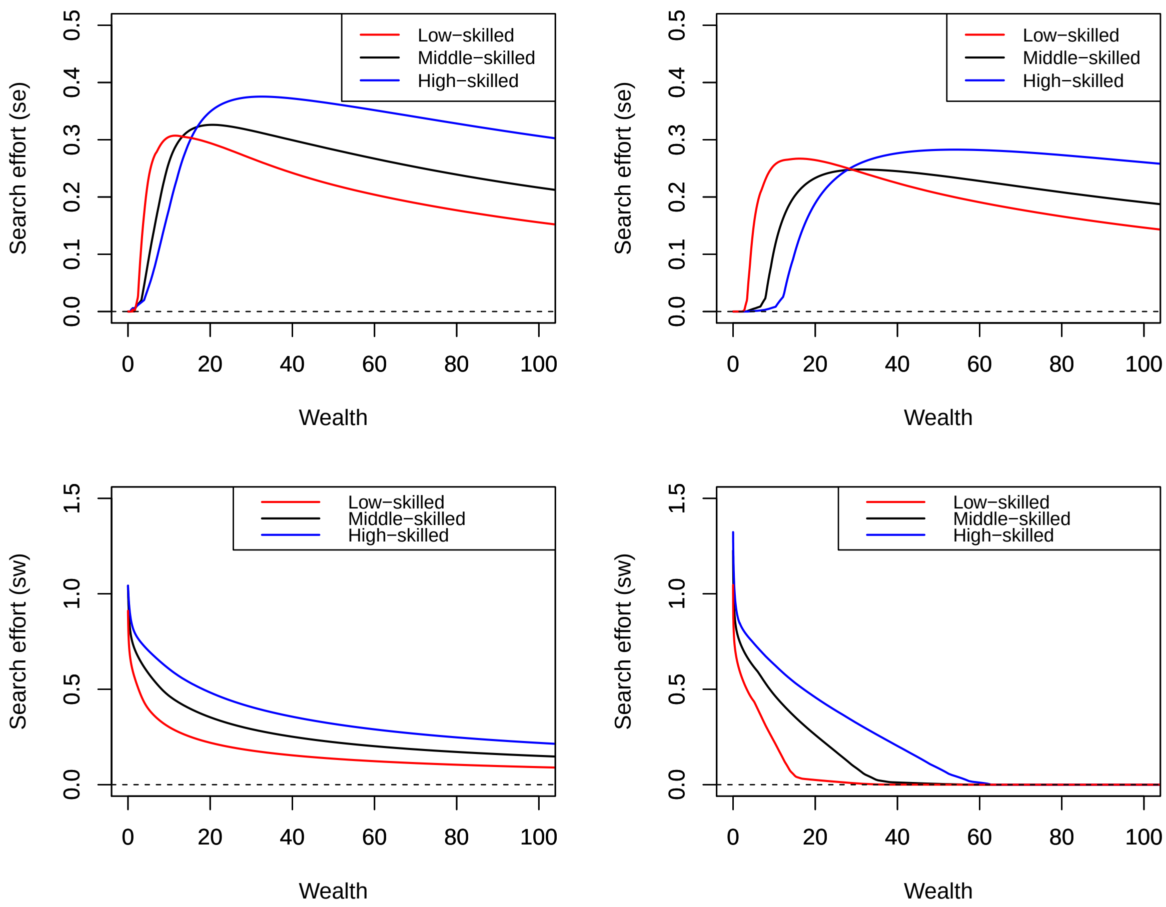

Figure 9. Optimal search efforts s_e and s_w for $\theta = \theta_1$. *Notes:* the figures describe optimal policies for non-excluded case. Top left panel: unemployed agents with UI, top right panel: workers ($y = y_3$), bottom left panel: entrepreneurs ($z_{-1} = z_1$), bottom right panel: unemployed agents with UI.

who fell in a bad shock have a higher probability to default, lowering their ability to borrow by increasing the charged interest rate.

D Distributions

Figure 11 displays the distribution of the three occupations in the model. As in Cagetti and De Nardi (2006), the distribution over entrepreneurs display important concentration at the top, consistent with the data.

E Algorithms

State space and grid definition In our model, an household is fully characterized by a state vector $\mathbf{x} = (o, y, \theta, z, e, j, a)$ with $a \in A$, $y \in \mathcal{Y}$, $z \in \mathcal{Z}$, $\theta \in \Theta$, $o \in \{w, e, u\}$, $e \in \{A, C\}$ and $j \in \{i, n\}$. We compute the household problem using a grid of asset $\mathbf{a}$ of 500 points spaced

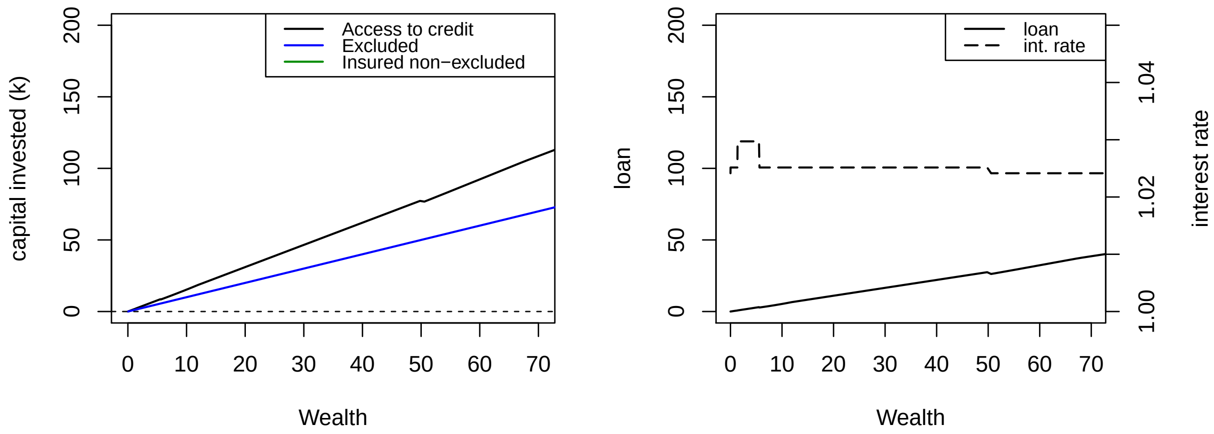

Figure 10. Entrepreneur's policy functions. Left panel: capital invested k, right panel: loan $k-a$ and resulting interest rate $r(\Phi, k)$ for non-excluded entrepreneurs. Plot correspond to $\theta = \theta_2$ and $z = z_6$.

according to an exponential rule. We discretize the process z, y and θ with respectively 7, 5 and 3 grid points. We compute the second stage entrepreneur's problem over a grid of cash-on-hand with 500 grid points.

E.1 Algorithm

We organize the algorithm as follows.

1. Initialize a full dimension grid space composed of all different possible asset values (a), productivity level (y), innate ability (θ) and entrepreneurial state (z). The maximum asset level is chosen sufficiently large to get ergodicity of the policy functions.

2. Guess initial tax rate τ_w and prices $\{w, r\}$.

3. Given prices, solve the consumption-saving-search (CSS) problem of a worker and an unemployed agent.

4. For the entrepreneur's problem, we proceed as follows.

   - First we solve the CSS problem of the values B, R and $\hat{E}^C$ on a grid of cash-on-hand.
   - Given the solution to the previous values, set a grid of possible investment value k with bound $[0, \lambda a]$.
   - Separate the problem in multiple regions. Between $[0, a]$, we apply a standard solver to find the optimal k. Between $[a, \lambda a]$, we apply a grid search that account for multiple solutions that could arise due to the change in the interest rate r^b.
   - For each $k > a$, start by providing the loan at the risk-free interest rate r. If the entrepreneur default for this interest rate, then compute the resulting new interest

rate r^b implied by the zero profit condition of the bank. Iterate the process until r^b is consistent with the default probability. A loan that implies a default probability equals to 1 is not allowed.

- Save the best solutions to the problem and work around to find the optimal k level.

5. Construct the transition matrix $\mathbf{M}$ generated by Π_y, Π_z and Π_θ, $a'(\mathbf{x})$, $s_w(\mathbf{x})$, $s_e(\mathbf{x})$ and the default decision. Compute the associated stationary measure of individuals $\Gamma(\mathbf{x})$, by first guessing an initial mass of one of households with zero asset and then by iterating on $\Gamma'(\mathbf{x}) = \mathbf{M}\Gamma(\mathbf{x})$ until $|\Gamma'(\mathbf{x}) - \Gamma(\mathbf{x})| < \mu$, with μ very small.

6. Compute the resulting total asset level, total labor supplied and total investment in the entrepreneurial sector. Total capital invested in the corporate sector is given as the difference between total savings and total capital invested in the entrepreneurial sector. Total labor used in the corporate sector is given by total labor supplied by workers.

7. Update prices $\{r, w\}$ using the marginal productivities in the corporate sector and tax rate τ_w to close the government budget up to a relaxation. Back to step 2 until convergence of labor income tax rate and prices.

E.2 Transition dynamic.

We assume that the economy is in the initial steady state in period 0 and the reform is announced and implemented in period 1. Agents did not anticipate the policy before its implementation. The economy makes a transition to reach the final steady state in period T. We choose T large enough so that the resulting stationary distribution in period T is close enough to the steady state distribution after the reform. The algorithm for transition dynamics is as follows:

1. Guess a path for $\{\mathcal{L}_1, ..., \mathcal{L}_{T-1}\}$ with $\mathcal{L}_t = \{r_t, w_t, \tau_{w,t}\}$. $\mathcal{L}_0$ and $\mathcal{L}_T$ are given by initial and final steady-states.

2. Use value functions of the final steady state (period T) to solve the households' problem backwards starting from $T-1$ until period 1.

3. Use the distribution of the initial steady state and the resulting policy functions to compute the path of the distribution of household $\{\hat{\Gamma}(\mathbf{x})_1, ..., \hat{\Gamma}(\mathbf{x})_T\}$.

4. Given these distributions, compute new path $\{\mathcal{L}_1, ..., \mathcal{L}_{T-1}\}$. Iterate from step 2 until the difference between the initial path is close enough to the resulting path.

5. When convergence is achieved, check if the resulting final distribution $\hat{\Gamma}(\mathbf{x})_T$ is close enough to the steady-state distribution $\Gamma(\mathbf{x})_T$ up to a relaxation. If the two distributions are identical, then stop, else, increase the number of periods T.

F Welfare criterion

We use the consumption equivalent variation (CEV) as defined by Flodén (2001), in order to compute the welfare along the transition and between the two steady-states. The conditional welfare change, $\omega(\mathbf{x})$, for a household with state vector $\mathbf{x}$ of a policy change between an economy A to another economy B is defined by:

$$E_0 \sum_{t=0}^{\infty} u(c_t^A(1+\omega(\mathbf{x})), s_{w,t}^A, s_{e,t}^A) = E_0 \sum_{t=0}^{\infty} u(c_t^B, s_{w,t}^B, s_{e,t}^B)$$

where $\omega(\mathbf{x})$ is given by:

$$\omega(\mathbf{x}) = \left(\frac{E_0 \sum_{t=0}^{\infty} u(c_t^B, s_{w,t}^B, s_{e,t}^B)}{E_0 \sum_{t=0}^{\infty} u(c_t^A, s_{w,t}^A, s_{e,t}^A)}\right)^{\frac{1}{1-\sigma}} - 1$$

We also compute the utilitarian social welfare change, by computing the premium ω_V that measures the percent of life-time consumption that agents in economy A are prepared to give up to get the policy change. Following Flodén (2001), it can be shown that in the case of a CRRA utility with risk-aversion parameter σ, we have:

$$\omega_V = \left(\frac{V^B}{V^A}\right)^{\frac{1}{1-\sigma}} - 1$$

where the life-time utility over all households in the economy i, V^i, is defined as:

$$V^i = \int_{\mathbf{x}} E_0 \sum_{t=0}^{\infty} u(c_t^i, s_{w,t}^i, s_{e,t}^i) d\Gamma^i(\mathbf{x})$$

Along the transition, we proceed in a similar fashion. The economy A is defined as the economy in period t whereas the economy B is the next period economy in period $t+1$. This allows us to assess the effect of the policy experiments along the transitional path. It measures the constant increment in percentage of consumption in every state that has to be given to each agent so that he is indifferent between remaining in the benchmark economy and moving to another economy that makes a transition to a new steady state implied by the alternative tax system.

G Transitions between occupations

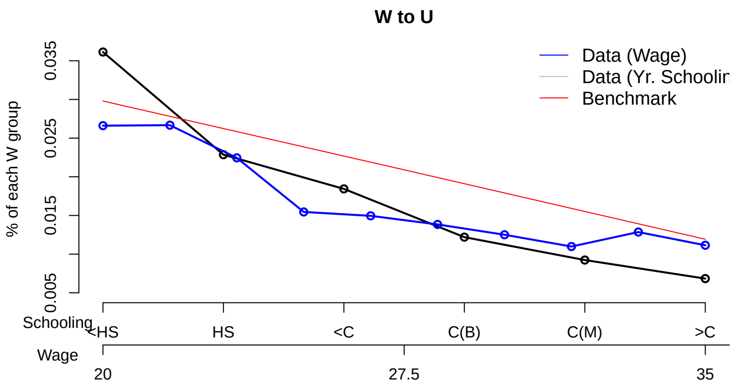

Figure 12. Transition from paid-employment to unemployment by educational attainment and wage level. *Source:* authors' calculation from CPS 2001 - 2008.

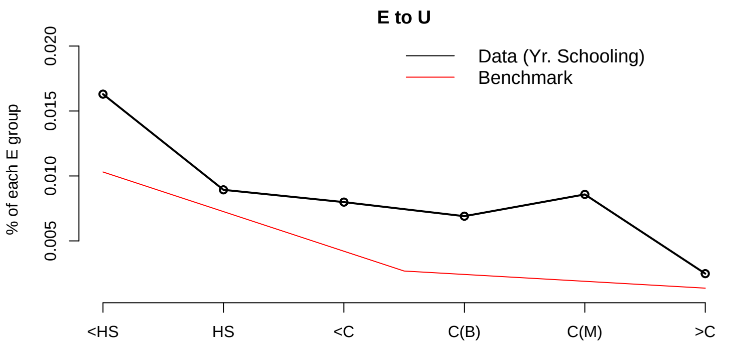

Figure 13. Transition from entrepreneurship to unemployment by productivity level (data: educational attainment, model: θ). *Source:* authors' calculation from CPS 2001 - 2008.

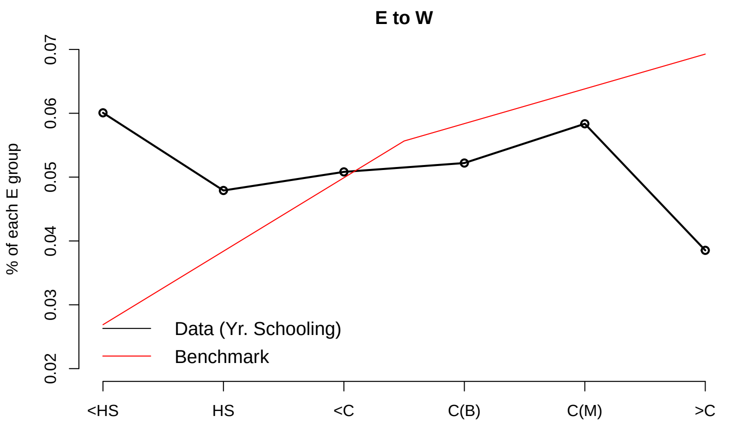

Figure 14. Transition from entrepreneurship to paid-employment by productivity level (data: educational attainment, model: θ). *Source:* authors' calculation from CPS 2001 - 2008.

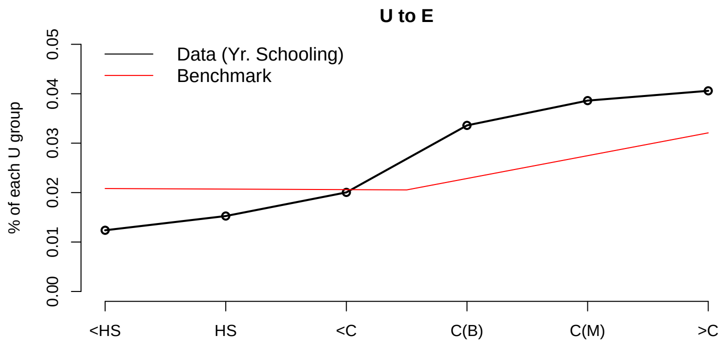

Figure 15. Transition from unemployment to entrepreneurship by productivity level (data: educational attainment, model: θ). *Source:* authors' calculation from CPS 2001 - 2008.

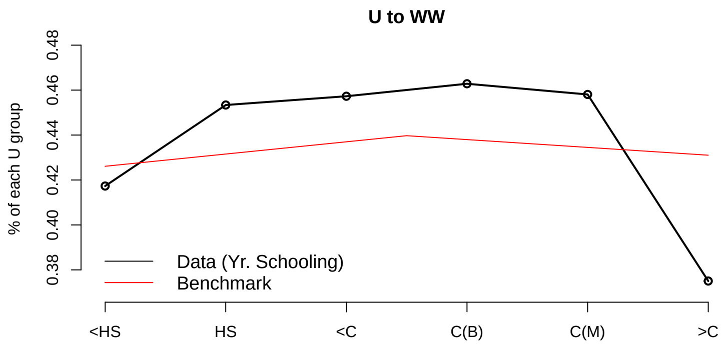

Figure 16. Transition from unemployment to paid-employment by productivity level (data: educational attainment, model: θ). *Source:* authors' calculation from CPS 2001 - 2008.

H Detailed model characterization

In this section, we provide all the details of the value functions. For convenience, we note W the value function associated with a worker, U with an unemployed individual and E an entrepreneur. For convenience, we characterise here the credit status with the superscript e and the insurance status with the subscript j, except for a worker who is by definition always insured. The future values of those value functions are respectively noted:

$$W^{e\prime} = W(a', \theta', y', e'), \qquad U_j^{e\prime} = U(a', \theta', e', j), \qquad E_j^{e\prime} = E(a', \theta', z', e', j)$$

As under the reduced model, the continuation value $\mathcal{E}_j^{e\prime}$ defines the future value of a new entrepreneur starting a business with insurance status j with credit status e.

Workers Following the notations of the paper, we can write the value function of a worker in details as follows:

$$\begin{aligned} W(a,\theta,y,e) = \max_{c,a',s_e} u(c,0,s_e) + \beta \sum_{\theta'\in\Theta}\sum_{y'\in\mathcal{Y}} \pi(y'|y)\pi(\theta'|\theta) \\ \Big\{(\mathbb{1}_{e=A}+\phi\mathbb{1}_{e=C})\Big[(1-\eta)\Big(\pi_e \max\{W^{A\prime},\mathcal{E}_n^{A\prime}\}+(1-\pi_e)W^{A\prime}\Big) \\ +\eta\Big(\pi_e\max\{U_i^{A\prime},\mathcal{E}_i^{A\prime}\}+(1-\pi_e)U_i^{A\prime}\Big)\Big] \\ +(1-\phi)\mathbb{1}_{e=C}\Big[(1-\eta)\Big(\pi_e\max\{W^{C\prime},\mathcal{E}_n^{C\prime}\}+(1-\pi_e)W^{C\prime}\Big) \\ +\eta\Big(\pi_e\max\{U_i^{C\prime},\mathcal{E}_i^{C\prime}\}+(1-\pi_e)U_i^{C\prime}\Big)\Big]\Big\} \end{aligned}$$

s.t. (2), (3), (4)

Notice that when $e = A$, then $\pi_c(e' = A|e = A) = 1$. Hence a worker with access to credit market remains non excluded next period. In the other case, if $e = C$, then $\pi_c(e' = A|e = C) = \phi$. The reduced model combines those probability in the expectation operator.

Unemployed individual Following the notations of the paper, we can write the value function of an unemployed individual in details as follows:

$$\begin{aligned} U(a,\theta,e,j) = \max_{c,a',s_w,s_e} u(c,s_w,s_e) + \beta\sum_{\theta'\in\Theta}\sum_{y'\in\mathcal{Y}} \Pi_y(y')\pi(\theta'|\theta) \\ \Big\{(\mathbb{1}_{e=A}+\phi\mathbb{1}_{e=C})\Big[\pi_w\Big((1-\pi_e)W^{A\prime}+\pi_e\mathcal{U}_j^A(W,E)\Big) \\ +(1-\pi_w)\Big(\pi_e\mathcal{U}_j^A(U,E)+(1-\pi_e)\mathcal{U}_j^A(U)\Big)\Big] \\ +(1-\phi)\mathbb{1}_{e=C}\Big[\pi_w\Big((1-\pi_e)W^{C\prime}+\pi_e\mathcal{U}_j^C(W,E)\Big) \\ +(1-\pi_w)\Big(\pi_e\mathcal{U}_j^C(U,E)+(1-\pi_e)\mathcal{U}_j^C(U)\Big)\Big]\Big\} \end{aligned}$$

s.t.

$$\mathcal{U}_j^{e\prime}(W,E) = \mathbb{1}_{\{j=i\}}\Big((1-\rho)\max\{W^{e\prime},\mathcal{E}_i^{e\prime}\}+\rho\max\{W^{e\prime},\mathcal{E}_n^{e\prime}\}\Big)+\mathbb{1}_{\{j=n\}}\max\{W^{e\prime},\mathcal{E}_n^{e\prime}\}$$

$$\mathcal{U}_j^{e\prime}(U,E) = \mathbb{1}_{\{j=i\}}\Big((1-\rho)\max\{U_i^{e\prime},\mathcal{E}_i^{e\prime}\}+\rho\max\{U_n^{e\prime},\mathcal{E}_n^{e\prime}\}\Big)+\mathbb{1}_{\{j=n\}}\max\{U_n^{e\prime},\mathcal{E}_n^{e\prime}\}$$

$$\mathcal{U}_j^{e\prime}(U) = \mathbb{1}_{\{j=i\}}\Big((1-\rho)U_i^{e\prime}+\rho U_n^{e\prime}\Big)+\mathbb{1}_{\{j=i\}}U_n^{e\prime}$$

(3), (4), (6), (7)

With ρ the probability that an unemployed individual loses his UI rights next period. The probability of getting the transitory shock y' is given by the invariant probability distribution Π_y and the shock is known before the decision to take the job.

Non excluded entrepreneur - repayment case

$$R(a,k,\theta,z,j) = \max_{c,a',s_w} u(c,s_w,0) + \beta \sum_{\theta'\in\Theta}\sum_{y'\in\mathcal{Y}} \Pi_y(y')\pi(\theta'|\theta)$$
$$\Big\{(\mathbb{1}_{\{j=i\}}q + \mathbb{1}_{\{j=n\}})\Big(\pi_w \max\{W^{A\prime}, E_n^{A\prime}\} + (1-\pi_w)\max\{U_n^{A\prime}, E_n^{A\prime}\}\Big)$$
$$+ \mathbb{1}_{\{j=i\}}(1-q)\Big(\pi_w \max\{W^{A\prime}, E_i^{A\prime}\} + (1-\pi_w)\max\{U_i^{A\prime}, E_i^{A\prime}\}\Big)\Big\}$$

s.t. (3), (7), (11), (12)

Such entrepreneur keeps access to the credit market next period.

Non excluded entrepreneur - bankruptcy case

$$B(a,k,\theta,z,j) = \max_{c,a',s_w} u(c,s_w,0) + \beta \sum_{\theta'\in\Theta}\sum_{y'\in\mathcal{Y}} \Pi_y(y')\pi(\theta'|\theta)$$
$$\Big\{\pi_w W^{C\prime} + (1-\pi_w)\big((\mathbb{1}_{\{j=i\}}q + \mathbb{1}_{\{j=n\}})U_n^{C\prime} + \mathbb{1}_{\{j=i\}}(1-q)U_i^{C\prime}\big)\Big\}$$

s.t. (3), (7), (24), (25)

Such entrepreneur is excluded from the credit market next period.

Excluded entrepreneur

$$\hat{E}(a,k,\theta,z,j) = \max_{c,a',s_w} u(c,s_w,0) + \beta \sum_{\theta'\in\Theta}\sum_{y'\in\mathcal{Y}} \Pi_y(y')\pi(\theta'|\theta)$$
$$\Big\{(\mathbb{1}_{\{j=i\}}q + \mathbb{1}_{\{j=n\}})\Big((1-\phi)\Big[\pi_w \max\{W^{C\prime}, E_n^{C\prime}\} + (1-\pi_w)\max\{U_n^{C\prime}, E_n^{C\prime}\}\Big]$$
$$+ \phi\Big[\pi_w \max\{W^{A\prime}, E_n^{A\prime}\} + (1-\pi_w)\max\{U_n^{A\prime}, E_n^{A\prime}\}\Big]\Big)$$
$$+ \mathbb{1}_{j=i}(1-q)\Big((1-\phi)\Big[\pi_w \max\{W^{C\prime}, E_i^{C\prime}\} + (1-\pi_w)\max\{U_i^{C\prime}, E_i^{C\prime}\}\Big]$$
$$+ \phi\Big[\pi_w \max\{W^{A\prime}, E_i^{A\prime}\} + (1-\pi_w)\max\{U_i^{A\prime}, E_i^{A\prime}\}\Big]\Big)\Big\}$$

Subject to: (3), (7), (?), (?)

The probability to be forgotten from the credit market is given by the probability ϕ.

I Optimal search efforts

We describe here the solution algorithm for computing ex-ante all the optimal search efforts. Given a set of parameter $(\kappa_w, \kappa_e, \psi_e, \psi_w)$, the solutions s_w and s_e for each occupation is computed only once.

Worker and entrepreneur search efforts The solution for the optimal search efforts of a worker and an entrepreneur (who either repay or bankrupt) is straightforward and are given respectively by the three first order conditions:

$$\frac{\partial W(a,\theta,y,e)}{\partial s_e} = 0$$
$$-\psi_w(s_w)^{\psi_w} + \beta\pi'_w(s_w)\underbrace{\Big[\eta\max\{0,\mathcal{E}'_i - U'_i\} + (1-\eta)\max\{0,\mathcal{E}'_n - W'\}\Big]}_{\Delta V>0} = 0$$

$$\frac{\partial R(a,k,\theta,z,j)}{\partial s_w} = 0$$
$$-\psi_e(s_e)^{\psi_e} + \beta\pi'_e(s_e)\underbrace{\Big[\max\{W',E'_{j'}\} - \max\{U'_{j'},E'_{j'}\}\Big]}_{\Delta V>0} = 0$$

To solve *ex-ante* these two search efforts, we set up a very large grid that we call **diffval** ($\mathcal{G}_{\mathbf{\Delta V}} = [0, dmax]$), which summarizes the option values (ΔV) of interest, that are needed to compute either s_w or s_e, as shown above. Given this grid, we solve for the optimal search efforts. We end up with grid $\mathcal{G}_{\mathbf{w}}$ and $\mathcal{G}_{\mathbf{e}}$ over optimal search efforts corresponding to values in the grid $\mathcal{G}_{\mathbf{\Delta V}}$. When solving for the household problem, we therefore compute ΔV and we find, using linear interpolation, the corresponding optimal search efforts $s_w(\Delta V)$ and $s_e(\Delta V)$.

Unemployed individuals an individual who is currently unemployed can search at the same time a business idea and a job. A convenient way to rewrite the value function in order to solve ex-ante the optimal search effort is to use option values as follows:

$$\begin{aligned} U(a,\theta,e,j) = \max_{c,a',s_w,s_e} & u(c,s_w,s_e) \\ & + \beta\mathbb{E}_{\theta',y',j',e'}\Big\{U'_{j'} + \pi_w(W' - U'_{j'}) + \pi_w\pi_e\max\{0,\mathcal{E}'_{j'} - W'\} \\ & + (1-\pi_w)\pi_e\max\{0,\mathcal{E}'_{j'} - U'_{j'}\}\Big\} \end{aligned}$$

The optimal job search effort is given by:

$$\frac{\partial U(a,\theta,e,j)}{\partial s_w} = 0$$
$$u_{s_w} + \beta\Big[\pi'_w(W' - U'_{j'}) + \pi'_w\pi_e\max\{0,\mathcal{E}'_{j'} - W'\} - \pi'_w\pi_e\max\{0,\mathcal{E}'_{j'} - U'_{j'}\}\Big] = 0$$

There are three cases:

$$\text{if } (\mathcal{E}'_{j'} - U'_j) > (W' - U'_j) \geq 0, \qquad u_{s_w} + \beta\Big[\pi'_w(1-\pi_e)(W' - U'_j)\Big] = 0 \tag{30}$$

$$\text{if } (W' - U'_j) > (\mathcal{E}'_{j'} - U'_j) \geq 0, \qquad u_{s_w} + \beta\Big[\pi'_w(W' - U'_j) - \pi'_w\pi_e(\mathcal{E}'_{j'} - U'_{j'})\Big] = 0 \tag{31}$$

$$\text{if } (\mathcal{E}'_{j'} - U'_j) < 0, \qquad u_{s_w} + \beta\pi'_w(W' - U'_j) = 0 \tag{32}$$

This means that for a given s_e, one can compute the optimal s_w on a grid defining $(W' - U'_j)$ and $(\mathcal{E}'_{j'} - U'_{j'})$. Similarly, the optimal business idea search effort, we have the following first order condition:

$$\frac{\partial U(a,\theta,e,j)}{\partial s_e} = 0$$
$$u_{s_e} + \beta\Big[\pi_w\pi'_e \max\{0,\mathcal{E}'_{j'} - W'\} + (1-\pi_w)\pi'_e \max\{0,\mathcal{E}'_{j'} - U'_{j'}\}\Big] = 0$$

with the following cases:

$$\text{if } (\mathcal{E}'_{j'} - U'_j) > (W' - U'_j) \geq 0, \qquad u_{s_e} + \beta\Big[\pi'_e(\mathcal{E}'_{j'} - U'_{j'}) - \pi_w\pi'_e(W' - U'_j)\Big] = 0 \tag{33}$$
$$\text{if } (W' - U'_j) > (\mathcal{E}'_{j'} - U'_j) \geq 0, \qquad u_{s_w} + \beta(1-\pi_w)\pi'_e(\mathcal{E}'_{j'} - U'_{j'}) = 0 \tag{34}$$
$$\text{if } (\mathcal{E}'_{j'} - U'_j) < 0, \qquad s_e = 0 \tag{35}$$

In order to solve for the joint search efforts, we proceed as follows. We set up a grid for the second search effort s^*, the option value $(W' - U'_j) \geq 0$ and the option value $(\mathcal{E}'_{j'} - U'_j)$. In the case where $(\mathcal{E}'_{j'} - U'_j) > (W' - U'_j) \geq 0$, we solve first equation (30) given s^* and $(W' - U'_j)$ and use the solution to interpolate the optimal π_w in (34) to find the corresponding optimal s_e. Given this, we find the optimal π_w by interpolating s_e on the grid of s^*.

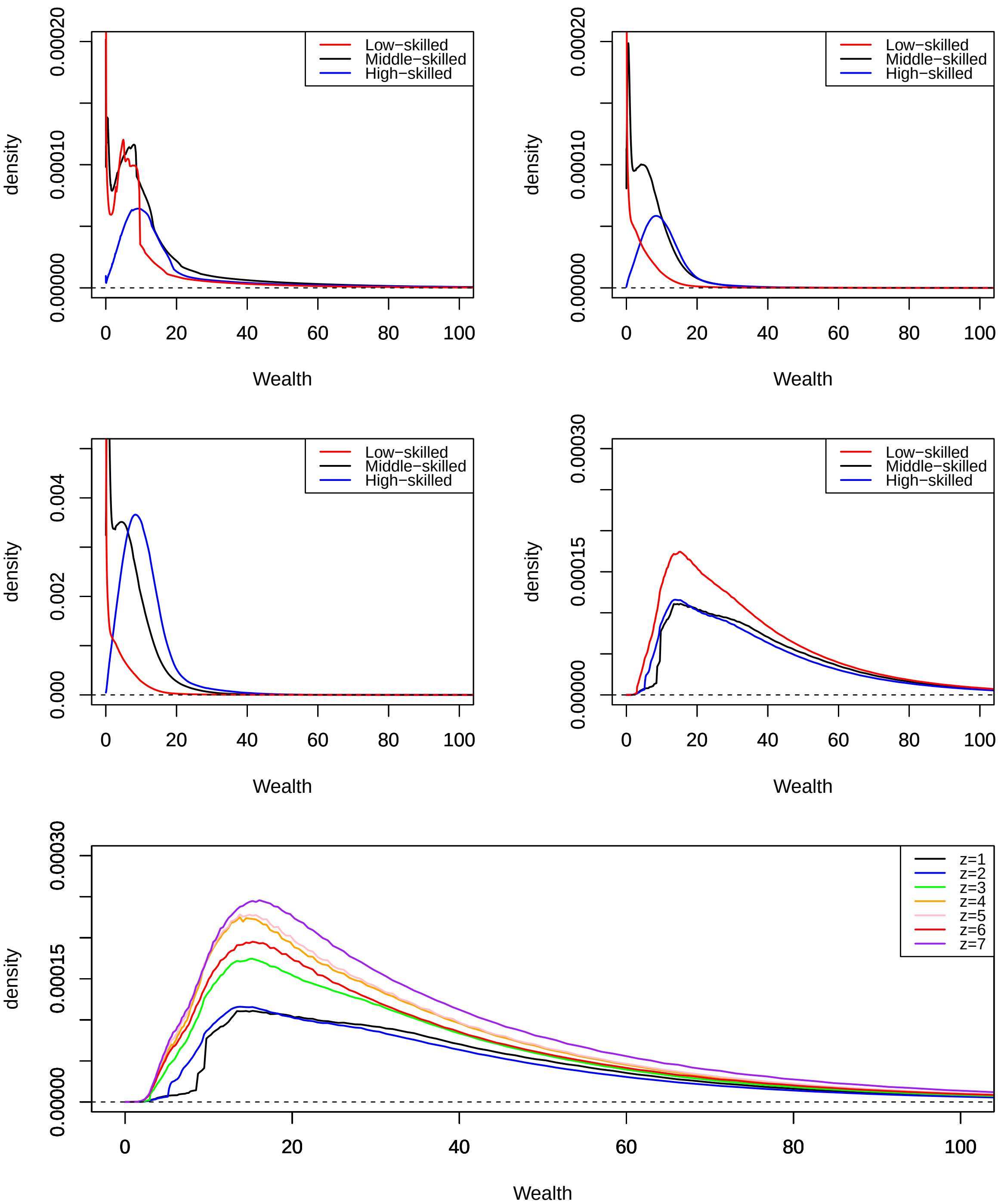

Figure 11. Optimal search efforts s_e and s_w for $\theta = \theta_1$. *Notes:* the figures describe optimal policies for non-excluded case. Top left panel: unemployed agents with UI, top right panel: workers ($y = y_3$), bottom left panel: entrepreneurs ($z_{-1} = z_1$), bottom right panel: unemployed agents with UI.