Endogenous Employment and Incomplete Markets*

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Abstract

This paper explores the role of effort and human capital as mechanisms to alleviate the idiosyncratic risk faced by individuals in the presence of incomplete markets. I construct a DSGE model where effort and human capital determine the probability of being employed the next period. While effort is a flow variable that has to be exerted every period, human capital is a stock variable chosen when the agent is born. I first show how effort and assets are inverse related, and then characterize the investment in education as a function of its cost. In the stationary equilibrium individuals diversify between market and non- market mechanisms to reduce risk. As a result, in the long run, the median individual will hold a negative credit balance, which better approximates the real wealth distribution when compared with previous studies. The results shed light on the potential implication of combining policies of unemployment insurance and subsidies to education to improve the wealth distribution.
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1 Introduction

The unemployment rate for college graduates is lower than for non-college graduates (4.4% versus 9.6% in 2011 according to the Bureau of Labor Statistics), as well as the median duration of spells of unemployment (2.6 months for less than high school graduate, 2.4 for a high school graduate and 1.9 months for individuals with at least some college). It is also true that college education is usually obtained by richer households, which creates a stronger tension towards a more unequal distribution of wealth.

However, recent empirical papers have provided evidence on the negative effect that wealth has on the probability of employment once a set of control variables, including human capital, are used (Algan, Chéron, Hairault, and Langot, 2003; Bloemen, 2002; Bloemen and Stancanelli, 2001; Stancanelli, 1999). On the theoretical side, such association was rationalized by Lentz and Tranæs (2005) in a search model with savings where effort must be exerted over time to increase the chance of being employed.

The above observations suggest a rather complex relationship between assets and the probability of employment, which seems to be negative in the short-run put positive in the long run. The purpose of this paper is to build a model to explore the joint role of effort and human capital investment as non-market mechanisms used by individuals to deal with their idiosyncratic risk. The analysis provides potential welfare implications for combining public policies related to unemployment insurance and subsidies to education to improve the wealth distribution and the long-run unemployment.

I develop a dynamic stochastic general equilibrium with heterogeneous agents that builds on the framework proposed by Huggett (1993) and Aiyagari (1994). Effort and human capital are variables determining the transition dynamics between states, whereas asset holdings are used directly to smooth consumption. Effort is modeled as a flow variable that has to be chosen every period to maintain a positive probability of being employed, thus following the literature on unemployment insurance (see for example

Hopenhayn and Nicolini (1997) and Wang and Williamson (1996)). This can be seen as search effort when the individual is unemployed, or effort in the job when the agent is employed. We assume the level of effort required in the latter case is more effective that the one when the agent is unemployed. This assumption matches with empirical data that has been studied in search models and emphasize the role of the depreciation of human capital during unemployment (Addison and Portugal (1989); Neal (1995)).

On the other hand, human capital is a binary stock variable that can be acquired when the individual is born. It improves the efficiency of effort when looking for a job or maintaining it. Although human capital has been usually studied as a mechanism to increase earnings, previous empirical work has also pointed out the effect of human capital on employment transitions. For example, Card and Sullivan (1988) estimate the effect of training on the probability of employment for the 1976 cohort of adult male participants in the Comprehensive Employment and Training Act (CETA). They found that the effect is positive, even for people who is already employed. Gritz (1993) also found that participation of women in private training programs increases both the frequency and duration of employment spells.

Although there exists some selection on the individuals that attend to college due to differences in abilities for example, I abstract from this issue. I assume agents are homogeneous in this dimension and that human capital does not affect the income when employed. Even with this simplication the model does a good job on replicating the wealth distribution.

As it is usual in this literature, asset holdings are restricted to be greater than a lower bound to prevent situations where individuals get indebted forever. This lower bound is used to model a financial friction usually found in reality, and is calibrated accordingly. An upper bound arises naturally from the optimal decisions and the fact that the interest rate is lower than the rate implied by the intertemporal discount factor. This discourages individuals from accumulate forever their asset holdings.

The role of the asset holdings in our model is similar to the one played in previous literature. When the individual is employed she accumulates assets, while she decreases her holdings when unemployed. Therefore, it keeps track of the employment history the individuals have had. However, assets also have a bequest motive in this model. Individuals die with an exogenous probability and newborns inherit the previous wealth. Given the assumptions, if the cost of attend college is sufficiently large, only sufficiently rich born individuals invest in human capital. This generates pressure towards more inequality.

On the other hand, effort has an inverse relationship with assets. If an individual becomes unemployed and has sufficient savings, she will not exert too much effort to find a job and instead use the savings to smooth consumption. However, the ability of the assets to smooth consumption loses importance when they are close to the debt limit. At that point effort plays a major role by increasing the likelihood of being employed next period.

In the stationary distribution most of the individuals will hold a small negative credit balance, while few of them will have positive savings. This means that most of the individuals combine both channels to smooth consumption rather than relying in one of them. As a consequence, the resulting stationary distribution of wealth is much closer to the real one than the wealth distributions obtained by previous studies. Papers that focus on market mechanisms to alleviate risk usually generate wealth distributions negatively skewed since precautionary savings are the only channel to smooth consumption. On the other hand, empirical papers have shown that only the top deciles have positive savings, while most households hold some degree of debt (Wolff, 2010).

Idiosyncratic shocks and consumption smoothing has been largely studied in the literature. Models of incomplete markets and heterogenous agents have been used to explain the risk premium (Huggett, 1993), the benefits of insurance (Hansen and İmrohoroğlu, 1992), optimal fiscal policy (Heathcote, 2005), and the distribution of income (Aiyagari, 1994; Heckman, Lochner, and Taber, 1998; Krusell and Smith, 1998), among others. The common characteristic of these models is that they use mechanisms affecting the budget constraint to smooth consumption. These mechanisms are usually identified with assets holdings (or credit balances), capital, or savings. However, the labor transitions are always specified exogenously.

Besides the theoretical contribution made by Lentz and Tranæs (2005) on endogenous transitions, other calibrated models of search with savings include Acemoglu and Shimer (2000), Rendon (2006) and Gomes, Greenwood, and Rebelo (2001). However, the inclusion of human capital and the characterization of the wealth distribution are new in our model.

The organization of the paper is as follows. The next section describes the model and the third section defines the equilibrium in this scenario. I then describe the performed numerical exercise, while section 5 devotes attention to its computation. In section 6 we show the results and its implications. The last section concludes.

2 Model

Consider an exchange economy with a continuum of agents with total mass equal to one who face idiosyncratic risk. There are two commodities: one perishable consumption good c and asset holdings a. Each agent receives an stochastic endowment s_t at the beginning of each period. Assume the endowment can take two possible values $s_L < s_H$, which are usually associated with unemployed/employed status, respectively.

Effort $e > 0$ is made in order to increase the probability of having a good endowment (state) next period. The probability of being employed next period also depends on whether the agent has a college degree or not, h_H or h_L, respectively. The probability in period t is defined as $\Pr(s_{t+1} = s_H|s_t, h) = P(e_t; s_t, h)$, which is an increasing concave function of the effort with $P(0; s, h) = 0$ and $\lim_{e\to\infty} P(e; s, h) = 1$. According to the empirical literature, assume that effort to remain employed is more effective than the effort to become employed when previously unemployed, and effort is also more effective when the individual has a college degree. Formally, $P(e_t; s_H, h) > P(e_t; s_L, h)$ for all h, $P(e_t; s, h_H) > P(e_t; s, h_L)$ for all s. Finally let the probability be supermodular in e, s, and h.

Individuals discount future at rate β and survive next period with probability δ. When an individual dies it is replaced by an unemployed newborn. The newly born agent inherits previous wealth and decides whether to obtain a college degree or not at a cost ϕ. Agents are altruistic and maximize lifetime utility of the household. Each individual derives instantaneous utility from consumption and effort according to an additive separable utility function $u(c) - e$ that is strictly concave and satisfies Inada conditions. Separability can be obtained assuming the existence of lotteries and simplifies the analysis importantly (Lentz and Tranæs, 2005). The fact that the disutility of effort is linear is just an innocuous normalization.

Each agent is able to smooth her consumption by holding a single riskless asset. This asset entitles the individual to receive one unit of future consumption for each unit of asset whose price is $q > 0$. The amount of claims held must remain above the limit $a_{\min}$, a restriction that represent the financial friction faced by individual in addition to the incompleteness of the markets. Therefore, the budget constraint faced by an individual who holds a claims, has a current endowment s, and chooses consumption c and future claims a', is given by

$$c + qa' \leq s + a \tag{1}$$

The agent's problem can be represented in recursive formulation as

$$\begin{aligned} v\left(a, s, h; q\right) = \max_{c,e,a'} \{ u\left(c\right) - e + \beta\delta \left[P\left(e; s, h\right) v\left(a', s_H, h; q\right) \right. \\ \left. + \left(1 - P\left(e; s, h\right)\right) v\left(a', s_L, h; q\right) \right] + \beta\left(1 - \delta\right) v_0\left(a'; q\right) \} \end{aligned} \tag{2}$$

subject to (1), $c \geq 0$, $e \geq 0$, and $a' \geq a_{\min}$; and where

$$v_0(a';q) = \max\{v(a', s_L, h_L; q); v(a'-\phi, s_L, h_H; q)\}$$

This problem is well defined since $v(a,s,h;q)$ will inherit the concavity properties of $u(\cdot)$, while also satisfying discounting and monotonicity (see Stokey, Lucas, and Prescott (1989)). On the other hand, the functional v_0 can be replaced without loss of generalization by its least concave function. Therefore, the first order conditions are necessary and sufficient, and the optimal decision rules $c(a,s,h;q)$, $e(a,s,h;q)$, and $a'(a,s,h;q)$ are given by

$$\begin{aligned}
1 &\geq \beta P_e(e;s,h)\left[v(a', s_H, h; q) - v(a', s_L, h; q)\right], \\
\text{with equality if } e &> 0 \\
u_c(c)\,q &\geq \beta\delta\mathbb{E}\left[u_c(c')\,|e,s,h\right] + \beta(1-\delta)\frac{\partial v_0(a';q)}{\partial a'}, \\
\text{with equality if } a' &> a_{\min} \\
c + qa' &\leq s + a
\end{aligned}$$

The first condition shows the tradeoff between the marginal disutility and the expected marginal benefits of exerting an effort. This condition is similar to the one obtained in the optimal unemployment insurance literature. Using the separability of the utility function we can prove the following lemma:

Lemma 1 *Effort is a decreasing function of assets*

The intuition behind this result relies on the fact that the difference on the value function for employed and unemployed people is decreasing in assets, formally $v(a', s_H, h; q) - v(a', s_L, h; q)$ is decreasing in a by supermodularity. In other words, it is less important for rich households whether they are employed or unemployed since they can use their assets to smooth consumption. Therefore the role of effort becomes less important. On the other hand, poor households cannot incur in more debt when they are close to the debt limit. Hence their current state generates great differences in their maximized utility so effort becomes crucial in increasing the probability of being employed.

The difference $v(a', s, h_H; q) - v(a', s, h_L; q)$ is also decreasing in assets by a similar reason. Using this fact and the concavity of the value function on a, we can obtain the following lemma:

Lemma 2 *Let* $A(\phi) = \{a > a_{\min} + \phi : v(a', s_L, h_L; q) < v(a' - \phi, s_L, h_H; q)\}$ *be the set of assets holdings such that a newborn with inherited wealth* $a \in A(\phi)$ *will prefer to acquire a college degree. Then there exists* ϕ_1 *and* ϕ_2 *such that:*

- *For any* $\phi < \phi_1 < \phi_2$*, there exists* $a_1(\phi)$ *such that* $A(\phi) = (a_{\min} + \phi, a_1(\phi)]$*, where* $a_1(\phi)$ *is increasing in* ϕ*;*
- *For any* $\phi > \phi_2 > \phi_1$*, , there exists* $a_2(\phi)$ *such that* $A(\phi) = [a_2(\phi), \infty)$*, where* $a_2(\phi)$ *is increasing in* ϕ
- *And if* $\phi_2 < \phi < \phi_1$*, then* $A(\phi) = [a_2(\phi), a_1(\phi)]$*.*

The lemma states that if the cost of education is sufficiently low, only poor individuals that can afford it will attend college. The reason behind the result is that, when the cost is low, individuals that decide not to acquire education have a greater marginal value for the assets than households that decide to invest. Then if some individual was indifferent between going to college or not, a richer one will definitely prefer to avoid the investment. However, if the cost of college is large the inequality reverses because of the concavity of the value function. Thus the marginal value for individuals that decide to attend college becomes greater and only rich enough individuals will attend college.

The second first order condition is very familiar to the literature that uses asset markets. The limiting behavior of consumption can be characterized by applying the theory of martingales. Let $Z_t = \left(\frac{\beta\delta}{q}\right)^t u_c(c_t) \geq 0$. Therefore,

$E_t\left[Z_{t+1} - Z_t|I_t\right] = \left(\frac{\beta\delta}{q}\right)^t E_t\left[\frac{\beta\delta}{q} u_c\left(c_{t+1}\right) - u_c\left(c_t\right)|I_t\right] < 0$, where I_t is the information set at time t, including e_t. The previous expectation implies that Z_t is a supermartingale. Since Z_t is nonnegative, we can apply the supermartingale convergence theorem. This theorem states that Z_t must converge almost surely to a nonnegative random variable (Williams, 1991); which leads to the following lemma:

Lemma 3 *In equilibrium* $\beta\delta < q$

If $\beta\delta > q$ then Z_t must converge to zero to avoid its divergence. But then this implies that c_t must diverge to infinity. This is obtained by letting the asset holdings go to infinity since the incentives to save are greater than the ones to get more debt. This explosive solution can not be an equilibrium. A similar behavior is obtained if $\beta\delta = q$, see Chamberlain and Wilson (2000) for an exposition.

On the other hand, if $\beta\delta < q$, then Z_t will converge to a nondegenerate nonnegative random variable. This implies that consumption and asset holdings will remain finite, a necessary condition to achieve an equilibrium. In fact, there will be an endogenous upper bound such that no agent would like to save more than such bound (see Ljungqvist and Sargent (2004)). The first order condition also implies that agents will save when facing a good shock and spend savings when facing an adverse shock.

It is important to note that optimal decision rules will depend on their state vector (a, s, h) and on the price of claims q. This price will be determined in equilibrium according to a market clearing condition for the asset holdings. The existence of such equilibrium is easy to obtain given the standard properties of the model; however, the equilibrium will not be unique. Since we are interested in the long run interaction in this economy, we focus only on the stationary equilibrium that we describe in the next section.

3 Stationary Equilibrium

The equilibrium in an exchange economy is usually defined as policy rules and prices that clear the markets given some aggregate states. However, the market clearing condition is always changing in this dynamic economy given that the distribution of individuals is always moving. Therefore, a definition of a stationary equilibrium is more appropriate in this context. In this definition we focus on market clearing when the distribution of wealth λ is invariant and plays the role of the aggregate variable that depends on the price q.

The law of motion of this state vector distribution is described by

$$\begin{aligned}
\lambda_{t+1}\left(a', s', h_H; q\right) &= \Pr\left(a_{t+1} = a', s_{t+1} = s', h_{t+1} = h_H\right) \\
&= \delta \int_{\{a:a'(a,s,h_H;q)\}} \sum_{i=L,H} \lambda_t\left(a, s_i, h_H; q\right) \cdot P\left(e_t; s_t, h_H\right) da_t \\
&\quad + (1-\delta) \int_{a\in A} \sum_{i=L,H} \sum_{j=L,H} \lambda_t\left(a, s_i, h_j; q\right) da
\end{aligned}$$

and

$$\begin{aligned}
\lambda_{t+1}\left(a', s', h_L; q\right) &= \Pr\left(a_{t+1} = a', s_{t+1} = s', h_{t+1} = h_L\right) \\
&= \delta \int_{\{a:a'(a,s,h_L;q)\}} \sum_{i=L,H} \lambda_t\left(a, s_i, h_L; q\right) \cdot P\left(e_t; s_t, h_L\right) da_t \\
&\quad + (1-\delta) \int_{a\in A^c} \sum_{i=L,H} \sum_{j=L,H} \lambda_t\left(a, s_i, h_j; q\right) da
\end{aligned}$$

A stationary distribution is thus defined as a distribution $\lambda\left(a, s, h; q\right)$ such that $T\lambda\left(a, s, h; q\right) = \lambda\left(a, s, h; q\right)$. The existence and uniqueness of the invariant distribution is established using the approach suggested by Hopenhayn and Prescott (1992). Therefore, starting from any initial distribution, a sufficient number of iterations will converge to the invariant one. Moreover, since $a'(a, s, h; q)$ is bounded, the sequence of averaged assets will also converge.

Definition 4 *A stationary equilibrium is defined by policy rules* $c(a, s, h; q)$, $e(a, s, h; q)$, *and* $a'(a, s, h; q)$; *a value function* $v(a, s, h; q)$; *a price* q; *and a stationary distribution* $\lambda(a, s, h; q)$, *such that*

- *The policy and value functions solve the agent's problem (2)*
- *Markets clear:* $\int_a \sum_{i=1,2} \sum_{j=1,2} a'(a, s_i, h_j; q)\, \lambda(a, s_i, h_j; q)\, da = 0$
- *The stationary distribution* $\lambda(a, s, h; q)$ *is induced by the policy functions and the endogenous Markov chains generated by* $P(e(a, s, h; q); s, h)$.

The first condition states the optimality of the decisions. The second one defines market clearing for assets, which means that the average holdings in the population must be zero. By Walras Law, if the market of loans is cleared, then the market of the consumption good is also cleared by making average consumption equal to the average endowment. The third condition requires that the distribution of assets remains the same over time. For that we need them to remain finite, this is assured by the lower bound and the fact that $\beta\delta < q$. It also plays an important role that $P(e; s_H, h) > P(e; s_L, h)$.

4 Numerical Exercise

We calibrate the model according to the previous literature on heterogenous agents, mainly Huggett (1993), and unemployment insurance (Hopenhayn and Nicolini, 1997). We first assume the utility function takes the form

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

This is the standard utility function used in this type of problems. According to Mehra and Prescott (1985), estimates of the risk aversion coefficient σ are around 1.5. The rest of the parameters are calculated according to periods of 8.5 weeks approximately, that is 6 periods per year. Huggett (1993) chose this length to match the average duration of unemployment spells of 17 weeks (Bureau of Labor Statistics), which is a underestimation of the current average duration of 21.6, but it fits the 5 year trend. For this the endowments were calibrated to $s_H = 1$ and $s_L = 0.1$, where the last number assumes that individual has access to social programs when he is unemployed. Finally $\beta = 0.99322$ to match an annual discount rate of 0.96, and$\delta = 0.995$ to match the average death rate.

Hugget also specified an exogenous Markov process where $\Pr(s_{t+1} = s_H | s_t = s_H) = 0.925$ and $\Pr(s_{t+1} = s_H | s_t = s_L) = 0.5$. This calibration replicates a coefficient of variation for the annual earnings of 20%, which is close enough to the actual data. It also generates an annual average endowment of 5.3; therefore, we set $a_{\min} = -5$ to simulate the financial friction. This bound generates in equilibrium an annual interest rate between 2.3% and 3.4% in Huggett's calculations and is close to the natural borrowing limit of $-\frac{s_L}{r}$ described by Aiyagari (1994).

In order to obtain similar quantitative results, we calibrate our endogenous Markov chain to find similar probabilities. We model the probability of having a high state tomorrow as a cdf of an exponential distribution with parameter $\mu(s_i, h_j) = s_i h_j$, that is $P(e; s_i, h_j) = 1 - \exp^{-s_i h_j e}$, where $h_L = 13$ and $h_H = 16$. This parameterization satisfies our initial assumptions of first order stochastic dominance and the ones described by Hopenhayn and Nicolini (1997) to characterize the optimal unemployment insurance. Moreover, as shown in the next section, the optimal probabilities in equilibrium will wander around Huggett's calibration. Finally, the cost of education is set to $\phi = 4$ to match the average cost of public college relative to average income (see the 2011 report from the College Board). Note this number allows individuals with some degree of debt to invest in education.

5 Computation

To find the optimal policy rules we first set a candidate for q, say q_1, belonging to a plausible interval of equilibrium prices. We then use value function iteration to obtain the optimal policy rules. Since all the desired properties of the value function are satisfied, convergence is achieved independently of the initial guess for the value function. To compute the solution we discretize the choice of a, obtain e from its first order condition and consumption from the budget constraint. The grid must be fine enough to achieve smooth policy functions.

As pointed out before, there exists a natural upper bound for a. Optimal future assets for an employed agent start above the 45^0 line (when current assets are negative), and then crosses this line for some positive level of current holdings, say $a_{\max}$. On the other hand, an unemployed agent will always reduce her holdings to maintain her consumption. See Fig. 2 in the appendix for an example of an optimal policy rule for asset holdings.

This shape of the optimal policy implies that $a_{\max}$ plays the role of a fixed point when an agent is always employed. Moreover, it also plays the role of an upper bound since once the agent receives a bad shock she will decrease her assets. Hence, an agent with any initial wealth will converge to the interval $[a_{\min}, a_{\max}]$, and remain there forever. This upper bound can only be computed by experimentation and thus the upper bound of the grid is set large enough to include the fixed point.

After obtaining the optimal decision rules we compute the stationary distribution. To obtain it we simulate an economy of 100000 agents and iterate for 200 periods.[1] The initial distribution of states and assets will not matter for the convergence. We first fix a set of two i.i.d shocks $\epsilon_{i,t}$ and $z_{i,t}$ with a uniform distribution between 0 and 1 for each individual and each period. We then interpolate the optimal decision using the optimal policy rules and the current asset holdings and state. If $z_{i,t} > \delta$ the individual

[1] We also chose a longer horizon without obtaining significant differences.

dies and a newborn must decide whether to acquire the college degree or not according to the inherited wealth. If this is not the case then I proceed to compare the first i.i.d shock with the probability associated with the optimal effort and the current state. If $P\left(e\left(a_{i,t}, s_{i,t}, h; q\right); s_{i,t}, h\right) \leq \epsilon_{i,t}$ then $s_{i,t+1} = s_L$, otherwise the agent will be employed.

After the stationary distribution is computed we calculate the excess demand for assets given the initial price q_1. Then we follow Huggett's process of bisection: if the excess demand is positive we increase the price q, if it is negative we decrease it. This algorithm follows the conjecture that the excess demand of assets is negatively correlated with its price. Although this is hard to prove in general, this is the case in the interval we examined, and it has been also true in related papers that follow the same methodology (see for example Huggett (1993) and Aiyagari (1994)). The process continues until excess demand is approximately 0 and the difference of the updated price is less than 0.001.

6 Results

Fig. 1 shows the concavity of the value function that permits the contraction to find the fixed point. It also shows how utilities diverge when asset holdings are close to the lower limit, a result that is intuitive after examining the policy rules. The optimal asset policy is shown in Fig. 2 and it follows the behavior described in the previous section. It shows how individuals with low states will decrease their holdings until the lower limit, while individuals with good shocks accumulate holdings until they reach the upper bound. This is a characteristic of the models in this branch of the literature.

In our model we also explore a different non-monetary mechanism used by individuals to alleviate risk. Individuals use effort to increase their probability of being employed next period, especially when their level of assets is approaching its lower limit. The optimal probability of employment conditional on human capital is decreasing on the asset holdings and is lower for unemployed individuals since by assumption is harder to change their status.

These probabilities are shown in Fig. 3 and wander around the probabilities calibrated by Huggett (1993), providing a good approximation of the steady state. They also show how the individual increases them when asset holdings are close to the lower bound.

As a consequence of this optimal strategy for risk bearing, consumption has very little variation across different types of individuals, except for unemployed agents whose asset holdings are close to the lower limit. Fig. 4 depicts the optimal consumption. Fig. 5 shows the excess demand of holdings, which depends negatively on the price. The price of assets that clears the market is 0.9933, which is equivalent to an annual interest rate of 4.1%. This rate is higher than the one obtained by Huggett (1993) since individuals have more incentive to acquire debt instead of save.

The obtained percentage of individuals with a college degree is 30.6% which is close enough to the real one (29%). The simulated rate of unemployment is 5.5%, consistent with unemployment rates for developed economies.[2] The model generates an unemployment rate of 4.6% and 6% for college and non-graduates, respectively. The generated gap between these two rates is not enough, since these numbers are currently 4.9% and 9.5% for the US. The model is also robust to small perturbations in the parameters. In an alternative scenario where $h_L = 16$ and $h_H = 20$, the rate of unemployment decreases to 5%, which is decomposed on 4.5% and 5.7% for college graduates and non-graduates, respectively.

The distribution of wealth in the stationary distribution differs from the one found by Huggett (1993) and the one potentially generated by the class of models where consumption can only be smoothed through market mechanisms. These models generate distributions skewed to the left since they must accumulate precautionary savings to deal with their idiosyncratic shocks. In contrast, when the transitions are endogenous, individuals will diversify be-

[2]Current unemployment for US is 7.6%, which is higher than the trend observed in previous years.

tween the market and the non-market mechanisms.

Fig. 6 shows how the wealth distribution in our model is skewed to the right, approximating better the real wealth distribution (Wolff, 2010). This suggests that in the long run individuals are not afraid of becoming indebted since they have an extra mechanism to smooth consumption. At the end, the incomplete markets partial insurance is successfully complemented by the effort. This result is a consequence of the convexity properties of the sets. In our model it can be traced to the concavity of the probability transition to the employed state, as well as the concavity of the utility function.

Fig. 7 shows the disaggregation of the wealth distribution for college graduates and non-graduates. It is found that distribution for the former is more dispersed and less skewed. Thus having college education seems to increase the expected wealth but creates more uncertainty at the same time.

7 Concluding remarks

I have studied a model of heterogenous agents who face idiosyncratic risk and smooth their consumption using a riskless assets and non-market mechanisms. Effort is a flow variable that must be exerted every period to obtain or maintan a job, whereas human capital increases the efficiency of effort in obtaining a job and persists until the individual dies. We found that effort and assets have an inverse relationship and it is shown how the investment in a college degree depends on its cost. If the cost is sufficiently high, as it appears to be according to the calibration, then only rich-born agents acquire education.

In the stationary equilibrium agents diversify among these mechanisms and as a result I obtain a distribution of wealth that is not as skewed as the one generated by previous models. In particular, the median individual holds a small negative credit balance and exert a medium amount of effort. This result contrasts with the ones previously obtained where the median individual holds a positive credit balance. Therefore, our framework replicates much better the real distribution of wealth.

The analysis also shows how the distribution of wealth for college graduates is more dispersed and less skewed than the distribution for non-graduates. The model could be used as a benchmark to evaluate the combination of unemployment insurance policies with subsidies for education to improve the wealth distribution. It first suggests how asset holdings could be used as a proxy to unobservable effort, and how education can be used as long-run insurance.

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A Figures

Figure 1: **Value function**

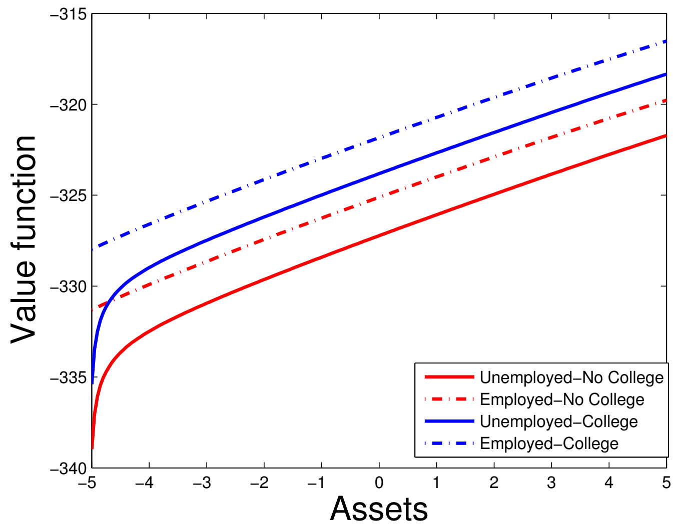

Figure 2: **Optimal policy rule for assets**

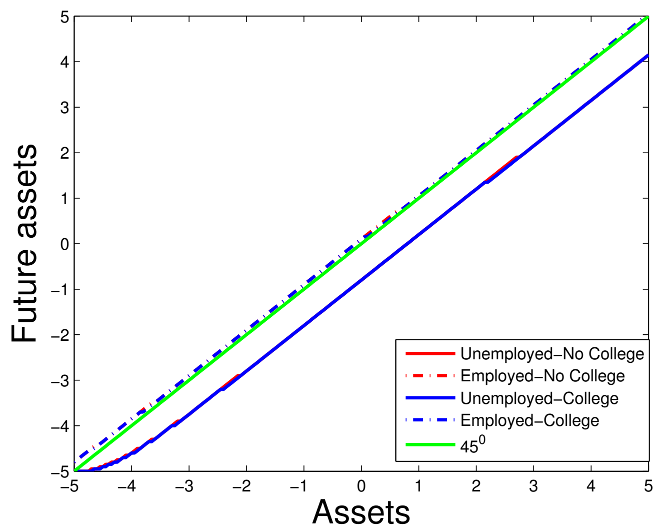

Figure 3: **Probabilities associated with optimal effort**

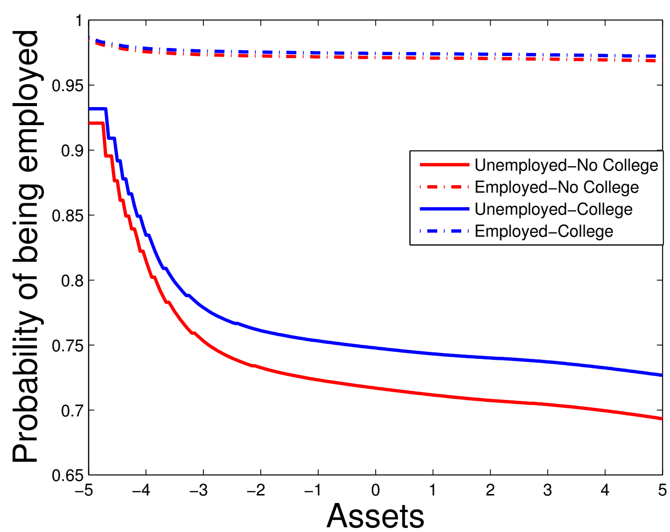

Figure 4: **Optimal policy for consumption**

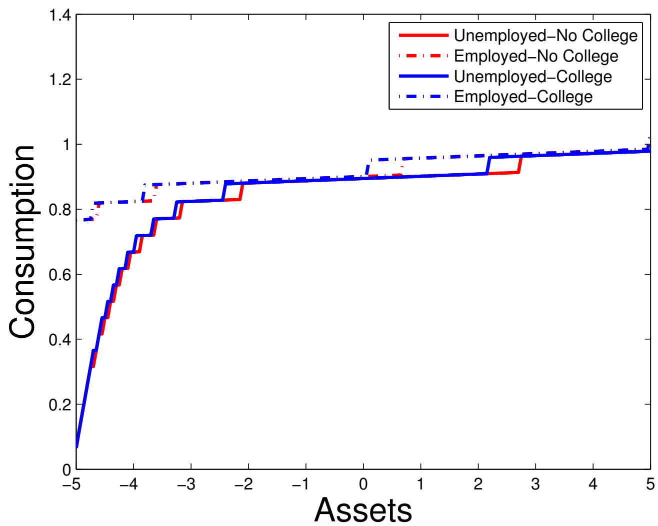

Figure 5: **Excess Demand for assets**

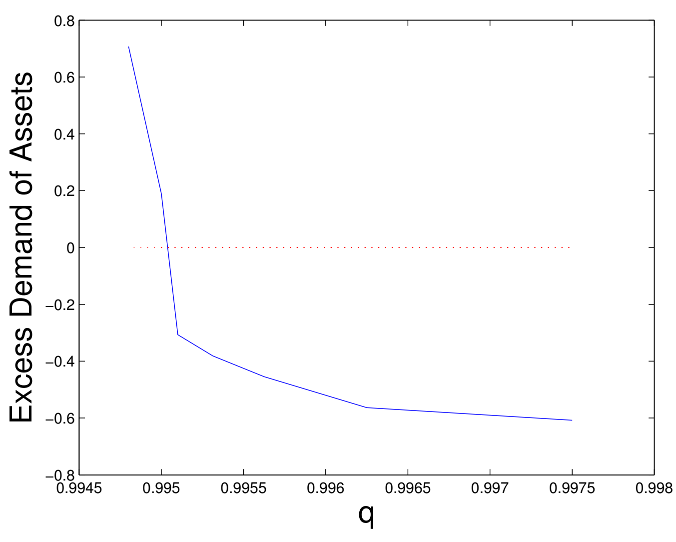

Figure 6: **Stationary distribution of assets**

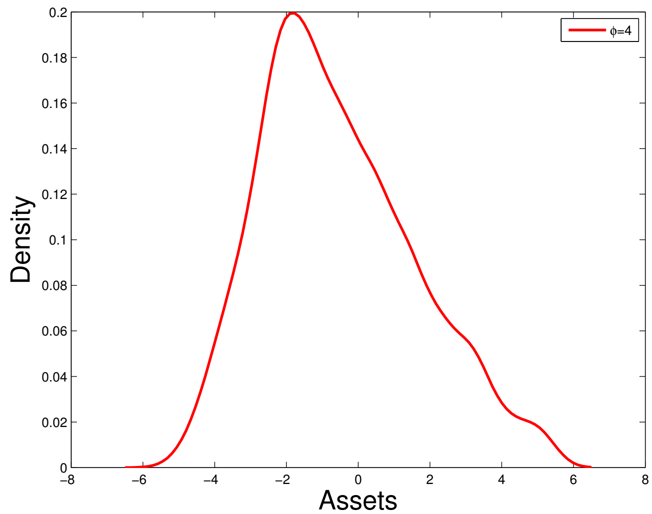

Figure 7: **Conditional stationary distribution of assets**