

Employment-based Health Insurance and Misallocation: Implications for the Macroeconomy*

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March 9, 2017

Abstract

Most working-age Americans obtain health insurance through the workplace. U.S. law requires employers to use a common price, but the value of insurance varies with idiosyncratic health risk. Hence, linking employment and health insurance creates a wedge between the marginal cost and benefit of insurance. We study the impact of this wedge on occupational choice and welfare in a general equilibrium model. Agents face idiosyncratic health expenditure shocks, have heterogeneous managerial and worker productivity, and choose whether to be workers or entrepreneurs. First, we consider a private insurance indemnity policy that removes the link between employment and health insurance, so only ability matters for occupational choice. By construction, this is the most efficient policy. We find a welfare gain of 2.28% from decoupling health insurance and employment. Second, we tighten the link by increasing employment-based health insurance from the current level of 62% to 100%, and find a welfare loss of - 0.61%.

JEL Classification: E23, I10, O40.

Keywords: Health Insurance, Occupational Choice, Entrepreneur, Misallocation, Uncertainty, Heterogeneity, Mandate, Patient Protection and Affordable Care Act

*We thank Tiago Cavalcanti, Sagiri Kitao, Felix Kubler, Makoto Nakajima and Constantine Yannelis for helpful discussions, and seminar participants at Arizona State University, Hong Kong University, Peking University, Purdue University, Shanghai University of Finance and Economics, University of Illinois, University of Iowa, University of Manchester, University of Oxford, Wuhan University, Zhongnan University of Economics and Law, and the SAET conference. Zhigang Feng worked on this article while he was in the faculty at University of Illinois at Urbana-Champaign, and he acknowledges computational support from David Kelly, Zongjun Hu and CCS at University of Miami.

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1 Introduction

The U.S. health insurance system has two distinctive features: First, most working-age Americans obtain health insurance coverage through the workplace, known as employment-based health insurance (EHI). Second, U.S. law requires employers that offer health plans to use a price common to all employees. When health insurance is linked to employment, occupational misallocation may occur: Some individuals with high managerial ability but adverse health risks might choose to become workers rather than entrepreneurs, and some individuals with moderate managerial talent but good health might choose to run a firm rather than become a worker. This misallocation affects more than just the individuals involved because entrepreneurs create jobs. Antunes, Cavalcanti and Villamil (2008a) show that in the absence of health shocks, funding a smaller number of highly talented entrepreneurs to run large firms may lead to higher earnings and output, making both entrepreneurs and workers better off. The main result of this paper is to quantify the misallocation associated with employment-based health insurance, which arises from distortions in occupational choice and firm size.

To accomplish our goals, we construct a general equilibrium model of occupational choice with heterogeneous agents and a credit market. Individuals are risk averse, live for many periods, and choose to either operate a firm and employ others or become a worker. Wages are determined endogenously and healthcare policy is given. The government maintains a balanced budget and uses lump sum taxes to pay for the benefits it provides. There are four sources of heterogeneity: managerial ability, worker productivity, health shocks, and assets. Differences in ability correspond to the standard Lucas (1978) “span of control” talent to manage a firm and worker productivity. As in Jeske and Kitao (2009), Fang and Gavazza (2011), Aizawa and Fang (2013) and Feng and Zhao (2014), we use the Medical Expenditure Panel Survey to measure the Markov process governing health shocks.¹ Agents’ assets evolve endogenously based on idiosyncratic factors; specifically, their initial assets, productivities as workers or managers, and health expenditure shocks.

We calibrate the model to the U.S., where on average 62% of workers get health insurance through their employers. In order to focus on the amount of misallocation associated with EHI, we conduct two policy experiments. First, we abolish EHI and provide all individuals with the opportunity to purchase actuarially fair private indemnity insurance under which the insurance provider agrees to pay for health expenditures incurred by the individual. The policy resembles a contingent claim and is efficient by design. Second, we extend EHI from the current 62% to 100% by requiring all employers to offer health insurance. Relative to the U.S. baseline, these two policies are polar extremes. For the indemnity policy, we find that decoupling health insurance

¹These papers focus on other issues. Jeske and Kitao (2009) examine U.S. healthcare subsidies and show that the tax is regressive. Fang and Gavazza (2011) construct a life cycle model of medical expenditure and find that EHI leads to dynamically inefficient investment in health. Aizawa and Fang (2013) develop a labor search model and use it to examine the ACA, with particular focus on the policy’s effect on the uninsured rate. Feng and Zhao (2014) study the impact of health policy on labor supply decisions.

from employment would lead to a welfare gain of 2.28%. For the policy where we expand EHI to all firms, we find a welfare loss -0.61% . To our knowledge, such EHI induced distortions on the macroeconomy have not been examined previously.

In general, the value of health insurance to risk-averse agents varies with their idiosyncratic health risk. In a market without frictions, compensation reflects individual ability and exogenous shocks, with marginal utility equalized across workers. Our model shows that when health insurance is linked to employment, this creates a wedge between the marginal cost and benefit of insurance. Since health risk can be sizable and insurance is part of total employee compensation, this wedge distorts firm and employee decisions. We use this model to assess the quantitative impact of occupational misallocation.

The literature on health policy, and firm and employee decisions, is large. For example, Garthwaite, Gross and Notowidigdo (2014) examine the effect of employer-sponsored health insurance in creating “employment locks” where agents pursue full-time jobs primarily to secure health insurance. Their focus is on the effect of health insurance on labor supply and they find microeconomic results consistent with a significant employment lock.² In contrast, Fairlie, Kapur and Gates (2011) focus on “entrepreneur locks” and examine whether the U.S. EHI system impedes business creation. Using innovative econometric methods, they find a negative effect of having a spouse without insurance for business creation and that business ownership rates increase at age 65 when individuals qualify for Medicare. We examine another aspect of an entrepreneur/worker lock with different methods. Using a general equilibrium model calibrated to U.S. data, we quantify the effects of occupational misallocation due to EHI on macroeconomic variables such as output, the distribution of firm sizes, earnings and welfare.

Our paper also contributes to a broad literature that studies macroeconomic aspects of health policies. This literature originates from Grossman (1972) and includes Brügemann and Manovskii (2010), Cole, Kim and Krueger (2014), Feng and Zhao (2014), French and Jones (2004), Hansen, Hsu and Lee (2014), Hall and Jones (2007), Jeske and Kitao (2009), Braun, Kopecky and Korshkova (2015), Pashchenko and Porapkkam (2012), among others. Our paper is most related to Jeske and Kitao (2009), who show that EHI subsidies constitute a regressive tax, and Cole, Kim and Krueger (2014) who study labor and health insurance market mandates but focus on static insurance gains versus dynamic incentive costs when effort can improve health.

In order to focus on EHI characteristics that can distort private agents’ occupational choice, we incorporate health risk and health insurance into a Lucas (1978) “span of control” model. Hence, our paper is related to the literature on entrepreneurship. For example, Antunes, Cavalcanti and Villamil (2008a) study the effect of credit market frictions on entrepreneurship. Cagetti and De Nardi (2006), Guner, Ventura and Xu (2008), Kitao (2008), Panousi (2008), and Li (2002) focus on the impact of government policies related to capital accumulation on entrepreneurship. Instead, this paper investigates the impact of a labor market friction on entrepreneurship. The

²Kolstad and Kowalski (2014) also use microeconomic techniques to examine an employer mandate and labor supply.

paper is also related to a large literature examining the causes and implications of factor misallocation. See Restuccia and Rogerson (2013) and the articles therein. Our work complements this literature by identifying a new friction associated with linking health insurance to employment, which leads to occupational misallocation.

In summary, in order to analyze occupational misallocation our model has the following key features. Individuals are endowed with heterogeneous managerial talent and heterogeneous health shocks. Firms face different costs of administering insurance that depend on their size. Contracts are incomplete: wages cannot be conditioned on health shocks by law. Section 2 summarizes stylized facts about the U.S. health insurance system. Section 3 builds a model consistent with these facts. Section 4 describes optimal behavior and the equilibrium. Section 5 contains the model calibration and the quantitative analysis is in section 6. Section 7 concludes.

2 U.S. Health Insurance Facts

We begin by summarizing some facts about the U.S. health insurance system that we wish our model to be consistent with.

Fact 1: U.S. health expenditure is high relative to OECD countries.³

Figure 1 shows that in 2012 the U.S. spent 17.9% of GDP on health, about twice the OECD average.

Fact 2: In contrast to most countries, the U.S. health insurance system is employment based.

In the U.S. over 90% of private health insurance coverage is employment based. Buchmueller and Monheit (2009) discuss two government decisions that cemented the link between employment and health insurance: (i) During World War II the U.S. imposed wage and price controls, and in 1943 the War Labor Board ruled that the controls did not apply to fringe benefits such as health insurance. Many employers used insurance benefits to attract and retain workers. (ii) In 1954 the Internal Revenue Service ruled that health insurance premiums paid by employers were exempt from income taxation, providing a subsidy to EHI through the U.S. tax code.

Fact 3: The probability that a firm offers EHI increases with firm size and administrative costs of providing insurance decline with firm size.

³The figure was produced by Veronique de Rugy, Mercatus Center at George Mason University based on OECD Health Data 2013. The OECD reports total health expenditure as a fraction of GDP, which is the sum of public and private health spending. The measure includes health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health, but does not include provision of water and sanitation. <http://data.worldbank.org/indicator/SH.XPD.TOTL.ZS>

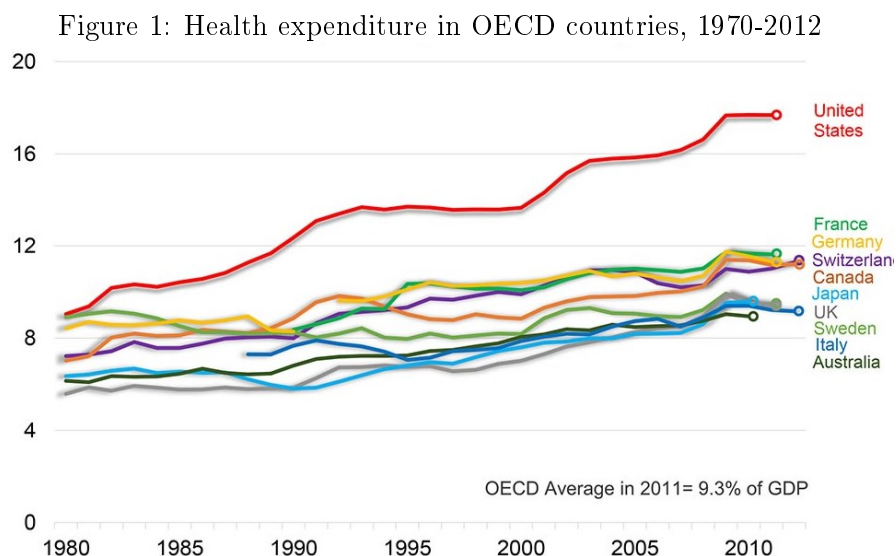
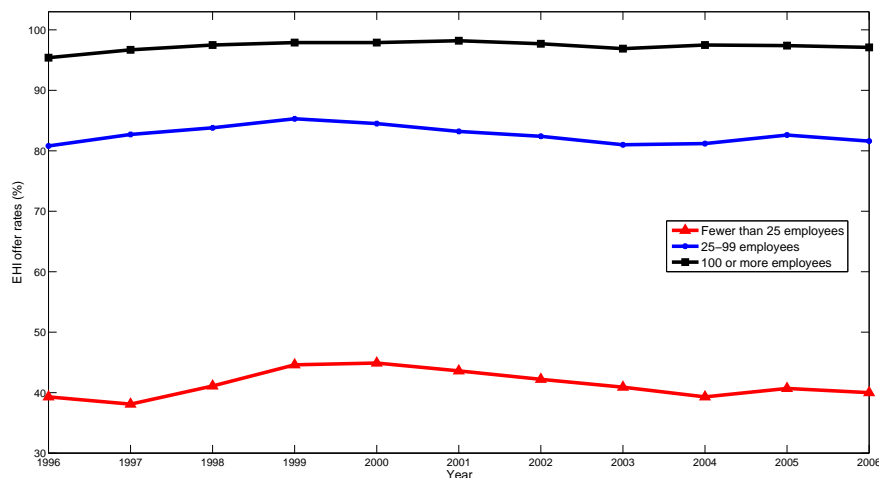


Figure 2 shows that EHI is strongly correlated with firm size and offer rates are fairly stable over time. About 97% of firms with over 100 employees offer health insurance, about 80% of firms with 25-99 employees offer insurance, and only 40% of firms with less than 25 employees offer coverage. The Agency for Healthcare Research & Quality (AHRQ) compiles the probability that a private firm in a given size bin offers health insurance, where size is measured by the number of employees. The AHRQ uses Medical Expenditure Panel Survey (MEPS), Insurance Component, private sector establishment data to compute this probability, $p_E(n)$.⁴ The average probability that a firm offers insurance is 62%. The table also reports the administrative cost of providing health insurance. Swartz (2006) shows that the cost savings from administrative economies of scale and better risk pooling increase with group size. Premiums are based on two components: average expected medical expenses for people in the group and a “loading fee.” Expected medical expenses are the same regardless of whether the person is in a large or small group, but the loading fee falls as size increases for three reasons: efficiencies in administration and marketing, lower risk of adverse selection in a bigger pool, and lower risk that a fraction of individuals will have very high costs. We denote this administrative cost by $g(n)$ and construct the function using data from the Small Business Administration, SBA (2011, p.38). The table reports $p_E(n)$ and $g(n)$ by firm employment size:

Firm size (j bins)	$n < 10$	10 – 24	25 – 99	100 – 999	$n > 1000$
$p_E(n)$	0.336	0.625	0.816	0.943	0.992
Administrative cost, $g(n)$	0.3	0.21	0.132	0.0849	0.06

⁴See Exhibit 1.2, Percentage of private-sector employees in establishments that offer health insurance, by detailed firm size, 2003-2014, p. 37, http://meps.ahrq.gov/mepsweb/survey_comp/MEPSICChartbook.pdf

Figure 2: EHI offer rate by establishment size, MEPS data



Fact 4: The share of premiums paid by employers is approximately constant over time, averaging about 85 percent for individual coverage and 75 percent for family coverage.⁵

Fact 5: Employment based health insurance has a premium based on a community rating.

The Employee Retirement Income Security Act of 1974 (ERISA), amended by the Health Insurance Portability and Accountability Act of 1996 (HIPAA), requires employers to offer health plans at common prices to all employees. The common price is known as *community rating*, where insurers evaluate risk factors of a market population rather than an individual. In contrast, private health insurance is generally based on individual characteristics and is more expensive than employment based (group) insurance. Community ratings are one way to address a fundamental market incompleteness that arises, for example, because individuals cannot choose their genes. Adjusted community ratings permit lifestyle factors such as smoking status to be considered.

Interviews conducted by the Employee Benefit Research Institute with large employers indicate that EHI remains a valuable tool in recruiting and retaining workers. The percentage of firms offering health insurance as an employee benefit has remained remarkably stable over time.

3 The Model: Economic Environment

Consider a Lucas (1978) span of control model, where individuals differ in the ability to manage capital and labor. Managerial productivity x^i for each agent i is drawn from a common continuous cumulative probability distribution with $x \in [0, \infty)$. Productivity is not hereditary and is publicly observed. Households receive an idiosyncratic labor productivity shock z that indicates the

⁵See p. 6, <https://kaiserfamilyfoundation.files.wordpress.com/2014/09/8625-2014-chartpack2.pdf>

efficiency units per unit of work hours. They also face an idiosyncratic health expenditure shock m_t^i , which follows a finite-state Markov process. For notational convenience, we drop agent superscript i and time subscript t whenever possible; χ' denotes the future value of a variable χ .

We will show that two types of individuals emerge, workers and entrepreneurs. We provide the intuition for, and then derive, a critical productivity value, x^* . Individuals above this value choose to be entrepreneurs and those below it are workers, *ceteris paribus*.

3.1 Preferences, endowments and technology

Preferences: Consumption by an agent in period t is c_t , with utility given by $U(c_t)$.

Endowments: Each individual faces either a managerial productivity shock as an entrepreneur, x , or a productivity shock as a worker, z . The distributions and realizations are public information. All agents also receive an idiosyncratic medical spending shock m , which is unobservable. Agents are endowed with an initial capital asset, a_0 , which can be used as an input in production.

Production: Firms use efficiency labor (n) and capital (k) to produce a single consumption good, y . Efficiency labor is $n = \int z\hat{n}$, the sum of hours worked, \hat{n} , weighted by the productivity of each worker, z . Capital depreciates at a constant rate of δ . Managers can operate only one project. The functional form of the production function is:

$$y = Xk^\alpha n^\gamma \quad \text{where } \alpha, \gamma > 0. \quad (1)$$

Managerial talent is given by $X = x^{1-(\alpha+\gamma)}$.

Factor remuneration: Firms rent capital at the common market rate $r(1 + \Delta)$, where r is the risk-free rate and $\Delta \geq 0$. We assume that the intermediary charges a proportional cost Δ per unit of funds loaned to the firm. As usual, this wedge above the risk-free rate accounts for intermediation costs and a risk premium.

We wish our model to be consistent with the employment-based health insurance (**EHI**) system in the United States, which we take as given. The firm offers a worker a compensation package \tilde{w} that includes a monetary wage w and a term that accounts for the expected cost of health insurance. In order to simplify and match our model to observable data, we assume that each firm offers **EHI** with given probability p_E , determined by random shock i_E .⁶ In the appendix we show that the firm's decision to offer health insurance can be made endogenous. Consistent with U.S. data compiled by AHRQ and summarized in fact 3 and figure 2, p_E increases with firm size. The firm's expected cost of providing EHI directly is $p_E [1 + g(n)] q_E$, where administrative cost $g(n)$ is a decreasing function of n because it is more costly for a small firm to offer health

⁶This is equivalent to modeling the EHI offer decision as a preference shock, see Aizawa and Fang (2013).

insurance than bigger firms (see fact 3). We assume that when insurance is not offered, which happens with probability $1 - p_E$, firms compensate employees for the average cost of providing EHI, q_E . Thus, total labor compensation is given by

$$\tilde{w} = w + p_E [1 + g(n)] q_E + (1 - p_E) q_E$$

Health insurance market: In the baseline model, there are three types of insurance options available to firms and workers: EHI, private insurance, or the opportunity to remain uninsured.

EHI: Households have access to EHI with probability \hat{p}_E , which is determined by shock i_E . We differentiate between p_E and \hat{p}_E because workers randomly match with firms of different sizes, but each worker has the same probability of receiving an EHI offer. Insurance covers a fraction $\phi(m)$ of total medical expenditures, where $\phi(\cdot) \in [0, 1]$. The EHI premium π_E does not depend on the individual's prior health history or any individual states. This accounts for the community rating practice in the U.S. where group health insurance cannot price-discriminate among the insured based on such individual characteristics (see fact 5). A fraction $\psi \in [0, 1]$ of the premium is paid by the employer as a subsidy.

Private: If a worker is not offered EHI (or declines the offer), she has the option to purchase health insurance in a private market at premium $\pi_P(m)$ with coinsurance rate $\phi(m)$. This can also occur if a household becomes a manager and does not offer (or has no access to) EHI.

Once the firm makes an offer to the worker ($i_E = 1$), the worker chooses either to obtain coverage (through EHI or private health insurance) or remain uninsured ($i'_{HI} = \{0, 1\}$).⁷ Health insurance companies are competitive. The premiums for EHI and private plans are determined by the expected expenditure for each contract plus a proportional markup denoted by η . EHI has two advantages compared with private insurance:

- (i) EHI receives a tax subsidy from the government, which is more cost-efficient for firms.
- (ii) EHI has a more inclusive risk pool, which helps to share risk among the insured.

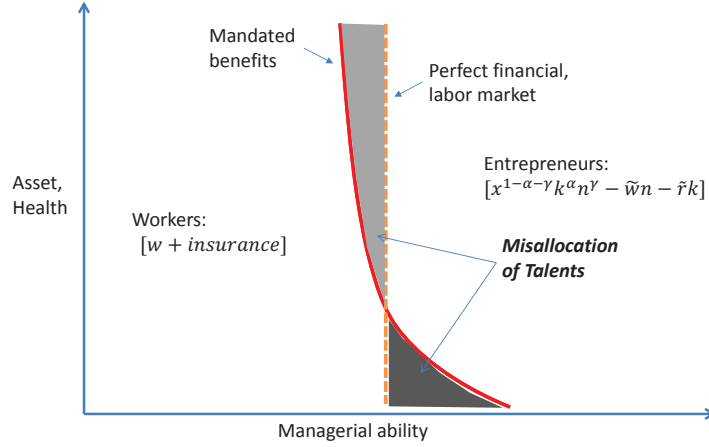
Government: The government runs a balanced budget each period and provides (only) two types of fiscal policies, which are financed through lump sum taxation, τ_y :⁸

- Public safety-net program, T_{SI} : This program guarantees each household a minimum consumption level of \underline{c} . This reflects the option available to U.S. households to rely on public transfer programs such as food stamps, Medicaid, disability and unemployment insurance if substantial income and health spending shocks occur.

⁷In line with Jeske and Kitao (2009), we assume a segmented labor market where employers do not adjust wages if EHI coverage is declined.

⁸Jeske and Kitao (2009) show that a distortionary tax with an EHI subsidy constitutes regressive taxation. We focus on the distortion that EHI induces in occupational choice, hence we abstract from distortionary taxation.

Figure 3: Talent misallocation



- In the baseline model, the government subsidizes EHI at rate τ_s .

3.2 Firm's problem

The firm's problem is:

$$\max_{n,k} Xk^{\alpha}n^{\gamma} - \tilde{w}n - rk \quad (2)$$

The average cost of hiring labor, \tilde{w} , includes monetary wage component w and the expected cost of EHI or a compensation payment by the firm when EHI is not offered. See appendix A.2 for the derivation of n^* and k^* , for constrained and unconstrained borrowing.

3.3 EHI and talent misallocation

Figure 3 illustrates that misallocation can occur when there is a link between insurance and employment. Exogenous managerial ability x is on the horizontal axis, which determines the profit if an individual decides to become an entrepreneur and manage a firm. Assets minus idiosyncratic health shocks are on the vertical axis. First consider a frictionless world, where there is no insurance distortion (or credit constraint).⁹ In this case there is no link between

⁹We focus on how health care policy affects occupational choice. Recent U.S. health care reform (ACA) also imposes an employer mandate that requires firms with over 50 employees to provide EHI, which could distort a firm's labor demand decision. Aizawa and Fang (2013) look at this issue and their results suggest that the effect is quite small, as does recent data in Garrett and Kaestner (2014).

employment and insurance, and a cutoff value x^* exists that differentiates entrepreneurs from workers. The vertical dashed line illustrates this. On the right side of the vertical line an agent’s managerial ability x is sufficiently high to yield greater profit from running a firm than from choosing to work at the market wage (i.e., without frictions only the vertical dotted line exists and the light grey and dark areas are not relevant). Choosing to be a worker is optimal on the left side of the line.

Now consider occupational choice when health insurance is employment-based and worker compensation includes a wage and health insurance package. Current U.S. law requires employers to offer a health plan at a price common to all employees. However, the value of health insurance to agents varies with their idiosyncratic health risk. Hence, the link between employment and health insurance creates a gap between the marginal cost and marginal benefit of health insurance. Figure 3 shows that two types of misallocation can occur: (i) Some healthy but low ability agents select into entrepreneurship, and (ii) some agents with high ability but adverse health shocks select out of entrepreneurship. Consider a healthy agent who would choose to be a worker in the absence of employment-based health insurance. This individual receives a wage plus health insurance as a worker, and does not value the firm’s health insurance greatly but cannot get additional compensation if he declines the insurance. This individual may find it more attractive to become an entrepreneur to get a higher return and either self-insure or get insurance in the private market. This is the light grey area. Now consider an individual with high managerial ability but an unfavorable health shock. It may be advantageous for this individual to work for a firm to get group health insurance. This is the dark area.

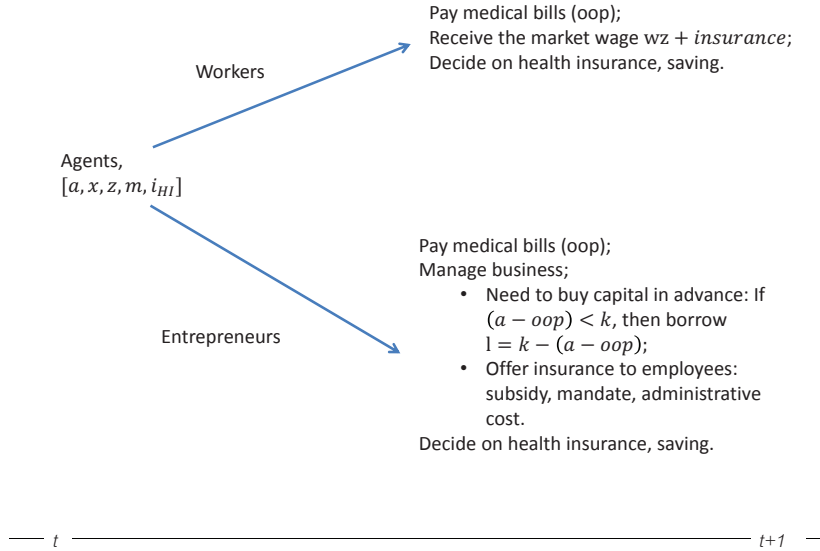
Overall the graph shows that some individuals that are healthy but less skilled become entrepreneurs, while others that are less healthy but highly skilled leave entrepreneurship. These misallocations relative to a frictionless world are caused by the link between health insurance and employment. We call this “talent misallocation” as the individuals in the light grey region with better health shocks but less managerial skill would be workers absent the EHI friction, while those with bad health shocks but high ability in the dark region would run firms. We will quantify the effects of counterfactual policy experiments on this misallocation.

4 Optimal behavior and equilibrium

In any time period t agents are distinguished by (a, x, z, m, i_{HI}) . The timing of the economy is given as follows.

1. Households enter each new period with assets a and health insurance status i_{HI} from the previous period.
2. Idiosyncratic shocks x (managerial ability), z (worker productivity) and m (medical expenditure) are drawn by nature.

Figure 4: Timing



3. Households make an occupation decision: entrepreneur ($\mathcal{I}_e = 1$) or worker ($\mathcal{I}_e = 0$).
4. Workers randomly match with firms. Idiosyncratic shock i_E is drawn, which determines if the firm offers EHI to workers and the manager.
5. Capital and labor markets clear and production takes place.
6. Households choose: health insurance ($i'_{HI} = \{0, 1\}$), consumption (c), borrowing/saving (a'). Managers and workers decide on health insurance purchases.

Figure 4 summarizes the timing. At time t agents make an occupational choice. At time $t + 1$ workers pay any medical bills (if not insured) or out of pocket (oop) expenses (if insured), receive the market wage plus insurance (if any), and choose health insurance (EHI, private, or none) and savings for next period. Entrepreneurs also pay any medical bills (if not insured) or out of pocket expenses (if insured), manage their business (buy capital and employ workers), and decide on health insurance (for herself only, for herself and workers, or no insurance) and savings for the next period.

In the baseline model we assume that workers are randomly matched with firms in order to simplify the analysis. Each firm offers EHI to the worker and herself (the entrepreneur), with a probability that is correlated with the firm's size. Contingent on being offered EHI, workers and the entrepreneur choose whether or not to take up insurance. In appendix A.1 we make the

firm's decision to offer health insurance endogenous.¹⁰

4.1 Firm manager

Firms are distinguished by their productivity realization x . Agents with sufficient ability to become managers choose the level of capital and the number of employees to maximize profit subject to a technological constraint and exogenously given health care policy. EHI exists for historical reasons (see Fact 2 in section 2).¹¹ In order to simplify the exposition, first consider the problem of a manager with talent x^i for a given level of capital k (i.e., labor input choice only):

$$\max_n Xk^\alpha n^\gamma - \tilde{w}n \quad (3)$$

where $\tilde{w} = [w + p_E(1 + g(n))q_E + (1 - p_E)q_E]$ is the firm's per capita labor cost and $g(n)$ is the administrative cost of organizing EHI at the firm level.

The first order conditions are:

$$n^*(k, x, \tilde{w}) = \left[\frac{\gamma X k^\alpha}{\tilde{w}} \right]^{\frac{1}{1-\gamma}} \quad (4)$$

Substituting (4) into (3) yields the manager's profit function for a given level of capital:¹²

$$y(k, x, \tilde{w}) = Xk^\alpha \left[\frac{\gamma X k^\alpha}{\tilde{w}} \right]^{\frac{\gamma}{1-\gamma}} \quad (5)$$

4.1.1 Remark on random matching

Workers supply labor inelastically at the given wage package \tilde{w} . They enter the market and are randomly matched to firms. Workers receive EHI with probability \hat{p}_E , which is determined by shock i_E . We differentiate between p_E and \hat{p}_E because each worker has the same probability of receiving an EHI offer. Consider two firms, one big and one small. The bigger firm offers insurance with 90% probability and the smaller with 50% probability. From the worker's point of view, probability \hat{p}_E is a weighted average of the two firms. In general, $\hat{p}_E = \frac{\int \mathcal{I}_e n^* p_E(n^*) d\Psi(s)}{\int \mathcal{I}_e n^* d\Psi(s)}$. Equivalently, $\hat{p}_E = \int \left[\frac{n^*}{\int n^* d\Psi(s)} \right] p_E(n^*) d\Psi(s)$, where the weight is given by the term in brackets.

¹⁰One reason offering workers insurance may be cheaper than offering a monetary wage is because EHI receives favorable tax treatment in the U.S. Appendix A.1 shows that using an exogenous shock to decide which individuals get insurance is equivalent to administrative cost function $g(n)$ receiving an exogenous shock. The key ideas are: (i) Idiosyncratic administrative health insurance costs are uncertain for firms, but mean costs decrease as firm size increases due to economies of scale. (ii) The idiosyncratic administrative cost determines whether a particular firm offers insurance, but larger firms are much more likely to offer health insurance as they benefit more from the economies of scale (captured by the decreasing concave function $g(n)$).

¹¹Clearly it would be more efficient to use an insurance pool. U.S. EHI emerged after WWII in response to wage and price controls. We take this as given.

¹²This will adjust with EHI offering status, since EHI has a tax subsidy.

4.1.2 Capital

Now consider the choice of capital. Let

- a denote the amount of self-finance; and
- l denote the amount rented from the capital market.

Both sources of funds are used to raise capital, with $k = (a - oop) + l$, where oop denotes out of pocket medical expenses. The entrepreneur can either use personal funds net of out-of-pocket medical spending ($a - oop$) or rent capital from the market (l). The two sources of funds have the following costs. The entrepreneur owns capital and therefore the opportunity cost of a is only the foregone interest the entrepreneur could have received from the capital market. This amount is given by ra . In addition, the entrepreneur may rent capital in the market, at cost $(1 + \Delta)rl$, $l \leq \bar{l}$. Here \bar{l} is an upper limit on borrowing. We will first consider the case where this borrowing constraint does not bind.

Self-financed firm: When initial assets are sufficient to run a business without renting new capital from the market (i.e., $l = 0$), the manager of the firm solves the problem:

$$\nu(a, x, i_E; \tilde{w}, r) = \max_{k \geq 0} y(k, x, \tilde{w}) - rk - \tilde{w}n(k, x, \tilde{w}) \quad (6)$$

This gives the optimal physical capital level:

$$\nu(a, x, i_E; \tilde{w}, r) = \max_{k \geq 0} Xk^\alpha \left[\frac{\gamma x k^\alpha}{\tilde{w}} \right]^{\frac{\gamma}{1-\gamma}} - rk - \tilde{w}n \quad (7)$$

$$k^*(x, \tilde{w}, r) = \left[X \left(\frac{\gamma}{\tilde{w}} \right)^\gamma \left(\frac{\alpha}{r} \right)^{1-\gamma} \right]^{\frac{1}{1-\alpha-\gamma}} \quad (8)$$

From equation (5), the manager's profit at the optimal level of capital is:

$$\nu(k^*, x, w) = Xk^\alpha \left[\frac{\gamma X k^{*\alpha}}{\tilde{w}} \right]^{\frac{\gamma}{1-\gamma}} - \tilde{w}n(k^*, x, \tilde{w}) - rk^* \quad (9)$$

The manager's consumption is determined as follows.

$$c + a' + (1 - i_{HI}\phi(m))m + \tilde{\pi} \leq (1 + r - \delta)a + \nu - \tau_y + T_{SI} + \tau_s i_E i'_{HI} \pi_E \quad (10)$$

where

$$\tilde{\pi} = \begin{cases} \pi_E & i'_{HI} = 1, i_E = 1 \\ \pi_P(m) & i'_{HI} = 1, i_E = 0 \\ 0 & i'_{HI} = 0 \end{cases} \quad (11)$$

$$T_{SI} = \max \{0, \underline{c} + \tau_s - \tau_s i_E i'_{HI} \pi_E + (1 - i_{HI} \phi(m)) m - (1 + r - \delta) a - \nu(k^*, x, \tilde{w})\} \quad (12)$$

$$a' \geq -\bar{a}. \quad (13)$$

The budget constraint is standard: consumption, saving/borrowing, uncovered (out of pocket) medical expenses, and insurance premia cannot exceed asset market returns, firm profit, lump sum taxes, government transfers, and the insurance subsidy. Lump-sum tax, τ_y , is collected to finance a consumption floor \underline{c} and EHI subsidy τ_s . The premium that the manager pays for insurance, $\tilde{\pi}$, has two components: i'_{HI} is the entrepreneur's choice to buy health insurance for herself for next period and i_E is the shock that indicates that the employer must provide health insurance to the employee. We focus on three cases: the entrepreneur purchases insurance for herself and the employees, the entrepreneur purchases insurance only for herself, and the entrepreneur purchases no insurance. The government defrays the cost of EHI by providing subsidy $\tau_s i_E i'_{HI} \pi_E$. T_{SI} denotes a transfer from the government as specified in Hubbard et al. (1995), where ν are firm profits, defined by (5), and the firm's borrowing is determined by the optimal k^* as explained in the appendix.

Firm with assets borrowed from the market: When managers do not have enough personal assets to operate the firm, they can rent l from the capital market at rate $(1 + \Delta)r$. The firm's problem is given as follows.

$$\tilde{v}^*(\tilde{k}, x, w) = \max_{\tilde{k}} X \tilde{k}^\alpha \tilde{n}^\gamma - \tilde{w} \tilde{n} - \tilde{r} (\tilde{k} - (a - oop)) \quad (14)$$

where

$$\tilde{r} = \begin{cases} r & \text{if } \tilde{k} \leq a - oop \\ (1 + \Delta)r & \text{if } \tilde{k} > a - oop \end{cases} \quad (15)$$

$$\tilde{n}^*(\tilde{k}, x, w) = \left[\frac{\gamma X \tilde{k}^\alpha}{\tilde{w}} \right]^{\frac{1}{1-\gamma}}. \quad (16)$$

4.2 Workers

Workers maximize expected discounted utility of consumption

$$\max_{\{c_t, a_{t+1}, i_{HI, t+1}\}} \mathbb{E} \sum_{t=0}^{\infty} \beta^t U(c_t)$$

subject to the following budget constraint:

$$c + a' + (1 - i_{HI}\phi(m))m + \tilde{\pi} \leq (1 + r - \delta)a + \tilde{w}z - \tau_y + T_{SI} + \tau_s i_E i'_{HI} \pi_E \quad (17)$$

where

$$\tilde{\pi} = \begin{cases} \pi_E(1 - \psi) & i'_{HI} = 1, i_E = 1 \\ \pi_P(m) & i'_{HI} = 1, i_E = 0 \\ 0 & i'_{HI} = 0 \end{cases} \quad (18)$$

$$\tilde{w} = \begin{cases} w + c_E & i_E = 0 \\ w & i_E = 1 \end{cases} \quad (19)$$

$$T_{SI} = \max \{0, \underline{c} + \tau_y - \tau_s i_E i'_{HI} \pi_E + (1 - i_{HI}\phi(m))m - [(1 + r - \delta)a + \tilde{w}]\} \quad (20)$$

$$a' \geq -\bar{a} \quad (21)$$

The worker's budget constraint indicates that consumption, saving/borrowing, out of pocket medical expenses, and insurance premia cannot exceed asset market returns, total labor compensation, lump sum taxes, government transfers, and the insurance subsidy. The insurance premium, $\tilde{\pi}$, again has two components: i'_{HI} is the agent's choice to buy health insurance for himself for next period where i_E is the shock that indicates that EHI is offered. There are three cases: the worker gets EHI but must pay the remaining $1 - \psi$ of the premium not paid for by the firm, the worker purchases insurance directly in the private market, or the worker purchases no insurance. The government defrays the cost of EHI by providing subsidy $\tau_s i_E i'_{HI} \pi_E$. Again T_{SI} is a transfer from the government that is analogous to the firm specification except that firm profits, ν , are replaced by employee total compensation $\tilde{w}z$.

4.3 Government

The government runs a balanced budget with a lump-sum tax τ_y :

$$\tau_y = \int (T_{SI} + \tau_s i_E i'_{HI} \pi_E) d\Psi(s)$$

$\Psi(s)$ represents the distribution of agents in equilibrium, defined in section 4.6.

4.4 The household's problem

Let \mathcal{I}_e indicate occupational choice, where $\mathcal{I}_e = 1$ if the household is an entrepreneur and $\mathcal{I}_e = 0$ if the household is a worker. We can write the household's problem recursively as follows.

$$\mathbf{V}(a, x, z, m, i_{HI}) = \max_{\{a', c, i'_{HI}, \mathcal{I}_e\}} [\mathcal{I}_e V_e + (1 - \mathcal{I}_e) V_w + \beta \mathbf{E} \mathbf{V}(a', x', z', m', i'_{HI})]$$

subject to

$$c + a' + oop + \tilde{\pi} \leq (1 - \tilde{r} - \delta)a + inc - Tax \quad (22)$$

where

$$\tilde{\pi} = \begin{cases} \pi_E(1 - \psi) & i'_{HI} = 1, i_E = 1 \\ \pi_P(m) & i'_{HI} = 1, i_E = 0 \\ 0 & i'_{HI} = 0 \end{cases} \quad (23)$$

$$Tax = \tau_y - T_{SI} - \tau_s i_E i'_{HI} \pi_E \quad (24)$$

$$T_{SI} = \max \{0, \underline{c} + \tau_y - \tau_s i_E i'_{HI} \pi_E + oop - [(1 - \delta)a + inc]\} \quad (25)$$

$$inc = \begin{cases} ra + \tilde{w}z + (1 - i_E) q_E & \text{if } \mathcal{I}_e = 0 \\ ra + \nu(k, x; \tilde{r}, \tilde{w}) & \text{if } \mathcal{I}_e = 1 \end{cases} \quad (26)$$

$$oop = (1 - i_{HI} \phi(m)) m \quad (27)$$

Tax is the lump sum tax net of social insurance benefit (if applicable) and the health care subsidy, inc is the earnings of the worker or entrepreneur, and oop is out of pocket medical expense.

The value functions V_e and V_w are defined as follows:

$$V_e = p_E(n^*)U(c|i_E = 1) + (1 - p_E(n^*))U(c|i_E = 0)$$

$$V_w = \hat{p}_E U(c|i_E = 1) + (1 - \hat{p}_E)U(c|i_E = 0).$$

\hat{p}_E and p_E reflect the random matching between workers and firms, as explained in section 4.1.2.

4.5 Health insurance

There are two kinds of insurance, private and employer based group insurance. The latter benefits from pooling and tax advantages, while private insurance has higher administrative costs. The cost of providing insurance for the firm is given as:

$$q_E = \psi \pi_E \quad (28)$$

The EHI premium equals the average cost of providing insurance:

$$\pi_E = (1 + \eta) \int i_E i'_{HI} \phi(m) m d\Psi(s) \quad (29)$$

The premium for private insurance equals:

$$\pi_P(m) = (1 + \eta) \frac{E[\phi(m') m' | m]}{1 + r - \delta}. \quad (30)$$

Markup η applies to both EHI and private insurance, consistent with MEPS data.

4.6 Steady state equilibrium

We characterize the steady state equilibrium. Denote the equilibrium aggregate variables by $\Phi = \{r, w, \pi_E, \hat{p}_E, \tau_y\}$. Individual state variables $s = \{a, x, z, m, i_{HI}\}$ denote asset holding $a \in \mathbb{A}$, managerial ability $x \in \mathbb{X}$, labor productivity $z \in \mathbb{Z}$, health spending shock $m \in \mathbb{M}$ and insurance status $i_{HI} \in \mathbb{I}$. Let $\mathbb{S} = \mathbb{A} \times \mathbb{X} \times \mathbb{Z} \times \mathbb{M} \times \mathbb{I}$ denote the entire state space.

Definition 1 *The steady state equilibrium for the economy is given by aggregate variables Φ , allocations $(c, a', i'_{HI}, \mathcal{I}_e)$ for households characterized by $s = (a, x, z, m, i_{HI})$ and the distribution of agents over the state space \mathbb{S} given by $\Psi(s), s \in \mathbb{S}$, such that:*

1. *Given Φ , allocations $(c, a', i'_{HI}, \mathcal{I}_e)$ solve the household's optimization problem.*
2. *The health insurance market is competitive.*
3. *The asset market clears: $\int k d\Psi(s) = \int a d\Psi(s)$.*
4. *The labor market clears: $\int \mathcal{I}_e n d\Psi(s) = \int (1 - \mathcal{I}_e) \hat{n} z d\Psi(s)$.*
5. *The goods market clears.*
6. *The government balances its budget: $\tau_y = \int (T_{SI} + \tau_s i_E i'_{HI} \pi_E) d\Psi(s)$.*
7. *Distribution $\Psi(s)$ is time-invariant. The law of motion for the distribution of agents over the state space \mathbb{S} satisfies $\Psi = \mathbf{F}_\Psi(\Psi)$, where \mathbf{F}_Ψ is a one-period transition operator on the distribution, i.e. $\Psi_{t+1} = \mathbf{F}_\Psi(\Psi_t)$.*

Note that labor market equilibrium condition 4 determines the “raw wage w .”

4.7 Analysis of competitive equilibrium

The following proposition states that there exists a cutoff value that differentiates entrepreneurs from workers based on managerial ability, as illustrated in figure 3.

Proposition 1 Denote by x^* the cutoff value such that an agent with $x \geq x^*$ becomes an entrepreneur; otherwise the agent is a worker. The cutoff value is a function of (a, z, m, i_{HI}) .

The proof follows from Antunes, Cavalcanti and Villamil (2008b), where the credit friction causes x^* to decrease with an agent's assets. In their case loans are given by $l = k - a$, at rate r . The ability to borrow allows some low asset but high ability agents to become entrepreneurs. In our case $l = k - \tilde{a}$, where $\tilde{a} = a - oop$ and $\tilde{r} = (1 + \Delta)r$, and EHI allows some individuals with poor health shocks and high ability to become entrepreneurs.

Proposition 2 The cutoff value is decreasing in a , if $\Delta > 0$.

Proof. See the Appendix. ■

We show that when EHI is a mandated benefit, this distorts the cutoff value. The following proposition states that agents with poor expenditure shocks need a higher x^* to become entrepreneurs.

Proposition 3 In the presence of EHI, cutoff value $x^*(a, z, m, i_{HI})$ increases with the size of m .

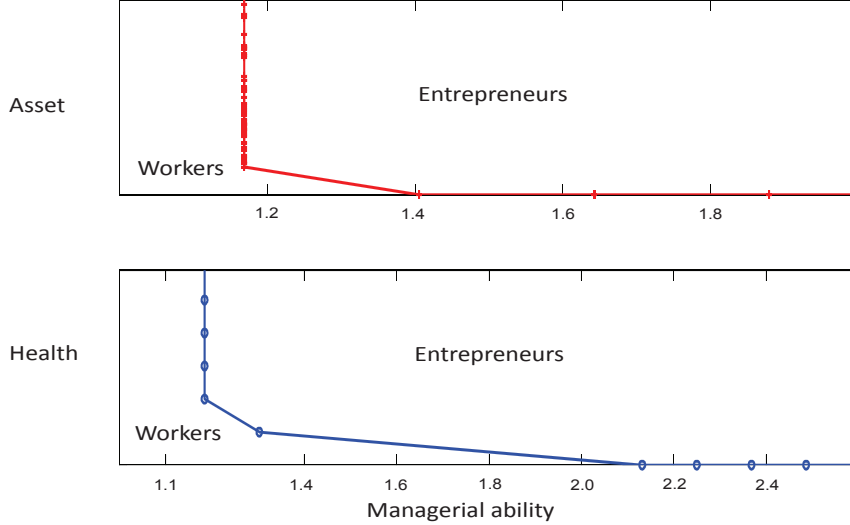
Proof. See the Appendix. ■

The cutoff value that we compute in the equilibrium is illustrated in figure 5. The two figures indicates that individuals with sufficiently high ability x , and assets (upper panel) or health (lower panel), become entrepreneurs. Those below the curve become workers. The cutoff in managerial ability x^* depends on other states and the figure represents an average across labor productivity states. We illustrate assets a (upper panel) and medical expenditure shocks m (lower panel) separately.

Consider the upper panel first. In the vertical area agents are not credit constrained and managerial ability x determines occupation: individuals above the line are entrepreneurs and those below it are workers. The credit friction causes the negatively sloped segment. As Antunes et al. (2008) show, when agents are credit constrained some high ability but poor entrepreneurs are unable to fund their firms and must become workers. In a general equilibrium environment, this misallocation affects the constrained individuals and other agents through lower output and (potentially) lower wages for all other workers. This occurs because less talented managers run smaller and less productive firms, which depresses wages.

The bottom panel shows a similar pattern for health. Adverse health shocks lower assets because they raise out of pocket expenses, where net assets are assets, a , minus out of pocket expenses, oop . Adverse medical expenditure shocks m raise out of pocket expenses, and the critical x^* increases with m . As above, in the vertical area managerial ability x determines occupation in the figure. In the negatively sloped area those with insurance have percentage $\phi(m)$ of their medical expenditures covered by insurance (EHI or private) and the uninsured must

Figure 5: Cutoff for ability x



cover their own expenditure shocks. This reduction in net assets can cause talented individuals who otherwise would have been entrepreneurs to become workers, an analogous misallocation of talent.

5 Calibration

Preferences: Household preferences are given by $\sum_{t=0}^{\infty} \beta^t U(c_t)$, where $U(c) = \frac{c^{1-\rho}-1}{1-\rho}$. The coefficient of relative risk aversion ρ is set to 1.5 in the baseline economy, which follows estimates in the literature. We also consider $\rho = 3$ as a robustness check. The subjective time discount factor β is set to 0.94 so that the aggregate capital-output ratio is 2.33 in the stationary equilibrium, consistent with U.S. data.

Labor Productivity: We assume that stochastic labor productivity z follows a first-order autoregressive process: $\ln z_t = \rho_z \ln z_{t-1} + \varepsilon_{z,t}$, where $\varepsilon_{z,t} \sim N(0, \sigma_z^2)$. As in Storesletten et al. (2004) and Hubbard et al. (1994), we choose the value for coefficient ρ_z and the residual variance σ_z^2 to be 0.94 and 0.02 respectively. To facilitate the computation, we approximate this process by a five state Markov process using the method of Tauchen and Hussey (1991). The calibrated

Markov process is represented by finite states:

$$z \in \{0.646, 0.798, 0.966, 1.169, 1.444\}$$

and a transition matrix

$$\Pi_z = \begin{bmatrix} 0.731 & 0.253 & 0.016 & 0.000 & 0.000 \\ 0.192 & 0.555 & 0.236 & 0.017 & 0.000 \\ 0.011 & 0.222 & 0.533 & 0.222 & 0.011 \\ 0.000 & 0.017 & 0.236 & 0.555 & 0.192 \\ 0.000 & 0.000 & 0.016 & 0.253 & 0.731 \end{bmatrix}.$$

Entrepreneurial ability and technology: The entrepreneur is endowed with managerial ability x and operates a firm with a neo-classical production function $Xk^\alpha n^\gamma$, where $X = x^{1-(\alpha+\gamma)}$. We choose the model capital share α to match the capital share of 0.32 for the U.S economy for the period 1960-2000. We assume that the stock of capital includes business equipment and structures, business inventories and business land. For the period 1960-2000, the capital to output ratio is 2.33 (NIPA, US Department of Commerce (2005), Table 1.3.5). Cooley and Prescott (1995) indicate that the share of capital averaged about 0.32 for the period 1960–2000. We choose labor share γ to match the fraction of entrepreneurs of 7.6% in the U.S. economy. Depending on the definition of entrepreneur used, Cagetti and De Nardi (2006, table 1) report that US entrepreneurs ranged from 7.6 to 16.7 percent of the population using data from the 1989 Survey of Consumer Finances (SCF). We choose 7.6% because the SCF surveys households rather than small businesses and includes professional practices (law, medicine, etc.), farms, financial, and real estate businesses that are not relevant for our occupational choice model. See Herranz, Krasa and Villamil (2009, p. 347) for a discussion of alternative data sets.

Guner, Ventura and Xu (2008) calibrate ability distribution $f(x)$ to be consistent with 1997 US Economic Census data on the fraction of establishments at different employment levels. They use data on all sectors to calculate the following targets: mean establishment size, fraction of establishments over the number of employees, and the share of total employment accounted for by large establishments (> 100 employees). They select the ability distribution to match these statistics. We use the same procedure and assumptions to calibrate $f(x)$.¹³ The distribution is log-normal with mean μ_x and variance σ_x^2 , so that $\log(x) \sim N(\mu_x, \sigma_x^2)$, with most mass at the bottom and an extreme value for managerial ability that captures the remainder at the very top. We find μ_x and σ_x^2 to match the fraction of firms at different levels of employees and the mean size of establishments, which are listed in Table 2. In line with Guner, Ventura and Xu (2008),

¹³They assume that log-managerial ability is distributed according to a truncated normal distribution $f(x)$, with mean μ and variance σ^2 . This distribution accounts for most firms, with total mass $1 - f_{max}$. To account for the remainder of the distribution of establishments, they select a top value for managerial ability, $x_{max} > x$, with corresponding fraction f_{max} .

we truncate the distribution of x and approximate it with 40 grid points.

Health spending shocks and health insurance: We use Medical Expenditure Panel Survey (MEPS) data to estimate health expenditure shocks and health insurance. We focus on the working population and use seven states for health expenditures. In line with Jeske and Kitao (2009), we divide data into bins of size (20%, 20%, 20%, 20%, 15%, 4%, 1%). The first bin contains all agents whose health expenditures fall in the bottom twenty percentiles, while the last bin has agents inside the first percentile of the distribution. We represent each bin using the mean expenditure in that bin and normalize them in terms of the average earnings in 2003 (based on MEPS 2003, the average wage income of all heads of households is \$32,800). To this end, health spending follows a finite state Markov chain, with $m \in \{0.000, 0.006, 0.022, 0.061, 0.171, 0.500, 1.594\}$. The transition matrix for m is estimated by counting the fraction of agents who move into each bin in the following year.

$$\Pi_m = \begin{bmatrix} 0.542 & 0.243 & 0.113 & 0.061 & 0.032 & 0.007 & 0.002 \\ 0.243 & 0.330 & 0.242 & 0.117 & 0.056 & 0.011 & 0.001 \\ 0.119 & 0.224 & 0.296 & 0.232 & 0.098 & 0.025 & 0.006 \\ 0.058 & 0.130 & 0.225 & 0.347 & 0.201 & 0.035 & 0.005 \\ 0.043 & 0.079 & 0.140 & 0.263 & 0.371 & 0.090 & 0.014 \\ 0.030 & 0.063 & 0.080 & 0.203 & 0.359 & 0.200 & 0.065 \\ 0.008 & 0.024 & 0.073 & 0.106 & 0.269 & 0.286 & 0.233 \end{bmatrix}.$$

We calibrate the coinsurance rate for each of the seven shocks from the MEPS data, which is given as follows.

Health spending	$m > 0.000$	0.006	0.022	0.061	0.171	0.500	1.594
$\phi(m)$	0.341	0.532	0.594	0.645	0.702	0.765	0.845

The probability of providing EHI is increasing with firm size and administrative costs decrease with firm size. The probability $p_E(n)$ that a firm in a given size bin, measured by number of employees, offers health insurance is taken from the AHRQ, averaged over 2003-2014. See fact 3 in section 2. We construct $g(n)$ from SBA (2011, p. 38) data. The SBA found that administrative costs for insurers of small firm health insurance plans make up about 25 to 27 percent of premiums compared to about 5 to 11 percent for large companies with self-insured health plans. We use these estimates to construct concave administrative cost function $g(n)$. See appendix A.1.

Firm size (bin j)	$n < 10$	10 – 24	25 – 99	100 – 999	$n > 1000$
$p_E(n)$	0.336	0.625	0.816	0.943	0.992
Administrative cost, $g(n)$	0.3	0.21	0.132	0.0849	0.06

On average 62% of U.S. private firms offered health insurance to employees in 2009. See AHRQ, Center for Financing, Access and Cost Trends, 2009 MEPS_IC, Table I.A.2.

Government: The minimum consumption floor \underline{c} is calibrated so that the model has 20% of households with net worth of less than \$5,000 in the benchmark economy. The payroll tax is 12%, consistent with U.S. Social Security and disability taxes, see <https://www.ssa.gov/OACT/ProgData/oasdiRates.htm>. Lump-sum tax τ_y is chosen in equilibrium to balance the overall government budget.

We must choose seven parameters to reproduce observations. The parameters are γ , α , μ , σ , x_{max} , f_{max} and β . The model matches the fraction of establishments at different levels of employees, the share of employment in establishments with more than 100 employees, mean firm size, the aggregate capital share and aggregate capital to output ratio. Table 1 summarizes our choices. The model period is one year.

Table 1: Parameter values, baseline economy

Parameters	Values	Description	Comments/observations
β	0.94	Discount factor	target K/Y ratio 2.33
α	0.3207	Capital share	target K share of 0.32
ρ	1.5, 3	Risk aversion	
γ	0.4693	Frac. of entrepreneurs	target 7.6%, Cagetti et al. (2006)
μ_x	-0.3667	Mean of distribution of x	Guner et al. (2008)
σ_x	2.302	Std. dev of distribution of x	Guner et al. (2008)
m	see text	Health spending shock	MEPS
$\phi(m)$	see text	Coinsurance rate	MEPS
η	0.1	Markup of health insurance	MEPS
ψ	0.8	Employer contribution to EHI	MEPS
$g(n)$	see text	Cost of providing EHI	SBA (2011)
$p_E(n)$	see text	Probability of providing EHI	AHRQ
\hat{p}_E	0.558	% covered by EHI	MEPS
\underline{c}	\$9700	Consumption floor	20% hhs with wealth < \$5000
τ_s	12%	Payroll tax	Social Security Adm
δ	6%	Capital depreciation	NIPA

6 Quantitative Analysis

In this section, we first present the performance of our benchmark model. We then explain the design of policy experiments, followed by a detailed analysis of two counter-factual experiments. Finally, we provide some remarks on our numerical exercises.

6.1 Baseline Economy

Our model succeeds in matching several aspects of the macroeconomy, including the distribution of firm size measured by the number of employees and observed patterns of health insurance coverage. Table 2 summarizes the performance of our model. In the benchmark, entrepreneurs account for 5.33% of the population, which is below the target of 7.6%. This underestimate of

Table 2: Benchmark

Statistics	U.S. Data	Baseline Economy
Annual real interest rate	4.0	4.33
Aggregate capital share	0.33	0.36
Capital output ratio	2.5	2.42
% of entrepreneurs	7.0	5.33
Mean size of the firm	17.09	17.76
% firm at 0-9	70.7	74.98 ($\bar{x}_1 = 1.55$)
% firm at 10-19	14.0	10.24 ($\bar{x}_2 = 2.05$)
% firm at 20-49	9.4	9.38 ($\bar{x}_3 = 2.38$)
% firm at 50-99	3.2	2.53 ($\bar{x}_4 = 2.82$)
% firm at 100+	2.6	2.87 ($\bar{x}_5 = 3.63$)
% of employment at firm 100+	44.95	44.01
Health insurance take-up ratio		
all	75.7	73.75
EHI offered	99.0	97.9
EHI not offered	35.5	32.8

Note: The number in parenthesis is average ability level x_i in each firm size group $i = 1, 2, 3, 4, 5$.

entrepreneurs is attributed to the fact that our model of occupational choice does not account for other reasons that individuals choose to become entrepreneurs such as the utility value from “being your own boss.”¹⁴ Hence our analysis provides a lower bound. On average, firms hire 17.76 employees in our benchmark, very close to 17.09 in the data, see, Gunar, Ventura and Xu (2008, table 2). The model is also successful in reproducing the fraction of firms with the selected levels of employment. Table 4 shows that average ability in each firm group increases with size, and firms in the largest size group are more than twice as productive ($\bar{x}_5 = 3.63$) as those in the smallest group ($\bar{x}_1 = 1.55$). In terms of health insurance coverage, our model has a take-up ratio of 73.75%, compared with 75.7% in the MEPS data.¹⁵ The take-up ratio is the share of agents who choose to purchase health insurance coverage given an offer (agents may choose to remain uninsured).

6.2 Policy designs

In this section we report the results of two policy experiments designed to estimate the amount of misallocation associated with employment based health insurance: (i) replace EHI with optional private indemnity insurance, and (ii) expand EHI from the current 62% of firms in the U.S. to 100%. Tables 4 and 5 report key statistics across the policy experiments.

¹⁴De Nardi, Doctor and Krane (2007), table 1, find that entrepreneur’s earnings are 3 to 4 times the earning of others in the Survey of Consumer Finances. In our baseline economy the ratio is about 6 (see table 3 below). Our model under predicts the fraction of entrepreneurs, which leads to a higher earnings ratio relative to SCF data.

¹⁵Employment-based insurance involves three factors: a worker must be employed by a firm that offers coverage, the worker must be eligible for coverage, and the worker must choose to take-up coverage.

6.2.1 No EHI: Private indemnity contract

This experiment considers the case where there is no EHI and all insurance is purchased on the private market (if any). The premium is actuarially fair and there are no tax insurance subsidies. The insurance provider pays for health expenditures incurred by an individual. The policy resembles a contingent claim and is efficient by design. This policy gives an estimate of the potential cost of misallocation associated with EHI relative to the baseline. The insurance take up rate falls from the baseline level of 75.26% to 23.2% in table 3.¹⁶ This is not surprising since private insurance is disadvantaged relative to EHI. Table 4 shows that the percentage of entrepreneurs falls from the baseline level of 5.46% to 4.93% because exposure to medical risk has increased and the potential assets available to invest in the firm have decreased (most agents choose to self insure). Average firm size increases from the baseline by 1.4% and output per firm increases by over 10%. Overall, we see fewer entrepreneurs running larger firms that are more productive. Worker and firm earnings increase. This leads to an aggregate welfare gain of 2.28 relative to the baseline. Almost all agents have a positive consumption-equivalent variation (CEV). The use of social insurance \bar{c} and taxes are higher than in the baseline.

6.2.2 Expansion of EHI

This experiment considers the polar opposite case that requires all firms to offer EHI, expanding the program from the current 62% level in the U.S. to cover 100% of workers, maintaining other baseline parameters. The first two columns of Table 3 show that there is a tradeoff: When EHI is expanded to 100% more people are insured (the insurance take-up increases from 75.26% to 99.98%), and health insurance makes agents better able to bear the risk of entrepreneurship. Offering EHI to all workers raises the cost of workers for firms, where (28) gives the average cost of providing insurance. This effect would tend to depress average firm size, which drops from the baseline by 4% in table 4. On the other hand, all individuals now have insurance at low cost (taxes drop from 1.78% in table 3 to 1.22%), hence individuals have more funds to invest in a firm. We should expect to see more entrepreneurs, and table 4 shows that the percentage of entrepreneurs increases from 5.46% in the baseline to 5.67%. Overall, we see more entrepreneurs running smaller firms that are less productive. The average ability for each size group, \bar{x} , is reported in parenthesis in table 4 and falls from $x_5 = 3.63$ for the largest firm group to $x_1 = 1.51$ for the smallest group. Table 4 shows that EHI expansion leads to a fall in the percentage of firms in the three highest groups (i.e., more small firms) and a decline in productivity of the smallest firm groups (\bar{x}_1 and \bar{x}_2 fall to 1.51 and 1.98 from the baseline values 1.55 and 2.05). Productivity falls because some individuals with lower managerial talent become entrepreneurs. This occurs because they no longer need to either self-insure to cover medical shocks or buy more

¹⁶We abstract from externalities such as communicable diseases and vaccinations, which would raise the socially optimal indemnity insurance rate. See Sun and Yannelis (2016) on measuring the insurance premium externality of individuals who choose not to purchase insurance in a different context.

expensive private health insurance, and they can use the funds to open firms. This misallocation of talent leads to an aggregate welfare loss of -0.61% relative to the baseline, with only 3.8% having a positive CEV.

Table 3: Aggregate variables, $\rho = 1.5$

<i>Statistics</i>	<i>Base</i>	<i>EHI exp</i>	<i>Indemnity</i>
Insurance take-up	75.26	99.98	23.2
real r (%)	4.34	4.34	4.30
wage	100	100.1	96.1
Worker earnings	100	97.51	110.2
Entrepreneur earnings	100	96.14	110.4
Aggregate output	100	99.97	100.17
% at \bar{c}	2.71	0.97	8.42
Ag. Welfare (%CEV)	-	- 0.61	2.28
% with CEV>0	-	3.8	96.05
tax/earn %	1.78	1.22	3.38

6.3 Size distribution

Table 4 shows how the two alternative policies affect the size distribution of firms. EHI expansion and the private insurance indemnity (no EHI) reduce the percentage of smallest firms (0-9 employees) but expand the next group (10-19 employees). This group’s productivity falls from $\bar{x}_2 = 2.05$ to 1.98. For the remaining groups, EHI expansion reduces the percentage of firms with 20-49, 50-99 and 100+ employees respectively, while the indemnity increases these larger and more productive groups. Overall, there are fewer entrepreneurs under the indemnity (4.93%) than under EHI expansion (5.67%). Furthermore, these entrepreneurs run larger (average firm size of 111.4% versus 95.98%, compared with the baseline) and more productive firms (average productivity of 102.45% versus 99.09%) under the indemnity policy experiment versus the EHI expansion policy.

One of the points of our analysis is that in a model with heterogeneity, averages and coarse firm bin sizes can mask important individual changes. Presumably the goal of the policy is not to increase the number of entrepreneurs, but rather to maximize consumption. This goal is accomplished by allocating individuals and capital to their most productive use. We now consider welfare analyses at the individual level to evaluate the consumption gains and losses from the policy changes.

6.4 Individual CEV: conditional change

We measure the consumption-equivalent variation (CEV) of a specific health policy by how much lifetime consumption, in percentage terms, an agent in state (a, x, z, m, i_{HI}) would gain or lose under the new policy in the steady-state, compared to the initial steady-state. Put

Table 4: Policy experiments

<i>Statistics</i>	<i>Base</i>	<i>EHI exp</i>	<i>Indemnity</i>
K/Y	2.42	2.42	2.43
Aggregate output	100	99.97	100.17
Entrepreneur %	5.46	5.67	4.93
Ave x (all firms)	100	99.09	102.46
Output per firm	100	96.19	110.97
Output per worker	100	100.16	99.58
Ave firm size	100	95.98	111.4
% firm at 0-9	74.98 ($\bar{x}_1 = 1.55$)	68.86 ($\bar{x}_1 = 1.52$)	64.83 ($\bar{x}_1 = 1.54$)
% firm at 10-19	10.24 ($\bar{x}_2 = 2.05$)	17.02 ($\bar{x}_2 = 1.98$)	19.21 ($\bar{x}_2 = 1.98$)
% firm at 20-49	9.38 ($\bar{x}_3 = 2.38$)	8.96 ($\bar{x}_3 = 2.38$)	10.13 ($\bar{x}_3 = 2.38$)
% firm at 50-99	2.53 ($\bar{x}_4 = 2.82$)	2.42 ($\bar{x}_4 = 2.82$)	2.74 ($\bar{x}_4 = 2.82$)
% firm at 100+	2.87 ($\bar{x}_5 = 3.63$)	2.74 ($\bar{x}_5 = 3.63$)	3.10 ($\bar{x}_5 = 3.63$)

Note: The number in parenthesis is average ability level x_i in each firm size group $i = 1, 2, 3, 4, 5$.

differently, we ask how much an agent with wealth-productivity tuple (a, x, z, m, i_{HI}) in the initial steady-state would be willing to pay as a percentage of lifetime consumption to avoid the reform. This is a conditional change because it is computed for an individual in a particular state. The consumption-equivalent variation (CEV) is the amount, $\varpi(a, x, z, m, i_{HI})$, that solves the equation:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u([1 + \varpi(a, x, z, m, i_{HI})] c_t^*) = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(\hat{c}_t)$$

c_t^* denotes consumption in the initial state, while \hat{c}_t is consumption under the new policy. For the case of CRRA preferences, $u(c) = \frac{c^{1-\rho}-1}{1-\rho}$, we can exploit the homogeneity of the utility function and the solution to the above equation is given by

$$\varpi(a, x, m, i_{HI}) = \left[\frac{\hat{V}(a, x, z, m, i_{HI}) + \frac{1}{(1-\rho)(1-\beta)}}{V^*(a, x, z, m, i_{HI}) + \frac{1}{(1-\rho)(1-\beta)}} \right]^{\frac{1}{1-\rho}} - 1.$$

The CEV is computed for an individual that is in a particular state, thus we consider welfare plots for various states $\varpi(a, x, z, m, i_{HI})$.

Figure 6: CEV, no EHI (private indemnity insurance only)

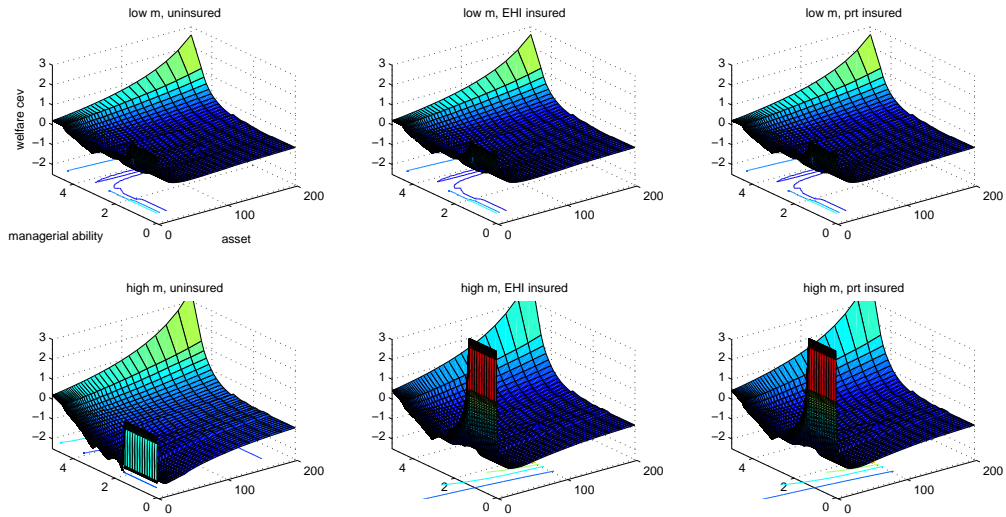


Figure 6 shows the CEV for the experiment where the current EHI baseline is replaced by private indemnity insurance. We illustrate two health expenditure shocks, high and low, and we introduce private indemnity insurance (only) relative to the individual's three insurance states: uninsured, baseline EHI insurance, and baseline private insurance. This policy gives an aggregate welfare gain of 2.28 in table 3, and 96.05% of people have positive welfare gains. This policy produces relatively high welfare gains for high ability and high asset individuals. The safety net helps the very poor with bad shocks, but overall the policy tends to slightly reduce welfare for a few low ability and some low asset individuals.

Figure 7: Conditional welfare change, EHI expansion

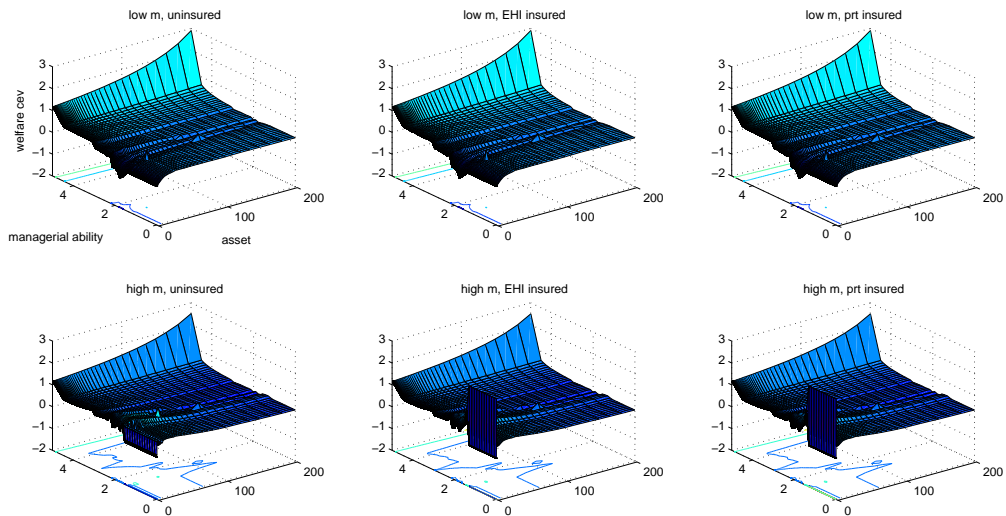


Figure 7 shows the conditional welfare change for EHI expansion to 100% coverage. We again consider two health shocks, high and low, when we expand EHI relative to the three insurance states for the individual: uninsured, baseline EHI insurance, and private insurance. The figure shows that expanding EHI increases the conditional welfare of high ability individuals (especially with high assets), and leads to welfare losses for low ability and poor agents. When the medical expenditure shock is high and individuals have baseline EHI or private insurance, we see that there are some welfare gains for the very poor, but overall EHI expansion largely favors high ability, high asset individuals because the lump sum taxes are inconsequential for these agents. Table 3 shows that the lump sum taxes required to fund the EHI expansion program are lower (1.22%) than in the baseline case (1.78%), thus expanded EHI reduces the tax on earnings. The policy benefits individuals with high ability and low assets because they now have insurance and more resources to invest in their firm. Table 3 also shows that the earnings of entrepreneurs are much higher than the earnings of workers, and expanded EHI reduces the risk of health shocks. As a consequence, members of this high ability, low asset group may now switch their occupation from worker to entrepreneur. Finally, table 3 shows that when individual gains and losses are summed over all agents there is a net welfare loss of -0.61, with only 3.8% of individuals having a positive welfare gain ($CEV > 0$). The figure shows the distribution of gains and losses is flat except for losses for the very poor and gains for the very rich and able.

6.5 CEV and risk aversion: stationary distribution

In this experiment we increase ρ from the baseline value of 1.5 to 3. Table 5 shows that under the indemnity, as expected, insurance uptake increases from 23.2% to 46.5% and welfare increases from 2.28% to 2.8% CEV. In the baseline, a few individuals have large gains and some have small losses. This occurs because few agents choose to buy private insurance, but the few poor agents with insurance benefit greatly. Overall, the losses are largest for the insured poor and low ability agents. In the baseline where agents are relatively tolerant to risk, some (8.42%) are willing to accept the protection provided by the social insurance program that gives consumption floor \underline{c} and is paid for through the tax system. Many individuals choose to remain uninsured because private insurance is relatively expensive. When agents are more risk averse ($\rho = 3$), the poor value insurance more because it is difficult for them to self-insure. Under the indemnity, output and efficiency increase, and the percentage of entrepreneurs decreases, but not by as much as when $\rho = 1.5$. When EHI is expanded to 100%, and agents are more risk averse, the welfare loss is smaller (- 0.41 versus - 0.61.) More agents have $CEV > 0$, but the percentage remains low.

6.6 Policy Summary

We consider two alternative health insurance policies relative to an EHI baseline: (i) replace EHI with a private insurance indemnity (only), and (ii) extend EHI to 100% coverage. Our baseline model incorporates distortions in the U.S. economy that we take as given. First, U.S. law (The

Table 5: Aggregate variables, $\rho = 3$

<i>Statistics</i>	<i>Base</i>	<i>EHI exp</i>	Indemnity
K/Y	3.31	3.03	3.06
real r (%)	2.64	2.65	2.59
Aggregate output	100	99.9	100.39
Insurance take-up	76.0	99.98	46.5
Entrepreneur %	5.50	5.70	4.98
Ave x	100	99.18	102.42
Ave firm size	100	96.39	111.13
% at \bar{c}	2.64	0.94	0.72
Ag. Welfare	-	- 0.41	2.80
% with CEV > 0	-	16.54	95.58
tax/earn %	1.76	1.22	2.92
% firm at 0-9	76.0 ($\bar{x}_1 = 1.53$)	70.34 ($\bar{x}_1 = 1.45$)	66.67 ($\bar{x}_1 = 1.46$)
% firm at 10-19	9.8 ($\bar{x}_2 = 2.05$)	16.11 ($\bar{x}_2 = 1.98$)	18.11 ($\bar{x}_2 = 1.98$)
% firm at 20-49	9.0 ($\bar{x}_3 = 2.38$)	8.51 ($\bar{x}_3 = 2.38$)	9.61 ($\bar{x}_3 = 2.38$)
% firm at 50-99	2.4 ($\bar{x}_4 = 2.82$)	2.28 ($\bar{x}_4 = 2.82$)	2.55 ($\bar{x}_4 = 2.82$)
% firm at 100+	2.7 ($\bar{x}_5 = 3.63$)	2.60 ($\bar{x}_5 = 3.63$)	2.93 ($\bar{x}_5 = 3.61$)

Note: The number in parenthesis is average ability level x_i in each firm size group $i = 1, 2, 3, 4, 5$.

Employee Retirement Income Security Act of 1974 (ERISA), amended by the Health Insurance Portability and Accountability Act of 1996 (HIPAA)) mandates benefits, requiring insurance premia based on a community rating rather than individual risk characteristics, and it sets minimum coverage standards. Second, there is a credit market friction, which we model as a standard interest rate wedge that is common across the policies. Third, the EHI baseline is advantaged relative to the other policies because in the U.S. EHI enjoys favorable tax treatment, has a more inclusive risk pool, and has economies of scale in administrative costs. Given the environment, our results indicate that the insurance indemnity gives the highest welfare gains (2.28% versus -0.61% for expanded EHI in table 3) when risk aversion is 1.5, and the corresponding net welfare numbers when $\rho = 3$ are 2.80% for the indemnity and -0.41 for expanded EHI in table 5. Due to agent heterogeneity, the policies have very different effects at the individual level.

Consider first the insurance indemnity. This policy replaces EHI with a contract under which the insurance provider pays for the individual's health expenditures. This contract is efficient by design, thus it is not surprising that it delivers positive net welfare gains. The take up ratio is 23.2% in table 3 and 46.5% in table 5 for this ex ante insurance contract, and ex post insurance occurs in the form of a higher \bar{c} of 8.42% when $\rho = 1.5$ (table 3) and 0.72% when $\rho = 3$ (table 5) that is paid for through the tax system when agents are hit with bad medical shocks. Notably, capital increases under the private insurance indemnity when agents are more risk averse ($\rho = 3$), which allows individuals to both better self insure and expand firm size. The increase in firm size is evident in table 4 under the indemnity, where the percentage of firms in the smallest size bin declines from 74.98% to 64.83%, and all other firm size bins increase.

Under expanded EHI health insurance becomes universal, taxes fall from 1.78% to 1.22%, and \bar{c} falls from 2.71 to 0.97%. Nonetheless welfare declines by -0.61% because worker and entrepreneur earnings decline due to changes in the distribution of firm sizes and lower output and efficiency.

Appendix A. 4 shows that these results are robust to changes in the administrative cost structure for health insurance and when we shut down the capital market distortion.

7 Conclusion

This paper identifies a new friction and shows how alternative health care policies affect the macroeconomy and welfare. When insurance is linked to employment and individuals are heterogeneous, talent misallocation can occur: Some individuals with high managerial talent but poor health shocks become workers, while other individuals with moderate managerial talent but good health become entrepreneurs. Because entrepreneurs create jobs, the misallocation of a few key individuals affects the broader macroeconomy, including firm size, output and earnings. Understanding the nature of this misallocation is important because poorly designed health care policies can exacerbate distortions instead of correcting them. The Council of Economic Advisers (2009) noted that one policy goal of health insurance reform is to reduce the “tax” on small firms associated with EHI to encourage entrepreneurship. Our occupational choice model shows that policy induced talent misallocation alters the endogenously determined distribution of firm sizes and EHI can have a significant effect on welfare, depending on how it is structured.

The contribution of our paper is to show that the link between health insurance and employment creates a friction that can lead to talent misallocation. We briefly consider three extensions. We focus on lump sum taxes because they do not distort occupational choice. Such taxes are more burdensome to poor agents than to rich. Progressive taxes could attenuate some of the welfare gains of high asset individuals and raise the welfare of lower asset agents by changing the tax burden. In general we find that higher ability agents enjoy the largest individual welfare gains and this “better treatment of high ability agents” is a standard result in optimal taxation for efficiency reasons - expanding the tax base by encouraging more productive individuals to work more permits marginal rates on less productive individuals to be lowered. In our model the analog is that it is more efficient for higher ability individuals to run larger firms, *ceteris paribus*, and they must be compensated to do this. See Scheuer (2014) for an analysis of optimal taxation and entrepreneurship.

In our model both managerial talent and health are given exogenously. Cole, Kim and Krueger (2014) construct a model that abstracts from occupational choice but where individuals can exert effort to maintain their current and future health. In their model this induces a stochastic link between effort and future health status with an associated moral hazard problem. Considering talent misallocation where actions today affect future health and productivity would extend our

focus on health insurance to provide insights about the evolution of health.

A final extension involves the labor market. As in Jeske and Kitao (2009), we assume a segmented labor market where employers do not adjust wages if EHI coverage is declined. Instead we could consider perfect compensation substitutability where workers sort to employers based on the demand for health insurance. This labor market structure might reduce occupational misallocation since a healthy agent can sort to a firm that offers monetary compensation but no EHI. Misallocation will continue to exist as long as private health insurance is not a perfect substitute for EHI. Nevertheless it would be interesting to see how a different market structure affects occupational misallocation. A model that considers search and matching in the labor market could address this issue. For example, Fonseca, Lopez-Garcia and Pissarides (2001) provide a good benchmark, but they do not consider the impact of health policy on firm and employment decisions. Incorporating a search friction into our model would also allow us to analyze the interaction between entrepreneurship and unemployment. These issues go beyond the current paper and we leave them for future research.

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Appendix

A.1 Endogenous firm insurance offer decision

We simplified whether or not a firm offers insurance by treating it as a preference shock, where $i_E = 1$ indicates the firm offers insurance and $i_E = 0$ indicates it does not. This section makes the firm’s choice to offer insurance endogenous because it is the least costly compensation alternative, given a cost structure. Figure 2 and the data in Section 5 on firm size indicate that large firms offer insurance with higher probability than small firms. We display the data again for convenience:

Firm size (j bins)	$n < 10$	10 – 24	25 – 99	100 – 999	$n > 1000$
$p_E(n)$	0.336	0.625	0.816	0.943	0.992
Administrative cost, $g(n)$	0.3	0.21	0.132	0.0849	0.06

In the model, we assume that total labor compensation is given by

$$\tilde{w} = w + p_E \left[1 + g(n)q_A^j \right] q_E + (1 - p_E)q_E$$

In the data we do not observe idiosyncratic administrative cost shock q_A^j , and therefore we cannot establish whether an individual firm chooses to offer insurance, which corresponds to the decision $i_E = 1$. However, we know that the firm will choose the least costly of its two options, and this will provide the link between unobserved firm choice i_E and observed probability $p_E(n)$.

The firm’s expected cost of providing EHI directly is $[1 + g(n)q_A^j]q_E$, where q_E is the fair price of insurance and q_A^j is the expected administrative cost of insuring workers in firm size bin

j. Under actuarially fair insurance, the cost of insurance equals the expected health shock, which is the price that would be charged in a perfectly competitive market

$$q_E = \sum_{s=0}^s E[\pi_s \phi_s m_s], \quad (31)$$

π_s is the probability of the shock given state of the world s , ϕ_s is the co-insurance rate, and m_s is the health shock. We introduce an expected administration cost q_A that affects the economies of scale that firms face $g(n)$,

$$q_E(n) = g(n)q_A^j + \sum_{s=0}^s E[\pi_s \phi_s m_s], \quad (32)$$

where shock q_A is uniformly distributed.¹⁷ Although the idiosyncratic administrative cost is uncertain for firms, the mean cost is decreasing as firm size increases. This is due to the presence of $g(n)$, a decreasing function of n , which we assume is $\frac{n^\theta}{n}$, in order to capture the effect evident in figure 2: it is more costly, on average, for a small firm to offer health insurance than bigger firms due to economies of scale.

In a competitive market without commitment, if a firm does not offer health insurance it must raise wages by an amount b . We define b as the monetary compensation that would make the worker indifferent between having insurance or being given a higher wage such that $EU[w + [1 + g(n)q_A]q_E] = EU[w + b]$.¹⁸ As workers are risk averse it follows that compensation payment b will be higher than the fair price of insurance q_E .

Due to the presence of the idiosyncratic administration cost q_A^j , offering insurance may not always be cheaper for an individual firm than offering a higher wage. It follows that a firm will offer health insurance if the cost of doing so is less than the compensation payment,

$$w + [1 + g(n)q_A^j]q_E < w + b \quad (33)$$

The idiosyncratic administration cost is important in determining whether a particular firm offers insurance, nonetheless larger firms are much more likely to offer health insurance as they benefit from economies of scale captured through the decreasing concave function $g(n)$.

In the model we express the total wage package for workers as

$$\tilde{w} = w + i_E [1 + g(n)q_A^j]q_E + (1 - i_E)b \quad (34)$$

¹⁷Idiosyncratic uncertainty stems from the fact firms do not know the health status of individuals they employ, heterogeneity in U.S. state laws, and bargaining power.

¹⁸This expression is an incentive compatibility constraint for workers, and is consistent with evidence from Olson (2002) and (Dey and Flinn 2005) that workers who are not offered benefits are given higher wages.

where $i_E = \{0, 1\}$. Firms choose $i_E = 1$ when the cost of providing EHI is lower than the compensation payment, and $i_E = 0$ otherwise. Probability p_E that the firm offers insurance is the value such that the expected value of the two payments is \tilde{w} , when $b = q_E$.¹⁹

If we assume that the average idiosyncratic shock q_A^j has the same mean and distribution across all firm sizes, we can infer an estimate of the value of $g(n)$ and hence the role that economies of scale have on the decision to offer health insurance. It follows that there will be a critical value of the idiosyncratic shock \hat{q}_A that determines whether a firm offers insurance or not. We obtain this critical value by rearranging equation (34)

$$\hat{q}_A = \frac{1}{g(n)} \left[\frac{b}{q_E} - 1 \right] \quad (35)$$

If the realized idiosyncratic shock is lower (higher) than the critical value $q_A^j < \hat{q}_A$ ($q_A^j > \hat{q}_A$), then a firm will offer (not offer) insurance. Substituting values of $g(n)$ into the above equation we see that as firm size increases, the critical level increases. This means that larger firms are more likely to offer health insurance as it will take a significantly higher idiosyncratic health cost, compared to smaller firms, to exceed the critical value.

Remark on administrative cost markup $g(n)$ Note that n^* will depend on the size of the firm, which depends on the functional form of the markup on health insurance $g(n)$. Under actuarially fair insurance, the cost of insurance is equal to the expected health shock. This is the cost of insurance that would be offered in a perfectly competitive market.

$$q_E = \sum_{s=0}^s E [\pi_s \phi_s m_s]. \quad (36)$$

We denote by q_E the cost of insurance, π is the probability of the shock given state of the world s , ϕ is the insurance rate, and m_S is the value of the health shock. We introduce an administrative cost for small firms, q_A .

$$q_E(n) = \lambda^j q_A + \sum_{s=0}^s E [\pi_s \phi_s m_s]. \quad (37)$$

To approximate $g(n)$, we assume that λ is a decreasing function of firm size n , where j is the number of intervals that λ decreases over. The administration costs represents the notion that the cost of group health insurance is decreasing in firm size because the fixed cost component is spread over a larger base.

Consider the simple case where j equals two. Economies-of-scale occur for sufficiently large firms and not for small firms. Hence, for small firms, λ is equal to 1.

¹⁹The optimal value of b differs across individuals due to heterogeneity in individuals' previous health costs. The firm can calculate b based on the average expected health costs. The model assumes complete information.

The optimal n^* for small firms therefore can be expressed as

$$\max_n x^i k^\alpha n^\gamma - [i_E (w + (1 + \lambda(n)q_A - \psi) q_E) + (1 - i_E) (w + b_E)] n \quad (38)$$

The FOC is given as

$$n'(k, x, w) = \gamma x^i k^\alpha n^{\gamma-1} - [i_E (w + (1 + \lambda'(n)q_A - \psi) q_E) + (1 - i_E) (w + b_E)] = 0 \quad (39)$$

Different n^* will exist depending on the size of the firm. Crucially, this will depend on how λ is distributed. We will assume that λ decreases over a number of intervals j . Consider the simple case where j equals two; there are economies-of-scale for sufficiently large firms and not for small firms. Hence, for small firms, λ is equal to 1. The optimal n^* for small firms therefore is

$$n_{SMALL}^{j*}(k, x, w) = \left[\frac{\gamma x^i k^\alpha}{i_E (w + (1 + q_A - \psi) q_E) + (1 - i_E) (w + b_E)} \right]^{\frac{1}{1-\gamma}}$$

For a large firm which can benefit from economies of scale n^* is

$$n_{LARGE}^{j*}(k, x, w) = \left[\frac{\gamma x^i k^\alpha}{i_E (w + (1 + \lambda q_A - \psi) q_E) + (1 - i_E) (w + b_E)} \right]^{\frac{1}{1-\gamma}}$$

where $\lambda \in (0, 1)$. Naturally, in this simple case there is an incentive for firms sufficiently close to the point where it becomes a “large” firm to employ more workers in order to obtain the savings from economies-of-scale.²⁰ From now on, we will use the subscript j to indicate that there are multiple steady-state variables depending on the distribution of the savings due to economies of scale λ .

Substituting n^* into (38) yields the manager’s profit function for a given level of capital:²¹

$$y_i^j(k, x, w) = x k^\alpha \left[\frac{\gamma x^i k^\alpha}{i_E (w + (1 + \lambda^j q_A - \psi) q_E) + (1 - i_E) (w + b_E)} \right]^{\frac{\gamma}{1-\gamma}} \quad (40)$$

As λ decreases with firm size, administration costs (q_A) will be lower for larger firms. Hence, larger firms will benefit from economies of scale and subsequently induce them to employ more workers (n) and produce more output (y).

A. 2 Derivation of k^*

Now consider the choice of capital. Let a denote the amount of self-financed capital and l denote the amount of funds borrowed from a bank. Both sources of funds are used to raise capital, with

²⁰This does not occur when the economies-of-scale effect λ is a convex function such as $\frac{n^\theta}{n}$. It can be shown that the marginal savings for a firm employing one more worker would not be greater than the marginal cost of employing one more worker.

²¹This will adjust with EHI offering status, since EHI benefits from a tax subsidy.

$k(\cdot) = a(\cdot) + l(\cdot)$. There is no commitment problem regarding bank loan repayment, so the two sources of funds have the same cost.

Unconstrained firm When initial assets are sufficient to run a business without resorting to credit finance (i.e., $l = 0$), the manager of the firm solves the problem:

$$\nu_i^j(a, x, i_E; w, r) = \max_{k \geq 0} y_i(k_i, x, w) - rk - \varphi \quad (41)$$

where $\varphi = [i_E(w + (1 + \lambda^j q_A - \psi)q_E) + (1 - i_E)(w + b_E)] \left[\frac{(1-\alpha)x^i k^\alpha}{i_E(w + (1 + \lambda^j q_A - \psi)q_E) + (1 - i_E)(w + b_E)} \right]^{\frac{1}{1-\gamma}}$ denotes the labor cost.

Substituting n_i^j into profits ν_i^j gives

$$\nu_i^{j*}(a, x, i_E; w, r) = (1 - \gamma)(xk)^{\frac{\alpha}{1-\gamma}} \left[\frac{\gamma}{i_E(w + (1 + \lambda^j q_A - \psi)q_E) + (1 - i_E)(w + b_E)} \right]^{\frac{\gamma}{1-\gamma}} \quad (42)$$

$$k_i^{j*}(x, w, r) = \left[x \left(\frac{\gamma}{i_E(w + (1 + \lambda^j q_A - \psi)q_E) + (1 - i_E)(w + b_E)} \right)^\gamma \left(\frac{\alpha}{r} \right)^{1-\gamma} \right]^{\frac{1}{1-\alpha-\gamma}} \quad (43)$$

From equation (5), the manager's profit at the optimal level of capital is:

$$\nu_i^j(k_i^{j*}, x, w) = xk^\alpha \left[\frac{\gamma x^i k_i^{*\alpha}}{i_E(w + (1 + \lambda^j q_A - \psi)q_E) + (1 - i_E)(w + b_E)} \right]^{\frac{\gamma}{1-\gamma}} - [i_E(w + (1 + \lambda^j q_A - \psi)q_E) + (1 - i_E)(w + b_E)] n(k^*, x, w) - rk^*$$

The manager's consumption is determined as follows.

$$c + a' + (1 - i_{HI}\phi)m + \tilde{\pi} \leq (1 + r)a + \nu_i(k^*, x, w) - Tax + T_{SI} + \tau_s i_E \pi_E \quad (44)$$

where

$$\tilde{\pi} = \begin{cases} \pi_E & i'_{HI} = 1, i_E = 1 \\ \pi_P(m) & i'_{HI} = 1, i_E = 0 \\ 0 & i'_{HI} = 0 \end{cases} \quad (45)$$

$$T_{SI} = \max \{0, \underline{c} + Tax + \tilde{\pi} - \tau_s i_E \pi_E + (1 - i_{HI}\phi)m + (1 + r)(k - a) - \nu_i(k^*, x, w)\} \quad (46)$$

$$a' \geq -\bar{a}. \quad (47)$$

$$l \leq (1 - \Delta) \frac{\nu_i(a, x, w) + rk^*}{1 + r} - oop \quad (48)$$

Note $\tilde{\pi}$ is the amount that the manager pays for insurance, i'_{HI} is the entrepreneur's choice to buy health insurance for himself for next period, and i_E is the shock (whether the employer must provide insurance to employee). The government subsidizes EHI purchases with $\tau_s i_E \pi_E$.

Equation (48) is a credit constraint for the firm, where *oop* is the out-of-pocket health shock of the entrepreneur and is defined as

$$oop = (1 - i_{HI}\phi(m))m. \quad (49)$$

Notice $\frac{\nu_i(a,x,w)+(1+r)k^*}{1+r}$ works as collateral, which yields the present value of the firm's earning net of labor cost. We assume that there is a proportional cost of borrowing, which is represented by $(1 - \Delta)$. This constraint introduces interesting dynamics as the entrepreneur's health insurance decision will affect its future available credit.

Constrained firm When managers do not have enough funds to operate the firm, they can borrow from the capital market at the risk free rate r , up to a limit of \bar{l} . If the optimal level of capital k^* can be financed by borrowing, then the firm's problem will be similar to the unconstrained one.

When managers are credit constrained, namely $a + \bar{l} < k^*$, the firm will operate at the capital level of $a + \bar{l}$. Borrowing limit \bar{l} is endogenous, see equation (48). Accordingly, the credit constrained firms have borrowing that is determined by the equation as follows.

$$\tilde{v}^{j*}(\tilde{k}, x, w) = x\tilde{k}^\alpha\tilde{n}^\gamma - i_E(w + (1 + \lambda^j q_A - \psi)q_E)\tilde{n} + (1 - i_E)(w + b_E)\tilde{n} - ra - (1 + r)\bar{l} \quad (50)$$

where

$$\tilde{k}^j = a + \bar{l} = a + \frac{\tilde{v}^*(\tilde{k}, x, w) + ra + (1 + r)\bar{l}}{(1 + r)}(1 - \Delta) - oop \quad (51)$$

$$\tilde{n}^{j*}(\tilde{k}, x, w) = \left[\frac{(1 - \alpha)x^i\tilde{k}^\alpha}{i_E(w + (1 + \lambda^j q_A - \psi)q_E) + (1 - i_E)(w + b_E)} \right]^{\frac{1}{1-\gamma}}. \quad (52)$$

Hence the credit constrained firms differ in their own capital holdings.

$$\tilde{k}^j = \begin{cases} k^{j*} & \text{if } a \geq k^* - \frac{\tilde{v}^*(\tilde{k}, x, w) + ra + (1 + r)\bar{l}}{(1 + r)}(1 - \Delta) + oop \\ a + \frac{\tilde{v}^*(\tilde{k}, x, w) + (1 + r)\tilde{k}^*}{(1 + r)}(1 - \Delta) - oop & \text{if } a < k^* - \frac{\tilde{v}^*(\tilde{k}, x, w) + ra + (1 + r)\bar{l}}{(1 + r)}(1 - \Delta) + oop \end{cases}$$

where \tilde{k}^{j*} is the solution to equation (50).

Proofs of propositions

The proof follows Antunes, Cavalcanti and Villamil (2008b).

A.3 Computation

Given the values for parameters, and distribution $\Gamma(x)$ for x , Ω_z for z , Ω_a for a , and Ω_m for m , the numerical algorithm works as follows.

1. Set a tolerance $\epsilon > 0$.
2. Guess $\Phi^0 = (r^0, w^0, \pi_E^0, \hat{p}_E^0, \tau_y^0)$. Solve for optimal household behavior:

$$f : (\theta; \Phi) \rightarrow (c, a', i'_{HI}, \mathcal{I}_e, n, k),$$

where $\theta = \{a, x, z, m, i_E, i_{HI}\}$. We will use the method of value function iteration as follows.

- (a) Guess value function $V^0(\theta; \Phi^0)$ and policy functions $f^0(\theta; \Phi^0)$.
- (b) Update value and policy functions:

$$V^1(\theta; \Phi^0) = \max_{a', i'_{HI}, \mathcal{I}_e} \{ \mathcal{I}_e V_e + (1 - \mathcal{I}_e) V_w + \beta \mathbb{E} [V^0(\theta'; \Phi^0)] \}$$

$$f^1(\theta; \Phi^0) = \arg \max V^1(\theta; \Phi^0)$$

- (c) Stop if $\max \{ |V^1 - V^0|, |f^1 - f^0| \} \leq \epsilon$. Otherwise, set $V^0 = V^1$, $f^0 = f^1$ and repeat step (b).
 - (d) Set $V^* = V^1$, and $f^* = f^1$.
3. Generate a large number of individuals, $N = 100000$. For each agent j assign a vector of initial condition $(a_0^j, x_0^j, z_0^j, m_0^j, i_{E,0}^j, i_{HI,0}^j)$, where $x_0^j \sim \Gamma(x)$, $z_0^j \in \Omega_z$, $m_0^j \in \Omega_m$, $i_{HI}^j = 0$.
 4. Simulate the economy for T periods, where T is sufficiently large.
 5. Calculate the following statistics from the simulated path $\left\{ a_t^j, x_t^j, z_t^j, m_t^j, i_{E,t}^j, i_{HI,t}^j, \mathcal{I}_w^j, \mathcal{I}_e^j, n^j, k^j \right\}_{t=0}^T$.

$$LS^0 = \frac{\sum_{j=1}^N (\mathcal{I}_w^j - \mathcal{I}_e^j n^j)}{N}$$

$$KS^0 = \frac{\sum_{j=1}^N (a^j - \mathcal{I}_e^j k^j)}{\sum_{j=1}^N a^j}$$

$$\pi_E^1 = \frac{\sum_{j=1}^N (i_E^j i_{HI}^j m^j)}{\sum_{j=1}^N (i_E^j i_{HI}^j)}$$

$$\hat{p}_E^1 = \frac{\sum_{j=1}^N (\mathcal{I}_e^j p_E(n^j) n^j)}{\sum_{j=1}^N (\mathcal{I}_e^j n^j)}.$$

and τ_y^1 that balances the government's budget.

6. Stop and set $(r^*, w^*, \pi_E^*, \hat{p}_E^*) = (r^0, w^0, \pi_E^0, \hat{p}_E^0)$, if $\max \{LS^0, KS^0, |\pi_E^1 - \pi_E^0|, |\hat{p}_E^1 - \hat{p}_E^0|\} \leq \epsilon$. Otherwise, update aggregate variables (restart from step 2):

$$\begin{aligned} r^0 &= \chi r^0 + (1 - \chi)\rho KS^0 \\ w^0 &= \chi w^0 + (1 - \chi)\rho LS^0 \\ \pi_E^0 &= \chi \pi_E^0 + (1 - \chi)\pi_E^1 \\ \hat{p}_E^0 &= \chi \hat{p}_E^0 + (1 - \chi)\hat{p}_E^1 \\ \tau_y^0 &= \chi \tau_y^0 + (1 - \chi)\tau_y^1 \end{aligned}$$

where $\chi \in (0, 1)$ is the step for updating aggregate variables.

A.4 Robustness checks: Administrative costs and no financial frictions

In this section show that the results are robust to changes in the administrative cost function for health insurance and financial market frictions. First consider changes in administrative cost function $g(n)$. In the baseline calibration $g(n)$ is concave, consistent with U.S. data in Fact 3. The robustness exercise in the table changes the form of this function to two fixed costs: $g(n)$ is 6% and 13.2%. We chose these values based on data in SBA (2011), which is used to construct administrative costs estimates of 13.2% for U.S. firms with 25-99 employees and the lowest cost is 6% for the largest firms with more than 1000 employees. We repeat the two policy experiments using these alternative costs, ceteris paribus.

Table 6: Robustness checks

<i>Statistics</i>	$g(n) = 0.06$			$g(n) = 0.132$			no r_wedge		
	<i>Base</i>	<i>EHI exp</i>	<i>no EHI</i>	<i>Base</i>	<i>EHI exp</i>	<i>no EHI</i>	<i>Base</i>	<i>EHI exp</i>	<i>no EHI</i>
K/Y	2.411	2.400	2.430	2.405	2.400	2.430	3.39	3.407	3.43
real r (%)	4.372	4.415	4.304	4.394	4.413	4.305	3.465	3.43	3.344
Aggregate output	100	99.71	100.38	100	99.87	100.52	100	100.21	100.53
Insurance take-up	74.91	99.98	23.17	75.2	99.98	23.185	74.6	99.98	11.44
Entrepreneur %	5.466	5.755	4.927	5.576	5.761	4.927	5.18	5.262	4.808
Ave x	100	98.66	102.5	100	99.16	103.05	100	99.66	101.94
Ave firm size	100	94.66	111.55	100	96.58	113.93	100	98.33	108.01
% at \bar{c}	2.72	0.964	8.42	2.701	0.966	8.419	5.112	1.784	13.225
Welfare		0.275	1.506		-0.02	1.944		-0.779	3.42
% with CEV>0		77.56	90.1		46.37	92.44		1.013	96.245
tax/earn %		1.215	3.371		1.216	3.371		1.2912	4.0976

We find that the results are robust to these cost changes. The table shows that a significant welfare loss remains when we vary the cost function. Under the indemnity policy, the welfare gain is 2.28 in the U.S. baseline (with a concave cost function). Under the two alternative fixed

costs welfare is 1.51 when $g(n)$ is 6% and 1.94 when $g(n)$ is 13.2%. Thus, changing $g(n)$ to constant costs that correspond to a low and the lowest empirical costs, leads to welfare cost of misallocation that remains non-trivial and positive. Similarly, in the EHI expansion policy the baseline welfare cost was -0.61 . When we vary the costs as explained we get 0.28 when $g(n)$ is 6% and -0.02 when $g(n)$ is 13.2%, which remain small.

In the table “no r wedge” corresponds to no capital market distortion. Again under the indemnity policy the the welfare gain is 2.28 in the U.S. baseline, and it remains positive at 3.42. Similarly, in the EHI expansion policy the baseline welfare cost was -0.61 and it is -0.78 . Herranz, Krasa and Villamil (2015) find that credit constraints are important in a dynamic model of entrepreneurship with heterogeneity, and we conduct this robustness check in order to isolate the effects of health insurance from credit constraints.

Note that the persistence of health care shocks would affect our results. Buera and Shin (2011) study the welfare cost of incomplete markets in an economy with persistent entrepreneurial risk. They show that more persistent shocks leads to a larger welfare loss due to missing consumption insurance. However, it gives entrepreneurs more time to save and finance a profitable project, and hence reduces the welfare cost of market incompleteness. In our framework the effect of a more persistent managerial shock depends on the correlation between entrepreneurial risk and the health shock. If the shocks are positively correlated, talented people tend to be healthier and more persistent entrepreneurial risk makes misallocation less likely. A highly talented but healthy (in the current period) agent knows that he will likely have similar entrepreneurial ability and a favorable health shock in the future. The incentive to get insurance by becoming a worker falls with the persistence of the entrepreneurial shock. On the contrary, if these two shocks are negatively correlated, the misallocation problem will be more severe.