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

David Chivers[†]
Oxford

Zhigang Feng[‡]
Illinois

Anne Villamil[§]
Iowa

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Abstract

Most working-age Americans obtain health insurance coverage through the workplace. U.S. law requires employers that offer health plans to use a price common to all in the group, but the value of insurance to each risk-averse individual varies with their idiosyncratic health risk. Hence, linking employment and health insurance creates a wedge between the marginal cost and benefit of insurance. Since health risk can be sizable and health insurance is part of total employee compensation, the wedge can affect firm and employee decisions. We study the impact of this wedge on occupational choice, productivity and welfare in a general equilibrium model with agents who are endowed with idiosyncratic health risk and heterogeneous managerial ability. Agents choose whether to be a worker or entrepreneur. We find that the wedge distorts occupational choice by causing two types of misallocations. Some highly skilled individuals with adverse health shocks leave entrepreneurship while individuals with intermediate skills but favorable health shocks opt to manage firms. Four counterfactual policies are analyzed: expansion of employer-based health insurance; private insurance only; health insurance exchanges; and universal health coverage. Welfare effects may be positive or negative, vary significantly with an individual's position in the asset and ability distributions, and are sensitive to changes in risk aversion. We also assess the effects of the policies on firm size, productivity, GDP and earnings.

JEL Classification: E23, I10, O40.

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

[†]Department of Economics, University of Oxford, Oxford, OX1 3UQ, david.chivers@exeter.ox.ac.uk

[‡]Department of Economics, University of Illinois at Urbana-Champaign, 214 David Kinley Hall, 1407 W. Gregory, Urbana, IL 61801, z.feng2@gmail.com

[§]Department of Economics, University of Iowa, Iowa City, IA 52242, annevillamil@gmail.com

1 Introduction

Rising and significant health care expenditures challenge many countries. In the United States, health care accounted for nearly 18 percent of GDP in 2012, which exceeds the OECD average of about 9 percent. In 2010 the U.S. passed the most significant regulatory overhaul of its health care system since the creation of the Medicare and Medicaid programs in 1965.[1] The 2010 reform is called the Patient Protection and Affordable Care Act (ACA). Because 90 percent of working age people in the U.S. who have health insurance obtain coverage from their employer, a report by Council of Economic Advisers (2009) argued that the current health care system imposes a heavy "tax" (health care cost) on small businesses and that the ACA would reduce this burden on small firms and encourage entrepreneurial activity. Small firms are important in the U.S. because they employ at least half of workers, and businesses with fewer than 20 employees account for a significant fraction of net employment growth (e.g., 25% from 1992 to 2005).

This paper focuses on the links among healthcare policy, small firms and the macroeconomy. We address two questions. How does a country's health care policy influence an individual's choice to become an entrepreneur or worker? How does health care policy affect GDP, firm size, wages, interest rates and welfare? In order to answer these questions, we take four alternative health care policies as given and investigate the policies' implications for occupational choice and macroeconomic performance. We construct an occupational choice model in which individuals differ in ability, assets, and health shocks. The government maintains a balanced budget and uses lump sum taxes to pay for the benefits it provides. We then use the model to assess quantitatively the macroeconomic effects of key aspects of health care policies.

The main finding is that U.S. healthcare policies can distort occupational choice. The frictions are generated by two distinctive features: First, most working-age Americans obtain health insurance coverage through the workplace, employment-based health insurance (EHI). Second, U.S. law requires employers that offer health plans to use a price common to all employees.[2] 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, and marginal utility is equalized across workers. We show that the link between employment and health insurance 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 can distort firm and employee decisions. Our goal is to identify precisely this distortion and assess the quantitative impact of four policies: expansion of EHI; private insurance only; health insurance exchanges; and universal health coverage. To our knowledge, such healthcare policy induced distortions on the macroeconomy have not been examined previously.

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[1] Medicare and Medicaid were the first U.S. public health insurance programs. Medicare provides federal health insurance for individuals at least age 65 or disabled, that paid into the system. Medicaid covers low income groups designated by statute such as children or pregnant women.

[2] 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 a common price.

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 operate a firm and employ others or become a worker. Wages are determined endogenously and healthcare policy is given. There are three sources of heterogeneity. The first is the standard Lucas (1978) "span of control" talent to manage a firm. The second is a health shock. The third is worker productivity. As in our paper, Jeske and Kitao (2009), Fang and Gavazza (2011), Aizawa and Fang (2013) and Feng and Zhao (2014) use the Medical Expenditure Panel Survey to measure the Markov process governing health shocks.[3]

We take all policies as given, and explore the effect of insurance mandates on occupational misallocations of two types: Relative to a benchmark regime, some highly skilled individuals with adverse health risks choose to become workers rather than entrepreneurs, and some individuals with moderate managerial talent but good health choose to run a firm rather than become workers. 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, fewer high talent entrepreneurs running larger firms may lead to higher wages and output, making both entrepreneurs and workers better off. We show that health shocks can lead to changes in occupational choice that reduce wages net of taxes, change the distribution of firm size, and have large and heterogeneous effects on welfare. We use this model to evaluate aspects of the ACA reform. We discuss the ACA in section 2.

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 micro econometric results consistent with a significant employment lock.[4] 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 entrepreneurship/worker lock with different methods. Using a general equilibrium model calibrated to U.S. data, we analyze the effects of occupational misallocation due to EHI on macroeconomic variables such as GDP, the distribution of firm size, wages and welfare.

The paper also contributes to a broad literature that studies macroeconomic aspects of health policies. This literature orginates from Grossman (1972) and includes Brugemann and Manovskii

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[3]They 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.

[4]Kolstad and Kowalski (2014) also use microeconometric techniques to examine the employer mandate and labor supply.

(2010), Cole, Kim and Kruger (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 Koreshkova (2015), Pashchenko and Porapkkam (2012), and 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 also study labor and health insurance market mandates but focus on static insurance gains versus dynamic incentive costs when individuals can use effort to improve health.

In order to focus on EHI characteristics that can distort private agent's 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. Antunes, Cavalcanti and Villamil (2008) and Herranz, Krasa and Villamil (2014) 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. Finally, the paper is related to a large body of literature examining the cause 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 health insurance mandates, 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 these stylized facts in the data and Section 3 builds a model consistent with the facts. Section 4 describes optimal behavior and the equilibrium. Section 5 contains the model calibration and quantitative analysis is performed in section 6. Section 7 concludes.

2 Facts and Policies

We now summarize some stylized facts about U.S. healthcare and the policies we consider.

2.1 U.S. Health Care

Fact 1: Figure 1 shows that U.S. health expenditure is high relative to OECD countries.[5]

In 2012 the U.S. spent 17.9% of GDP on healthcare, about twice the OECD average.

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[5]The figure is from Kaiser (2011): `http://kff.org/health-costs/issue-brief/snapshots-health-care-spending-in-the-united-states-selected-oecd-countries/` 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`
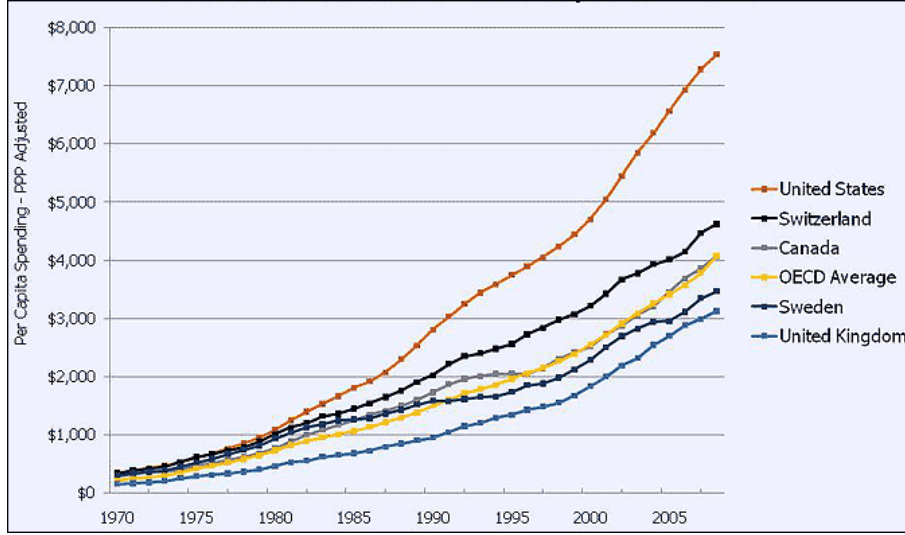
Figure 1: Health expenditure in OECD countries, 1970-2012

Fact 2: In contrast to most countries, the U.S. healthcare 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.
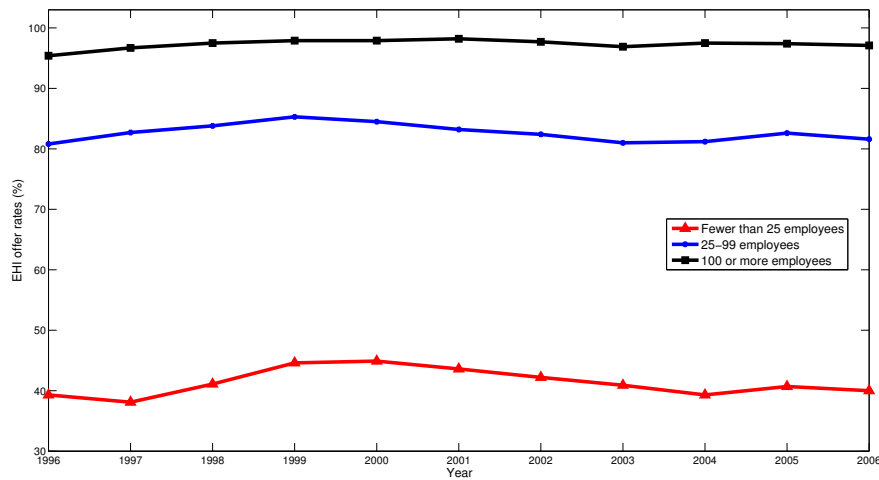

Figure 2: EHI offer rate by establishment size, MEPS data

Fact 3: EHI is strongly correlated with firm size and offer rates are fairly stable over time.

Figure 2 shows that 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.

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.[6]

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.

Fact 6: The administrative cost for EHI is about half of the cost of individually purchased policies: 15-20% versus 30-40% and administrative costs decline with firm size.

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.

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.

2.2 Policies

We focus on four health care policies:

1. *Employer provided health insurance*: EHI is offered as part of employee compensation. The

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[6]See p. 6, https://kaiserfamilyfoundation.files.wordpress.com/2014/09/8625-2014-chartpack2.pdf

Table 1: Income levels and insurance premium subsidies under ACA

Income in % of FPL	Premium subsidy rate
100-150%	94%
150-200%	77%
200-250%	62%
250-300%	42%
300-350%	25%
350-400%	13%

key feature is that an employer offers a worker a total compensation package consisting of a monetary wage plus a health insurance benefit.

2. Indemnity: This policy replaces EHI with an indemnity contract 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.

3. Health exchanges with an insurance mandate and subsidies: The 2010 Patient Protection and Affordable Health Care Act (ACA) reformed the U.S. EHI health care system in key ways. The goal of ACA is to increase the quality and affordability of health care, lower the rate of uninsured, and reduce the cost of healthcare.[7] We focus on key features of the law:

- Individual mandate: Requires most U.S. citizens and legal residents to have insurance.

- Policy mandate: Insurance market and rating rules

    - *Guaranteed issue*: Insurance companies are required to cover all applicants regardless of pre-existing conditions.

    - *Community rating*: Insurance companies must charge a single premium to all individuals in a market with the premium based on the risk factors of a market population, not an individual.

    - *Coverage standards*: Policies must meet minimum coverage standards.

- HIX: Create health insurance exchanges (HIX) through which individuals who do not have access to EHI can purchase coverage.

- Subsidies: Premium and cost-sharing credits are available to individuals/families with income between 133-400% of the federal poverty level (FPL). The poverty level was $19,530 for a family of three in 2013. Employers will pay penalties for employees who receive tax credits for health insurance through an Exchange, with exceptions for small employers.

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[7]See the Kaiser Foundation for a summary (`http://kff.org/health-reform/fact-sheet/summary-of-the-affordable-care-act/`).

4. Universal health coverage: This policy extends health care coverage to all members. In practice taxation is the main source of funding, but individuals or employers may pay supplements. Some countries have private insurance and universal health care (e.g., Germany), while other countries have single payer systems where the government contracts for health care with private providers (Canada) or operates a national health care system directly (the United Kingdom).

3 The Model: Economic Environment

Consider a Lucas (1978) span of control model, where individuals differ in the ability to manage capital and labor. 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 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, and $'$ denotes the future value of a variable.

We will show that two types of individuals emerge, workers and managers. We begin with an overview. In section 3.3 we provide the intuition for a critical value, x^*, where individuals above this value choose to be managers and those below it are workers.

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 is endowed with managerial talent, x, and productivity z. Assume that the distribution and realizations are public information. Each agent receives a medical spending shock m. Agents are also 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:

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

where 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 want 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 $\widetilde{w}$ that includes a monetary wage w and a term that accounts for the expected cost of insurance. In order to simplify and match our model to observable data, we assume that each firm offers employment-based health insurance (**EHI**) with given probability p_E, determined by random shock i_E. Consistent with the data in figure 2, p_E increases with firm size.[8] The firm's expected cost of providing EHI directly is $p_E [1 + g(n)] q_E$, where $g(n)$ is a decreasing function of n because it is more costly for a small firm to offer health insurance than bigger firms due to economies of scale. We assume that when insurance is not offered, then with probability $1 - p_E$ firms compensate employees for the average cost of providing EHI, q_E. Thus, total labor compensation is given by

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

In the appendix we show that the decision to offer health insurance can be endogenized and link the equation above to observable data.

Health insurance market: There are two types of insurance, EHI and private insurance:

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 are randomly matched 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 is denoted by π_E and is not dependent 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. A fraction $\psi \in [0, 1]$ of the premium is paid by the employer as a subsidy.

Private: If the worker is not offered EHI (or declines the EHI offer), she has the option to purchase health insurance in the private market at premium $\pi_P(m)$ with coinsurance rate $\phi(m)$. This can happen 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, which is denoted as $i_E = 1$, the worker chooses either to obtain coverage (through EHI or purchase health insurance in the private market) or remain uninsured ($i'_{HI} = \{0, 1\}$).[9] Health insurance companies are competitive. The premiums

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

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

for EHI and private plans are determined by the expected expenditures 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 policies, which are financed through lump sum taxation, τ_y:[10]

- 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.

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

3.2   Firm's problem

The firm's problem is:

$$\max_{n,k} X k^{\alpha} n^{\gamma} - \widetilde{w} n - rk \tag{2}$$

where $\widetilde{w}$, the average cost of hiring labor, includes monetary wage component w and the expected cost of EHI or a compensation payment by the firm when EHI is not offered. See the appendix 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. Idiosyncratic health risk is on the vertical axis. First consider a frictionless world, where there is no insurance distortion (or credit constraint).[11] In this case a cutoff value x^* exists that differentiates entrepreneurs from workers. This is illustrated by the vertical red dashed line. On the right side of the vertical line an agent's x is sufficiently high to yield greater profit from running a firm than from choosing to work at the market wage (i.e., only the vertical dotted line exists and the red and blue areas are not relevant). Choosing to be a worker is optimal on the left side of the line.

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

[11]We focus on how health care policy affects occupational choice. 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).
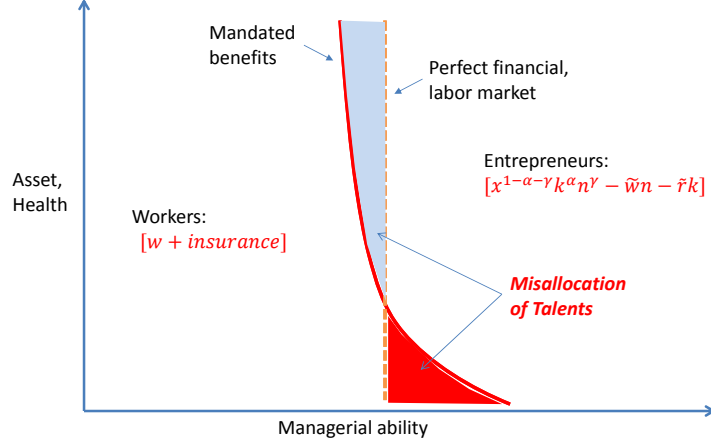
Figure 3: Talent misallocation

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 poor 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 blue 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 red 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 blue region that are healthy but less-skilled would be workers absent the EHI friction, while those with bad

health shocks but high ability in the red region would run firms. We will quantify the effects of counterfactual policy experiments related to the ACA on this misallocation.

4 Optimal behavior and equilibrium

The timing of the economy is given as follows.

1. Households enter each new period with assets a and health insurance status i_{HI}.

2. Idiosyncratic shocks x, z and m are drawn by nature.

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 the EHI offering status (EHI availability for workers).

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.

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. The benefits component of EHI exists for historical reasons and clearly it would be more efficient to use an insurance pool. 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., the labor input choice only):

$$\max_n X k^\alpha n^\gamma - \widetilde{w} n \tag{3}$$

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

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

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

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

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[12]This will adjust with EHI offering status, since EHI benefits from a tax subsidy.

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, $\hat{p}_E = \frac{\int \mathcal{I}_e n^* p_E(n^*) \mathrm{d}\Psi(s)}{\int \mathcal{I}_e n^* \mathrm{d}\Psi(s)}$. Equivalently, $\hat{p}_E = \int [\frac{n^*}{\int n^* d\Psi(\mathrm{s})}] p_E(n^*) d\Psi(\mathrm{s})$, where the weight is given by the term in brackets.[13]

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 $k(\cdot) = (a(\cdot) - oop) + l(\cdot)$, 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:

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

This gives the optimal physical capital level:

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

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

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[13]We model the way firms offer EHI as a preference shock i_E, an approach also used by Aizawa and Fang (2013). In the appendix we consider a cost shock, which is an alternative approach that endogenizes the insurance offer.

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

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

The manager's consumption is determined as follows.

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

where

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

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

$$a' \geq -\bar{a}. \tag{13}$$

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 himself 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 himself and the employees, the entrepreneur purchases insurance only for himself, 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.

$$\tilde{\nu}^*(\tilde{k}, x, w) = \max_{\tilde{k}} X\tilde{k}^\alpha \tilde{n}^\gamma - \widetilde{w}\tilde{n} - \tilde{r}\left(\tilde{k} - (a - oop)\right) \tag{14}$$

where

14

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

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

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:

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

where

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

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

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

$$a' \ge -\bar{a} \tag{21}$$

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:

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

where $\Psi(s)$ represents the distribution of agents in equilibrium as explained below.

4.4 The household's problem

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

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

subject to

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

where

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

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

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

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

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

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:

$$q_E = \psi \pi_E \tag{28}$$

The EHI premium equals the average cost of providing insurance:

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

The premium for private insurance equals:

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

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: $\int k \mathrm{d}\Psi(s) = \int a \mathrm{d}\Psi(s)$.*

4. *The labor market clears: $\int \mathcal{I}_e n \mathrm{d}\Psi(s) = \int (1 - \mathcal{I}_e) \hat{n} z \mathrm{d}\Psi(s)$.*

5. *The goods market clears.*

6. *The government balances its budget: $\tau_y = \int (T_{SI} + \tau_s i_E i'_{HI} \pi_E) \mathrm{d}\Psi(s)$.*

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 $\mathbf{F}_\Psi$ is a one-period transition operator on the distribution, i.e. $\Psi_{t+1} = \mathbf{F}_\Psi(\Psi_t)$.*

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 less healthy agents 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 4.

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 2.42 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 $\varepsilon_{z,t} \sim N(0, \sigma_z^2)$. In line with the literature, we choose the value for coefficient ρ_z and the residual variance σ_z^2 to be 0.94 and 0.02 respectively.[14] To facilitate the computation, we approximate this process by a five state Markov process using

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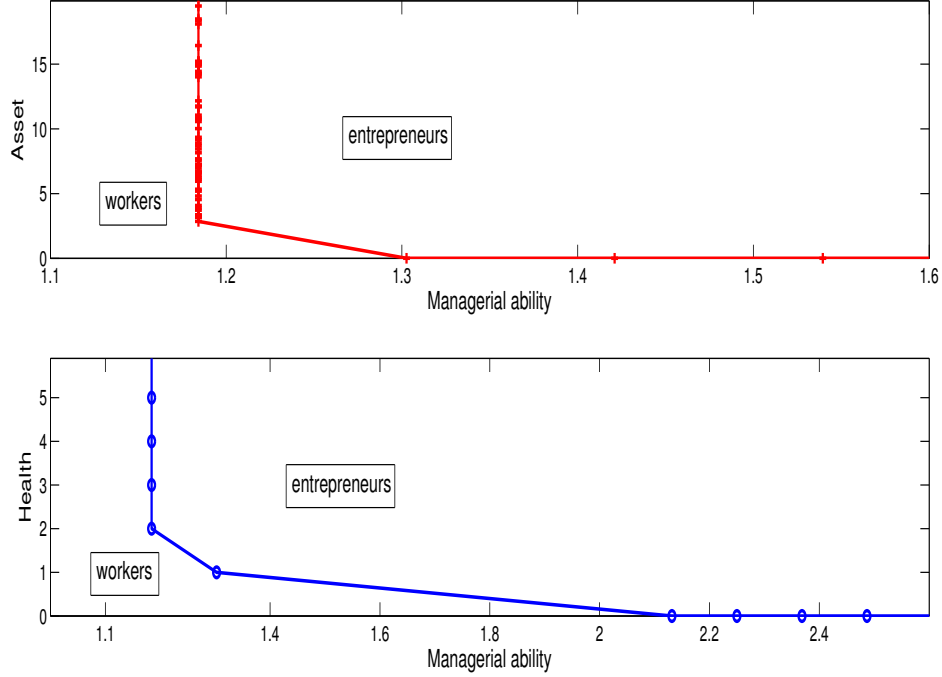[14] See Storesletten et al. (2004) and Hubbard et al. (1994).

Figure 4: Cutoff for ability x

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 assume that managerial ability is distributed log-normal with mean μ_x and variance σ_x^2, so that $\log(x) \sim N(\mu_x, \sigma_x^2)$. We choose α to match the capital share of 0.34 for the U.S economy for the period 1960-2000. We choose γ to match the fraction of entrepreneurs in the economy. 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 3. In line with Guner, Ventura and Xu (2008), 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

Consistent with the data in section 2, the probability of providing EHI is increasing with firm size. In addition, administrative costs decrease with firm size.

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

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%. Lump-sum tax τ_y is chosen in equilibrium to balance the overall government budget.

Table 2: Parameter values, baseline economy

Parameters	Values	Description	Comments/observations
β	0.94	Discount factor	target K/Y ratio 2.42
α	0.3207	Capital share	target K share of 0.34
ρ	1.5, 3	Risk aversion	
γ	0.4693	Frac. of entrepreneurs	Antunes et al. (2008)
μ_x	-0.3667	Mean of distribution of x	mean size of firms
σ_x	2.302	Std. dev of distribution of x	size distribution of firms
m		Health spending shock	MEPS
$\phi(m)$		Coinsurance rate	MEPS
η	0.1	Markup of health insurance	MEPS
ψ	0.8	Employer contribution of EHI	MEPS
$g(n)$		Cost of providing EHI	MEPS
$p_E(n)$		Probability of providing EHI	MEPS
$\hat{p}_E$	0.558	% covered by EHI	MEPS
$\underline{c}$		Consumption floor	20% hhs with wealth < $5000
τ_s	12%	Payroll tax	
δ	6%	Capital depreciation	

6 Quantitative Analysis

In this section, we first present the performance of our benchmark model. We then explain the design of policy experiments. This is followed by a detailed analysis of our counter-factual policy 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 3 summarizes the performance of our model. In the benchmark, entrepreneurs account for 5.33% of the population, which is slightly below the target of 7%. This underestimate of entrepreneurship 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."[15] 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. The model is also successful in reproducing the fraction of firms with the selected levels of employment. 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

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[15]De 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 4 below). Our model underpredicts the fraction of entrepreneurs, which leads to a higher earnings ratio relative to SCF data.

Table 3: 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 ($\bar{x}_5 = 3.63$)
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 $i = 1, 2, 3, 4, 5$.

insurance coverage, our model has a take-up ratio of 73.75%, compared with 75.7% in the MEPS data.[16] The take-up ratio is the share of agents with health insurance coverage.

6.2 Policy designs

In this section we report the results of four policy experiments: (i) expand EHI from the current level of 62% to full coverage, (ii) replace EHI with private indemnity insurance, (iii) supplement the current system with health insurance exchanges, and (iv) replace the current EHI system with universal health insurance. Tables 4 and 5 report key statistics across the policy experiments.

6.2.1 Expansion of EHI

This experiment requires all firms to offer EHI, expanding the program from the 62% level in the data to 100% coverage of workers. The first two columns of Table 4 show that there is a tradeoff: When EHI is expanded to 100% more people are insured, and this makes agents more willing to bear the risk of entrepreneurship. This raises the cost of workers for firms. Recall (28) gives the average cost of providing insurance. This effect would tend to depress average firm size, which drops from 17.76 workers to 16.95 in table 5. On the other hand, all individuals now have insurance at low cost (taxes drop to 1.89% in table 4 from 2.2%), hence individuals have more funds to put in the firm. We should expect to see more entrepreneurs, and table 5 shows that the percentage of entrepreneurs increases from 5.33% in the baseline to 5.56%. Overall, we see more entrepreneurs running smaller firms that are less productive. The average ability for

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[16]Employment-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.

each size group, $\bar{x}$, is reported in parenthesis in table 5 and falls from $x_5 = 3.63$ for the largest firm group to $x_1 = 1.51$ for the smallest group. Table 5 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; they no longer need to either self-insure to cover medical shocks or buy more expensive health insurance, and they can use the funds to open firms.

6.2.2 No EHI: Private indemnity contract

This experiment considers the polar opposite case where there is no EHI and all insurance is purchased on the private market (if any). The take up rate falls from the baseline level of 73.75% to 23.0% in table 4. This is not surprising since private insurance is disadvantaged relative to EHI. Table 5 shows that the percentage of entrepreneurs falls from the baseline level of 5.33% to 4.94% because risk has increased and the potential assets available to invest in the firm have decreased (most agents self insure). Average firm size increases to 19.26 from 17.76 workers and output per firm increases to 36.54 from 33.78. Overall, we see fewer entrepreneurs running larger firms that are more productive.

6.2.3 Health insurance exchange

Under the health insurance exchanges, such as those established in the ACA reform, individuals who have no access to EHI can purchase insurance at subsidized premium rates that are independent of an individual's health risk. The health insurance exchange changes the premium equations (11), (18) as follows:

$$\tilde{\pi} = \begin{cases} \pi_E & i'_{HI} = 1, i_E = 1 \\ \pi_{HIX}(1 - \tau_{HIX}) & i'_{HI} = 1, i_E = 0 \\ 0 & i'_{HI} = 0 \end{cases} \tag{31}$$

The health insurance exchange premium is π_{HIX} and τ_{HIX} is the subsidy rate from table 1. HIX does not involve firm administrative costs $g(n)$, but instead specifies a loading cost: the ACA requires the medical loss ratio to be at least 80%, which translates into a upper bound on the loading cost of 0.25. The lump-sum tax increases relative to the baseline (3.06% versus 2.2% in table 4) and the percentage of entrepreneurs increases from 5.33% to 5.68% in table 5. There are significantly more very small firms, but average productivity within size groups does not change relative to the baseline.

Table 4: Aggregate variables

Statistics	Base	EHI exp	Universal	no EHI	HIX
Insurance take-up	73.75	97.56	97.55	23.0	97.36
real r (%)	4.33	4.30	4.34	4.30	4.38
wage	0.80	0.80	0.89	0.77	0.76
Worker earnings	1.19	1.17	1.26	1.28	1.17
Entrepreneur earnings	7.76	7.42	8.07	8.36	7.29
Aggregate output	100	100.1	99.9	100.2	99.7
% at $\bar{c}$	3.53	1.73	1.93	8.44	1.03
Welfare (%CEV)		-0.03	0.37	0.23	-1.60
% with CEV>0		41.69	68.71	61.98	2.62
tax/earn %	2.2	1.89	6.64	3.40	3.06

6.2.4   Universal health insurance

In this experiment the government provides insurance as, for example, in Canada. The government now pays the individual's premium and there are no subsidies. Recall that in the baseline the government defrays the worker's cost of EHI by providing a subsidy given by the last term in (20), the worker's budget constraint. See (21) and recall that ψ is the employer's contribution to the EHI premium. Under universal health insurance the government provides the insurance directly and pays for it through the tax system, eliminating the firm's part of insurance payments and firm administrative cost $g(n)$. Entrepreneur earnings increase because the health care burden is taken "off the backs" of employers. Worker earnings drop net of taxes because taxes as a percentage of earnings increase from 2.2% in the baseline to 6.64% under universal insurance (see table 4). The take up rate is nearly 100%, as expected. Table 5 shows that entrepreneurs fall from the baseline of 5.33% to 5.14%, and firm size increases from 17.76 to 18.47, and there are less firms in the smallest size group.

6.3   Size distribution

Table 5 shows how the alternative policies affect the size distribution of firms. EHI expansion, universal insurance 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 $x_2 = 2.05$ to 1.98. HIX increases the size of smallest group, lowers the next three groups relative to the baseline, and slightly decreases the largest group from 2.87% in the baseline to 2.69%, with little change in $\bar{x}$. 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 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 policy changes.

Table 5: Policy experiments

Statistics	Base	EHI exp	Universal	no EHI	HIX
K/Y	2.42	2.43	2.42	2.43	2.41
Aggregate output	100	100.1	99.9	100.2	99.7
Entrepreneur %	5.33	5.56	5.14	4.94	5.68
Ave x (all firms)	1.77	1.76	1.79	1.81	1.75
Output per firm	33.78	32.29	35.05	36.54	31.61
Output per worker	1.90	1.91	1.90	1.90	1.90
Ave firm size	17.76	16.95	18.47	19.26	16.60
% firm at 0-9	74.98 ($\bar{x}_1 = 1.55$)	68.86 ($\bar{x}_1 = 1.51$)	66.19 ($\bar{x}_1 = 1.52$)	64.83 ($\bar{x}_1 = 1.54$)	76.50 ($\bar{x}_1 = 1.55$)
% firm at 10-19	10.24 ($\bar{x}_2 = 2.05$)	17.02 ($\bar{x}_2 = 1.98$)	18.47 ($\bar{x}_2 = 1.98$)	19.21 ($\bar{x}_2 = 1.98$)	9.63 ($\bar{x}_2 = 2.05$)
% firm at 20-49	9.38 ($\bar{x}_3 = 2.38$)	8.96 ($\bar{x}_3 = 2.38$)	9.73 ($\bar{x}_3 = 2.38$)	10.13 ($\bar{x}_3 = 2.38$)	8.78 ($\bar{x}_3 = 2.38$)
% firm at 50-99	2.53 ($\bar{x}_4 = 2.82$)	2.42 ($\bar{x}_4 = 2.82$)	2.63 ($\bar{x}_4 = 2.82$)	2.74 ($\bar{x}_4 = 2.82$)	2.38 ($\bar{x}_4 = 2.82$)
% firm at 100+	2.87 ($\bar{x}_5 = 3.63$)	2.74 ($\bar{x}_5 = 3.63$)	2.98 ($\bar{x}_5 = 3.63$)	3.10 ($\bar{x}_5 = 3.63$)	2.69 ($\bar{x}_5 = 3.63$)

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

6.4 Welfare analysis: conditional change

We measure the welfare cost or gain 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 if the agent lived through the transition to the new policy, compared to the initial steady-state. Put 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 pass the reform. This is a conditional welfare change because it is computed for an individual in a particular state. The welfare change is the consumption-equivalent variation (CEV), where the amount that an agent would pay to avoid the reform is the $\varpi(a, x, z, m, i_{HI})$ that solves the equation:

$$E_0 \Sigma_{t=0}^{\infty} \beta^t u \left([1 + \varpi(a, x, z, m, i_{HI})] c_t^* \right) = E_0 \Sigma_{t=0}^{\infty} \beta^t u \left(\hat{c}_t \right)$$

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

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

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

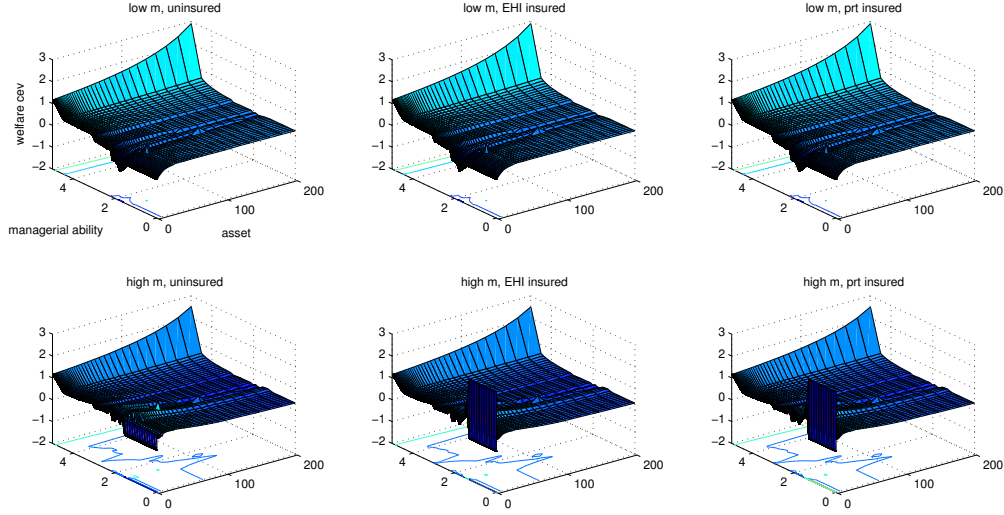Figure 5: Conditional welfare change, EHI expansion

Figure 5 shows the conditional welfare change for EHI expansion to 100% coverage. We 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 shock is high and individuals have baseline EHI or private insurance, we see that there are some welfare gains for the very poor with high ability, but overall EHI expansion largely favors high ability, high asset individuals because lump sum taxes are inconsequential for these agents. Table 4 shows that the lump sum taxes required to fund the EHI expansion program are lower (1.89%) than in the baseline case (2.2%), 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 4 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 4 shows that when individual gains and losses are summed over all agents there is essentially no net welfare change, with 41.69% of individuals having a positive welfare gain (CEV>0). The figure shows the distribution of gains and losses vary greatly, which a utilitarian sum treats equally.
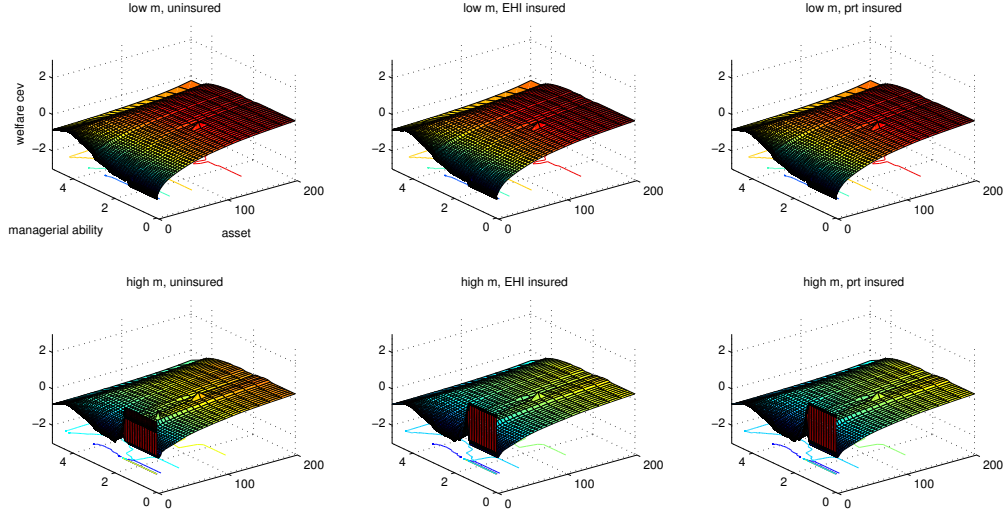
Figure 6: Conditional welfare change, HIX

Figure 6 shows the conditional welfare change for the health insurance exchange policy (HIX). We again consider two health shocks, high and low, and introduce HIX relative to the three insurance states for the individual: uninsured, baseline EHI insurance, and private insurance. The figure shows that the distribution is fairly flat, but losses are tilted toward low ability and low asset individuals. This is the case because low ability agents will generally be workers, whether they have high or low assets. Table 4 shows that workers' wages and earnings fall under HIX and taxes rise as a percentage of earnings, which explains their welfare losses. Entrepreneurs's earnings also fall. Aggregate welfare losses are -1.60 under HIX in table 4, with only 2.62% of individuals with a positive welfare gain (who have extremely low or high assets).

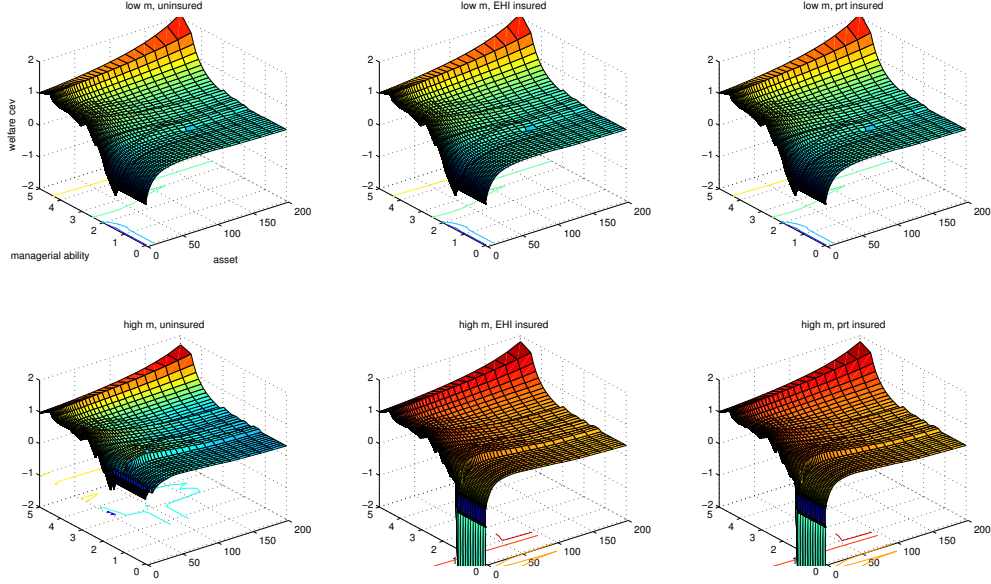Figure 7: Conditional welfare change, Universal Health Insurance

Figure 7 shows the conditional welfare change for universal health insurance. Again there are two health shocks, high and low, and we introduce universal health insurance relative to the three insurance states for the individual: uninsured, baseline EHI insurance, and private insurance. Overall, the figure shows that there are more positive welfare values relative to the previous two policies and losses are tilted toward low ability and low asset individuals. In general, high ability and high asset individuals gain from the policy. Low ability and low asset individuals suffer losses relative to the EHI baseline because now there is no subsidy and the lump sum taxes necessary to fund universal health insurance are high (6.64%) relative to the baseline (2.2%). Table 4 shows that there is an aggregate welfare gain of 0.37 and 68.71% of individuals have a positive welfare gain.

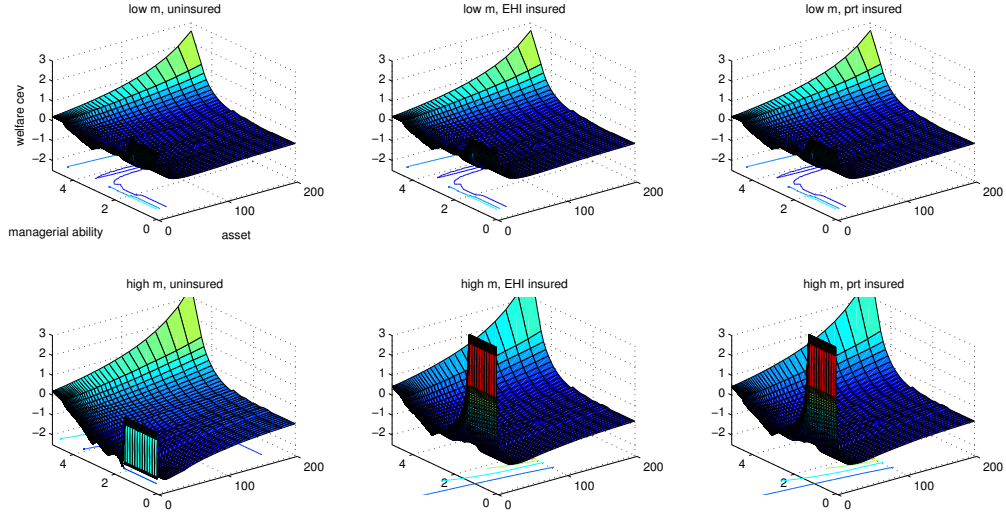Figure 8: Conditional welfare change, no EHI (private insurance only)

Figure 8 shows the conditional welfare change for the experiment where the current EHI baseline is dropped and there is only private insurance. Again there are two health care shocks, high and low, and we introduce private insurance (only) relative to the individual's three insurance states: uninsured, baseline EHI insurance, and private insurance. This policy gives an aggregate welfare gain of 0.23 in table 4, and 61.98% of people have positive welfare gains. Consistent with the observed pattern, this policy produces welfare gains for high ability and high asset individuals, and the gains can be substantial for some. The subsidies help the very poor, but overall the policy reduces welfare for lower ability and asset individuals.

6.5 Welfare and risk aversion: stationary distribution

Figure 9 shows the welfare of all individuals for all four policy changes when $\rho = 1.5$ and figure 10 shows the results when $\rho = 3$. As we would expect, when ρ increases from 1.5 to 3 welfare falls.

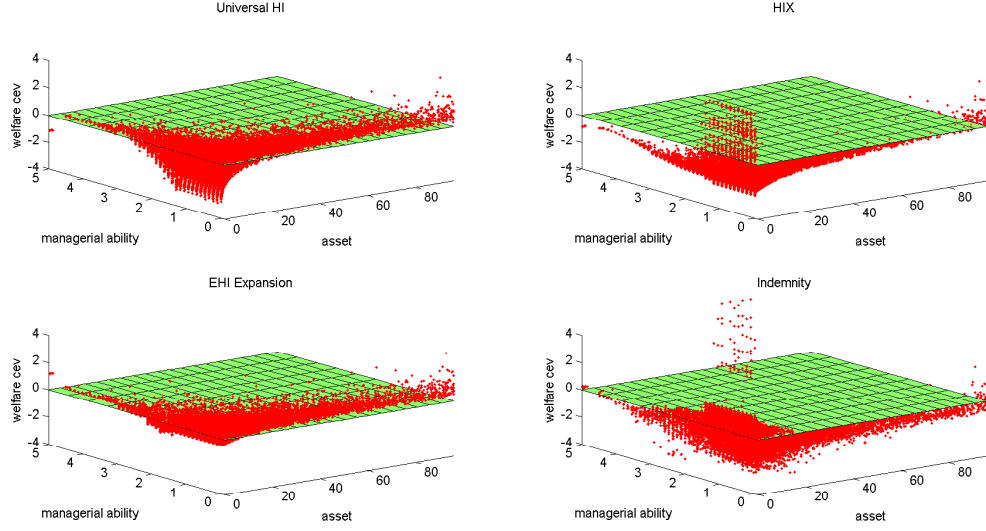Figure 9: Welfare in simulations, $\rho = 1.5$

Figure 10: Welfare in simulations, $\rho = 3$
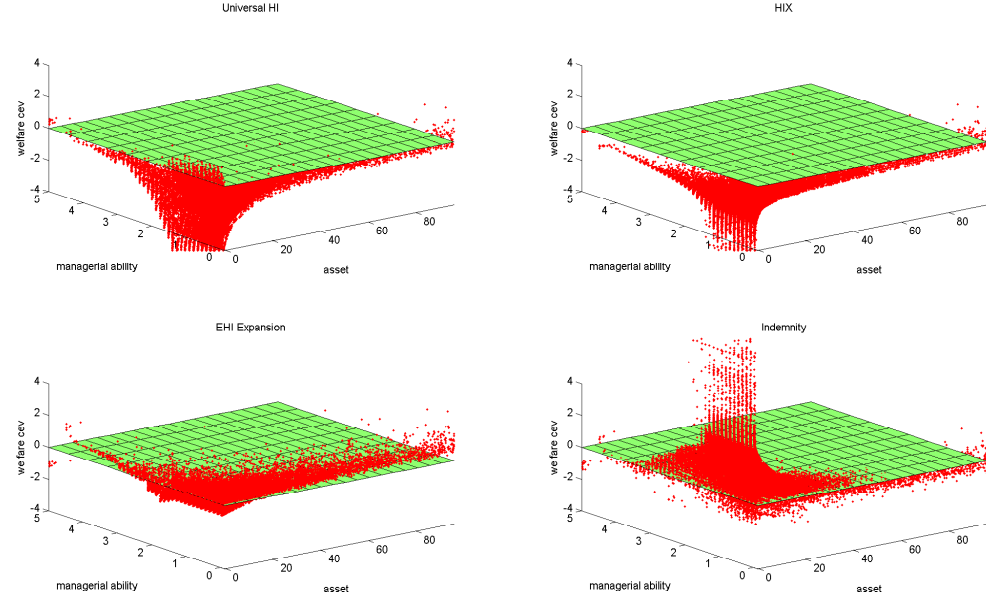
When $\rho = 1.5$, welfare is positive under universal health insurance except for the very poor with low ability. The program is expensive (the tax is 6.64% in table 4), and the very poor now pay the lump sum tax for insurance when they previously had subsidies in the baseline. This causes a decline in welfare for this group. Under the HIX policy virtually all of the very poor with low ability receive positive welfare gains ex ante due to the subsidized insurance.

Higher ability and asset (except for the very top) individuals suffer declines in welfare because the program increases their taxes. EHI expansion has essentially no net welfare change. Now all individuals have access to EHI at lower cost, but the very poor already had a consumption floor through social insurance. Finally, most agents have small welfare losses under the private insurance indemnity, but a few have large gains. This occurs because few agents choose to buy private insurance, but the few poor agents with insurance benefit greatly. Overall, the welfare losses are largest for poor and low ability agents.

When agents are relatively tolerant to risk ($\rho = 1.5$), some are willing to accept the protection provided by the social insurance that gives consumption floor $\underline{c}$. The take up rate is very low under private insurance, and many individuals choose to remain uninsured because private insurance is relatively expensive. When agents are more risk averse ($\rho = 3$), figure 10 shows that welfare switches to significantly negative values for the poor under universal insurance and HIX, and table 6 shows that taxes are high. Some individuals now value (slightly) the expanded EHI insurance regime, which provides insurance at the lowest cost. Under private insurance, the take-up rate is slightly higher when $\rho = 3$ and the poor value insurance because it is difficult for them to self-insure.

Table 6: Aggregate variables, $\rho = 3$

Statistics	Base	EHI exp	Universal	no EHI	HIX
K/Y	3.02	3.01	3.04	3.05	3.02
real r (%)	2.68	2.70	2.65	2.62	2.69
Aggregate output	100	100.1	100.3	100.4	100.1
Insurance take-up	76.52	99.98	99.98	39.17	97.13
Entrepreneur %	5.60	5.89	5.38	5.22	5.71
Ave x	1.73	1.70	1.74	1.75	1.74
Ave firm size	16.86	16.05	17.61	18.15	16.52
% at $\bar{c}$		2.75	1.18	7.11	1.01
Welfare		-0.08	-2.14	2.42	-2.06
% with CEV>0		38.42	35.51	93.5	0.23
tax/earn %	1.66	1.18	7.86	2.57	3.05

Statistics	Base	EHI exp	Universal	no EHI	HIX
% firm at 0-9	76.0 ($\bar{x}_1 = 1.53$)	70.34 ($\bar{x}_1 = 1.45$)	67.47 ($\bar{x}_1 = 1.48$)	66.67 ($\bar{x}_1 = 1.46$)	76.64 ($\bar{x}_1 = 1.54$)
% firm at 10-19	9.8 ($\bar{x}_2 = 2.05$)	16.11 ($\bar{x}_2 = 1.98$)	17.70 ($\bar{x}_2 = 1.98$)	18.11 ($\bar{x}_2 = 1.98$)	9.56 ($\bar{x}_2 = 2.05$)
% firm at 20-49	9.0 ($\bar{x}_3 = 2.38$)	8.51 ($\bar{x}_3 = 2.38$)	9.35 ($\bar{x}_3 = 2.38$)	9.61 ($\bar{x}_3 = 2.38$)	8.77 ($\bar{x}_3 = 2.38$)
% firm at 50-99	2.4 ($\bar{x}_4 = 2.82$)	2.28 ($\bar{x}_4 = 2.82$)	2.50 ($\bar{x}_4 = 2.82$)	2.55 ($\bar{x}_4 = 2.82$)	2.35 ($\bar{x}_4 = 2.82$)
% firm at 100+	2.7 ($\bar{x}_5 = 3.63$)	2.60 ($\bar{x}_5 = 3.63$)	2.85 ($\bar{x}_5 = 3.63$)	2.93 ($\bar{x}_5 = 3.61$)	2.68 ($\bar{x}_5 = 3.61$)

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

6.6 Policy Summary

We consider four distinct healthcare policies: (i) expand the current EHI system to 100% coverage, (ii) replace EHI with a private insurance indemnity (only), (iii) add a health care exchange

(HIX) to EHI, and (iv) replace EHI with universal insurance (only). These policies provide insight into the recent U.S. Affordable Care Act (ACA), a reform designed to increase the quality and affordability of health care, reduce the cost of healthcare, and lower the rate of uninsured. Tables 4, 5 and 6 and the figures show that significant differences exist among the four policies relative to the baseline economy.

Our model incorporates distortions in the U.S. economy that we take as given. First, the ACA mandates benefits, requiring insurance premia based on a community rating rather than individual risk characteristics, and it sets minimum coverage standards. Our expanded EHI experiment achieves 100% coverage by design, and under HIX and universal insurance nearly all individuals choose to have insurance. Second, there is a credit market friction, which we model as a standard interest rate wedge that is common across all policies. Third, EHI 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 administrative economies of scale. Given the environment, our results indicate that universal insurance and private indemnity insurance (no EHI) give the highest welfare gains (0.37% and 0.23% in table 4) when risk aversion is 1.5, and only private insurance gives positive net welfare when $\rho = 3$ (2.42% in table 6). Due to 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% in table 4 and 39.17% in table 6 for this ex ante insurance contract, and significant ex post insurance occurs in the form of a higher $\bar{c}$ of 8.44% when $\rho = 1.5$ (table 4) and 7.11% when $\rho = 3$ (table 6) that is paid for through the tax system when agents are hit with bad medical shocks. Notably, capital increases under the 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 6 under the indemnity, where the percentage of firms in the smallest size bin declines from 74.98% to 66.67%, and all other firm size bins increase.

Tables 4 and 6 show that expanded EHI is the least costly policy in terms of taxes because administrative economies of scale lead to the lowest tax burden and the percentage of people requiring social insurance falls from 3.53% to 1.73% when $\rho = 1.5$ and to 2.75% when $\rho = 3$. In addition to being tax advantaged, EHI has a better risk pool. Health care exchanges are a key feature of the ACA. Thus our HIX policy considers the case where individuals who do not have EHI can purchase insurance with subsidies given by the ACA (see table 1). A wedge exists between EHI and HIX because the exchanges are effectively subsidized private insurance.[17] Under universal health insurance households pay the highest lump sum tax for insurance and more people are driven to social insurance ex post than under expanded EHI ($\bar{c}$ is 1.93% under UI but only 1.73% under expanded EHI). The reason for the increase in $\bar{c}$ is that higher taxes

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[17]In our model if EHI is not offered, then the individual gets additional monetary compensation to buy insurance either on the HIX or privately, which are not perfect substitutes for EHI.

cause saving to decrease, and lower savings then cause more people with adverse shocks to hit the consumption floor because they are less able to absorb shocks.

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 wages. Understanding the nature of this misallocation is important because poorly designed health care policies can exacerbate distortions instead of correcting them.

The statutory goals of the ACA are to increase the quality and affordability of health care; reduce the cost of healthcare for individuals and the government; and lower the rate of uninsured. Subsidies make health care more affordable, accomplishing the first goal for some individuals.[18] We model two aspects of healthcare costs, the insurance premium paid by individuals and government subsidies and a public safety net. The computational experiments show that the policies have very different cost implications. The goal to reduce the rate of uninsured is accomplished by all policies except private insurance.[19] A separate goal stated by the Council of Economic Advisers (2009) is to reduce the healthcare "tax" on small firms to encourage entrepreneurship. Our occupational choice model shows that policy induced talent misallocation alters the endogenously determined distribution of firm sizes. While HIX policy leads to more small firms (as intended), interestingly these firms have lower productivity and welfare declines for most agents.

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 and we briefly consider three extensions. 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 healthcare insurance to provide insights about the evolution of health.

We focus on lump sum taxes because they do not distort occupational choice, and 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

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[18]We abstract from quality.

[19]We abstract from externalities such as communicable diseases and vaccinations, which would raise the socially optimal indemnity insurance rate. Sun and Yannelis (2015) measure the insurance premium externality of individuals who choose not to purchase insurance in an alternative context.

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.

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

Link between $p_E(n)$ and i_E

We model whether or not the firm offers insurance as a preference shock, where $i_E = 1$ indicates that the firm offers insurance and $i_E = 0$ indicates that the firm does not offer insurance. This section does two things: (i) we consider the firm's choice to offer insurance as the least costly compensation alternative, given its cost structure; and (ii) we link the random shock $i_E = \{0, 1\}$ approach that we use to observable outcome $p_E(n)$, which is the average probability that a firm in size bin j offers health insurance. 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

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

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 administrive cost of insuring workers in firm size bin j. Under actuarily fair insurance, the cost of insurance equals the expected health shock, which is the price that would be charged in a perfectly competitive market

$$q_E = \sum_{s=0}^{s} E\left[\pi_s \phi_s m_s\right],\tag{32}$$

where 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 $g(n)$,

$$q_E(n) = g(n)q_A^j + \sum_{s=0}^{s} E\left[\pi_s \phi_s m_s\right],\tag{33}$$

where shock q_A is uniformly distributed.[20] 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 such as $\frac{n^\theta}{n}$, which captures 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

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[20]Idiosyncratic 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.

$$EU[w + [1 + g(n)q_A] \, q_E] = EU[w + b].^{21}$$ 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,

$$w + \left[1 + g(n)q_A^j\right] q_E < w + b \tag{34}$$

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

$$\widetilde{w} = w + i_E \left[1 + g(n)q_A^j\right] q_E + (1 - i_E)b \tag{35}$$

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 $b = q_E$.[22]

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 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 (37)

$$\hat{q}_A = \frac{1}{g(n)} \left[\frac{b}{q_E} - 1\right] \tag{36}$$

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. Notice that by substituting values of $g(n)$ into the above equation we can 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 the Health Insurance Markup 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 actuarily fair insurance, the cost of insurance is equal to the expected health shock. This is the

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[21]This 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.

[22]The 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.

cost of insurance that would be offered in a perfectly competitive market.

$$q_E = \sum_{s=0}^{s} E\left[\pi_s \phi_s m_s\right]. \tag{37}$$

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.

$$q_E(n) = \lambda^j q_A + \sum_{s=0}^{s} E\left[\pi_s \phi_s m_s\right]. \tag{38}$$

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 deceases 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.

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

$$\max_n x^i k^\alpha n^\gamma - \left[i_E \left(w + (1 + \lambda(n)q_A - \psi) q_E\right) + (1 - i_E)(w + b_E)\right] n \tag{39}$$

The FOC is given as

$$n'(k, x, w) = \gamma x^i k^\alpha n^{\gamma-1} - \left[i_E \left(w + \left(1 + \lambda'(n)q_A - \psi\right) q_E\right) + (1 - i_E)(w + b_E)\right] = 0 \tag{40}$$

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 would be expressed as

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

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

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

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.[23] 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 (39) yields the manager's profit function for a given level of capital:[24]

$$y_i^j(k, x, w) = xk^\alpha \left[\frac{\gamma x^i k^\alpha}{i_E \left(w + \left(1 + \lambda^j q_A - \psi\right) c_E\right) + (1 - i_E)\left(w + b_E\right)} \right]^{\frac{\gamma}{1-\gamma}} \tag{41}$$

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

Derivation of $k*$

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:

$$\nu_i^j(a, x, i_E; w, r) = \max_{k \geq 0} y_i(k_i, x, w) - rk - \varphi \tag{42}$$

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

Substituting n_i^j into profits ν_i^j gives

$$\nu_i^{j*}(a, x, i_E; w, r) = (1 - \gamma)(xk)^{\frac{\alpha}{1-\gamma}} \left[\frac{\gamma}{i_E \left(w + \left(1 + \lambda^j q_A - \psi\right) c_E\right) + (1 - i_E)\left(w + b_E\right)} \right]^{\frac{\gamma}{1-\gamma}} \tag{43}$$

$$k_i^{j*}(x, w, r) = \left[x \left(\frac{\gamma}{i_E \left(w + \left(1 + \lambda^j q_A - \psi\right) c_E\right) + (1 - i_E)\left(w + b_E\right)} \right)^{\gamma} \left(\frac{\alpha}{r}\right)^{1-\gamma} \right]^{\frac{1}{1-\alpha-\gamma}} \tag{44}$$

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

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

$$\left[i_E\left(w + \left(1 + \lambda^j q_A - \psi\right) c_E\right) + (1 - i_E)\left(w + b_E\right)\right] n(k^*, x, w) - rk^*$$

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[23]One way around this is to consider the economies-of-scale effect λ being 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.

[24]This will adjust with EHI offering status, since EHI benefits from a tax subsidy.

The manager's consumption is determined as follows.

$$c + a' + (1 - i_{HI}\phi)\, m + \tilde{\pi} \leq (1 + r)a + \nu_i(k^*, x, w) - Tax + T_{SI} + \tau_s i_E \pi_E \qquad (45)$$

where

$$\tilde{\pi} = \begin{cases} \pi_E & i'_{HI} = 1, i_E = 1 \\ \pi_P(m) & i'_{HI} = 1, i_E = 0 \\ 0 & i'_{HI} = 0 \end{cases} \qquad (46)$$

$$T_{SI} = \max\left\{0, \underline{c} + Tax + \tilde{\pi} - \tau_s i_E \pi_E + (1 - i_{HI}\phi)\, m + (1 + r)(k - a) - \nu_i(k^*, x, w)\right\} \qquad (47)$$

$$a' \geq -\bar{a}. \qquad (48)$$

$$l \leq (1 - \Delta)\frac{\nu_i(a, x, w) + rk^*}{1 + r} - oop \qquad (49)$$

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

$$oop = (1 - i_{HI}\phi(m))\, m. \qquad (50)$$

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. However, they can borrow 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 $a + \bar{l}$. Notice the borrowing limit $\bar{l}$ is endogenous, see equation (49). Accordingly, the credit constrained firms have borrowing that is determined by the equation as follows.

$$\tilde{\nu}^{j^*}(\tilde{k}, x, w) = x\tilde{k}^\alpha \tilde{n}^\gamma - i_E\left(w + \left(1 + \lambda^j q_A - \psi\right)q_E\right)\tilde{n} + (1 - i_E)(w + b_E)\tilde{n} - ra - (1 + r)\bar{l} \quad (51)$$

where

$$\tilde{k}^j = a + \bar{l} = a + \frac{\tilde{\nu}^*(\tilde{k}, x, w) + ra + (1+r)\bar{l}}{(1+r)}(1 - \Delta) - oop \tag{52}$$

$$\tilde{n}^{j*}(\tilde{k}, x, w) = \left[\frac{(1-\alpha)x^i \tilde{k}^\alpha}{i_E\left(w + (1 + \lambda^j q_A - \psi)\, q_E\right) + (1 - i_E)\left(w + b_E\right)} \right]^{\frac{1}{1-\gamma}}. \tag{53}$$

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

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

where $\tilde{k}^{j*}$ is the solution to equation (51).

Proofs of propositions

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

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 $\Phi^0 = \left(r^0, w^0, \pi_E^0, \hat{p}_E^0, \tau_y^0\right)$. Solve for optimal household behavior:

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

   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 $V^0\left(\theta; \Phi^0\right)$ and policy functions $f^0\left(\theta; \Phi^0\right)$.

   (b) Update value and policy functions:

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

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

   (c) Stop if $\max\left\{\left|V^1 - V^0\right|, \left|f^1 - f^0\right|\right\} \leq \epsilon$. 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 $\left(a_0^j, x_0^j, z_0^j, m_0^j, i_{E,0}^j, i_{HI,0}^j\right)$, 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 $\left\{a_t^j, x_t^j, z_t^j, m_t^j, i_{E,t}^j, i_{HI,t}^j, \mathcal{I}_w^j, \mathcal{I}_e^j, n^j, k^j\right\}_{t=0}^{T}$.

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

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

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

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

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

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

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

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