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RESEARCH ARTICLE

Funding employer-based insurance: regressive taxation and premium exclusions

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Abstract
In the US, health insurance is linked to employment. The tax code treats health insurance premiums preferentially for employers, but not individuals. We show that this regressive policy reduces talent mis-allocation in two ways: (i) The larger tax benefit to those with higher health risk and managerial talent, conditional on being entrepreneurs, alters the incentive to be an entrepreneur. (ii) This enlarges the tax base, which reduces the effective tax rate, and increases wage and capital income. Our general equilibrium model with heterogeneous agents shows that the subsidy can increase welfare, with a maximum gain of 0.46% in consumption equivalent variation.

Keywords Employer-based health insurance · Entrepreneurship · Regressive tax · Imperfect information · Mis-allocation

JEL Classification E23 · I10 · O40

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1 Introduction

In the United States, the amount that employers pay for workers' health insurance is excluded from workers' taxable income, providing a subsidy to employment-based health insurance (EHI).[1] Individuals who buy insurance privately do not enjoy this tax break. This EHI subsidy is criticized for two reasons. First, excluding EHI premiums from taxation reduces federal tax revenue, constituting the single largest tax break in the federal tax code; CBO (2018) estimates foregone revenue of $300 billion in 2018. Second, the policy is regressive because income tax rates are progressive.[2] The US has a mix of employment-based health insurance and private health insurance for the working age population. EHI is required by law not to discriminate among employees based on health status, which reduces adverse selection in the EHI market. In the private insurance market, where no such requirement exists, insurance companies have an incentive to price-discriminate and offer favorable terms to individuals at lower risk for high health expenditure shocks. Private health insurance, therefore, leads to less pooling, less risk sharing, and higher premiums. Small firms are more likely to rely on the private health insurance market. Empirically, health expenditure shocks are large and persistent in the US relative to other countries (OECD Health Statistics 2017), adding to the importance of the problem.

This paper focuses on misallocation that may arise in an individual's choice to work as an entrepreneur or employee. Entrepreneurs have three health insurance options: (i) Operate a firm, cover the entrepreneur, and offer EHI to workers. (ii) Purchase insurance for the entrepreneur on the private market and not offer EHI to workers. (iii) Remain uninsured (e.g., if private insurance is too costly). Individuals differ in their abilities as managers and workers and in their health risk. Some individuals with high health risk who have high ability to manage a firm may choose to work as employees with EHI coverage. They may forgo becoming entrepreneurs if health insurance on the private market does not exist or is sufficiently expensive. Our paper provides the first quantitative analysis of the impact of regressive tax policy on this occupational misallocation. The current regressive US tax policy that permits a tax exemption for employment-based health insurance premiums can partially correct this type of occupational misallocation because it is equivalent to a subsidy to individuals with high managerial talent but adverse health shocks, conditional on being an entrepreneur.

We evaluate tax policy in an occupational choice model where individuals have heterogeneous ability as workers and entrepreneurs and health expenditure shocks. They choose either to operate a firm or become a worker, and crucially EHI is linked with employment. Section 2 explains that EHI emerged in response to wage and price controls imposed after World War II rather than by explicit policy design. We take this

[1] Employer contributions to employee health insurance are deductible to the employer and non-taxable to the employee. See Cogan, Hubbard and Kessler (2011).

[2] For example, consider two individuals A and B who pay $10,000 for identical insurance. A has higher income with a 30% tax rate, and B has lower income with a 10% tax rate. This policy is regressive because individual A excludes $3000 from her taxable income, while B excludes only $1000. See https://www.taxpolicycenter.org/briefing-book/how-does-tax-exclusion-employer-sponsored-health-insurance-work.

system as given, and the fact that the link between health insurance and employment creates a wedge between the marginal cost and benefit of choosing to be a worker.

Two types of occupational misallocations can occur: some individuals with high managerial ability and adverse health shocks leave entrepreneurship to work at firms with EHI, while individuals with intermediate managerial skill but favorable health shocks opt to manage firms. In an important paper, Jeske and Kitao (2009) studied adverse selection in the health insurance market in a quantitative macro model and found that regressive policy can improve risk sharing. They showed that regressive EHI subsidies hold the insurance risk pool together, by inducing individuals with better health risk profiles to remain in the insurance market. We extend their approach by introducing a new channel through which this regressive policy can improve welfare - alleviating occupational misallocation.

Despite active policy debate and the importance of entrepreneurs to the macroeconomy, there is a surprising lack of analysis of the effect of health insurance tax policy on entrepreneurship. Our paper fills this gap by building a general equilibrium model with occupational choice, Markov health expenditure shocks, a health insurance decision, and an endogenously determined managerial ability distribution that is affected by tax policy associated with health insurance. We extend the general equilibrium model of occupational choice in Chivers et al. (2017), which has lump sum taxes, to non-linear taxation in order to model this regressive tax policy. In the Chivers et al. model individuals choose to earn income either as a worker or an entrepreneur. Each individual has an idiosyncratic talent for entrepreneurship, which is the ability to manage labor and capital, idiosyncratic labor productivity as a worker, and idiosyncratic health risk. We use the model to estimate the size of occupational misallocation, and show how nonlinear health insurance taxes and subsidies can be used to improve welfare. The key mechanism is that nonlinear taxes alter the distribution of entrepreneurial talent in the economy (i.e., the mix of occupations). Appropriate taxes and subsidies induce some highly skilled individuals with adverse health shocks to become entrepreneurs. Analogously, individuals with intermediate managerial skill but favorable health shocks, who would otherwise opt to manage firms, optimally choose to become workers.

In an economy with heterogeneity and imperfect information, non-linear income taxes involve a classical tradeoff. On one hand, a progressive tax system counteracts inequality in initial conditions and can substitute for imperfect insurance against idiosyncratic risk. This insurance motive associated with taxation is well understood: progressive income taxes allow a government to redistribute from rich to poor individuals or from those who experience good versus bad expenditure shocks. On the other hand, progressive taxes reduce the incentive of more able individuals to participate (e.g., work). Given these two effects, it is generally optimal for the most able agents to pay a relatively lower marginal tax rate to keep them in the market. This regressive optimal tax structure expands the tax base and allows marginal taxes to be lowered for the remaining individuals.

The fact that the EHI premium can be excluded from taxable income makes US health insurance tax policy regressive. An individual with a propensity for high health risk and high managerial skill will benefit more from this favorable tax treatment of EHI, and has a stronger incentive to become an entrepreneur than an individual with a propensity for better health shocks and lower managerial skill. Compared with an agent with intermediate skill, one with higher skill will earn a larger profit as an entrepreneur, which means a larger tax subsidy from the EHI premium (higher income falls into a higher tax bracket). Furthermore, due to the more favorable health risk, the better health shock profile-medium skill individual may optimally choose to forgo insurance or obtain health insurance in the private market when she chooses to be an entrepreneur. In either case, the EHI subsidy is not applicable, which reduces the incentive to become an entrepreneur. Consequently, the regressive tax counteracts the misallocation associated with EHI.

We use the model to conduct several counterfactual policy experiments. First, we conduct a "flat rate subsidy" experiment: We use the average tax rate from the benchmark model, which fixes the subsidy at this rate. For example, in an economy with two individuals and an EHI premium of \$10,000, if the marginal tax rate is 10% the deduction is \$1000 and if the tax rate is 30% the deduction is \$3000. Instead, in this experiment we fix the tax at a common rate of about 20%, so that each individual gets a common fixed deduction. Our flat rate subsidy experiment is similar to Jeske and Kitao's (2009) experiment in which they give all agents a common lump sum subsidy. They find that this improves welfare by 0.07% CEV. In contrast, we find a negative impact of 0.08% when we incorporate occupational choice. In Jeske and Kitao's model the welfare gain accrues solely from better risk sharing. Our model accounts for both gains from better risk sharing and losses from occupational misallocation. Under the assumption that the models and experiments are similar, comparing the results provides an estimate of the welfare effect of misallocation, which is 0.15% in the flat rate subsidy experiment (0.07% CEV gain from risk sharing in Jeske and Kitao less the 0.08% loss from occupational misallocation in our model.)

Experiment 1 fixes the subsidy on EHI (only). Experiment 2 extends the subsidy to the private sector, as Jeske and Kitao do in a subsequent experiment. We find a welfare gain of 0.34% CEV, while Jeske and Kitao found 0.24% CEV. The welfare gain in our model is higher because we consider both the gain from reducing misallocation and better risk sharing, while Jeske and Kitao consider only risk sharing. Assuming that the models and experiments are similar except for occupational choice, experiment 2 provides an alternative estimate of the welfare effect of misallocation of 0.34 – 0.24 = 0.1. In summary, experiments 1 and 2 provide estimates of the welfare gain associated with this regressive tax policy. Under current US policy, measured in CEV, the welfare estimates are 0.1 to 0.15, respectively.

Experiment 3 analyzes the optimal subsidy and provides an estimate of the maximum welfare gain. The current US subsidy parameter is 0.151, and we find that the optimum is about 0.4. In other words, increasing the progressiveness of the subsidy (equivalently, regressiveness of the tax policy) would improve welfare by about 0.7%. This measure again incorporates the risk sharing and talent allocation effects. Under the assumption that the models and policies are similar except for occupational choice, we again use the risk sharing estimate from Jeske and Kitao (0.24%) to isolate an estimate of the maximum effect. We find that 0.7–0.24 = 0.46, is the maximum gain in welfare that would arise if the subsidy were set at the optimal level rather than at the current US level.

We also consider a universal health insurance policy in which all individuals are covered by a government funded insurance scheme. This policy eliminates talent misallocation as it breaks the link between the health insurance decision and occupational choice, which comes with a cost of slightly rising inequality as the entrepreneur's earning increases with their productivity. The policy improves risk sharing against medical expenditure shocks, and it generates significant welfare gain.

Our paper takes as given limited information, the absence of perfectly discriminating taxes, and the historical structure of the US EHI system. Governments observe income, but not health expenditure shocks or managerial ability. Therefore, direct corrective intervention to ameliorate misallocation is difficult. A government would like to subsidize individuals with high managerial ability that are at greater risk for large health expenditure shocks or tax those with less managerial talent and more favorable shocks; it cannot because the government does not observe ability and health risk directly. We show that a regressive policy can improve the talent distribution, and hence output and welfare. Of course these results would not hold if perfect information, perfectly discriminating taxes, and perfect insurance were possible.

The paper is organized as follows. Section 2 summarizes stylized facts and describes the policies. Section 3 builds a simple endowment model to illustrate the intuition. Section 4 develops a general equilibrium model that is consistent with the facts. Section 5 describes optimal behavior and the equilibrium. Section 6 contains the model calibration and quantitative analysis is performed in Sect. 7. Section 8 concludes.

2 Facts

A unique feature of the US health care system is that over 90% of working-age Americans obtain health insurance through employers. U.S. law requires employers to offer health plans at common prices to all employees. The EHI premium is deductible from employees' taxable income, which is subject to a progressive income tax. Consequently, this tax policy is regressive because high-income individuals face a higher marginal tax rate and receive a larger tax break for insurance purchase than lower income individuals.

In 2010 the US passed the Patient Protection and Affordable Care Act (PPACA), which represents the most significant regulatory overhaul of its health care system since the creation of the Medicare and Medicaid programs in 1965.[3] Despite uncertainty about the future of the US health insurance system, most working-age American continue to rely on EHI for coverage. We summarize some stylized facts.

Fact 1: The US healthcare system is largely employment based (over 90%).

Buchmueller and Monheit (2009) discuss two government decisions that cemented the link between employment and health insurance: (i) During World War II the US 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 firms 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 tax code.

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

Fact 2: 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 based on *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 address market incompleteness, e.g., individuals do not choose genetic risk. Adjusted community ratings permit lifestyle factors such as smoking status to be considered.

Fact 3: The EHI premium is deductible from taxable income and treats workers and entrepreneurs asymmetrically.

The EHI exclusion reduces federal tax revenues by about \$300 billion, and is by far the largest federal tax expenditure; see CBO (2018). Total tax revenue from the EHI exclusion, denoted "Tax," has two parts, a non-linear income tax, $T(inc)$, and a payroll tax, $\tau_s\,[payroll]$:

$$Tax = T(inc) + \tau_s\,[payroll]$$

First, $T(inc)$ is a non-linear income tax: inc denotes (labor income + capital income $-\mathbf{1}_{\mathbf{subsidy}}$premium), where $\mathbf{1}_{\mathbf{subsidy}}$ is an indicator function. The compensation for each occupation is:

- Workers: wage income + insurance − T(wage income + capital income − $\mathbf{1}_{\mathbf{subsidy}}$premium).
- Entrepreneurs: firm profit−T(profit income+capital income−$\mathbf{1}_{\mathbf{subsidy}}$premium).

When the EHI premium is excluded from income, the indicator function is one. A high health risk-high skill individual will benefit more from this favorable tax treatment of EHI and has a stronger incentive to become an entrepreneur than a low health risk-medium skill individual. Compared with a medium skilled agent, the high skilled will earn a bigger profit as an entrepreneur, which means a larger tax subsidy from the EHI premium as this income will fall into a higher (progressive) tax bracket. In addition, due to the more favorable health risk, the low health risk-medium skill individual may optimally choose to self-insure (i.e., forego insurance) or to obtain health insurance in the private market when he chooses to be an entrepreneur. In either case, the EHI subsidy is not applicable, which reduces the incentive to become an entrepreneur.[4] Second, in most cases workers can deduct payroll taxes, $\tau_s\,[payroll]$, but entrepreneurs cannot. The payroll tax is for Social Security and Medicare (publicly

[4] As a consequence, the regressive tax associated with EHI counteracts the misallocation inherent in linking health insurance with employment. In the absence of a subsidy, the indicator function is zero and a low health risk individual may become an entrepreneur even without high managerial ability. This occurs if the profit from running a firm exceeds the monetary value of a worker's wage plus EHI. Such an individual does not value EHI, but firms are required to provide insurance for workers above a certain firm size. In contrast, an individual with adverse health expenditure shocks but higher managerial ability may become a worker due to the high personal (but not publicly observable) value of insurance.

provided retirement benefits and healthcare benefits for those at least age 65 or disabled and who paid into the system).

On the margin, an individual making a choice between two occupations is choosing between two compensation packages. Tax policy treats workers and entrepreneurs asymmetrically because workers can deduct the insurance premium from $T(inc) + \tau_s[payroll]$ but entrepreneurs can only deduct the insurance premium from $T(inc)$. Because the exclusion reduces taxable income, it is more beneficial to taxpayers in higher tax brackets than those facing lower tax rates. Importantly, workers and entrepreneurs are treated differently as a class in the tax code, but US law prohibits contracts that discriminate among individuals based on personal characteristic such as health status for EHI.[5]

Fact 4: EHI affects occupational choice.

Empirically, health insurance and individual health status affect self-employment. Fairlie et al. (2011) find that business ownership rates increase at age 65 when individuals qualify for Medicare. Using a panel of tax returns from 1999 to 2004, Heim and Lurie (2010) find that an increase in the deductibility of health insurance premiums for self-employed individuals (originating from the Tax Reform Act of 1986) increased the probability of being self-employed by 1.5 percentage points. Wellington (2001) estimates that a guaranteed alternative source of health insurance would increase the probability of self-employment in the workforce by 2 to 3.5 percentage points, based on 1993 Current Population Survey (CPS) data.[6]

Jackson et al. (2019) find that small business owners and self-employed individuals are about three times as likely to purchase PPACA Marketplace coverage as workers. Twenty percent of PPACA Marketplace consumers were small business owners or self-employed in 2014. Middle and lower-income Americans who buy coverage through the Marketplace are eligible for tax credits to make coverage affordable. They report that about 65 percent of small business owners and 69 percent of all self-employed or independent workers have incomes below $65,000, the group most likely to rely on the PPACA Marketplace for health insurance. Overall coverage purchased in the Marketplace increased by about 50 percent between 2014 and 2015, and increased further in 2016. Jackson et al. (2019) Fig. 3 shows that the percentage of self-employed increased over the period 2000 to 2014 and Table 4 shows a similar pattern for self-employed, sole proprietors, and small business owners.

5 The Tax Reform Act of 1986 (TRA86) took the first step toward equalization by allowing self-employed workers to deduct 25 percent of their premiums from income prior to calculation of adjusted gross income (AGI). This percentage was increased to 30 percent in 1996, and rose to 40 percent in 1997, 45 percent in 1998, 60 percent in 1999-2001, 70 percent in 2002, and finally 100 percent in 2003. Despite these changes, subsidies for the self-employed are lower than for workers because premiums remain subject to a self-employment tax.

6 Using MEPS data for the period 2000–2008, Gai and Minniti (2015) find that poor individual or family health status is associated with a lower likelihood of self-employment. Most people who transition from employed worker to self-employed have better health status measured by total medical expenditure, presence of disease, illness or disability. DeCicca (2012) finds that New Jersey's Individual Health Coverage Plan, implemented in 1993 with an extensive set of reforms that loosened the link between employment and health insurance, increased self-employment in NJ by 14-20%. Individuals with lower health status had larger behavioral responses to policy changes.

3 Simple endowment economy to build intuition

We first present a simple model of occupational choice with endowments.[7] Households have a common utility function given by $U(\cdot)$. If an agent chooses to operate a firm she receives a random return of consumption good, and if she chooses to be a worker she receives a possibly different random return. Heterogeneity is described by three shocks:

- Managerial ability x: units of consumption good if the agent chooses to be an entrepreneur. For each agent i, x^i is drawn from a uniform distribution $x \in [\underline{x}, \bar{x}]$.
- Labor productivity z: units of consumption good if the agent chooses to be a worker.
- Medical expenditure shock m: agent health spending (in consumption good), with $m \in \{\underline{m}, \bar{m}\}$. Each household receives the low health spending shock $\underline{m}$ with probability p, which is drawn from a uniform distribution $p \in [\underline{p}, \bar{p}]$. Agent health type p is unobservable to the firm and insurance company.

Consider an extreme example, where workers can buy health insurance coverage either from their employer (EHI) or in a private market. Entrepreneurs can purchase health insurance only in the private market.[8] EHI offers a pooling price π_E and is actuarially fair. Private health insurance sets a price $\pi(p)$ based on the agent's type p. Both types of health insurance are subject to perfect competition and charge an actuarily fair premium to cover health expenditures. Assume that risk aversion is sufficiently strong that every individual will enroll in either EHI or private health insurance. To simplify the exposition, we assume that all workers purchase EHI (e.g., due to the subsidy). The health shock is independent of the managerial ability and labor productivity shocks. Hence we can derive the price of each type of health insurance as follows:

- EHI Insurance premium: $\pi_E = \frac{\int_{\underline{p}}^{\bar{p}} (x^*(p)-\underline{x})(p\underline{m}+(1-p)\bar{m})dp}{\int_{\underline{p}}^{\bar{p}} (x^*(p)-\underline{x})dp}$, where an agent with $x < x^*(p)$ becomes a worker and chooses EHI, $\left(x^*(p) - \underline{x}\right)$ is the measure of insured workers with health type p.
- Private insurance premium: $\pi(p) = p\underline{m} + (1 - p)\bar{m}$.

We consider three variations for this simple model.

Economy A. autarky (no EHI or private insurance) The agent's occupation choice hinges on the following equation:

$$p\cdot u(x - \underline{m}) + (1 - p)\cdot u(x - \bar{m}) \gtreqless p\cdot u(z - \underline{m}) + (1 - p)\cdot u(z - \bar{m})$$

The left (right) hand side represents the expected payoff of being an entrepreneur (employed worker). Clearly there is a cutoff value of $x_A^*(p) = z$ so that agents with

[7] We base this section on comments provided by Soojin Kim.

[8] We use this extreme assumption in this section solely to capture the fact that small business owners face higher insurance costs. We make this simplification in this example to build intuition. In the full model we match US data on entrepreneur and worker access to EHI. The two expenditure shocks will also be extended to match health insurance data from the US economy.

managerial ability higher than $x_A^*(p)$ will become entrepreneurs. In Fig. 1, we plot the equilibrium frontier of occupation choice $x_A^*(p)$. Note that the vertical line is independent of the agent's health type p.

Economy B. EHI, private insurance and talent misallocation Now introduce EHI into economy A. By assumption workers have access to EHI or private market insurance, while entrepreneurs have access only to the private market. Similarly, we find a cutoff value for occupational choice from the following equation:

$$u(x - \pi(p)) \gtreqless u(z - \pi_E).$$

Clearly, $x_B^*(p) = z - [\pi_E - \pi(p)]$. Note that $\pi_E = \frac{\int_{\underline{p}}^{\bar{p}} (x^*(p)-\underline{x})(p\underline{m}+(1-p)\bar{m})dp}{\int_{\underline{p}}^{\bar{p}} (x^*(p)-\underline{x})dp} > \bar{p}\underline{m} + (1-\bar{p})\bar{m} = \pi(\bar{p})$ and $\frac{\int_{\underline{p}}^{\bar{p}} (x^*(p)-\underline{x})(p\underline{m}+(1-p)\bar{m})dp}{\int_{\underline{p}}^{\bar{p}} (x^*(p)-\underline{x})dp} < \underline{p}\underline{m} + (1-\underline{p})\bar{m} = \pi(\underline{p})$. This happens as $\left(p\underline{m} + (1-p)\bar{m}\right)$ decreases in p, and π_E equals the average health spending shock $\left(p\underline{m} + (1-p)\bar{m}\right)$ weighted by the measure of workers $\left(x^*(p) - \underline{x}\right)$. Since $\pi(p)$ is continuous in p, it follows immediately that there exists a cutoff value p^* such that $\pi_E = \pi(p^*)$. Let's consider individuals whose ability is given as $x = z$. Among them, only healthier agents with $p > p^*$ will become entrepreneurs as $z - \pi(p) < z - \pi_E$. We also have $x_B^*(\underline{p}) > x_A^*(\underline{p})$ and $x_B^*(\bar{p}) < x_A^*(\bar{p})$. These imply that, compared with economy A, introducing EHI creates two types of misallocations. Agents with

- better health (with $p \to \bar{p}$) and lower ability ($x_B^*(p) < x_A^*(p)$) enter entrepreneurship;
- worse health (with $p \to \underline{p}$) and higher ability ($x_B^*(p) > x_A^*(p)$) exit entrepreneurship;

Figure 1 shows that linking employment with health insurance distorts occupation choice by rotating the equilibrium frontier.

Economy C. EHI, private insurance and a subsidy Next we introduce a subsidy to the purchase of EHI and private insurance. To mimic the regressive subsidy (i.e., premium exemption), assume that the government pays a subsidy of $\alpha z \pi_E$ for EHI and a subsidy of $\alpha x \pi(p)$ for private insurance. Here a higher $\alpha > 0$ means a more regressive subsidy, while $\alpha < 0$ represents a progressive tax. The cutoff value follows from the equation:

$$u(x - \pi(p) + \alpha x \pi(p)) \gtreqless u(z - \pi_E + \alpha z \pi_E).$$

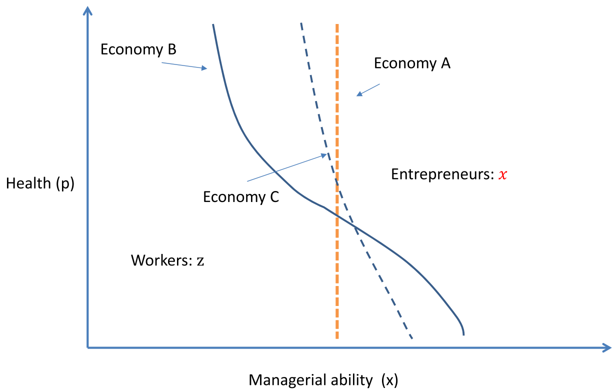

Fig. 1 Talent misallocation and regressive tax

We find that $x_C^*(p) = \frac{z-\pi_E+\pi(p)+\alpha z\pi_E}{1+\alpha\pi(p)}$. It is straightforward to show that $x_C^*(p) - x_B^*(p) > 0$ for larger p, and $x_C^*(p) - x_B^*(p) < 0$ for smaller p. This means that this extended subsidy corrects both types of misallocations.[9]

Summary This simple example shows how talent misallocation occurs when entrepreneurs face a higher cost to obtain EHI than workers. Figure 1 shows that a regressive tax can partially restore efficiency by rotating the equilibrium frontier of occupation choice toward the first best allocation in economy A. In the next section we extend the endowment economy to a dynamic general equilibrium model. We replace the extreme EHI insurance cost asymmetry used in this example by a setting that mimics key features of the U.S. economy. Specifically, health insurance is linked to employment and EHI premia are tax advantaged relative to private insurance.

4 Dynamic general equilibrium model: economic environment

In this section, we extend the basic endowment economy in Sect. 3 to a general equilibrium model in order to evaluate how counterfactual policies affect output, productivity, factor prices, and the distribution of managerial ability in the economy. The economy has incomplete markets, distortionary taxes, and ability is unobservable. We use a Lucas (1978) span of control production technology. Individuals differ in the ability to manage capital and labor, with productivity x^i for each agent i drawn from a common continuous cumulative probability distribution with $x \in [0, \infty)$. Productivity is not hereditary. Households also receive an idiosyncratic labor productivity shock z that indicates the efficiency units per unit of work hours. All agents face an idiosyncratic health expenditure shock m_t^i, which follows a finite-state Markov process. For

[9] There is a tradeoff associated with the regressive subsidy because financing it requires additional tax revenue. This introduces further distortions into the economy. We take up this issue in the dynamic model.

notational convenience, we drop agent superscript i and time subscript t whenever possible, and φ' denotes the future value of the variable φ.

As in Chivers et al. (2017) two types of individuals emerge in equilibrium, workers and managers. Section 4.1 specifies the economy and Sect. 4.2 provides intuition for the equilibrium frontier of occupational choice, x^*, where individuals above this value choose to be managers and those below it are workers.

4.1 Preferences, endowments, technology, insurance and government

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 labor productivity z, which are random variables specified in Sect. 6. The distributions are known, but realizations are not publicly observable. 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. They have one unit of time that they supply inelastically to the firm as a worker.

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. Note that $\hat{n} = 1$ in equilibrium. Capital depreciates at a constant rate of δ. Managers can operate only one project. The functional form of the production function is:

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

Firm productivity is given by $X = x^{1-(\alpha+\gamma)}$. We assume $\alpha + \gamma < 1$.

Factor remuneration, capital Firms rent capital at the common market rate $r - \delta$, where r is the risk-free rate and δ is depreciation.

Factor remuneration, labor Firms offer workers a compensation package $\widetilde{w}$ that includes a monetary wage w and a term that accounts for the expected cost of insurance q_E.[10] Workers supply labor inelastically at the given wage package $\tilde{w}$. We build our model to be consistent with the EHI system in the US, which we take as given (see Sect. 2).

In order to simplify and match our model to observable data, we assume that each firm offers EHI with given probability p_E, determined by random shock i_E. Consistent with the data, $p_E(n)$ is a function of n such that the probability of having EHI increases with firm size n.[11]

[10] This is equivalent to a model where the firm offers a monetary wage w and subtracts the cost of EHI from the wage rate. See Jeske and Kitao (2009).

[11] This is equivalent to modeling the EHI offer decision as a preference shock. See Aizawa and Fang (2020) or Nakajima and Tuzemen (2016).

- The firm's expected cost of providing EHI is $p_E\,[1+g(n)]\,q_E$. Function $g(n)$ is decreasing in firm size n and accounts for the fact that it is more costly for small firms to offer health insurance than large firms.
- We assume that when insurance is not offered, which happens with probability $1-p_E$, firms compensate employees for the average cost of providing EHI, q_E.

Thus, total labor compensation is given by[12]

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

Health insurance market Consistent with the facts in Sect. 2, there are two types of insurance, EHI and private.

EHI Employment-based insurance has the following features.

- π_E: The EHI premium does not depend on an individual's prior health history or individual states). In the US group health insurance cannot price-discriminate by law among the insured based on individual characteristics (i.e., community rating, facts 1 and 2).
- $\phi(m)$: The co-insurance rate specifies the fraction of total medical expenditures covered, where $\phi(\cdot)$ is a mapping $m \to [0, 1]$.
- $\psi \in [0, 1]$: The fraction of the premium the employer pays (part of employee compensation).
- $\hat{p}_E$: The probability that a worker has access to EHI, 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. We use random matching because it makes employment history irrelevant (i.e., it is not necessary to keep track of which worker worked for which firm). [13]

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. This can also happen if a household becomes a manager and does not offer (or has no access to) EHI.

- $\pi_P(m)$: The private insurance premium depends on private medical expenditure shocks.
- $\phi(m)$: The coinsurance rate is the fraction of total medical expenditures covered.

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 the private market) or remain uninsured ($i'_{HI} = \{0, 1\}$).[14] Health insurance companies are competitive. The premiums

[12] Chivers et al. (2017) show that the decision to offer health insurance can be endogenized and link the equation for compensation to observable data.

[13] Chivers et al. (2017) consider two type 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. They also consider a cost shock, an alternative approach that endogenizes the insurance offer.

[14] 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. There are two advantages to EHI compared with private insurance:

(i) The government gives EHI a tax subsidy, which is more cost-efficient for firms (see below).
(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 funds three programs.

- Public safety-net program, T_{SI}, to guarantee households minimum consumption level $\underline{c}$: US households can use public transfer programs such as food stamps, Medicaid, disability and unemployment insurance if substantial income and health expenditure shocks occur.
- EHI premium exclusion: In the baseline model, the government subsidizes EHI by excluding premiums from payroll tax and income tax. Entrepreneurs can deduct private market health insurance premiums from income tax.
- Spending G: The government finances exogenous spending.

The government funds these programs with taxes (fact 3, section 2):

- τ_s: payroll tax (Medicare and social security)
- $T(y)$: progressive income tax

Firm's problem The firm's problem is:

$$\max_{n,k} Xk^{\alpha}n^{\gamma} - \widetilde{w}n - (r - \delta)k \tag{2}$$

The average cost of hiring labor, $\widetilde{w}$, includes monetary wage component w and the expected cost of EHI or a compensation payment by the firm when EHI is not offered. See Chivers et al. (2017) for the derivation of n^* and k^*, for constrained and unconstrained borrowing.

4.2 EHI and talent misallocation

In a model with EHI and lump sum taxes, Chivers et al. (2017) find that some individuals that have lower health risk and lower skill become entrepreneurs, while others with higher health risk and skill leave entrepreneurship. These misallocations relative to a frictionless world are caused by the link between health insurance and employment. "Talent misallocation" occurs when individuals with bad health shocks but high ability would run firms absent the EHI friction, and a corresponding distortion for workers. The government can potentially counteract these misallocations by subsidizing high health risk and skill individuals, while taxing agents with intermediate skill and good health risk, conditional on them becoming entrepreneurs. The unobservability of managerial ability and health risk make this direct redistribution, or "tagging," impossible. A non-linear income tax may partially correct misallocation through indirect general equilibrium effects. In our framework, the tax deductibility

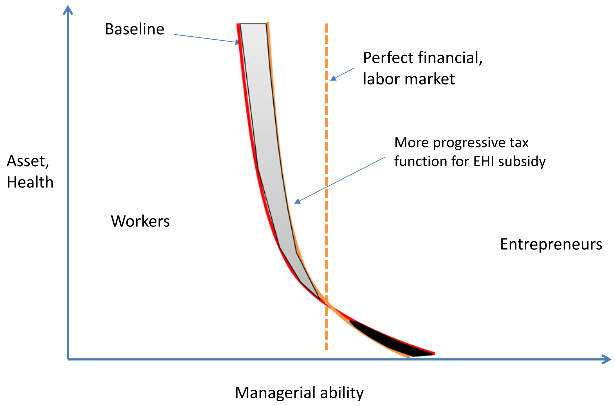

Fig. 2 Talent misallocation and regressive tax

of EHI premiums is effectively such a regressive tax. This is because high income individuals face a higher marginal tax rate and receive a larger tax break for insurance purchase than lower income individuals.

Compared to the economy without a subsidy to EHI, this tax policy provides high health risk and more skilled individuals a larger tax benefit than lower health risk and less skilled agents, conditional on being entrepreneurs. The high skilled will earn a bigger profit as entrepreneurs, and a larger EHI premium tax subsidy, because their income will fall into a higher tax bracket. Hence the policy encourages these individuals to become entrepreneurs (the black area in Fig. 2). In contrast, lower health risk and skill individuals may optimally choose to self-insure (or obtain health insurance in the private market if an entrepreneur). In either case, the EHI subsidy is not applicable, which reduces the incentive to become an entrepreneur (the grey area in Fig. 2). Consequently, the regressive tax associated with EHI deductibility directly counteracts the misallocation caused by linking health insurance with employment in an EHI system. There are also indirect effects. As the regressive tax policy reduces talent misallocation, more high skilled individuals run larger firm. The profits of these individuals increase, which translates into higher taxable income and a larger tax base. Higher firm productivity implies a higher wage and capital return. This benefits workers through what Scheuer (2014) calls a "trickle down" effect.

5 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 whether or not the firm offers EHI to workers.

5. Capital and labor markets clear and production takes place.
6. Households (as managers or workers) decide: health insurance ($i'_{HI} = \{0, 1\}$), consumption (c), and borrowing/saving (a').

5.1 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 insurance policy. The US EHI system exists for historical reasons (fact 1) 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):

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

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

The first order conditions are:

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

Substituting (4) into (3) yields the manager's profit function for a given level of capital:[15]

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

5.1.1 Capital

Now consider the choice of capital. Let

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

Both sources of funds are used to raise capital, with $k = (a - oop) + l$, where oop denotes out of pocket medical expenses. The entrepreneur can either use personal funds net of out-of-pocket medical spending ($a - oop$) or rent capital from the market (l). Each source of funds has the following costs. First, the entrepreneur owns capital and the opportunity cost of a is the foregone interest the entrepreneur could have received from the capital market. This amount is given by ra. Second, the entrepreneur may rent capital in the market, at cost rl, $l \leq \bar{l}$. Here $\bar{l}$ is an upper limit on borrowing. For simplicity, we first consider the case where this borrowing constraint does not bind. Whether or not the constraint binds is an equilibrium outcome, e.g., the constraint may bind if a bad medical expenditure shock occurs.

[15] This will adjust with EHI offering status, since EHI has a tax subsidy.

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:

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

This gives the optimal physical capital level:

$$k^*(x, w, r) = \left[X \left(\frac{\gamma}{\widetilde{w}}\right)^{\gamma} \left(\frac{\alpha}{(r-\delta)}\right)^{1-\gamma} \right]^{\frac{1}{1-\alpha-\gamma}} \tag{7}$$

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

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

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 r. Denote the optimal factor demands when the credit constraint binds by $\tilde{n}$ and $\tilde{k}$. The firm's problem is:

$$\tilde{\nu}^*(\tilde{k}, x, w) = \max_{\tilde{k}} X\tilde{k}^{\alpha}\tilde{n}^{\gamma} - \widetilde{w}\tilde{n} - (r - \delta)\left(\tilde{k} - (a - oop)\right) \tag{9}$$

where

$$\tilde{n}^*(\tilde{k}, x, w) = \left[\frac{\gamma X \tilde{k}^{\alpha}}{\widetilde{w}}\right]^{\frac{1}{1-\gamma}} \tag{10}$$

Similar to the self-financed firm, the optimal capital demand when the firm borrows in the market will be a function of aggregate factor prices: $\tilde{r}$ and $\tilde{w}$.

5.2 Workers

Workers receive wage income from the firm and choose consumption, saving and health insurance to maximize the 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 budget constraint

$$c_t + a_{t+1} + oop + \tilde{\pi}_t \leq (1 + r_t - \delta)a_t + \tilde{w}z + (1 - i_E)\, q_E - Tax + T_{SI} \quad (11)$$

Premium $\tilde{\pi}_t$ workers pay depends on the type of insurance purchased, see equation (13) below.

5.3 The household's problem

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

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

subject to

$$c + a' + oop + \tilde{\pi} \leq (1 + r)a + inc - Tax + T_{SI} \quad (12)$$

where

$$\tilde{\pi} = \begin{cases} \pi_E(1 - \psi) & i'_{HI} = 1, i_E = 1 \\ \pi_P(m) & i'_{HI} = 1, i_E = 0 \\ 0 & i'_{HI} = 0 \end{cases} \quad (13)$$

$$Tax = T(inc) + \tau_s\left[(1 - \mathcal{I}_e)\tilde{w}z + \mathcal{I}_e \nu(k, x; r - \delta, \widetilde{w}) - (1 - \mathcal{I}_e) i_E \tilde{\pi}\right] \quad (14)$$

$$T_{SI} = \max\left\{0, (1 + \tau_c)\underline{c} + T(\widetilde{inc}) + oop - [a + inc]\right\} \quad (15)$$

$$inc = \begin{cases} (r - \delta)a + \tilde{w}z + (1 - i_E)\, q_E - i_E \tilde{\pi} & \text{if } \mathcal{I}_e = 0 \\ (r - \delta)a + \nu(k, x; r - \delta, \widetilde{w}) - i_E \tilde{\pi} & \text{if } \mathcal{I}_e = 1 \end{cases} \quad (16)$$

$$\widetilde{inc} = \begin{cases} (r - \delta)a + \tilde{w}z + (1 - i_E)\, q_E & \text{if } \mathcal{I}_e = 0 \\ (r - \delta)a + \nu(k, x; r - \delta, \widetilde{w}) & \text{if } \mathcal{I}_e = 1 \end{cases} \quad (17)$$

$$oop = (1 - i_{HI}\phi(m))\, m \quad (18)$$

Budget constraint (12) is standard: consumption, saving/borrowing, uncovered (out of pocket) medical expenses, and insurance premia cannot exceed asset market returns, labor income, net of taxes, and government transfers. The premium for insurance in equation (13), $\tilde{\pi}$, has two components: i'_{HI} is the household's choice to buy health insurance for next period and i_E is the shock that indicates that the employer must provide health insurance to the employee. The government defrays the cost of EHI by excluding the EHI premium from income tax and payroll tax, see equation (14). In (14) note that the entrepreneur, with indicator $\mathcal{I}_e = 1$ does not deduct the premium from the payroll tax, but can deduct it from the income tax. Equation (15) is a public safety net payment T_{SI} from the government (possibly zero) as specified in Hubbard et al. (1995). Equation (16) specifies the taxable income of the worker and for the entrepreneur. Equation (17) reflects the fact that the EHI premium enjoys income tax exemption status, but not when one calculates the transfer. Equation (18) gives out of pocket medical expense oop.

The instantaneous payoff 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 Sect. 4.1.

5.4 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:

$$q_E = \psi \pi_E \tag{19}$$

The EHI premium equals the expected cost of covering health spending among the insured, including a proportional markup η.

$$\pi_E = (1+\eta)\frac{\int \left[i_E i'_{HI} \phi(m) m\right] \mathrm{d}\Psi(s)}{\int \left(i_E i'_{HI}\right) \mathrm{d}\Psi(s)} \tag{20}$$

The premium for private insurance is:

$$\pi_P(m) = (1+\eta)\frac{\mathbb{E}\left[\phi(m')m'|m\right]}{1+r-\delta}. \tag{21}$$

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

5.5 Government

The government collects income tax $T(inc)$ and payroll tax τ_s to finance a consumption floor $\underline{c}$, the EHI subsidy and other government spending G. Note that agent's eligibility to receive an EHI subsidy depends on the individual's occupational choice $\mathcal{I}_e$, the availability of EHI i_{EHI} and insurance decision i_{HI}, see equations (13) and (16).

$$\int \left\{T(inc) + \tau_s\left[(1-\mathcal{I}_e)\tilde{w}z + \mathcal{I}_e\nu(k,x;\tilde{r},\tilde{w}) - (1-\mathcal{I}_e)i_E\tilde{\pi}\right]\right\} \mathrm{d}\Psi(s)$$
$$= \int (T_{SI})\,\mathrm{d}\Psi(s) + G. \tag{22}$$

5.6 Stationary equilibrium

We characterize the stationary equilibrium. Denote the equilibrium aggregate variables by $\Phi = \left\{\tilde{r}, \tilde{w}, \tilde{\pi}, \hat{p}_E, \phi(\cdot), T(\cdot), \tau_s, \tau_y\right\}$. 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 stationary equilibrium for the economy is given by aggregate variables Φ, allocations $\left(c, a', i'_{HI}, \mathcal{I}_e\right)$ 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 $\left(c, a', i'_{HI}, \mathcal{I}_e\right)$ solve the household's optimization problem.
2. The health insurance market is competitive and premiums are given by (20, 21).
3. The asset market clears: $\int k\mathrm{d}\Psi(s) = \int a\mathrm{d}\Psi(s)$.
4. The labor market clears: $\int (\mathcal{I}_e n)\,\mathrm{d}\Psi(s) = \int \left[(1-\mathcal{I}_e)\,\hat{n}z\right]\mathrm{d}\Psi(s)$.
5. The goods market clears.
6. The government balances its budget, equation (22).
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. $\Psi_{t+1} = \mathbf{F}_\Psi(\Psi_t)$.

6 Model parameters

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 2.0 in the baseline economy, which follows estimates in the literature. We also consider $\rho = 3.0$ 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.[16] To facilitate computation, we approximate this process by a five state Markov process using the method of Tauchen and Hussey (1991). See "Appendix 1".

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

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 x 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 during the period of 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. See Chivers et al. (2017) for the details on calibration.

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) and Feng (2010), 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 percentile, while the last bin has agents inside the first percentile of the distribution. The other bins are defined analogously. 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). See "Appendix 1".

Government The government finances exogenous spending G, which is set to 18% of GDP in the benchmark economy. See the CBO Economic Outlook (2016), excluding social security. The payroll tax for Social Security and Medicare is 12%. 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.[17]

Feldstein (1969) provided a tax function to characterize US tax and transfer policies that link a household's taxable income to a parameter that determines the degree of progressivity of the tax system. Using data from the 2000-2006 Panel Study of Income Dynamics, Heathcote et al. (2017) found that this non-linear tax function precisely matches the tax/transfer scheme in the US: $T(y) = y - \lambda_p y^{(1-\tau_p)}$, where y is the household's total taxable income and τ_p measures the degree of progressivity of the tax system.[18] When $\tau_p > 0$ the income tax is progressive, and when $\tau_p < 0$ the tax system is regressive. Parameter λ_p is determined in equilibrium so that the government runs a balanced budget in each period.

We summarize the parameters in Table 1.

[17] See Chivers et al. (2017) and Nakajima and Tuzemen (2016).

[18] Heathcote et al. (2017) use data from the Panel Study of Income Dynamics (PSID) and estimate that $\tau_p = 0.151$ with a standard error of 0.003. An alternative way is to model the non-linear income tax function is: $T(y) = \kappa_0 \left(y - \left(y^{-\kappa_1} + \kappa_2 \right)^{-\frac{1}{\kappa_1}} \right)$ based on the estimation of Gouveia and Strauss (1994). See Conesa et al. (2009) for an application.

Table 1 Parameter values, baseline economy

Parameters	Values	Description	Comments/observations
β	0.94	Discount factor	Target K/Y ratio 2.5
ρ	2, 3	Risk aversion	
α	0.3207	Production parameter on capital	Target K share of 0.34
γ	0.4693	Production parameter on labor	Target fraction of entrepreneurs
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 (Soc Sec & Medicare)	CBO Outlook 2016
τ_p	0.151	Progressivity of the tax system	Heathcote et al. (2017)
δ	6%	Capital depreciation	

7 Quantitative analysis

We first present the performance of our benchmark model and then explain the design of three counterfactual policy experiments, followed by a detailed analysis of the experiments.

7.1 Baseline economy

Our model succeeds in matching several aspects of the macroeconomy, including the distribution of firm sizes and observed patterns of health insurance coverage. Table 2 summarizes the performance. In the baseline economy, entrepreneurs account for 7.81% of the population, slightly below the target of 8.3%. This underestimate of entrepreneurship may occur because our model does not account for other reasons that individuals become entrepreneurs such as the utility value from "being your own boss." Hence our analysis provides a lower bound. Firm size is measured by number of employees. On average, firms hire 17.76 employees in our baseline, 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, with firms in the largest size group more than twice as productive as those in the smallest group (average productivity of 3.14 in the largest group versus 1.36 in the smallest group. In terms of health insurance coverage, our model has a take-up ratio

Table 2 Benchmark

Statistics	U.S. Data	Baseline Economy
Annual real interest rate (%)	4.0	4.33
Aggregate capital share	0.33	0.36
Capital output ratio	2.5	2.7
% of entrepreneurs	8.3	7.81
Mean size of the firm	17.09	17.76
% firm at 0–9	70.7	74.85 ($\bar{x}_1 = 1.36$)
% firm at 10–19	14.0	15.46 ($\bar{x}_2 = 1.79$)
% firm at 20–49	9.4	6.68 ($\bar{x}_3 = 2.13$)
% firm at 50–99	3.2	2.35 ($\bar{x}_4 = 2.54$)
% firm at 100+	2.6	0.66 ($\bar{x}_5 = 3.14$)
Health insurance take-up (%)		
All	75.7	70.3
EHI offered	99.0	97.9
EHI not offered	35.5	32.8

of 70.3%, compared with 75.7% in the MEPS data.[19] The take-up ratio is the share of agents with health insurance coverage.

7.2 Policy experiments

We now conduct counterfactual policy experiments. In all experiments, we compute the utilitarian social welfare implied by the new policy.[20] We then compute the consumption equivalent variation (CEV) to assess the welfare effect of each policy. CEV measures the agent's percentage change in consumption in every state of the world to determine if the agent is willing to move to another economy given a specific tax policy. The first two experiments are designed to study the effect of the current EHI premium exclusion policy on allocations. In experiment 1 we counterfactually replace the current regressive subsidy on EHI (only) with a fixed subsidy. In experiment 2 we counterfactually extend the current regressive EHI subsidy to private insurance.[21] The goal is to obtain estimates of the welfare costs of talent misallocation, which we do by comparing our results to corresponding experiments in Jeske and Kitao (2009). The third experiment determines the optimal regressiveness of the subsidy. We also

[19] 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.

[20] da Costa and Maestri (2019) study taxation in non-competitive labor markets under alternative social welfare criteria.

[21] In the first two experiments we keep the level of government expenditure G fixed. In experiment 3 we vary the progressivity of the EHI premium exclusion (i.e., the subsidy to EHI τ_p) and balance the government budget by adjusting parameter λ_p. We use the Heathcote et al. (2017) progressive income tax function: $T(y) = y - \lambda_p y^{(1-\tau_p)}$, where τ_p measures the degree of progressivity of the tax system and λ_p is determined in equilibrium to balance the government's budget.

Table 3 Tax subsidy rate across experiments

		Baseline	1. Flat	2. Extend	3. Extend Subsidy τ_p'
Worker	EHI	$\frac{T(y;\tau_p)}{y} + \tau_s$	$\hat{\tau}$	$\frac{T(y;\tau_p)}{y} + \tau_s$	$\frac{T(y;\tau_p')}{y} + \tau_s$
	private	0	0	$\frac{T(y;\tau_p)}{y} + \tau_s$	$\frac{T(y;\tau_p')}{y} + \tau_s$
Entrepreneur	EHI	$\frac{T(y;\tau_p)}{y}$	$\hat{\tau}$	$\frac{T(y;\tau_p)}{y}$	$\frac{T(y;\tau_p')}{y}$
	private	0	0	$\frac{T(y;\tau_p)}{y}$	$\frac{T(y;\tau_p')}{y}$

consider an experiment in which the government provides universal health insurance to the entire population. This experiment allows us to further identify the cost of talent misallocation associated with employer-based health insurance policy.

Table 3 summarizes the tax subsidies to health insurance across these experiments. To determine the amount of subsidy the individual will receive, multiply the subsidy formula in Table 3 by the insurance premium the individual pays. For example, consider an entrepreneur with income y who has EHI. The table indicates that, when multiplied by the EHI premium, this individual receives subsidy $\frac{T(y;\tau_p)}{y} \cdot \pi_E$ in the baseline economy, $\hat{\tau} \cdot \pi_E$ in policy experiment 1 ("Flat"), and $\frac{T(y;\tau_p)}{y} \cdot \pi_E$ and $\frac{T(y;\tau_p')}{y} \cdot \pi_E$, respectively, in policy experiments 2 ("Extend") and 3 ("Extend Subsidy τ_p'").[22] Here y denotes the individual's taxable income (its actual value may vary with the policy experiment as it is an endogenous variable), and $\hat{\tau}$ is the average effective tax rate in the baseline model (endogenously determined in equilibrium). Finally, τ_p' is the optimal tax progressivity determined in experiment 3. The rate in each experiment affects only the subsidy individuals receive, but not the income tax they must pay.[23]

Table 4 reports results for aggregate variables and Table 5 reports welfare results for the baseline and the three policy experiments.

7.21 Policy 1 and 2

Policy 1: Flat Rate Subsidy for EHI premium In this experiment, we use the average tax rate from the baseline model, thus the subsidy to EHI is a fixed rate. For example, in an economy with two individuals and a premium of \$10,000, if the marginal tax rate is 10% the deduction is \$1000 and if it is 30% the deduction is \$3000. Instead, in this experiment we fix the tax at 24.6%, so each individual gets a fixed deduction of \$2460.

Column "Flat" in Table 4 summarizes the impact of this experiment. The first column presents statistics for the baseline model. The first group of rows present statistics on K/Y and output. The second group of rows present statistics on health insurance. The lower section presents statistics on the firm size distribution and other aggregate measures of productivity. Imposing a flat rate subsidy to EHI raises the

[22] Note that the agent is subject to an effective tax rate of $\frac{T(y;\tau_p)}{y}$, and the total income tax is $T(y;\tau_p)$.

[23] In all three experiments the household is subject to the same income tax $\left[T(y;\tau_p) + \tau_s \cdot y\right]$.

effective cost of EHI. Agents with lower health risk face a lower premium in the private insurance market and will drop out of the EHI pool. The table shows that health insurance take-up and EHI coverage decline relative to the baseline. The departure of lower health risk agents decreases the overall “health quality” of the EHI pool, which leads to an increase in the EHI premium. This is consistent with findings in Jeske and Kitao (2009).

On the production side, the higher EHI premium drags down the wage, which encourages more lower-skilled and lower health risk agents to become entrepreneurs. It also reduces entrepreneur profit, particularly those who have higher skills but higher health risk since they run bigger firms and are more likely to provide EHI to employees. This is because the removal of tax deductibility of EHI premiums raises the cost of providing health insurance for the firm. Hence they may opt out of entrepreneurship. Consequently, this policy rotates the equilibrium frontier of occupational choice counter-clockwise. As the lower section of Table 4 shows, there are fewer entrepreneurs, 7.74% versus 7.81% in the baseline. However, these entrepreneurs are less productive. Aggregate productivity falls from 100 to 99.48. Output per firm and per worker falls. The percentage of very small firms (0-9 employees) rises. Overall, there are more lower-skilled agents who run smaller firms.

Column “Flat” in Table 5 reports the welfare effect of this policy change. Relative to the baseline, welfare declines (−0.08). Only 18.7% of agents have an increase in welfare, and the rest of the population experience a decline in welfare. Note that the average taxes on workers and entrepreneurs increase, and the net tax earnings of workers and entrepreneurs decrease after the implementation of this policy. This is because when productivity falls, due to the misallocation of talent, taxes must rise to support the same level of government expenditure.

Policy 2: Extend tax deductibility to non-group insurance This policy extends tax deductibility to the non-group (private) insurance market. This policy has exactly the opposite effect compared with Policy 1. In terms of the health insurance market, the extended tax subsidy encourages health insurance take up in the non-group market. Overall health insurance coverage increases to 97.2%, from the baseline of 69.5% in Table 4. The fiscal cost of extending deductibility is reflected in the higher effective income tax on entrepreneurs, who have higher earnings than workers. The tax on workers falls relative to the baseline model. See Table 5.

The extended tax subsidy increases the opportunity cost of leaving the wage sector for less-skilled and healthy agents as private insurance gets cheaper. For the same reason, it raises the potential gain for higher-skilled and higher health risk agents to become entrepreneurs. Consequently, this policy helps restore the equilibrium frontier of occupational choice as explained in Economy C in Sect. 3. In Table 4 we observe an 0.85% increase in aggregate productivity. Compared to the benchmark, this policy benefits most agents (99.9% have a positive CEV) and leads to a welfare gain of 0.34% measured by consumption equivalence (Table 5).

Welfare estimate Our flat rate subsidy experiment 1 is similar to Jeske and Kitao’s (2009) experiment in which they give all agents a common lump sum subsidy. They find that this improves welfare by 0.07% CEV. In contrast, we find a negative impact of 0.08% when we incorporate occupational choice. In Jeske and Kitao's model the welfare gain accrues solely from better risk sharing. Our model accounts for both gains from better risk sharing and losses from occupational misallocation. Under the assumption the models and experiments are similar, a comparison of the results provides an estimate of the welfare effect of misallocation, which is 0.15% in flat rate subsidy experiment 1 (0.07% CEV gain from risk sharing in Jeske and Kitao less the 0.08% loss from occupational misallocation in our model.)

Experiment 2 extends the subsidy to the private sector, as Jeske and Kitao do in a subsequent experiment. We find a welfare gain of 0.34% CEV, while Jeske and Kitao found 0.24% CEV. The welfare gain in our model is higher because we consider both the gain from reducing talent misallocation and better risk sharing, while Jeske and Kitao consider only risk sharing. Again assuming that the models and experiments are similar except for occupational choice, experiment 2 provides an alternative estimate of the welfare effect of 0.34 – 0.24 = 0.1.

We also consider a universal health insurance policy ("Universal") in which all individuals are covered by a government funded insurance scheme. To isolate the distortionary cost of taxation, we assume that this policy is financed with a lump-sum tax. This policy eliminates talent misallocation as it breaks the link between the health insurance decision and occupational choice. There are fewer entrepreneurs running larger firms that are more productive. Average firm productivity increases from the baseline by 3.1% and output per firm increases by over 18%. This exacerbates inequality with the wealth Gini coefficient rising from 0.80 in the baseline to 0.82, as the entrepreneur's earnings rise more significantly compared with workers. With 100% insurance coverage, it improves risk sharing against the medical expenditure shock. This leads to an aggregate welfare gain of 3.04% relative to the baseline. Almost all agents have a positive consumption-equivalent variation. Compared with Experiments 1 and 2, it suggests that a more fundamental overhaul of EHI policy is needed to address occupational misallocation.

7.22 Optimal regressive subsidy

Policy 3: Optimal level of regressive tax subsidy to EHI There is an interesting tradeoff when the tax subsidy is extended in Policy 2. Effectively this is a regressive tax as the income tax is progressive. A higher income earner gets a larger subsidy as they face a higher marginal income tax rate. A more regressive tax subsidy helps to restore the equilibrium frontier of occupational choice, but it also reduces welfare because it reduces risk sharing associated with the income shock.

Policy 3 extends tax deductibility to non-group insurance as in Policy 2 and adjusts the non-linear tax base function for the tax deductibility of EHI premiums. The household's total income tax is adjusted from $T(inc;\tau_p^{baseline})$ to $T(inc;\tau_p^{baseline}) + \frac{T(inc;\tau_p^{exp})-T(inc;\tau_p^{baseline})}{inc} i_E \tilde{\pi}$ conditional on the agent choosing to be an entrepreneur, where $\frac{T(inc;\tau_p^{exp})-T(inc;\tau_p^{baseline})}{inc}$ represents the marginal tax rate change from the baseline to this policy. We want to find the optimal level of the regressive tax subsidy to

Table 4 Aggregate variables

Statistics	Base	Flat	Extend	Universal	Extend Subsidy τ'_p				
					$\tau_p = 0$	$\tau_p = 0.15$	$\tau_p = 0.25$	$\tau_p = 0.35$	$\tau_p = 0.45$
K/Y	2.70	2.71	2.711	2.69	2.71	2.71	2.71	2.72	2.71
Ag output	100	98.92	99.49	99.95	100.03	99.49	99.35	99.15	99.22
Gini coefficient	0.80	0.79	0.81	0.82	0.79	0.81	0.81	0.82	0.82
HI take-up (%)	70.3	68.92	97.21	100	97.20	97.21	97.22	97.23	96.69
EHI coverage (%)	65.81	64.45	66.29	n/a	65.91	66.29	66.39	66.46	66.43
EHI premium	100	101.88	100.13	n/a	100.06	100.13	100.14	100.17	100.2
Entrepreneur %	7.81	7.74	7.43	6.56	7.73	7.43	7.33	7.26	7.23
Ave x	100	99.48	100.85	103.1	100.17	100.85	101.1	101.27	101.35
Output per firm	100	99.8	104.52	118.05	101.03	104.52	105.88	106.67	107.17
Output per worker	100	98.85	99.09	98.67	99.95	99.09	98.83	98.57	98.55
% firm at 0–9	74.85	75.85	73.81	70.3	74.82	73.81	73.43	73.18	73.06
% firm at 10–19	15.46	14.86	16.10	18.25	15.48	16.10	16.34	16.49	16.56
% firm at 20–49	6.68	6.35	6.95	7.88	6.69	6.95	7.06	7.12	7.15
% firm at 50–99	2.35	2.31	2.45	2.78	2.35	2.45	2.48	2.51	2.52
% firm at 100+	0.66	0.64	0.69	0.778	0.66	0.69	0.70	0.70	0.71

Table 5 Welfare comparison

Statistics	Base	Flat	Extend	Universal	Extend Subsidy τ'_p				
					$\tau_p = 0$	$\tau_p = 0.15$	$\tau_p = 0.25$	$\tau_p = 0.35$	$\tau_p = 0.45$
Welfare	0	− 0.08	0.34	3.04	− 0.22	0.34	0.51	0.52	0.49
% with CEV>0	0	18.7	99.88	99.34	3.78	99.88	99.9	99.89	99.87
Net-tax earning									
Workers	100	97.08	100.44	106.7	100.66	100.44	100.39	100.42	100.35
Entrepreneurs	100	98.59	103.24	117.8	99.88	103.24	104.60	105.47	106.0
Ave. tax (%)									
Workers	18.22	20.49	17.59	19.42	17.70	17.59	17.57	17.54	17.56
Entrepreneurs	40.35	41.01	41.07	42.07	41.03	41.07	41.05	41.0	40.98

EHI, measured by τ_p^{opt}, which balances the efficiency gain from an improvement in talent allocation and the loss from reduced risk sharing.

As the subsidy gets more regressive, entrepreneurship becomes less attractive to lower-skilled and low health risk agents. This is because they will receive a smaller subsidy as they run smaller firms and earn lower profit. The opposite is true for higher-skilled and higher health risk agents. Hence, a more regressive subsidy to health insurance has a beneficial effect on talent allocation. As we can see from the last column of Table 5, a higher value of τ_p leads to fewer entrepreneurs but a bigger fraction of larger firms. That is, entrepreneurs fall from 7.73% to 7.23%, and the percentage of firms with 0-9 employees falls while the percentage of firms in all four

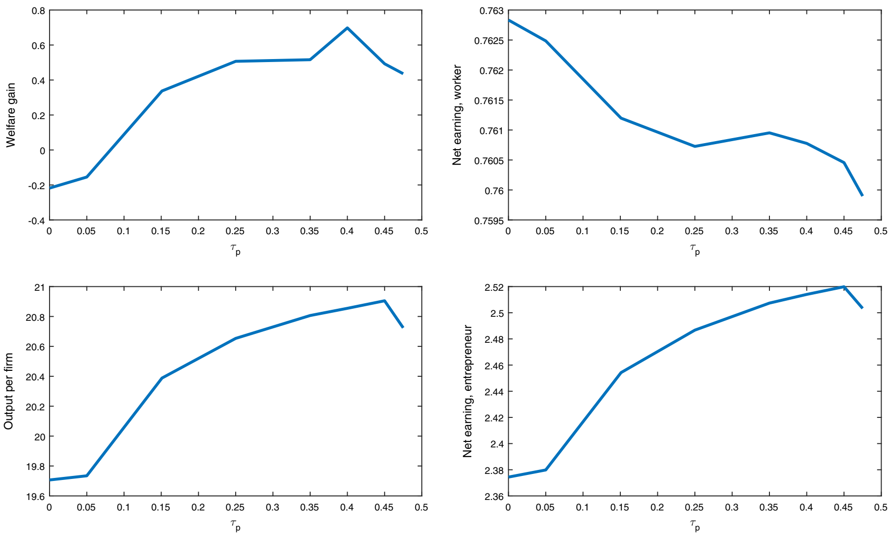

Fig. 3 Regressive subsidy and talent allocation

larger employee size groups grows. The key insight in the model, as in the data, is that larger firms are more productive. Average productivity increases from 1.36 for firms with 0-9 employees to 3.14 for firms with more than 100 employees (see the values in the last column of Table 1 for $\bar{x}$, which range from 1.36 to 3.14).

In addition, aggregate productivity can vary by over 1% when τ_p increases from 0 to 0.45. The bottom left panel of Fig. 3 presents the change in output per firm as τ_p increases. While a higher value of τ_p improves talent allocation, it also affects the income distribution.[24] As we increase τ_p, workers' after-tax income drops and it increases for entrepreneurs. The right two panels of Fig. 3 document how the after-tax earnings of workers and entrepreneurs change with the value of τ_p. Overall, the top left panel shows an inverted U-shape welfare effect with respect to the value of τ_p. The optimum occurs at about 0.40 with a welfare gain of about 0.7.

Finally, we use the risk sharing estimate from Jeske and Kitao (0.24%) to isolate an estimate of the maximum welfare effect. We find that 0.7-0.24 = 0.46, is the maximum that would arise if the subsidy were set at the optimal level rather than at the current U.S. level. This welfare gain comes at a cost of increased inequality. The measured wealth Gini coefficient increases from 0.80 in the baseline to 0.82 when the value of τ_p reaches the optimum level.

8 Conclusion

The U.S. federal tax system provides preferential treatment for health insurance that individuals purchase through an employer. In contrast to wage compensation, employ-

[24] Its effect on the distribution works mainly through redistribution via the progressive tax subsidy, see Wan and Zhu (2019) in an economy with bequests and estate taxes.

ers' payments for employees' health insurance premiums are excluded from income and payroll taxes. The CBO estimates that this favorable tax treatment led to $300 billion in forgone federal tax revenue in 2018, and it expects this loss to rise over time as the cost of health care increases. This is the federal government's largest single tax exclusion, constituting about 1.5% of GDP.

Our paper examines the impact of this regressive tax subsidy on talent allocation. The policy is regressive because higher income individuals face a higher marginal tax rate, which gives them a higher EHI subsidy. Jeske and Kitao (2009) found that a regressive tax has merit because it helps to maintain the "health quality" of the insurance pool and it reduces adverse selection in the EHI market. Our policy experiments show that the regressive nature of EHI tax deductibility can improve the allocation through both direct and indirect effects. The policy provides a larger tax benefit to individuals with higher health risk and managerial talent, relative to those with less risk and skill, conditional on being entrepreneurs. Hence it directly alters the individual's incentive to engage in entrepreneurial activity, changing the "mix" of entrepreneurs and workers in the economy and firm size. It also improves the allocation indirectly by enlarging the tax base, which reduces the effective tax rate, and increases wage and capital income.

Scheuer (2013) considered a model with fixed investment in which individuals had different skills as a manager and worker, chose their occupation, and faced adverse selection in the credit market. He found that taxes on business income that are less progressive than taxes on labor income can mitigate frictions that entrepreneurs face in credit markets.[25] In our model adverse selection is also important, but we focus on health insurance rather than the credit market. Regressive taxes alter the mix of occupational choices and affect risk pooling in the insurance market. Our policy instruments are differential subsidies for health insurance rather than differential taxes on income and profit. Our quantitative macro model allows us to estimate the size of occupational misallocation, and our model permits variable investment. We find that entrepreneurs with idiosyncratic shocks optimally vary investment and firm size, and our model endogenously determines the distribution of firm sizes.[26]

There are a number of extensions that would be interesting. As in Scheuer (2013), in order to focus on equilibrium occupational choice and the role of an elastic occupational choice margin, our paper abstracts from endogenous labor supply. In this case the regressivity of optimal taxes is not driven by a desire to stimulate the intensive effort margin or to manipulate wages. Instead, this allows us to focus on the inefficiency of occupational choice from endogenous cross subsidization. Recently, in models that abstract from occupational choice, Feng and Zhao (2017) study the effect of health insurance on aggregate labor supply and Rong (2017) examines inequality in health insurance and wages. Goenka and Liu (2020) study the impact of public health policy on the accumulation of human capital and long-run economic growth. While we would lose the focus on occupational choice, these are interesting extensions.

[25] Endogenous cross-subsidization occurs and leads to the wrong "mix" of agents - excessive (insufficient) entry of low-skilled (high-skilled) into entrepreneurship. A profit tax that is regressive relative to the tax on labor income can restore efficient occupational choice.

[26] Cole et al. (2019) study investment and health, but focus on dynamic incentives. See Restuccia and Rogerson (2013) and the references therein for recent work on misallocation in quantitative macro models.

In line with most of the existing macro-health literature, we model health risk as an exogenous medical expenditure shock. In a recent study, Chen et al. (2020) document that high income earners are healthier and healthy individuals face less severe medical expenditure risk. Entrepreneurs have average earnings significantly higher than wage earners in our model, as in U.S. data. If we extend our model by allowing for endogenous health investment, the correlation between income, health and medical expenditure may reduce the magnitude of our misallocation estimate. However, if self-employed people experience greater stress than employees, which has a negative impact on physical health, cf., Cardon and Patel (2015), this would increase the magnitude of our estimate. As a consequence, if health were a state variable, the impact of insurance on talent misallocation would be ambiguous.

Finally, our paper abstracts from a life-cycle structure. In a related paper, Antunes, Cavalcanti and Villamil 2015 consider a model of entrepreneurship in which agents live for J periods. Households become infinitely lived as J goes to infinitely. In their model agents face financial frictions, which have long run effects on output only when agents are finitely lived or entrepreneurial ability changes over time. Our model has tax rather than financial frictions, but the insight holds that an Aiyagari infinite horizon model is less likely to produce output distortions than a life cycle model, ceteris paribus. In this sense our model provides a lower bound on distortions.

Appendix 1

This Appendix contains details from the model calibration for:

- Calibrated Markov process for stochastic labor productivity z. The five states are:

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

  and a transition matrix

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

- Calbrated Markov process for medical expenditure shocks m. The seven expenditure states are:

$$m \in \{0.000, 0.006, 0.022, 0.061, 0.171, 0.500, 1.594\}.$$

The transition matrix for m is estimated by counting the fraction of agents who move into each bin in the following year.

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

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

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

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

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

Appendix 2

In the baseline model the coefficient of risk aversion is 2. Table 5 reports the results when risk aversion is 3. Observe that the welfare loss is smaller in the "no subsidy" experiment (only -0.05 when ρ is 3 versus -0.08 when ρ is 2). This occurs because when risk aversion is higher EHI participation remains relatively high (65.1% when ρ is 3) even after the subsidy is abolished. This lowers the loss from less risk sharing. The welfare gain from extending the subsidy is higher when risk aversion increases

Table 6 Talent Allocation under Policies with $\rho = 3.0$

Statistics	*Base*	*Flat subsidy*	*Extend subsidy*
Welfare	0	− 0.05	0.62
% with CEV>0	0	0.3	98.8
HI take-up (%)	70.3	69.1	97.6
EHI coverage (%)	65.81	65.1	65.9
EHI premium	100	102.7	84.0
Entrepreneurs %	7.81	8.82	7.71
Ave x	100	99.5	99.8
Output per firm	100	99.8	97.5
% firm at 0–9	74.85	74.93	74.76
% firm at 10–19	15.46	15.57	15.52
% firm at 20–49	6.68	5.86	6.7
% firm at 50–99	2.35	2.06	2.36
% firm at 100+	0.66	0.58	0.66
Net-tax earning			
Workers	100	98.71	102.41
Entrepreneurs	100	98.54	103.01
Ave. tax (%)	24.0	24.4	24.8

from 2 to 3 (0.62 versus 0.34). This occurs because more risk averse households have stronger incentives to takeup EHI once it becomes less expensive. Consequently, the EHI premium is lower compared with the case of $\rho = 2$.

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