Federal Subsidization and State Medicaid Provision*

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Abstract

This paper explores the determination of state Medicaid provision in the United States and quantifies the effects of federal subsidization on Medicaid provision. The U.S. federal government matches every state at least one dollar for each dollar that the state spends on Medicaid. We measure the effect of the subsidy by constructing a multi-regional, heterogeneous-agent, dynamic general equilibrium model with incomplete insurance markets and calibrating it to the U.S. economy. In the model, state governments take the federal subsidy as given and implement Medicaid policy according to the decision of the median voter. The benchmark economy delivers a close approximation to the Medicaid coverage rate in 2012. To measure the effect of the federal subsidy, we set the subsidy to zero and find that state Medicaid coverage declines by 9%. We then study the mechanism determining Medicaid provision and find a positive relationship between progressivity of the tax structure and Medicaid coverage.

Keywords: public health insurance; federalism; political economy.

JEL Classification Numbers: E62, H77, I13, I18, P16

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1 Introduction

In the United States, the Medicaid program is the primary source of financing for medical expenses of low-income citizens. Medicaid is a means-tested program administered by states (subject to federal limitations) and financed jointly by the state and federal governments. For each dollar that a state spends on Medicaid, the federal government contributes at least one dollar to the state's Medicaid expenditures. The percentage of each state's federal subsidy is determined by the Federal Medical Assistance Percentage (FMAP) formula.[1] Because the federal subsidy effectively reduces the marginal cost of Medicaid provision, the policy creates an incentive for states to increase the generosity of the program. This paper measures the influence of federal Medicaid subsidies on Medicaid provision.[2]

To measure the effect of federal Medicaid subsidies, we construct a multi-regional overlapping-generations, general equilibrium model with idiosyncratic medical expenditure and productivity risk. Regional governments choose an income threshold that determines eligibility for a government-financed health insurance program (Medicaid). A percentage of medical expenses incurred by the regional government is paid by the federal government, and the remainder is financed through local taxes. The federal government, in turn, finances the subsidy through taxes collected from individuals in every region. The design of the federal policy creates an incentive for regional governments to increase the income eligibility threshold.

We recreate salient features of the U.S. government and health care system in order to understand the decisions of regional governments. We allow for limited public and private health insurance, as well as age-dependent and means-tested transfer payments. Both levels of government must also finance an exogenous stream of expenses. Regional governments finance expenditures by levying a consumption tax and progressive income tax, while the federal government finances expenditures through a progressive income tax and Medicare premiums. Medical expenses and other features of the U.S. health care system are calibrated using estimates from the Medical Expenditure

[1] Specifically, the formula is $FMAP^i = min\left\{.83, max\left\{.5, 1 - .45 \times (\frac{y^i}{Y})^2\right\}\right\}$, where y^i is state i's per capita income, and Y is federal per capita income.

[2] In discussions of the theoretical model, we will generally refer to geographic states as "regions" to differentiate geographic states from probabilistic states of nature.

Panel Survey (MEPS).

A key feature of the model is the politico-economic determination of regional-level Medicaid policy. Regional Medicaid provision in the model reflects the preferences of the median voter. The benchmark model delivers an equilibrium Medicaid eligibility threshold such that 16.8% of working-age individuals are covered by the Medicaid program. Although this measure modestly exceeds the percentage of individuals covered by Medicaid in 2012, it coincides with one of the biggest expansions of the program since the inception of the Medicaid program in 1965. In order to measure how much of state Medicaid provision is induced by the federal subsidy, we eliminate the federal subsidy and solve the model again. We find that eliminating the federal subsidy would result in a 9% reduction of regional Medicaid provision. This result suggests that some alternative Medicaid policy proposals, such as block grants issued by the federal government to states, may have a limited impact on regional Medicaid provision.

To understand the mechanisms determining equilibrium Medicaid provision, we solve the model in partial equilibrium under alternative tax regimes. We find that the model generates a higher Medicaid provision when increases in Medicaid provision are financed by more progressive tax instruments. Specifically, our results show that increases in Medicaid provision financed by capital taxes generate much higher provision than increases financed by income taxes, and increases financed by income taxes lead to a higher provision than increases financed by consumption taxes. We substantiate this result by estimating the correlation between state tax progressivity and the percentage of individuals covered by Medicaid in the corresponding state. Using these metrics, we find a positive correlation of 0.56, which supports the model's prediction.

Within the class of incomplete-market general equilibrium models, our paper extends Huggett (1996) to include medical expenditure risk, health insurance markets, and multiple levels of government. Our paper builds on the health care models of Attanasio, Kitao, and Violente (2011) and Pashchenko and Porapakkarm (2013). The first paper studies Medicare policy reform in a neo-classical growth model with medical expenditure and productivity risk, while the second paper measures the level of redistribution generated by Medicaid policy reform in the Patient Protection and Affordable Care Act of 2010 (ACA) using a similar model. Our model extends the literature by focusing on the role of intergovernmental subsidies in health care financing. In order to keep our model computationally tractable, we focus on the federal policy prior to the increase in the federal Medicaid subsidies that began in January 2014.

Medicaid is a multi-faceted program that affects certain age groups in different ways. For example, the State Children's Health Insurance Program (SCHIP) under Medicaid influences states to increase coverage to low-income children whose parents might not qualify for Medicaid. Because children's economic decisions are largely made by their parents, our framework does not explicitly consider SCHIP or the medical expenditure risk faced by children. Medicaid also pays for nursing home services, which benefit the disabled and low-income elderly. While our model does not explicitly account for the possibility of entering a nursing home, Kopecky and Koreshkova (2014) and De Nardi, French, and Jones (2010) find this to be a large source of risk for the elderly. We simplify these models by considering a single type of medical expenditure shock that depends only on age and previous medical expenditures.

Regional-level Medicaid policy in the model is determined by the median voter. The politico-economic equilibrium concept is restricted to full commitment for computational tractability, as in the special case described in Corbae, D'Erasmo, and Kuruscu (2009). The influence of federal policy on regional decisions in our model falls under the topic of fiscal federalism. Bordignon, Manasse, and Tabellini (2001) study a theoretical model of optimal federal redistribution when regional governments are both an agent to the federal government and a principle to its own citizens. Regions in our model have identical economic environments, which abstracts away from any value of inter-regional redistribution through federal policy. Instead, we focus explicitly on the responsiveness of state Medicaid provision to changes in the federal subsidy. A generalized version of the inter-regional game generated by a federal subsidy is solved in Barro (2012). That paper applies a similar model to study the effects of U.S. federal subsidization of state-provided extended unemployment insurance. Because the intergovernmental financing of Medicaid is the same as the financing of unemployment insurance extensions, a similar algorithm is also applied to solve the computational model in this paper.

The rest of the paper is organized as follows: Section 2 of the paper presents the theoretical model. Section 3 describes the calibration, and Section 4 discusses the benchmark results. Section 5 studies alternatives to the benchmark model and presents empirical findings, and Section 6 concludes. An overview of the parameters, the computational algorithm, and a description of the data are provided in the appendix.

2 Model

This section presents a dynamic general equilibrium model with overlapping-generations of heterogeneous agents. Insurance markets are incomplete, and the regional provision of a means-tested public health insurance program is determined by the region's median voter in a federalist system of government.

2.1 Individuals

2.1.1 Preferences and Demographics

The model economy is a federation $\mathcal{N}$, which is defined as a unit measure of identical disjoint regions r_i, such that $\cup_{i\in\mathcal{N}} r_i = \mathcal{N}$. In each period, a finite measure of agents is born into each region, where they remain permanently. Individuals reside in exactly one region where they can supply their labor exclusively, but capital is perfectly mobile across regions. Each individual survives to the next period of life with age-dependent probability s_{j+1} and lives for a maximum of T periods. The population grows at rate η. Individuals are endowed with a unit of time in each period, which can be allocated to labor n or leisure $1-n$, and they begin retirement at age Tr. They have utility over consumption c and leisure:

$$u(c, 1-n) = \frac{\left(c^{\chi}(1-n)^{1-\chi}\right)^{1-\sigma}}{1-\sigma}, \tag{1}$$

where σ is the risk aversion parameter, and χ is the consumption share of utility. Future utility is discounted at rate β.

2.1.2 Medical Expenditures and Health Insurance

In each period of life, $j = 1, \ldots, T$, the agent realizes an exogenous health shock $h \in \mathcal{H} = \{h_1, \ldots, h_H\}$ that determines, with certainty, the magnitude of medical expenditures, $m(h, j)$. Health shock h has transition probability $\pi_h(h'|h, j)$ that depends on age and current health shock. We assume that health shocks do not directly affect utility or survival. Individuals potentially have access to public or private insurance plans that pay a portion of medical expenses realized. Insurance markets in our model follow Pashchenko and Porapakkarm (2013). An insurance plan, $ins \in \mathcal{I}$, is defined as a premium Π_{ins} paid to the insurer by the individual at time j (after the realization of the shock at time j) and a fully committed promise by the insurer to pay a (potentially nonlinear) fraction $\phi_{ins}(m(h', j+1))$ of the realized medical expenses at time $j+1$. The set of insurance plans is $\mathcal{I} = \{\text{Medicaid, private, ESHI, Medicare, uninsured}\}$.

Medicaid is a means-tested insurance plan. If an individual's gross income level y^m is less than the Medicaid income-eligibility threshold $\bar{y}$ set by their regional government, then the individual can choose the Medicaid insurance plan. This plan has premium $\Pi_{Medicaid} = 0$, and the insurer's fraction of the medical expenses $\phi_{Medicaid}(m(h', j+1))$ is paid jointly by the regional and federal governments.

Private insurance companies are perfectly competitive and risk-neutral. Their costs consist of an exogenous proportional insurance load γ and the fraction of expenses paid by the insurer $\phi_{private}(m(h', j+1))$. To simplify the model, we assume that private insurers can observe an individual's age and current medical expenses. No arbitrage then implies that premiums are simply the insurer's discounted expected costs:

$$\Pi_{private}(j, h) = \frac{\gamma}{1+r} \sum_{h' \in \mathcal{H}} \pi_h(h'|h, j)\phi_{private}(m(h', j+1))m(h', j+1), \tag{2}$$

where r is the equilibrium interest rate.

In each period, the agent has a chance of being offered an employer-sponsored health insurance (ESHI) plan. This option is exactly the same as a private insurance plan, except the premium can be deducted from taxable income. The likelihood of getting an ESHI offer ($g = 0$ implies not offered,

$g = 1$ implies offered) depends on age and previous offer outcome and has transition probability $\pi_g(g'|g, j)$. We assume that private and ESHI insurance plans are only available to working-age agents.

Once individuals reach retirement ages $j \geq Tr$, they pay premium $\Pi_{Medicare}$ and Medicare pays a constant fraction $\phi_{Medicare}$ of medical expenses. The Medicare portion of expenses are financed by the federal government. The retiree may also qualify for Medicaid. If the retiree does qualify, then Medicaid pays the fraction $\phi_{Medicaid}(m(h', j + 1))(1 - \phi_{Medicare})$ of the medical bill.

Finally, an individual may choose to be uninsured. This means that the individual pays no premium but must finance the entire amount of the medical expenses in the following period.

2.1.3 Labor Productivity

Labor productivity $\epsilon(j, z)$ depends on age and a persistent exogenous productivity shock $z \in \mathcal{Z} = \{z_1, \ldots, z_Z\}$, with transition probability $\pi_z(z'|z)$. Individuals choose their labor supply in each of the first $Tr - 1$ periods of life and do not work thereafter. In the working years, labor supply n returns labor income $w\epsilon(j, z)n$, where w is the wage.

2.2 Technology

A constant returns to scale technology takes aggregate capital K and aggregate efficient labor L as inputs and produces output Y according to

$$Y = K^a L^{1-a}, \tag{3}$$

where a is the capital share of production. Capital depreciates at rate δ in each period.

2.3 Taxes and Government Transfers

Individuals pay a proportional consumption tax τ_c and a progressive income tax $\tau^r(y)$ to the regional government. They also pay progressive income taxes $\tau^f(y)$ to the federal government. A proportional Medicare tax $\tau_m y$ and a Social Security tax $\tau_{ss} min\{y^{ss}, y\}$ is levied by the federal government, where y^{ss} is an upper bound taxable income for the Social Security tax. The taxes on income levied by the regional government and federal government are, respectively:

$$\tau^r(y) = \kappa_0(y - (y^{-\kappa_1} + \kappa_2^r)^{-\frac{1}{\kappa_1}}) \tag{4}$$

$$\tau^f(y) = \kappa_0(y - (y^{-\kappa_1} + \kappa_2^f)^{-\frac{1}{\kappa_1}}) + \tau_m y + \tau_{ss} min\left\{y^{ss}, y\right\}, \tag{5}$$

where the first term is the Gouveia and Strauss (1994) income tax function. In accordance with the federal tax code, we allow ESHI and Medicare health insurance premiums and out-of-pocket medical expenses that exceed 7.5% of income to be deducted from income taxes. Beginning at age Tr, agents receive lump-sum Social Security payments ss in each period. The regional and federal governments jointly finance a consumption floor $\underline{c}$, which ensures that agents have a minimum consumption of $\frac{\underline{c}}{1+\tau_c}$.[3] Unintended bequests are generally treated one of two ways in the literature: collected by the government as tax revenue, as in Attanasio, Kitao, and Viotente (2011), or collected by the government and redistributed among all living agents, as in Huggett (1996) and Conesa, Kitao, and Krueger (2009). To keep the model computationally tractable while maintaining features of each method, we fix redistributed bequests at the benchmark economy value and assume the federal government collects or finances the discrepancies in all subsequent evaluations.

2.4 Government Revenue and Expenditures

Government activity is conducted at both the regional and federal level. The federal government and each regional government must finance an exogenous stream of expenditures, G^f and G^r, respectively. In addition to G^f, the federal government finances Social Security, Medicare, a percentage $1 - \alpha$ of each region's Medicaid program, and a percentage $1 - \alpha^w$ of each region's consumption floor. Regional governments then finance the remaining percentage α of Medicaid expenditures, percentage α^w of the consumption floor, and the exogenous stream of expenditures. Federal government expenditures are financed through federal income taxes and Medicare pre-

[3] In the U.S., social welfare programs, such as Temporary Assistance to Needy Families, are jointly financed by the state and federal government.

miums, while regional government expenditures are financed by consumption taxes and regional income taxes.

2.5 Individual Optimization

Working-age individuals choose consumption, labor supply, health insurance, and asset holdings to maximize their expected utility. Retired households only choose over consumption and asset holdings to maximize expected utility, as the health insurance choice of retirees is directly implied by asset holdings. A single risk-free asset can be purchased in order to smooth consumption and insure against any remaining risk, implying that asset markets are incomplete.

Individuals take as given age j, capital k, insurance status ins, health shock h, labor productivity shock z, ESHI offer status g, a vector of age- and health-dependent insurance premiums Π, prices $\{w, r\}$, federal government policy $\left\{\tau^f(y), \tau, ss\right\}$, regional government policy $\{\bar{y}, \tau_c, \{\tau_t^r(y)\}_{t=0}^{\infty}\}$, initial distribution Γ_0, and law of motion $H(\cdot, \bar{y})$ corresponding to the Medicaid policy $\bar{y}$.

2.5.1 Working-Age Individuals

An individual of age $j < Tr$ optimizes according to:

$$V_j(k, ins, h, z, g; \Gamma)) = \max_{n,k',ins'} u(c, 1-n) + s_{j+1}\beta E_{\{h',z',g'|h,z,g\}} V_{j+1}(k', ins', h', z', g'; \Gamma') \tag{6}$$

$$\begin{aligned} \text{s.t.} \quad (1+\tau_c)c = (1+r)k - k' + w\epsilon(j,z)n - (1-\phi_{ins}(m(h,j)))m(h,j) \\ -\Pi_{ins'} - \tau_t^r(y^{tax}) - \tau^f(y^{tax}) + \tau + beq \end{aligned} \tag{7}$$

$$\begin{aligned} \tau = \max[0, \frac{\underline{c}}{1+\tau_c} - ((1+r)k + w\epsilon(j,z)n - (1-\phi_{ins}(m(h,j)))m(h,j) \\ -\tau^r(y^{tax}) - \tau^f(y^{tax}) + beq)] \qquad \text{(Consumption floor)} \end{aligned} \tag{8}$$

$$\begin{aligned} \tau_D = \max[0, (1-\phi_{ins}(m(h,j)))m(h,j) - .075(rk + w\epsilon(j,z)n + beq)] \\ +\mathbf{1}_{\{ins=ESHI\}}\Pi_{ESHI}(j,h) \qquad \text{(Tax deduction)} \end{aligned} \tag{9}$$

$$y^{tax} = rk + w\epsilon(j,z)n + beq - \tau_D \qquad \text{(Taxable income)} \tag{10}$$

$$y^m = rk + w\epsilon(j,z)n + beq \qquad \text{(Medicaid means test)} \tag{11}$$

$$\Gamma' = H(\Gamma; \bar{y}) \qquad \text{(Aggregate Law of Motion)} \tag{12}$$

where E is the expectation operator, τ is a government transfer that ensures individuals have consumption no less than $\frac{\underline{c}}{1+\tau_c}$, y^{tax} is taxable income, and y^m is the income tested for Medicaid eligibility. Out-of-pocket health spending is determined by age, the idiosyncratic health shock, and insurance status ins. Medicaid is in the individual's insurance choice set only if the individual's means-tested income level y^m is less than the region's Medicaid eligibility threshold $\bar{y}$. Similarly, ESHI is in the individual's insurance choice set only if $g = 1$. Insurance choices of working-age agents are mutually exclusive.

2.5.2 Retired Individuals

Retirees receive Social Security benefit ss in each living period, and Medicare pays for a constant fraction $\phi_{Medicare}$ of their medical expenses. Medicare premiums $\Pi_{Medicare}$ are levied by the federal government. If a retiree's income is sufficiently low, they may also become eligible for Medicaid. We assume that the income eligibility threshold for the retirees $\bar{y}^R$ is exogenous and equivalent across regions. All remaining medical expenses are paid out-of-pocket. A retiree of age $j \geq Tr$ optimizes according to:

$$V_j(k, ins, h; \Gamma) = \max_{k'} u(c, 1) + s_{j+1}\beta E_{\{h'|h\}} V_{j+1}(k', ins', h'; \Gamma') \tag{13}$$

$$\text{s.t.} \quad (1+\tau_c)c = (1+r)k - k' + ss - \tilde{m} - \Pi_{Medicare} - \tau_t^r(y^{tax}) - \tau^f(y^{tax}) + \tau + beq \tag{14}$$

$$\tau = \max[0, \frac{\underline{c}}{1+\tau_c} - ((1+r)k + ss - \tilde{m} - \tau_t^r(y^{tax}) - \tau^f(y^{tax}) + beq] \qquad \text{(Consumption floor)} \tag{15}$$

$$\tilde{m} = (1 - \mathbf{1}_{\{ins=Medicaid\}}\phi_{Medicaid}(m(h,j)))(1-\phi_{Medicare})m(h,j) \qquad \text{(Out-of-pocket medical expenditures)} \tag{16}$$

$$\tau_D = \max[0, \tilde{m} + \Pi_{Medicare} - .075(rk + ss + beq)] \qquad \text{(Tax deduction)} \tag{17}$$

$$y^{tax} = rk + ss + beq - \tau_D \qquad \text{(Taxable income)} \tag{18}$$

$$y^m = rk + ss + beq \qquad \text{(Medicaid means test)} \tag{19}$$

$$\Gamma' = H(\Gamma; \bar{y}) \qquad \text{(Aggregate Law of Motion).} \tag{20}$$

2.6 Equilibrium

We restrict attention to steady-state equilibria. To account for the transition path in the evaluation of regional policy, we allow for aggregate dynamics in the regional economy. Since regional economies are measure-zero relative to the federal economy, an individual region's policy does not affect factor prices or quantities at the federal level. Further, since capital is perfectly mobile across regions, local factor prices are not affected by a region's policies.

We begin by defining an equilibrium transition path at the regional level, where economic agents optimize taking prices and policy as given, and the regional government adjusts tax rates to clear the regional government budget constraint. Next, we impose symmetry of the representative region's activity among all regions and find the prices that clear factor markets and federal government policy that clears the federal government budget constraint in a steady-state. Since we define a politico-economic equilibrium where regions choose not to deviate, equilibrium at the federal level is well-defined in a stationary environment. Finally, we define the politico-economic equilibrium at the regional level, which describes the determination of Medicaid policy.

2.6.1 Regional Equilibrium

To suppress notation, define an individual's state vector over all state variables as x, where $x = \{j, k, ins, h, z, g\}$, $j \in \mathcal{J} = \{1, \ldots, T\}$, $k \in \mathcal{K} = [0, \infty)$, $h \in \mathcal{H}$, $z \in \mathcal{Z}$, $g \in \mathcal{G} = \{0, 1\}$, $ins \in \mathcal{I}$. Define the state space to be $\mathcal{X} = \mathcal{J} \times \mathcal{K} \times \mathcal{H} \times \mathcal{Z} \times \mathcal{G} \times \mathcal{I}$. Denote the distribution over the state space as $\Gamma(x)$. Then, for a given government policy $\{\tau_c, \tau^f(y), ss, \underline{c}, \bar{y}, \bar{y}^R, \phi_{Medicaid}(m), \phi_{Medicare}, \Pi_{Medicare}\}$, a recursive competitive equilibrium is a set of value functions $V(x)$, decision rules $\{n(x), k(x), ins(x)\}$, tax functions $\{\tau^r_t(y)\}_{t=0}^{\infty}$, and initial regional distribution Γ_0 such that:

1. Given government policy, prices, and tax functions, the value function and decision rules solve the individual optimization problem.

2. Distributions of agents in each region are consistent with individual behavior:

$$\Gamma' = H(\Gamma; \bar{y}), \tag{21}$$

where H is determined by agent decision rules, survival probabilities, and the transition probabilities over productivity, health, and ESHI insurance offer.

3. The regional income tax $\tau^r(y)$ adjusts to clear the regional budget constraint in each period:

$$\begin{aligned} \tau_c \int_{\mathcal{X}} c(x) d\Gamma(x) + \int_{\mathcal{X}} \tau^r(y) d\Gamma(x) \\ = \alpha^w \int_{\mathcal{X}} \tau d\Gamma(x) + \alpha \int_{\mathcal{X}} \phi_{Medicaid}(m(h,j)) m(h,j) \mathbf{1}_{\{y^m \leq \bar{y}\}} \mathbf{1}_{\{j \leq Tr-1\}} d\Gamma(x) \\ \alpha \int_{\mathcal{X}} \phi_{Medicaid}(m(h,j))(1 - \phi_{Medicare}) m(h,j) \mathbf{1}_{\{y^m \leq \bar{y}^R\}} \mathbf{1}_{\{j \geq Tr\}} d\Gamma(x) + G^r \end{aligned} \tag{22}$$

where $\mathbf{1}$ is an indicator function.

2.6.2 Recursive Competitive Equilibrium

A recursive competitive equilibrium is defined at the federal level as a set of factor prices $\{r, w\}$, insurance premiums $\{\Pi_{private}, \Pi_{ESHI}\}$, and tax function $\tau^f(y)$, such that:

1. Value functions and decision rules satisfy regional equilibrium.

2. Factor prices are determined competitively:

$$r = F_K(K, L) - \delta \tag{23}$$

$$w = F_L(K, L) \tag{24}$$

3. The labor market clears:

$$L = \int_{\mathcal{X}} \epsilon(j,z) n(x) d\Gamma(x) \tag{25}$$

4. The asset market clears:

$$K = \int_{\mathcal{X}} (k(x) + \mathbf{1}_{\{ins(x)=private\}} \Pi_{private}(x) + \mathbf{1}_{\{ins(x)=ESHI\}} \Pi_{ESHI}(x)) d\Gamma(x) \tag{26}$$

5. The final good market clears:

$$F(K,L) + (1-\delta)K = \int_{\mathcal{X}} [c(x) + m(x)]\, d\Gamma(x) + K' + G, \tag{27}$$

where G is the sum of exogenous regional and federal government expenditures.

6. Equation (2) holds so that the private health insurers make zero profits.

7. The federal government's budget constraint clears:

$$\begin{aligned} \int_{\mathcal{X}} \tau^f(y) d\Gamma(x) + \hat{beq} = (1-\alpha) \int_{\mathcal{X}} \phi_{Medicaid}(m(h,j)) m(h,j) \mathbf{1}_{\{y^m \leq \bar{y}\}} \mathbf{1}_{\{j \leq Tr-1\}} d\Gamma(x) \\ + (1-\alpha) \int_{\mathcal{X}} \phi_{Medicaid}(m(h,j)))(1-\phi_{Medicare}) m(h,j) \mathbf{1}_{\{y^m \leq \bar{y}^R\}} \mathbf{1}_{\{j \geq Tr\}} d\Gamma(x) \\ + (1-\alpha^w) \int_{\mathcal{X}} \tau d\Gamma(x) + \int_{\mathcal{X}} (\phi_{Medicare} m(h,j) + ss - \Pi_{Medicare}) \mathbf{1}_{\{j \geq Tr\}} d\Gamma(x) + G^f \end{aligned} \tag{28}$$

where surplus bequests, $\hat{beq}$, are determined according to $\hat{beq} = \int_{\mathcal{X}} (1 - s_{j+1}) k(x) d\Gamma(x) - beq \int_{\mathcal{X}} d\Gamma(x)$.

2.6.3 Regional Politico-economic Equilibrium

We now consider the determination of the policy variable $\bar{y}$ as the preferred policy of the median voter. We focus on a full-commitment, or equivalently, a once-and-for-all vote on the Medicaid threshold.[4] Let $\Gamma(x; \bar{y_0})$ denote the steady-state distribution corresponding to the recursive com-

[4]Corbae, et al. (2009) introduce a sequential voting framework to explain realizations over a period of two decades. Since we only wish to explain Medicaid coverage at a single point in time, we impose this framework. This restriction substantially reduces computational burden without detracting from the purpose of model.

petitive equilibrium where regional governments have Medicaid threshold $\bar{y_0}$. For several different values of $\bar{y_0}$, we will consider the value to a voter of deviating to $\bar{y}$. Let $\tilde{V}(x;\bar{y_0},\bar{y})$ denote the value function of an individual with state x in a regional equilibrium corresponding to $\bar{y}$ with current distribution $\Gamma(x;\bar{y_0})$. A regional politico-economic equilibrium with full commitment can then be defined as an individual policy function $\psi(x;\bar{y_0})$, policy outcome function $\Psi(\bar{y_0})$, and fixed point $\bar{y}^*$ such that:

1. An individual with state x has preferred Medicaid policy $\bar{y}^i$ according to:

$$\bar{y}^i = \psi(x;\bar{y_0}) = \underset{\bar{y}}{\text{argmax}}\tilde{V}(x;\bar{y_0},\bar{y}) \tag{29}$$

2. Policy outcome $\bar{y}^M = \Psi(\bar{y_0})$ is determined by:

$$\int_{\mathcal{X}} \mathbf{1}_{\{\bar{y}^i \geq \bar{y}^M\}} d\Gamma(x;\bar{y_0}) = \frac{1}{2} \tag{30}$$

$$\int_{\mathcal{X}} \mathbf{1}_{\{\bar{y}^i \leq \bar{y}^M\}} d\Gamma(x;\bar{y_0}) = \frac{1}{2} \tag{31}$$

3. The fixed point $\bar{y}^*$ satisfies $\bar{y}^* = \Psi(\bar{y}^*)$.

The first condition on the politico-economic equilibrium defines the most preferred Medicaid eligibility threshold for each individual in the region. The second condition determines the Medicaid threshold most preferred by the median voter. Finally, the third condition ensures that the recursive competitive equilibrium is well-defined in a stationary environment. More specifically, the initial distribution will be $\Gamma(x;\bar{y}^*)$, which is the steady-state distribution corresponding to Medicaid threshold $\bar{y}^*$. Then, the law of motion corresponding to $\bar{y}^*$ is $H(\cdot;\bar{y}^*)$, which gives the fixed-point of the distribution $\Gamma(x;\bar{y}^*) = H(\Gamma(x;\bar{y}^*);\bar{y}^*)$.

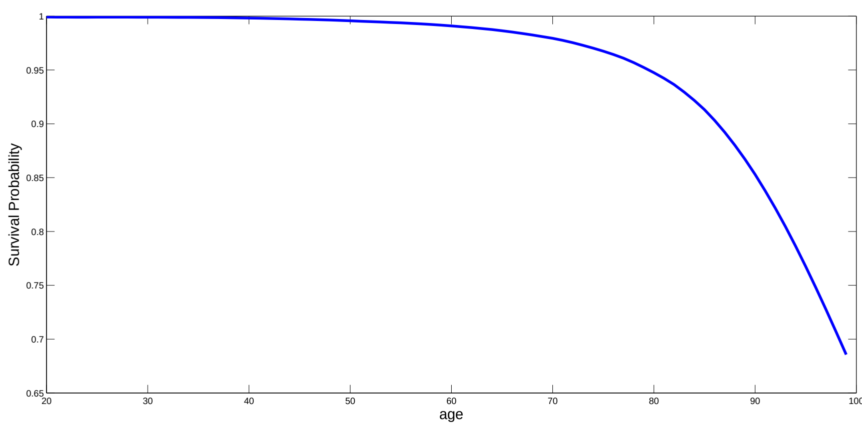
3 Calibration

This section discusses the calibration of the model economy. The model is calibrated to values representing the U.S. economy around the year 2011, and individual health care parameters are estimated using MEPS data. Output in the model is normalized to one.[5]

3.1 Demographics, Preferences, and Technology

In the model, agents are born at age 20 ($j = 1$), begin retirement at age 65 ($Tr = 46$), and live a maximum of 99 ($T = 80$) years. Survival rates, s_{j+1} depend only on age, and we use the rates reported in the 2008 Center for Disease Control and Prevention Life Tables. We follow Attanasio et al. (2010) and set the population growth rate at 1.2% per year.

Figure 1: 2008 CDC Unconditional Survival Probability



The risk aversion parameter σ is set to 4, and the consumption share of utility $\chi = .3$ generates an average of 31% of the time endowment allocated to working. Together, these parameters imply a coefficient of relative risk aversion of 1.9 and a Frisch labor supply elasticity of 1.05. The personal discount factor $\beta = .9875$ is calibrated to target an aggregate capital-to-output ratio of 3. We assume Cobb-Douglas production $F(K, L) = K^a L^{1-a}$, where $a = .36$, and capital depreciates at rate $\delta = .083$, generating an investment-to-output ratio of 25%.

[5] Dollar values are mapped into the model based on average income per household of approximately $44,000 in 2011.

3.2 Labor Productivity and Medical Expenditures

We allow for the correlation between labor productivity and medical expenditures. We do this by dividing the sample by age into quartiles of log wages and above/below 90th percentile of medical expenditures. Estimated age-productivity profiles are displayed in Figure 2. Medical expenditures and the persistence of medical expenditure shocks are shown in Figures 3 and 4, respectively. Next, we directly estimate the probability of being in a productivity-medical expenditure bin at age j and being in another productivity-medical expenditure bin at age $j+1$. For each age group, this gives an eight-by-eight transition matrix over productivity and medical expenditure states. To compare the empirical properties of our productivity process with estimates from the literature, we generated a panel of simulated productivity shocks and estimated a first-order autoregressive process. The results summarized in Table 1 show that the productivity moments are close to those reported in Huggett (1996). We find that the correlation coefficient for productivity and medical expenditures is .176.

Table 1: Moments of the Productivity Process

Moment	Model Estimates	Huggett (1996)
Variance of initial distribution	.29	.36
Coefficient on lagged dependent variable	.97	.96
Variance of error	.0295	.045

The age-medical expenditure profiles in Figure 3 show that as individuals age, the probability of a health condition requiring costly treatment grows. However, the medical expenditure profile indicates that after about age 80, purchases of the most costly treatments begins to decline. This decline can be explained by a shorter life expectancy that reduces the lifetime benefits of a procedure as well as a preference to avoid the most invasive procedures for individuals in that range of the age distribution.

3.3 Health Insurance

ESHI offers are defined based on whether a person was offered insurance in two of three reporting periods during the year (following Pashchenko and Porapakkarm (2013)). A person is defined

Figure 2: Lifecycle Productivity

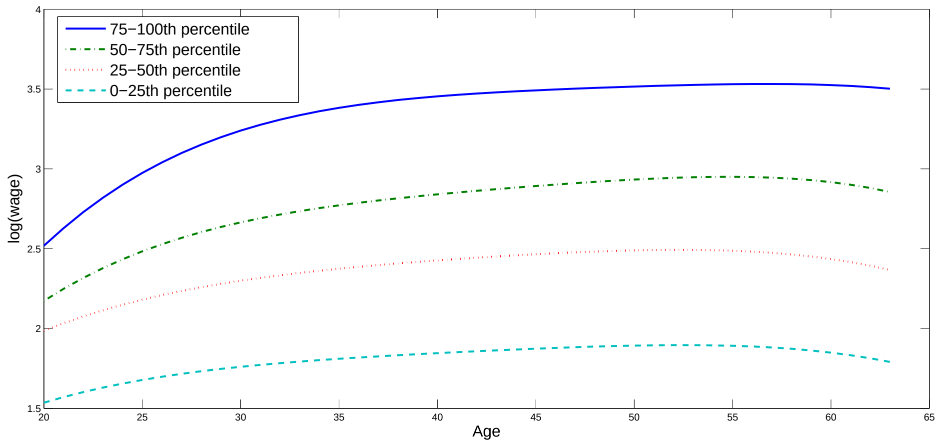


Figure 3: Lifecycle Medical Expenditures

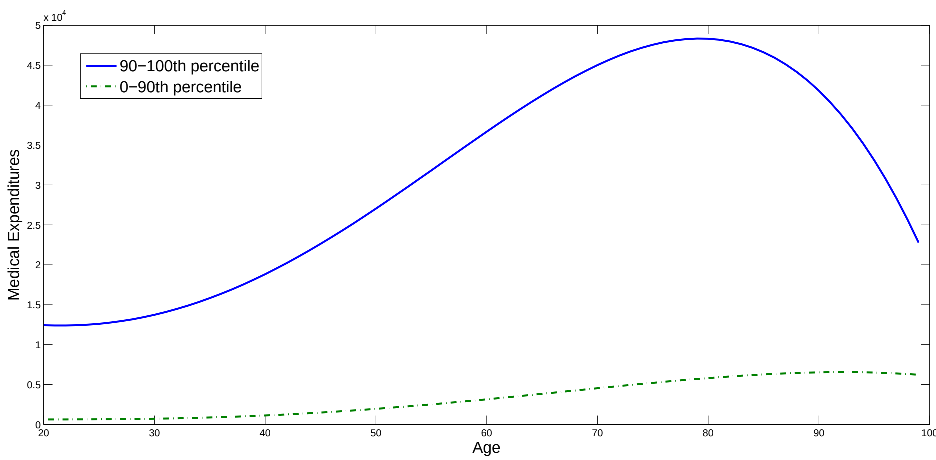
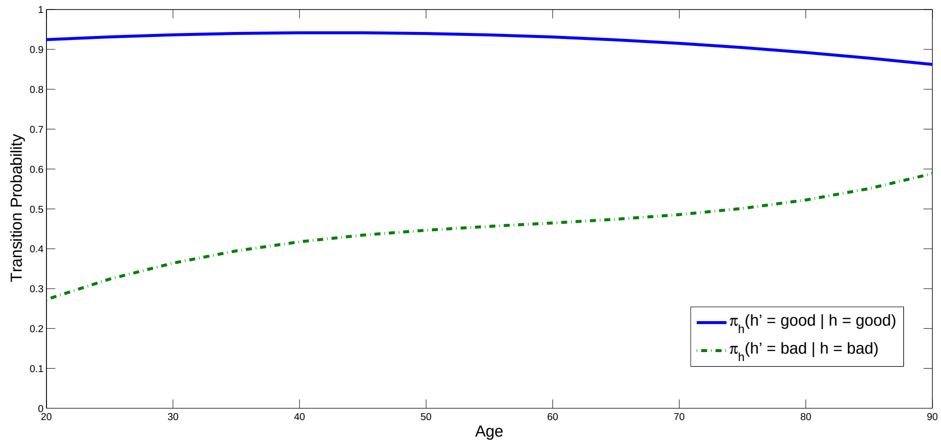


Figure 4: Persistence of Medical Expenditures

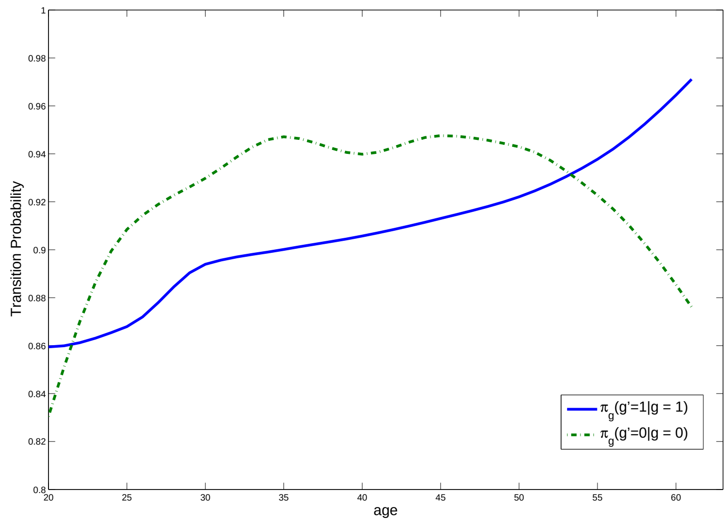


as being offered insurance if a working adult in the health insurance eligibility unit was offered insurance. The two years of data collected on each sample individual are used to estimate transition probabilities that an individual who was offered or not offered ESHI in the first year is offered or not offered ESHI in the subsequent year. The transition probabilities $\pi_g(g'|g,j)$ shown in Figure 5 are estimated independently within each of the five-year age bins. We set the value of the insurance load, $\gamma = 1.11$ based on Kahn et al. (2005).

To determine the initial distribution of coverage by each type of insurance, individuals are grouped into discrete categories of insurance coverage. Insurance coverage types are restricted to ESHI, other private insurance, Medicaid, and uninsured. Insurance coverage status for 20 year olds as of April in the corresponding survey year is used to estimate the initial percentage of individuals in each insurance coverage group. The Medicaid income threshold for retirees $\bar{y}^R$ is calibrated so that 6% of of the elderly population to match the corresponding percentage of non-institutionalized individuals over 65 years enrolled in Medicaid.

To assess the generosity of Medicaid and private insurance coverage, the portion covered by each type of insurance is estimated by regressing total spending by Medicaid or private insurance on a quadratic of total medical expenditures. This is used to express average Medicaid and private expenditures per recipient as a function of total medical expenditures. The corresponding private

Figure 5: ESHI Offer Persistence



insurance and Medicaid payment shares are shown in Figure 6. We estimate that Medicare pays for approximately 50% of elderly medical expenses, so we set $\phi_{Medicare} = .5$. According to Attanasio et al. (2011), we set Medicare premiums to be 2.2% of per capita income, and the Medicare tax is set to 2.9% of taxable income.

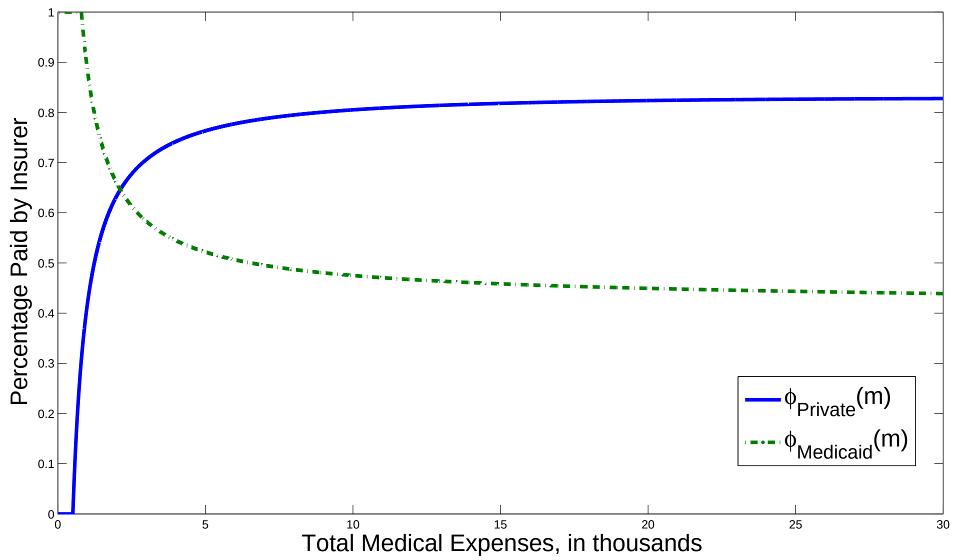
The MEPS data are known to understate aggregate medical expenditures.[6] Following Attanasio et al. (2011), we normalize medical expenditures to match observed aggregate medical expenditures to GDP in the benchmark economy. Aggregate medical expenses reported by the Centers for Medicaid and Medicare Services were approximately 18% of GDP in 2011. Accordingly, we scale all model medical expenditures by a factor of 1.38 to ensure that medical expenditures in the model are 18% of total output.

3.4 Government

To calculate the exogenous component of regional and federal government expenditures, G^r and G^f, respectively, we assume that total government expenditures are 20% of GDP in the benchmark

[6] See Bernard, et al. (2012).

Figure 6: Percent of Medical Expenses Covered by Insurer



economy. According to the National Income and Product Account published by the Bureau of Economic Analysis, the U.S. federal government expenditures in 2012 were roughly twice that of regional governments. Accordingly, we set the region's fraction of aggregate government expenditures to one-third, leaving the federal government to finance the remaining two-thirds. Then we use data from the 2011 Annual Survey of State Government Finances from the U.S. Census Bureau to estimate the percentage of non-Medicaid state government expenses. We find that Medicaid comprises approximately 25% of state expenditures. We do the same for the federal government and find that Medicaid, Medicare, and Social Security comprise about 45% of federal expenses. The exogenous component of regional and federal government expenditures are then set to the remaining shares.

The Social Security benefit ss is calibrated so that federal benefits paid are 4.5% of GDP, as in Attanasio et al. (2011). The consumption floor is calibrated to 6% of per capita income, which is an approximation to the value provided in De Nardi et al. (2010). We assume that the federal government has a progressive income tax function estimated by Gouveia and Strauss (1994) where the parameters $\kappa_0$and κ_1 are set to .258 and .768, respectively. The federal government also levies a proportional Social Security and Medicare tax. The Social Security tax rate is set to $\tau_{ss} = 12.4\%$, and the Medicare $\tau_m = .029$. Both Social Security and Medicare taxes are expressed as the sum of the employer and employee portion of the tax. The maximum taxable income for the Social Security tax, y^{ss}, is set to 2.5 times per capita income, which was approximately $110,000 in 2012. The remaining parameter is κ_2, which we use to clear the federal government's budget constraint.

In reality, U.S. state governments vary significantly in the ways they finance expenditures. Because of the homogeneity in regional environments in our model, we simplify by assuming that each state levies a proportional consumption tax, τ_c, and the same progressive income tax function as the federal government. The consumption tax is set to $\tau_c = .057$ following Mendoza, Razin, and Tesar (1994), the parameters κ_0 and κ_1 are the same as the federal income tax function, and κ_2 is adjusted to clear the regional government's budget constraint.[7]

We use the intergovernmental allocation for the Temporary Assistance for Needy Families (TANF) to approximate the federal and state division of the consumption floor financing. According to Falk (2013), the federal government finances just over half of the TANF program, so we set $\alpha^w = .5$. Finally, the percentage of the federal Medicaid subsidy, or the region's FMAP, $1 - \alpha$ is set to the average of all states in 2011, which is 60%.

4 Results

This section presents the results of the computational exercise. The model economy is evaluated by comparing the benchmark economy to the corresponding values in the U.S. data. We then present the results of the counterfactual experiments.

4.1 The Benchmark Economy

The benchmark model matches several key features of the U.S. health care system in 2012. Most importantly, the model delivers a politico-economic equilibrium in which 16.8% of working-age individuals are covered by Medicaid. While this magnitude overstates the actual Medicaid

[7]We relax this assumption in Section 5 and allow other tax instruments to clear the regional government budget constraint.

coverage rate in 2012, it coincides with the passage of the ACA, which significantly expanded the Medicaid program. The model also provides a close match for the percent of the population that is uninsured. Finally, while the model does not closely match individual types of private health insurance rates (private ESHI and private non-ESHI), the total private health insurance rate in the model is remarkably close to the data.[8]

Table 2: Comparing the Benchmark Model to the U.S. Economy

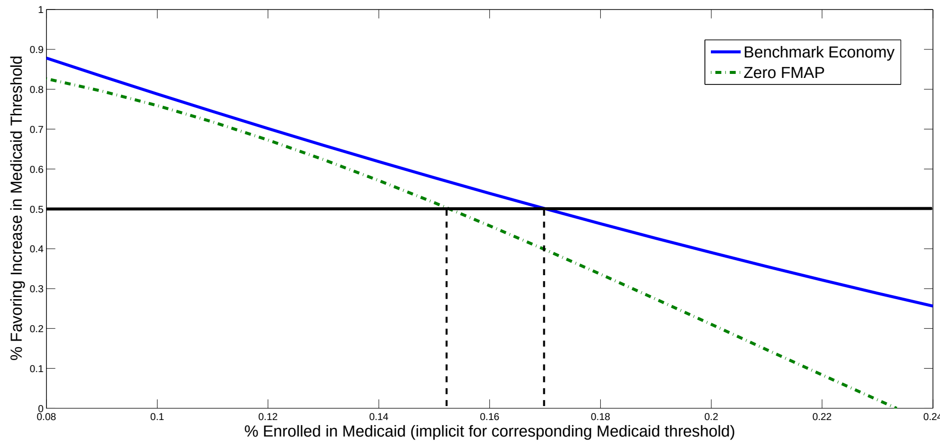
Variable	U.S. data	Benchmark Model
Medicaid coverage	11%	16.8%
Uninsured	21%	20.1%
Total Private	65%	63.1%
Other	3%	0%

Equilibrium Medicaid policy is shown in Figure 7. The graph shows election outcomes between $\bar{y}_0$ and $\bar{y}_0 + \epsilon$, or mathematically $\int_{\mathcal{X}} \mathbf{1}_{\{\tilde{V}(x,\bar{y}_0,\bar{y}_0+\epsilon)\geq\tilde{V}(x,\bar{y}_0,\bar{y}_0)\}} d\Gamma(x)$, over a continuum of values $\bar{y}_0$ and for a small ϵ. Since model values of the Medicaid threshold are difficult to interpret, the graph implicitly defines the percentage of individuals covered by Medicaid corresponding to the given Medicaid threshold. While proving uniqueness of the equilibrium is not feasible, Figure 7 suggests that the equilibrium is at least locally unique.

To understand the determination of Medicaid policy in this economy, we study the demographic and economic composition of voting outcomes. The average age of an individual voting in favor of increasing Medicaid ("yea-voter") in the benchmark economy is 31.3, while the average age of an individual voting against expanding Medicaid ("nay-voter") is 62.2. Medicaid provision is only voted upon for working-age Medicaid eligibility. Accordingly, increases in working-age Medicaid provision increases retirees' taxes without increasing their Medicaid provision. Without the increased benefits, all retirees vote unfavorably for increases in the provision. Table 3 shows the economic composition of those favoring a small increase in Medicaid provision at the equilibrium threshold. Yea-voters tend to be younger, more productive, healthier, and pay higher taxes, but they also have lower capital accumulation, as shown in Figure 8. Many of these variables, such as productivity and

[8]Private non-ESHI comprises 6% and Private ESHI is 58% in the data, while the model values are 22.1% and 40.6%, respectively.

Figure 7: Politic-economic Equilibrium Medicaid Provision



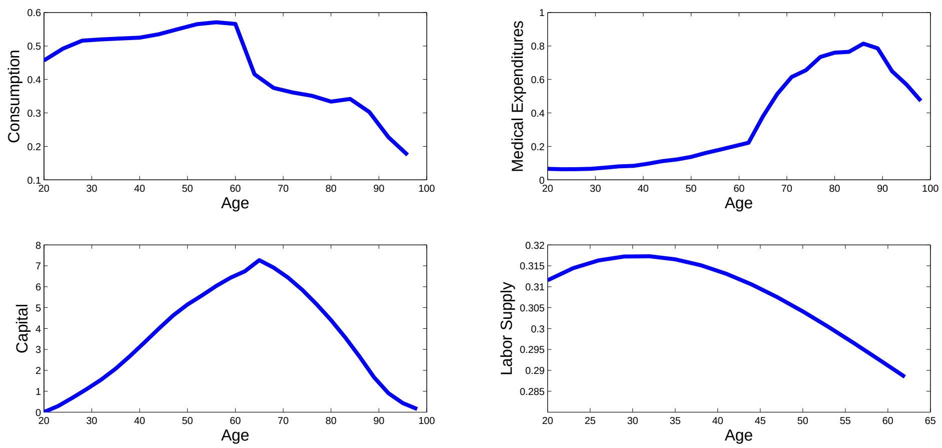
medical expenditures are inherently correlated with age. Despite the fact that yea-voters incur lower medical expenditures and higher taxes, they prefer greater Medicaid provision because their assets are lower and they cannot fully insure against future medical expenses. As the individual ages, the possibility of working-age Medicaid eligibility declines, the likelihood of an opportunity to purchase ESHI rises, and the ability to self-insure increases. These factors combine to drive down the value of working-age Medicaid provision as an individual ages.

Table 3: Characteristics of Voters in an Election

Variable*	Benchmark Economy	Zero FMAP
Capital	29.4%	34.3%
Hours**	181.1%	206.0%
Effective Labor**	166.7%	191.5%
Total consumption	107.9%	111.3%
Consumption tax	107.9%	111.3%
Federal income tax	141.1%	160.8%
State income tax	127.1%	144.0%
Medical expenditures	21.4%	20.7%
Medicaid expenditures	64.2%	82.6%

*Mean of yea-voters, relative to mean of nay-voters.
**Comparison of working-age agents.

Figure 8: Life-cycle Properties of the Benchmark Model



4.2 Effect of the Federal Subsidy

Next, we measure the effect on equilibrium Medicaid provision caused by the federal subsidy. To that extent, we solve the model again with the federal subsidy set to zero and compare the equilibrium outcomes. We find that the federal subsidy has a modest effect on equilibrium Medicaid provision. Equilibrium Medicaid determination is shown in Figure 7, while the distribution over health insurance types are summarized in Table 4. The Medicaid coverage rate falls from 16.8% down to 15.3%, reflecting a 9% reduction in enrollment.

Table 4: Comparing the Benchmark Model to the Counterfactual

Variable	Benchmark Model	Zero FMAP
Medicaid coverage	16.8%	15.3%
Uninsured	20.1%	21.2%
Total Private	63.1%	63.5%

Characteristics of voters in this counterfactual scenario are summarized in Table 3. Without the federal subsidy, the measure of individuals voting favorably shifts downward, bringing the average age down to 30.9 for a yea-voter and 61.7 for a nay-voter in equilibrium. Although the average age of a yea-voter declines, the average capital of a yea-voter increases, reflecting an increase in self-insurance for this demographic in the counterfactual case.

The increase in Medicaid provision resulting from the federal subsidy is also associated with a decline in both uninsured and privately insured individuals. An increase in public health insurance coverage caused by a reduction in total private health insurance is called *crowd-out*, and it is measured as $\frac{\Delta\text{total private}}{\Delta\text{Medicaid}}$. We find that Medicaid crowd-out caused by the federal subsidy is 29.6%. By comparison, Cutler and Gruber (1996) report general estimates of Medicaid crowd-out around 50%.

5 Tax Structure and Medicaid Provision

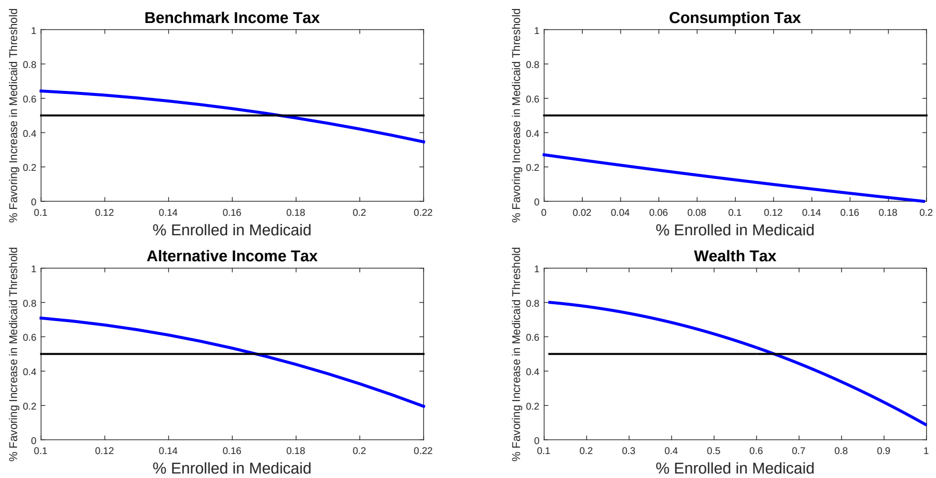
This section re-addresses the question of politico-economic Medicaid provision under alternative regional tax regimes in a partial equilibrium framework. This approach serves two purposes. First, exploring other tax instruments provides robustness of the benchmark economy. Second, the results posit a theory relating tax progressivity and Medicaid provision, which may explain the heterogeneity in U.S. state Medicaid provision. We finish this section by providing empirical support for our model's findings.

5.1 Alternative Regional Tax Regimes

The previous section provided the results of individual regional deviations from policies where all other regions acted symmetrically. In contrast, this section focuses on the results of regional deviations when all other regions choose the equilibrium in the benchmark case. To that extent, we study an individual region's deviations over a larger set of income eligibility thresholds, holding all other regions constant at the benchmark equilibrium.

We study cases where changes in Medicaid provision are financed by consumption taxes, income taxes (with alternative specification relative to the benchmark), and capital taxes. To ensure likewise comparison, we reproduce the results of the benchmark economy under partial equilibrium and proceed to the individual alternative cases. The alternative income tax solves the model using the same Gouveia-Strauss income tax functional form, but instead uses the parameter κ_0 to clear the regional budget constraint. The results show little variation under this alternative, suggesting that the income tax function is robust with respect to the alternative parameter chosen to clear the regional budget constraint. Finally, the consumption tax and wealth tax simply levy proportional taxes on consumption and wealth, respectively.

Figure 9: Politico-economic Medicaid Provision under Alternative Tax Regimes



The politico-economic equilibria under the alternative tax regimes are shown in Figure 9. The benchmark income tax again corresponds to Medicaid provision covering roughly 17% of the working population, while the alternative income tax delivers equilibrium Medicaid coverage less than one percentage point lower than the benchmark. The consumption tax, which is the least progressive tax under consideration, results in a corner solution where Medicaid is not provided. When Medicaid is financed by a wealth tax, however, coverage rises markedly to 64%.

The sharply higher equilibrium Medicaid provision under wealth taxes happens for at least two reasons. First, as shown in Figure 8, the wealth tax falls heavily on individuals over 65 years old who only comprise approximately 20% of the population and do not benefit from working-age Medicaid expansions. Second, capital taxes in a life-cycle model serve as a progressive mechanism to mitigate the effects of idiosyncratic risk when the revenues raised are appropriated to those incurring bad shocks.[9]

The results suggest that when more progressive tax instruments are levied to finance expansions

[9]See Conesa, Kitao, and Kreuger (2009) for a discussion on the role of capital taxes in a life-cycle model.

in means-tested government health provision, constituents choose a higher provision. In reality, U.S. states finance government expenditures with a variety of tax instruments, but the model's results predict a positive relationship between Medicaid provision and the progressivity of the tax structure.

5.2 Empirical Evidence

States generally use a combination of tax instruments to finance state government with most states relying on income and consumption taxes as the primary sources of revenue. There is significant heterogeneity in state tax structures and rates at which those taxes are imposed creating wide variation in the progressivity of state taxes. To investigate the relationship between differences in tax structure and state Medicaid provision, we use data from the Institute on Taxation and Economic Policy that compares the total state taxes paid by low income residents to total state taxes paid by high income residents.

We measure Medicaid generosity using the percentage of the population covered by Medicaid in each state and the District of Columbia. According to the Kaiser Family Foundation, prior to the Medicaid expansions under the ACA, Medicaid coverage ranged from a low of 5% of the population in Montana to a high of 22% in the District of Columbia. Our primary measure of progressivity is the ratio of average state taxes paid (as a percentage of total income) for the highest 1% of income earners to the lowest 20%, so a higher ratio implies higher tax progressivity. Using this metric, the least progressive tax structure is in Wyoming, and the most progressive state tax structure is in the District of Columbia. We find a moderate correlation of 0.56 between state tax progressivity and Medicaid provision, which supports the model's prediction.

6 Conclusion

The primary goal of this paper was to investigate how states choose Medicaid provision and to measure the influence of U.S. federal subsidies on this provision. We accomplished this by developing a quantitative politico-economic theory of means-tested public health care financing in a federalist system and evaluating a counterfactual experiment with no federal subsidies. We calibrated the theoretical model to the U.S. economy and solved for state-level Medicaid provision, given the design of the federal policy. We found that the model replicated several features of the U.S. health care system, including Medicaid provision and the distribution of health insurance types. To measure the effect of the federal subsidy on state-level Medicaid provision, we removed the subsidy and solved the model again. We found that the effect of the federal subsidy accounted for approximately 9% of Medicaid enrollment. Our model also showed that politico-economic Medicaid provision is higher when more progressive tax instruments clear the government budget constraint, which is consistent with empirical findings on tax policy and Medicaid coverage.

The model makes several contributions to the literature. First, the model provides a positive theory of means-tested, intergovernmental health care financing in the U.S. Second, the model provides a platform for evaluating existing U.S. health care policy and proposed alternatives to the current system. Finally, the model provides a framework for evaluating intergovernmental fiscal policy by combining elements of political economy and fiscal federalism.

This paper also leaves many important questions for future research. For example, why does the federal government subsidize state provision of Medicaid? Should the U.S. federal government continue financing such a large portion of Medicaid expenditures in wealthy states? Is a proportional match an efficient way to redistribute income across states? The computational tractability of the model limited the equilibrium concept to a voting outcome with commitment. However, if we consider a recursive voting model in a simpler environment, could the results explain the substantial growth in the percentage of government-financed health care expenditures from 25% in 1960 to 46% in 2003?[10] Many health care questions remain to be answered in the macroeconomics literature. This paper addresses some important questions, and provides a framework for many others.

References

[1] Adda, J. and R. Cooper (2003) "Dynamic Economics: Quantitative Methods and Applications." Cambridge, Mass., MIT Press.

[10] http://aspe.hhs.gov/health/medicalexpenditures/

[2] Attanasio, O., S. Kitao and G. Violante (2011) "Financing Medicare: A General Equilibrium Analysis," in J. B. Shoven, ed., *Topics in Demography and the Economy* (University of Chicago Press): 333366.

[3] Barro, J., (2012) "Federal Subsidization and Optimal State Provision of Unemployment Insurance in the U.S.," Working paper.

[4] Bernard, D., C. Cowan, T. Selden, L. Cai, A. Catlin, and S. Heffler, (2012) "Reconciling Medical Expenditure Estimates from the MEPS and NHEA, 2007," *Medicare & Medicaid Research Review* 2 (4): 1:20.

[5] Bordignon, M., Manasse, P., and G. Tabellini (2001) "Optimal Regional Redistribution under Asymmetric Information," *American Economic Review* 91 (3): 709-723

[6] Burman, L. E., Bowen, G., and S. Khitatrakun, (2008) " The Tax Code, Employer-Sponsored Insurance, and the Distribution of Tax Subsidies," in H. Aaron and L. Burman (eds.). *Using Taxes to Reform Health Insurance: Pitfalls and Promises* (Brookings Institution Press): 36-56.

[7] Conesa, J. C. , S. Kitao, D. Krueger, (2009) "Taxing Capital? Not a Bad Idea After All!," *American Economic Review* 99 25-48.

[8] Corbae, D., P. D'Erasmo, and B. Kuruscu. (2009) "Politico-economic Consequences of Rising Wage Inequality," *Journal of Monetary Economics* 56: 43-61.

[9] Cutler, D. M., and J. Gruber, (1996) "Does Public Insurance Crowd Out Private Insurace?" *Quarterly Journal of Economics* 111 (2): 391-430.

[10] Davis, C., K. Davis, M. Gardner, H. Heimovitz, S. Johnson, R. S. McIntyre, R. Phillips, A. Sapozhnikova, and M. Wiehe. "Who Pays? A Distributional Analysis of the Tax Systems in All 50 States," Rep. The Institute on Taxation & Economic Policy, Jan. 2015. Available at http://www.itep.org/pdf/whopaysreport.pdf

[11] De Nardi, M., E. French and J. B. Jones (2010) "Why do the Elderly Save? The Role of Medical Expenses," Journal of Political Economy, 118 (1): 3775.

[12] Falk, G. (2013) "The Temporary Assistance for Needy Families (TANF) Block Grant: A Primer on TANF Financing and Federal Requirements," Congressional Research Service Report for Congress.

[13] French, E., (2005). "The Effects of Health, Wealth, and Wages on Labor Supply and Retirement Behaviour," *Review of Economic Studies*, 72(2), pages 395-427.

[14] Gouveia, M. and R. P. Strauss (1994) "Effective Federal Individual Income Tax Functions: An Exploratory Empirical Analysis," *National Tax Journal*, 47: 317339.

[15] Gruber, J. (2003) "Medicaid," in R. Moffitt, ed., *Means-Tested Transfer Programs in the United States* (University of Chicago Press): 15-77

[16] Huggett, M. (1996) "Wealth Distribution in Life-Cycle Economies," *Journal of Monetary Economics* 38: 469-494.

[17] Kahn, J., R. Kronick, M. Kreger, and D. Gans, (2005) "The Cost of Health Insurance Administration in California: Estimates for Insurers, Physicians, and Hospitals," *Health Affairs* 24 (6) 1629-1639.

[18] Kaiser Family Foundation (2013) "Health Insurance Coverage of Adults 19-64," Available at http://kff.org/other/state-indicator/adults-19-64/

[19] Kaiser Family Foundation (2016) "Medicaid Coverage Rates for the Nonelderly by Age," Available at http://kff.org/medicaid/state-indicator/rate-by-age-3/

[20] Kopecky, K., and T. Koreshkova (2014) "The Impact of Medical and Nursing Home Expenses on Savings," *American Economic Journal: Macroeconomics* 6 (3) 29-72.

[21] Kotlikoff, L., and L. Summers (1981) "The Role of Intergenerational Transfers in Aggregate Capital Accumulation," *Journal of Political Economy* 89 706-732.

[22] Krusell, P., V. Quadrini, and J. V. Rios-Rull, (1997) "Politico-economic Equilibrium and Economic Growth," *Journal of Economic Dynamics and Control* 21 (1) 243-272.

[23] Mendoza, E. G., Razin, A., and L. L. Tesar (1994). "Effective Tax Rates in Macroeconomics: Cross-country Estimates of Tax Rates on Factor Incomes and Consumption," *Journal of Monetary Economics* 34 (3): 297-323.

[24] Pashchenko, S. and P. Porapakkarm (2013) "Quantitative analysis of health insurance reform: Separating regulation from redistribution," *Review of Economic Dynamics*, 16 (3): 383-404.

[25] Stone, L. (2014) "Which States Have the Most Progressive Income Taxes?" Tax Foundation. N.p., Available at http://taxfoundation.org/blog/which-states-have-most-progressive-income-taxes-0

Appendix 1: Overview of Parameters

Table 5: Model Parameters

Parameter	Value	Target/Source
Demographics		
Retirement age (Tr)	46 (65)	Assumed
Max lifetime (T)	80 (99)	Assumed
Survival probability (s_{j+1})	Figure 1	CDC Life Tables (2008)
Population growth (η)	.012	Attanasio et al.
Preferences		
Discount factor (β)	.9875	$K/Y = 3$
Risk Aversion (σ)	4	Elasticity of intertemporal substitution = .5
Consumption share (χ)	.3	avg. hours = .31
Health care		
Private insurance load (γ)	1.11	Kahn et al. (2005)
Medical expense scaling	1.38	Aggregate medical expenses 18% of GDP
Medicare premium ($\Pi_{Medicare}$)	.022	2.2% of per-capita income (Attanasio et al.)
Medicare insurance rate ($\phi_{Medicare}$)	.5	MEPS data
Elderly Medicaid threshold ($\bar{y}^R$)	.125	6% of noninstitutionalized elderly on Medicaid
Technology		
Capital share (a)	.36	Data
Depreciation rate (δ)	.083	I/Y = 25.5%
Government Policy		
FMAP ($1-\alpha$)	.6	Average across states in 2011
Transfer payment share ($1-\alpha^w$)	.5	Approximation to TANF share
Tax parameter 1 (κ_0)	.258	Gouveia and Strauss (1994)
Tax parameter 2 (κ_1)	.768	Gouveia and Strauss (1994)
(Federal) Tax parameter 3 (κ_2^f)	.4625	Clear federal budget constraint
(State) Tax parameter 3 (κ_2^r)	.1199	Clear state budget constraint
Consumption tax (τ_c)	.057	Mendoza, Razin, and Tesar (1994)
Medicare tax (τ_m)	.029	U.S. Tax Code
Social Security tax (τ^{ss})	.124	U.S. Tax Code
Consumption floor ($\underline{c}$)	.06	De Nardi et al. (2010)

Appendix 2: Computational Algorithm

This section provides an overview of the computational algorithm used to solve the model. The computation involves two steps. The first step solves the steady-state values at the federal level for a given Medicaid threshold. The second step solves the value of deviating from that threshold at the regional level.

A2.1: Solving the Federal Equilibrium

Since regions are measure-zero, deviations do not affect federal-level aggregates. Therefore, the federal economy simplifies to determining steady-state factor prices and taxes for a given Medicaid threshold.

1. For a given Medicaid threshold, $\bar{y}_0$, guess a federal income tax parameter κ_2^f, regional income tax parameter κ_2^r, and capital-to-labor ratio.
2. Solve the individual agent problem over a grid of assets, insurance, and labor supply.[11]
3. Solve for the distribution over all types and determine aggregate variables.
4. If the capital-to-labor ratio is the same as the initial guess, the loop is complete. Otherwise, update the guess (using partial adjustment) and iterate to convergence.
5. If the state government budget constraint clears, the loop is complete. Otherwise, update the guess (using bisection) and iterate to convergence.
6. If the federal government budget constraint clears, the loop is complete. Otherwise, update the guess (using bisection) and iterate to convergence.

A2.2: Solving the Regional Equilibrium

Since regional deviations do not affect federal-level aggregates, this part of the computation takes factor prices and federal tax rates as given. What remains is to solve for the regional equilibria

[11] Ensuring that the distribution over the highest gridpoint has a mass of zero in every exercise.

deviating from a the Medicaid threshold $\bar{y}_0$ and finding the percentage of individuals favoring the deviation. We find that $T^{ss} = 80$ periods provides enough time for the economy to converge to a steady-state in all deviations.

1. For each deviation $\bar{y}' \in \{\bar{y}_1 \ldots \bar{y}_K\}$, guess a vector of length T^{ss} of regional income tax parameters, κ_2^r, that clears the regional government budget in every period. The value determined in the federal-level steady-state provides a good first guess. Then a sequence of intervals around that point can be chosen as initial boundaries for bisection.

2. Given the new Medicaid threshold $\bar{y}'$, the sequence of regional tax rates, the federal tax rate, and the factor prices, solve for the individual optimization problem. This is a computationally-intensive process, since it involves solving for the remainder of each age-cohort's life plus the initial periods of agents' lives that are born into the transition.

3. Solve for the transition path of the distribution, taking the steady-state distribution solved at the federal level as the initial distribution, and solve for aggregates in each period.

4. If the regional government budget constraint clears in each period of the transition, then the loop is complete. Otherwise, update using bisection, and iterate to convergence.

5. Given $\bar{y}_0$, solve for the deviation $\bar{y}'$ most preferred by the median voter. If $\bar{y}_0 = \bar{y}'$, then the computation is complete. Otherwise, choose a new $\bar{y}_0$ in the direction of the Medicaid policy preferred by the median voter, and start the computation over again at the federal level, iterating to convergence.

Appendix 3: Data

We use data from the household component of the MEPS for the years 1996-2010 to estimate empirical moments and parameters related to medical expenses and health insurance. The MEPS household component is a household survey with overlapping panels that are followed for two years and interviewed a total of five times. The survey collects data on all members of the household, but we analyze data at the individual level by combining the full year consolidated files to be able to track individuals over the two-year panel.

Each consolidated file contains year two of the previous year's panel and year one of the new panel with the exception of the 1996 file, which is the first year that MEPS was collected and contains only year one of the first sample. The new panel introduced in 2010 was excluded from analyses focused on individual transitions over time since we had only one year of data on those individuals from the 2010 consolidated file. The sample is restricted to adults age 20 or older who are in scope for the entire year. This excludes individuals who moved out of the household and would have incomplete data. The resulting sample sizes are shown in Table 6 for the first year of each panel.

Table 6: Sample Size by Year

Panel	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sample Size	15,101	8,715	7,495	9,412	7,518	15,275	11,149	11,518	11,520	11,291	11,918	9,196	13,191	12,050	10,734

Data are weighted to represent the civilian non-institutionalized population, but because person-level weights are generated within a year, weights are divided by the number of years in the pooled sample. Expenditure data are adjusted for inflation to 2010 dollars using the Medical Consumer Price Index. Analyses generally utilize the data as a single pooled sample of two-year panels and do not include year or cohort effects, which means that estimated parameters can be thought of as representing the average characteristics of the population during this time period.

Insurance and employment variables are estimated for each adult in our sample. Insurance status is defined as having continuous coverage of that type for the entire year. For example, private insurance coverage is assigned only to individuals who held private insurance for the entire year. Similarly, individuals are considered employed if they report being employed for the full year.

Other key variables are taken directly from the MEPS variable that captures that information. Wages are defined using the variable HRWG31X, which is the hourly wage reported in round 3 for individuals in their second year and round 1 for individuals in their first year in the MEPS. Medical expenses are defined based on the expenditure variables showing total expenditures (TOTEXP), expenditures paid by Medicaid (TOTMCD), expenditures paid by private insurance (TOTPRV), and expenditures paid by self (TOTSLF).