

Distributional Effects of Public Health Insurance Reform

Job Market Paper

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Abstract

This paper quantifies the effects of key parts of the 2010 health care reform legislation. I construct a lifecycle incomplete markets model with an endogenous choice of health insurance coverage and calibrate it to U.S. data. I find that the reform decreases the fraction of uninsured households by 94% and increases ex-ante household welfare by 2.3% in consumption equivalence. The main driving force behind the reduction in the uninsured population is the health insurance mandate, although I find no significant welfare loss associated with the elimination of the mandatory health insurance provision.

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1 Introduction

As of 2006, almost 20% of non-elderly households in the U.S. did not have health insurance. There has been recurring debate on the merits of using public policy to reduce the fraction of uninsured households in the U.S.¹ One of the explicit goals of the the 2010 Patient Protection and Affordable Care Act (PPACA) is to provide health insurance to 72% of those households that are currently uninsured.²

The purpose of this paper is to evaluate the consequences of the PPACA legislation. In particular, I answer the following questions. To what extent does the legislation reduce the fraction of uninsured households? What is the net cost of reform to the government? How does the reform change household incentives to work and purchase insurance through the employer? Ultimately, in any analysis of public policy reform, a key question is the effect on households welfare. To that end, I conduct a welfare analysis to find what households win and lose in the reform.

To answer these questions, I conduct a quantitative analysis using a heterogeneous agent incomplete markets model in the spirit of Aiyagari (1994) and Hugget (1993), augmented to include idiosyncratic medical expenditure shocks that are partially insurable primarily through a private employer-sponsored health insurance market. Access to this health insurance market

¹Economic Report of the President (2010)

²The PPACA was later amended by the Health Care and Education Reconciliation Act of 2010. I refer to the amended version of the law in this paper.

is restricted to employed households that are sufficiently productive. Households also face idiosyncratic productivity shocks. The government runs a public health insurance scheme with eligibility subject to means and asset tests. I analyze three key components of the PPACA legislation: 1) the health insurance mandate, 2) creation of a health insurance market or “exchange” with premium subsidies and out-of-pocket medical expenditure caps for eligible households, and 3) expansion of Medicaid eligibility.

My key results can be summarized as follows. First, the reform is associated with a decrease in the fraction of uninsured households from 22.6% to 1.1%. However, the reform is associated with crowding-out of the private insurance market that reduces participation from 66.3% to 61.7%. The main driving force behind the reduction in the uninsured population is the mandate that increases the cost of foregoing health insurance coverage. Implementation of the reform without the mandate results in 8.7% of households choosing not to purchase health insurance.

Second, I find the net cost to the government of the reform is 1.3% of output. Direct costs of reform, composed of insurance exchange premium subsidies, caps to household out-of-pocket expenditures, and Medicaid amount to 2.5% of output. However, taxes do not increase by this magnitude for two reasons. First, I show that reform is associated with a decrease in transfer payments of 1.2% of output. These transfer payments guarantee a minimum consumption level for low-productivity households and cover medical expenses of households that are unable to pay. Second, I find an increase in

the income tax base. This is due to a reduction in tax-exempt private health insurance premiums and a decrease in private insurance participation.

Third, health reform reduces household incentives to use employment as a mechanism to smooth consumption in times of low productivity or large medical expenditure shocks. This reduction in employment is especially prominent among households approaching retirement. In addition, health reform encourages households that qualify for Medicaid under the current system only by choosing not to work to leave the welfare program and seek employment. This is due to generous insurance exchange premium subsidies and caps to out-of-pocket expenditures that reduce the cost of insurance. While these two effects partially offset each other, I find that aggregate employment increases from 83% to 84.3%.

Fourth, the reform is associated with an ex-ante welfare increase of 2.3%. The key factor that drives welfare gains from the reform are premium subsidies for health insurance purchase through the exchange. I also find that households with high realizations of initial labor productivity gain more than those with low initial productivity realizations. This finding is striking since more productive households are more likely to have health insurance prior to the reform. Initially high productive households realize the most welfare gains through lower cost of insurance later in the lifecycle. These households avoid high marginal income tax rates by changing their source of income. Consequently, households not only maintain insurance coverage against medical expenditures, but also receive generous subsidies for the insurance exchange.

There is a rich literature on the role of public policy in reducing the number of uninsured households.³ This literature can be divided into two strands. The first strand of the literature, for example Cutler and Gruber (1996), Shore-Sheppard (2008), and Gruber and Simon (2008), quantify the effects of public insurance expansion aimed at covering the uninsured. More recently, Kolstad and Kowalski (2010) analyze the reduction in the number of uninsured due to health insurance reform in Massachusetts. A second strand of literature examines the expansion of tax subsidies aimed at encouraging uninsured households to purchase private insurance. Examples of this literature include Finkelstein (2002), Gruber (2005), and Jeske and Kitao (2009).

This study is most similar to Jeske and Kitao (2009) in modeling the household insurance purchase decision. The key feature in their environment is the exogenous eligibility for group health insurance that is correlated with income. Yet, even low-productivity households can often choose whether or not to work for an employer that offers health insurance. I show that incorporating labor supply along the extensive margin has important implications for quantifying the effects of reform by changing household incentives to work and insure through the workplace.

Finally, Brugemann and Manovskii (2010) explicitly address the effects of health care reform. Their focus, however, is on the effect of the reform on the distribution of firm size. My model differs from theirs in that I allow for

³See Gruber (2008) for an excellent survey of this literature.

households heterogeneity in labor productivity and model household opportunities for insurance outside the labor market. More importantly, I focus on changes in household allocations of consumption, labor, and insurance coverage and address the welfare implications of the reform.

The paper proceeds as follows. Section 2 presents the model. The details of the calibration procedure and an evaluation of the benchmark model are found in Section 3. Section 4 details the results and Section 5 concludes.

2 Model

Consider an overlapping-generations model where households live for J periods. Each generation is comprised of a continuum of households of equal measure. The total mass of households, indexed by i , is normalized to measure 1. Working-age households face idiosyncratic uncertainty to labor productivity and medical expenditures. Households retire at age J_R and face no uncertainty during retirement.⁴

⁴Retired households are eligible for Medicare benefits against medical expenditure shocks. I abstract from this dimension as the health reform legislation is primarily focused on working-age households.

2.1 Environment

Preferences. All households have identical preferences over consumption and labor represented by:

$$\mathbf{E}_0 \left\{ \sum_{j=0}^J \beta^j \left[\frac{c_{ij}^{1-\sigma}}{1-\sigma} - \alpha h_{ij} \right] \right\}$$

where β denotes the discount factor, $1/\sigma$ is the intertemporal elasticity of substitution, and α is disutility from labor. The variables c_{ij} and h_{ij} are consumption and hours worked of household i at age j .

I assume labor is indivisible, $h_{ij} \in \{0, \bar{h}\}$, so that household adjustment of labor hours takes place along the extensive margin. This is a sensible restriction since health insurance benefits through the employer are usually contingent on full-time employment.⁵

Endowments. Labor productivity of household i at age j is denoted $e_{ij} = \exp(\mu_j + z_{ij} + s_{ij})$, where μ_j is an age-specific deterministic endowment, z_{ij} is a persistent shock, and s_{ij} is a purely transitory component. The persistent component follows a Markov chain represented by the transition matrix $\Pi(z, z')$. Realizations of the transitory shock are iid across time and across households.

I follow Hubbard *et al.* (1995) in modeling medical expenditures as an exogenous stochastic process. Medical expenses are denoted m_{ij} and follow

⁵Only about 30% of part-time employees are offered health insurance through their employer. In contrast, 90% full-time workers are eligible for health insurance through their employer. (Stanton, 2004)

a Markov chain with an age-specific transition matrix $\Pi_j(m, m')$.⁶ Labor productivity and medical expenditure shocks are not correlated.⁷

2.2 Asset Market

There is an asset market for one-period risk-free claims to consumption with an exogenous interest rate r . Let k_{ij} denote the asset holdings of household i at age j . Households are restricted from borrowing, i.e. $k_{i,j} \geq 0$.

2.3 Health Insurance

The structure of the market for health insurance in the US is quite complex. I model a market for limited private insurance against medical expenditures that is simple and tractable, yet captures some of the key features of the US market. First, I first focus on health insurance provided through the employer. This is a key assumption as most non-elderly households currently obtain health insurance through their employer. In fact, only 2% of households insured privately purchase health insurance outside the workplace.

Second, I assume that all individuals face the same price for private health insurance contracts. While in reality premiums vary across firms of different

⁶Given our focus on insurance against medical expenditures and not the optimal medical expenditures, we abstract from the household decision to seek medical treatment. Some work exists on endogenizing medical consumption by households: Khwaja (2002), Hall and Jones (2007), Halliday *et al.* (2009), Yogo (2009), and De Nardi *et al.* (2010).

⁷This assumption is supported by Feenberg and Skinner (1994) who find medical expenditures to not vary much across income. Furthermore, regression estimation of *household* earnings on medical expenditures yield insignificant results when controlling for age, family size, education, and health insurance coverage.

sizes, I abstract from this dimension since I do not focus on the impact of the reform on firm size distribution.⁸ Third, I assume working households have access to a single pooling health insurance contract.⁹ Most households choose from a small set of health insurance contracts. According to the 1987 National Medical Expenditure Survey, almost 85% of working-age households are offered two or fewer health insurance contracts through their employer. I assume the contract takes the following form: households pay a premium π and are reimbursed a fraction ϕ of medical expenses.¹⁰ Employee health insurance benefits are not subject to payroll or income taxes. This feature is key as it provides an incentive for households to purchase insurance instead of self-insuring. In equilibrium, π is chosen so as to cover all medical payments out of the health insurance pool.

I assume households must be productive enough to cover the cost of the premium, i.e. $e_{i,j}\bar{h} > \pi$. In reality, low wage workers are less likely to be

⁸See Brügemann and Manovskii (2010) for an analysis of health reform that incorporates search frictions and firm size dynamics.

⁹Health insurers are limited in their ability to discriminate between households either by screenings based on household characteristics. There is little evidence that insurers allow households to self-select from a large menu of contracts. IRS Section 125 non-discrimination rules limit the ability of employers to offer different health insurance contracts to different employees. Furthermore, the 1996 Health Insurance Portability and Accountability Act (HIPAA) limits exclusion of workers from health insurance benefits based on past medical expenditures or illness. This does not imply, however, that medical treatments for these conditions are covered by the insurer. Health insurers have the ability to exempt coverage for certain treatments.

¹⁰I do not differentiate between the employee contribution and the employer contribution of the health insurance premium. In reality, between 11%-23% of the premium is paid directly by employees (Sommers, 2002). Given evidence that changes in the health insurance premium are passed onto the employees in the form of lower compensation (Gruber, 1994), omitting this aspect is innocuous.

eligible for health insurance benefits through the employer. Approximately 66% of households with labor earnings less than \$30,000 are offered health insurance through their employer. In contrast, 97% of households with labor earnings \$80,000 or above receive the choice of coverage from the employer. This suggests that low-wage households must search for jobs that offer health insurance benefits. However, Cutler and Gerber (2009) find that the duration of time uninsured is usually less than one year. This suggests that, at least for a model calibrated to a year, these frictions might not be of first order importance.

Households are allowed access to a public health insurance that is modeled to capture the key features of Medicaid. In particular, program eligibility is determined by an income and asset test. I denote the income test y^g and the asset test k^g . The public insurance program is characterized by a reimbursement function that covers a fraction ϕ^g of expenditures. I assume households that pass the income and asset test, but purchase private insurance, are not eligible for Medicaid.

One important feature of the health insurance market is that uninsured households pay *more* for the same medical procedure or service than insured households.¹¹ I model this feature as a mark-up λ for uninsured households to the realization of the medical expenditure shock m to reflect the disparity in pricing. This feature turns out to be important in generating the incentive necessary to match the aggregate private health insurance rates in the data.

¹¹See Anderson (2007) or Gruber and Rodriguez (2007).

In a model with exogenous medical expenditure shocks and borrowing constraints, even insured households may not be able to finance their out-of-pocket medical expenses. Therefore, I introduce a government-provided transfer that guarantees a minimum consumption level $\underline{c}$. This transfer program serves two roles. First, the program provides insurance to low-income households.¹² Second, transfers pay for out-of-pocket medical expenses that exceed households financial resources. The latter corresponds to “uncompensated care,” such as emergency-room treatment, for which the households did not pay for themselves.¹³ I denote government transfers to the household by $T(\cdot)$.

2.4 Taxes and Social Security

The government runs a social security program that provides households with a lump sum transfer b during retirement. The social security program is financed by a payroll tax denoted τ^p . The government incurs exogenous

¹²I model transfers that guarantee $\underline{c}$ as cash transfers rather than transfers in-kind. Apart from subsidized housing, the main transfer programs, such as unemployment insurance and Temporary Aid to Needy Families (TANF) are cash transfers. Food stamps can be approximated by cash transfers due to trafficking (Moffitt, 1989).

¹³By the 1986 Federal Emergency Medical Treatment and Labor Act (EMTALA) hospitals are required give emergency care regardless of insurance status, ability to pay, or citizenship. Furthermore, hospitals cannot discharge patients until they are stabilized or transferred to another facility. Hospitals and physicians are reimbursed for these services in part through Medicaid disproportionate share hospital (DSH) payments. Note that “uncompensated care” in my model is not reflected in private health insurance premiums due to hospital cost shifting. This is in line with evidence from Hadley *et al.* (2008) who calculate the majority (75%) of “uncompensated care” is paid for by the government.

expenditures G .¹⁴ Public insurance and transfer payments for minimum consumption are financed by an income tax represented by function $T^x(y)$ where y is taxable income.

2.5 Household Problem

I define the household problem recursively. Each period, working-age households makes decisions in two stages. At the start of the first stage, a household with age j , savings k , and medical expenditures in the previous period m_{-1} , realizes productivity shocks z and s that determine labor productivity e in the current period. The household formulates expectations of the medical expenditure shock in the second stage m and makes an employment participation decision and a private health insurance purchase decision. In the second stage, the medical expenditure shock is realized and household out-of-pocket payment liability is determined by the insurance status determined in the first stage. The household then makes a consumption and savings decision.

I formally represent the recursive household problem using Bellman equations. Let $V^j(k, z, s, m_{-1})$ and $W^j(k, z, s, m, h, n)$ denote the value functions in the first and second stage, respectively. The value of the second stage for a household with age j , savings k , productivity shocks z and s , and a

¹⁴I incorporate G into the model because the level of taxes matters for my welfare calculations.

realization of a medical expenditure shock m is,

$$W^j(k, z, s, m, h, n) = \max_{c, k'} \left\{ \frac{c^{1-\sigma}}{1-\sigma} - \alpha h + \beta \mathbf{E}_{z', s'} [V^{j+1}(k', z', s', m) | z, j] \right\}$$

subject to the following budget constraint,

$$\begin{aligned} c + k' + \Phi(k, z, s, m, h, n) &= (1+r)k + (1-\tau^p)[eh - n\pi] \\ &\quad - T^x(eh + rk) + T(k, z, s, m, h, n) \\ c &\geq 0, k' \geq 0 \\ e &= \exp(\mu_j + s + z) \end{aligned}$$

where,

$$\Phi(k, z, s, m, h, n) = \begin{cases} (1-\phi)m & \text{if } h = \bar{h}, n = 1 \\ (1-\phi^g)m & \text{if } n = 0, k \leq k^g, eh + rk \leq y^g \\ \lambda m & \text{otherwise} \end{cases}$$

is the household's out-of-pocket medical expenditure payment that is determined by private insurance coverage n and public insurance eligibility.

Given the value of the second stage for each m , the household forms expectations over the possible realizations of medical expenditure shocks m when making decisions in the first stage. I denote the labor decision $h \in$

$\{0, \bar{h}\}$ and the health insurance decision as $n \in N(j, z, s, h)$ where:

$$N(j, z, s, h) = \begin{cases} \{0, 1\} & \text{if } eh > \pi \\ \{0\} & \text{otherwise} \end{cases}$$

That is, the household has a choice of purchasing health insurance only when working and their labor income is enough to cover the health insurance premium. I represent the value of a household that enters age j with assets k , productivity shocks z and s , and past medical expenditures m_{-1} by,

$$V^j(k, z, s, m_{-1}) = \max_{h \in \{0, \bar{h}\}, n \in N(j, z, s, h)} \mathbf{E}_m [W^j(k, z, s, m, h, n) | m_{-1}, j]$$

Finally, I assume the household faces no uncertainty in retirement. I represent the household problem in retirement as,

$$V^j(k) = \max_{c, k'} \left\{ \frac{c^{1-\sigma}}{1-\sigma} + \beta V^{j+1}(k') \right\}$$

subject to:

$$c + k' = (1 + r)k + b - T(rk)$$

$$c \geq 0, k' \geq 0$$

where the terminal value function is $V^{J+1}(k) = 0$ for all k .

2.6 Equilibrium

In this section, I define equilibrium for the economy. For the purpose of compactness, we suppress individual state variables into a vector:

$$x = \begin{cases} x_v = (j, k, z, s, m_{-1}) & \text{in stage 1} \\ x_w = (j, k, z, s, m, h, n) & \text{in stage 2} \end{cases}$$

Define the state space to be $X_v \subset \{0, 1, \dots, J\} \times \mathfrak{R} \times Z \times S \times M$ and $X_w \subset \{0, 1, \dots, J\} \times \mathfrak{R} \times Z \times S \times M \times \{0, \bar{h}\} \times \{0, 1\}$. Denote $B(X)$ to be the Borel σ -algebra on $X \in \{X_v, X_w\}$ and $\Psi(X)$ the probability measure of households with state $x \in X$.

Definition: A stationary recursive competitive equilibrium is a list of value functions $V(x_v)$, $W(x_w)$, policy functions $h(x_v)$, $n(x_v)$, $c(x_w)$, $a'(x_w)$, a premium π , a payroll tax τ^p , an income tax function $T^x(x_w)$, and a measure of households $\Psi(x)$ such that:

1. Household decision rules $h(x_v)$, $n(x_v)$, $c(x_w)$, $a'(x_w)$ solve the household problem
2. Private health insurance firms earn zero profits in equilibrium:

$$\int \pi \mathbf{I}[n(x_v) = 1] d\Psi = \int \phi m \mathbf{I}[n(x_v) = 1] d\Psi$$

3. Government budget is balanced:

$$\int \tau^p [eh(x_v) - n(x_v)\pi] d\Psi = \int b\mathbf{I}(j \geq J_R) d\Psi$$

$$\int T^x(x_w) d\Psi = G + \int T(x_w) d\Psi + \int \phi^g m \mathbf{I}[elig] d\Psi$$

where $e = \exp(\mu_j + z + s)$ and $\mathbf{I}[elig]$ is an indicator function that takes a value of 1 when $k \leq k^g$, $rk + eh(x_v) \leq y^g$, $n(x_v) = 0$, and 0 otherwise.

4. Distribution of households Ψ is consistent with individual behavior:

$$\Psi(B_0) = \int_{B_0} \left[\int P(x_w, x'_w) d\Psi \right] dx'_w$$

for all $B_0 \subset B(X)$ where $P(x_w, x'_w)$ is the probability that an agent in state x_w transitions to state $x'_w \in B_0$ in the following period.

3 Calibration

The objective of this paper is to quantify the effects of health insurance reform using the model specified in the previous section. To do so, I first need to assign parameter values in the model. I choose the parameter values such that the stationary equilibrium matches key features of the U.S data. I will refer to this as the baseline calibration. In particular, I require that the baseline equilibrium matches aggregate purchases of public and private health

insurance rates, and aggregate labor market participation. Second, I calibrate the medical expenditure process and the process for labor earnings to U.S. household data. These two processes are the key sources of heterogeneity in my model that are crucial in quantifying the winners and losers in the reform.

The model is capable of generating moments that are not directly targeted in our calibration procedure. However, to ensure that the model provides a reasonable setting in which to conduct the health reform policy experiment, I evaluate the ability of the model to match several key moments of the distribution of households across insurance categories. In particular, I examine the extent to which my model generates household participation rates in each insurance category by household characteristics that are consistent with data.

Each model period corresponds to one calendar year. Initial model age $j = 0$ corresponds to household age 25. Households live until age 75, implying $J = 51$. Since households spend ten years in mandatory retirement, I set $J_R = 41$. The risk-free rate of return is set to 4%, so that $r = 0.04$ (McGrattan and Prescott, 2001). I set preference parameters to those commonly found in the literature, which implies $\beta = 0.96$ and $\sigma = 2.0$. I calibrate the disutility from labor parameter $\alpha = 5.6$ to match the employment-to-population ratio of households ages 25-64 of 0.83.

3.1 Labor Productivity

There is a large literature that estimates the structure of the process for idiosyncratic shocks to labor earnings and wages. Notable examples include Card (1994), Chang and Kim (2006), Floden and Linde (2001), and Heathcote *et al.* (2010).¹⁵ I use the standard structure of the productivity process. Namely, household labor productivity of a household i at age j is defined:

$$\ln(e_{ij}) = \mu_j + z_{i,j} + s_{i,j}$$

where the persistent component is AR(1):

$$z_{i,j+1} = \rho z_{i,j} + \epsilon_{i,j+1}$$

where $\epsilon_{i,j} \sim N(0, \sigma_\epsilon^2)$, $s_{ij} \sim N(0, \sigma_s^2)$. I assume $z_{i,-1}=0$ for all i and the initial value for the persistent component is drawn from $N(0, \sigma_{\epsilon_0}^2)$. I parametrize this process using the estimates from Heathcote *et al.* (2010). This gives $\rho = 0.973$, $\sigma_\epsilon^2 = 0.018$, $\sigma_s^2 = 0.048$, and $\sigma_{\epsilon_0} = 0.124$.

The deterministic age-specific component is obtained from Hansen (1993) and is pictured in Figure 1.

Households have a time endowment of 5475 annual hours (15 hours per day) and contribute an average of 2223 hours per year consistent with data

¹⁵With the exception of Floden and Linde (2001), these studies provide estimates for labor productivity based on analysis of male heads of households only. Therefore, the definition of household used in this paper is consistent with single-earner households with the male contributing all of the hours to market work.

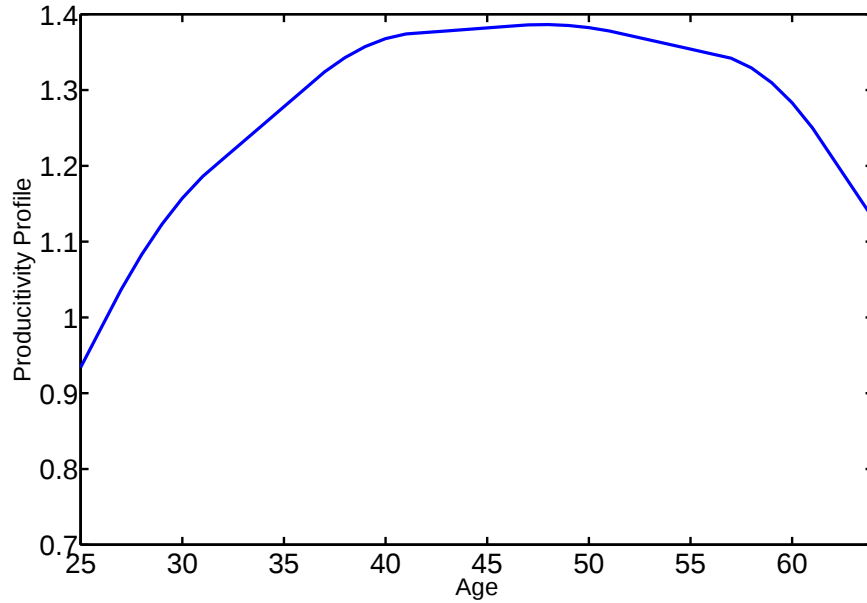


Figure 1: Labor Productivity Profile

in Heathcote *et al.* (2010). I divide average hours by the time endowment to arrive at $\bar{h} = 0.4$.

3.2 Medical Expenditures

Data on household medical expenditures are taken from the Medical Expenditure Panel Survey (MEPS).¹⁶ A key feature of the MEPS is information on total household medical expenditure and source of payment. The MEPS provides the share of total medical expenditures that were covered by private or public insurance and household out-of-pocket expenses. Another important feature of the MEPS data is that households are followed for two years

¹⁶Details on variable construction are available in the appendix.

allowing me to model persistence of medical expenditures across time.

Following Jeske and Kitao (2009), I assume the process for medical expenditures is a persistent autoregressive AR(1) process in logs. For a household i at age j , medical expenditures are defined:

$$\ln(m_{i,j}) = \beta_0 + \beta_1 j + \rho \ln(m_{i,j-1}) + \epsilon_{i,j}^m$$

where $\epsilon_{i,j} \sim N(0, \sigma_{\epsilon^m}^2)$ and $\epsilon_{i,0} \sim N(0, \sigma_{\epsilon_0^m}^2)$.

Recall that medical expenditures of uninsured households are scaled by parameter λ relative to insured households in the model. This captures the fact that uninsured households face different prices than insured households for the same medical good or service. These differences in prices for medical services differ by a factor of 1.5 for physicians (Rodriguez and Gruber, 2007) and 2.5 for hospitals (Anderson, 2007). I set λ to match the aggregate private insurance purchases observed in the data and obtain a value $\lambda = 2.3$ that is consistent with the above literature. To estimate the process for medical expenditures, I divide medical expenditures for uninsured households in the data by λ to obtain the “true” distribution of medical expenditures.

I estimate the above process via weighted-OLS using MEPS data. Estimation results are presented in Table 1. I take the value of the mean square error from the regression as the estimate of σ_{ϵ^m} . This implies $\sigma_{\epsilon^m}^2 = 1.70$. Initial young households face the same variance of the medical expenditure process that reflects the dispersion in medical expenditures for 25 year old

Table 1: Medical Expenditure Process Estimates

Coefficient	Estimate	Std. Err.	t-value
ρ	0.572	0.008	71.83
β_1	0.016	0.001	13.38
β_0	2.578	0.071	-36.07

households in the data. This implies $\sigma_{\epsilon_m}^2 = 1.70$. Note that the process for labor earnings is calibrated to household heads while the medical expenditure process is specified at the household level. To ensure I accurately specify the financial burden of medical expenditures, I express the medical expenditures in the model as a fraction of average *household* earnings that is consistent with the data.

To illustrate the ability of the model to generate age-specific distributions of medical expenditures, I plot the distribution of log medical expenditures from the data and model for age 30 and age 60 households. As seen in top two panels of Figure 2, the model does fairly well in replicating the distribution. However, a closer look reveals that the model underestimates the probability of expenditures one standard deviation above the mean.

One key feature of the data of particular interest in is the persistence of large expenditure shocks. The degree of persistence of large expenditure shocks determines the degree to which uninsured households are willing to use capital accumulation to smooth consumption. As persistence of medical expense shocks increases, uninsured households need to hold a larger stock of

capital to purchase insurance against these shocks. Since holding capital is costly, the degree of persistence determines the willingness of households to insure when the health reform is implemented. To get a sense of the models ability to replicate persistence of large medical expenditure shocks, I plot the distribution of medical expenditures conditional on the household incurring medical expenditures of the top 1 and 5 percentiles in the previous period. The bottom two panels in Figure 2 illustrate the distribution in the data and that implied in the model. Again, the results suggest that our model does a fair job of replicating this feature of the medical expenditure data.

3.3 Health Insurance Reimbursement

The share of household medical expenditures reimbursed by private and public health insurance are set to $\phi = 0.7$ and $\phi^g = 0.5$ using MEPS data.¹⁷ These parameters are consistent with earlier estimates by Attanasio *et al.* (2011).

3.4 Government

3.4.1 Consumption floor

I model transfers that guarantee consumption floor $\underline{c}$ following Hubbard *et al.* (1995). Transfers are made net of labor income, wealth, and medical

¹⁷The results are not sensitive to the choice of modeling insurance reimbursement as a polynomial function of m (Jeske and Kitao, 2009) or a locally linear function (Bajari *et al.*, 2006).

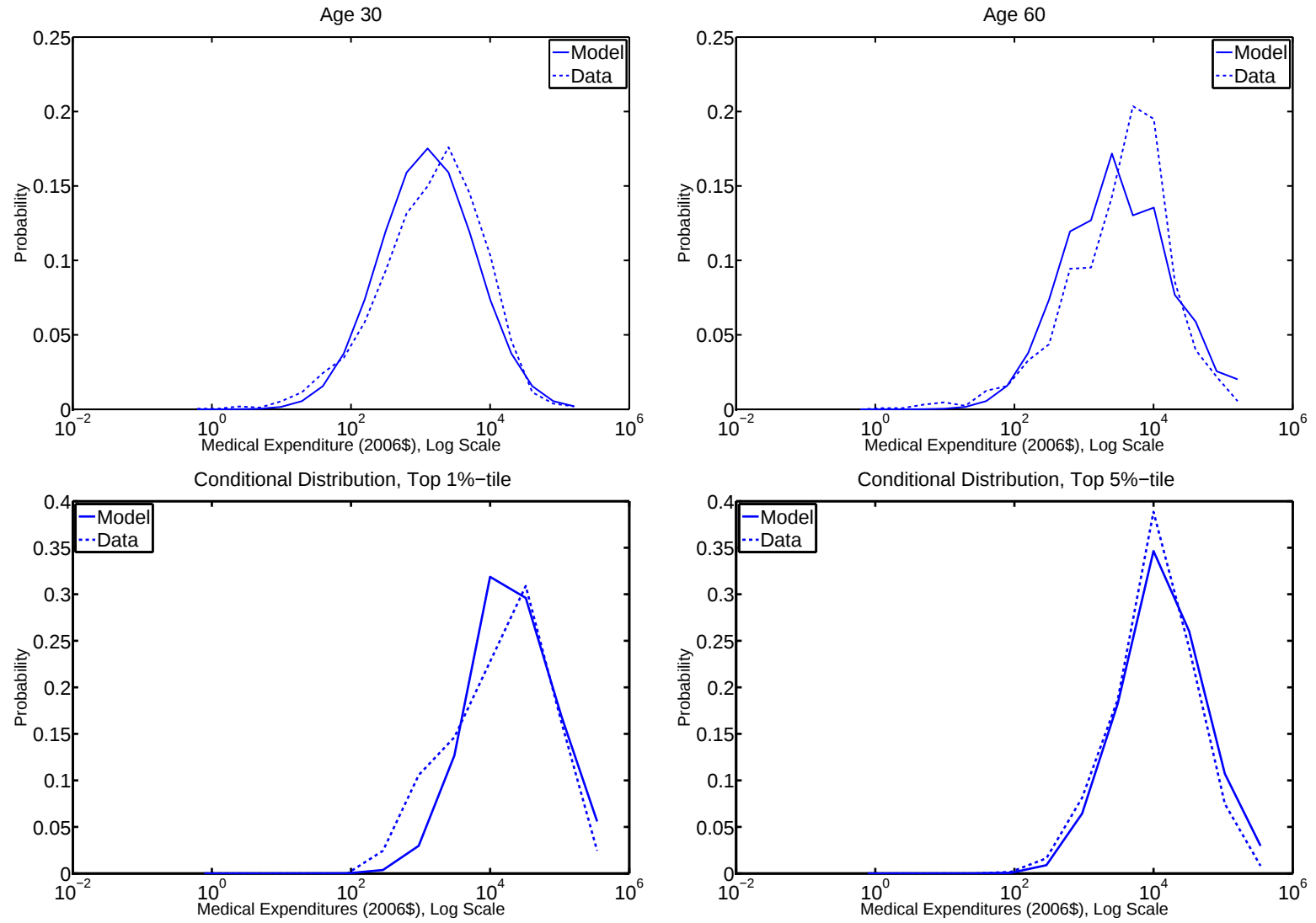


Table 2: Medical Expenditures Model and Data

expenditures:

$$T(j, k, z, s, m, h, n) = \max\{0, \underline{c} - [(eh - n\pi)(1 - \tau^p) + (1 + r)k - \Phi(j, k, z, s, m, h) - T^x(y)]\}$$

where $y = rk + eh - n\pi$ is household income. The value of the government-provided consumption floor, $\underline{c} = \$14,600$ is set to match aggregate Medicaid coverage of 13.2%. This value is slightly larger than previous estimates by of \$14,000 by Hubbard *et al.* (1995) and \$11,000 by Moffit (2002).¹⁸ In the formulation of transfers, I assume the government pays for medical expenditures net of household resources to mimic “uncompensated care” benefits available to all households.

3.4.2 Medicaid Eligibility Thresholds

Eligibility for Medicaid is contingent on passing a means test and an asset test. The thresholds, however, differ by states. For example, the means test for Alabama is 24% of federal poverty level, while in Minnesota the means test is 215% of the federal poverty level for low-income adults. I use an estimate that is a population-weighted average across states. This yields 87%. I use the poverty level of income for a family of 4, \$20,000 in 2006, in the baseline calibration. This yields $e^g = \$17,400$.

Asset or resource tests also vary across states. Most states count financial

¹⁸Previous estimates are deflated to 2006 dollars and exclude Medicaid benefits.

assets, such as savings accounts, bonds, stocks, and money market accounts toward the asset test. Major exclusions include primary housing, value of life insurance, vehicles, and retirement accounts. Since the definition of assets used in the model is most consistent with financial assets, I disregard the value of excluded assets in my definition of the asset test. Most states set their asset test to between \$1,000 and \$3,000. I use a population-weighted average that yields $k^g = \$2,350$.¹⁹

3.4.3 Taxes and Social Security

Income taxes in the model consist of two components. The first component is a proportional income tax and the second is a progressive tax. I use the tax structure specified by Guner *et al.* (2010):

$$T^x(y) = \left[\tau + \eta \ln \left(\frac{y}{\bar{y}} \right) \right] y$$

where $y = rk + eh - n\pi$ is household income and $\bar{y}$ is average household income in the baseline economy. The parameter of the progressive component is $\eta = 0.09$ that is consistent with my definition of household size from Guner *et al.* (2010). The proportional component τ balances the government government expenditures on Medicaid, transfers for the consumption floor, and exogenous government spending G . I set exogenous government expenditures G to equal 19% of output in equilibrium.

¹⁹About 10 states have moved recently to eliminate the asset test completely. I omit these states from my calculation.

The social security transfer $b = \$22,500$ is chosen to achieve a 45% replacement rate of average earnings consistent with Whitehouse (2003). The social security system is financed by a payroll tax τ^p that is set to balance the budget in equilibrium. This yields $\tau^p = 0.09$.

3.5 Computation

The model does not have an analytical solution. Therefore, I compute the equilibrium numerically. The value functions, decision rules, premium, and tax rates are computed by backward induction. I solve the household problem starting with the last period of life given the value of the premium and tax rates. Decision rules are obtained using a grid for asset holdings and discrete approximations of the labor productivity and medical expenditure process. I discretize the labor productivity process using the method outlined in Tauchen (1986) that yields $\Pi(z, z')$ and a discrete support S for the transitory shock. The process for medical expenditures is approximated in the same manner with transitions defined relative to the age-specific mean. Using the estimates of the mean presented earlier yields the transition matrices $\Pi_j(m, m')$.²⁰

²⁰The grid space for assets K is 100 points and the grid space for productivity and medical expenditures (Z, S, M) are 19 grid points each, respectively. For each grid point in (K, Z, S, M) , the algorithm obtains the next period asset by bracketing the optimum search over asset gridpoints. Once the asset space containing the optimum is found, the asset decision rule is computed using a golden section search procedure.

Table 3: Aggregate Statistics

	Data	Baseline
Private	66.4	66.3
Public	13.2	13.0
Uninsured	20.4	20.7
Premium π	\$6,760	\$6,410

3.6 Baseline Fit

In this section I show that using the parametrization described above, my baseline equilibrium does well in replicating key distributional components of household characteristics across insurance categories. The goal in this section is to show that the model provides a reasonable setting in which to analyze the distributional changes associated with the health insurance reform.

Table 3 illustrates aggregate insurance coverage rates by insurance category. The model does very well along this dimension. This is not surprising since these moments were targeted in my calibration. 66.3% households purchase private health insurance in the model (66.4% in the data) and 13.0% households participate in public insurance (13.2% in the data). Since insurance categories are mutually exclusive, the model also does well in matching the fraction of households without health insurance. The equilibrium premium in the private health insurance market is also consistent with the data.

The pattern of private health insurance purchases is also broadly consistent with the data along household characteristics. Figure 2 presents the fraction of households in each insurance category by labor earnings and med-

ical expenditures. Households with higher medical expenditures tend to be privately insured, while households with the lowest medical expenditures are most likely to be uninsured. The fraction of households with private coverage is flat for medical expenditures above the mean (approximately \$5,500) at around 0.8. This pattern is not surprising given that households have some information regarding their future medical expenditures due to the deterministic age component and persistence of the AR(1) process.

The model performs fairly well in matching insurance coverage by labor earnings. In general, more productive households tend to purchase private health insurance. Note, however, that as labor earnings increase above the Medicaid threshold level we observe higher private insurance rates than in the data. This is due to some extent to my approximation of Medicaid coverage rules. Medicaid income eligibility rules are less stringent for coverage of children and higher Medicaid participation along the labor earnings dimension could reflect partial coverage of the household. Namely, the model fails to capture households in which children are covered by Medicaid, but parents are uninsured.

Figure 3 plots household health insurance coverage over the lifecycle. The model does well in replicating the general patterns of the age distribution of health insurance. First, we observe that private health insurance coverage is increasing in age. This is sensible as the the mean for the medical expenditure process is increasing with age. Older households have larger expected expenditures and therefore tend to purchase private coverage later in life. Second,

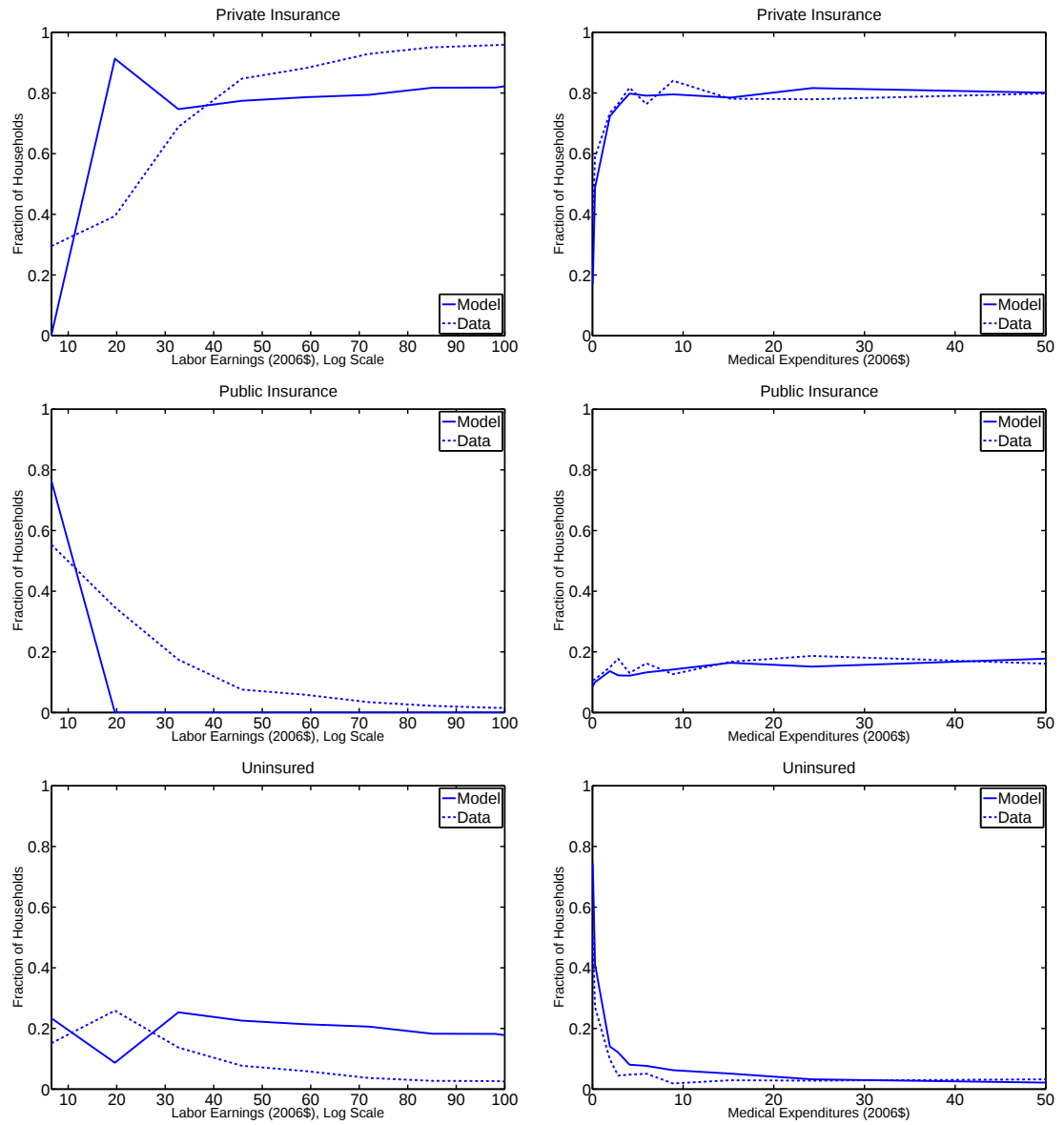


Figure 2: Insurance Coverage by Characteristic and Source of Coverage

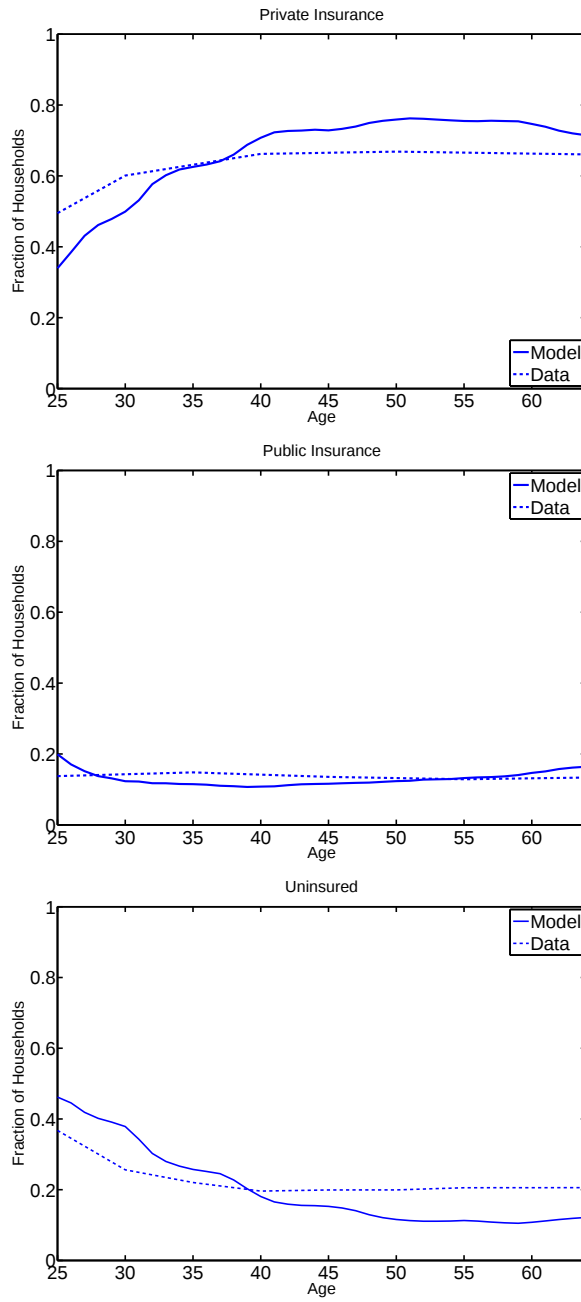


Figure 3: Insurance Coverage over the Lifecycle

the profile for public health insurance is largely flat over the life-cycle. Third, the fraction of households without health insurance is decreasing with age. Note that we slightly overestimate private health insurance purchases later in life at the expense of the uninsured. Recall, that while the model does well approximating the process for medical expenditures, it overstates the probability of high medical expenditures later in life (Figure 2). Therefore, households in the model have more incentive to purchase private coverage later in life than in the data.

In summary, an evaluation of the baseline calibration here reveals that the model does well in replicating key dimensions along which households differ across insurance categories. The model also does relatively well in matching the distribution of households along labor earnings and medical expenditures. The model is also consistent with health insurance coverage rates over the lifecycle. In the following section, I introduce health reform to our model and analyze the implications of reform in the economy.

4 Assessing the Reform

In this section, I quantify the effects of public health insurance expansion on household health insurance purchases, taxes, and welfare. In the analysis, I focus on 1) which component of the reform is critical to obtaining the results, and 2) the extent to which each component accounts for the changes in insurance composition by key household characteristics.

4.1 Public Health Insurance Reform

The 2010 PPACA legislation is complex. I focus on three policies that capture the key elements of the bill. The health reform I implement consists of three policies:

1. An insurance mandate with a fine for households that choose not to purchase coverage
2. A health insurance “exchange” with subsidies to eligible households for expenditures on health insurance premiums and a cap on out-of-pocket expenditures
3. Expansion of Medicaid through an increase in income eligibility and elimination of the asset test

I now describe each of the policy changes in more detail. In the 2010 PPACA legislation, the health insurance mandate requires all households to obtain health insurance coverage. The penalty for households that choose not to purchase coverage will be 1% of income in 2014, 2% of income in 2015, and 2.5% from 2016 onward. In the model, I set the fine at 2.5% of income since I abstract from transitional dynamics in the analysis.

The legislation calls for a creation of a private health insurance market, termed the “exchange,” that is available to all households with incomes above 100% federal poverty level. The exchange is characterized by a set of contracts where 1) premiums are not contingent on households health history

and 2) reimbursement rates are regulated to cover a certain fraction of medical expenditures depending on the generosity of coverage purchased. In the model, I do not focus on the menu of plans offered in the “exchange.” Instead, households are offered a single contract, characterized by a premium π^x and a reimbursement rate ϕ^x . In equilibrium, the premium equals expected medical payments. The legislation does not explicitly specify the value of the reimbursement rate. Therefore, I choose $\phi^x = \phi$ in the model. That is, I set the reimbursement rate in the exchange to that found in the private insurance market. In the Appendix, I present a sensitivity analysis of this choice of reimbursement rate.

The legislation includes two types of subsidies for health insurance purchased through the exchange. First, eligible households are not responsible for payment of the health insurance premium above a certain fraction of household income. The size of the premium subsidy is decreasing in income and is a function of household size. Second, households eligible for premium subsidies in the exchange only pay for a fraction of total out-of-pocket expenses. Eligibility for subsidies is determined by household income between 100%-400% of the federal poverty level (FPL). The schedule for subsidies and caps as a function of income is presented in Table 4 for a family of 4. Households with income greater than \$80,000 are allowed to participate in the insurance exchange, but do not receive subsidies. In the model, I introduce subsidies and out-of-pocket payment caps directly from Table 4.

Table 4: Health Insurance Exchange Subsidies

Household Income ^a	Premium Cap Share of Income	Out-of-pocket Cap
<\$20,000	Medicaid	Medicaid
\$20,000- \$30,000	3.0%	\$3,500
\$30,000- \$40,000	4.0%	\$3,500
\$40,000-\$50,000	6.3%	\$5,230
\$50,000-\$60,000	8.5%	\$5,230
\$60,000-\$80,000	9.5%	\$7,000
>\$80,000	-	\$10,500

a: Income thresholds are based on FPL guidelines for a family of four.

Finally, Medicaid reform consists of two components. First, the income eligibility threshold increases from its current value to 138% of the federal poverty level. Second, the asset test is eliminated. The Medicaid reform is reflected in the model through changes in the income test and asset test thresholds. I set $e^g = \$27,600$ and $k^g = \infty$. Note that households with incomes between 100% and 138% of the federal poverty level can choose whether to participate in the insurance exchange or Medicaid.

These three policies imply a new equilibrium, which I will refer to as the reform equilibrium, with distinct value functions, decision rules, tax rates, and premiums. I omit the formal definition of equilibrium under the new policies here and refer the interested reader to the Appendix.

4.2 Effects on Allocations and Prices

The main results are summarized in Table 5. Changes in aggregate insurance rates from the adoption of the health reform in the model are shown in the first section of the table. We see that the fraction of households without health insurance decreases by more than 94% (from 20.7% to 1.1%) and Medicaid coverage increases 12% (from 13.0% to 14.6%). While health reform is effective at reducing the fraction of uninsured households, one consequence of reform is crowding-out of private (employer) health insurance. The fraction of households with private health insurance decreases from 66.8% in the baseline calibration to 61.7% in the reform equilibrium.

Evidence of crowding-out of private insurance suggests that some households drop private insurance coverage to participate in the insurance exchange.²¹ What types of households are more likely to switch insurance coverage? Changes in insurance premiums suggest that households sort across the two insurance categories with the more healthy households choosing private insurance and less healthy households joining the insurance exchange. In the second section of Table 5 we see a striking decrease in private insurance premiums due to the reform. Private health insurance premiums decrease 32%. Furthermore, premiums in the insurance exchange are more than twice those in the private insurance market.

²¹Crowding-out of private insurance is largely due to creation of the insurance exchange rather than Medicaid expansion. I show in the Appendix that health reform implemented without an expansion of Medicaid eligibility still results in a decrease in private insurance participation.

The effects of the reform on the price of insurance are in sharp contrast with the conventional wisdom that suggests that health reform will result in an *increase* in private insurance premiums.²² Private insurance premium increases are possible in the transition to the stationary reform equilibrium due to incremental adoption of the reforms. For example, new eligibility rules that allow dependents under the age of 26 to be insured under their parent’s plan take effect in 2010. These changes in eligibility are likely to increase premiums. However, the creation of the subsidized health insurance exchange that will allow households to sort between plans will not occur until 2014. Since I do not model the transition from the baseline to reform equilibrium, we do not observe increase in premiums that might occur on the transition path.

Since the change in premiums suggests sizable changes in the composition of households across insurance categories. I compare the characteristics of household with private insurance and those participating in the insurance exchange in Figure 6. As a function of household medical expenditures, health reform reduces the fraction of high expenditure households participating in private health insurance, but increases the fraction of low expenditure households. This is not surprising: less healthy households benefit the most from the caps on out-of-pocket payments.

²²See for example “New Bill Would Raise Rates, Says Insurance Group,” (Oct. 12, 2009) *The Washington Post*, “Health Insurers Plan Hikes” (Sept. 7, 2010) *The Wall Street Journal*, and a report by *PricewaterhouseCoopers*, “Potential Impact of Health Reform on the Cost of Private Health Insurance Coverage” (2009).

Table 5: Baseline and Reform Aggregate Statistics

	Data	Baseline	Reform
Private	66.4	66.3	61.7
Public	13.2	13.0	14.6
Uninsured	20.4	20.7	1.1
Exchange	0.0	0.0	22.6
Premium π	\$6,760	\$6,410	\$4,350
Exchange premium π^x	-	-	\$10,600
Income tax τ (%)	-	20.5	21.4
Payroll tax τ^p (%)	-	9.0	8.9
Aggregate transfers T /output	-	3.6	2.4
Aggregate Medicaid/output	-	0.9	0.8
Aggregate Exchange/output	-	0.0	2.6
Employment/population	83.0	83.0	84.3

Note: All statistics in percent unless specified otherwise.

The cost to the government of the reform is considered in the third section of Table 5. The direct cost to the government of reform is composed of expenditures to premium subsidies, caps to household out-of-pocket payments, and Medicaid. I find the direct cost to the government is approximately 2.5% of output. Note that government expenditures for Medicaid *decrease* slightly despite increased enrollment. This is due to sorting of less healthy households out of Medicaid and into the insurance exchange due to relatively more generous reimbursement for larger medical expenditures. How does the direct cost of reform to the government in my model compare to other estimates in the literature? The Congressional Budget Office (CBO) found that expenditures on insurance exchange and Medicaid will total \$230 billion or

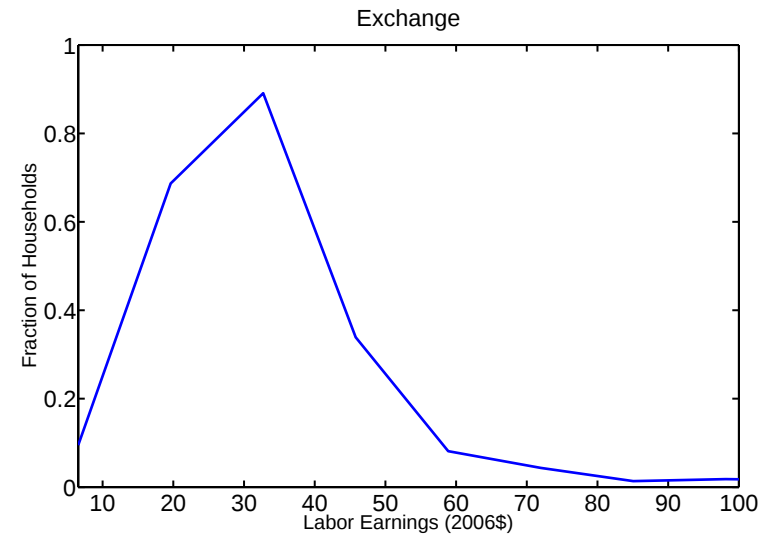
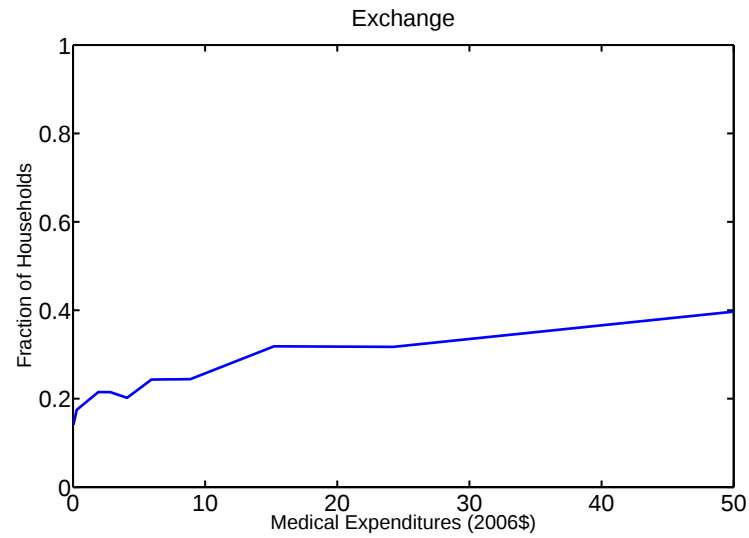
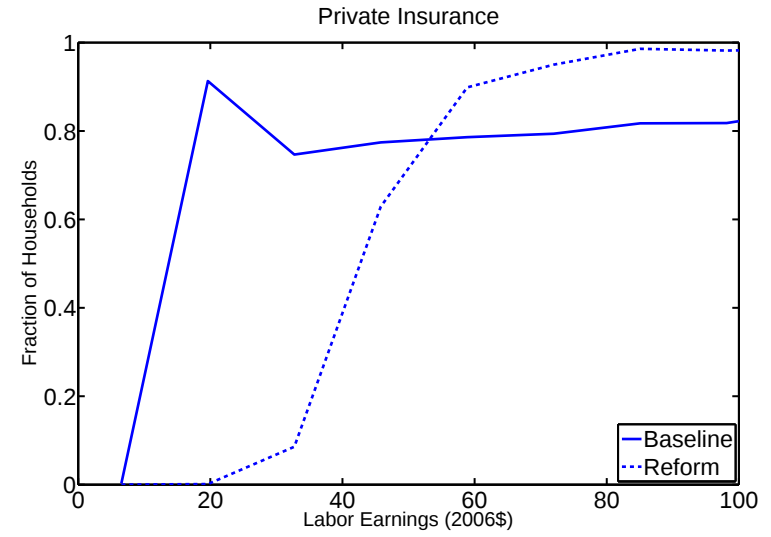
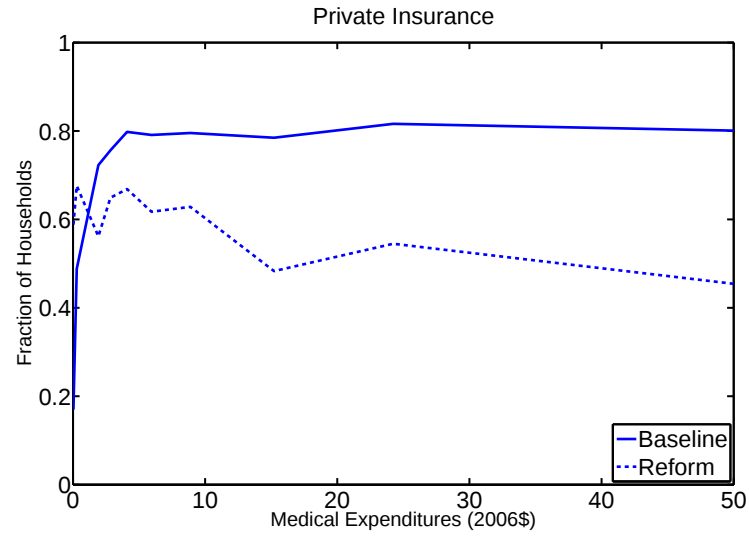


Table 6: Private and Exchange Insurance Coverage by Household Type

1.1% of output by 2019.²³ My results differ from the CBO estimates for two reasons. First, in contrast to the CBO estimates, I find substantial crowding-out in the private health insurance market discussed earlier. Second, I find that Medicaid participation increases by less than predicted by the CBO. This is due to generous reimbursement of the insurance exchange relative to Medicaid that attracts less healthy households.²⁴

I find direct costs are partially offset by a decrease in transfer payments for the minimum consumption floor and payments for “uncompensated care.” The net cost of the reform to the government, that is the direct cost adjusted for the reduction in transfer payments, comes to 1.3% of output. In comparison, government expenditures on social security, the largest federal transfer program, account for 4.2% of output. Therefore, the net cost of reform to the government constitutes about 30% of the largest federal transfer program. The magnitude of the tax increase is offset by a 2% increase total taxable income as a fraction of output due to a 32% decrease in private insurance premiums that are tax exempt.

How does the reform change household incentives to work? I find that the health reform has a sizable effect on employment. The employment-to-population rate increases from 0.83 to 0.843. This increase is the product of

²³I use the CBO estimate for 2019 GDP of \$21,667 billion. CBO estimates of the health reform are available from <http://www.cbo.gov/publications/collections/health.cfm>. These cost estimates are only available up to 2019.

²⁴According to the PPACA legislation, the Medicaid reimbursement rate will be raised to the level of Medicare. I abstract from this provision since the increase in Medicaid reimbursement is temporary and set to expire in 2014.

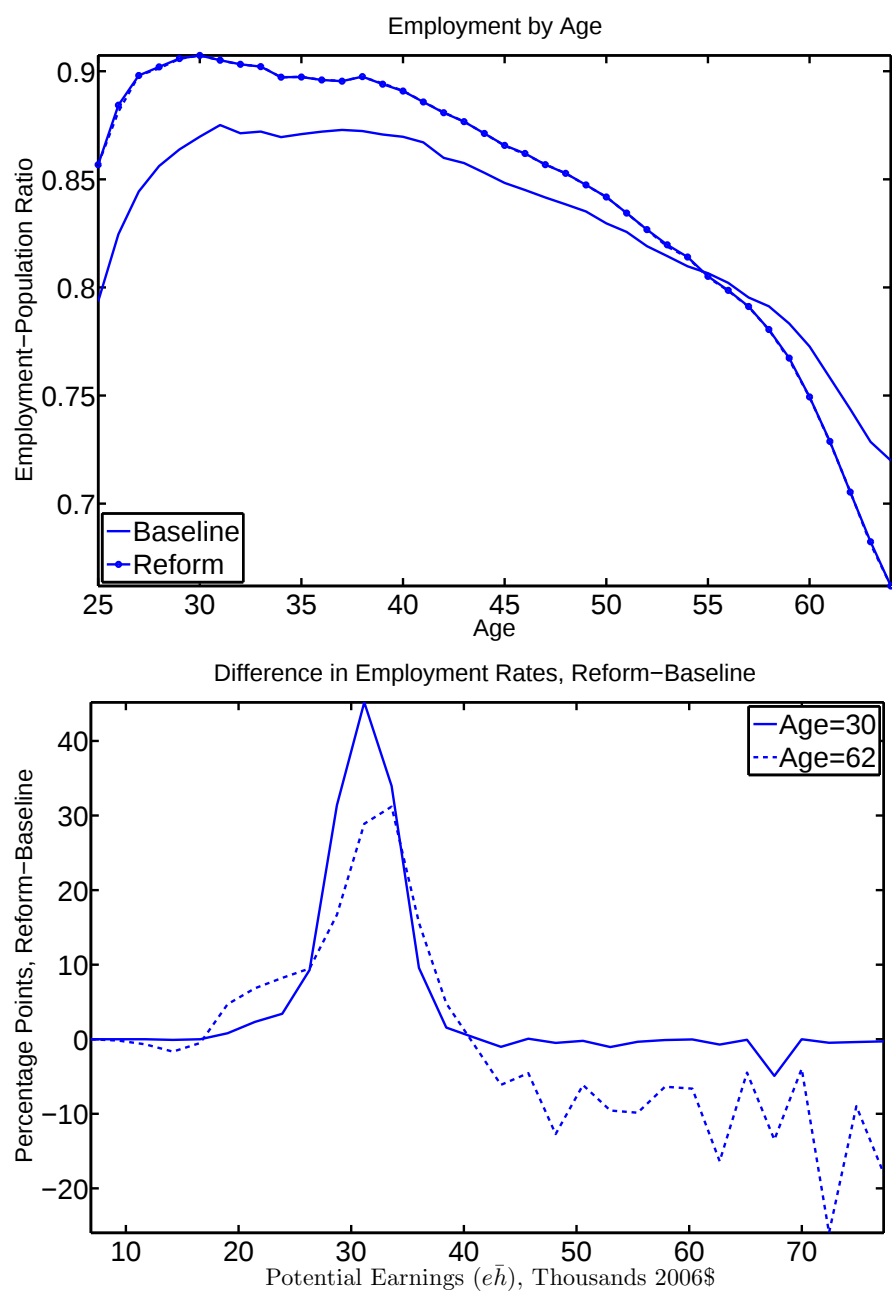


Figure 4: Employment by Household Type

two opposing effects. First, health insurance reform reduces the household need to use employment as a mechanism to smooth consumption in times of low productivity or large medical expenditure shocks. In particular, with the adoption of the health reform, low productivity households have two additional ways to smooth consumption: Medicaid and the insurance exchange. After the reform, I find that 90.5% of non-employed households are enrolled in Medicaid, while 9.5% choose to purchase health insurance through the exchange. Almost all non-employed households are insured.

Second, the reform increases the incentive for low productivity households to exit the welfare program and work. In the baseline model, some low productive households are eligible for Medicaid only when not working. These households choose not to work to receive Medicaid benefits and government transfers. In contrast, the reform provides generous premium subsidies and limits household out-of-pocket expenditures to low productive households only when working. Since eligibility in the insurance exchange is contingent on a minimum income level, the reform increases households incentives to work in order to obtain insurance exchange coverage.

To see these two opposing effects more clearly, I plot the employment-population ratio for each age group in the top panel of Figure 4. We see that younger households are *more* likely to work. To see why, I plot the differences in employment rates (reform-baseline) as a function of potential labor earnings ($e\bar{h}$) in the second panel of Figure 4. Note that households with potential labor earnings between \$28,000-\$36,000 have a strong incentive to

work due to the reform. By working, these households are eligible for generous premium subsidies and out-of-pocket expenditure caps in the insurance exchange that provide better insurance against medical expenditure shocks than Medicaid. The reform increases the incentives for young households to work.

Older households with potential earnings above \$40,000 are *less* likely to work. This is due to the progressive structure of the income tax. Households with asset holding can reduce their tax burden by changing their source of income from labor income to capital income. In addition, changing the source of income allows households to pass the means test for access to insurance against medical expenditure shocks through Medicaid or the insurance exchange. To find out whether the benefit of better insurance opportunities for the household is outweighed by the tax distortion of financing the reform, I conduct a welfare analysis.

4.3 Welfare

I define welfare in terms of consumption equivalence. That is, I measure change in welfare by calculating the percentage change in lifetime consumption required to make households *ex-ante* indifferent between the baseline and reform economies. Therefore for some γ ,

$$\mathbf{E}^B \left\{ \sum_{j=0}^J \beta^j [u(c_j^B) - \alpha h_j^B] \right\} = \mathbf{E}^E \left\{ \sum_{j=0}^J \beta^j [u((1 + \gamma)c_j^E) - \alpha h_j^E] \right\}$$

where superscripts B and E represent expected streams of consumption and labor hours under the baseline equilibrium and the public expansion equilibrium. Solving for γ we obtain:

$$\gamma = \left(\frac{\mathbf{E}^B \left\{ \sum_{j=0}^J \beta^j [u(c_j^B) - \alpha h_j^B] \right\} + \mathbf{E}^E \left\{ \sum_{j=0}^J \beta^j \alpha h_j^E \right\}}{\mathbf{E}^E \left\{ \sum_{j=0}^J \beta^j u(c_j^E) \right\}} \right)^{\frac{1}{1-\sigma}} - 1$$

If $\gamma > 0$, we would need to increase consumption in every state of the world in the experiment economy by a fraction γ to make an household ex-ante indifferent between the baseline and the experiment economy. In other words, given a choice, the household would choose the baseline over the experiment economy.

There is a welfare gain associated with the reform of 2.3%. Despite a marginal increase in income taxes, households gain access to better risk sharing against medical expenditure shocks. These gains are not uniform across the distribution of agents in the economy. In particular, the initial young households (age 25) are heterogeneous due to initial draws of labor productivity and medical expenses. The shocks are realized before any households decisions are made. By analyzing welfare along heterogeneity of the initial young, we can more clearly distinguish which types of households gain more or less in the reform.

The top panel of Figure 6 shows the change in welfare of the initial young in the economy. I plot welfare as a function of the initial persistent productivity shock z between $-3\sigma_{\epsilon_0}$ and $3\sigma_{\epsilon_0}$ for select values of the initial medical

expenditure shock component m . More productive households gain more than less productive households. Households with higher medical expenditures also gain more relative to those with smaller medical expenditures. The second panel of Figure 6 shows the distribution of welfare gains across households. While all initial young households gain in the reform, 65% gain less than the 2.3%. Furthermore, the largest welfare gains are enjoyed by a small number of high productive households.

Since higher productivity households are more likely to be insured in the baseline equilibrium, this suggests that uninsured do *not* gain the most from the reform. This result is striking given the focus of reform on providing insurance against medical expenditures to the uninsured. Why do households with highest initial labor productivity gain the most? I find that households with high initial labor productivity gain the most due to the generous premium subsidies and out-of-pocket limits that they enjoy later in life. These subsidies allow high productive or high wealth households decrease their marginal tax rate in anticipation of retirement.

Households with high initial productivity are the most likely to 1) use the insurance exchange, and 2) choose not to work later in the lifecycle. To see this, I plot the the fraction of households that choose not to work and to enroll in the insurance exchange as a function of age and initial realization of labor productivity in Figure 5. For example, almost 25% of households that received a realization of z that is 2 standard deviations above the mean at birth will participate in the insurance exchange and not work at age 60. In

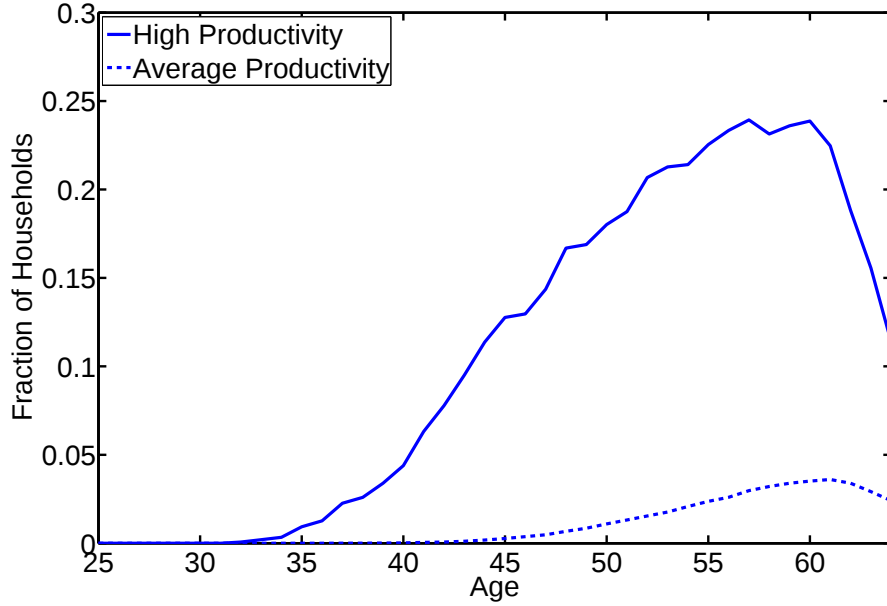


Figure 5: Non-employed Households with Insurance Exchange Coverage by Initial Productivity

contrast, less than 4% households with an initial realization of z at the mean will join the exchange and not work with probability at age 60. Health reform increases welfare the most for highly productive households by providing a mechanism to avoid high marginal tax rates by allowing households to change the source of income.

In the baseline model, provision of health insurance through the employer gives an incentive for older households to work despite high marginal tax rates due to high capital income. This is because health insurance is most valuable for older households due to the increasing lifecycle profile of medical expenditures. Health reform provides households with a channel to insure against

Table 7: Welfare Experiment

Experiment	Welfare (%)
Reform	-2.3
Reform without mandate	-2.2
Reform without premium subsidies	0.0
Reform without out-of-pocket caps	-1.6
Reform without Medicaid expansion	-2.6

medical expenditure shocks outside employment.²⁵ This channel allows high wealth households to avoid increase in income tax that is associated with working to obtain health insurance benefits by changing their income source to capital income. In turn, changing the source of income allows high wealth households to meet income eligibility requirements for subsidies in the exchange that make insurance against medical expenditure shocks less costly relative to the private insurance market. For example, a non-working household with accumulated savings of \$500,000 is eligible to receive the most generous subsidies through the exchange since interest income is \$20,000. Since households with high initial productivity are the most likely to have a high stock of wealth later in life, it is sensible that we see these households gain the most from the reform.

The above analysis suggests that the welfare results are driven by generous premium subsidies or caps on out-of-pocket expenditures for eligible households. To verify the importance of these two transfer programs as-

²⁵However, expansion of Medicaid alone can undo incentives for younger households to purchase of private insurance and make households worse off (in terms of ex-ante welfare). We explore this further in the Appendix.

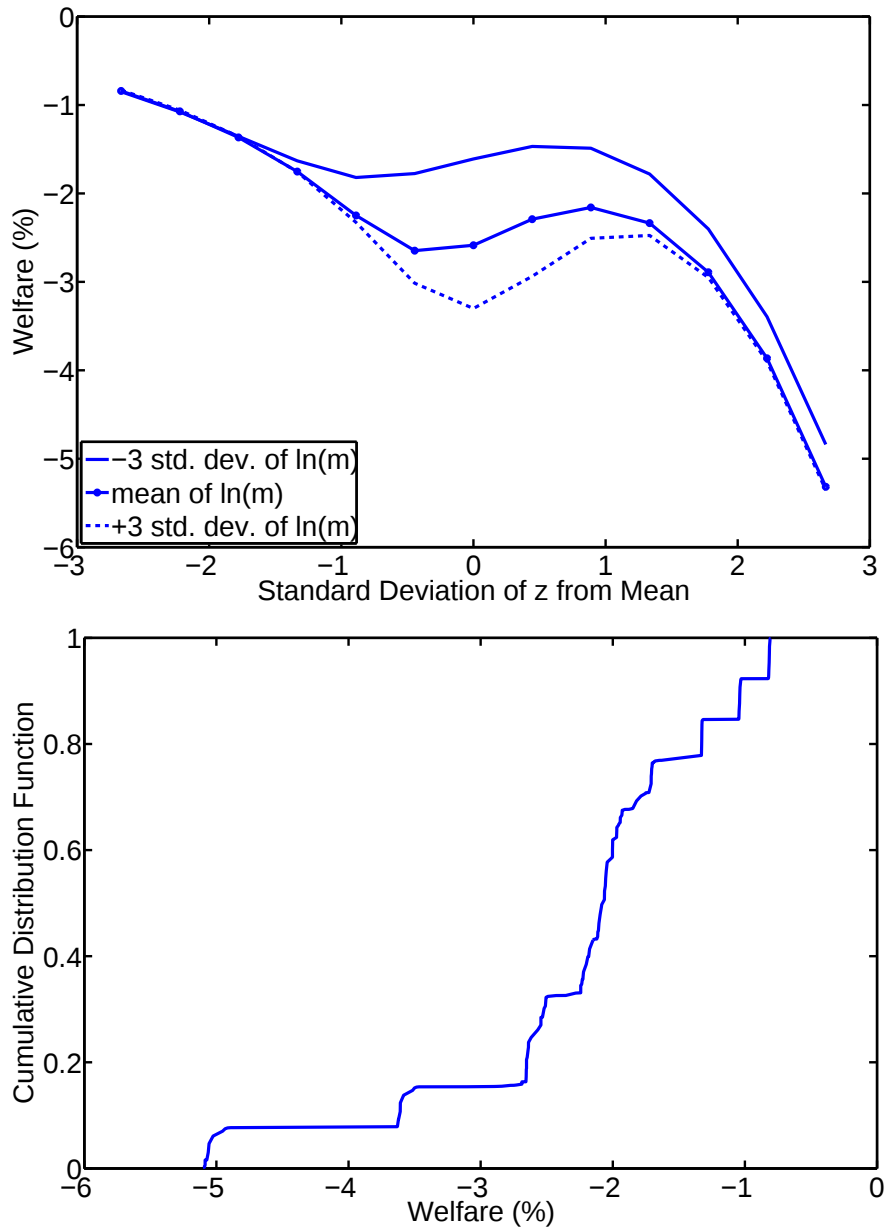


Figure 6: Welfare of Age 25 Households by Initial Condition

sociated with the insurance exchange, I perform the following experiment. I calculate the welfare change relative to the baseline economy when each provision is removed and the others held in place. In addition, I separately remove subsidies and caps to out-of-pocket expenditures in the insurance exchange. The results are shown in Table 7. We see a striking decrease in welfare when subsidies to premiums in the insurance exchange are removed, while the effect of out-of-pocket expenditure caps is more modest. Why are premium subsidies critical to the health care reform? The removal of the subsidies virtually eliminates participation in the insurance exchange since only the least healthy households participate in the insurance exchange due to caps on out-of-pocket expenditures. However, since the insurance mandate is still in place, the healthiest households purchase insurance through the market place despite the actuarially unfair price. Ex-ante welfare is lower than in the baseline economy.

4.4 Role of Mandate

What role does the mandate play in obtaining the results? This question is particularly relevant given the debate over the legality of the provision. Indeed, 19 states have launched litigation efforts to nullify the portion of the reform. While my model has nothing to say regarding the legality of the insurance mandate, it does provide a reasonable framework for analyzing the consequences of elimination of the provision. In this section I compute the reform equilibrium, but eliminate the penalty to households that choose not

Table 8: Role of Mandate in Reform

	Baseline	Reform	No mandate
Private	66.3	61.7	53.0
Public	13.0	14.6	14.6
Uninsured	20.7	1.1	8.7
Exchange	0.0	22.6	23.7
Premium π	\$6,410	\$4,350	\$4,800
Exchange premium π^x	-	\$10,600	\$10,500
Income tax τ (%)	20.5	21.4	21.4
Payroll tax τ^p (%)	9.0	8.9	8.9
Aggregate transfers T /output	3.6	2.4	2.4
Aggregate Medicaid/output	0.9	0.8	0.8
Aggregate Exchange/output	0.0	2.6	2.6
Employment/population	83.0	84.3	84.3
Welfare	-	-2.3	-2.2

Note: All statistics in percent unless specified otherwise.

to purchase health insurance. We see from Table 8 that the mandate does have sharp implications for the aggregate insurance rates. Most striking is that the mandate is crucial for significantly reducing the fraction of households without health insurance. In fact, the fraction of households without health insurance increases from 1.1% in the reform equilibrium to 8.7%. This increase is accompanied by a decrease from 61.7% to 53.0% in the fraction of privately insured households.

The removal of the mandate results in the healthiest households reducing the rate of insurance coverage. Since these households are most likely to be privately insured, this results in an increase in private insurance premiums. Participation in the insurance exchange increases and premiums decrease as

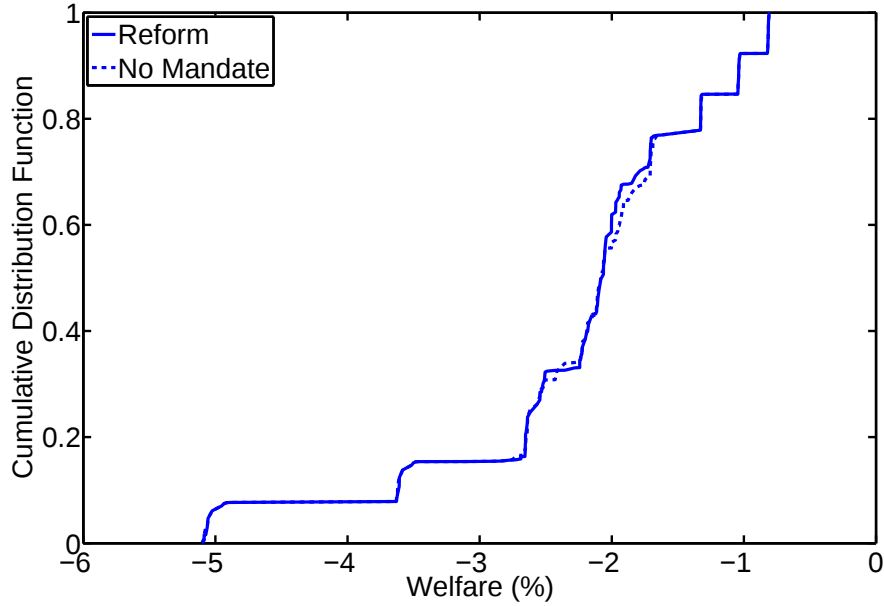


Figure 7: Effect of Mandate on Distribution of Welfare

healthier household join relative to the reform equilibrium. There is no significant change in the level government expenditures or tax rates on households from elimination of the mandate. Despite the large changes in the aggregate fraction of households without health insurance, the removal of the mandate does little to reduce the overall welfare gain of the complete reform. In particular, Figure 7 shows that the distribution of welfare across the initial young remains very similar to the economy with the mandate in place.

The importance of the mandate depends on the goal of the legislation and the cost of enforcement. If the goal of the legislation is to significantly reduce the fraction of households without health insurance, then the mandate is crucial. Relative to the baseline, the complete reform reduces the number

of uninsured by 94%, while the removal of the mandate decreases that number to almost 55%. If the goal of the legislation is to maximize ex-ante household welfare, then the role of the mandate is minor. If the goal is the latter, then the additional cost of enforcement of the mandate might eliminate some of the welfare gains of the reform with the mandate provision in place.

5 Conclusion

In this paper, I use a standard incomplete markets model augmented to include partial insurance against medical expenditure risk to quantify the effects of key elements of the 2010 PPACA reform on household welfare and the composition of households across insurance coverage. In particular, I analyze each component of the reform to see which element is critical for the results obtained. The results can be summarized as follows.

First, I find reform decreases in the fraction of uninsured households, but leads to significant crowding-out of the private insurance market. The main driving force behind the reduction in the uninsured population is the mandate that increases the cost of foregoing health insurance coverage.

Second, I find the direct cost of reform to the government is offset by a reduction in transfer payments to households and an increase in the income tax base that limits the extent of income tax increases.

Third, health reform has two offsetting effects on employment. The reform reduces incentives of older households to use employment as a mecha-

nism to smooth consumption in times of low productivity or large medical expenditure shocks. The reform also encourages households with higher labor productivity to leave the welfare program and seek employment.

Fourth, the reform is associated with an ex-ante welfare increase of 2.3%. The key factor that drives welfare gains from the reform are premium subsidies for health insurance purchase through the exchange. Most striking, I find that households with high labor productivity, that is households that are most likely to be insured in the baseline equilibrium, gain the most.

In order to focus on the role of health insurance reform on household incentives to insure against medical expenditure risk, I abstracted from several factors that deserve further study. Most notably, I abstracted from the role of medical expenditures as an investment good. Households *choose* to purchase medical goods and services, such as preventive screenings and tests, to reduce the probability of high medical expense shocks in the future. In this case, households choose how much medical care to consume to reduce probability of illness or expenditures in the future. The degree to which households undertake such investments might be influenced by the availability and price of insurance coverage available later in the lifecycle.

A Data Appendix

I use longitudinal data from the Medical Expenditure Panel Survey (MEPS). The MEPS contains detailed individual level data on household medical ex-

penditures, insurance coverage, insurance copayments and out-of-pocket expenditures, as well as labor earnings and wage data. Each individual is interviewed for two years. For this paper, I combine Panels 9 (2004-2005), Panel 10 (2005-2006), and Panel 11 (2006-2007). I aggregate the data at the family level defined in the MEPS as the Household Insurance Eligibility Unit (HIEU). The HIEU is composed of members of the household that are most often eligible for private group insurance coverage. All variables are expressed in 2006 dollars. Medical expenditures are deflated by the CPI - Medical Care Index and all other variables are deflated by the CPI - All Items Index. I present summary statistics of the data used in Table 9.

Table 9: MEPS Summary Statistics

Statistic	Ages 20-64	Age 30	Age 60
No. Obs.	25,803	6,331	3,987
Mean	5,669	3,730	9,173
Std. Dev.	14,801	8,446	17,366
Select Percentiles			
25th	355	203	1,284
50th	1,880	1,155	4,063
75th	5,870	3,805	9,709
90th	21,554	10,035	21,674
99th	55,174	35,343	79,764

Note: 2004-2007 pooled MEPS data deflated to 2006\$

Health Insurance. I assign private (employer-sponsored and independently purchased) and public insurance coverage to households that maintain coverage more than 6 months out of the year. Public coverage includes Med-

icaid, SCHIP, and any other state and federal health insurance programs.

Medical Expenditures. Medical expenditures refers to household medical goods and services consumed during the year and paid for by the household directly (out-of-pocket) payments, and payments by private and public insurance. These expenditures reflect discounting charges for the uninsured and excludes charges associated with bankruptcy (bad debt or uncollected liability) or charitable care. I exclude medical expenditures that are paid by workers compensations and Veterans Administration since these programs do not reflect the nature of public insurance in the model.

B Reform Equilibrium

In this Appendix, I formally show how the household problem and equilibrium definition change once the reforms are implemented. The problem of the household in the second stage is now,

$$W^j(k, z, s, m, h, n) = \max_{c, k'} \left\{ \frac{c^{1-\sigma}}{1-\sigma} - \alpha h + \beta \mathbf{E}_{z', s'} [V^{j+1}(k', z', s', m) | z, j] \right\}$$

subject to the following budget constraint,

$$\begin{aligned}
c + k' + \Phi(k, z, s, m, h, n) &= (1 + r)k + (1 - \tau^p)[eh - \mathbf{I}[n = 1]\pi] \\
&\quad - T^x(rk + eh - \mathbf{I}[n = 1]\pi) + T(k, z, s, m, h, n) \\
c &\geq 0, k' \geq 0 \\
e &= \exp(\mu_j + s + z)
\end{aligned}$$

where,

$$\Phi(k, z, s, m, h, n) = \begin{cases} (1 - \phi)m & \text{if } h = \bar{h}, n = 1 \\ (1 - \phi^g)m & \text{if } n = 0, y \leq y^g \\ \min(\bar{m}_{oop}(y), (1 - \phi^x)m) & \text{if } n=2 \\ \quad + \min(\bar{m}(y), \pi^x) & \\ \lambda m + \xi y & \text{otherwise} \end{cases}$$

is the household's out-of-pocket medical expenditure payment that is determined by insurance coverage n and public insurance eligibility. Let household income be defined by $y = rk + eh$, caps on out-of-pocket expenditures by $\bar{m}_{oop}(y)$, and health insurance premium subsidies by $\bar{m}(y)$, and the penalty paid by uninsured households by ξ . The size of the subsidy is then $\max\{0, \pi^x - \bar{m}(y)\}$ and the expenditure cap on out-of-pocket expenditures is $\max\{0, m - \phi^x m - \bar{m}_{oop}(y)\}$.

I redefine the health insurance decision to be $n \in N(j, k, z, s, h)$ where 1

represents private coverage and 2 represents exchange coverage:

$$N(j, k, z, s, h) = \begin{cases} \{0, 1, 2\} & \text{if } eh > \pi, rk + eh > \underline{y}^s \\ \{0, 2\} & \text{if } eh \leq \pi, rk + eh > \underline{y}^s \\ \{0\} & \text{otherwise} \end{cases}$$

where $\underline{y}^s$ represents the minimum income level needed to purchase insurance in the exchange. The corresponding Bellman equation for the household problem in the first stage can be written as before:

$$V^j(k, z, s, m_{-1}) = \max_{h \in \{0, \bar{h}\}, n \in N(j, k, z, s, h)} \mathbf{E}_m [W^j(k, z, s, m, h, n) | m_{-1}, j]$$

I now define equilibrium for the reform economy. Note the addition of the health insurance exchange and the new government budget constraint.

Definition: A stationary recursive competitive equilibrium is a list of value functions $V(x_v)$, $W(x_w)$, policy functions $h(x_v)$, $n(x_v)$, $c(x_w)$, $a'(x_w)$, premiums π and π^x , a payroll tax τ^p , an income tax function $T^x(x_w)$, and a measure of households $\Psi(x)$ such that:

1. Household decision rules $h(x_v)$, $n(x_v)$, $c(x_w)$, $a'(x_w)$ solve the household problem
2. Private health insurance firms earn zero profits in equilibrium:

$$\int \pi \mathbf{I}[n(x_v) = 1] d\Psi = \int \phi m \mathbf{I}[n(x_v) = 1] d\Psi$$

3. Health insurance exchange budget is balanced:

$$\int \pi^x \mathbf{I}[n(x_v) = 2] d\Psi = \int \phi^x m \mathbf{I}(n(x_v) = 2) d\Psi$$

4. Government budget is balanced:

$$\int \tau^p [eh(x_v) - \pi \mathbf{I}[n(x_v) = 1]] \Psi = \int b \mathbf{I}(j \geq J_R) d\Psi$$

$$\begin{aligned} \int T^x(x_w) d\Psi + \int \xi y \mathbf{I}[n(x_v) = 0] d\Psi = G + \\ \int T(x_w) d\Psi + \int \phi^g m \mathbf{I}[elig] d\Psi + G^S \end{aligned}$$

where,

$$G^S = \int [\max\{0, \pi^x - \bar{m}(y)\} + \max\{0, (1 - \phi^x)m - \bar{m}_{oop}(y)\}] \mathbf{I}[n(x_v) = 2] d\Psi$$

and $y = rk + eh(x_v)$. Denote $e = \exp(\mu_j + z + s)$ and $\mathbf{I}[elig]$ an indicator function that takes a value of 1 when $rk + eh(x_v) \leq y^g$, $n(x_v) = 0$, and 0 otherwise.

5. Distribution of households Ψ is consistent with individual behavior:

$$\Psi(B_0) = \int_{B_0} \left[\int P(x_w, x'_w) d\Psi \right] dx'_w$$

for all $B_0 \subset B(X)$ where $P(x_w, x'_w)$ is the probability that an agent in

state x_w transitions to state $x'_w \in B_0$ in the following period.

C Role of Medicaid Expansion

In this Appendix, I examine the role of Medicaid expansion in the health care reform. Recall that the proposed health care reform increases income eligibility of households to 138% of the federal poverty level (or \$27,600 for a family of 4) and eliminates the asset test. I perform two experiments. First, I eliminate the change in Medicaid eligibility thresholds, but keep the remaining reforms in place. Second, I eliminate all reforms, but keep the new Medicaid eligibility thresholds.

Table 10: Role of Medicaid in Reform

	Reform	No Medicaid Expansion	Medicaid Expansion Only
Private	61.7	63.2	63.7
Public	14.6	8.8	20.4
Uninsured	1.1	3.2	15.9
Exchange	22.6	24.8	0.0
Premium π	\$4,350	\$4,400	\$6,300
Exchange premium π^x	\$10,600	\$10,300	-
Income tax τ	21.4	21.1	21.1
Payroll tax τ^p	8.9	8.7	9.3
Employment/population	84.3	86.7	80.1
Welfare	-2.3	-2.6	0.1

Note: All statistics in percent unless specified otherwise.

From Table 10 we see that elimination of the Medicaid expansion com-

ponent of the reform increases participation in the insurance exchange and private coverage. One striking finding is a welfare gain relative to the benchmark economy with Medicaid eligibility set at benchmark values. Even more surprising is the finding that reform without Medicaid expansion results in a welfare gain that is *larger* than implied by the complete reform. Health reform limits the incentive of households with potential earnings between \$20,000 and \$27,000 not to work and receive welfare transfers and Medicaid benefits. This is because these households now obtain generous health insurance benefits by working and meeting the minimum income test for eligibility for the insurance exchange.

Finally, I perform a policy experiment where I remove all health care reforms, but expand Medicaid to the eligibility thresholds proposed in the PPACA legislation. Most striking, is the welfare *loss* associated with expansion of Medicaid eligibility. We see a decline in aggregate private insurance coverage from 66.4% to 63.7% and an increase in Medicaid participation from 13.2% to 20.4%. Health insurance premiums decrease 7%. The removal of the asset test provides an incentive for households approaching retirement to enroll in Medicaid. These households have accumulated assets in anticipation of retirement. Average asset holdings of Medicaid recipients increase from essentially zero in the benchmark model to \$105,000. The means test decreases incentives for these households to work and the aggregate employment-population ratio decreases from 0.83 to 0.80. The welfare decrease is due to an increase in tax rates that are needed to finance Medicaid

expenditures of the older and consequently sicker households.

D Role of Insurance Exchange Contract

In the reform calibration, I assume the reimbursement rate of the insurance exchange is identical to that found in the private insurance market, i.e. $\phi^x = \phi$. However, there is no strong justification for this assumption other than it being a natural starting point. As a sensitivity analysis, I now change the reimbursement rate and see the degree to which the results vary. For this experiment, I set the insurance exchange reimbursement function to that of Medicaid, i.e. $\phi^x = \phi^g$. There is a relatively large difference in generosity of reimbursement across magnitude of medical expenditure (0.7 vs. 0.5). This exercise is instructive because it illustrates the sensitivity of the results to the choice of reimbursement function. The results are presented in Table 11.

Table 11 shows that aggregate rates of households insurance are in general not sensitive to the choice of the reimbursement function. Aggregate private and private rates do not change significantly, nor does the fraction of households without health insurance relative to the reform equilibrium. However, insurance exchange participation decreases from 22.6% to 18.6%. Under the alternative reimbursement contract for exchange coverage, the reimbursement of larger medical expenditures is worse than that found in the reform equilibrium. It is sensible that insurance exchange participation decreases. However, caps on out-of-pocket medical expenditures limit the magnitude

Table 11: Alternative Insurance Exchange Contract

	Data	Baseline	Reform $\phi^x = \phi$	Reform Alt. Contract $\phi^x = \phi^g$
Private	66.4	66.3	61.7	64.7
Public	13.2	13.2	14.6	15.4
Uninsured	20.4	20.7	1.1	1.3
Exchange	0.0	0.0	22.6	18.6
Premium π	\$6,760	\$6,410	\$4,350	\$4,470
Exchange premium π^x	-	-	\$10,600	\$10,860
Income tax τ	-	20.5	21.4	21.3
Payroll tax τ^p	-	9.0	8.9	9.0
Aggregate transfers T /output	-	3.6	2.4	2.6
Aggregate Medicaid/output	-	0.9	0.8	0.9
Aggregate subsidies/output	-	0.0	2.6	2.3
Employment/population	83.0	83.0	84.3	83.8
Welfare	-	-	-2.1	-1.9

of the decline in participation. Perhaps not surprisingly, the results show a drop welfare gain generated by the reform equilibrium with the alternative contract relative to the original reform equilibrium.

References

- [1] Aiyagari, S. (1994) “Uninsured Idiosyncratic Risk and Aggregate Saving,” *Quarterly Journal of Economics*, 109, 659-684
- [2] Anderson, G. (2007) “From ‘Soak The Rich’ To ‘Soak The Poor’: Recent Trends In Hospital Pricing,” *Health Affairs*, 26, 780-789
- [3] Attanasio, O., Kitao, S., Violante, G. (2011) “Financing Medicare: A General Equilibrium Analysis.” In Shoven J. (ed.) *Demography and the Economy*: University of Chicago Press
- [4] Bajari P., Hong, H., Khwaja A. (2006) “Moral Hazard, Adverse Selection and Health Expenditures: A Semiparametric Analysis,” NBER Working Paper 12445
- [5] Card, D. (1994) “Intertemporal Labor Supply: An Assessment,” in *Advances in Econometrics*, edited by Christopher Sims, Cambridge University Press, 49-80
- [6] Chang, Y., Kim, S. (2006) “From Individual to Aggregate Labor Supply: A Quantitative Analysis Based on a Heterogenous Agent Macroeconomy,” *International Economic Review*, 47, 1-27
- [7] Council of Economic Advisers (2010). Economic Report of the President. Washington, DC
- [8] Cutler, D., Gruber, J. (1996) “Does Public Health Insurance Crowdout Private Insurance,” *Quarterly Journal of Economics*, 111, 391-430
- [9] De Nardi, M., French E., Jones, J. (2010) “Why Do the Elderly Save? The Role of Medical Expenses,” *Journal of Political Economy*, 118, 39-75

- [10] Finkelstein, A. (2002). "The Effect of Tax Subsidies to Employer-Provided Supplementary Health Insurance: Evidence from Canada," *Journal of Public Economics*, 84, 305-340
- [11] Floden, Linde (2001) "Idiosyncratic Risk in the United States and Sweden: Is There a Role for Government Insurance?," *Review of Economic Dynamics*, 4, 406-437
- [12] Feenberg, D., Skinner J. (1994) "The Risk and Duration of Catastrophic Health Care Expenditures," *The Review of Economics and Statistics*, 76, 633-647
- [13] Guner, N., Kayagusuz R., Ventura, G. (2010) "Taxation and Household Labor Supply," University of Iowa
- [14] Gruber, J. (1994) "The Incidence of Mandated Maternity Benefits," *American Economic Review*, 84, 622-41
- [15] Gruber, J. (2005) "Tax Policy for Health Insurance." In Poterba J. *Tax Policy and the Economy*, Vol. 19, NBER
- [16] Gruber, J. (2008) "Covering the Uninsured in the United States," *Journal of Economic Literature*, 46, 571-606
- [17] Gruber, J., Rodriguez, D. (2007) "How much uncompensated care do doctors provide?," *Journal of Health Economics*, 26, 1151-1169
- [18] Gruber, J., Simon, K. (2008) "Crowd-Out Ten Years Later: Have Recent Expansions of Public Insurance Crowded-Out Private Health Insurance?" *Journal of Health Economics*, 27, 201-217
- [19] Hall R., Jones C. (2007) "The Value of Life and the Rise in Health Spending," *Quarterly Journal of Economics*, 122, 39-72
- [20] Halliday, T., He, H., Zhang, H. (2009) "Health Investment Over the Life-Cycle," University of Hawaii
- [21] Hansen, G. (1993) "The cyclical and secular behavior of the labor input: comparing efficiency units and hours worked," *Journal of Applied Econometrics*, 8, 71-80

- [22] Heathcote J., Storesletten, K., Violante, G. (2010) "The Macroeconomic Implications of Rising Wage Inequality in the United States," *Journal of Political Economy*, forthcoming
- [23] Hubbard, R., Skinner, J., Zeldes, S. (1995) "Precautionary Saving and Social Insurance," *Journal of Political Economy*, 103, 360-397
- [24] Jeske, K., Kitao, S. (2009) "U.S. tax policy and health insurance demand: Can a regressive policy improve welfare," *Journal of Monetary Economics*, 56, 210-221
- [25] Khwaja, A. (2002) "Health Insurance, Habits and Health Outcomes: A Dynamic Stochastic Model of Investment in Health." In Case A., Fernandez, R., Rust, J., Wolpin K. (eds.) *Proceedings of the 2002 North American Summer Meetings of the Econometric Society: Labor Economics and Applied Econometrics*
- [26] Kolstad, J., Kowalski, A. (2010) "The Impact of Health Care Reform on Hospital and Preventive Care: Evidence from Massachusetts," NBER Working Paper 16012
- [27] McGrattan, E., Prescott E. (2001) "Is the Stock Market Overvalued?" *Federal Reserve Bank of Minneapolis Quarterly Review*, 24, 20-40
- [28] Moffitt, R. (1989) "Estimating the Value of an In-Kind Transfer: The Case of Food Stamps," *Econometrica*, 57, 385-409
- [29] Moffitt, R. (2002) "Documentation for Moffitt Welfare Benefits File." Manuscript, Johns Hopkins University. <http://www.econ.jhu.edu/People/Moffitt/DataSets.html>
- [30] Shore-Sheppard L. (2008) "Stemming the Tide? The Effect of Expanding Medicaid Eligibility On Health Insurance Coverage," *The B.E Journal of Economic Analysis & Policy*, 8
- [31] Sommers, J. (2002) "Estimation of expenditures and enrollments for employer-sponsored health insurance." Agency for Healthcare Research and Quality, MEPS Methodology Report 14.
- [32] Stanton, M. (2004) "Employer-Sponsored Health Insurance: Trends in Cost and Access," Research in Action Issue 17, Agency for Healthcare Research and Quality

- [33] Tauchen, G. (1986) “Finite State Markov-Chain Approximations to Univariate and Vector Autoregressions,” *Economic Letters*, 20, 177–181
- [34] Whitehouse, E. (2003) “The value of pension entitlements: A model of nine OECD countries.” OECD Social, Employment and Migration Working Papers No.9.
- [35] Yogo, M. (2009) “Portfolio Choice in Retirement: Health Risk and the Demand for Annuities, Housing, and Risky Assets,” University of Pennsylvania